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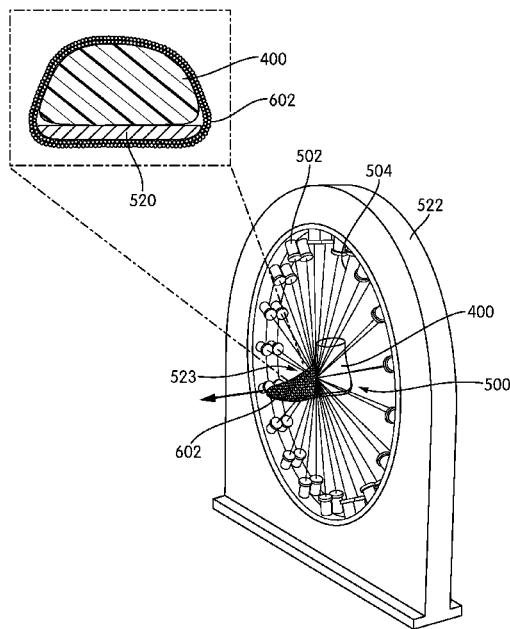
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(54) Title: BRAIDED ARTICLE WITH INTERNAL MIDSOLE STRUCTURE



(57) Abstract: A method of making an article of footwear includes temporarily attaching a midsole structure to a last and inserting the midsole structure and footwear last through a braiding machine. A braided structure in the form of an upper is formed. The upper includes a midsole structure disposed within an interior cavity of the upper.

FIG. 7



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## BRAIDED ARTICLE WITH INTERNAL MIDSOLE STRUCTURE

### BACKGROUND

**[0001]** The present embodiments relate generally to articles of footwear, and in particular to articles of footwear with uppers.

**[0002]** Articles of footwear generally include an upper and one or more sole structures. The upper may be formed from a variety of materials that are stitched or adhesively bonded together to form a void within the footwear for comfortably and securely receiving a foot. The sole structures may include midsole structures that provide cushioning and shock absorption.

## SUMMARY

**[0003]** In one aspect, the present invention provides a method of making a braided upper for an article of footwear, comprising: associating a midsole structure with a lower surface of a last; wherein a forefoot portion of the last has a cross-sectional area and a peripheral contour that bounds the cross-sectional area, and the last and midsole structure provide a combined peripheral contour, wherein a medial side portion of the peripheral contour has a first curvature, and a lateral side portion of the peripheral contour has a second curvature, wherein a medial side portion of the combined peripheral contour has a third curvature and a lateral side portion of the combined peripheral contour has a fourth curvature; and wherein the third curvature is substantially less than the first curvature, and/or wherein the fourth curvature is substantially less than the second curvature; the method further comprising inserting the last and the midsole structure through a braiding device while the midsole structure is associated with the lower surface of the last so as to form a braided structure around the last and the midsole structure, wherein the reduced curvature of the third curvature with respect to the first curvature and/or reduced curvature of the fourth curvature with respect to the second curvature presents a smoother peripheral contour to the braiding device than would be presented by the last alone; and thereby forming the braided upper from the braided structure, wherein the midsole structure is disposed within an interior cavity of the braided upper.

**[0004]** In another aspect, the present invention provides a method of making an article of footwear, comprising: associating a midsole structure with a lower surface of a last; wherein a forefoot portion of the last has a cross-sectional area and a peripheral contour that bounds the cross-sectional area, and the last and midsole structure provide a combined peripheral contour, wherein a medial side portion of the peripheral contour has a first curvature, and a lateral side portion of the peripheral contour has a second curvature, wherein a medial side portion of the combined peripheral contour has a third curvature and a lateral side portion of the combined peripheral contour has a fourth curvature; and wherein the

third curvature is substantially less than the first curvature, and/or wherein the fourth curvature is substantially less than the second curvature; the method further comprising inserting the last and the midsole structure through a braiding device while the midsole structure is associated with the lower surface of the last so as to form a braided structure around the last and the midsole structure, wherein the reduced curvature of the third curvature with respect to the first curvature and/or reduced curvature of the fourth curvature with respect to the second curvature presents a smoother peripheral contour to the braiding device than would be presented by the last alone, thereby forming a braided upper from the braided structure, wherein the midsole structure is disposed within an interior cavity of the braided upper; removing the last from the braided upper; attaching an outer sole structure to a lower portion of the braided upper, the outer sole structure including a ground engaging surface; and thereby forming the article of footwear.

**[0005]** In another aspect, the present invention provides an article of footwear, comprising: a braided upper which is a braided structure, the braided upper including an interior cavity and an opening providing entry to the interior cavity and wherein the braided upper includes a closed lower portion and an upper portion; a midsole structure disposed within the interior cavity such that the midsole structure is disposed closer to an inner surface of the lower portion than an outer surface of the lower portion, the midsole structure having an exterior surface comprising a first surface and a second surface, the second surface being an upper surface of the midsole structure; and an outer sole structure attached to the outer surface of the lower portion, wherein a forefoot portion of the inner cavity defined by the upper portion of the braided upper and the second surface of the midsole structure has a cross-sectional area and a peripheral contour that bounds the cross-sectional area, and the inner cavity provides a combined peripheral contour, wherein a medial side portion of the peripheral contour has a first curvature, and a lateral side portion of the peripheral contour has a second curvature, wherein a medial side portion of the combined peripheral contour has a third curvature and a lateral side portion of the combined peripheral contour has a

fourth curvature; and wherein the third curvature is substantially less than the first curvature, and/or wherein the fourth curvature is substantially less than the second curvature.

**[0006]** Other systems, methods, features and advantages of the embodiments will be, or will become, apparent to one of ordinary skill in the art upon examination of the following figures and detailed description. It is intended that all such additional systems, methods, features and advantages be included

within this description and this summary, be within the scope of the embodiments, and be protected by the following claims.

## 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.

**[0008]** FIG. 1 is a schematic isometric view of an embodiment of an article of footwear including an enlarged cross-sectional view of a forefoot portion of the article of footwear;

**[0009]** FIG. 2 is a schematic isometric exploded view of the article of footwear of FIG. 1;

**[0010]** FIG. 3 is a schematic view of the article of FIG. 1 with a foot inserted within an upper, including an enlarged cross-sectional view of a forefoot portion of the article of footwear and foot;

**[0011]** FIG. 4 is a schematic isometric view of a step of temporarily attaching a midsole structure to a last, according to an embodiment;

**[0012]** FIG. 5 is a schematic bottom isometric view of an embodiment of a midsole structure temporarily attached to a last;

**[0013]** FIG. 6 is a schematic isometric view of the last and midsole structure of FIG. 5, including an enlarged cross-sectional view of the last and midsole structure;

**[0014]** FIG. 7 is a schematic isometric view of an embodiment of a last and midsole structure inserted through a braiding device to form a braided structure over the last and midsole structure;

**[0015]** FIG. 8 is a schematic isometric view of a braided upper being cut to form an opening according to an embodiment;

**[0016]** FIG. 9 is a schematic view of a last being removed from a braided upper according to an embodiment;

**[0017]** FIG. 10 is a schematic view of an outer sole structure being attached to a lower surface of a braided upper according to an embodiment;

**[0018]** FIG. 11 is a schematic view of an embodiment of an upper with an interior midsole structure;

**[0019]** FIG. 12 is a schematic view of the upper of FIG. 11 with the midsole structure removed;

**[0020]** FIGS. 13-15 illustrate schematic views of an alternative embodiment of an upper formed from a braided structure, where the upper is formed on a last and a midsole structure is inserted after the upper is formed on the last.

## DETAILED DESCRIPTION

**[0021]** FIG. 1 is an isometric view of an embodiment of an article of footwear 100. In the exemplary embodiment, article of footwear 100 has the form of an athletic shoe. However, in other embodiments, 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, 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.

**[0022]** 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.

**[0023]** 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. Moreover, these directions and reference portions may also be used in describing sub-components of an article of footwear (e.g., directions and/or portions of a midsole structure, an outer sole structure, an upper or any other components).

**[0024]** 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). In some cases, the longitudinal direction may extend from a forefoot portion to a heel portion 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. In other words, the lateral direction may extend 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 generally perpendicular to a lateral and longitudinal direction. For example, in cases where an article is planted flat on a ground surface, the vertical direction may extend from the ground surface upward. Additionally, the term "inner" refers to a portion of an article disposed closer to an interior of an article, or closer to a foot when the article is worn. Likewise, the term "outer" refers to a portion of an article disposed further from the interior of the article or from the foot. Thus, for example, the inner surface of a component is disposed closer to an interior of the article than the outer surface of the component. 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.

**[0025]** Article 100 may be characterized by a number of different regions or portions. For example, article 100 could include a forefoot portion, a midfoot portion, a heel portion and an ankle portion. Moreover, components of article 100 could likewise comprise corresponding portions. Referring to FIG. 1, article 100 may be divided into forefoot portion 10, midfoot portion 12 and heel portion 14. Forefoot portion 10 may be generally associated with the toes and joints connecting the metatarsals with the phalanges. Midfoot portion 12 may be generally associated with the arch of a foot. Likewise, heel portion 14 may be generally associated with the heel of a foot, including the calcaneus bone. Article 100 may also include an ankle portion 15 (which may also be referred to as a cuff portion). In addition, article 100 may include lateral side 16 and medial side 18. In particular, lateral side 16 and medial side 18 may be opposing sides of article 100. Furthermore, both lateral side 16 and medial side 18 may extend through forefoot portion 10, midfoot portion 12, heel portion 14 and ankle portion 15.

**[0026]** FIGS. 1-2 illustrate various components of article of footwear 100, including an upper 102, a midsole structure 120 and an outer sole structure 130. For purposes of illustration, in FIG. 1, midsole structure 120 is shown in phantom in the isometric view of article 100.

**[0027]** Upper 102 may be a braided upper. More specifically, upper 102 may comprise a braided structure having the form of an upper for an article of footwear. As used herein, the term “braided structure” (or braided component) refers to any structure that may be formed by intertwining three or more tensile elements to form the structure. Such tensile elements could include, but are not limited to: threads, yarns, strings, filaments, fibers, wires, cables as well as possibly other kinds of tensile elements. As used herein, tensile elements may describe generally elongated materials with lengths much greater than corresponding diameters. In other words, tensile elements may be approximately one-dimensional elements, in contrast to sheets or layers of textile materials that may generally be approximately two-dimensional (e.g., with thicknesses much less than their lengths and widths). As an example, upper 102 as seen in FIGS. 1-2 is formed from a plurality of tensile elements 105 (e.g., yarns or strands of material) that are braided together to form a shape that is globally similar to the shape of a foot. For purposes of illustration, the individual tensile elements 105 are only shown in representative patches on upper 102 in the figures, but it may be understood that in at least some embodiments the entirety of upper 102 may comprise tensile elements 105 in a braided configuration.

**[0028]** Braiding can be used to form three-dimensional structures, by braiding strands of yarn over a form or a last. Strands of a braided structure, such as plurality of tensile elements 105 of the exemplary embodiment, can be fabricated from fibers such as nylon, carbon, polyurethane, polyester, cotton, aramid (e.g., Kevlar®), polyethylene or polypropylene. These strands can be braided to form three-dimensional structures for a wide variety of applications.

**[0029]** Braided structures may be fabricated manually, or may be manufactured using automated braiding machinery, such as the machinery

disclosed in U.S. Patents Nos. 7,252,028; 8,261,648; 5,361,674; 5,398,586; and 4,275,638, all of which are incorporated by reference in their entirety herein. One exemplary manufacturing method, including the use of a radial braiding machine, is discussed below and shown in FIG. 7.

**[0030]** Some embodiments may include braided uppers that extend beneath the foot, thereby providing 360 degree coverage at some regions of the foot. However, other embodiments need not include uppers that extend beneath the foot. In other embodiments, for example, a braided upper could have a lower periphery joined with a sole structure and/or sock liner. In the exemplary embodiment, upper 102 includes a closed lower portion 115 (see FIGS. 1-3) that extends beneath a foot when the article is worn.

**[0031]** Embodiments could incorporate any of the braided structures, methods of making braided structure as well as any of the related provisions that are disclosed in Bruce, U.S. Patent Publication Number 2015/0007451, now U.S. Patent Application Number 14/495,252 filed September 24, 2014, and titled "Article of Footwear with Braided Upper," the entirety of which is herein incorporated by reference and hereafter referred to as "the Braided Upper application".

**[0032]** Referring to FIGS. 1-2, upper 102 is seen to have an opening 107 that may receive a foot. Opening 107 may provide access to an interior cavity 109 of upper 102. In the exemplary embodiment, upper 102 may have a bootie-like configuration without any additional fasteners. Depending on the material of the individual tensile strands 105, the exemplary embodiment may be configured to stretch fit over a foot without the need for additional fasteners. For example, using tensile strands 105 with elastic properties may allow upper 102 to stretch over a foot and provide the needed amount of tension to keep article 100 on the foot. However, in other embodiments, upper 102 could incorporate fastening provisions including laces, straps, zippers or other kinds of fasteners that may help secure upper 102 around a foot. For example, other embodiments could utilize any of the

fastening provisions for a braided upper that are disclosed in the Braided Upper application.

**[0033]** Upper 102 may also be characterized by an outer surface 111, which is an exterior or exposed surface. In addition, upper 102 may include an inner surface 113 that is opposite outer surface 111.

**[0034]** Midsole structure 120 may generally incorporate various provisions associated with midsoles. In different embodiments, a midsole structure may be configured to provide cushioning, shock absorption, energy return, support, as well as possibly other provisions.

**[0035]** Midsole structure 120 may comprise an exterior surface 122. Exterior surface 122 may be further comprised of a first surface 124 and a second surface 126 disposed opposite of first surface 124. Here, first surface 124 may be a lower surface of midsole structure 120, while second surface 126 may be an upper surface of midsole structure 120. Moreover, first surface 124 may include a first surface periphery 128 (e.g., a lower surface periphery), which extends around the boundary of first surface 124. In some cases, first surface periphery 128 may be associated with the sides (or sidewalls) of midsole structure 120. Second surface 126 may extend from first surface periphery 128 (i.e., second surface 126 is proximate to, or even continuous with, first surface periphery 128) and across the top side of midsole structure 120.

**[0036]** In different embodiments, the geometry of midsole structure 120 could vary. In some embodiments, midsole structure 120 may have a two-dimensional geometry (e.g., a geometry in the plane spanned by the longitudinal and lateral directions) corresponding to a foot sole. In other embodiments, however, the geometry of midsole structure 120 could vary and could include various contours or features not associated with a foot sole.

**[0037]** In different embodiments, the dimensions of midsole structure 120 could vary. In some embodiments, midsole structure 120 has a length approximately equal to a length of upper 102, as midsole structure 120 may extend through the entirety of interior cavity 109 in the longitudinal direction. In

other embodiments, however midsole structure 120 could have a length less than the length of upper 102. For example, in another embodiment, a midsole structure may only extend through the midfoot and heel portions of an article of footwear. In some embodiments, midsole structure 120 has a width approximately equal to a width of upper 102, as midsole structure 120 may extend through the entire of interior cavity 109 in the lateral direction. However, in other embodiments, a midsole structure could only extend partially across the width of upper 102.

**[0038]** In some embodiments, the thickness of midsole structure 120 may vary. In some embodiments, a midsole structure could be thicker than either an upper or an outer sole structure. In other embodiments, a midsole structure could be thinner than an upper and/or an outer sole structure. In some cases, a midsole structure could be equal in thickness to an upper and/or a sole structure. In the exemplary embodiment, midsole structure 120 has a thickness 141 that corresponds to the distance between first surface 124 and second surface 126 of midsole structure 120. In addition, upper 102 has a thickness 142 and outer sole structure 130 has a thickness 143. Moreover, thickness 141 is greater than thickness 142. Also, thickness 141 is greater than thickness 143. This relatively greater thickness for midsole structure 120 may ensure that midsole structure 120 provides a larger degree of the shock absorption, cushioning and/or support than may be provided by the material structures of upper 102 and outer sole structure 130.

**[0039]** A midsole structure may be formed from a variety of different materials. Exemplary materials that could be used in various embodiments include, but are not limited to: expanded rubber, foam rubber, various kinds of foams, polyurethane as well as possibly other materials. For example, in one embodiment, a midsole structure may be formed from a polymer foam material that attenuates ground reaction forces (i.e., provides cushioning) during walking, running, and other ambulatory activities. In various embodiments, midsole structures 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.

**[0040]** Outer sole structure 130 may include provisions for cushioning and/or may include provisions to enhance ground contact. In some embodiments, outer sole structure 130 could primarily comprise an outsole. In such embodiments, the outsole forms a ground-contacting element of the footwear and is usually fashioned from a durable and wear-resistant rubber material that includes texturing to impart traction. In other embodiments, outer sole structure 130 could also include cushioning provisions, including provisions associated with a midsole layer.

**[0041]** In the embodiments of FIGS. 1-2, outer sole structure 130 may be characterized by a first surface 131 and a second surface 132 that is opposite of first surface 131. First surface 131 may face inwardly, or towards upper 102, while second surface 132 may face outwardly and may be a ground contacting surface. In some embodiments, second surface 132 could include provisions for enhancing traction with a ground surface such as treads, cleats, or other provisions.

**[0042]** As seen in FIGS. 1-2, midsole structure 120 may be disposed within upper 102. Specifically, midsole structure 120 may be disposed within interior cavity 109 of upper 102. In some cases, first surface 124 of midsole structure 120 (i.e., a lower surface) may be disposed against inner surface 113 of upper 102. In other cases, first surface 124 of midsole structure 120 could be disposed against an intermediate layer, or may be otherwise spaced apart from inner surface 113 of upper 102. In either case, midsole structure 120 may be disposed closer to inner surface 113 of lower portion 115 (of upper 102) than to outer surface 111 of lower portion 115. Such an arrangement may be contrasted with other possible embodiments, where a midsole structure may be disposed externally to an upper and therefore disposed closer to an outer surface of the upper than to the inner surface of the upper.

**[0043]** Outer sole structure 130 may be disposed against outer surface 111 of upper 102. More specifically, first surface 131 outer sole structure 130 may be disposed against outer surface 111 on lower portion 115 of upper 102. Thus, whereas midsole structure 120 may be disposed within interior cavity 109 of upper 102, outer sole structure 130 may be disposed outwardly on upper 102. Therefore, lower portion 115 of upper 102 may separate, or be disposed between, midsole structure 120 and outer sole structure 130.

**[0044]** For purposes of clarity, article 100 is shown without an inner liner or insole. In such an embodiment, a foot (or sock worn on the foot) may directly contact a surface of a midsole structure. For example, in some embodiments, second surface 126 of midsole structure 120 may be configured to receive and contact a foot directly. Such an exemplary configuration is shown in FIG. 3, which shows a schematic view of a foot 300 inserted within article of footwear 100 along with a cross-sectional view of the article and foot as taken along a vertical plane 304. In the configuration of FIG. 3, foot 300 directly contacts second surface 126 of midsole structure 120. In other embodiments, however, an optional insole or inner liner could be present between a foot and midsole structure 120 when article 100 is worn. Such a liner or insole may be disposed on second surface 126 of midsole structure 120.

**[0045]** Each component may be characterized by various material characteristics, including cushioning and compressibility. In various embodiments, the relative material characteristics of each component (e.g., upper 102, midsole structure 120 and outer sole structure 130) could be varied. In one exemplary embodiment, midsole structure 120 may provide greater cushioning than either upper 102 or outer sole structure 130. In addition, in one embodiment, midsole structure 120 may be more compressible than upper 102 and midsole structure 120 may be more compressible than outer sole structure 130.

**[0046]** The exemplary embodiment shown in FIG. 3 shows the relative compressibility of midsole structure 120 relative to upper 102 and outer sole structure 130. For example, midsole structure 120 is seen to compress under the

weight of foot 300. Specifically, midsole structure 120 undergoes a change from an uncompressed thickness 320 to a compressed thickness 322. In contrast, upper 102 does not undergo any significant compression (e.g., change in thickness) at lower portion 115 under the weight of foot 300. Likewise, outer sole structure 130 does not undergo any significant compression under the weight of foot 300.

**[0047]** In different embodiments, the degree of relative compressibility between midsole structure 120 and other components of article 100 can vary. In at least some embodiments, midsole structure 120 can undergo changes in thickness due to compressive forces (e.g., weight of foot or other ground contact forces) that are greater than the thickness of upper 102. In other words, the change in thickness (e.g., between uncompressed thickness 320 and compressed thickness 322) could be greater than a thickness of upper 102 (e.g., thickness 142 as shown in FIG. 1). The degree of compression for a given force can vary according to factors including but not limited to: desired cushioning properties, midsole structure materials, midsole structure geometry as well as possibly other factors. Moreover, the compression of midsole structure 120 can be tuned to achieve optimal comfort and cushioning for a user.

**[0048]** In different embodiments, the attachment configurations of various components of article 100 could vary. For example, in some embodiments, midsole structure 120 could be bonded or otherwise attached to an inner surface of upper 102. Such bonding or attachment could be accomplished using any known methods for bonding components of articles of footwear, including, but not limited to: adhesives, films, tapes, staples, stitching, or other methods. In some other embodiments, it is contemplated that midsole structure 120 may not be bonded or attached to upper 102, and instead could be free-floating.

**[0049]** Outer sole structure 130 may be attached to upper 102 and/or midsole structure 120. In some embodiments, outer sole structure 130 could be attached directly to upper 102 using various attachment methods including, but not

limited to: adhesives, tapes, staples, stitching, or other methods. In one embodiment, outer sole structure 130 and/or upper 102 could include one or more heat bonding materials (e.g., thermoplastics or other resins) that may act as a bonding layer between outer sole structure 130 and upper 102 when heated.

**[0050]** It is also contemplated that in at least some embodiments, outer sole structure 130 may be attached directly to midsole structure 120 through openings in the braided structure of upper 102 (e.g., through the spaces between strands). Thus, in at least some cases, an adhesive could be applied to first surface 131 of outer sole structure 130 to bond outer sole structure 130 to upper 102 and portions of midsole structure 120 simultaneously. In still other embodiments, outer sole structure 130 and/or midsole structure 120 could be made of heat bondable materials, so that after arranging outer sole structure 130 and midsole structure 120 relative to upper 102, heat may be applied to melt and bond outer sole structure 130 and midsole structure 120 to one another. In such cases, outer sole structure 130 and midsole structure 120 could be formed from bond compatible materials. Such an arrangement where outer sole structure 130 is attached directly to midsole structure 120 may help to anchor outer sole structure 130 to article 100.

**[0051]** In order to form a braided upper with an internal midsole structure, a midsole structure may first be temporarily attached to a last. The last with the temporarily attached midsole structure (also referred to collectively as a lasting assembly) may then be fed through a braiding device (such as a radial braiding machine) to form a braided structure in the form of a braided upper around the last and midsole structure. Upon removal of the last, a braided upper with an internal midsole structure may be assembled with an outer sole structure to form an article of footwear, similar to article 100 discussed above and shown in FIGS. 1-3.

**[0052]** FIGS. 4 and 5 illustrate schematic steps in a process of making an article of footwear, such as article 100, according to an embodiment. Specifically, FIG. 4 illustrates an exploded isometric view of a last 400 (i.e., a

footwear last), adhesive film elements 420 and midsole structure 520. FIG. 5 illustrates a bottom isometric view of midsole structure 520 attached to last 400 using adhesive film elements 420. It will be understood that midsole structure 520 may be similar to midsole structure 120 of the embodiments shown in FIGS. 1-3, and may optionally include some or all of the provisions discussed with respect to midsole structure 120.

**[0053]** In FIGS. 4 and 5, a process of temporarily attaching midsole structure 120 to last 400 may be accomplished using adhesive film elements 420. In particular, second surface 526 of midsole structure 120 may be temporarily bonded to a lower surface 410 (i.e., a sole surface) of last 400 by inserting adhesive film elements 420 between second surface 126 and lower surface 410.

**[0054]** For purpose of clarity, only two film elements are shown, however in other embodiments any number, size, and arrangement of adhesive film elements could be used. In other embodiments, of course, any other method of temporarily fixing, attaching, bonding, adhering or otherwise temporarily joining a midsole structure with a last could be used. Exemplary methods include, but are not limited to, the use of adhesives, films, tapes, putties, as well as possibly other methods. It is contemplated that in some embodiments a last could be configured with a fastening element (such as a screw or other projection) and a midsole structure could be configured with provisions to receive the fastening element (such as a threaded hole to receive a screw). Thus, in some embodiments, a last and a midsole structure could be temporarily secured using some kind of mechanical fasteners, including, but not limited to: screws, bolts, hook and loop fasteners, clips, straps, as well as possibly other mechanical provisions. The method of temporarily joining a midsole structure and a last can be selected according to various factors including: last material and/or dimensions, midsole structure material and/or dimensions, as well as possibly other factors.

**[0055]** For purposes of understanding the arrangement of midsole structure 520 and last 400, last 400 may be characterized as comprising various different portions. For example, last 400 may include not only a lower surface 410

(i.e., the sole surface of last 400), but also an upper surface 412. As used herein, the term “upper surface” of a last refers to the area of the last surface that does not include lower surface 410, which is the surface of the last corresponding to the sole of a foot. Thus, upper surface 412 may generally include the medial side surface, the lateral side surface as well as the upper, forward and rearward surfaces of last 400. Upper surface 412 may generally extend to, or join, a lower surface periphery 414 of lower surface 410.

**[0056]** As seen in FIGS. 4 and 5, midsole structure 520, when temporarily attached to last 400, covers only lower surface 410 of last 400. In particular, upper surface 412 may be exposed when midsole structure 120 is temporarily attached to last 400. Such an arrangement may be in contrast, for example, to the placement of a bootie-like liner over last 400, which would tend to cover both lower surface 410 and upper surface 412. In other words, the exemplary configuration of a component applied to last 400 is one where the component (a midsole structure) is applied only to a local portion of last 400, namely the lower surface 410 of last 400, rather than being uniformly applied over last 400 as in the case of a liner or other intermediate layer.

**[0057]** In order to enhance the operation of a braiding device, such as a radial braiding machine, it may be important to use last assemblies having smooth geometries. For purposes of clarity in characterizing the smoothness of these geometries, the term peripheral contour is used herein to denote the contour or boundary of a given cross-sectional area of a component. Additionally, contours, or lines that bound a given cross-sectional area, can be characterized as having curvature that may vary over different sections of the contour. In the present discussion, the curvature of a given section of a contour may be described by a radius of curvature and the curvature of different sections can be compared according to the differences in their radii of curvature.

**[0058]** FIG. 6 illustrates an isometric view of lasting assembly 500, comprising last 400 and midsole structure 520, including an enlarged cross-sectional view of a portion of lasting assembly 500. In particular, a cross-sectional

view of forefoot portion 430 of last 400 is shown taken along a plane 450. As seen in FIG. 6, forefoot portion 430 has a cross-sectional area 425 and a peripheral contour 427 that bounds the cross-sectional area 425. Peripheral contour 427 may further be comprised of a top portion 432, a bottom portion 434, a medial side portion 436 and a lateral side portion 438.

**[0059]** As shown in FIG. 6, medial side portion 436 and lateral side portion 438 may be representative of portions of the exterior surface of last 400 where the curvature is relatively high and non-constant. For example, medial side portion 436 may have a first curvature, represented in FIG. 6 by first radius of curvature 460. Additionally, lateral side portion 438 may have a second curvature, represented in FIG. 6 by second radius of curvature 462.

**[0060]** As shown in FIG. 6, when temporarily attached to last 400, midsole structure 520 may help reduce regions of high curvature. In FIG. 6, last 400 and midsole structure are seen to provide a combined peripheral contour 470. The combined peripheral contour 470 represents the peripheral contour that will be presented to a braiding machine during formation of a braided upper. In this case, a medial side portion 476 of combined peripheral contour 470 has a third radius of curvature 464 and a lateral side portion 478 of combined peripheral contour 470 has a fourth radius of curvature 466.

**[0061]** As clearly seen in FIG. 6, the geometry of combined peripheral contour 470 may be different than the geometry of the last 400. For example, combined peripheral contour 470 is significantly less curved on the medial and lateral sides of last 400 and midsole structure 520. Specifically, third curvature 464 may be substantially less than first curvature 460 on the medial sides of last 400 and midsole structure 520. Likewise, fourth curvature 466 may be substantially less than second curvature 462 on the lateral sides of last 400 and midsole structure 520. Because of this reduced curvature on the lateral and medial sides, last 400 and midsole structure 120 may together present a smoother peripheral contour (e.g., a cross-sectional area with a smoother boundary) to a braiding machine than would be presented by last 400 alone.

**[0062]** It will be understood that the curvature of last 400 may vary over different portions from the curvature depicted for forefoot portion 430. It may be appreciated that in other portions where last 400 may have high curvature the addition of midsole structure 120 may also help present a smoother contoured periphery to the braiding machine.

**[0063]** FIG. 7 illustrates a step of inserting lasting assembly 500 (i.e., last 400 and midsole structure 520) through a braiding device 522. In some embodiments, braiding device 522 may include provisions for over-braiding strands onto a lasting assembly. In the configuration shown in FIG. 7, braiding device 522 includes spools 502 with threads 504 that may be over-braided onto last 400 and midsole structure 520 as these components are inserted through a central braiding area 523 of braiding device 522.

**[0064]** In some embodiments, lasting assembly 500 may be manually fed through braiding device 522 by a human operator. In other embodiments, a continuous last feeding system can be used to feed lasting assembly 500 through braiding device 522. The present embodiments could make use of any of the methods and systems for forming a braided upper disclosed in the Braided Upper application.

**[0065]** As shown in FIG. 7, as lasting assembly 500 is fed through braiding device 522, a braided structure 602 is formed around last 400 and midsole structure 120. In this case, braided structure 602 forms a continuously braided upper that conforms to last 400 and midsole structure 120, and therefore has the approximate geometry of the combination of last 400 and midsole structure 120.

**[0066]** In some embodiments, methods of braiding may also include provisions for holding and/or feeding articles through braiding device 522. For example, some embodiments may include support platforms (not shown) that can facilitate feeding articles through braiding device 522. Generally, any systems known in the art for feeding objects through a braiding machine could be used. In some embodiments, a conveyor system could be used to automatically move a

footwear last through braiding device 522. In some other embodiments, each footwear last could be manually inserted through braiding device 522.

**[0067]** As seen in FIG. 7, the exemplary method provides a generally rounded cross-sectional shape without any regions of high curvature that might interfere with the over-braiding process.

**[0068]** FIGS. 8-9 illustrate a schematic view of a step of cutting a braided structure 602 and removing last 400. In some cases, as schematically shown in FIGS. 8-9, after forming braided footwear structure 602, a section 608 of braided footwear structure 602 can be cut or otherwise removed to form an opening 610 in braided footwear structure 602. In some cases, last 400 can be removed from opening 610, which may further serve as an opening for a foot.

**[0069]** Although not shown here, some embodiments can also include provisions for assembling trim, overlay, or other components or portions of material for assembly with a braided structure. As used herein, the term “overlay” refers to any material layer that could be disposed over a layer of braided material, including braided material for an upper. Overlays could be comprised of any kinds of materials and may be configured with a variety of different characteristics (e.g., stretch, elasticity, density, weight, durability, breathability, etc.). Also, overlays could have any dimensions and could be configured to cover some portions and/or all portions of a braided structure. Overlays could be disposed on an interior surface of a braided structure and/or an exterior surface of a braided structure. Embodiments could use any of the overlays, and/or methods for attaching overlays to braided structure, disclosed in Bruce, U.S. Patent Publication Number 2014/0373389, now U.S. Patent Application Number 14/163,438, filed January 24, 2014, and titled “Braided Upper with Overlays for Article of Footwear,” the entirety of which is herein incorporated by reference.

**[0070]** FIG. 10 illustrates an isometric view of an embodiment of a braided upper 604 formed from braided structure 602 (incorporating internal midsole structure 520) being assembled with an outer sole structure 650. Here, surface 652 of outer sole structure 650 may be temporarily bonded to a lower

surface 605 (i.e., a sole surface) of braided upper 604 using an adhesive 660 between surface 652 and lower surface 605. In other embodiments, of course, any other method of temporarily fixing, attaching, bonding, adhering or otherwise temporarily joining an outer sole structure with an upper could be used. Exemplary methods include, but are not limited to, the use of adhesives, films, tapes, as well as possibly other methods. Still other embodiments may not include an outer sole structure. Further, in other embodiments, additional sole components or layers could be incorporated between an outer sole structure and a braided upper.

**[0071]** Embodiments could use any methods for manufacturing braided articles including uppers with internal midsoles. In particular, embodiments could use any of the methods of braiding uppers, forming and attaching overlay structures (using 3D printing and high frequency welding) as well any other methods, systems or provisions disclosed in Bruce, U.S. Patent Publication Number \_\_\_\_\_, filed as U.S. Patent Application Number 14/565,582 on December 10, 2014, entitled "Portable Manufacturing System for Articles of Footwear," the entirety of which is herein incorporated by reference.

**[0072]** FIGS. 11-12 illustrate schematic views of upper 604 with internal midsole structure 520 (FIG. 11) and without midsole structure 520 (FIG. 12). It will be understood that FIG. 12 is only intended for purposes of clarifying provisions of the exemplary designs. In particular, in some embodiments a midsole structure may not be removable and instead may be permanently disposed within an interior cavity of an upper.

**[0073]** As seen by comparing the enlarged cross-sectional views in FIG. 11 and FIG. 12, upper 604 maintains an approximately identical cross-sectional shape between the two configurations. Specifically, the lower portion 710 of upper 604, associated with lower surface 712 and peripheral side surfaces 714 of upper 604, may not change in geometry or dimension even when midsole structure 520 is removed in the configuration of FIG. 12. This consistent geometry for lower portion 710 may be due to the process of forming upper 604. Specifically, tensile

strands are braided around midsole structure 520 so that the resulting braided structure has a geometry that corresponds with the contours of midsole structure 520 in a relaxed or un-tensioned state of upper 604. For example, as shown in FIG. 12, at a top portion 739 of upper 604 the strands 740 of the braided structure may be spaced apart by a similar amount to strands 742 in lower portion 710 of the braided structure, thereby indicating roughly even tension throughout upper 604 in this state.

**[0074]** Such a configuration for upper 604 may be in contrast to alternative embodiments in which a midsole structure is inserted after the upper has been formed in an over-braiding process (or other braiding process). For example, in an alternative embodiment shown in FIGS. 13-15, a braided upper 804 may be formed on a last 800 without a midsole structure (FIG. 13). Next, once braided upper 804 has been formed (and last 800 removed), a midsole structure 820 may be inserted into braided upper 804, as shown in FIG. 14. In this case, braided upper 804 must stretch, especially at a lower portion 810, to accommodate the contours of midsole structure 820. Such stretching may result in increased tension at lower portion 810 of braided upper 804, which is tension within upper 804 caused by the presence of midsole structure 820. Finally, FIG. 15 illustrates that if midsole structure 820 is removed from braided upper 804, braided upper 804 may revert to an earlier configuration where the geometry of lower portion 810 fails to retain the contours of midsole structure 820 (i.e., lower portion 810 no longer has a geometry corresponding to midsole structure 820). This may occur as upper 804 contracts with the removal of midsole structure 820.

**[0075]** In contrast to the embodiment of FIGS. 11-12, the embodiment shown in FIGS. 13-15 results in greater stretching in some portions of upper 804 due to the presence of midsole structure 820. Specifically, in lower portion 810 of upper 802 the strands 842 of the braided structure are spaced further apart than the strands 840 in top portion 839 of the braided structure, indicating an uneven tension throughout upper 802.

**[0076]** By forming an upper so that the upper geometry accommodates a midsole structure without stretching, as occurs in the exemplary embodiments shown in FIGS. 1-12, the upper may be made more resilient and may also more easily accommodate additional tensions from ground contact forces, bending, etc.

**[0077]** While various embodiments have been described, the description is intended to be exemplary, rather than limiting and it will be apparent to those of ordinary skill in the art that many more embodiments and implementations are possible that are within the scope of the embodiments. Any feature of any embodiment may be used in combination with or substituted for any other feature or element in any other embodiment unless specifically restricted. Accordingly, the embodiments are not to be restricted except in light of the attached claims and their equivalents. Also, various modifications and changes may be made within the scope of the attached claims.

**[0078]** Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

**[0079]** The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

**THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:**

1. A method of making a braided upper for an article of footwear, comprising:  
associating a midsole structure with a lower surface of a last;  
wherein a forefoot portion of the last has a cross-sectional area and a peripheral contour that bounds the cross-sectional area, and the last and midsole structure provide a combined peripheral contour,  
wherein a medial side portion of the peripheral contour has a first curvature, and a lateral side portion of the peripheral contour has a second curvature,  
wherein a medial side portion of the combined peripheral contour has a third curvature and a lateral side portion of the combined peripheral contour has a fourth curvature; and  
wherein the third curvature is substantially less than the first curvature, and/or wherein the fourth curvature is substantially less than the second curvature;  
the method further comprising inserting the last and the midsole structure through a braiding device while the midsole structure is associated with the lower surface of the last so as to form a braided structure around the last and the midsole structure, wherein the reduced curvature of the third curvature with respect to the first curvature and/or reduced curvature of the fourth curvature with respect to the second curvature presents a smoother peripheral contour to the braiding device than would be presented by the last alone; and  
thereby forming the braided upper from the braided structure, wherein the midsole structure is disposed within an interior cavity of the braided upper.
2. The method according to claim 1, wherein associating the midsole structure with the lower surface of the last includes temporarily bonding the midsole structure to the lower surface.
3. The method according to claim 2, wherein the method includes applying a bonding material between the midsole structure and the lower surface.

4. The method according to claim 3, wherein the bonding material is an adhesive film.

5. The method according to claim 3, wherein the bonding material is a liquid adhesive layer.

6. The method according to claim 1, wherein the midsole has a first thickness, wherein the braided upper has a second thickness and wherein the first thickness is greater than the second thickness.

7. The method according to claim 1, wherein the lower surface of the last includes a lower surface periphery, wherein the last includes an upper surface extending to the lower surface periphery, and wherein the upper surface is exposed while the midsole structure is temporarily attached to the last.

8. The method according to claim 1, wherein the method includes removing the last from the braided upper.

9. The method according to claim 1, wherein the braiding device is a radial braiding machine.

10. A method of making an article of footwear, comprising:  
associating a midsole structure with a lower surface of a last;  
wherein a forefoot portion of the last has a cross-sectional area and a peripheral contour that bounds the cross-sectional area, and the last and midsole structure provide a combined peripheral contour,  
wherein a medial side portion of the peripheral contour has a first curvature, and a lateral side portion of the peripheral contour has a second curvature,  
wherein a medial side portion of the combined peripheral contour has a

third curvature and a lateral side portion of the combined peripheral contour has a fourth curvature; and

wherein the third curvature is substantially less than the first curvature, and/or wherein the fourth curvature is substantially less than the second curvature;

the method further comprising inserting the last and the midsole structure through a braiding device while the midsole structure is associated with the lower surface of the last so as to form a braided structure around the last and the midsole structure, wherein the reduced curvature of the third curvature with respect to the first curvature and/or reduced curvature of the fourth curvature with respect to the second curvature presents a smoother peripheral contour to the braiding device than would be presented by the last alone, thereby forming a braided upper from the braided structure, wherein the midsole structure is disposed within an interior cavity of the braided upper;

removing the last from the braided upper;  
attaching an outer sole structure to a lower portion of the braided upper, the outer sole structure including a ground engaging surface; and

thereby forming the article of footwear.

11. The method according to claim 10, wherein the midsole structure is made of a first material, the braided upper is made of a second material and the outer sole structure is made of a third material, and wherein the first material is different from the second material and the third material is different from the second material.

12. The method according to claim 11, wherein the first material is different from the third material.

13. The method according to claim 11, wherein the first material is more compressible than the second material.

14. An article of footwear, comprising:

a braided upper which is a braided structure, the braided upper including an interior cavity and an opening providing entry to the interior cavity and wherein the braided upper includes a closed lower portion and an upper portion;

a midsole structure disposed within the interior cavity such that the midsole structure is disposed closer to an inner surface of the lower portion than an outer surface of the lower portion, the midsole structure having an exterior surface comprising a first surface and a second surface, the second surface being an upper surface of the midsole structure; and

an outer sole structure attached to the outer surface of the lower portion,

wherein a forefoot portion of the inner cavity defined by the upper portion of the braided upper and the second surface of the midsole structure has a cross-sectional area and a peripheral contour that bounds the cross-sectional area, and the inner cavity provides a combined peripheral contour,

wherein a medial side portion of the peripheral contour has a first curvature, and a lateral side portion of the peripheral contour has a second curvature,

wherein a medial side portion of the combined peripheral contour has a third curvature and a lateral side portion of the combined peripheral contour has a fourth curvature; and

wherein the third curvature is substantially less than the first curvature, and/or wherein the fourth curvature is substantially less than the second curvature.

15. The article of footwear according to claim 14, wherein the lower portion is disposed between the midsole structure and the outer sole structure.

16. The article of footwear according to claim 14, wherein the midsole structure is bonded to the inner surface of the lower portion of the braided upper.

17. The article of footwear according to claim 14, wherein the midsole structure is thicker than the braided upper.

18. The article of footwear according to claim 14, wherein the midsole structure is thicker than the outer sole structure.
19. The article of footwear according to claim 14, wherein the midsole structure is more compressible than the outer sole structure.
20. The article of footwear according to claim 14, wherein the midsole structure is more compressible than the braided upper.

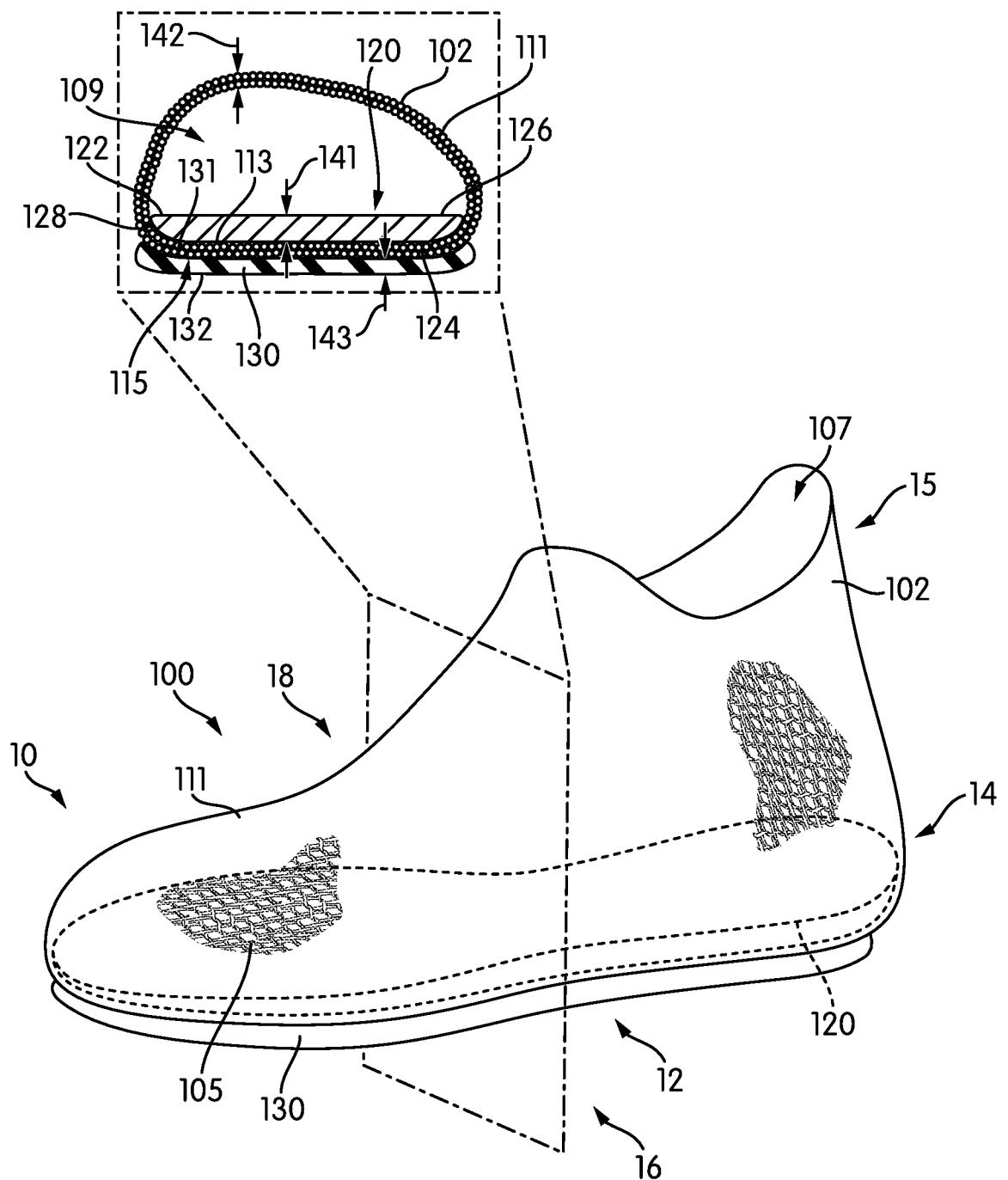


FIG. 1

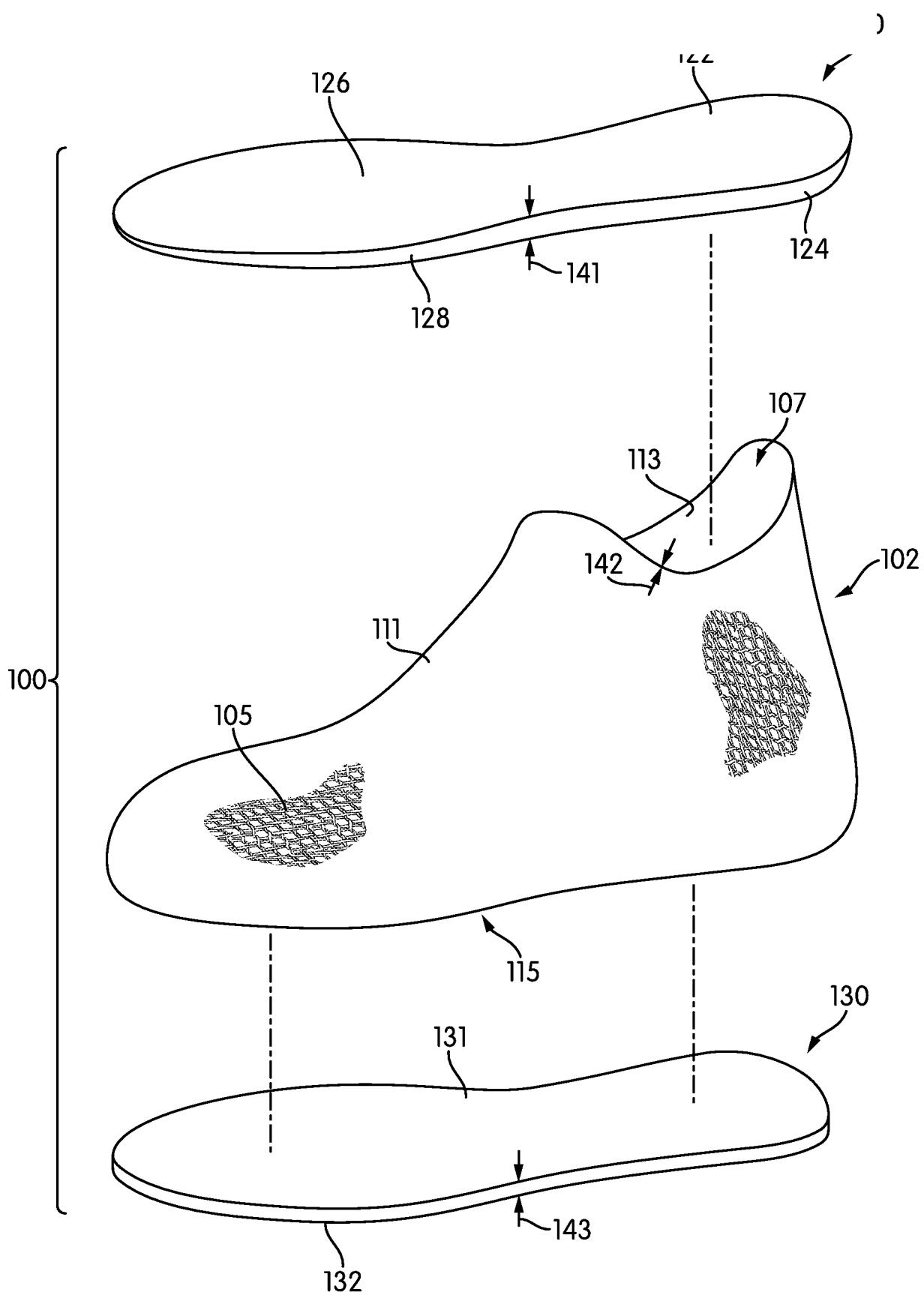


FIG. 2

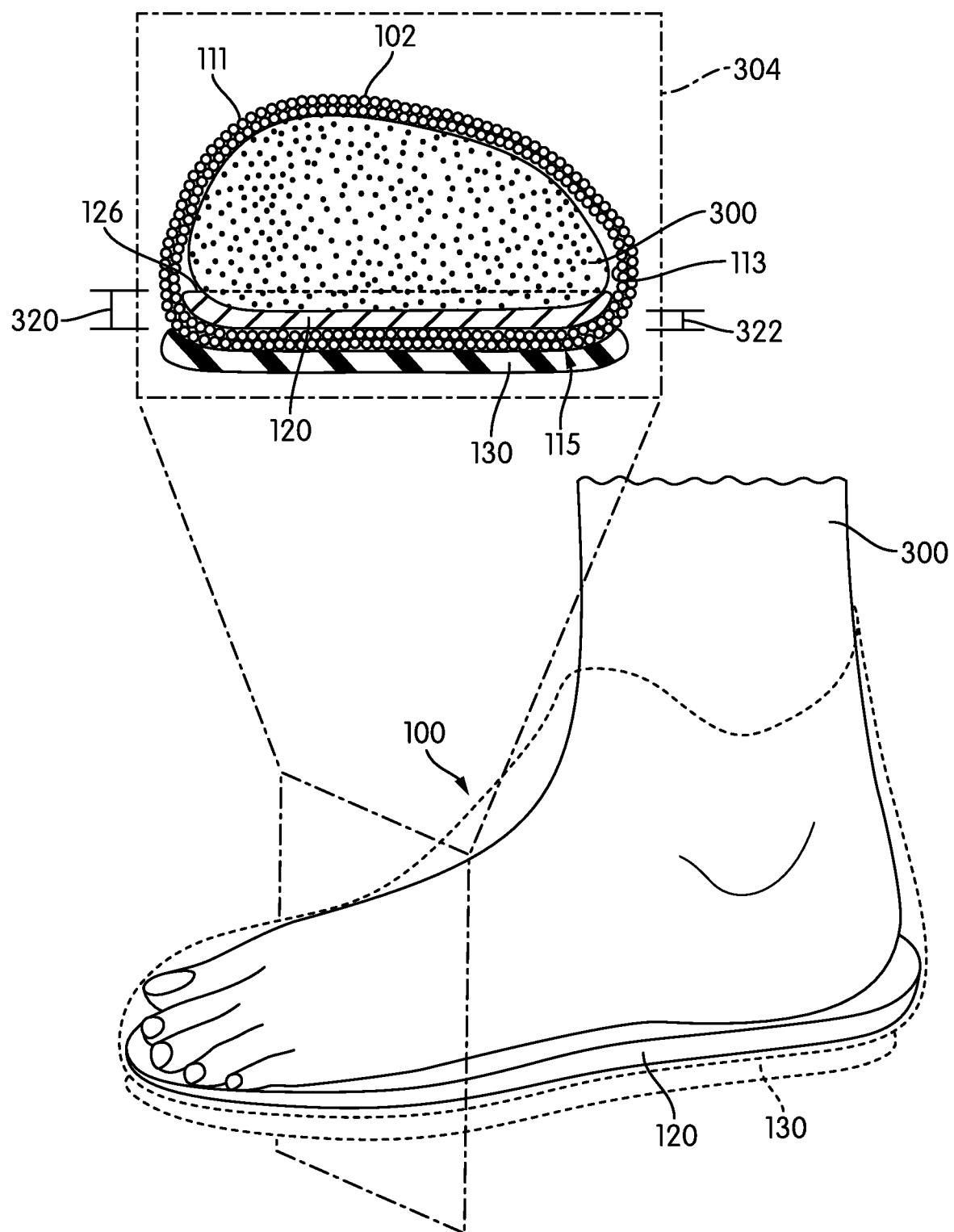


FIG. 3

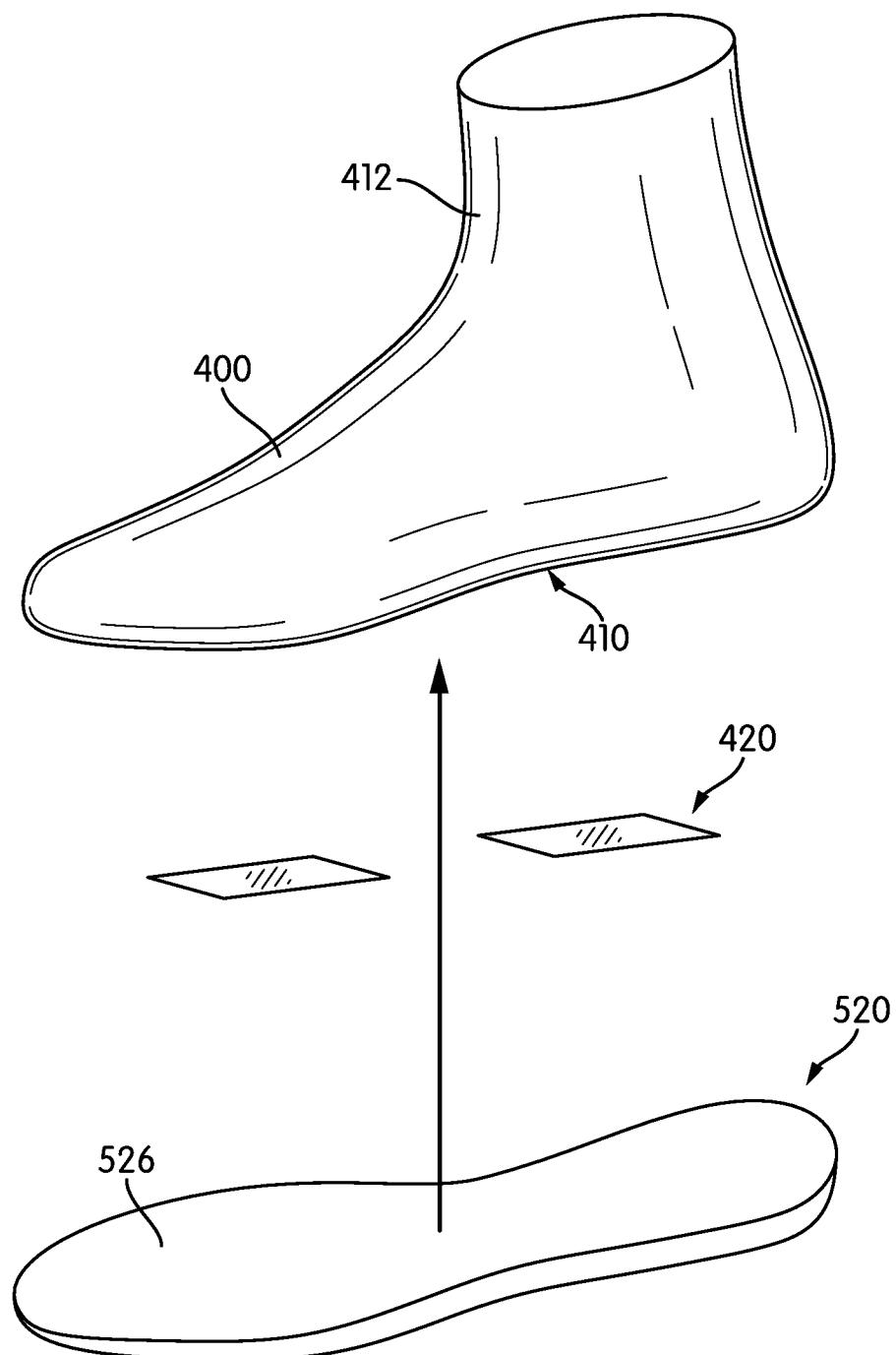


FIG. 4

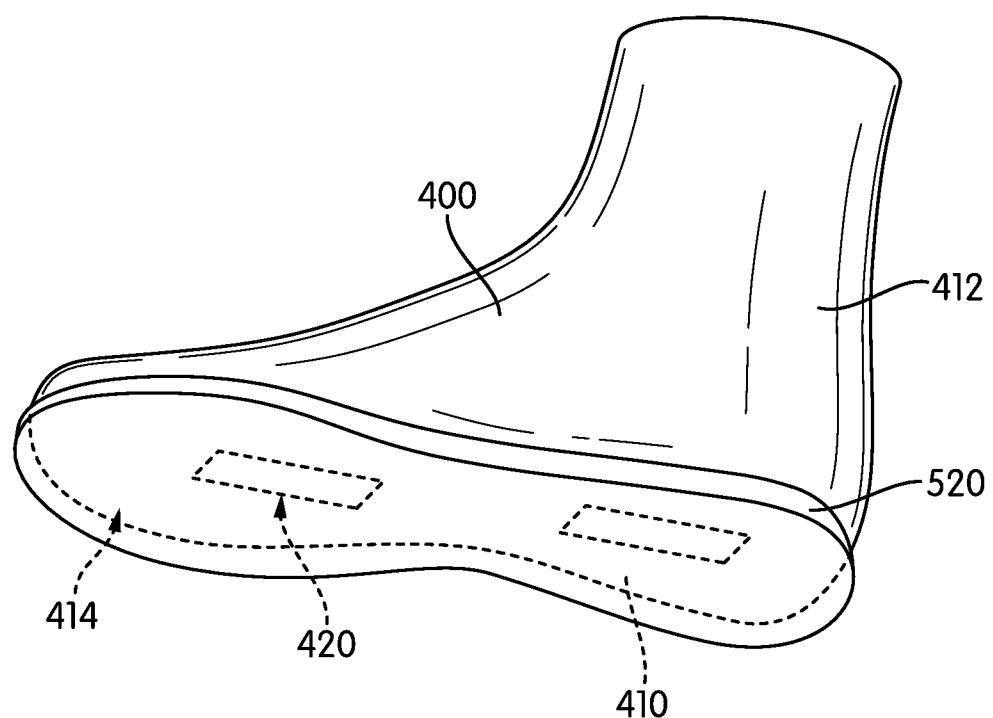


FIG. 5

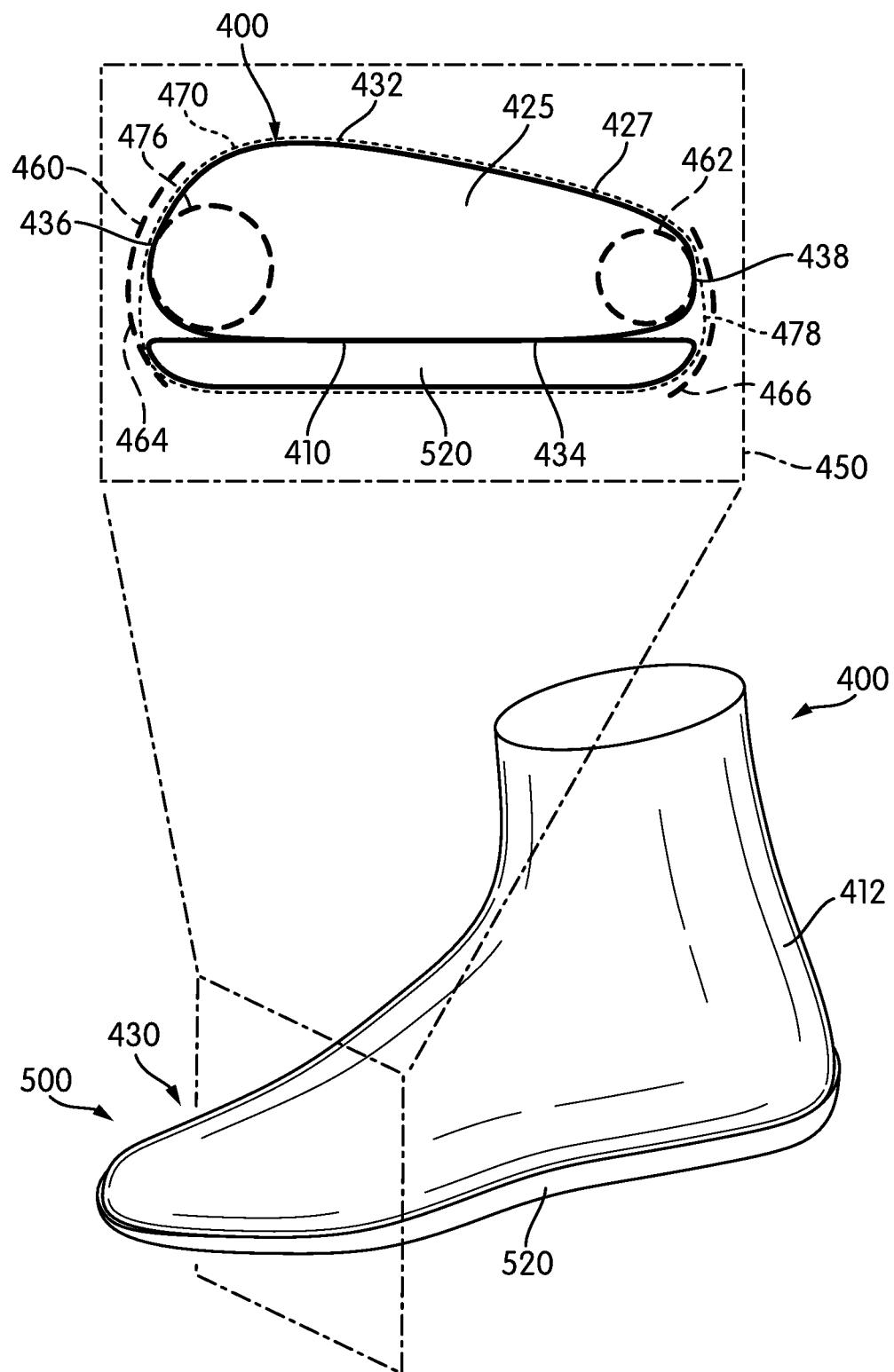


FIG. 6

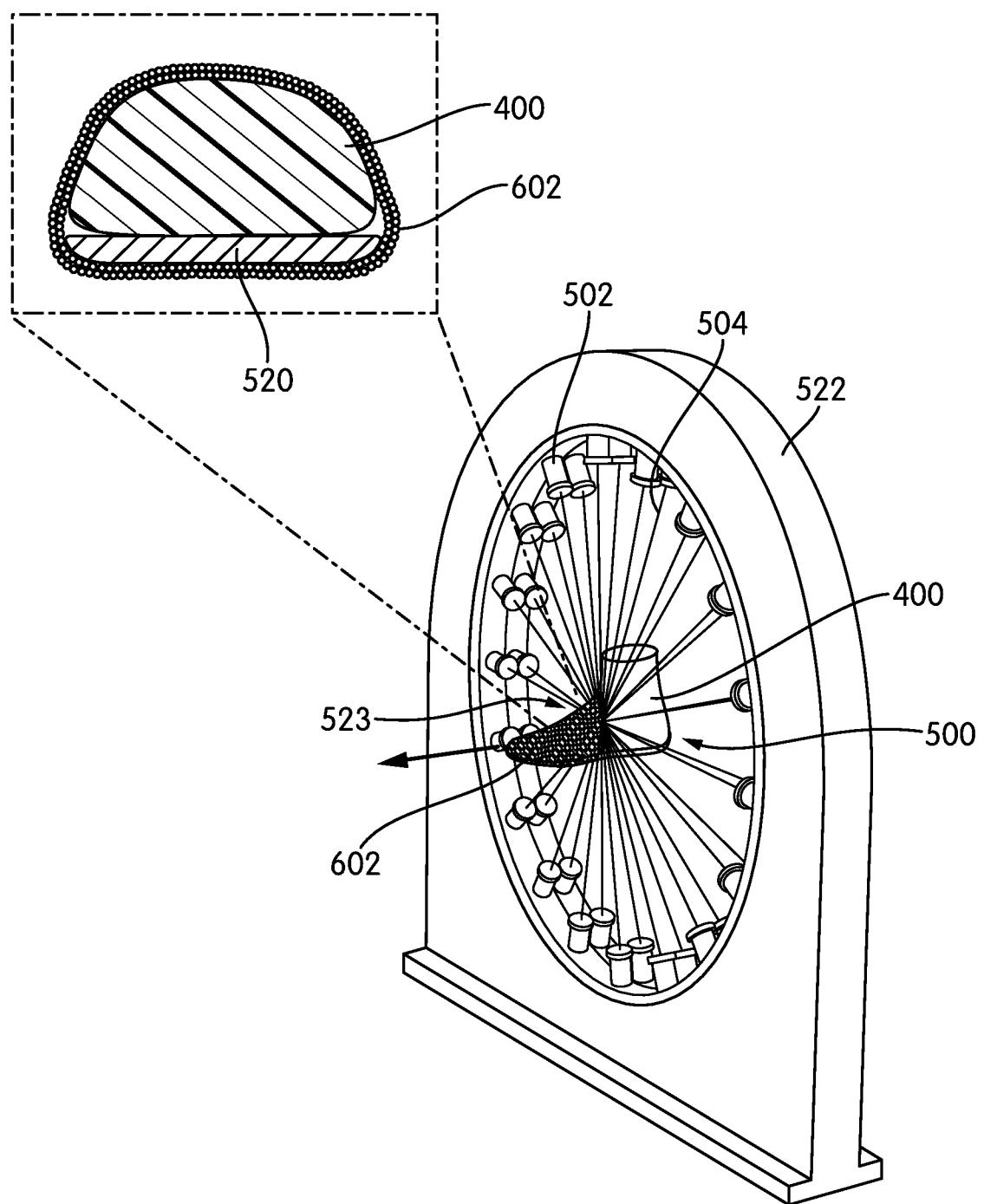


FIG. 7

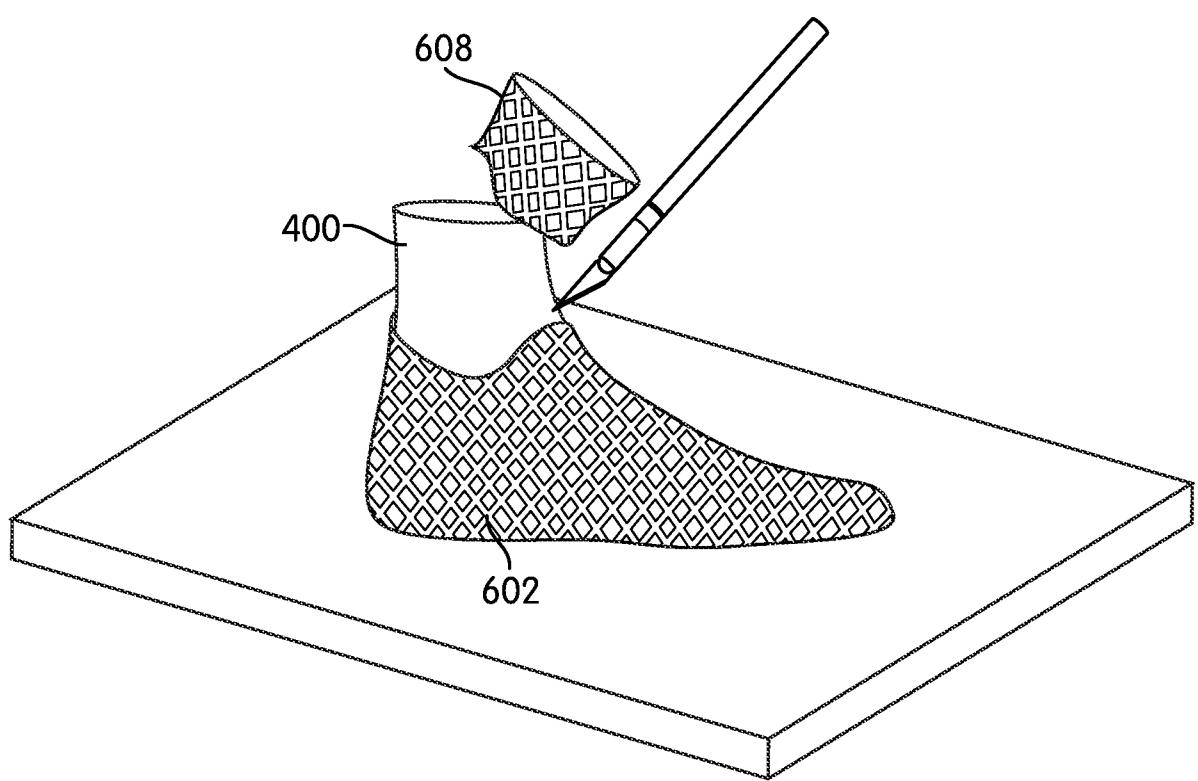


FIG. 8

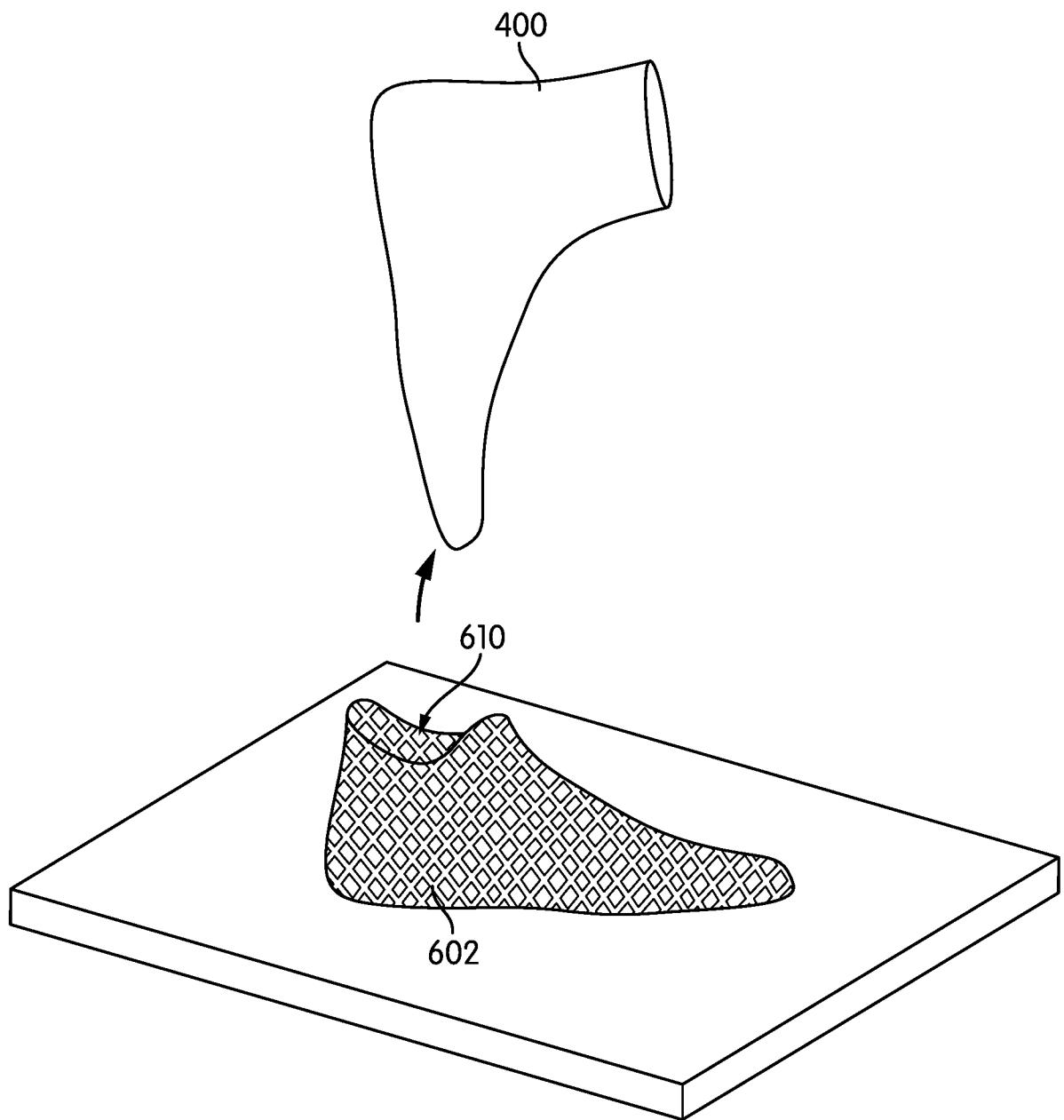


FIG. 9

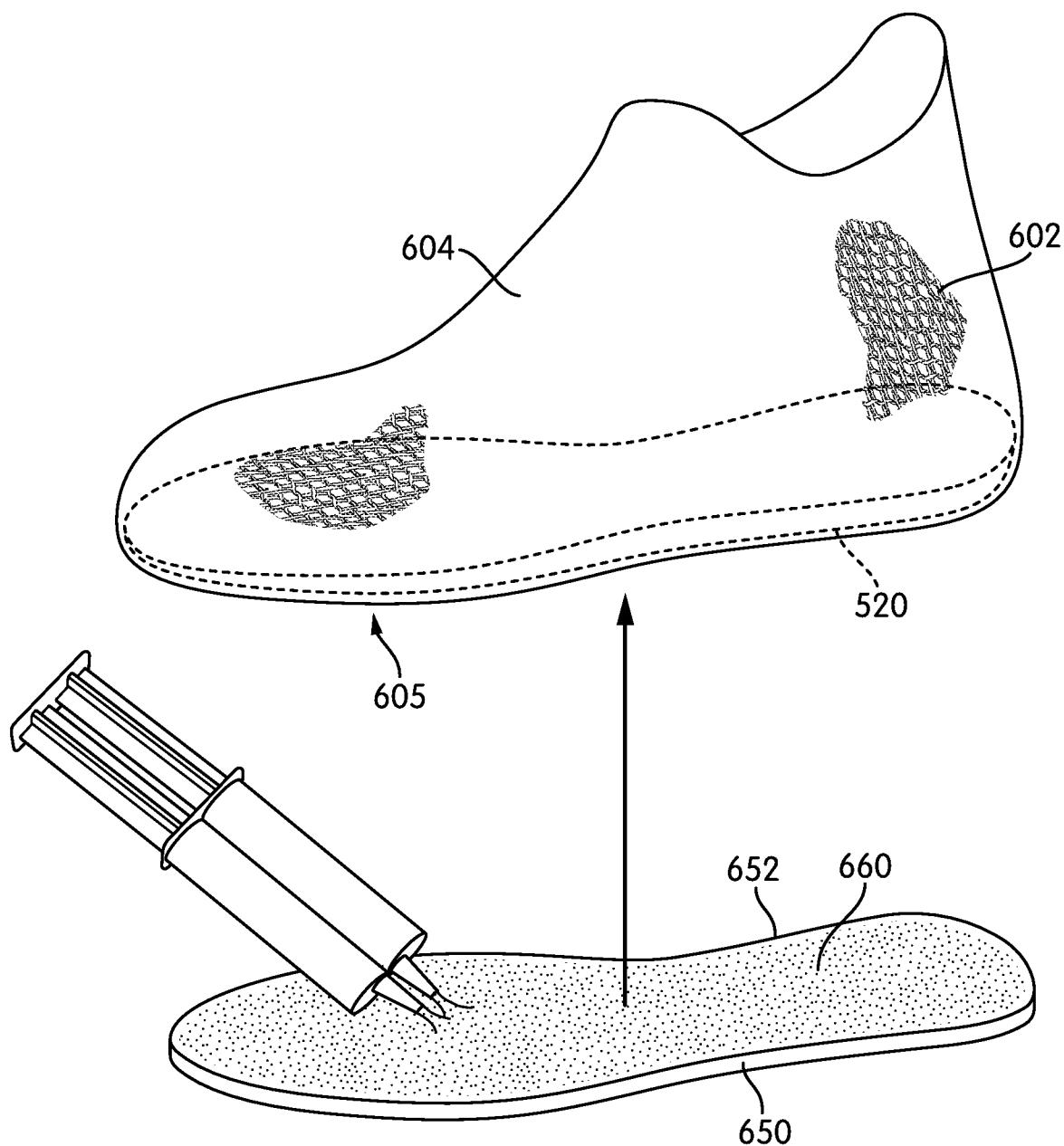


FIG. 10

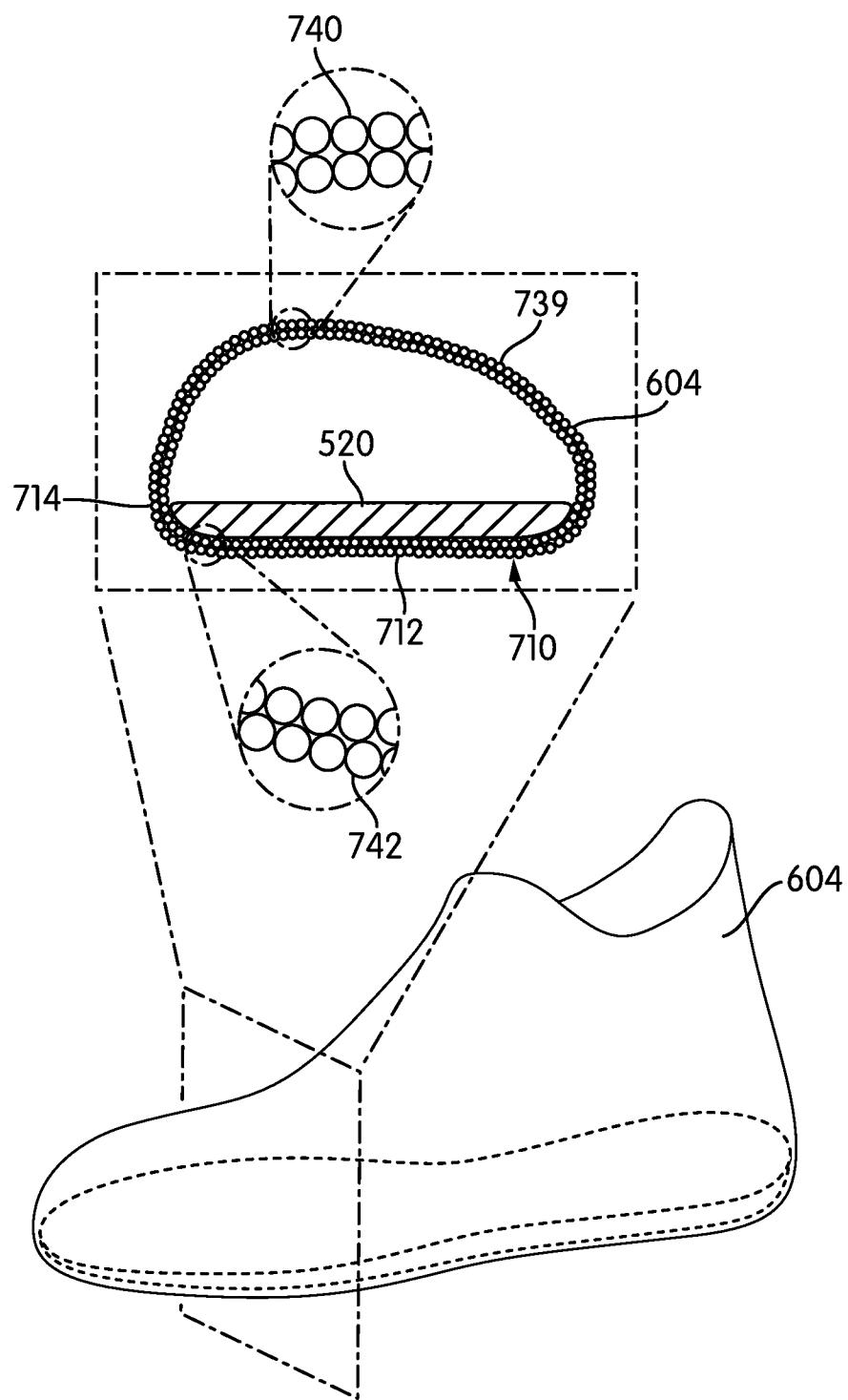


FIG. 11

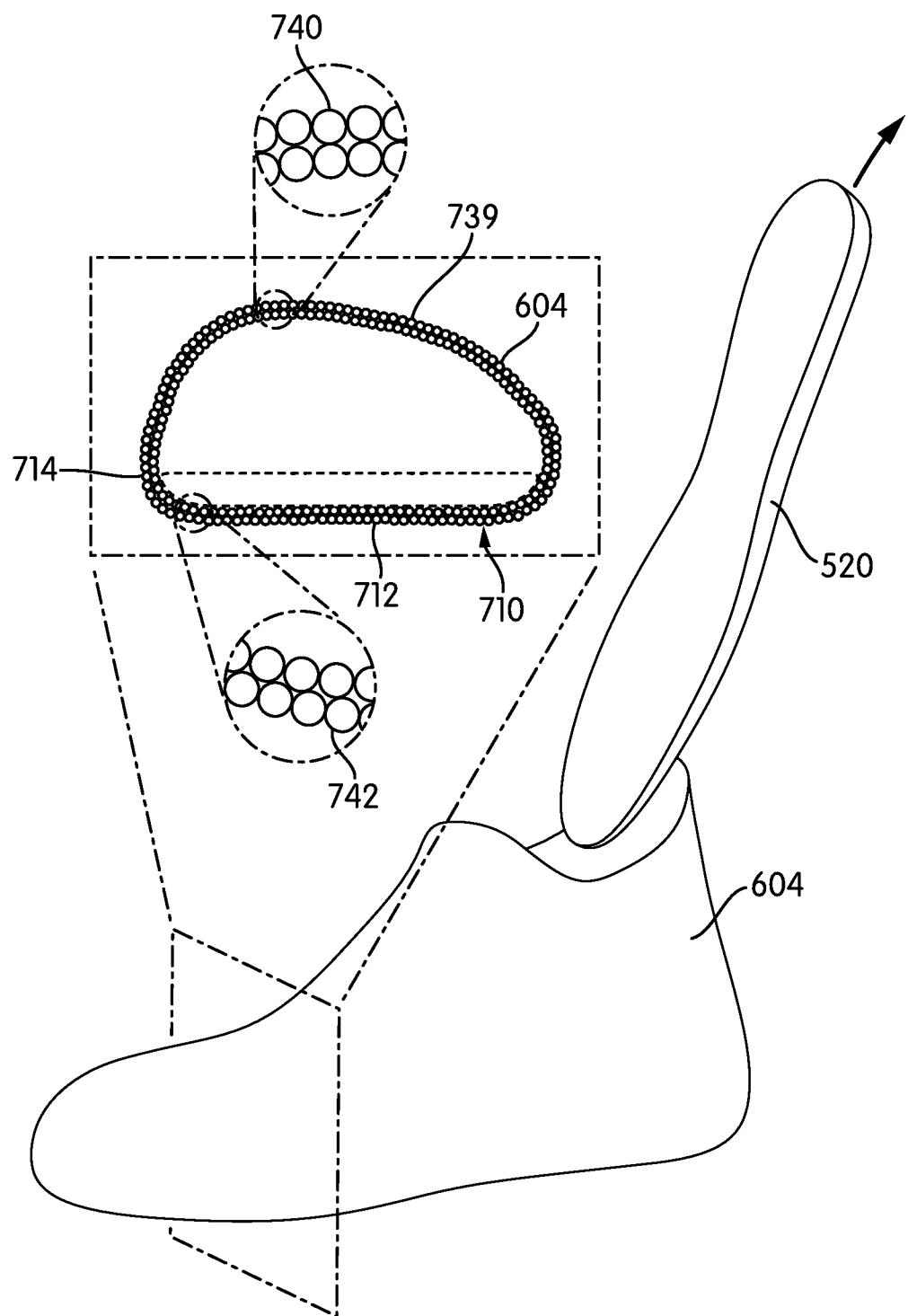


FIG. 12

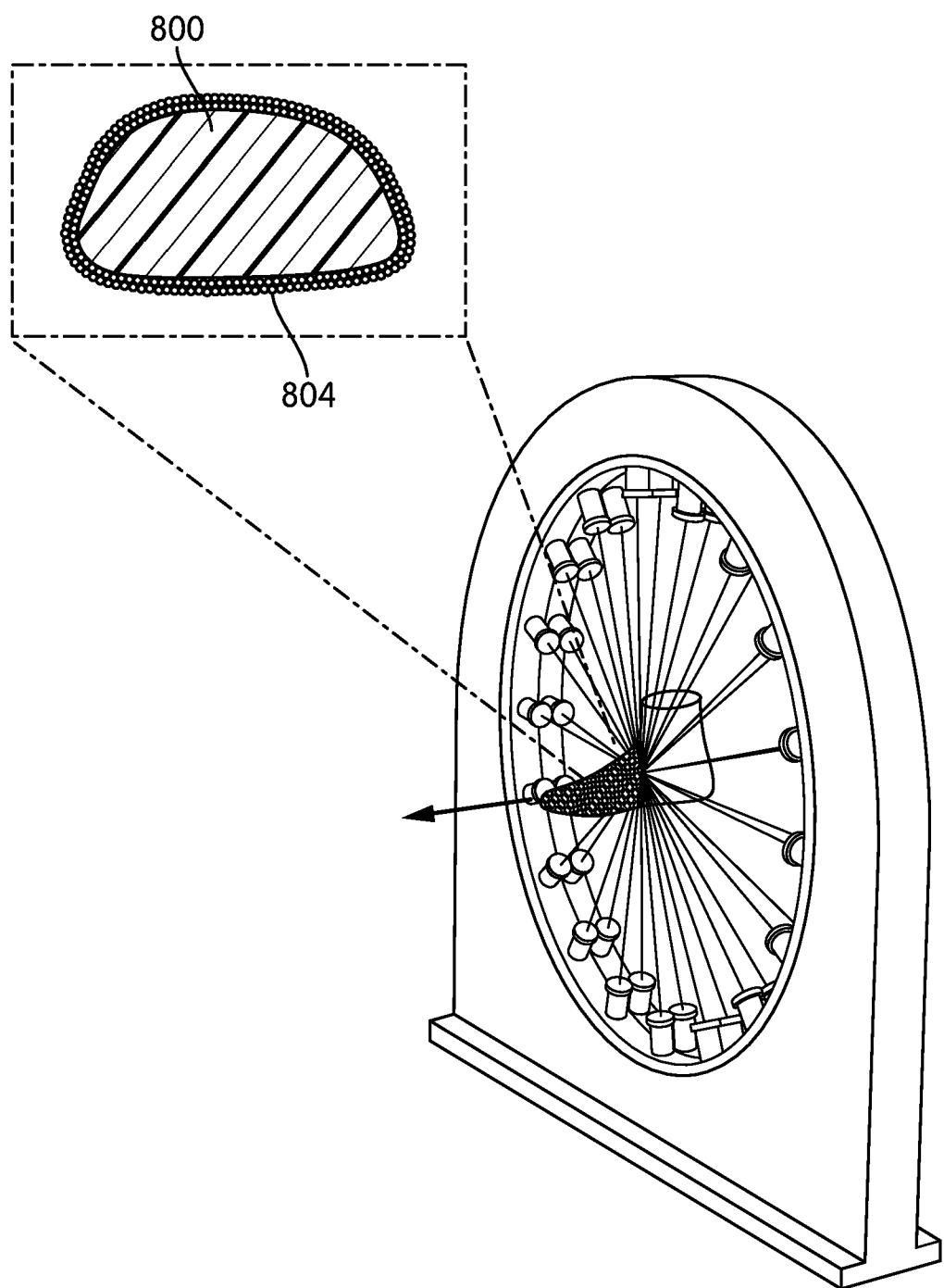


FIG. 13

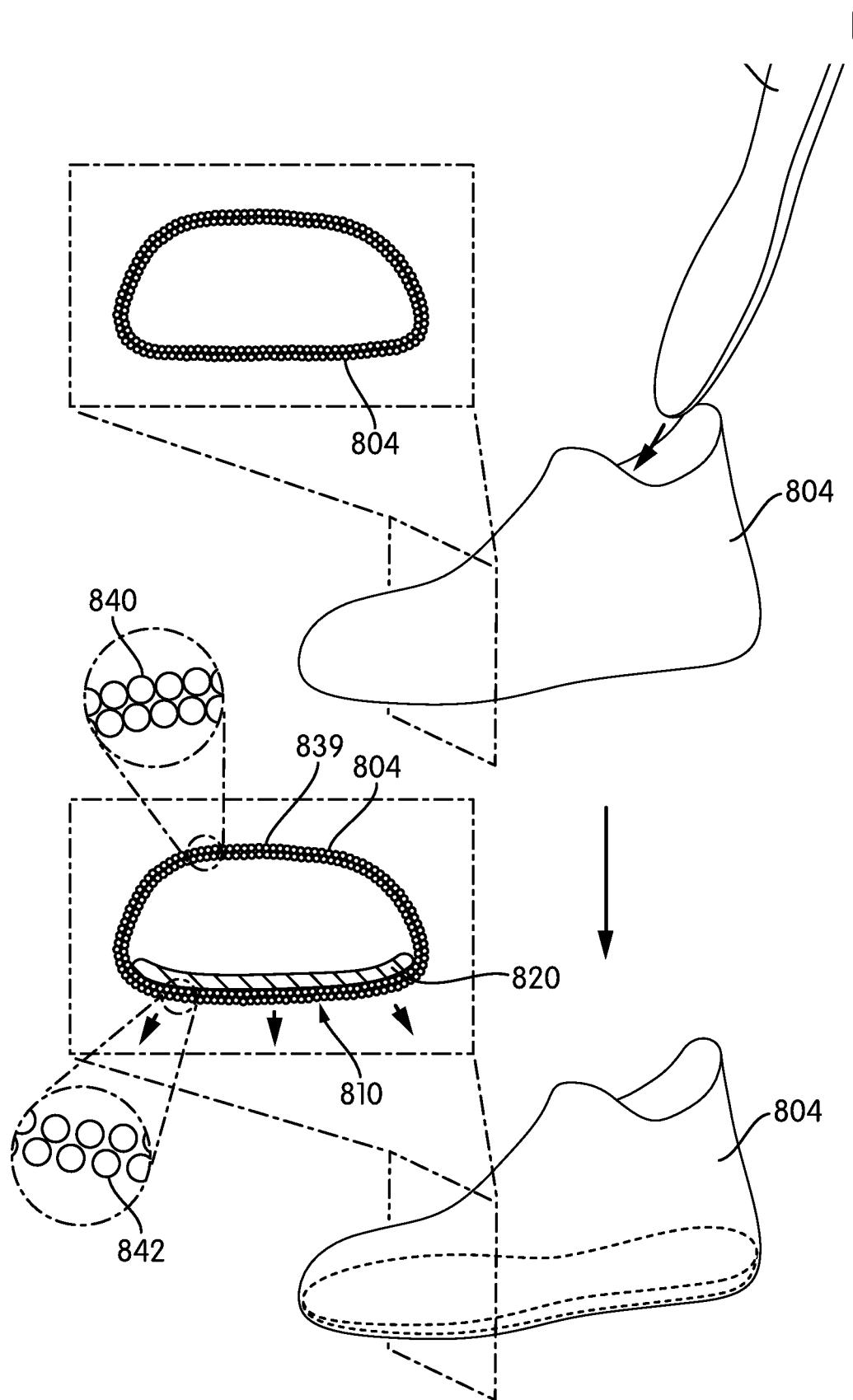


FIG. 14

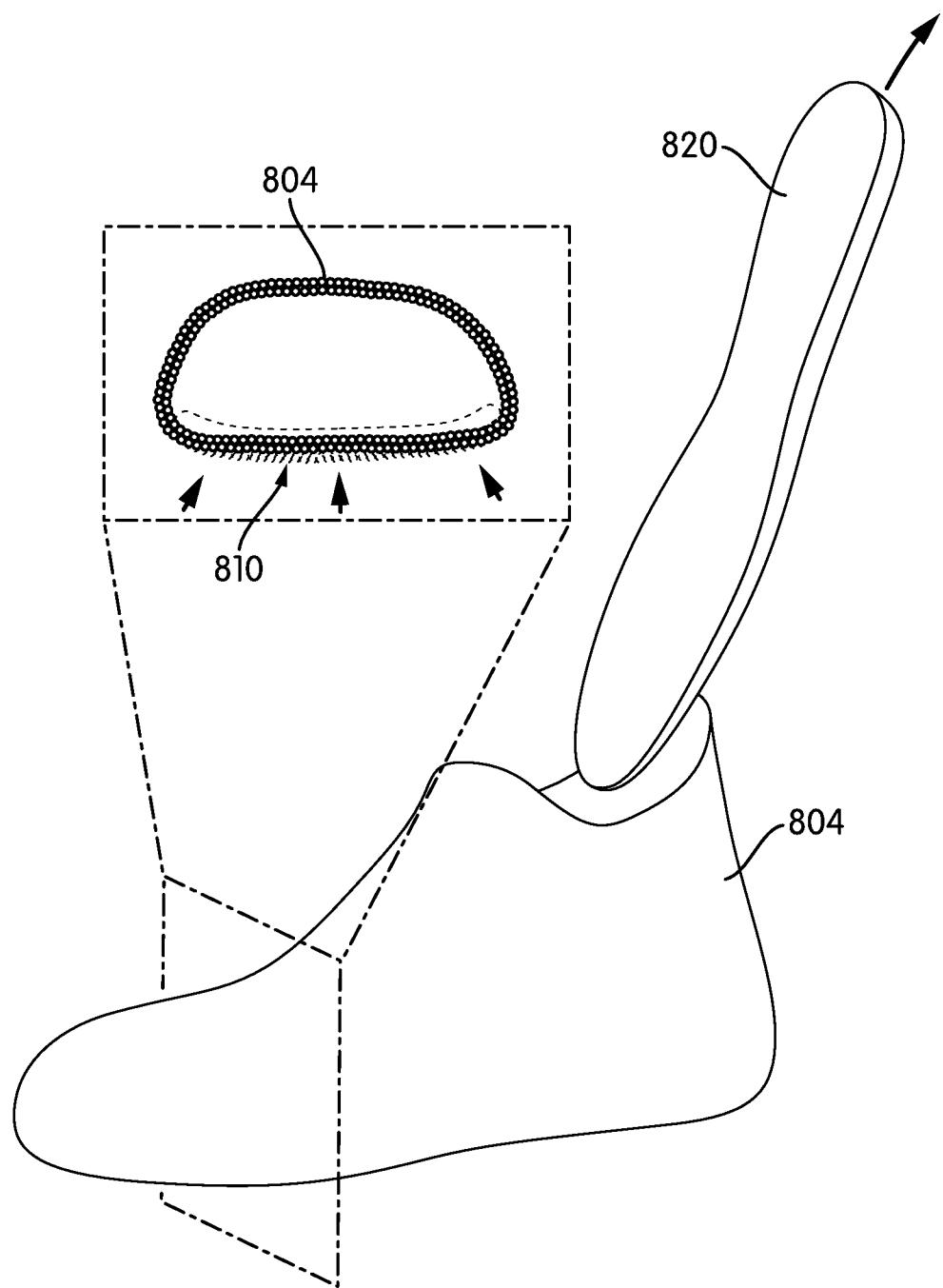


FIG. 15