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(54) **SOLE STRUCTURE FOR ARTICLE OF FOOTWEAR**

(57) An article of footwear includes an upper and a sole structure coupled with the upper. The sole includes an upper plate that is configured to couple with the upper and a lower plate that is spaced from and pivotably coupled with the upper by a beam. The beam is oriented along a heel-to-toe direction of the article of footwear and is configured to provide a resistive moment to control the

rotation between the upper plate and the lower plate. The sole structure further includes a midsole that is configured to surround at least a portion of the beam and to extend between the upper plate and the lower plate to provide a force that resists the rotation between the upper plate and the lower plate.

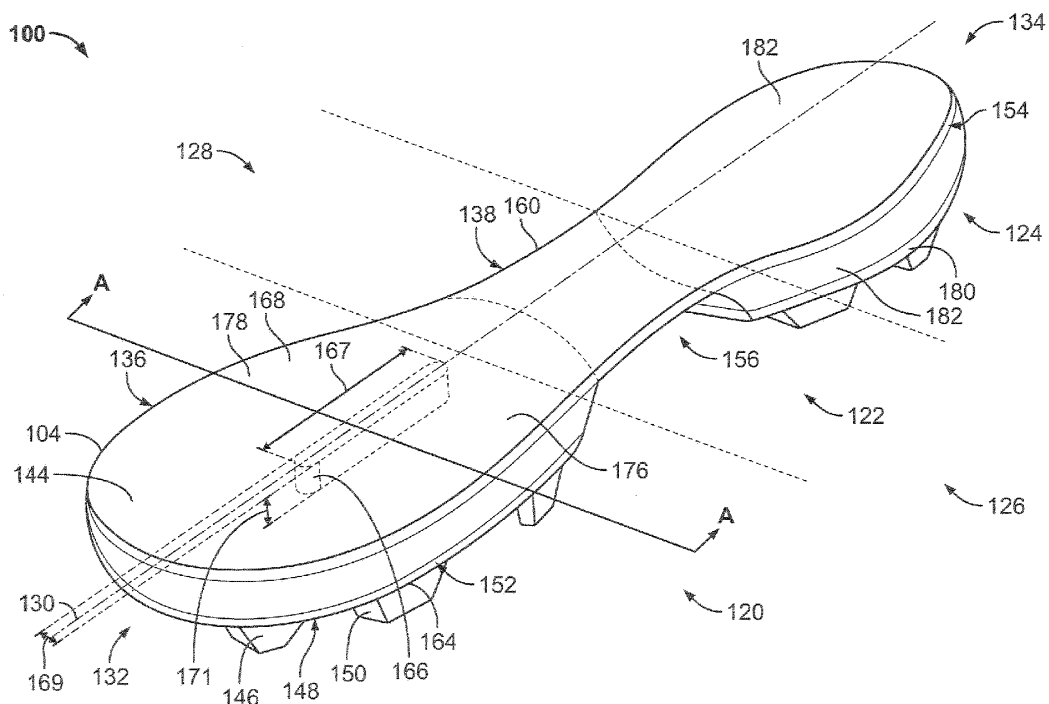


FIG. 1

Description

Field of the Disclosure

[0001] The present disclosure relates generally to a sole structure for an article of footwear with a flexible forefoot region to provide for improved traction. The forefoot region of the sole structure includes an upper plate that is coupled to a lower plate (*i.e.*, an outsole) by a beam. The beam is oriented along a heel-to-toe direction (*i.e.*, a length of the sole structure) to allow the lower plate and the upper plate to pivot in both of a lateral direction and a medial direction (*e.g.*, about a longitudinal axis of the article of footwear). Additionally, a midsole surrounds the beam and extends between the upper and lower plates to provide a resistive force that opposes the relative rotation between the upper and lower plates. The midsole can be tuned to provide a desired amount of resistance, which may be different on each of the medial and lateral sides.

Description of the Background

[0002] Many conventional shoes or other articles of footwear generally comprise an upper and a sole attached to a lower end of the upper. Conventional shoes further include an internal space (*i.e.*, a void or cavity) which is created by interior surfaces of the upper and sole that receives a foot of a user before securing the shoe to the foot. The upper generally extends upward from the sole and defines an interior cavity that completely or partially encases a foot. In most cases, the upper extends over instep and toe regions of the foot, and across medial and lateral sides thereof. Many articles of footwear may also include a tongue that extends across the instep region to bridge a gap between edges of medial and lateral sides of the upper, which define an opening into the cavity. The tongue can be disposed below a lacing or other closure system and between medial and lateral sides of the upper, to allow for adjustment of shoe tightness. The tongue may be manipulable by a user to permit entry or exit of a foot from the internal space or cavity. In addition, the lacing system may allow a user to adjust certain dimensions of the upper or the sole, thereby allowing the upper to accommodate a wide variety of foot types having varying sizes and shapes.

[0003] The upper may comprise a wide variety of materials, which may be chosen based on one or more intended uses of the shoe. The upper may also include portions comprising varying materials specific to a particular area of the upper. For example, added stability may be desirable at a front of the upper or adjacent a heel region so as to provide a higher degree of resistance or rigidity. In contrast, other portions of a shoe may include a soft woven textile to provide an area with stretch-resistance, flexibility, air-permeability, or moisture-wicking properties.

[0004] The sole is attached to a lower surface or bound-

ary of the upper and is positioned between the upper and the ground. As a result, the sole typically provides stability and cushioning to the user when the shoe is being worn. In some instances, the sole may include multiple components, such as an outsole, a midsole, and an insole. The outsole may provide traction to a bottom surface of the sole, and the midsole may be attached to an inner surface of the outsole and may provide cushioning or added stability to the sole. For example, a sole may include a particular material or be configured in a particular shape that may increase stability at one or more desired locations along the sole, or that may reduce stress or impact energy on the foot or leg when a user is running, walking, or engaged in another activity.

[0005] Sole assemblies generally extend between a ground surface and the upper. In some examples, the sole assembly includes an outsole that provides abrasion-resistance and traction with the ground surface. The outsole may be formed from rubber or other materials that impart durability and wear-resistance, as well as enhancing traction with the ground surface.

[0006] However, while many currently available shoes have varying features related to the above-noted properties, many shoes, including athletic shoes and hiking shoes, have sole structures with bottom surfaces that are generally inflexible along a width of the sole structure (*e.g.*, a direction extending between lateral and medial sides of the sole structure). That is, while a sole structure may offer some flexibility due to the cushioning properties of a midsole, for example, when running along a curve or over an uneven or sloped surface, a substantial portion of an outsole may remain angled to and, therefore, not in contact with the ground. As a result, the contact patch between the outsole and ground is reduced and, correspondingly, traction is also reduced. To increase traction in these types of scenarios, a user may intentionally pronate or supinate to place the outsole approximately in parallel with the ground to increase traction. Intentional pronation and supination by a user, especially when under increased loading during physical activity, can increase the possibility of injury and reduce athletic performance.

[0007] Therefore, articles of footwear having features that aid in stability and traction are desired. These and other deficiencies with the prior art are outlined in the following disclosure.

SUMMARY

[0008] A number of advantages of the articles of footwear described herein will be apparent to those having ordinary skill in the art. For example, an article of footwear can include an outsole configured as a lower plate, which can be pivotably connected with an upper plate by a beam. The lower plate and the upper plate can be spaced apart from one another by the beam and a midsole, which can surround the beam to provide a resistive force that opposes the movement (*i.e.*, rotation) between the lower

and upper plates about the beam.

[0009] According to one aspect, the present disclosure provides a sole structure for an article of footwear having an upper and defining a forefoot region, a midfoot region, and a heel region. The sole structure can include a first plate and a second plate. The first plate can extend from the forefoot region, through the midfoot region, to the heel region, and can be configured to couple to the upper. The second plate is disposed within the forefoot region and can be spaced from the first plate by a gap, the second plate being disposed within the forefoot region. A beam can extend between the first plate and the second plate so that the first plate is pivotally coupled to the second plate by the beam.

[0010] In some embodiments, the beam can be configured as a linear beam that is aligned along a longitudinal axis of the sole structure. The beam can define a length that is parallel to the longitudinal axis, a width that is perpendicular to the length in a lateral-to-medial direction, and a height between the first plate and the second plate that is perpendicular to both the length and the width. The length can be greater than the at least one of the width or the height. In some cases, the beam can have a rectangular cross-section taken perpendicular to the length.

[0011] In some embodiments, the sole structure can further include a midsole that can be disposed between the first plate and the second plate. The midsole can include a first midsole portion positioned along a lateral side of the beam and a second midsole portion positioned along a medial side of the beam. The first midsole portion can be a first cushioning member having a first density and can be coupled to at least one of the first plate or the second plate. The second midsole portion can be a second cushioning member having a second density that can be different from the first density, and can be coupled to at least one of the first plate or the second plate.

[0012] In some cases, the midsole can further include a third midsole portion that can be coupled to the first plate in the heel region, opposite the upper. The third midsole portion can be spaced from the first midsole portion and the second midsole portion by a gap, which can extend from a lateral side to a medial side in the midfoot region.

[0013] In some embodiments, the beam can be integrally formed with at least one of the first plate or the second plate. The second plate can be configured as an outsole that can include at least one ground engaging element extending from a bottom surface of the second plate.

[0014] In some embodiments, the beam can be configured to allow the first plate and the second plate to pivot by a first maximum angular rotation in a first direction and by a second maximum angular rotation in a second direction. Each of the first maximum angular rotation and the second maximum angular rotation can be between about 10 degrees and about 30 degrees. In some cases, the first maximum angular rotation can be different

from the second maximum angular rotation.

[0015] According to another aspect, the present disclosure provides a sole structure for an article of footwear having an upper and defining a forefoot region, a midfoot region, and a heel region. The sole structure can include an upper plate and a lower plate that can be spaced from and pivotably coupled with the upper plate by a beam. The beam can be configured to allow the upper plate and lower plate to rotate relative to one another toward each of a lateral side and a medial side of the sole structure. A first midsole portion can be disposed on the lateral side of the beam. The first midsole portion can be coupled to each of the upper plate and the lower plate so that the relative rotation of the upper plate and the lower plate causes the first midsole portion to deform. The deformation of the first midsole portion can provide a first resistive force that opposes the relative rotation of the upper and lower plates. A second midsole portion can be disposed on the medial side of the beam. The second midsole portion can be coupled to each of the upper plate and the lower plate so that the relative rotation of the upper plate and the lower plate causes the second midsole portion to deform. The deformation of the second midsole portion can provide a second resistive force that opposes the relative rotation of the upper and lower plates.

[0016] In some embodiments, each of the lower plate, the first midsole portion, and the second midsole portion can extend from a first end in the forefoot region to a second end in the midfoot region. In some cases, the beam can be aligned along a longitudinal axis of the sole structure and can be disposed entirely within the forefoot region. The beam can be configured to allow the upper plate and the lower plate to rotate relative to one another by a maximum angular rotation that can be between about 15 degrees and about 35 degrees.

[0017] According to yet another aspect, the present disclosure provides a sole structure for an article of footwear having an upper and defining a forefoot region, a midfoot region, and a heel region. The sole structure can include an upper plate that can be configured to couple to the upper and that can extend from the forefoot region, through the midfoot region, to the heel region. A forefoot portion can be positioned predominately in the forefoot region and a heel portion positioned predominately in the heel region, and the forefoot portion and the heel portion can be spaced apart from one another by a gap in the midfoot region. The forefoot portion can include a first lower plate that can be spaced from and pivotably coupled with the upper plate by a beam. The beam can be configured to allow the upper plate and lower plate to rotate relative to one another toward each of a lateral side and a medial side of the sole structure. A first midsole portion can be positioned between the upper plate and the first lower plate. The first midsole portion can at least partially surround the beam, such that the first midsole portion includes a lateral midsole portion positioned along a lateral side of the beam and a medial midsole portion disposed along a medial side of the beam. The

heel portion can include a second lower plate and a second midsole member than can be positioned between the upper plate and the second lower plate.

[0018] In some embodiments, the lateral midsole portion and the medial midsole portion can each be coupled to both the upper plate and the first lower plate.

[0019] In some embodiments, the first lower plate can be configured as a first outsole portion and the second lower plate can be configured as a second outsole portion.

[0020] Other aspects of the articles of footwear described herein, including features and advantages thereof, will become apparent to one of ordinary skill in the art upon examination of the figures and detailed description herein. Therefore, all such aspects of the articles of footwear are intended to be included in the detailed description and this summary.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

FIG. 1 is a top, front, and lateral perspective view of a sole structure for an article of footwear according to aspects of the disclosure;

FIG. 2 is a lateral side view of the sole structure of FIG. 1 with an upper of the article of footwear shown in phantom;

FIG. 3 is a medial side view of the sole structure of FIG. 1 with an upper of the article of footwear shown in phantom;

FIG. 4 is a top plan view of the sole structure of FIG. 1;

FIG. 5 is a cross sectional view of the sole structure of FIG. 1 taken along line A-A;

FIG. 6 is a cross sectional view of the sole structure of FIG. 5 with the sole structure being compressed along a lateral side; and

FIG. 7 is a cross-sectional view of another sole structure with the sole structure being compressed along a lateral side.

DETAILED DESCRIPTION OF THE DRAWINGS

[0022] The following discussion and accompanying figures disclose various embodiments or configurations of a shoe having an upper and a sole structure. Although embodiments are disclosed with reference to a sports shoe, such as a running shoe, tennis shoe, basketball shoe, etc., concepts associated with embodiments of the shoe may be applied to a wide range of footwear and footwear styles, including basketball shoes, cross-training shoes, football shoes, golf shoes, hiking shoes, hiking boots, ski and snowboard boots, soccer shoes and cleats, walking shoes, and track cleats, for example. Concepts of the shoe may also be applied to articles of footwear that are considered non-athletic, including dress shoes, sandals, loafers, slippers, and heels.

[0023] The term "about," as used herein, refers to variations in the numerical quantity that may occur, for example, through typical measuring and manufacturing procedures used for articles of footwear or other articles of manufacture that may include embodiments of the disclosure herein; through inadvertent error in these procedures; through differences in the manufacture, source, or purity of the ingredients used to make the compositions or mixtures or carry out the methods; and the like.

Throughout the disclosure, the terms "about" and "approximately" refer to a range of values $\pm 5\%$ of the numeric value that the term precedes.

[0024] Also as used herein, unless otherwise limited or defined, "or" indicates a non-exclusive list of components or operations that can be present in any variety of combinations, rather than an exclusive list of components that can be present only as alternatives to each other. For example, a list of "A, B, or C" indicates options of: A; B; C; A and B; A and C; B and C; and A, B, and C. Correspondingly, the term "or" as used herein is intended to indicate exclusive alternatives only when preceded by terms of exclusivity, such as "only one of," or "exactly one of." For example, a list of "only one of A, B, or C" indicates options of: A, but not B and C; B, but not A and C; and C, but not A and B. In contrast, a list preceded by "one or more" (and variations thereon) and including "or" to separate listed elements indicates options of one or more of any or all of the listed elements. For example, the phrases "one or more of A, B, or C" and "at least one of A, B, or C" indicate options of: one or more A; one or more B; one or more C; one or more A and one or more B; one or more B and one or more C; one or more A and one or more C; and one or more A, one or more B, and one or more C. Similarly, a list preceded by "a plurality of" (and variations thereon) and including "or" to separate listed elements indicates options of multiple instances of any or all of the listed elements. For example, the phrases "a plurality of A, B, or C" and "two or more of A, B, or C" indicate options of: one or more A and one or more B; one or more B and one or more C; one or more A and one or more C; and one or more A, one or more B, and one or more C. Further, as used herein, unless otherwise defined or limited, directional terms are used for convenience of reference for discussion of particular figures or examples. For example, references to "downward," or other directions, or "lower" or other positions, may be used to discuss aspects of a particular example or figure, but do not necessarily require similar orientation or geometry in all installations or configurations.

[0025] The terms first, second, third, etc. may be used herein to describe various elements, components, regions, layers, and/or sections. These elements, components, regions, layers and/or sections should not be limited by these terms. These terms may be only used to distinguish one element, component, region, layer or section from another region, layer, or section. Terms such as "first," "second," and other numerical terms do not imply a sequence or order unless clearly indicated by the

context. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer, or section without departing from the teachings of the example configurations.

[0026] The present disclosure relates to an article of footwear with a sole structure attached to an upper. The sole structure includes an upper plate that is coupled to the upper and outsole that is configured as a lower plate, which defines a bottom of the article of footwear. The upper plate and the lower plate can be spaced from and pivotably coupled with one another by a beam defining a length that is approximately parallel to a length of the article of footwear (*i.e.*, a dimension taken along heel-to-toe direction). Accordingly, the upper plate and the lower plate can rotate about the length of the beam and the beam can provide a resistive moment that can oppose and control the movement (*i.e.*, rotation) between the upper plate and the lower plate. In some embodiments, the upper plate, the lower plate, and the beam can be disposed within the forefoot region; however, other configurations are possible. Additionally, in some embodiments, the upper plate, the lower plate, and the beam can be co-molded to form a single unitary body, or they may be configured as separate components that can be coupled to one another, for example, by fasteners or an adhesive.

[0027] In some embodiments, a sole structure can further include a midsole that is disposed between an upper plate and a lower plate that are pivotably coupled by a beam. More specifically, at least a portion of the midsole is disposed along each of a lateral side of the beam and a medial side of the beam. In some cases, the midsole can at least partially surround the beam along its sides (*e.g.*, the sides of the beam extending between the upper and lower plates), such that a first portion of the midsole is positioned along a lateral side of the beam and so that a second portion of the midsole is positioned along a medial side of the beam. The midsole can be made from, for example, a foam material (*e.g.*, EVA) to provide cushioning for the user. Accordingly, as the upper plate and the lower plate rotate about the beam, at least a portion of the midsole can be compressed between the upper and lower plates. Thus, due to the resilient nature of material of the midsole, the midsole provides an opposing force that resists the movement between the upper and lower plates, thereby controlling the movement by acting as a dampener. In that regard, the specific material properties of the midsole can be chosen to tune the midsole for specific dampening and cushioning characteristics.

[0028] For example, in some embodiments, the midsole can be a multi-density midsole with two or more portions that can be configured to provide different amounts of cushioning. In particular, a midsole can include a first or lateral midsole portion that is disposed on a lateral side of the flexible member and a second or medial midsole portion that is disposed on a medial side of the flexible member. The lateral midsole member can have a low density to impart the lateral side of the sole structure

with enhanced flexibility and cushioning, while the medial midsole member can have a comparatively high density to impart the medial side of the sole structure with increased stability. Correspondingly, such an arrangement can help to reduce pronation. In other embodiments, the midsole can be configured differently, for example, to help reduce pronation in one foot of a user while reducing supination in the other foot.

[0029] In addition to reducing pronation and supination, by allowing the upper and lower plates to rotate about the beam relative to one another, the sole structure can provide improved traction when moving along a curve, wherein a user's body naturally leans into a turn, and when moving along uneven or sloped surfaces. In particular, the articulation of the upper and lower plates about the beam can compress a portion of the midsole (*e.g.*, a lateral or medial side), while expanding (*e.g.*, stretching) another portion of the midsole (*e.g.*, the medial or lateral side, respectively), thereby allowing the lower plate to remain approximately parallel with the ground, thereby creating the largest possible contact patch therebetween.

[0030] FIGS. 1-6 depict an exemplary embodiment of an article of footwear 100 including an upper 102 (shown in phantom in FIGS. 2-5) and a sole structure 104, with the sole structure 104 being configured to extend between the upper 102 and the ground. For reference, as illustrated in FIGS. 1-4, in particular, the article of footwear 100 generally defines a forefoot region 120, a midfoot region 122, and a heel region 124. The forefoot region 120 generally corresponds with portions of the article of footwear 100 that encase portions of the foot that include the toes, the ball of the foot, and joints connecting the metatarsals with the toes or phalanges. The midfoot region 122 is proximate and adjoining the forefoot region 120, and generally corresponds with portions of the article of footwear 100 that encase the arch of a foot, along with the bridge of a foot. The heel region 124 is proximate and adjoining the midfoot region 122 and generally corresponds with portions of the article of footwear 100 that encase rear portions of the foot, including the heel or calcaneus bone, the ankle, or the Achilles tendon.

[0031] The article of footwear 100 also defines a lateral side 126, and a medial side 128. Further, the article of footwear 100 defines a longitudinal axis 130 that extends from a toe end 132 that is located at a distal end of the forefoot region 120, to a heel end 134 that is located at a distal end of the heel region 124, opposite the toe end 132. The longitudinal axis 130 defines a middle of the article of footwear 100 with the lateral side 126 extending from one side of the longitudinal axis 130 and the medial side 128 extending from the other. Put another way, the lateral side 126 and the medial side 128 adjoin one another along the longitudinal axis 130. In particular, the lateral side 126 corresponds to an outside portion of the article of footwear 100 and the medial side 128 corresponds to an inside portion of the article of footwear 100. As such, left and right articles of footwear have opposing

lateral 126 and medial 128 sides, such that the medial sides 128 are closest to one another when a user is wearing the article of footwear 100, while the lateral sides 126 are defined as the sides that are farthest from one another while being worn.

[0032] The forefoot region 120, the midfoot region 122, the heel region 124, the medial side 128, and the lateral side 126 are intended to define boundaries or areas of the article of footwear 100, and collectively span an entire length of the article of footwear 100, from the toe end 132 to the heel end 134. It should be appreciated that aspects of the disclosure may refer to portions or elements that are coextensive with one or more of the forefoot region 120, the midfoot region 122, the heel region 124, the medial side 128, or the lateral side 126. The forefoot region 120 extends from the toe end 132 to a widest portion 136 of the article of footwear 100 (*i.e.*, a distance between the medial side 128 and the lateral side 126 of the sole structure 104). The midfoot region 122 extends from the widest portion 136 to a thinnest portion 138 of the article of footwear 100 (*i.e.*, a distance between the medial side 128 and the lateral side 126 of the sole structure 104). The heel region 124 extends from the thinnest portion 138 to the heel end 134 of the article of footwear 100.

[0033] The lateral side 126 begins where the toe end 132 intersects the longitudinal axis 130 and bows outward (*i.e.*, away from the longitudinal axis 130) along the forefoot region 120 toward the midfoot region 122. At the widest portion 136, the lateral side 126 bows inward (*i.e.*, toward the longitudinal axis 130) toward the thinnest portion 138, entering the midfoot region 122. Upon reaching the thinnest portion 138, the lateral side 126 bows outward and extends into the heel region 124. The lateral side 126 then bows back inward toward the heel end 134 and terminates where the heel end 134 intersects with the longitudinal axis 130. Similarly, the medial side 128 begins where the toe end 132 intersects the longitudinal axis 130 and bows outward (*i.e.*, away from the longitudinal axis 130) along the forefoot region 120 toward the midfoot region 122. At the widest portion 136, the medial side 128 bows inward (*i.e.*, toward the longitudinal axis 130) toward the thinnest portion 138, entering the midfoot region 122. Upon reaching the thinnest portion 138, the medial side 128 bows outward and extends into the heel region 124. The medial side 128 then bows back inward toward the heel end 134 and terminates where the heel end 134 intersects with the longitudinal axis 130.

[0034] It should be understood that numerous modifications may be apparent to those skilled in the art in view of the foregoing description, and individual components thereof, may be incorporated into numerous articles of footwear. Accordingly, aspects of the article of footwear 100 and components thereof, may be described with reference to general areas or portions of the article of footwear 100, with an understanding the boundaries of the forefoot region 120, the midfoot region 122, the heel region 124, the lateral side 126, and/or the medial side 128 as described herein may vary between articles of foot-

wear. Furthermore, aspects of the article of footwear 100 and individual components thereof, may also be described with reference to exact areas or portions of the article of footwear 100 and the scope of the appended claims herein may incorporate the limitations associated with these boundaries of the forefoot region 120, the midfoot region 122, the heel region 124, the lateral side 126, and/or the medial side 128 discussed herein.

[0035] With continued reference to FIGS. 1-4, the upper 102 can be configured to at least partially enclose the foot of a user and may be made from one or more materials. As illustrated, the upper 102 is disposed above and coupled to the sole structure 104 (see FIGS. 2 and 3), and can extend along the entirety of each of the lateral side 126 and the medial side 128, as well as extending over the top of the forefoot region 120 and around the heel region 124. Accordingly, the upper 102 defines an interior cavity 140 (see FIGS. 5 and 6) into which a foot of a user may be inserted. The upper 102 can be formed from one or more layers. For example, many conventional uppers are formed from multiple elements (*e.g.*, textiles, polymer foam, polymer sheets, leather, and synthetic leather) that are joined through bonding or stitching at a seam. In various embodiments, a knitted component may incorporate various types of yarn that may provide different properties to an upper. In other embodiments, the upper may incorporate multiple layers of different materials, each having different properties, for example, increased breathability or moisture wicking.

[0036] A number of other features may also be coupled to or included in an upper to provide or enhance certain properties of the upper. For example, an upper can include a tongue (not shown) that may include a tongue lining and/or a foam pad to increase comfort. The tongue may be a separate component that is attached to the upper or it may be integrally formed with one or more layers of the upper. Additionally, an upper can also include a tensioning system 123 that allows a user to adjust the upper to fit a foot of a user. The tensioning system 123 can extend through the midfoot region 122 and/or the forefoot region 120 of the upper 102 and may be attached to the upper 102 by an attachment structure. For example, an upper may include a plurality of holes (*e.g.*, punch holes) and/or eyelets that are configured to slidably receive laces so that the user can secure (*e.g.*, by tightening and tying the laces) the article of footwear to a foot. In other embodiments, a tensioning system may be another laceless fastening system known in the art.

[0037] Furthermore, an upper can include an insole (not shown) positioned within an interior cavity, which can be in direct contact with a user's foot while an article of footwear is being worn. Moreover, an upper may also include a liner (not shown) that can increase comfort, for example, by reducing friction between the foot of the user and the upper, and/or providing moisture wicking properties. The liner may line the entirety of interior cavity or only a portion thereof. In other embodiments, a binding (not shown) may surround the opening of the interior cav-

ity to secure the liner to the upper and/or to provide an aesthetic element on the article of footwear.

[0038] As mentioned above, the sole structure 104 is disposed below the upper 102 and extends between the upper 102 and the ground to support the foot of a user. In general, the sole structure 104 includes a midsole 144 disposed above an outsole 146 that defines a bottom surface 148 of the article of footwear 100. The midsole 144 is the portion of the sole structure 104 that is disposed between the upper 102 and the outsole 146 and provides cushioning for a user by absorbing the impact that occurs when the user's foot contacts the ground. Accordingly, the midsole 144 acts as a cushioning member for the article of footwear. In some cases, multiple cushioning members can be provided, which can collectively form the midsole, to impart specific cushioning properties at different regions of the sole structure, in the forefoot region 120, the midfoot region 122, the heel region 124, the lateral side 126, or the medial side 128. To provide the desired cushioning characteristics, the thickness of the midsole 144 (e.g., a dimension taken along a direction that is normal to the bottom surface 148) can be varied, with thicker regions providing greater cushioning and stability, and thinner regions providing less cushioning and greater flexibility.

[0039] Additionally, midsole 144, including any individual cushioning members that collectively form the midsole 144, can be made of one or more materials to provide the midsole 144 with the desired cushioning characteristics. For example, a cushioning member of a midsole may be individually constructed from a thermoplastic material, such as polyurethane (PU), for example, and/or an ethylene-vinyl acetate (EVA), copolymers thereof, or a similar type of material. In other embodiments, cushioning members of a midsole may be an EVA-Solid-Sponge ("ESS") material, an EVA foam (e.g., PUMA® ProFoam Lite™, IGNITE Foam), polyurethane, polyether, an olefin block copolymer, a thermoplastic material (e.g., a thermoplastic polyurethane, a thermoplastic elastomer, a thermoplastic polyolefin, etc.), or a supercritical foam. A cushioning member may be a single polymeric material or may be a blend of materials, such as an EVA copolymer, a thermoplastic polyurethane, a polyether block amide (PEBA) copolymer, and/or an olefin block copolymer. One example of a PEBA material is PEBAX®.

[0040] In embodiments where a cushioning member is formed from a supercritical foaming process, the supercritical foam may comprise micropore foams or particle foams, such as a TPU, EVA, PEBAX®, or mixtures thereof, manufactured using a process that is performed within an autoclave, an injection molding apparatus, or any sufficiently heated/pressurized container that can process the mixing of a supercritical fluid (e.g., CO₂, N₂, or mixtures thereof) with a material (e.g., TPU, EVA, polyolefin elastomer, or mixtures thereof) that is preferably molten. During an exemplary process, a solution of supercritical fluid and molten material is pumped into a pressurized container, after which the pressure within the

container is released, such that the molecules of the supercritical fluid rapidly convert to gas to form small pockets, e.g., pockets of nitrogen gas, within the material and cause the material to expand into a foam, which may be used as the cushioning member. In further embodiments, a first cushioning member may be formed using alternative methods known in the art, including the use of an expansion press, an injection machine, a pellet expansion process, a cold foaming process, a compression molding technique, die cutting, or any combination thereof. For example, a first cushioning member may be formed using a process that involves an initial foaming step in which supercritical gas is used to foam a material and then compression molded or die cut to a particular shape.

[0041] The outsole 146 is disposed below the midsole 144 and is configured to contact the ground along the bottom surface 148. Accordingly, the outsole 146 can be made of a comparatively tough material that can resist wear and provide traction for a user, for example, rubber (natural or synthetic) or rubber-like compounds and composites. Additionally, to further improve traction, some embodiments can include a plurality of ground engaging protrusions 150, e.g., lugs or spikes.

[0042] In the illustrated embodiment, the sole structure 104 is configured as an articulable, i.e., flexible, sole structure that can flex perpendicularly to the longitudinal axis 130. Because the sole structure 104 can flex perpendicularly to the longitudinal axis 130, the bottom surface 148 of the sole structure 104 can be approximately parallel with the ground, even where the ground is sloped or the article of footwear 100 is tilted, e.g., when running along a curve, so that there is a non-zero angle between the ground and the bottom surface 148. Put another way, the sole structure 104 can flex so that, when the bottom surface 148 and the ground are not in contact and there is a non-zero angle therebetween, any subsequent contact between the bottom surface 148 and the ground causes the sole structure 104 to flex so that bottom surface 148 is approximately parallel with the ground. In this way, the bottom surface 148 can contact the ground along an entire width, e.g., a dimension extending between the lateral side 126 and the medial side 128, of the bottom surface 148.

[0043] As discussed in greater detail below, to provide for improved flexing capabilities, the sole structure 104 can include multiple discrete sole portions that are spaced apart from one another. For example, in the illustrated embodiment, the sole structure 104 includes a first or forefoot portion 152 that is in a fixed spatial relationship with a second or heel portion 154. That is, the forefoot portion 152 can extend throughout the forefoot region 120 and partially into the midfoot region 122 and the heel portion 154 can extend throughout the heel region 124 and partially in the midfoot region 122, such that the forefoot portion 152 and the heel portion 154 are spaced apart by a gap 156 in the midfoot region 122. Correspondingly, each of the forefoot portion 152 and

the heel portion 154 can include respective midsole or outsole portions that are also separated from one another by the gap 156. Here the gap 156 is positioned in the midfoot region 122, such that the forefoot portion 152 is disposed predominately in the forefoot region 120 and the heel portion 154 is disposed predominately in the heel region 124, although both may extend at least partially into the midfoot region 122. Accordingly, the midsole 144 is discontinuous across at least a portion of the midfoot region 122. More specifically, the forefoot portion 152 of the sole structure 104, *i.e.*, each of the first lower plate 164 and the first midsole portion 168, extend from a first end in the forefoot region 122 to a second end in the midfoot region 122, and the heel portion 154 of the sole structure 104 extends from a first end in the midfoot region 122 to a second end in the heel region 124. In other embodiments, the sole structure 104 may be configured differently, for example, as a single unitary body, or to have additional sole portions, for example, another midsole portion (not shown) that is positioned between the forefoot and heel portions.

[0044] To secure the forefoot portion 152 and the heel portion 154 in this spaced relationship, each of the forefoot portion 152 and the heel portion 154 are fixedly coupled to an upper plate 160. The upper plate 160 defines an upper surface of the sole structure 104, which is configured to couple to the upper 102. Accordingly, each of the forefoot portion 152 and the heel portion 154 extend downwardly, *e.g.*, away from the upper 102, from the upper plate 160 to make contact with the ground. As illustrated, the upper plate 160 is configured as a curved plate, with a concave side facing upward toward the upper 102 (see FIGS. 5 and 6). In addition, the upper plate 160 extends along the length of the sole structure 104, between the toe end 132 and the heel end 134, and throughout a forefoot region 120, a midfoot region 122, and a heel region 124. In other embodiments, the upper plate 160 can be configured differently. For example, the upper plate 160 can be curved differently or be flat, and may only extend along a portion of the sole structure 104.

[0045] The forefoot portion 152 is configured to allow the sole structure 104 to flex perpendicularly to the longitudinal axis 130 of the article of footwear 100. In particular, the forefoot portion 152 includes a first outsole portion configured as a first lower plate 164. Correspondingly, in some cases, the first lower plate 164 can include one or more ground engaging elements 150, *e.g.*, cleats, studs, or spikes, that depend from a bottom surface of the first lower plate 164 to engage with the ground, thereby improving traction. In some cases, a separate outsole portion can be coupled to a lower surface of the first lower plate 164, such as to reduce wear on the first lower plate 164 and increase traction for a user.

[0046] The first lower plate 164 is spaced from and pivotably coupled with the upper plate 160 by a beam 166. That is, the first lower plate 164 is spaced below the upper plate 160 to define a gap 165 therebetween and the beam 166 extends across the gap to couple the first

lower plate 164 and the upper plate 160 together. Depending on the shape of the plates 160, 164, the gap 165 may be a constant or it may vary. For example, as illustrated in FIG. 5, the curvature of the upper plate 160 causes the gap 165 to increase moving outward from the beam 166 to each of the lateral and medial sides 126, 128. Accordingly, due to the gap 165, the upper plate 160 and the first lower plate 164 can pivot relative to one another via the beam 166, in either a medial or a lateral direction. For example, and as will be described in greater detail below, the upper plate 160 and the first lower plate 164 can pivot in a lateral direction, *i.e.*, a first direction, to bring their respective lateral sides closer together, while moving their respective medial sides farther apart, or in a medial direction, *i.e.*, a second direction, to bring their respective medial sides closer together, while moving their respective lateral sides farther apart.

[0047] As shown in FIG. 1, the beam can be disposed entirely within the forefoot region 120. However, it is also possible that the beam 166 may extend from the forefoot region 120 and into either of the midfoot region 122 or the heel region 124.

[0048] In general, the sole structure 104, *e.g.*, the beam 166, can be configured to allow the upper plate 160 and the first lower plate 164 to rotate relative to one another by a predetermined amount. For example, of the upper plate 160, the first lower plate 164, and the beam 166 (see FIG. 5), the upper plate 160 and the first lower plate can be permitted to rotate relative to one another by a first maximum angular rotation in a first rotational direction and to rotate by up to a second maximum angular rotation in a second rotational direction. For example, relative to an unflexed or neutral state in which the upper plate 160 and the lower plate 164 are at a first angle 181 relative to one another (see FIG. 5), the upper plate 160 and the lower plate 164 can rotate away from the neutral state to be at a second angle 183 relative to one another (see FIG. 6), where the angular rotation is the magnitude of the difference between the first angle 181 and the second angle 183.

[0049] The first and second maximum angular rotations may be the same angular rotations or different angular rotations, such that the first maximum angular rotation is greater than or less than the second angular rotation. Accordingly, each of the first and second maximum angular rotations may range between about 5 degrees and about 45 degrees, or more specifically, about 45 degrees, about 40 degrees, about 35 degrees, about 30 degrees, about 25 degrees, about 20 degrees, about 15 degrees, about 10 degrees, about 5 degrees, or any ranges therein (*e.g.*, between about 15 degrees and about 30 degrees, between about 10 degrees and about 20 degrees, etc.).

[0050] The beam 166 is configured as a linear, elongate member with a length 167 (see FIGS. 1 and 4) that is oriented in a heel-to-toe direction, *e.g.*, approximately parallel with the longitudinal axis 130, and a width 169 (see FIG. 4) that is perpendicular to the length 167 in a

lateral-to-medial direction. Further, the beam 166 defines a height 171 between the upper plate 160 and the first lower plate 164, which is perpendicular to both the length 167 and the width 169. The beam 166 is an elongate beam in which the length 167 is greater than both the width 169 and the height 171. In particular, the length 167 can be at least 150%, 200%, 300%, or 400% of one of the width 169 or the height 171. Additionally, it may be preferable that, depending on the desired bending or flexing characteristics of the beam, the height 171 is greater than equal to the width, for example, to be at least 100%, 150%, or 300% of the width 169, as may allow for greater bending of the beam 166.

[0051] Further, as shown in FIG. 4, the beam 166 is generally aligned with the longitudinal axis 130 to be centered between the lateral and medial sides 126, 128 of the sole structure 104. In some cases, the beam 166 may be biased to be closer to one of the lateral side 126 or the medial side 128, as it may allow the sole structure 104 to more easily flex to either the lateral side 126 or the medial side 128.

[0052] Due to the elongate shape of the beam 166, the upper plate 160 and the first lower plate 164 can rotate (e.g., pivot or hinge) about the length the beam 166, e.g., about an axis extending along the length of the beam 166), while remaining rigid in a heel-to-toe direction. Depending on the specific characteristics of the beam 166 (e.g., material properties, size, etc.), the beam 166 may flex along its height 171, e.g., a distance between the upper plate 160 and the first lower plate 164, or the upper plate 160 or the first lower plate 164 may flex about their respective connections to the beam 166.

[0053] The beam 166 can provide a resistive moment that can help to control the movement (i.e., rotation) of the upper plate 160 and the first lower plate 164. The moment provided by the beam 166 can be tuned in a number of ways. For example, modifying material properties of the beam 166 can either increase (e.g., by using a stiffer material) or decrease (e.g., by using a softer, less stiff material) the resistive moment that can be provided by the beam 166. Similarly, increasing the width and/or length, and decreasing the height of the beam 166 can increase the resistive moment that can be provided by the beam 166, while decreasing the width and/or length, and increasing the height can decrease the resistive moment that can be provided by the beam 166. In other embodiments, other modifications to the beam 166 can also affect the resistance that can be provided by the beam 166, for example, by including longitudinal grooves along the length of the beam 166, or projections that extend in a medial-to-lateral direction from the beam 166.

[0054] Further, the shape of the beam 166 can also be adjusted to provide a specific bending characteristic, for example, to have an equal resistance to bending in both the lateral and medial directions, or to have different resistance to bending in each of the lateral and medial directions. Further still, the cross sectional shape of the

beam 166 can be tuned to provide a desired bending characteristic. For example, as is best shown in FIGS. 5 and 6, the beam 166 can have a generally rectangular cross-sectional shape. In other embodiments, other cross-sectional shapes can also be used, including, trapezoids, parallelograms, hourglass-like (e.g., with inwardly curving sides), ellipsoids, or other types of cross-sectional shapes.

[0055] Moreover, the position of the beam 166 can also affect the resistance that can be provided by the beam 166. For example, in the illustrated embodiment, the beam 166 is disposed approximately in the center of the forefoot region 120. That is, the beam 166 is disposed between the lateral and medial sides 126, 128 so that a central axis running along the length of the beam is aligned with the longitudinal axis 130 of the article of footwear 100, and so that the beam 166 is approximately equidistant from each of the toe end 132 of the forefoot region 120 and the heel end 134 of the forefoot region 120. Accordingly, the beam 166 can provide the same effective resistance when the upper plate 160 and the first lower plate 164 rotate to come together on the lateral side 126, as when the upper plate 160 and the first lower plate 164 rotate to come together on the medial side 126. However, if the beam 166 were biased so as to be closer to the lateral side 126 than to the medial side 128, the beam 166 would provide a greater effective resistance when the upper plate 160 and the first lower plate 164 rotate to come together on the lateral side 126, as compared to when the upper plate 160 and the first lower plate 164 rotate to come together on the medial side 128.

[0056] As illustrated in FIGS. 5 and 6, the upper plate 160, the first lower plate 164, and the beam 166 can be integrally formed with one another. For example, in some cases, the upper plate 160, the first lower plate 164, and the beam 166 can be formed as unitary body using an injection or compression molding process. Accordingly, the upper plate 160, the first lower plate 164, and the beam 166 can be made from a polymeric material, for example, TPU. In other cases, as may be determined by a specific use of the article of footwear 100, the one or more of the upper plate 160, the first lower plate 164, and the beam 166 can be separate components that are coupled together. For example, the upper plate 160 or the first lower plate 164 can be a carbon fiber or other type of composite plate to provide rigidity and reduce weight, while the beam 166 can be made from a comparatively softer, more flexible material, such as TPU, to promote bending and flexing to allow the upper plate 160 and the first lower plate 164 to pivot relative to one another. In still other embodiments, other combinations are possible, for example, the upper plate 160 can be a separate composite plate, while the beam 166 and the first lower plate 164 can be integrally formed.

[0057] Additionally, the forefoot portion 152 can include a first midsole portion 168 that can provide further resistance to oppose the movement between the upper plate 160 and the first lower plate 164, as well as to pro-

vide cushioning. As illustrated, the first midsole portion 168 is disposed between the upper plate 160 and the first lower plate 164, and is configured to at least partially surround the beam 166. Accordingly, a first part of the first midsole portion 168, *i.e.*, a lateral portion, can be positioned on a lateral side of the beam 166 to be between the beam 166 and a lateral edge of the sole structure 102, and a second part of the first midsole portion 168, *i.e.*, a medial portion, can be positioned on a medial side of the beam 166 to be between the beam 166 and a medial edge of the sole structure 102. In some cases, the first midsole portion 168 may be in contact with the beam 166; however, this may not always be the case.

[0058] As mentioned above, the first midsole portion 168 provides cushioning, whereby the first midsole portion 168 can compress or expand (*i.e.*, stretch) in response to an impact. Accordingly, the first midsole portion 168 can deform in response to the relative movement of the upper plate 160 and the first lower plate 164 and can provide a corresponding opposing force that resists such movement.

[0059] For example, with specific reference to FIG. 3, when an external force 170 (*i.e.*, pressure) is applied along the lateral side 126 of one or both of the upper plate 160 and the first lower plate 164, *e.g.*, as may occur when a user takes a step, the upper plate 160 and the first lower plate 164 are brought together along the lateral side 126. Accordingly, where the first midsole is coupled to both the upper plate 160 and the first lower plate 164, a first lateral midsole portion 176, *i.e.*, the lateral side 126 of the first midsole portion 168, is compressed. At the same time, since the upper plate 160 and the first lower plate 164 can each rotate about the beam 166, the upper plate 160 and the first lower plate 164 are moved apart from one another along the medial side 128, thereby stretching a first medial midsole portion 178, *i.e.*, a medial side 128 of the first midsole portion 168. The inverse occurs where pressure is applied to the medial side 128, such that the first lateral midsole portion 176 is stretched and the first medial midsole portion 178 is compressed. As mentioned above, in some cases, the first lateral midsole portion 176 and the first medial midsole portion 178 can be separate midsole portions that collectively form the first midsole portion 168. Correspondingly, movement of the plates 160, 164 relative to one another also changes the magnitude of the gap 165 on each side of the beam 166.

[0060] Due to the resilient nature of the material of the first midsole portion 168, the first midsole portion 168 produces resistive forces at each of the first lateral midsole portion 176 and the first medial midsole portion 178. More specifically, the compression of the first lateral midsole portion 176 produces a first resistive force 172 that acts in the opposite direction of the external force 170 to push the upper plate 160 and the first lower plate 164 apart on the lateral side 126. Conversely, the expansion (*i.e.*, stretching) of the first medial midsole portion 178 produces a second resistive force 174 that acts in the

same direction as the external force 170 to pull the upper plate 160 and the first lower plate 164 together on the medial side 128. In this way, the resistive forces 172, 174 provided by the first midsole portion 168 create a moment that acts in conjunction with the moment provided by the beam 166 to counteract the external force 170.

[0061] In other embodiments, it is possible that the first midsole portion 168, *i.e.*, either of the first lateral midsole portion 176 or the first medial midsole portion 178, are only coupled to one of the upper plate 160 or the first lower plate 164. In such cases, deformation of the first lateral midsole portion 176 or the first medial midsole portion 178 may only occur by compression on the side where the respective portions of the plates 160, 164 are moved together, *e.g.*, on the lateral side 126 or the medial side 128. Conversely, on the opposing side, *i.e.*, the other of the lateral side 126 or the medial side 128, where the respective portions of the plates 160, 164 are moved apart, the unconnected plate can move independently away from the first midsole portion 168, so as not to cause stretching of the respective part of the first midsole portion 168.

[0062] In some cases, the first midsole portion 168 can be comprised of multiple portions, *i.e.*, sub-portions. For example, the first lateral midsole portion 176 and the first medial midsole portion 178, which are disposed along the lateral side 126 and the medial side 128 of the beam 166, respectively, can be configured as separate portions. Each of the first lateral midsole portion 176 and the first medial midsole portion 178 can be made from the same or different materials to allow the flexibility of the sole structure 104 to be tailored for a specific application or purpose. For example, the first lateral midsole portion 176 can be made from a material having a lower density than the first medial midsole portion 178, or vice versa. This difference in material density can allow the forefoot portion 152 to have differing amounts of flexibility to rotate in each direction.

[0063] That is, different material properties in the midsole portions 176, 178 can result in one of the lateral side 126 or the medial side 128 having a different spring constant or speed of recovery than the other. As a result, one side may be more difficult to deform, *i.e.*, require greater force to cause an equivalent deformation, or may recover to its original shape faster than the other side. As one particular example, where the first lateral midsole portion 176 has a lower density than the first medial midsole portion 178, the lateral side 126 can remain more flexible than the medial side 128, making it easier, *e.g.*, by requiring less force, for the upper plate 160 and the first lower plate 164 to rotate to come together on the lateral side 126, as shown in FIG. 3, as compared with the medial side 128. This arrangement can be beneficial in reducing pronation of a foot of a user. In other embodiments, the first lateral midsole portion 176 and the first medial midsole portion 178 can be configured differently, for example, to reduce supination.

[0064] Additionally, in some cases, materials of the first

lateral midsole portion 176 and the first medial midsole portion 178 can be selected to be more flexible in the same direction, *e.g.*, so that a left shoe is more flexible to rotate to a lateral side and so that a corresponding right shoe is more flexible to rotate to a medial side. This may be particularly beneficial in, for example, sports shoes, such as track spikes, which can be configured for use on banked track surfaces with a known angle or range of angles. To that end, the first lateral midsole portion 176 and the first medial midsole portion 178 can be tuned to easily flex within a predetermined angular range, *e.g.*, between about 0 degrees and about 18 degrees from an unflexed state in a first rotational direction, and to be more resilient to flexing outside of that predetermined angular range, *e.g.*, greater than about 18 degrees or less than about 0 degrees from the unflexed state in the first rotational direction, *i.e.*, to rotate in a second, opposite direction. To allow for such variable resistance, the first lateral midsole portion 176 or the first medial midsole portion 178 can be a multiple density cushioning element.

[0065] As compared with the forefoot portion 152, the heel portion 154 is not specifically configured to flex perpendicularly to the longitudinal axis 130 of the article of footwear 100, although it may do so in some cases. That is, the heel portion 154 includes a second outsole portion configured as a second lower plate 180 that is spaced from the upper plate 160. However, the second lower plate 180 is not pivotably coupled with the upper plate 160 by a beam. Rather, the second lower plate 180 is coupled with the upper plate 160 by a second midsole portion 182 that extends between the second lower plate 180 and the upper plate 160. In this regard, the heel portion 154 functions in a manner that is similar to a conventional midsole in providing cushioning for a foot of a user.

[0066] However, in other embodiments, the heel portion 154 can be configured similarly to the forefoot portion 152, as described above. That is, a heel portion of a sole structure can be configured similarly to the forefoot portion 152 in that it can include a beam and a midsole that is positioned on each of a medial side and a lateral side of the beam, as described above, to provide resistance to bending. Accordingly, a heel portion can also be configured to maintain a corresponding outsole portion in contact with the ground during a heel strike by allowing an upper plate and a lower plate to pivot relative to one another about a beam connecting therebetween.

[0067] In yet other embodiments, a sole structure for an article of footwear may not include separate and discrete portions, *e.g.*, the forefoot portion 152 and the heel portion 154. Instead, a sole structure can include an upper plate and an outsole configured as a lower plate, which are joined by a midsole. Accordingly, each of an upper plate, a lower plate, and a midsole can extend throughout a forefoot region, a midfoot region, and a heel region. However, such a sole structure may still include a beam that extends between and connects the upper

plate to the lower plate to help guide the sole structure, or portions thereof, to flex perpendicularly to a longitudinal axis of the article of footwear, as described above.

[0068] FIG. 7 shows a similar sole structure 204 that can be used with the article of footwear 100. In general, the sole structure 204 is configured similarly to the sole structure 104 in accordance with the description above. However, as shown, the first lateral midsole portion 176 is a first cushioning member made of a first material having a first density and the first medial midsole portion 178 is a second cushioning member made of a second material having a second density. The first and second materials can be different from one another, *i.e.*, have different chemical compositions) or they can be the same material. Likewise, the first and second densities can be different from one another or the same. The first lateral midsole portion 176 and the first medial midsole portion 178 can be connected together, *e.g.*, by an adhesive or comolding, or spaced apart from one another. Additionally, as similarly described above, each of the first lateral midsole portion 176 and the first medial midsole portion 178 are shown being coupled to only the first lower plate 164. Accordingly, when compressed to the lateral side 126, the first lateral midsole portion 176 is compressed between the upper plate 160 and the first lower plate 164 on the lateral side 126, and the upper plate 160 moves away from the first medial midsole portion 178 to define a gap 189 therebetween on the medial side 128, such that the first medial midsole portion 178 remains in an uncompressed state.

[0069] Additionally, the upper plate 160 is made of a first material, *e.g.*, a polymeric or composite material, and the first lower plate 164 and beam 166 are integrally formed from a polymeric material. Further, a separate outsole 246 is coupled to a lower surface of the first lower plate 164 to provide a ground contacting surface.

[0070] Any of the embodiments described herein may be modified to include any of the structures or methodologies disclosed in connection with different embodiments. For example, certain features and combinations of features that are presented with respect to particular embodiments in the discussion above can be utilized in other embodiments and in other combinations, as appropriate. Similarly, materials or construction techniques, other than those disclosed above, may be substituted or added in some embodiments according to known approaches. Further, the present disclosure is not limited to articles of footwear of the type specifically shown. Still further, aspects of the articles of footwear of any of the embodiments disclosed herein may be modified to work with any type of footwear, apparel, or other athletic equipment.

[0071] As noted previously, it will be appreciated by those skilled in the art that while the disclosure has been described above in connection with particular embodiments and examples, the disclosure is not necessarily so limited, and that numerous other embodiments, examples, uses, modifications and departures from the em-

bodiments, examples and uses are intended to be encompassed by the claims attached hereto.

[0072] Numerous modifications to the present invention will be apparent to those skilled in the art in view of the foregoing description. Accordingly, this description is to be construed as illustrative only and is presented for the purpose of enabling those skilled in the art to make and use the invention. The exclusive rights to all modifications which come within the scope of the appended claims are reserved.

Claims

1. A sole structure (104) for an article of footwear (100) having an upper (102) and defining a forefoot region (120), a midfoot region (122), and a heel region (124), the sole structure comprising:
 - a first plate (160) extending from the forefoot region (120), through the midfoot region (122), to the heel region (124), the first plate (160) being configured to couple to the upper (102);
 - a second plate (164) that is spaced from the first plate (160) by a first gap, the second plate (164) being disposed within the forefoot region (120); and
 - a beam (166) extending between the first plate (160) and the second plate (162) so that the first plate (160) is pivotally coupled to the second plate (164) by the beam (166).
2. The sole structure according to claim 1, **characterized in that** the beam (166) is configured as a linear beam that is aligned along a longitudinal axis of the sole structure.
3. The sole structure according to claims 1 or 2, **characterized in that** the beam (166) defines a length that is parallel to the longitudinal axis, a width that is perpendicular to the length in a lateral-to-medial direction, and a height between the first plate (160) and the second plate (164) that is perpendicular to both the length and the width, wherein the length is greater than the at least one of the width or the height.
4. The sole structure according to one of claims 1 to 3, **characterized in that** the beam (166) has a rectangular cross-section taken perpendicular to the length.
5. The sole structure according to one of claims 1 to 4, **characterized in that** it further includes a midsole (144) that is disposed between the first plate (160) and the second plate (164), the midsole (144) including a first midsole portion positioned along a lateral side of the beam (166) and a second midsole portion positioned along a medial side of the beam (166).
6. The sole structure according to claim 5, **characterized in that** each of the second plate (164), the first midsole portion, and the second midsole portion extends from a first end in the forefoot region (120) to a second end in the midfoot region (122).
7. The sole structure according to claims 5 or 6, **characterized in that** the first midsole portion is a first cushioning member having a first density and the second midsole portion is a second cushioning member having a second density that is different from the first density.
8. The sole structure according to claim 7, **characterized in that** the first midsole portion is coupled to at least one of the first plate (160) or the second plate (164), wherein the second midsole portion is coupled to at least one of the first plate (160) or the second plate (164).
9. The sole structure according to claim 5, **characterized in that** the midsole (144) further includes a third midsole portion coupled to the first plate (160) in the heel region (124), opposite the upper (102), wherein the third midsole portion is spaced from the first midsole portion and the second midsole portion by a gap that extends from a lateral side to a medial side in the midfoot region.
10. The sole structure according to one of claims 1 to 9, **characterized in that** the beam (166) is integrally formed with at least one of the first plate (160) or the second plate (164).
11. The sole structure according to one of claims 1 to 10, **characterized in that** the second plate (164) is configured as an outsole that includes at least one ground engaging element extending from a bottom surface of the second plate (164).
12. The sole structure according to one of claims 1 to 11, **characterized in that** the beam (166) is configured to allow the first plate (160) and the second plate (164) to pivot by a first maximum angular rotation in a first direction and by a second maximum angular rotation in a second direction.
13. The sole structure according to claim 12, **characterized in that** each of the first maximum angular rotation and the second maximum angular rotation are between about 10 degrees and about 30 degrees.
14. The sole structure according to claim 12, **characterized in that** the first maximum angular rotation is different from the second maximum angular rotation.
15. The sole structure according to one of claims 1 to 14, **characterized in that** the beam (166) is dis-

posed entirely within the forefoot region (120).

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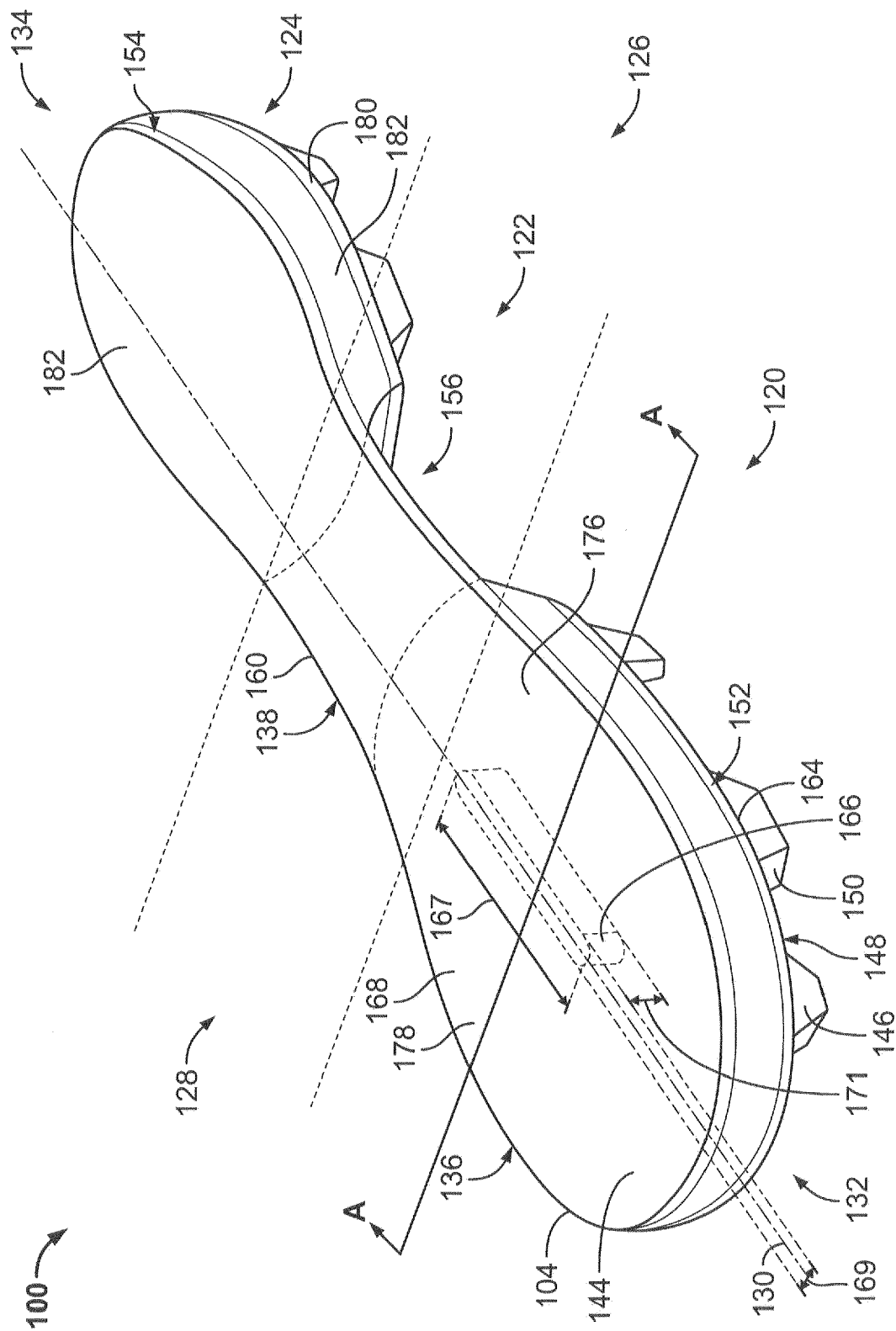


FIG. 1

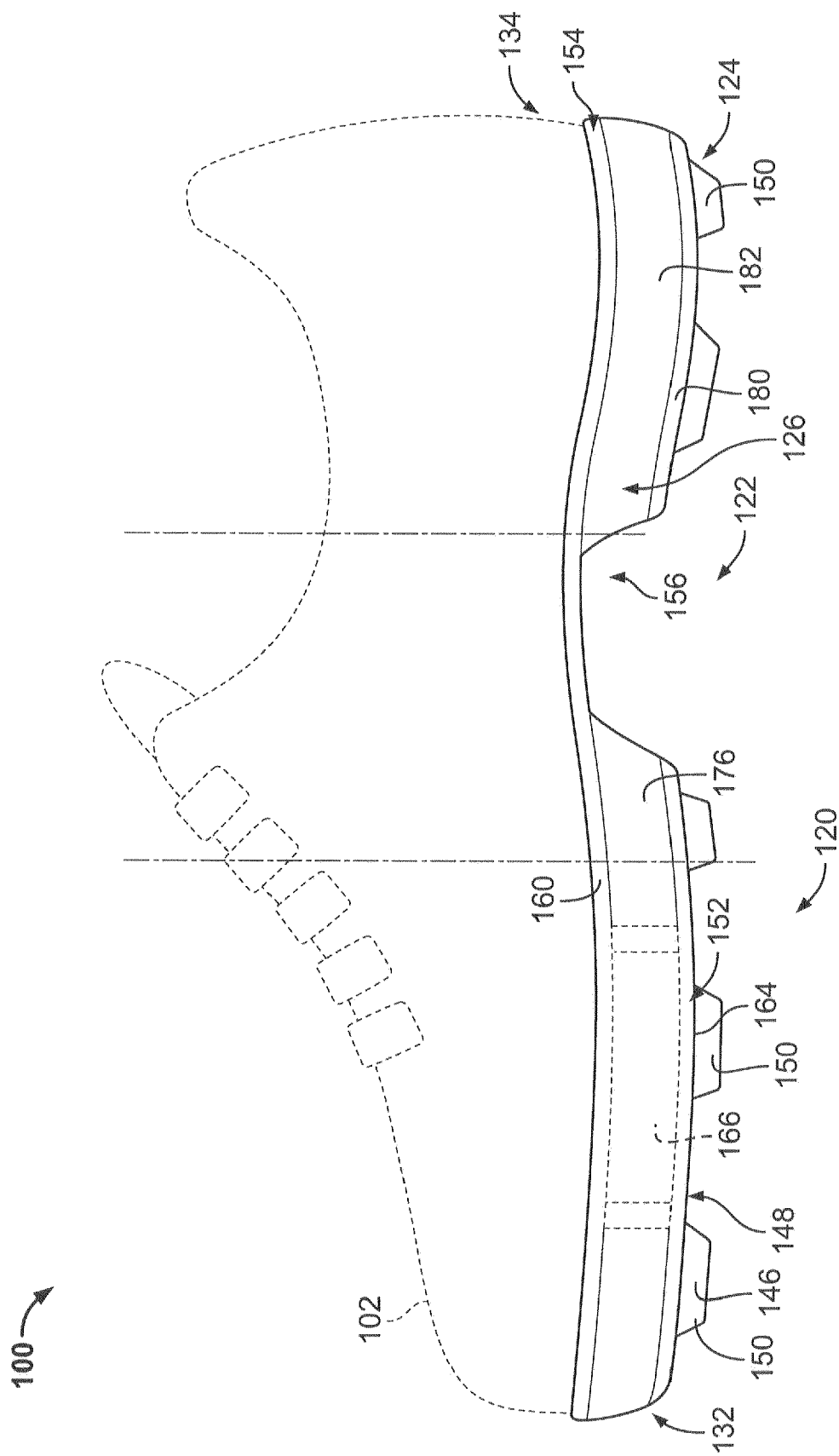


FIG. 2

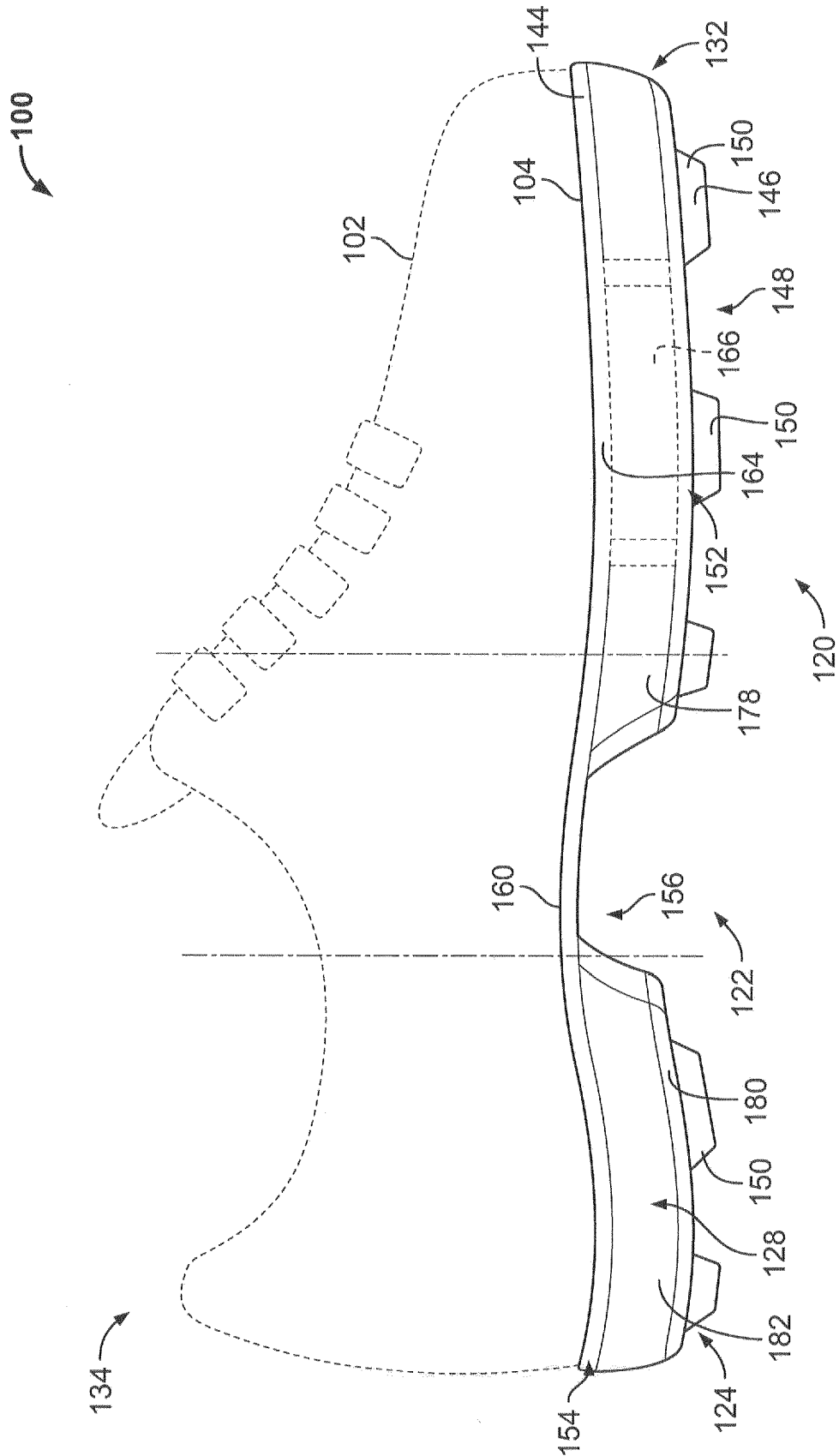
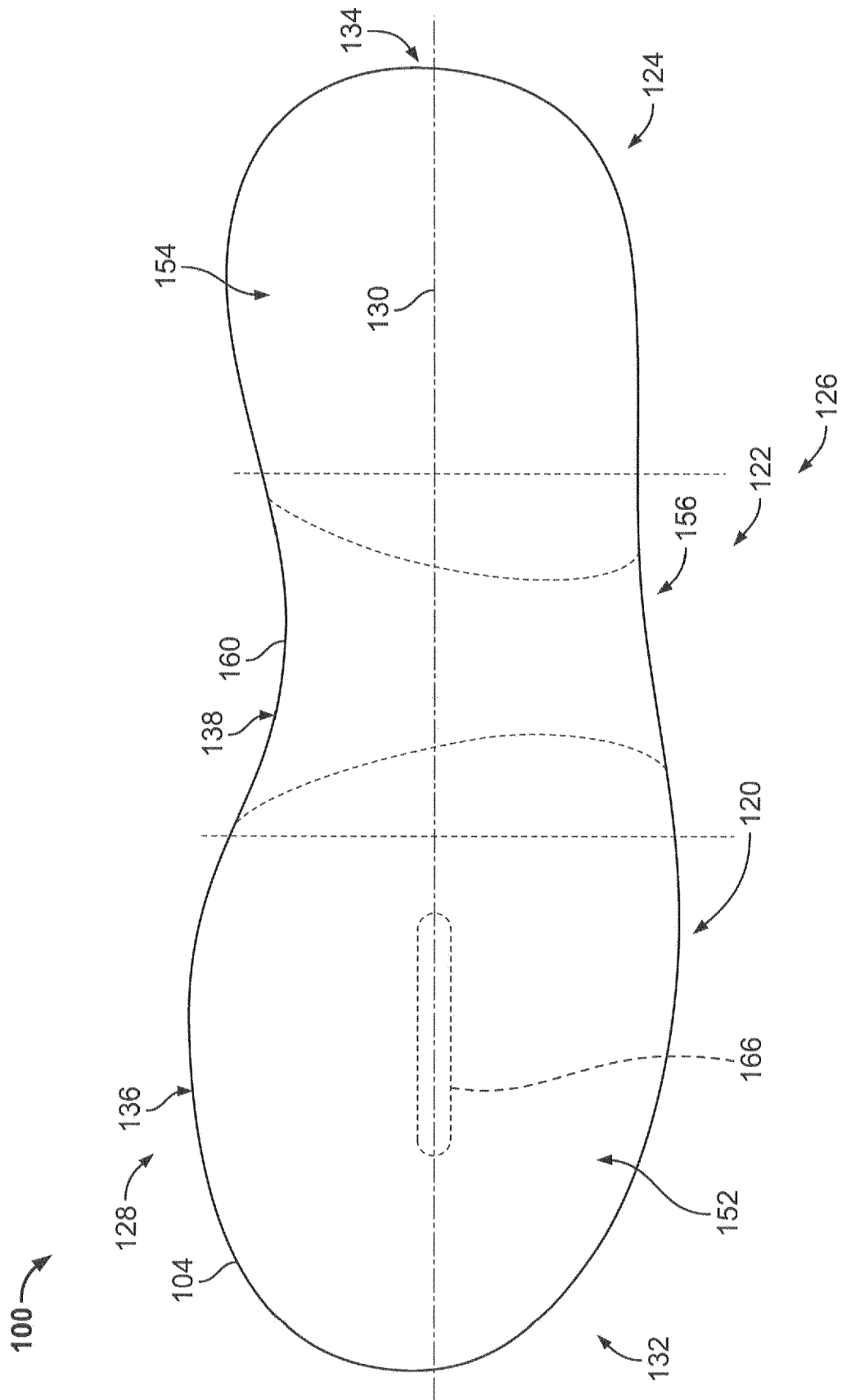


FIG. 3



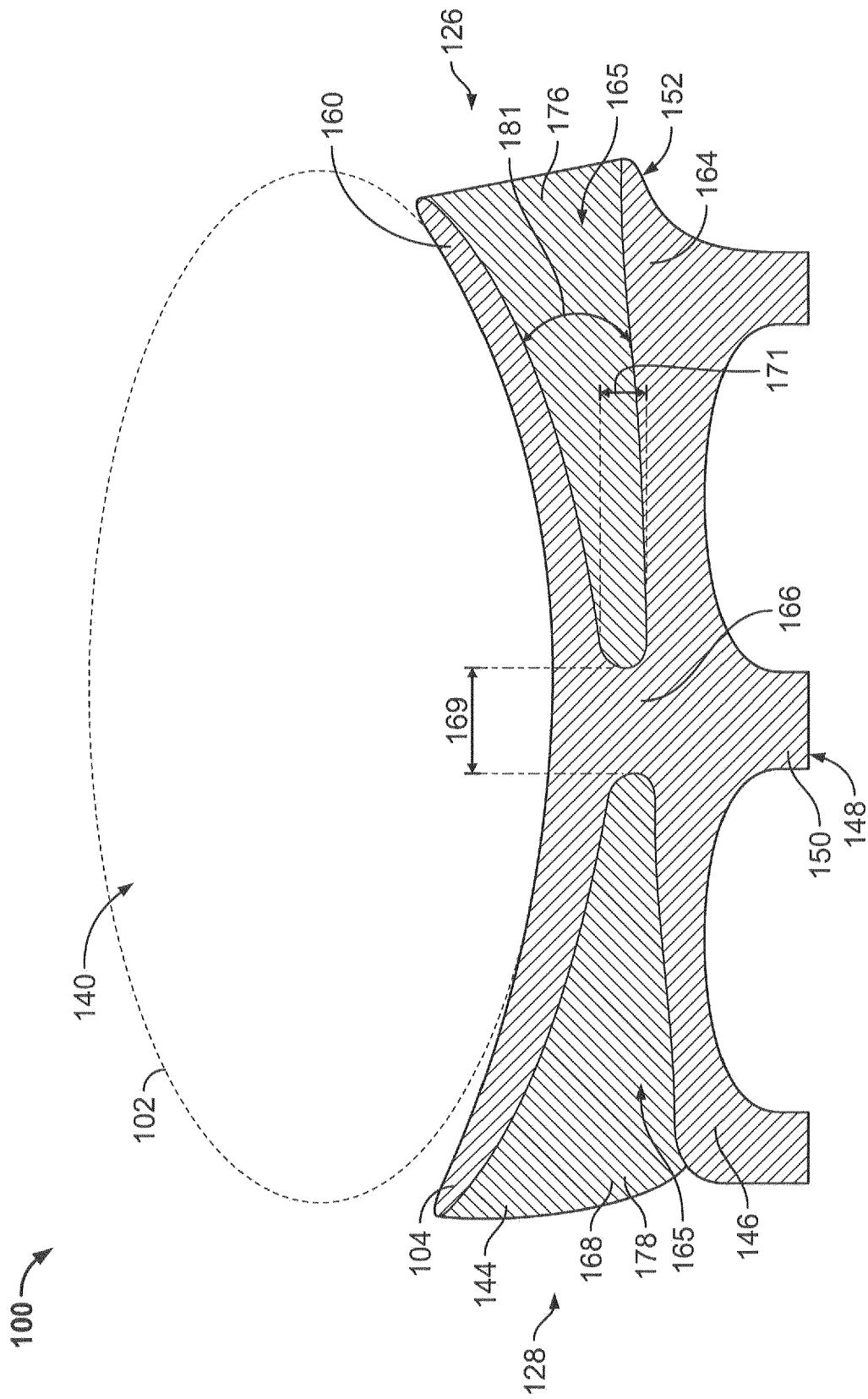


FIG. 5

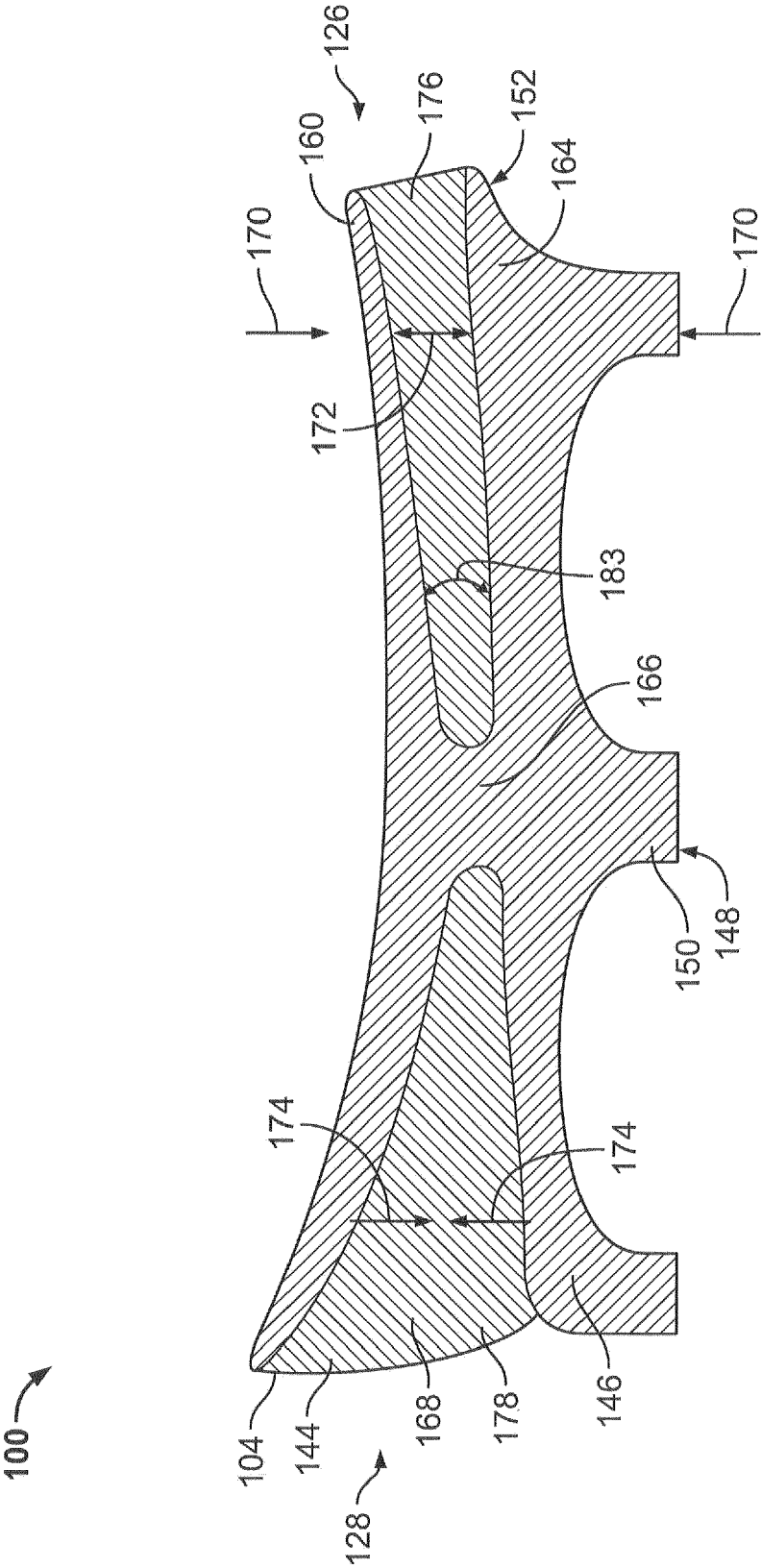


FIG. 6

204

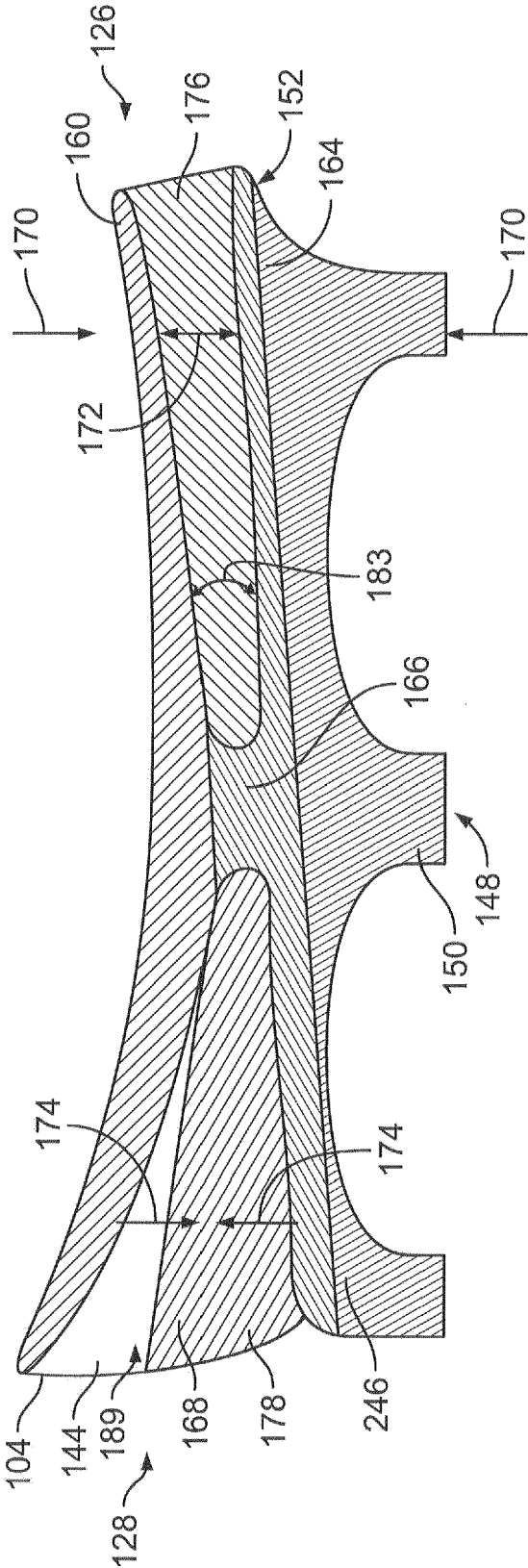


FIG. 7



EUROPEAN SEARCH REPORT

Application Number

EP 22 20 5052

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2007/044451 A1 (NIKE INC [US]; NIKE INTERNATIONAL LTD; FALLON KEVIN PATRICK [US]) 19 April 2007 (2007-04-19) * abstract * * paragraphs [0004] - [0042] * * figures 1-9 * * claims 1-33 *	1-15	INV. A43B7/24 A43B13/12 A43B13/14 A43B13/18 A43B13/42
X	WO 2016/149112 A1 (NIKE INNOVATE CV [US]; FOXEN THOMAS [US]; HOFFER KEVIN W [US]) 22 September 2016 (2016-09-22) * abstract * * paragraphs [0003] - [0118] * * figures 1-25 * * claims 1-20 *	1-8, 10, 12-15	
A		9, 11	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC) A43B
Place of search The Hague		Date of completion of the search 7 March 2023	Examiner Espeel, Els
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