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(71) Applicant: **Acushnet Company**
Fairhaven, MA 02719 (US)

(72) Inventors:
• **BIDAL, Jean-Marie**
Marlborough, 01752 (US)
• **BENTO, Robert S.**
Raynham, 02767 (US)
• **Duffy, Keith M.**
Whitman, 02382 (US)
• **LIN, Chao-Wei**
408 Taichung City (TW)

(74) Representative: **Murgitroyd & Company**
165-169 Scotland Street
Glasgow G5 8PL (GB)

(54) **RECYCLABLE GOLF SHOE**

(57) The present disclosure provides a recyclable golf shoe. The shoe may comprise an upper and a sole assembly. The upper may comprise: a membrane layer configured to at least partially surround or enclose a foot of a subject wearing the golf shoe; an internal A-shaped frame structure attached or coupled to the membrane layer to structurally support or stiffen the upper; a mesh layer comprising a first side and a second side, the first side attached or coupled to the membrane layer and the internal A-shaped frame structure; and a saddle connected to the second side of the mesh layer. The membrane layer, the internal A-shaped frame structure, the mesh layer, and the saddle may comprise one or more recyclable thermoplastic urethane (TPU) materials that can be processable into another article or component comprising at least one recycled or recyclable TPU material.

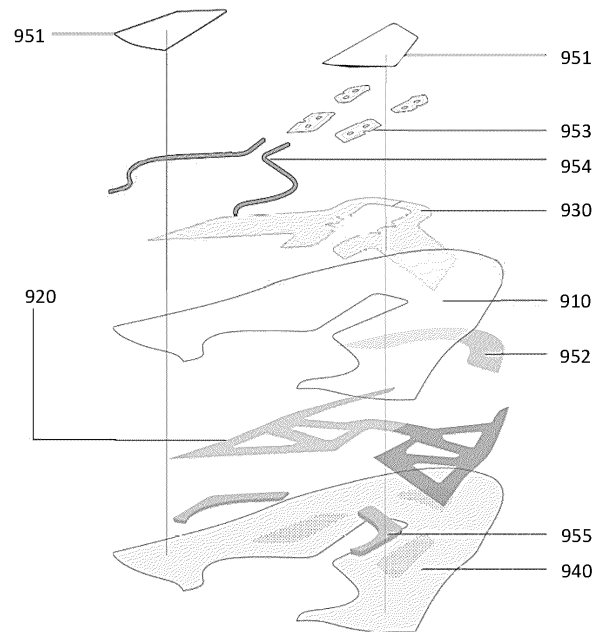


FIG. 9

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Description

BACKGROUND

[0001] The sport of golf can involve a variety of actions such as swinging a golf club, walking a golf course, and/or crouching down to line up a putt. The equipment used to play golf can affect how well a golfer performs or executes golf-related actions or movements.

[0002] Golf shoes are one example of a piece of equipment that can affect performance. In some cases, the components and materials of a golf shoe can be selected based on aesthetics and/or performance considerations. In many cases, the components and materials used for conventional golf shoes may not be optimized for recyclability, which can make it difficult or challenging to efficiently recycle golf shoes.

SUMMARY

[0003] Recognized herein are various shortcomings and disadvantages of conventional golf shoes. When designed properly, golf shoes can provide stability, traction, and comfort on multiple different types of surfaces. However, in order to provide the performance characteristics needed for golf, many conventional golf shoes incorporate materials that are difficult or impossible to recycle. To mitigate the social and environmental impacts associated with non-recyclable materials or compositions, some golf shoes may utilize recyclable materials. In some cases, the inclusion of recyclable materials may require additional structural optimizations to preserve the performance characteristics needed for golf. However, many recyclable golf shoes that are currently available do not implement such structural optimizations, which can negatively impact performance at the expense of recyclability.

[0004] The present disclosure addresses the above-mentioned shortcomings and disadvantages of conventional golf shoes, which may not be optimally structured or otherwise configured to provide the response characteristics needed for a high performance recyclable golf shoe. In one aspect, the present disclosure provides various examples of high performance recyclable golf shoes. The golf shoes disclosed herein can be recycled efficiently with minimal effort from end users (e.g., consumers who provide used shoes for recycling) or recyclers (e.g., entities that process or recycle shoes to create a source material for producing another article). The high performance golf shoes of the present disclosure may comprise a recyclable assembly that does not compromise or sacrifice performance to achieve or preserve recyclability. The presently disclosed recyclable golf shoes may provide comfort, traction, stability, support, and/or control, all of which may be desirable performance-related characteristics that can improve or enhance a golfer's game. The high performance golf shoes disclosed herein may also be recycled to generate source materials for

constructing other recyclable components or articles, thereby minimizing waste and maximizing the utility of the recyclable source materials used to fabricate the shoes of the present disclosure.

[0005] In one aspect, the present disclosure provides a golf shoe comprising: an upper and a sole assembly connected to the upper. In some embodiments, the upper may comprise: a membrane layer configured to at least partially surround or enclose a foot of a subject wearing the golf shoe; an internal A-shaped frame structure attached or coupled to the membrane layer to structurally support or stiffen the upper; a mesh layer comprising a first side and a second side, the first side attached or coupled to the membrane layer and the internal A-shaped frame structure; and a saddle connected to the second side of the mesh layer. In some embodiments, the upper and the sole assembly may comprise 100% thermoplastic urethane (TPU) by weight or mass. In some embodiments, the membrane layer, the internal A-shaped frame structure, the mesh layer, and the saddle may each comprise one or more TPU materials. In some embodiments, the one or more TPU materials may comprise a material derived from a recycled shoe comprising at least one recyclable TPU material. In some embodiments, the at least one recyclable TPU material may comprise (i) a virgin TPU material or (ii) a pre-recycled or re-grinded TPU material. In some embodiments, the one or more TPU materials may be processable into another golf shoe comprising the at least one recyclable TPU material.

[0006] In some embodiments, the internal A-shaped frame structure may be positioned between (i) the membrane layer and (ii) the mesh layer or the saddle. In some embodiments, the mesh layer may be positioned between (i) the saddle and (ii) the internal A-shaped frame structure or the membrane layer. In some embodiments, the mesh layer and the internal A-shaped frame structure may be positioned between (i) the membrane layer and (ii) the saddle.

[0007] In some embodiments, the membrane layer and the mesh layer may have a different translucence or opacity. In some embodiments, the membrane layer and/or the mesh layer may be (i) fully transparent, (ii) translucent, or (iii) fully opaque.

[0008] In some embodiments, the membrane layer may comprise one or more regions with one or more surface features or perforations to facilitate a movement of a fluid through or across the membrane layer. In some embodiments, the one or more regions may comprise one or more non-laminated regions. In some embodiments, the one or more regions may be decoupled or detached from the mesh layer to enhance breathability. In some embodiments, the membrane layer may be configured as a hotmelt backer for the mesh layer. In some embodiments, the hotmelt backer may comprise one or more non-laminated regions having one or more mechanical or laser perforations. In some embodiments, the membrane layer may comprise a microporous membrane configured as an internal bootie system or assem-

bly.

[0009] In some embodiments, the internal A-shaped frame structure may comprise one or more truss-like members. In some embodiments, the one or more truss-like members may extend between (i) a midfoot or rear-foot region of the golf shoe and (ii) a forefoot region of the golf shoe. In some embodiments, the internal A-shaped frame structure may be asymmetric with different frame configurations on a medial and lateral side of the golf shoe.

[0010] In some embodiments, the golf shoe may comprise one or more TPU foam ankle pads attached or coupled to the membrane layer. In some embodiments, the golf shoe may comprise an air pocket or an air bladder that supports or cushions an ankle region of a subject's foot.

[0011] In some embodiments, the golf shoe may further comprise one or more TPU heel components hot melted to the membrane layer. In some embodiments, the golf shoe may further comprise a TPU toe component hot melted to the first side of the mesh layer. In some embodiments, the golf shoe may further comprise a TPU collar material hot melted to the upper. In some embodiments, the golf shoe may further comprise one or more TPU eyelets hot melted to the upper. In some embodiments, the golf shoe may further comprise one or more TPU laces threaded through the one or more TPU eyelets. In some embodiments, the one or more TPU laces may comprise a plurality of welded layers to control an elasticity or a tensile strength of the laces. In some embodiments, the one or more TPU laces may have a tensile strength ranging from about 1 megapascal (MPa) to about 100 MPa or more.

[0012] In some embodiments, the golf shoe may further comprise a first cement or adhesive for the sole assembly. In some embodiments, the first cement or adhesive may comprise a solvent cement, a water based cement, a water based or solvent based primer, or a hotmelt cement. In some embodiments, the golf shoe may further comprise a second cement or adhesive for the upper. In some embodiments, the second cement or adhesive may comprise a solvent cement, a hotmelt cement, a water based cement, or a water based primer. In some embodiments, the first cement or adhesive and the second cement or adhesive may be configured to evaporate during a chemical recycling process that yields said at least one recyclable TPU material from the one or more TPU materials. In some embodiments, the first cement or adhesive and/or the second cement or adhesive may comprise a water-based, a TPU-based, or a PETbased cement or adhesive.

[0013] In some embodiments, the golf shoe may further comprise an additional layer of material that is attached or coupled to a bottom portion of the upper to form a Strobel construction. In some embodiments, the golf shoe may further comprise a footbed for supporting a subject's foot. In some embodiments, the footbed may comprise a die cut TPU sheet foam or a molded footbed.

[0014] In some embodiments, the golf shoe may further comprise a stability clip that is insertable between the footbed and a midsole portion of the sole assembly to control a movement or a deformation of the midsole portion in response to one or more forces exerted on the golf shoe. In some embodiments, the stability clip may comprise a sidewall and a beam extending laterally from the sidewall. In some embodiments, the beam and the sidewall may form a T-shape. In some embodiments, the beam may comprise a tapered end or a pointed edge.

[0015] In some embodiments, the golf shoe may further comprise a removable insole or tag coupled to the upper or a portion thereof. In some embodiments, the removable insole or tag may include recycling instructions for the golf shoe. In some embodiments, the removable insole or tag may comprise a different material than the upper or the sole assembly.

[0016] In some embodiments, the upper of the golf shoe may be water-resistant or waterproof. In some embodiments, the sole assembly of the golf shoe may comprise a midsole and an outsole that are co-molded. In some embodiments, the midsole may comprise a variable hardness that changes along a portion of the midsole.

[0017] In some embodiments, the golf shoe may comprise one or more support sidewalls extending along a medial side and/or lateral side of the golf shoe. In some embodiments, the one or more support sidewalls may be integrated or associated with the upper of the golf shoe. In some embodiments, the one or more support sidewalls may be integrated or associated with the sole assembly (e.g., the midsole and/or the outsole) of the golf shoe.

[0018] In another aspect, the present disclosure provides a golf shoe comprising an upper comprising a mesh layer and a sole assembly connected to the upper. In some embodiments, the sole assembly comprises a first plurality of foam layers in a rearfoot region of the golf shoe; a second plurality of foam layers extending between the rearfoot region of the golf shoe and a forefoot region of the golf shoe; and a support positioned adjacent to the second plurality of foam layers. In some embodiments, the support may comprise a plate, an insert, a panel, a sheet (e.g., a die cut sheet), or a layer of material. In some embodiments, the second plurality of foam layers may be positioned between the first plurality of foam layers and the support.

[0019] In some embodiments, the mesh layer, the first plurality of foam layers, the second plurality of foam layers, and/or the support each comprise one or more polyethylene terephthalate (PET) materials. In some embodiments, the upper and the sole assembly comprise 100% PET by weight or mass. In some embodiments, the one or more PET materials comprise a material derived from a recycled shoe comprising at least one recyclable PET material. In some embodiments, the one or more PET materials are processable into another golf shoe comprising the at least one recyclable PET material. In some embodiments, the one or more PET materials may comprise a foamed PET material.

[0020] In some embodiments, the shoe may comprise one or more mechanical fasteners configured to attach or couple (i) the first plurality of foam layers to (ii) the second plurality of foam layers. In some embodiments, shoe may comprise one or more mechanical fasteners configured to attach or couple (i) the first plurality of foam layers and/or the second plurality of foam layers to (ii) the support.

[0021] In some embodiments, the shoe may comprise a water-based cement or primer configured to adhesively couple the first plurality of foam layers to (i) the second plurality of foam layers or (ii) the support. In some embodiments, the shoe may comprise a water-based cement or primer configured to adhesively couple the second plurality of foam layers to (i) the first plurality of foam layers or (ii) the support.

[0022] In some embodiments, the shoe may comprise an insole board. In some embodiments, the insole board may comprise a PET material.

[0023] In some embodiments, the second plurality of foam layers and/or the support may be coupled to the insole board. In some embodiments, the second plurality of foam layers and/or the support may be mechanically or adhesively coupled to the insole board. In some embodiments, a portion of the mesh layer may be configured to extend between (i) the insole board and (ii) the support or the second plurality of foam layers.

[0024] In some embodiments, the shoe may comprise a footbed that is insertable into an enclosed or partially enclosed interior region formed by the upper and the sole assembly. In some embodiments, the footbed comprises a PET or polyester based material.

[0025] In some embodiments, the shoe may comprise one or more laces for securing the upper around a subject's foot. In some embodiments, the one or more laces may comprise a recyclable material (e.g., a recyclable PET material).

[0026] In some embodiments, the shoe may comprise an insole component that is attachable to the upper to form a Strobel construction. In some embodiments, the insole component comprises an insole board or a non-woven support layer comprising a polyester filament. In some embodiments, the insole component comprises a ply rib geometry.

[0027] In some embodiments, the shoe may comprise a PET foam support positioned between the insole component and the sole assembly. In some embodiments, the PET foam support may be positioned between two or more support members or features of the insole components.

[0028] In some embodiments, the shoe may comprise a welt construction configured to provide a plurality of attachment points for (i) coupling the upper to a portion of the sole assembly or (ii) coupling a portion of the sole assembly to the upper. In some embodiments, the welt construction may comprise (i) a first section that is curved to accommodate a curvature of the upper and (ii) a second section configured to extend laterally from the first

section across a portion of the sole assembly.

[0029] In some embodiments, the sole assembly may comprise a cup sole construction. In some embodiments, the cup sole construction may comprise one or more sidewalls extending across or over the lateral and/or medial sides of the upper. In some embodiments, the one or more sidewalls may extend across or over the forefoot, midfoot, and/or rearfoot regions of the upper or the sole assembly.

[0030] Additional aspects and advantages of the present disclosure will become readily apparent to those skilled in this art from the following detailed description, wherein only illustrative embodiments of the present disclosure are shown and described. As will be realized, the present disclosure is capable of other and different embodiments, and its several details are capable of modifications in various obvious respects, all without departing from the disclosure. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not as restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] Non-limiting and non-exhaustive examples and embodiments of the present disclosure are described with reference to the following figures.

FIGURE 1 schematically illustrates an exemplary golf shoe, in accordance with some embodiments.

FIGURE 2A schematically illustrates an exemplary golf shoe comprising a forefoot region, a midfoot region, and a rearfoot region, in accordance with some embodiments.

FIGURES 2B and **2C** schematically illustrate a central axis extending through the forefoot, midfoot, and/or rearfoot regions of an exemplary golf shoe to divide the golf shoe into a medial side and a lateral side, in accordance with some embodiments.

FIGURE 3 schematically illustrates an exemplary method for recycling an article, in accordance with some embodiments.

FIGURES 4, 5, and **6A - 6B** schematically illustrate examples of a recyclable high performance golf shoe, in accordance with some embodiments.

FIGURES 7A - 7D schematically illustrate various views of a recyclable high performance golf shoe, in accordance with some embodiments.

FIGURE 8 schematically illustrates a tongue assembly for a recyclable golf shoe, in accordance with some embodiments.

FIGURE 9 schematically illustrates various compo-

nents and layers of a recyclable golf shoe, in accordance with some embodiments.

FIGURE 10 schematically illustrates a frame structure for supporting an upper of a recyclable golf shoe, in accordance with some embodiments.

FIGURES 11A and **11B** schematically illustrate one or more surface features that can be integrated into a layer of a golf shoe to enhance breathability, in accordance with some embodiments.

FIGURES 11C - 11G schematically illustrate various examples of a waterproof and/or breathable construction for a recyclable golf shoe, in accordance with some embodiments.

FIGURES 12 and **13** schematically illustrate various additional examples of a recyclable golf shoe, in accordance with some embodiments.

FIGURE 14 schematically illustrates an example of a stability clip for a high performance recyclable golf shoe, in accordance with some embodiments.

FIGURE 15 schematically illustrates an alternative exemplary outsole for a casual recyclable golf shoe, in accordance with some embodiments.

FIGURES 15A and **15B** schematically illustrate various examples of a component that can be detachably coupled to or removably integrated with the recyclable golf shoes of the present disclosure.

FIGURES 16 and **17** schematically illustrate various alternative embodiments of a recyclable golf shoe, in accordance with some embodiments.

FIGURES 18A and **18B** schematically illustrate additional alternative embodiments of a recyclable golf shoe, in accordance with some embodiments.

FIGURE 19 schematically illustrates an example of a recyclable golf shoe with a welt construction, in accordance with some embodiments.

FIGURE 20A schematically illustrates an example of a recyclable golf shoe with sidewall stitching, in accordance with some embodiments.

FIGURE 20B schematically illustrates an example of an extruded PET welt that can be integrated with the recyclable golf shoes of the present disclosure.

FIGURE 21 schematically illustrates an example of a recyclable golf shoe with a cup sole construction, in accordance with some embodiments.

DETAILED DESCRIPTION

[0032] The present disclosure will now be described more fully in reference to the accompanying figures, which show various non-limiting embodiments. The views shown in the figures are of a right shoe and/or a left shoe, and it is understood that in some cases, the components for a left shoe can be mirror images of the right shoe, and vice versa. It shall also be understood that the shoe(s) may be made in various sizes and thus the size and/or shape of the components or features of the shoe may be adjusted depending on the shoe size.

[0033] The terminology used herein is for the purpose of describing various embodiments only and is not intended to be limiting. As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0034] When numerical lower limits and numerical upper limits are set forth herein, it is contemplated that any combination of these values may be used. Other than in the operating examples, or unless otherwise expressly specified, all of the numerical ranges, amounts, values and percentages such as those for amounts of materials and others in the specification may be read as if prefaced by the word "about" even though the term "about" may not expressly appear with the value, amount or range. Accordingly, unless indicated to the contrary, the numerical parameters set forth in the specification and attached claims are approximations that may vary depending upon the desired properties sought to be obtained by the present technology.

[0035] It shall be understood that when an element is referred to as being "attached," "coupled" or "connected" to another element, it can be directly attached, coupled or connected to the other element (with or without any intervening elements). In contrast, when an element is referred to as being "directly attached," "directly coupled" or "directly connected" to another element, there may not or need not be any intervening elements present.

[0036] It is noted that any one or more aspects or features described with respect to one or more exemplary embodiments may be incorporated in various other different embodiments. That is, embodiments and/or features of any embodiments can be combined in any way and/or in any order with any other embodiments and/or any other features thereof, without limitation. Applicant reserves the right to modify any originally filed claim or file any new claim(s) accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim. Various non-limiting aspects and embodiments of the present disclosure are provided in further detail in the specification set forth below.

Overview

[0037] The present disclosure provides various non-

limiting examples and embodiments of recyclable golf shoes. The golf shoes described herein may be constructed to enhance recyclability without compromising structural integrity or performance. In some embodiments, the recyclable golf shoes of the present disclosure may comprise high performance golf shoes configured to provide the comfort, traction, stability, support, and/or control characteristics desired by dedicated golfers. In some cases, the presently disclosed recyclable golf shoes may be recycled easily and efficiently without requiring disassembly into separate components or sub-assemblies.

Recyclable Material

[0038] In some embodiments, the recyclable golf shoes of the present disclosure may comprise a recyclable material. In some cases, the recyclable material may comprise a material that can be processed (e.g., recycled) into a source material. The source material may comprise a recycled material derived from the recyclable material. The source material may itself be a recyclable material that can be processed into another source material that is both recycled and recyclable. In some cases, the source material may be used to form another article (e.g., another golf shoe or other golf-related equipment or apparel) and/or a component for another article.

[0039] In some embodiments, the recyclable material may comprise a material derived from a recycled article. In some cases, the recycled article may include an article (e.g., a shoe) that was previously worn and/or recycled. The recycled article may or may not be derived from other recycled articles. In some cases, the recycled article may be processable (e.g., recyclable) into the recyclable material used to form the golf shoes of the present disclosure.

[0040] In some embodiments, the recyclable material may comprise a recycled material derived from a recycled shoe comprising at least one recyclable material. In some cases, the recycled shoe may include a shoe that was previously worn. In other cases, the recycled shoe may include a new shoe that was not previously worn but recycled in order to harvest a source material for constructing the presently disclosed golf shoes. In some embodiments, the recyclable material harvested from the recycled shoe may be processable into another article or component comprising a recyclable material.

[0041] In some embodiments, the at least one recyclable material may comprise one or more virgin materials. The one or more virgin materials may not or need not be derived from a previously used or worn article. In other embodiments, the recyclable material may comprise a pre-recycled material and/or a re-grinded material derived from a recycled article or component which may or may not have been previously used or worn. In some cases, the pre-recycled material and/or the re-grinded material may include a first amount of virgin plastic and a second amount of recycled content. In some cases,

the first amount and the second amount may be equal or approximately equal. In other cases, the first amount and the second amount may be different. In some cases, the ratio of virgin plastic material to recycled content (by weight, mass, or volume) may be about 90:10, 80:20, 70:30, 60:40, 50:50, 40:60, 30:70, 20:80, or 10:90. In some cases, the recyclable material may comprise 100% re-grinded and/or pre-recycled content (i.e., the recyclable material may not comprise any virgin materials). In other cases, the recyclable material may not or need not include any pre-recycled and/or re-grinded material (i.e., the recyclable material may entirely comprise virgin materials).

[0042] In some embodiments, the upper and/or the sole assembly may comprise a recyclable material. In some cases, the upper and/or the sole assembly may comprise a thermoplastic urethane (TPU) material. The TPU material may be recyclable, with or without further processing. In some cases, the upper and/or the sole assembly may comprise 100% TPU by weight or mass. In some embodiments, the recyclable golf shoe may comprise a membrane layer, a frame structure, a mesh layer, and/or a saddle (described in greater detail below). In some cases, the membrane layer, the frame structure, the mesh layer, and/or the saddle of the recyclable golf shoe may comprise one or more recyclable TPU materials.

[0043] In some embodiments, the recyclable material may comprise a polymeric material. In some cases, the polymeric material may comprise a urethane material. In some cases, the polymeric material may comprise a polyurethane material. In some cases, the polymeric material may comprise a thermoplastic polyurethane (TPU) material.

[0044] In some embodiments, the recyclable golf shoe may comprise one or more TPU parts. In some cases, the one or more TPU parts may include, for example, injected TPU parts, molded TPU parts, extruded TPU parts, machined TPU parts, and/or 3D printed TPU parts.

[0045] In some embodiments, the upper and/or the sole assembly may comprise a recyclable material. In some cases, the upper and/or the sole assembly may comprise a polyethylene terephthalate (PET) material. The PET material may be recyclable, with or without further processing. In some cases, the upper and/or the sole assembly may comprise 100% PET by weight or mass. In some embodiments, the recyclable golf shoe may comprise a mesh layer, one or more foam layers, and/or a moderator plate (described in greater detail below). In some cases, the mesh layer, the one or more foam layers, and/or the moderator plate of the recyclable golf shoe may comprise one or more recyclable PET materials.

[0046] In some embodiments, the recyclable material may comprise a polymeric material. In some cases, the polymeric material may comprise a thermoplastic polymer material. In some cases, the polymeric material may comprise a polyester material. In some cases, the poly-

meric material may comprise a polyethylene terephthalate (PET) material.

[0047] In some embodiments, the recyclable golf shoe may comprise one or more PET parts. In some cases, the one or more PET parts may include, for example, injected PET parts, molded PET parts, extruded PET parts, machined PET parts, and/or 3D printed PET parts.

[0048] In some embodiments, the various components, parts, sections, and/or layers of the recyclable shoe may comprise one or more recyclable materials. In some cases, the one or more recyclable materials may comprise a same recyclable material. In other cases, the one or more recyclable materials may comprise a plurality or combination of different recyclable materials. In some cases, the plurality of different recyclable material may include two or more recyclable materials selected from a same class of materials. In some cases, the plurality of different recyclable material may include two or more recyclable materials selected from different classes of materials. In some cases, the two or more recyclable materials may have a same or similar set of material properties (e.g., hardness, stiffness, rigidity, tensile strength, etc.). In other cases, the two or more recyclable materials may have a different set of material properties.

[0049] In some embodiments, the recyclable shoes of the present disclosure may comprise a plurality of components, parts, sections, and/or layers formed from the one or more recyclable materials. The one or more recyclable materials may be recycled using one or more recycling processes or procedures. In some cases, the plurality of components, parts, sections, and/or layers may be recyclable concurrently or simultaneously (e.g., in a same recycling process or procedure). In other cases, the plurality of components, parts, sections, and/or layers may be recyclable using a plurality of different recycling processes or procedures.

Material Properties

[0050] In some embodiments, the one or more recyclable materials may comprise a rigid or semi-rigid material. In some embodiments, the one or more recyclable materials may comprise a deformable or elastic material. In some embodiments, the one or more recyclable materials may be configured to bend or flex in response to a force exerted on the shoe during a golf-related movement or action. In some embodiments, the one or more recyclable materials may be configured to resist bending or flexing in response to forces exerted on the shoe during a golf-related action or movement.

[0051] In some embodiments, the one or more recyclable materials may comprise a selectively permeable material. In some cases, the selectively permeable material may be configured to permit a passage of fluids or vapors from the inside of the shoe to an environment external to the shoe. In some cases, the selectively permeable material may be configured to control, restrict, or regulate a passage of fluids or vapors from an environ-

ment external to the shoe to an inside of the shoe.

[0052] In some cases, one or more components, parts, sections, and/or layers of the recyclable shoe may be water-resistant or waterproof. In some cases, the components, parts, sections, and/or layers of the recyclable shoe may be configured as breathable components. In some cases, the recyclable shoe may comprise one or more pieces, layers, or panels configured to allow a selective movement of moisture, vapor, and/or perspiration across or through the pieces, layers, or panels to regulate temperature and/or humidity without sacrificing or compromising water-resistance or water-proofness.

[0053] In some embodiments, the components, parts, sections, and/or layers of the shoe may have a uniform or substantially uniform set of material properties. In other embodiments, the components, parts, sections, and/or layers of the shoe may have a plurality of regions with different material properties. In some embodiments, the different material properties may include, for example, a hardness, a softness, a stiffness (e.g., flexural stiffness or torsional stiffness), a rigidity, a tensile strength, or any of the other material properties described herein. In some embodiments, a hardness, stiffness, rigidity, or tensile strength of the components, parts, sections, and/or layers may gradually change or vary across different regions of the shoe.

Structures

[0054] In an aspect, the present disclosure provides a golf shoe. The golf shoe may comprise an article of footwear (e.g., a shoe) that can be worn by a subject to aid in a physical activity such as golf, or any other physical activity involving one or more actions or movements that can be used in the sport of golf.

[0055] In some cases, the golf shoe may comprise a high performance golf shoe. The high performance golf shoe may provide an optimal combination of support, control, stability, and flex characteristics. In some cases, the high performance golf shoe may be configured to provide a comfortable and stable support platform for golf-related actions or movements while retaining a desired stiffness and/or flex characteristic.

[0056] In some cases, the golf shoe may comprise a recyclable golf shoe. The recyclable golf shoe may be processed or recycled to yield a source material that is usable to form another article (e.g., another golf shoe, an article of apparel, golf-related equipment, etc.). The source material may comprise a recyclable material that can be processed or recycled one or more times to form additional articles that may also be recyclable.

[0057] The golf shoe may be worn by a subject. The subject may be, for example, an athlete or a golf player. When worn by the subject, the golf shoe may provide an optimal balance of comfort and control that allows the subject to focus on his or her game and maximize performance. The golf shoe may be sized, shaped, and configured to support the subject's foot and/or control a

movement of the subject's foot during a golf-related movement to enhance (i) comfort, (ii) stability, and/or (iii) the subject's posture, stance, swing, stability, or overall performance (e.g., accuracy or precision).

[0058] FIGURE 1 depicts an exemplary golf shoe 100, also referred to herein as a shoe. In some embodiments, the shoe 100 may comprise a shoe upper 110 and a sole assembly 120. In some cases, the upper 110 may include an insole. The insole may comprise an insole component such as an insole footbed and/or an insole board. In some cases, the sole assembly 120 may include a midsole and/or an outsole. In some embodiments, the sole assembly may be connected or attached to the upper. In some embodiments, a footbed may be positioned above an insole board of the shoe. In some embodiments, the insole board may be positioned between the footbed and the midsole of the shoe.

Upper

[0059] In some embodiments, the golf shoe 100 may comprise an upper 110. In some cases, the upper 110 may comprise a vamp for covering at least a forefoot region of a subject's foot. In some cases, the upper 110 may comprise a quarter for covering and/or supporting one or more side or rear portions of a subject's foot (e.g., the area adjacent to, surrounding, and/or below the Achilles tendon, the posterior of the heel, and/or the talus and calcaneus bones).

[0060] In some embodiments, the heel region of the shoe may comprise a heel cup. In some cases, the heel cup may comprise a molded heel cup. In some embodiments, at least a portion of the quarter may form a part of the molded heel cup. In some embodiments, the quarter may comprise a plurality of layers that can be molded together to form the heel cup.

[0061] In some embodiments, the heel region of the shoe may comprise a heel counter. In some cases, the heel counter may be an external heel counter. In other cases, the heel counter may be an internal heel counter.

[0062] In some embodiments, the vamp and the quarter may comprise separate pieces of material that are connected or fused to each other mechanically, chemically, thermally, or adhesively. In some cases, the upper material may comprise various materials that are stitched or bonded together to form the upper structure.

[0063] In some embodiments, the upper 110 may comprise a continuous piece of material for the vamp and quarter. In some cases, the continuous piece of material may comprise a single material comprising a plurality of regions each having different material properties. In other cases, the continuous piece of material may comprise a plurality of materials having different material properties. The material properties associated with the plurality of regions or the plurality of materials may include, for example, density, porosity, water absorbency/repellence, strength, flexibility, elasticity, softness, durability, chemical resistance, thermal conductivity, and the like.

[0064] In some cases, the upper 110 may comprise, for example, one or more natural or synthetic materials that can be recycled or processed to produce a source material comprising at least one recycled or recyclable material. In some cases, the upper 110 may comprise a breathable mesh and/or synthetic textile fabrics made from materials such as nylons, polyesters, polyolefins, polyurethanes, rubbers, foams, or any of the recyclable materials described herein. The material of the upper 110 may be selected and/or optimized based on desired properties such as breathability, durability, flexibility, comfort, and/or water resistance.

[0065] In some embodiments, the shoe 100 may be waterproof. In some cases, at least a forefoot, midfoot, and/or rearfoot area of the upper may be constructed of one or more materials or layers (e.g., membranes) having water resistant or water repellent properties. Additional features (e.g., non-porous or semi-porous membranes that permit a selective movement or passage of moisture) may be applied when fabricating the shoe 100 to provide additional waterproofing capabilities.

[0066] In some embodiments, the upper 110 may comprise an instep region with an opening for receiving a subject's foot. In some cases, the instep region may include a tongue member. In some embodiments, the upper 110 may comprise a heel collar extending around at least a portion of the opening. The heel collar may be configured to enhance comfort and fit.

[0067] In some embodiments, the upper 110 may comprise an insole component (e.g., an insole footbed or an insole board). In some cases, the insole component may be designed to provide support for a subject's foot (e.g., as the subject exerts a force on the insole while walking, running, kneeling, squatting, or executing a swing). The insole component may be flexible, semi-rigid, or rigid. In some cases, the insole component may be a removable insert that can be positioned within the shoe 100. In some cases, the insole component can be worn inside the shoe 100 and may be designed to provide cushioning or support for the subject wearing the shoe 100.

[0068] In some embodiments, the forefoot region of the upper 110 may comprise an eye stay that can be attached to the vamp. In some cases, the eye stay may cover at least a portion of the tongue member. In some cases, the eye stay may comprise one or more eyelets through which one or more tightening devices or mechanisms can be threaded.

[0069] In any of the embodiments described herein, a variety of tightening systems or mechanisms can be used to secure the shoe 100 around the contour of the foot. In some cases, laces of various types of materials (e.g., natural or synthetic fibers, metal cables, recyclable materials, etc.) may be used to tighten the shoe and/or to secure the shoe in a desired position and/or orientation relative to the subject's foot. In some cases, the shoe 100 may include a cable-based tightening assembly comprising a dial, a spool, a housing, and a locking mechanism for locking the cable in place.

Sole Assembly

[0070] In some embodiments, the golf shoe 100 may comprise a sole assembly 120. The sole assembly 120 may comprise a midsole and/or an outsole. In some embodiments, the sole assembly 120 may be connected to the upper 110. In some cases, a portion of the upper 110 may be heated or melted and then fused with the sole assembly 120.

[0071] In some embodiments, the sole assembly 120 may comprise a midsole. In some cases, the midsole may comprise a relatively lightweight material configured to provide cushioning and/or support to the shoe 100.

[0072] In some embodiments, the midsole may be made from one or more midsole materials. The one or more midsole material may comprise a recyclable material as described elsewhere herein. In some cases, the one or more midsole materials may comprise a foam material. In some case, the foam material may comprise a material with a foam or foam-like structure. In some cases, the foam material may comprise an open cell foam comprising one or more open or partially open cells. In other cases, the foam material may comprise a closed cell foam comprising one or more closed or partially closed cells. In some non-limiting embodiments, the foam material may comprise an elastic foam. In other non-limiting embodiments, the foam material may comprise a viscous foam. In some alternate embodiments, the foam material may comprise a viscoelastic foam. The viscoelastic foam may have the elastic properties of an elastic foam and/or the viscous properties of a viscous foam. In some cases, the viscoelastic foam may comprise a memory foam or a memory foam-like material. In any of the embodiments described herein, the midsole may comprise one or more recyclable foam materials. The one or more recyclable foam materials may include, for example, a polyurethane foam composition or a polyethylene foam composition.

[0073] In some embodiments, the midsole or outsole may comprise one or more support sidewalls. In some cases, the one or more support sidewalls may be configured to extend along a medial side and/or a lateral side of the golf shoe. In some cases, the one or more support sidewalls may extend across or over the upper of the golf shoe. In some cases, the support sidewalls may comprise a recyclable material (e.g., a recyclable TPU or PET material as described elsewhere herein).

[0074] In some non-limiting embodiments, the midsole or outsole may have one or more material properties that vary along a dimension of the midsole or outsole. In some embodiments, the one or more material properties may include, for example, a hardness, a softness, a stiffness (e.g., flexural stiffness or torsional stiffness), a rigidity, or a tensile strength of the midsole or outsole material. In some embodiments, the midsole or outsole may have a variable hardness, softness, stiffness, rigidity, or tensile strength to provide different material properties and/or performance characteristics to different regions of the

shoe.

[0075] In some embodiments, the sole assembly 120 may comprise an outsole. The outsole may be configured to provide support and traction for the shoe. In some embodiments, the outsole may be integrated with the midsole. For example, the midsole may be fused with the outsole, co-molded with the outsole, or otherwise attached to outsole (e.g., using an adhesive or as part of a manufacturing process for the midsole and/or the outsole). In some cases, the midsole can be molded as a separate piece and then joined to a top surface of the outsole using stitches, adhesives, or other suitable means. In some cases, the midsole can be heat-pressed and bonded to the top surface of the outsole. In some cases, the midsole and the outsole can be molded using a single shot or multi-shot molding method. In any of the embodiments described herein, the midsole may be positioned above the outsole such that at least a portion of the midsole is between a subject's foot and the outsole.

[0076] In some embodiments, the outsole may comprise an outsole material. In some cases, at least a portion of the outsole material may be configured to grip or otherwise engage a ground surface underneath the shoe (e.g., during a golf-related action or movement). In some embodiments, the outsole material may comprise a recyclable material. In some embodiments, the outsole material may include, for example, thermoplastics such as nylons, polyesters, polyethers, polyolefins, and/or polyurethanes. In some non-limiting embodiments, the outsole material may include polyurethane compositions such as, for example, Estane® TRX thermoplastic polyurethanes. In some embodiments, the outsole material may include a rubber material or a thermoplastic rubber material, such as polybutadiene, polyisoprene, ethylene-propylene rubber ("EPR"), ethylene-propylene-diene ("EPDM") rubber, and/or styrenebutadiene rubber. In some embodiments, the outsole material may comprise a plastic material, a thermoplastic material, a thermoset plastic material, or any combination thereof. In some non-limiting embodiments, the outsole material may comprise acrylic, polymethyl methacrylate (PMMA), polycarbonate (PC), polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), polyvinyl chloride (PVC), or acrylonitrile-butadiene-styrene (ABS).

[0077] In some embodiments, a bottom surface of the outsole may include a plurality of traction members. The plurality of traction members may be configured to provide traction between the shoe 100 and the different surfaces of a golf course/range or other ground surfaces near a course/range. In some embodiments, the traction members may comprise a recyclable material. In some embodiments, the recyclable material may comprise thermoplastics such as nylons, polyesters, polyolefins, and/or polyurethanes. In some embodiments, the traction members may comprise thermoplastic polyurethane (TPU) or polyethylene terephthalate (PET). In some embodiments, the traction members may comprise one or more rubber materials and/or one or more plastic mate-

rials. In other embodiments, the traction members may comprise different polyamide compositions including, for example, polyamide copolymers and/or aramids. In some alternative embodiments, the traction members may comprise an elastomer formed from one or more block copolymers made of rigid polyamide blocks and/or soft polyether blocks.

[0078] In some embodiments, the plurality of traction members may comprise one or more spikes (e.g., hard spikes or soft spikes). In some cases, the one or more spikes may comprise a protrusion that is configured to at least partially penetrate or otherwise physically interface with or contact a ground surface. The one or more spikes may or may not be removable or detachable.

[0079] In some embodiments, the plurality of traction members may not or need not comprise any spikes. For example, the traction members may comprise a grooved or textured surface or material that is configured to reduce a lateral or translational movement of the shoe relative to a ground surface when a force is exerted on the sole assembly of the shoe. In some cases, the grooved or textured surface may have a higher coefficient of friction (static and/or dynamic frictional coefficient) than other portions of the outsole. In some embodiments, at least one of the plurality of traction members may be removable or detachable from the outsole. In other embodiments, at least one of the plurality of traction members may be permanently attached or coupled to the outsole or another portion of the sole assembly. In some alternative embodiments, the outsole may not or need not comprise any traction elements.

Foot Subregions

[0080] In any of the embodiments described herein, the upper, the sole assembly, and/or any components thereof (e.g., the insole footbed, the insole board, the midsole, and/or the outsole) may comprise a forefoot region, a midfoot region, and a rearfoot region. Each of the forefoot region, the midfoot region, and the rearfoot region may correspond to a respective forefoot, midfoot, and rearfoot anatomy of a subject's foot. In general, the anatomy of a human foot can be divided into three bony regions. The rearfoot region of the foot may include the ankle (talus) and heel (calcaneus) bones. The midfoot region of the foot may include the cuboid, cuneiform, and navicular bones that form the longitudinal arch of the foot. The forefoot region of the foot may include the metatarsals and the toes. The shoe, and accordingly, the components of the upper and/or the sole assembly, may comprise a rearfoot region corresponding to the rearfoot and/or heel area, a midfoot region that corresponds to the midfoot, and a forefoot region corresponding to the forefoot and/or toe area.

[0081] In some cases, the rearfoot region (including the heel area) can correspond to a posterior end of the shoe. In some cases, the forefoot area (including the toe area) can correspond to an anterior end of the shoe. In

some cases, the midfoot area can correspond to a portion of the shoe that is between the anterior end and the posterior end of the shoe.

[0082] In addition to having a rearfoot region, a midfoot region, and a forefoot region, the recyclable high performance golf shoes described herein may have a medial side and a lateral side that are opposite one another. The medial side may generally correspond to an inside area of the wearer's foot and a surface that faces towards the wearer's other foot. The lateral side may generally correspond to an outside area of the wearer's foot and a surface that faces away from the wearer's other foot. The lateral side and the medial side may extend along each of the rearfoot area, the midfoot area, and the forefoot area. In some cases, the medial side and the lateral side may extend around the periphery or perimeter of the shoe.

[0083] **FIGURE 2A** illustrates the various regions of an exemplary left and right sole assembly 120. The sole assembly 120 may comprise a forefoot region, a midfoot region, and/or a rearfoot region. The forefoot, midfoot, and rearfoot regions may extend laterally along a first dimension (e.g., a width) of the sole assembly 120. The forefoot, midfoot, and rearfoot regions may extend laterally between a medial side and a lateral side of the sole assembly, as described above. The forefoot, midfoot, and rearfoot regions may extend laterally along different portions or sections of a second dimension (e.g., a length) of the sole assembly 120. The forefoot, midfoot, and rearfoot regions may extend between a posterior end and an anterior end of the sole assembly 120, as described above.

[0084] **FIGURES 2A, 2B, and 2C** schematically illustrate a central axis 200 of the sole assembly 120. The central axis 200 may extend from a rear most portion of the rearfoot region of the sole assembly 120 towards the midfoot and/or forefoot region of the sole assembly 120. In some embodiments, the central axis 200 may extend in a direction that is perpendicular or normal to an axis tangential to the rear most portion of the rearfoot region of the sole assembly 120.

[0085] Referring to **FIGURE 2B**, in some embodiments, a portion of the central axis 200 (e.g., the portion extending through at least the rearfoot and/or midfoot region of the sole assembly 120) may divide or bisect the sole assembly 120 into a medial side and a lateral side. In some cases, a portion of the central axis 200 (e.g., the portion extending between the midfoot region of the sole assembly 120 and the forefoot region of the sole assembly 120) may not precisely divide or bisect the sole assembly 120 into a medial side and a lateral side. As shown in **FIGURE 2C**, in some embodiments, the medial side ① and the lateral side ② of the forefoot region of the sole assembly may be divided along a curved axis 201 that deviates from the central axis 200. Any references herein to a medial side or a lateral side of a shoe or a component of a shoe may contemplate a delineation of the medial and lateral sides along the central axis 200 and/or along

a curved axis 201 (e.g., as shown in **FIGURES 2B** and **2C**).

Recycling Methods

[0086] **FIGURE 3** schematically illustrates an exemplary method for recycling an article. The article may comprise any of the recyclable high performance golf shoes described herein. In some embodiments, a recyclable high performance golf shoe 301 may be recycled by an individual 302. The individual 302 may be, for example, a subject who has previously worn the recyclable high performance golf shoe 301 or taken possession of a recyclable high performance golf shoe 301. In some cases, the recycled high performance golf shoe 301 may be processed at a facility 303. In some cases, the facility 303 may comprise a shoe manufacturing or fabrication facility that can recycle the high performance golf shoe 301 and generate another recyclable article 305 from various source materials harvested from the recycled high performance golf shoe 301. In other cases, the facility 303 may comprise a recycling facility that harvests a recycled material 304 from the recyclable high performance golf shoe 301. In some cases, the recycled material 304 may be processed by another entity (e.g., another facility capable of manufacturing or fabricating article) to generate another recyclable article 305. The recyclable article 305 may comprise another shoe, an article of apparel, or any other golf-related equipment. The recyclable article 305 may comprise any of the recyclable materials described herein.

[0087] In one aspect, the present disclosure provides various examples and embodiments of recyclable golf shoes. The recyclable golf shoes may comprise a recyclable material as described elsewhere herein. In some cases, the recyclable material may include a TPU-based material or a PET-based material.

[0088] **FIGURES 4, 5,** and **6A- 6B** illustrate various examples of a recyclable high performance golf shoe 400 comprising a recyclable TPU-based material. In some embodiments, the recyclable high performance golf shoe 400 may comprise an upper 410 and a sole assembly 420. The upper 410 and the sole assembly 420 may comprise one or more recyclable TPU-based materials.

[0089] In some cases, the upper 410 of the recyclable high performance golf shoe 400 may comprise a mesh construction. In some cases, the mesh construction may comprise a recyclable mesh layer (e.g., a 100% TPU-based mono mesh layer). In some cases, the mesh construction may be directly exposed to an environment external to the shoe.

[0090] In some cases, the upper 410 of the recyclable high performance golf shoe 400 may comprise a membrane layer 440. In some cases, the membrane layer 440 may comprise a recyclable material (e.g., a TPU-based recyclable material). In some cases, the membrane layer 440 may be configured as a reinforcement or support layer for the recyclable high performance golf shoe 400.

In some cases, the membrane layer 440 may be positioned between the mesh construction of the upper 410 and a foot of a subject wearing the golf shoe 400.

[0091] In some cases, the mesh construction and the membrane layer 440 may collectively form one or more layers of the upper 410. In some cases, the mesh construction and the membrane layer 440 may be shaped to accommodate a subject's foot.

[0092] In some embodiments, the recyclable golf shoe may further comprise an additional layer of material that is attached or coupled to a bottom portion of the upper. In some cases, the additional layer of material, the mesh construction of the upper 410, and the membrane layer 440 may form a partially enclosed interior region configured to receive a subject's foot. In some cases, the additional layer of material may form a Strobel construction. In some cases, a first side of the additional layer of material may comprise a fabric layer that can be attached to the upper (or one or more components or layers forming the upper) to create a sock-like construction. In some cases, a second side of the additional layer of material may provide a surface or support to which a portion of the sole assembly can be attached or coupled.

[0093] In some embodiments, the sole assembly 420 may comprise a midsole. In some cases, the midsole may comprise a recyclable TPU-based foam. In some cases, the recyclable TPU-based foam may comprise a nitrogen infused TPU foam.

[0094] In some embodiments, the midsole or outsole may comprise one or more support sidewalls. In some cases, the one or more support sidewalls may be configured to extend along a medial side and/or a lateral side of the golf shoe. In some cases, the one or more support sidewalls may extend across or over the upper of the golf shoe. In some cases, the support sidewalls may comprise a recyclable material (e.g., a recyclable TPU material as described elsewhere herein).

[0095] In some embodiments, the sole assembly 420 may comprise an outsole. In some cases, the outsole may comprise one or more support structures 425 for supporting the midfoot region and/or the heel region of the shoe. In some cases, the one or more support structures 425 may include a supportive sidewall.

[0096] In some cases, the one or more support structures 425 may comprise one or more members extending along the medial and/or lateral sides of the golf shoe. In some cases, the one or more members may comprise a plurality of members that converge to form a truss-like structure. In some cases, the truss-like structure may comprise three or more sides. In some cases, the truss-like structure may comprise an opening configured to expose the underlying midsole material.

[0097] Referring to **FIGURE 5**, in some cases, the plurality of members may comprise a first member 426 and a second member 427. The first member 426 and the second member 427 may be configured to extend in different directions or angular orientations. In some cases, the first member 426 and the second member 427 may

intersect at an angle. In some cases, the angle may range from about 30 degrees to about 150 degrees.

[0098] Referring to **FIGURE 6A**, in some cases, the plurality of members may comprise a first member 426, a second member 427, and a third member 428. The first member 426, the second member 427, and the third member 428 may be configured to extend in different directions or angular orientations. In some cases, the third member 428 may extend between the first member 426 and the second member 427. In some cases, the first member 426 and the third member 428 may converge at a first convergence point. In some cases, the second member 427 and the third member 428 may converge at a second convergence point. In some cases, the first convergence point and the second convergence point may be disposed at different heights. In some cases, the third member 428 may be angled or sloped such that the third member 428 extends or slopes upwards and/or downwards between the first and second convergence points.

[0099] In some embodiments, the outsole may comprise one or more traction elements 430 as described elsewhere herein. In some cases, the one or more traction elements 430 may comprise a TPU-based recyclable material.

[0100] **FIGURE 6B** illustrates an example of an outsole 415 that can be used for a recyclable high performance golf shoe. In some embodiments, the outsole 415 may comprise a plurality of tracks 416 extending around a central region 417 of the outsole. In some embodiments, the traction elements 430 may be spaced apart and arranged along the plurality of tracks 416 (e.g., in a staggered, non-channeling, and/or non-trenching configuration). The recyclable golf shoes of the present disclosure may utilize various different types of outsoles and traction configurations in combination with the other structures and components described herein, and may optionally include one or more characteristics or features of the outsoles and traction configurations shown and described in U.S. Patent Application No. 18/133,841 and U.S. Patent Application No. 18/133,857, each of which is incorporated herein by reference in its entirety for all purposes.

[0101] In some embodiments, the outsole 415 may comprise a plurality of traction elements 430 positioned around a central region 417 of the outsole 415. In some embodiments, the plurality of traction elements 430 may comprise (i) a first set of traction elements arranged along a perimeter or edge of the outsole 415 in a first spatial configuration corresponding to a shape or profile of the perimeter or edge of the outsole 415, and (ii) a second set of traction elements nested between the first set of traction elements and a third set of traction elements. In some embodiments, the second set of traction elements may be arranged in a second spatial configuration corresponding to a shape or profile of the first spatial configuration.

[0102] In some embodiments, the first spatial configuration

may define a first enclosed shape around the central region 417 of the outsole 415, and the second spatial configuration may define a second enclosed shape around the central region 417 of the outsole 415. In some embodiments, the second enclosed shape may be nested within the first enclosed shape.

[0103] In some embodiments, the first and second sets of traction elements may comprise (i) one or more directional traction elements and (ii) one or more omni-directional traction elements. In some embodiments, the one or more directional traction elements can be positioned on a medial side or a lateral side of the outsole 415. In some embodiments, the one or more omni-directional traction elements can be positioned on an anterior end or a posterior end of the outsole 415. In some embodiments, the one or more omni-directional traction elements may comprise a set of directional traction elements that collectively provide the article of footwear with an omni-directional traction property or response.

[0104] In some embodiments, the first and second sets of traction elements may include (i) one or more traction elements arranged along an anterior end and a posterior end of the outsole 415 and (ii) one or more traction elements arranged along a medial side and a lateral side of the outsole 415. In some embodiments, the anterior or posterior end of the outsole 415 may have a greater traction element density (i.e., a greater number of traction elements per unit area of the outsole) than the medial or lateral side of the outsole 415.

[0105] In some embodiments, the first set of traction elements and the second set of traction elements may each comprise a series of spaced apart traction elements respectively arranged in the first or second spatial configuration. In some embodiments, the first and second sets of traction elements may be staggered relative to each other in a non-channeling and/or non-trenching configuration in order to enhance traction.

[0106] In some embodiments, the plurality of traction elements 430 may comprise two or more traction elements having different sizes and/or different shapes. In some embodiments, the plurality of traction elements 430 may comprise two or more traction elements oriented in different directions. In some embodiments, a size, a shape, an orientation, or a directional bias of the plurality of traction elements can change or vary along a medial or lateral side of the shoe. In some embodiments, a size, a shape, an orientation, or a directional bias of the plurality of traction elements 430 can gradually change or vary between (i) a medial or lateral side of the shoe and (ii) an anterior or posterior end of the shoe.

[0107] In some non-limiting embodiments, the plurality of traction elements 430 may have at least one flat or substantially flat surface and/or at least one curved surface. In some non-limiting embodiments, the plurality of traction elements 430 may have an ellipsoidal shape or profile. In some non-limiting embodiments, the plurality of traction elements 430 may have a half moon shape or a fanged profile.

[0108] In some embodiments, the plurality of traction elements 430 can be arranged around the central region 417 of the outsole 415 to expose an interior region or component of the sole assembly. In some embodiments, the interior region or component of the sole assembly may comprise a midsole of the golf shoe. In some embodiments, the interior region or component of the sole assembly may comprise a functional insert that is positioned (i) within the midsole or (ii) between the midsole and the outsole.

[0109] In some embodiments, the components of the recyclable high performance golf shoe 400 may be attached or coupled to each other using an adhesive 450. In some cases, the adhesive 450 may include a recyclable cement or primer. In some cases, the recyclable cement or primer may comprise a TPU-based cement or a PET-based cement. In some cases, the adhesive 450 may comprise a water-based or solvent-based cement or primer. In some cases, the adhesive 450 may comprise a hot melt cement. Additional examples of primers are described in greater detail elsewhere herein.

[0110] FIGURES 7A - 7D schematically illustrate another example of a recyclable golf shoe 700. In some cases, the recyclable golf shoe 700 may comprise an upper 710. In some cases, the upper 710 may comprise a mesh layer. In some cases, the mesh layer may comprise a recyclable mesh layer (e.g., a 100% TPU-based mono mesh layer).

[0111] In some cases, the recyclable golf shoe 700 may include a sole assembly 720 comprising a midsole. In some cases, the midsole may comprise a recyclable material. In some cases, the recyclable material may include a recyclable foam material. In some cases, the recyclable foam material may comprise a TPU-based foam.

[0112] In some optional embodiments, the recyclable golf shoe 700 may comprise a window provided in or near a heel region of the shoe. In some cases, the window may comprise a transparent material revealing a select material or a feature of the shoe. In some cases, the select material may include a layer or a section of the upper. In some cases, the select feature may include a logo. In some embodiments, a logo may be cut out from the window. In other embodiments, a logo may be cut into the window.

[0113] In some optional embodiments, the recyclable golf shoe 700 may comprise a hot melt border. In some cases, the hot melt border may line or extend around an opening of the golf shoe. In some cases, the hot melt border may form a portion of the heel collar of the shoe. In some embodiments, the recyclable golf shoe may comprise or utilize a hotmelt tape to create one or more aesthetic details or functional structures. In other embodiments, the aesthetic details or functional structures may be formed using one or more pieces that are die cut from a hotmelt sheet or layer. In some cases, the aesthetic details may correspond to lines, surfaces, shapes, profiles, colors, or other visual characteristics of the recyclable golf shoes disclosed herein. In some cases, the func-

tional structures may correspond to any structural portion, component, piece, layer, or material of the recyclable golf shoes disclosed herein.

[0114] In some optional embodiments, the recyclable golf shoe 700 may comprise a TPU padding. In some cases, the TPU padding may be formed from a mono mesh material. In some cases, the TPU padding may be formed from a recyclable foam material (e.g., a recyclable TPU foam as described elsewhere herein). In some cases, the TPU padding may comprise a same or similar material as the mesh layer of the upper 710. In other cases, the TPU padding and the upper 710 may comprise different materials.

[0115] Referring to FIGURE 7B, in some embodiments, the golf shoe 700 may comprise a saddle 730. In some cases, the saddle 730 may comprise an internal saddle or an external saddle. In some cases, the saddle 730 may comprise a recyclable material as described elsewhere herein.

[0116] In some cases, the saddle 730 may comprise two or more segments 731 that extend upwards from a bite line region of the shoe and converge towards the throat region or eyelet region of the shoe. In some cases, the two or more segments 731 may converge to form an end portion of the saddle 730. In some cases, the end portion of the saddle 730 may be folded and wrapped around the laces of the golf shoe. In some cases, the end portion of the saddle 730 may be hot melted to another portion of the saddle 730 to secure the end portion of the saddle 730 around the laces of the golf shoe. In some cases, when the laces are tightened, the tension in the laces may draw the segments 731 of the saddle 730 upwards to secure the saddle 730 and the medial and/or lateral sides of the upper around a subject's foot.

[0117] FIGURE 7C illustrates a rear view of a heel portion of the recyclable golf shoe 700. In some embodiments, the heel portion of the golf shoe may include a stitch (e.g., a zigzag stitch) that runs vertically along the upper. In some embodiments, the golf shoe may comprise an adhesive component 740 that is placed over the stitch. In some cases, the adhesive component 740 may be configured to conceal the stitch. In other cases, the adhesive component 740 may be configured as a protective barrier for the stitch. In some alternative cases, the adhesive component 740 may be configured to provide additional structural support for the heel portion of the golf shoe. In some embodiments, the adhesive component 740 may comprise a heat-activated tape that can be thermally activated and adhered to the upper material.

[0118] FIGURE 7D illustrates a top view of a recyclable golf shoe. As described elsewhere herein, the recyclable golf shoe may comprise an upper 710 comprising a mesh material. The mesh material may comprise a recyclable mesh material. In some embodiments, the recyclable golf shoe may also comprise a saddle 730 that can be tensioned or tightened around a subject's foot when the shoe is laced. As described above, in some cases, the saddle 730 may be configured to interface with the laces of the

shoe. In some cases, the saddle 730 may be configured to couple to the laces of the shoe so that the saddle 730 can be secured around a subject's foot when the laces are tightened. In some cases, the saddle 730 may also be configured to manage or control the direction in which the laces are routed across the tongue 750 of the shoe.

[0119] FIGURE 8 illustrates a detailed view of a tongue 850 that can be incorporated with the recyclable golf shoe. In some cases, the tongue 850 may comprise a base mono mesh layer 810. In some cases, the base mono mesh layer 810 may be attached or coupled to a backer layer 820. In some cases, the base mono mesh layer 810 and the backer layer 820 may be attached or coupled by way of a hot melt process. In some cases, the base mono mesh layer 810 and the backer layer 820 may be hot melted together.

[0120] In some embodiments, a hot melt border 830 may be arranged or provided along an edge portion of the base mono mesh layer 810 and/or the backer layer 820. In some cases, the hot melt border 830 may extend along an entire perimeter of the base mono mesh layer 810 and/or the backer layer 820. In other cases, the hot melt border 830 may extend around only a select portion or section of the perimeter of the base mono mesh layer 810 and/or the backer layer 820.

[0121] In some embodiments, a lace guide component 840 may be provided on or attached to the base mono mesh layer 810 and/or the backer layer 820. In some cases, the lace guide component 840 may be configured to route or organize one or more laces extending across the tongue 850 of the shoe.

[0122] In some embodiments, the tongue 850 may be formed by attaching or coupling together the base mono mesh layer 810, the backer layer 820, the hot melt border 830, and/or the lace guide component 840. In some cases, the base mono mesh layer 810, the backer layer 820, the hot melt border 830, and/or the lace guide component 840 may be hot melted together to form the tongue 850.

[0123] In some cases, the tongue 850 may comprise a symmetric shape or profile about a longitudinal axis extending from the heel region of the shoe to the toe region of the shoe. In some cases, the various components or layers of the tongue 850 may comprise a symmetric shape or profile. For example, the base mono mesh layer 810, the backer layer 820, and/or the hot melt border 830 may comprise a symmetric shape or profile.

[0124] In other cases, the tongue 850 may comprise an asymmetric shape or profile about a longitudinal axis extending from the heel region of the shoe to the toe region of the shoe. In some cases, the various components or layers of the tongue 850 may comprise an asymmetric shape or profile. For example, the base mono mesh layer 810, the backer layer 820, and/or the hot melt border 830 may comprise an asymmetric shape or profile.

Shoe Construction

[0125] In another aspect, the present disclosure provides a golf shoe comprising an upper and a sole assembly connected to the upper. In some embodiments, the upper may comprise a membrane layer, a frame structure, a mesh layer, and/or a saddle as described elsewhere herein. In some embodiments, the sole assembly may comprise a midsole and/or an outsole as described in further detail elsewhere herein.

[0126] FIGURE 9 illustrates an example of a recyclable golf shoe. In some embodiments, the recyclable golf shoe may comprise a TPU mono mesh layer 910. The TPU mono mesh layer 910 may be directly exposed to an environment external to the shoe. In some embodiments, the recyclable golf shoe may comprise an internal frame structure 920. In some cases, the internal frame structure 920 may be configured to provide additional structural support to the upper. A detailed view of the internal frame structure 920 is shown in FIGURE 10. In some embodiments, the recyclable golf shoe may comprise a saddle 930. As described elsewhere herein, the saddle 930 may be configured to interface with one or more laces of the shoe. In some cases, the saddle may be secured around a subject's foot when the laces of the shoe are tightened. In some cases, the recyclable golf shoe may comprise a membrane layer 940. In some cases, the membrane layer 940 may comprise a base layer to which other components or layers of the shoe can be attached or coupled. In some cases, the membrane layer 940 may comprise a TPU hotmelt membrane layer.

Membrane Layer

[0127] In some embodiments, the upper of the golf shoe may comprise a membrane layer 940. The membrane layer 940 may be configured to at least partially surround or enclose a foot of a subject wearing the golf shoe. In some cases, the membrane layer 940 may be positioned adjacent to the subject's foot. In some cases, the membrane layer 940 may be configured to directly contact a subject's foot. In some cases, the membrane layer 940 may correspond to a layer of the upper that is positioned closest to the subject's foot.

Breathable Membrane

[0128] In some embodiments, the membrane layer 940 may be a breathable membrane comprising one or more regions with one or more surface features or perforations. In some cases, the one or more surface features or perforations may be configured to facilitate a movement of a fluid or vapor through or across the membrane layer. In some cases, the one or more regions having the one or more surface features or perforations can be physically decoupled or detached from other adjacent components or layers of the shoe (e.g., the mesh layer 910) to enhance breathability.

[0129] In some cases, the one or more surface features or perforations may comprise one or more openings through which a fluid or vapor can be transported. In some cases, the one or more openings may have a size (e.g., a width) ranging from about 0.001 millimeters (mm) to about 0.002 mm. In some cases, the size or width of the openings may be greater than about 0.002 mm. In other cases, the size or width of the openings may be less than about 0.001 mm.

[0130] In some cases, the one or more surface features or perforations may comprise a plurality of openings through which a fluid or vapor can be transported. In some cases, adjacent or neighboring openings may be remotely spaced by a pre-determined separation distance. In some cases, the pre-determined separation distance may range from about 0.005 mm to about 0.006 mm. In some cases, the pre-determined separation distance may be greater than about 0.006 mm. In other cases, the pre-determined separation distance may be less than about 0.005 mm.

Example 1

[0131] In some embodiments, the golf shoe may comprise a membrane with one or more micropores. In some cases, the micropores may be created on the membrane prior to a lamination or hot press process which seals materials together to create a composite structure. To avoid losing the micropores and related breathability features during the lamination or hot press process, a non-stick material may be applied or provided to leave one or more predetermined zones of the membrane as non-laminated regions that can preserve their micropore characteristics. In some cases, the non-stick material may create or preserve one or more air pockets between the layers of the shoe, to prevent the layers from sticking in the predetermined zones so that the membrane can retain one or more micropores for breathability within the predetermined zones.

[0132] FIGURES 11A and 11B show an exemplary membrane layer 1140 with one or more perforated regions 1150. As shown in FIGURE 11A, the one or more perforated regions 1150 may include one or more perforations or micropores for controlling a movement of a fluid or a vapor across or through the membrane layer 1140. In some cases, the exemplary membrane layer 1140 may include a plurality of perforated regions 1150. In some cases, the plurality of perforated regions 1150 may include a perforated region in a forefoot region of the exemplary membrane layer 1140. In some cases, the plurality of perforated regions 1150 may include a perforated region on the medial side and/or the lateral side of the membrane layer 1140. As shown in FIGURE 11B, in some cases, a non-adhesive material 1160 may be applied to cover the membrane layer 1140 before the membrane layer 1140 undergoes a hotmelt process (e.g., a hotmelt process to join one or more other layers or components of the shoe to the membrane layer 1140). The

non-adhesive material 1160 may be configured to prevent hotmelt bonding in one or more select regions (e.g., the perforated regions shown in FIGURE 11A). In some cases, the non-adhesive material 1160 may include, for example, a wax paper material.

Example 2

[0133] In some embodiments, a regular hotmelt film may be used as the backer instead of a traditional membrane. In some cases, one or more micropores may be provided on the hotmelt film and/or the backer.

[0134] In some cases, the pores may be created on the backer hotmelt layer (e.g., by mechanical or laser perforation) before a lamination or hotmelt process. In some cases, when the perforations are created on the backer pre-lamination, one or more non-stick materials such as wax paper can be used to preserve the holes/breathability feature through the lamination or hotmelt process.

[0135] In some alternative cases, the pores may be created on the backer hotmelt layer after a lamination or hot melt process. In such cases, the pores may be created by mechanical or laser perforation through multiple layers of a laminated and hot melted construction comprising the backer hotmelt layer.

Example 3

[0136] In some embodiments, the membrane of the golf shoe may comprise a microporous membrane. In some cases, the microporous membrane may form a portion or a layer of an internal bootie system or assembly of the golf shoe. In some cases, the microporous membrane may be configured as an internal bootie system or assembly. In some cases, the internal bootie system or assembly may be configured to float inside the shoe. In some cases, the internal bootie system or assembly may not or need not be laminated with or hot melted to other layers of the shoe. In some cases, the internal bootie system or assembly may provide a softer upper build compared to other golf shoe embodiments which utilize laminated or hot melted layers to enhance stiffness.

[0137] FIGURES 11C - 11G schematically illustrate various examples of a waterproof and/or breathable construction for a recyclable golf shoe. As shown in FIGURE 11C, in some embodiments, the recyclable golf shoe may comprise a membrane layer 1140 comprising a TPU hotmelt base. In some cases, the TPU hotmelt base may not or need not comprise any perforations or micropores. In some cases, the TPU hotmelt base may be waterproof or water resistant. In some cases, the TPU hotmelt base may have limited or restricted breathability. In some cases, the TPU hotmelt base may not or need not be breathable.

[0138] Referring to FIGURE 11D, in some alternative embodiments, the recyclable golf shoe may comprise a membrane layer 1140 comprising a TPU hotmelt base

with one or more perforations. In some cases, the one or more perforations may be localized in or near one or more select locations on the TPU hotmelt base. The one or more select locations may include, for example, a medial and/or lateral side of a midfoot portion of the TPU hotmelt base. In some cases, the one or more select locations may include a toe portion of the TPU hotmelt base. In some embodiments, the one or more perforations may include one or more mechanical perforations. In other embodiments, the one or more perforations may include one or more laser perforations. In some embodiments, the membrane layer 1140 may be waterproof or water resistant. In some embodiments, the membrane layer 1140 may be breathable at least in part due to the one or more perforations. In some embodiments, the one or more perforations may be configured to enhance or control a breathability of the membrane layer 1140.

[0139] As described elsewhere herein, in some cases, the one or more perforations may be preserved during a hot melt or heat press process by providing a barrier material that prevents the removal or destruction of the perforations during the hot melt or heat press process. In some cases, the barrier material may comprise a wax-based material or a silicone-based material. In some cases, the barrier material may be removable after the hot melt or heat press process.

[0140] Referring to **FIGURE 11E**, in some non-limiting embodiments, the recyclable golf shoe may comprise a membrane layer 1140 comprising a microporous TPU membrane base. In some embodiments, wax paper or silicone patches can be temporarily placed adjacent to or over select regions of the membrane layer 1140 to preserve the micropores in the select regions during a hot melt or heat press process. In some cases, the wax paper or the silicone patches can be removed after the hot melt or heat press process to yield a membrane layer 1140 with micropores in the select regions. The micropores may be configured to enhance or control the breathability of the membrane layer 1140 in the select regions.

[0141] Referring to **FIGURE 11F**, in some non-limiting embodiments, the recyclable golf shoe may comprise a membrane layer 1140 comprising a microporous TPU membrane base. In some embodiments, a hotmelt layer 1170 may be layered over or overlaid on the microporous TPU membrane base. In some cases, the hotmelt layer 1170 may be positioned between (i) the membrane layer 1140 and (ii) a mesh layer, a frame structure, and/or a saddle component of the recyclable golf shoe (e.g., as shown in **FIGURE 9**). In some cases, the hotmelt layer 1170 may comprise one or more apertures or windows 1175. In some cases, the one or more apertures or windows 1175 may be positioned directly adjacent to one or more select regions of the membrane layer 1140. The one or more select regions may correspond to regions of the membrane layer 1140 with micropores that can or should be preserved to enhance or control the breathability of the membrane layer 1140. In some cases, the

placement of the one or more apertures or windows 1175 directly adjacent to the select regions may provide a physical clearance between the select regions and other layers or components of the shoe, so that the select regions do not adhere to the other layers or components during a hot melt or heat press process. In some cases, the one or more apertures or windows 1175 may be positioned in a medial and/or lateral side of a midfoot portion of the hotmelt layer 1170. In some cases, the one or more select locations may include a toe portion of the hotmelt layer 1170.

[0142] Referring now to **FIGURE 11G**, in some non-limiting embodiments, the recyclable golf shoe may comprise a bootie system comprising a recyclable TPU material. The bootie system may be waterproof and/or breathable. In some cases, the bootie system may comprise two or more membrane layers 1140 that are attached together along a perimeter or edge of the membrane layers. In some cases, the membrane layers 1140 may comprise a microporous membrane. In some cases, the two or more microporous membranes may be attached by way of a heat press process that seals the respective perimeters or edges of the membrane layers together. In some cases, the two or more microporous membranes may be welded at the respective perimeters or edges of the membrane layers (e.g., by way of high frequency welding or other TPU welding techniques). In some cases, a portion of the respective perimeters or edges of the microporous membrane layers may not or need not be attached (e.g., to create or provide a throat opening configured to receive a subject's foot). In some cases, the two or more microporous membranes may not or need not be laminated to a separate backer panel or layer.

[0143] Referring still to **FIGURE 11G**, in some embodiments, the recyclable golf shoe may comprise a bootie system comprising two or more membrane layers 1140 that are attached together along a perimeter or edge of the microporous membranes. In some cases, a barrier material 1180 may be provided between the two or more membrane layers 1140 (e.g., during a hot melt, HF welding, or heat press process) to prevent the microporous membrane layers from adhering to each other and effectively removing or destroying the micropore structures in the microporous membranes. In some cases, the barrier material 1180 may be applied before a hot melt, HF welding, or heat press process. In some cases, after the hot melt, HF welding, or heat press process is completed (and the perimeters or edges of the membrane layers 1140 are sealed or fused together), the barrier material 1180 may be removed via the throat opening to yield a waterproof and/or breathable bootie system with a microporous membrane structure. In some non-limiting embodiments, the barrier material 1180 may comprise a wax paper or a silicone piece/patch as described elsewhere herein.

Hotmelt Construction

[0144] In some embodiments, the membrane layer of the recyclable golf shoe may be configured as a hotmelt backer for the mesh layer of the recyclable golf shoe. In some cases, the hotmelt backer may be configured as a substrate or a support to which other layers of the shoe can be attached or coupled (e.g., by way of a thermal treatment such as a hot melt procedure or a heat press method).

[0145] In some embodiments, a hotmelt film may be used as the backer, instead of or in addition to a traditional membrane. In some cases, the hotmelt film may have a lower melting point than the upper material and/or the midsole material so that the hotmelt film can be activated without subjecting the upper and/or midsole to elevated temperatures that can (i) shrink or deform the upper and/or midsole or (ii) damage or otherwise compromise the structural integrity of the upper and/or midsole or any other components of the shoe (e.g., the Strobel threads of the shoe). In some cases, the hotmelt film can be activated in a negative pressure space (e.g., a vacuum environment).

Optical Properties

[0146] In some embodiments, the membrane layer may be fully transparent (i.e., all light passes through the membrane layer). In some cases, the membrane layer may be translucent (i.e., some light passes through the membrane layer). In some cases, the membrane layer may be fully opaque (i.e., no light passes through the membrane layer). The transparency, translucence, and/or opacity of the membrane layer may be adjusted depending on a subject's preference, for aesthetic reasons, and/or for various performance benefits (e.g., to reduce or prevent discoloration or wear, to regulate a movement of fluids, vapors, or gases through or across the membrane layer, or to regulate a transfer of thermal energy across the membrane layer).

[0147] In some embodiments, the membrane layer may have a different transparency, translucence, and/or opacity than other layers of the shoe. For example, the membrane layer and the mesh layer may have different transparencies, translucencies, and/or opacities. The different transparencies, translucencies, and/or opacities can collectively provide a desired aesthetic appearance and/or one or more desirable performance benefits. In some cases, the one or more desirable performance benefits may include resistance to wear or discoloration due to exposure to sunlight or UV rays. In some cases, the one or more desirable performance benefits may include an ability to regulate a movement of fluids, vapors, or gases through or across the membrane or mesh layer. In some cases, the performance benefits may include an ability to regulate a transfer of thermal energy across the membrane or mesh layer.

Internal Frame

[0148] In some embodiments, the recyclable golf shoes of the present disclosure may comprise a frame structure. **FIGURES 9 and 10** illustrate an example of a frame structure 920 that can be used to structure the upper of the golf shoe. In some cases, the frame structure 920 may comprise an internal frame structure attached or coupled to the membrane layer, the mesh layer, and/or the saddle of the shoe to structurally support or stiffen the upper. In some non-limiting embodiments, the internal frame structure 920 may comprise an A-shaped support frame.

[0149] In some embodiments, the A-shaped support frame may comprise a plurality of members that converge and/or diverge with respect to one another to form a truss-like configuration. The truss-like configuration may comprise supporting members configured to support loads in two or more directions. In some cases, the supporting members may be linked together and arranged to form one or more windows or openings. In some cases, the one or more windows or openings may expose a portion of the membrane layer or the mesh layer and allow the membrane layer and the mesh layer to directly contact each other.

[0150] In some embodiments, the frame structure 920 may support or stiffen multiple portions or components of the upper. In some cases, the frame structure 920 may be attached to one or more other layers of the shoe to provide structure to the upper and/or to stiffen the upper. In some cases, the frame structure 920 may be attached to the other layers of the shoe by way of a hot melt process or a heat press procedure. In some cases, the frame structure 920 may be laminated with or to one or more other layers of the shoe.

[0151] In some embodiments, the frame structure 920 may be configured to stiffen a lateral side and/or a medial side of the upper. In some embodiments, the frame structure 920 may be configured to stiffen a forefoot region, a midfoot region, and/or a rearfoot region of the upper.

[0152] In some cases, the frame structure 920 may be positioned between (i) the membrane layer 940 and (ii) the mesh layer 910 of the shoe. In some cases, the frame structure 920 may be positioned between (i) the membrane layer 940 and (ii) the saddle 930 of the shoe.

[0153] In some embodiments, the frame structure 920 may be configured to extend from a rearfoot region of the shoe to a midfoot region of the shoe. In some embodiments, the frame structure 920 may be configured to extend from a rearfoot region of the shoe to a forefoot region of the shoe. In some embodiments, the frame structure 920 may be configured to extend from a midfoot region of the shoe to a forefoot region of the shoe.

[0154] In some embodiments, the frame structure 920 may be configured to extend along the medial side of the shoe. In some embodiments, the frame structure 920 may be configured to extend along the lateral side of the shoe.

[0155] In some embodiments, the frame structure 920 may be configured to extend around or along a toe region of the shoe. In other embodiments, the frame structure 920 may not or need not extend around or along the toe region of the shoe.

[0156] In some embodiments, the frame structure 920 may be configured to extend around or along a heel region of the shoe. In other embodiments, the frame structure 920 may not or need not extend around or along the heel region of the shoe.

Truss Structure

[0157] In some embodiments, the internal A-shaped frame structure 920 may comprise one or more truss-like structures. The one or more truss-like structures may comprise a plurality of support members that are mechanically coupled or integrally formed. The plurality of support members may converge and/or diverge to form one or more windows or openings between the support members. In some cases, the one or more truss-like structures may be configured to bear one or more loads that are exerted on the support members of the truss-like structures. In some cases, the one or more truss-like structures may provide structural support for the layers of the shoe (e.g., to limit an amount of stretching or deformation of the various layers of the shoe in response to one or more forces exerted on the shoe during a golf-related action or movement).

[0158] In some embodiments, the one or more truss-like structures may extend between (i) a rearfoot region of the golf shoe and (ii) a midfoot region of the golf shoe. In some embodiments, the one or more truss-like structures may extend between (i) a rearfoot region of the golf shoe and (ii) a forefoot region of the golf shoe. In some embodiments, the one or more truss-like structures may extend between (i) a midfoot region of the golf shoe and (ii) a forefoot region of the golf shoe.

[0159] In some embodiments, the frame structure 920 may be symmetric (i.e., the size and/or shape of the frame structure on the medial and lateral sides of the shoe may be the same or similar). In other embodiments (e.g., as shown in **FIGURES 9** and **10**), the frame structure 920 may be asymmetric. For example, the frame structure 920 may have different frame configurations on a medial side and a lateral side of the golf shoe. In some cases, the lateral portion of the frame structure 920 and the medial portion of the frame structure 920 may comprise a different number of truss-like structures, a different number of openings or windows, and/or different structural configurations. In some cases, the lateral portion of the frame structure 920 and the medial portion of the frame structure 920 may have different sizes, shapes, and/or dimensions. In some cases, the lateral portion of the frame structure 920 and the medial portion of the frame structure 920 may extend across or cover different regions of the upper.

Lightweight Frame

[0160] In some embodiments, the frame structure 920 may comprise a lightweight frame structure. In some cases, the lightweight frame structure may be at most about 250 grams (g). In some cases, the lightweight frame structure may be at most about 200 grams (g). In some cases, the lightweight frame structure may be at most about 150 grams (g). In some cases, the lightweight frame structure may be at most about 100 grams (g) or less.

Mesh Layer

[0161] In some cases, the golf shoe may comprise a mesh layer 910 comprising a first side and a second side. In some cases, a portion of the mesh layer 910 may correspond to or form a vamp piece, a quarter panel, a toe cover, or a heel counter of the golf shoe. In some cases, the mesh layer 910 may comprise a layer of the shoe that is directly exposed to an environment external to the shoe.

[0162] In some cases, the first side of the mesh layer 910 may be attached or coupled to the membrane layer 940 and/or the frame structure 920 of the shoe. In some cases, the second side of the mesh layer 910 may be connected to the saddle 930 of the golf shoe.

[0163] In some embodiments, the mesh layer 910 can be positioned between (i) the saddle 930 of the golf shoe and (ii) the internal frame structure 920 or the membrane layer 940. In some embodiments, the mesh layer 910 and the internal frame structure 920 can be positioned between (i) the membrane layer 940 and (ii) the saddle 930 of the golf shoe.

Optical Properties

[0164] In some embodiments, at least a portion of the mesh layer may be fully transparent (i.e., all light may pass through the layers). In some cases, the mesh layer may be translucent (i.e., some light may pass through the layers). In some cases, the mesh layer may be fully opaque (i.e., no light can pass through the layers). In some embodiments, the transparency, translucence, and/or opacity of the mesh layer may be adjusted depending on a subject's preference, for aesthetic reasons, and/or for performance benefits. In some cases, the performance benefits may include reducing or preventing discoloration or wear. In some cases, the performance benefits may include regulating a movement of fluids, vapors, or gases through or across the mesh layer. In some cases, the performance benefits may include regulating a transfer of thermal energy across the mesh layer.

[0165] In some embodiments, the mesh layer may have a different transparency, translucence, and/or opacity than other layers of the shoe. For example, the mesh layer and the membrane layer may have different

transparencies, translucencies, and/or opacities. The different transparencies, translucencies, and/or opacities can collectively provide a desired aesthetic appearance and/or one or more desirable performance benefits. In some cases, the one or more desirable performance benefits may include resistance to wear or discoloration due to exposure to sunlight or UV rays. In some cases, the one or more desirable performance benefits may include an ability to regulate a movement of fluids, vapors, or gases through or across the mesh or membrane layer. In some cases, the performance benefits may include an ability to regulate a transfer of thermal energy across the mesh or membrane layer.

Saddle

[0166] In some cases, the golf shoe may comprise a saddle 930 connected to the second side of the mesh layer. In some cases, the saddle 930 may comprise one or more panels, pieces, or layers of material extending across the upper. In some cases, the one or more panels, pieces, or layers of material may extend across at least a midfoot portion of the upper. In some cases, a first portion of the saddle 930 may extend along a lateral side of the upper, and a second portion of the saddle 930 may extend along a medial side of the upper. In some cases, the first and second portions of the saddle 930 may be attached at or near a toe region of the upper. In some cases, the first and second portions of the saddle 930 may not or need not be attached at or near the heel region of the upper.

[0167] In some embodiments, the saddle 930 may be configured to interface with the laces of the shoe. In some cases, the saddle 930 may be configured to couple to the laces of the shoe so that the saddle 930 can be secured around a subject's foot when the laces are tightened. In some cases, the saddle 930 may be configured to manage or control the direction in which the laces are routed across the upper of the shoe.

Ankle Pads

[0168] In some embodiments, the golf shoe may further comprise one or more TPU foam ankle pads 955 attached or coupled to the membrane layer 940. The one or more TPU foam ankle pads 955 may be configured to cushion or support an ankle region of the subject's foot.

[0169] In other embodiments, the golf shoe may not or need not comprise any TPU foam ankle pads. For example, in some alternative embodiments, the golf shoe may comprise an air pocket or an air bladder that supports or cushions an ankle region of the subject's foot (in lieu of any foam components). In some cases, the air pocket or air bladder may be formed between two or more layers of the golf shoe. In some cases, the two or more layers may include the membrane layer, the mesh layer, the frame structure, and/or the saddle of the golf shoe.

Heel Components

[0170] In some embodiments, the golf shoe may further comprise one or more TPU heel components 951 attached to the membrane layer 940. In some cases, the TPU heel components 951 may be hot melted to the membrane layer 940. In some cases, the TPU heel components 951 may comprise a piece, layer, or panel of recyclable material configured to structure or support the heel region of the shoe.

Toe Component

[0171] In some embodiments, the golf shoe may further comprise one or more TPU toe components 952 attached to a forefoot region of the mesh layer or the membrane layer. In some cases, the one or more TPU toe components 952 may be hot melted to the mesh layer 910 (e.g., the first or second side of the mesh layer 910). In some cases, the one or more TPU toe components 952 may be hot melted to the membrane layer 940. In some cases, the one or more TPU toe components 952 may comprise a piece, layer, or panel of recyclable material configured to structure or support the toe region of the shoe.

Collar

[0172] In some embodiments, the golf shoe may further comprise a TPU collar material 954 attached to the upper. In some cases, the TPU collar material 954 may be hot melted to the upper. In some cases, the TPU collar material 954 may form, shape, structure, or line a portion of the collar of the shoe.

Eyelets

[0173] In some embodiments, the golf shoe may further comprise one or more eyelets 953. In some cases, the one or more eyelets 953 may comprise a recyclable component configured to receive or interface with one or more fastening mechanisms. The fastening mechanisms may include, for example, laces, cables, fiber, or other elongated structures that can flexibly couple two or more pieces, layers, or panels of the shoe. In some embodiments, the eyelets 953 may be attached to the saddle 930 of the shoe. In some embodiments, the eyelets 953 may be hot melted to the saddle 930. In some embodiments, the eyelets 953 may be hot melted to another layer of material forming the upper or a portion thereof.

Laces

[0174] In some embodiments, the golf shoe may comprise one or more laces threaded through the one or more eyelets. The one or more laces may comprise a recyclable material as described elsewhere herein. In some cases, the one or more laces may comprise a plurality of

welded layers of a TPU material. The plurality of welded layers may collectively enhance the tensile strength of the laces.

[0175] In some cases, the one or more laces have a tensile strength ranging from about 1 kilopascal (kPa) to about 1 megapascal (MPa). In some cases, the tensile strength of the laces may be less than 1 kPa. In some cases, the tensile strength of the laces may be greater than 1 MPa.

[0176] FIGURES 12 and 13 schematically illustrate another example of a recyclable golf shoe 1300 comprising a recyclable material. In some cases, the recyclable material may include a TPU-based recyclable material as described elsewhere herein. In some embodiments, the recyclable golf shoe 1300 may comprise an upper 1310 comprising a TPU mesh material. In some embodiments, the recyclable golf shoe 1300 may comprise a sole assembly 1320 comprising a TPU foam material. In some non-limiting embodiments, the sole assembly 1320 may comprise a die cut wedge sole formed from a TPU sheet foam material.

[0177] In some non-limiting embodiments, the recyclable golf shoe 1300 may comprise a mesh liner 1340 extending around an opening of the shoe. In some case, the mesh liner 1340 may comprise a recyclable material (e.g., a TPU-based recyclable material).

[0178] In some non-limiting embodiments, the recyclable golf shoe 1300 may comprise a weld down line detail. In some cases, the weld down line detail may extend across the upper of the shoe (e.g., from a medial side to a lateral side of the shoe). In some cases, the weld down line detail may extend from a forefoot region of the shoe to a midfoot region of the shoe. In some cases, the weld down line detail may extend from a midfoot region of the shoe to a rearfoot region of the shoe. In some cases, the weld down line detail may extend between the forefoot region and the rearfoot region of the shoe.

Footbed

[0179] In some embodiments, the recyclable golf shoe may comprise a footbed for supporting the subject's foot. The footbed may be insertable into and/or removable from the interior region of the shoe. In some cases, the footbed may comprise a die cut TPU sheet foam. In other cases, the footbed may comprise a molded footbed. In some cases, the footbed may be molded using the same molding process and/or the same source materials as the midsole.

Stability Clip

[0180] In some embodiments, the recyclable golf shoe 1300 may comprise a stability clip 1330. In some cases, the stability clip 1330 may be provided on a medial side and/or a lateral side of the golf shoe 1300. In some embodiments, the stability clip 1330 may comprise a recyclable material as described elsewhere herein. In some

non-limiting embodiments, the stability clip 1330 may comprise an injected TPU stability clip comprising a recyclable TPU-based material.

[0181] FIGURE 14 schematically illustrates an exemplary stability clip 1330 that can be used with the recyclable golf shoes of the present disclosure. In some embodiments, the stability clip 1330 may comprise a sidewall and a beam extending laterally from the sidewall. In some embodiments, the beam and the sidewall may collectively form a T-shape. In some embodiments, the beam may comprise a tapered end or a pointed edge.

[0182] In some embodiments, the stability clip 1330 may be insertable between the footbed of the shoe and a midsole portion of the sole assembly to control a movement or a deformation of the midsole portion in response to one or more forces exerted on the golf shoe. In some cases, the stability clip 1330 may be configured as a support structure that extends over the midsole and under the footbed to prevent over rotation (e.g., due to a deformation of the relatively soft material of the midsole during a golf-related action or movement).

[0183] FIGURE 15 illustrates an example of an outsole 1500 that can be utilized with the recyclable shoes of the present disclosure. In some embodiments, the outsole 1500 may be configured for a casual golf shoe. In some embodiments, the outsole 1500 may be integrated with a sole assembly of a casual golf shoe. In some embodiments, the outsole 1500 may comprise a recyclable material. In some cases, the recyclable material may comprise, for example, a TPU sheet foam material. In some embodiments, the outsole 1500 may comprise a die cut slab.

[0184] In some non-limiting embodiments, the outsole 1500 may comprise a window 1510. In some embodiments, the window 1510 may comprise a die cut open window. In some embodiments, the window 1510 may comprise an opening or a transparent material that reveals an underlying outsole or midsole material of the shoe.

[0185] In some cases, a logo may be cut into the outsole. In other cases, a portion of the outsole material may be cut, excised, or removed to form a window in the shape of a desired logo.

[0186] In some embodiments, the outsole 1500 may comprise one or more traction elements 1550. In some cases, the one or more traction elements 1550 may comprise one or more grooves or ridges extending between the medial side and the lateral side of the shoe. In some cases, the one or more traction elements 1550 may comprise one or more traction members extending from the outsole 1500 towards a ground surface under the outsole 1500. In some cases, the one or more traction members may comprise a plurality of protrusions or projections extending across the outsole 1500. In some cases, the plurality of protrusions or projections may have different sizes, shapes, and/or angular orientations. Other types of outsole configurations and/or traction elements may be used without departing from the spirit and scope of the

present disclosure, such as, for example, the outsoles and traction elements described in U.S. Patent Publication No. 2022/0175080 A1, U.S. Patent No. 11,490,689 B2, U.S. Patent No. 11,497,272 B2, U.S. Patent No. 11,490,677 B2, and U.S. Patent No. 11,019,874 B2; U.S. Patent No. 11,425,959 B2, U.S. Patent No. 11,425,958 B2, and U.S. Patent Application No. 17/360,583; U.S. Patent No. 9,999,275 B2, U.S. Patent No. 10,595,585 B2, and U.S. Patent No. 10,856,613 B2; U.S. Design Patent Application No. 29/796,891; U.S. Patent Publication No. 2022/0408879 A1, U.S. Patent Publication No. 2022/0007792 A1, U.S. Patent Publication No. 2022/0007793 A1, and U.S. Design Patent Application No. 29/778,886; U.S. Patent Application No. 17/821,996, U.S. Patent Application No. 17/686,146, U.S. Design Patent Application No. 29/845,372, U.S. Design Patent Application No. 29/842,673, and U.S. Design Patent No. D815,413 S1; U.S. Patent Publication No. 2022/0079295 A1; U.S. Patent No. 5,979,083; U.S. Patent No. 5,932,336 and U.S. Patent No. 5,987,783; U.S. Patent Publication No. 2018/0084862 A1; U.S. Patent No. 6,708,426 B2 and U.S. Patent No. 7,143,529 B2; U.S. Patent No. 7,905,034 B2, U.S. Patent No. 7,673,400 B2, and U.S. Patent No. 8,677,657 B2; U.S. Patent Publication No. 2015/0096195 A1; and U.S. Design Patent No. D934,542 S1, the disclosures of which are incorporated herein by reference.

Removable Component

[0187] In some embodiments, the recyclable golf shoe may comprise a removable component. **FIGURES 15A** and **15B** schematically illustrate various examples of a component that can be detachably coupled to or removably integrated with the recyclable golf shoes of the present disclosure. In some cases, the removable component may comprise a removable insole 1561 or a removable tag 1562 that can be detachably coupled to the upper or the sole assembly. In some cases, the removable component may comprise recycling instructions for the golf shoe. In some embodiments, the removable component may comprise a same or similar material as the upper or the sole assembly. In some embodiments, the removable component may comprise a different material than the upper or the sole assembly. In some embodiments, the removable component may be recyclable. In other embodiments, the removable component may not or need not be recyclable. In some alternative embodiments, a portion of the removable component may be recyclable.

[0188] In some cases, the removable component of the recyclable golf shoe may comprise a pull tab with instructions to recycle the shoe. In some cases, the pull tab may be removed before recycling the shoe. In other cases, the pull tab may not or need not be removed before recycling the shoe.

[0189] In any of the embodiments described herein, the removable component of the recyclable golf shoe

may be detachably coupled to or removably integrated with the shoe. In some embodiments, the removable component may be coupled to or integrated with an upper of the shoe. In some cases, the removable component may be coupled to or integrated with a heel region of the upper. In other embodiments, the removable component may be coupled to or integrated with the sole assembly of the shoe. In some cases, the removable component may be inserted into an opening of the shoe and secured within the interior region of the shoe, between the medial and lateral sides of the shoe and/or between the anterior and posterior ends of the shoe.

Adhesives

[0190] In some embodiments, the various components or layers of the recyclable golf shoe may be attached or coupled together using a cement or an adhesive. As described elsewhere herein, the cement or adhesive may include, for example, a water-based cement or primer, a solvent-based cement or primer, or a cement or primer that is based on a recyclable material. In some cases, a TPU-based film cement may be applied to attach or couple two or more components or layers of the recyclable golf shoe.

[0191] In some embodiments, the recyclable golf shoe may comprise one or more adhesives configured to attach or couple two or more components, layers, or materials of the recyclable golf shoe. In some cases, the one or more adhesives may comprise a plurality of adhesives. In some cases, the plurality of adhesives may include water-based or solvent-based adhesives, cements, and/or primers. In some cases, the one or more adhesives may include a thermally activated adhesive, cement, or primer.

[0192] In some embodiments, the golf shoe may comprise a first cement or adhesive that is applied to or placed in contact with the sole assembly. In some cases, the first cement or adhesive may comprise a solvent cement, a solvent primer, or a hotmelt cement. In some cases, the first cement or adhesive may comprise a water based cement or a water based primer. In some cases, the first cement or adhesive may comprise a TPU-based cement, primer, or adhesive.

[0193] In some embodiments, the golf shoe may comprise a second cement or adhesive that is applied to or placed in contact with a component, a layer, or a material of the upper. In some cases, the second cement or adhesive may comprise a solvent cement, a solvent primer, a hotmelt cement, a water based cement, or a water based primer. In some cases, the second cement or adhesive may comprise a TPU-based cement, primer, or adhesive.

[0194] In some cases, the first cement or adhesive and/or the second cement or adhesive may be configured to evaporate during a chemical recycling process that yields at least one recycled or recyclable material from a recycled article. In other cases, the first cement or ad-

hesive and/or the second cement or adhesive may be recyclable and may not or need not evaporate during a chemical recycling process that yields at least one recycled or recyclable material.

[0195] In another aspect, the present disclosure provides a recyclable golf shoe comprising an upper and a sole assembly connected to the upper. The upper and/or the sole assembly may comprise a recyclable material as described elsewhere herein. In some cases, the recyclable material may comprise polyethylene terephthalate (PET) and/or any analogues or derivatives thereof. In some cases, the recyclable material may comprise a polyester-based material.

[0196] FIGURES 16 and 17 illustrate various examples of a recyclable golf shoe 1600 comprising a recyclable material. In some cases, the recyclable material may comprise a PET based recyclable material. In some cases, the PET-based recyclable material may comprise a foamed PET material. In some cases, the foamed PET material may comprise a mechanically foamed PET material. In some cases, the recyclable golf shoe 1600 may comprise 100% PET by weight or mass.

[0197] In some embodiments, the PET-based recyclable material may comprise a material derived from a recycled article comprising at least one recyclable PET material. In some embodiments, the PET-based recyclable material may be processable into one or more articles comprising the at least one recyclable PET material. The one or more articles may include, for example, an article of footwear, an article of apparel, and/or golf-related equipment.

Shoe Structure

[0198] In some embodiments, the upper of the recyclable golf shoe 1600 may comprise a mesh layer 1610. In some embodiments, the recyclable golf shoe 1600 may comprise a support or a support plate. In some cases, the support or support plate may comprise a moderator plate 1620 that can be attached or coupled to the mesh layer 1610. In some embodiments, the recyclable golf shoe 1600 may comprise one or more foam layers 1630 extending under the moderator plate 1620. In some embodiments, the recyclable golf shoe 1600 may comprise an insole board 1640 and/or a footbed 1650 configured to support a foot of a subject wearing the recyclable golf shoe 1600.

Mesh Layer

[0199] In some embodiments, the upper may comprise a mesh layer 1610. The mesh layer 1610 may comprise one or more recyclable PET materials as described elsewhere herein. In some cases, the mesh layer 1610 may be configured to extend around the subject's foot. In some cases, the mesh layer 1610 may extend from the rearfoot region to the forefoot region of the shoe. In some cases, the mesh layer 1610 may extend along the lateral

side and/or the medial side of the shoe. In some cases, the mesh layer 1610 may extend around or across a toe region of the shoe. In some cases, the mesh layer 1610 may extend around or across a heel region of the shoe.

In some cases, at least a portion of the mesh layer 1610 may correspond to or form a vamp piece, a quarter panel, a toe cover, or a heel counter of the shoe.

Moderator Plate

[0200] In some embodiments, the recyclable golf shoe 1600 may comprise a moderator plate 1620. The moderator plate may comprise one or more recyclable PET materials as described elsewhere herein. The moderator plate 1620 may comprise a structural support extending under and along a bottom portion of the mesh layer 1610. In some embodiments, the moderator plate 1620 may comprise a sheet or layer of recyclable material. In some cases, the moderator plate 1620 may comprise a die cut sheet made of a recyclable material.

[0201] In some embodiments, the moderator plate 1620 may be more rigid, stiffer, stronger, and/or harder than the foam layers 1630 extending under the moderator plate 1620. In some embodiments, the moderator plate 1620 may be more rigid, stiffer, stronger, and/or harder than the mesh layer 1610 forming the upper of the recyclable golf shoe 1600.

[0202] In some embodiments, the moderator plate 1620 may comprise a flat or substantially flat surface. In other embodiments, the moderator plate 1620 may comprise a curved or sloped surface. In some alternative embodiments, the moderator plate 1620 may comprise a plurality of flat, curved, angled, and/or sloped surfaces or segments.

[0203] In some embodiments, the moderator plate 1620 may comprise a plurality of sections extending between the anterior end and the posterior end of the shoe. In some cases, the plurality of sections may have different slopes or curvatures. In some cases, the plurality of sections may include a section that is flat or substantially flat, a section that is angled or sloped, and/or a section that is curved upwards or downwards. In some cases, the plurality of sections may be configured to conform to the shape or profile of a subject's foot to enhance comfort and stability.

[0204] In some non-limiting embodiments, the moderator plate 1620 may be sloped and curved in a midfoot and/or a forefoot region of the shoe. In some cases, the moderator plate 1620 may be configured to (i) slope or curve downwards in the midfoot region of the shoe and (ii) slope or curve upwards in the forefoot region of the shoe. In some non-limiting embodiments, the moderator plate 1620 may be flat or substantially flat in a rearfoot region of the shoe.

Foam Layers

[0205] In some embodiments, the recyclable golf shoe

1600 may include a sole assembly comprising one or more foam layers. The one or more foam layers may comprise one or more recyclable PET materials as described elsewhere herein. In some cases, the one or more foam layers may comprise a plurality of foam layers 1630.

[0206] In some cases, the plurality of foam layers 1630 may comprise a first plurality of foam layers 1631 in a rearfoot region of the golf shoe. In some cases, the plurality of foam layers 1630 may comprise a second plurality of foam layers 1632 extending between the rearfoot region of the golf shoe and a forefoot region of the golf shoe. In some embodiments, the second plurality of foam layers 1632 may be positioned between the first plurality of foam layers 1631 and a moderator plate 1620 of the recyclable golf shoe. In some embodiments, the moderator plate 1620 may be positioned adjacent to the second plurality of foam layers 1632.

[0207] In some embodiments, the plurality of foam layers may comprise a plurality of stacked foam layers. In some cases, the plurality of stacked foam layers may be die cut from one or more sheets of foam and assembled together to form the sole assembly. In other embodiments, the plurality of foam layers may comprise a foamed material (e.g., a foamed PET material).

[0208] In some embodiments, the plurality of foam layers may comprise at least one foam layer with a surface that is configured to contact a ground surface underneath the shoe. In some cases, the surface may include a ground contacting surface. In some cases, the ground contacting surface may comprise one or more recyclable PET materials that are configured to grip and/or adhere to the ground surface. In some cases, the ground contacting surface may include one or more grooves or textured regions configured to engage the ground surface and provide traction by way of frictional engagement between the ground surface and the one or more grooves or textured regions. In some cases, the ground contacting surface may comprise one or more traction elements. In some cases, the one or more traction elements may comprise a plurality of protrusions or projections extending from the outsole. In some cases, the plurality of protrusions or projections may be configured to penetrate the ground surface and provide traction by way of a mechanical interlock between the ground surface and the plurality of protrusions or projections.

Insole Board

[0209] In some embodiments, the recyclable golf shoe may comprise an insole board 1640. The insole board 1640 may comprise one or more recyclable PET materials as described elsewhere herein. In some cases, the insole board 1640 may be attached or coupled to the upper. In some cases, the insole board 1640 may be attached or coupled to the moderator plate 1620 and/or the one or more foam layers 1630 extending under the moderator plate 1620. In some embodiments, the mod-

erator plate 1620 may be attached or coupled to the insole board 1640 of the recyclable golf shoe 1600. In some embodiments, the second plurality of foam layers 1632 or the moderator plate 1620 may be coupled to the insole board 1640. In some embodiments, the second plurality of foam layers 1632 or the moderator plate 1620 may be mechanically or adhesively coupled to the insole board 1640.

[0210] In some embodiments, a portion of the mesh layer 1610 may be configured to extend under the insole board 1640. In some embodiments, a portion of the mesh layer 1610 may be configured to extend between (i) the insole board 1640 and (ii) the moderator plate 1620 of the golf shoe. In some embodiments, a portion of the mesh layer 1610 may be configured to extend between (i) the insole board 1640 and (ii) the one or more foam layers 1630 forming the midsole or outsole of the recyclable golf shoe. In some embodiments, a portion of the mesh layer 1610 may be configured to extend between (i) the insole board 1640 and (ii) the second plurality of foam layers 1632.

Footbed

[0211] In some embodiments, the recyclable golf shoe may comprise a footbed 1650 configured to support a subject's foot. In some cases, the footbed may comprise one or more recyclable PET materials as described elsewhere herein. In some cases, the footbed may comprise a PET or polyester based recyclable material.

[0212] In some embodiments, the footbed may be insertable into and/or removable from the partially enclosed interior region. In some embodiments, the footbed 1650 may be positioned inside a partially enclosed region formed by the mesh layer 1610 of the upper and the insole board 1640. In some embodiments, the footbed 1650 may be positioned above the insole board 1640. In some cases, the footbed 1650 may be secured to the mesh layer 1610. In some cases, the footbed 1650 may be secured to the insole board 1640. In some cases, the footbed 1650 may not or need not be secured to the mesh layer 1610 or the insole board 1640.

Fasteners

[0213] In some embodiments, the recyclable golf shoe may comprise one or more mechanical fasteners. In some cases, the one or more mechanical fasteners may comprise a thread or a stitch formed of a recyclable PET material. In some cases, the one or more mechanical fasteners may be configured to attach or couple the first plurality of foam layers 1631 to the second plurality of foam layers 1632 (or vice versa). In some cases, the one or more mechanical fasteners may be configured to attach or couple the first plurality of foam layers 1631 and/or the second plurality of foam layers 1632 to the moderator plate 1620.

Additional Examples

[0214] Referring now to **FIGURES 18A** and **18B**, in some embodiments, the recyclable golf shoe may comprise a Strobel construction that can be formed by attaching the upper 1810 of the shoe to an insole component 1840 of the shoe. In some cases, the insole component 1840 may comprise a board. In some cases, the board may comprise an insole board or a strobel board.

[0215] In some non-limiting embodiments, the upper 1810 may be attached to a strobel board that is configured to cover or close off the bottom of the upper. In some embodiments, the strobel board of the shoe may be interchanged or replaced with a die cut insole board formed from a thin PET sheet. In other embodiments, the strobel board may be interchanged or replaced with a non-woven support layer comprising a recyclable material. In some cases, the recyclable material may comprise a polyester filament. In some cases, the recyclable material may comprise 100% polyester by weight or mass.

[0216] In some cases, the upper 1810 may be attached to the board using a thread 1860. In some cases, the thread 1860 may be configured to attach the bottom portion of the upper 1810 to the board in order to cover or close off the bottom opening of the upper (thereby creating a partially enclosed volume for accommodating a footbed 1850 that can support a subject's foot). In some cases, the thread 1860 may comprise a recyclable material (e.g., a recyclable polyester-based material).

[0217] In some embodiments, the recyclable golf shoe may comprise a welt construction 1870. In some cases, the welt construction 1870 may comprise a piece of material extending around the upper of the shoe. In some cases, the welt construction 1870 may be attached to the upper and/or the sole assembly of the shoe. In some cases, the welt construction 1870 may be configured to provide a plurality of attachment points for (i) coupling the upper to a portion of the sole assembly (e.g., the midsole) or (ii) coupling a portion of the sole assembly (e.g., the midsole) to the upper. In some cases, the welt construction 1870 may be configured as an intermediary component that facilitates a direct or indirect mechanical connection between the upper and the sole assembly. In some cases, the upper and/or the sole assembly may be coupled to the welt construction 1870 using a fastener or an adhesive. In some cases, the fastener may comprise a PET thread or a thread comprising a recyclable polyester-based material. In some cases, the adhesive may comprise a PET-based adhesive, a water or solvent based cement or primer, or any of the other adhesives, cements, or primers described elsewhere herein.

[0218] **FIGURE 19** illustrates another exemplary embodiment of a recyclable golf shoe. In some embodiments, the recyclable golf shoe may comprise an upper 1910 configured to extend around a subject's foot. In some cases, the upper 1910 may form a partially enclosed interior region configured to receive a subject's foot. In some cases, the recyclable golf shoe may com-

prise a footbed 1950 that is positionable within the partially enclosed interior region to provide a supportive platform for the subject's foot.

[0219] In some embodiments, the recyclable golf shoe may further comprise an insole component 1940. The insole component 1940 may be integrated with or implemented in the recyclable golf shoe in lieu of a ply rib insole which is typically or commonly used for shoes with a Goodyear welt construction. In some cases, the insole component 1940 may comprise an injection molded PET part. In some cases, the injection molded PET part may have a ply rib geometry. In some cases, the insole component 1940 may comprise an insole board. In some cases, the insole board may comprise a fiberboard insole comprising 100% polyester by weight or mass. In some cases, the fiberboard insole may comprise a plurality of polyester filaments. In some cases, the insole component 1940 may comprise a PET-based component comprising a ply rib flange. In some cases, the ply rib flange may be formed by way of a compression molding process. In some cases, the ply rib flange may be formed during a compression molding process for producing or manufacturing the fiberboard.

[0220] In some embodiments, the recyclable golf shoe may further comprise a PET foam support 1945 extending between the medial and lateral sides of the insole component 1940. The PET foam support 1945 may be integrated with or implemented in the recyclable golf shoe in lieu of a cork bed which is typically or commonly used for shoes with a Goodyear welt construction. In some cases, the PET foam support 1945 may be configured to extend between two or more vertical support columns of the insole component 1940. In some cases, the PET foam support 1945 may be positioned under or below the insole component 1940 of the recyclable golf shoe. In some cases, the PET foam support 1945 may be positioned between the insole component 1940 and a sole assembly of the recyclable golf shoe. The PET foam support 1945 may comprise a PET-based foam or any other type of recyclable foam material as described elsewhere herein.

[0221] In some embodiments, the recyclable golf shoe may comprise a welt construction 1970 extending around the shoe. The welt construction 1970 may be attached to the upper and/or the sole assembly of the golf shoe. In some cases, the welt construction 1970 may be provided along an interface between the upper and the sole assembly. In some cases, the welt construction 1970 may be disposed between the upper and the sole assembly. In some cases, the welt construction 1970 may be configured as an intermediary component that facilitates a direct or indirect mechanical connection between the upper and the sole assembly. In some non-limiting embodiments, the welt construction 1970 may comprise a PET welt comprising a recyclable PET-based material.

[0222] In some embodiments, the recyclable golf shoe may comprise a first set of stitches 1961 and a second set of stitches 1962. In some cases, the first set of stitches

1961 may be used to couple at least two of: the upper 1910, the sole assembly, the insole component 1940, the PET foam support 1945, and/or the welt construction 1970 of the recyclable golf shoe. In some cases, the second set of stitches 1962 may be used to couple at least two of: the midsole, the outsole, and/or the welt construction 1970 of the recyclable golf shoe. In some cases, the first set of stitches 1961 and the second set of stitches 1962 may be used to couple different components or combinations of components of the recyclable golf shoe. The first set of stitches 1961 and/or the second set of stitches 1962 may comprise a recyclable material as described elsewhere herein. In some non-limiting embodiments, the first set of stitches 1961 and/or the second set of stitches 1962 may comprise one or more PET-based threads.

[0223] Referring now to **FIGURES 20A** and **20B**, in some embodiments, the recyclable golf shoe may comprise an extruded PET welt structure 2070. The extruded PET welt structure 2070 may permit the use of sidewall stitching to assemble the upper with the sole assembly, without using any adhesives or cements.

[0224] As shown in **FIGURE 20B**, in some embodiments, the extruded PET welt structure 2070 may comprise a first section 2071 and a second section 2072 extending from the first section 2071. In some cases, the first section 2071 may have a curvature corresponding to a curvature, shape, or profile of the upper 2010. In some cases, the second section 2072 may be configured to extend laterally across an upper surface of the midsole of the recyclable golf shoe. In some cases, the first section 2071 and the second section 2072 may converge to form an angle θ ranging from about 10 degrees to about 90 degrees.

[0225] Referring back to **FIGURE 20A**, in some embodiments, the upper 2010 of the recyclable golf shoe may form a partially enclosed interior region for receiving a subject's foot. In some cases, the partially enclosed interior region may be configured to accommodate a footbed for supporting the subject's foot. In some embodiments, the recyclable golf shoe may further comprise an insole component 2040 to which the bottom portion of the upper 2010 can be attached (e.g., to cover or close off the open bottom of the upper 2010). In some cases, the insole component 2040 may comprise a Strobel board. In other cases, the insole component 2040 may comprise a thin PET sheet or a non-woven material comprising 100% polyester filament. In some cases, the thin PET sheet or the non-woven material may be used in lieu of the Strobel board (i.e., the Strobel board typically or commonly used for traditional shoe constructions may be replaced with the thin PET sheet or the non-woven material comprising 100% polyester filament).

[0226] In some embodiments, the recyclable golf shoe may comprise a plurality of stitches. In some cases, the plurality of stitches may comprise a first set of stitches 2061, a second set of stitches 2062, and a third set of stitches 2063. In some cases, the first set of stitches 2061

may be used to couple the insole component 2040 to the upper 2010 or the sole assembly. In some cases, the second set of stitches 2062 may be used to couple the extruded PET welt structure 2070 directly to the upper 2010. In some cases, the second set of stitches 2062 may be provided by way of a cup sole sidewall stitching operation. In some cases, the third set of stitches 2063 may be used to couple the extruded PET welt structure 2070 to the midsole and/or the outsole of the sole assembly. In some cases, the third set of stitches 2063 may comprise a rapid stitch construction or configuration.

[0227] **FIGURE 21** illustrates another exemplary embodiment of a recyclable golf shoe comprising a cup sole construction. In some embodiments, the recyclable golf shoe may comprise an upper 2110 and a cup sole construction 2120. In some cases, the cup sole construction 2120 may extend under the upper 2110 or around a bottom portion of the upper 2110. In some cases, the cup sole construction 2120 may comprise one or more sidewalls extending up and across or over a portion of the upper 2110. In some non-limiting embodiments, the cup sole construction 2120 may comprise a PET-based foam material. In some cases, the PET-based foam material may be machined from a sheet foam or molded into the shape of the cup sole construction 2120.

[0228] In some embodiments, the recyclable golf shoe may further comprise a footbed and/or an insole component 2140. The insole component 2140 may comprise any of the insole components described elsewhere herein. In some cases, the insole component 2140 may comprise a board or a support configured to cover or close off the open bottom of the upper 2110.

[0229] In some embodiments, the recyclable golf shoe may comprise a plurality of stitches. In some cases, the plurality of stitches may comprise a first set of stitches 2161 and a second set of stitches 2162. In some cases, the first set of stitches 2161 may be used to couple the insole component 2140 to the upper 2110 and/or the sole assembly. In some cases, the second set of stitches 2162 may be used to couple the sidewalls of the cup sole construction 2120 to a portion of the upper 2110. In some cases, the second set of stitches 2162 may be provided by way of a cup sole sidewall stitching operation.

45 Laces

[0230] In some embodiments, the golf shoe may comprise one or more PET laces for securing the upper around a subject's foot. The one or more PET laces may comprise a recyclable PET material as described elsewhere herein. In some cases, the one or more PET laces may not or need not be removed prior to recycling the recyclable golf shoes of the present disclosure.

55 Removable Component

[0231] In some embodiments, the recyclable golf shoe may comprise a component that can be detachably cou-

pled to or removably integrated with the recyclable golf shoes of the present disclosure. In some cases, the component may comprise a removable insole or a removable tag that can be detachably coupled to or removably integrated with the upper or the sole assembly. In some cases, the removable component may comprise recycling instructions for the golf shoe. In some embodiments, the removable component may comprise a same or similar material as the upper or the sole assembly. In some embodiments, the removable component may comprise a different material than the upper or the sole assembly. In some embodiments, the removable component may be recyclable. In other embodiments, the removable component may not or need not be recyclable. In some alternative embodiments, a portion of the removable component may be recyclable.

[0232] In some cases, the removable component of the recyclable golf shoe may be detachably coupled to or removably integrated with the shoe. In some embodiments, the removable component may be coupled to or integrated with an upper of the shoe. In some cases, the removable component may comprise a pull tab that can be coupled to or integrated with a heel region of the upper. In other embodiments, the removable component may be coupled to or integrated with the sole assembly of the shoe. In some cases, the removable component may comprise an insole component that can be inserted into an opening of the shoe and secured within the interior region of the shoe (e.g., between the medial and lateral sides of the shoe and/or between the anterior and posterior ends of the shoe).

Adhesives

[0233] In some embodiments, the recyclable golf shoe may comprise one or more adhesives. In some cases, the one or more adhesives may be configured to adhesively couple (i) the first plurality of foam layers to (ii) the second plurality of foam layers. In some cases, the one or more adhesives may be configured to adhesively couple (i) the first plurality of foam layers and/or the second plurality of foam layers to (ii) the moderator plate.

[0234] In some embodiments, the one or more adhesives may comprise a cement or a primer. In some cases, the cement or primer may comprise a water-based cement or primer. In other cases, the cement or primer may comprise a solvent-based cement or primer. In some cases, the cement or primer may comprise a PET-based cement or primer.

[0235] In some embodiments, the one or more adhesives may be configured to evaporate during a recycling process for the recyclable golf shoe. In some cases, the recycling process may yield at least one recyclable material. The at least one recyclable material may comprise a PET-based recyclable material that is usable to form an article or a component thereof. In other embodiments, the one or more adhesives may not or need not evaporate during a recycling process for the recyclable golf shoe.

[0236] In some cases, the one or more adhesives may not or need not be removed before the recyclable golf shoe is recycled. In some cases, the one or more adhesives may not or need not be processed separately from the other components of the recyclable golf shoe (i.e., the recyclable golf shoe may be recycled as is with the one or more adhesives applied).

Methods of Manufacture

[0237] In another aspect, the present disclosure provides various methods for manufacturing and constructing the recyclable high performance golf shoes of the present disclosure. In some embodiments, the method may comprise constructing an upper. In some cases, various parts, layers, or components may be stitched, glued, or otherwise attached together to form the upper. In some embodiments, the upper may be connected or fused to a sole assembly (e.g., using a cement assembly process).

[0238] In some embodiments, the method may comprise constructing a sole assembly. In some cases, the sole assembly may comprise a midsole. In some cases, the midsole or the sole assembly may comprise a support structure or a support frame that is configured to stiffen, strengthen, secure, or stabilize one or more regions of the recyclable shoe. In some cases, the support structure or support frame can be configured to stiffen, strengthen, secure, or stabilize one or more components, parts, sections, and/or layers of the recyclable shoe. In some cases, the midsole or the sole assembly may comprise an internal structure that is integrated with or embedded in the midsole or sole assembly. The internal structure may be configured to modify or optimize a response characteristic or a property of the midsole or sole assembly during a golf-related action or movement.

[0239] In some embodiments, the method may comprise constructing an outsole. In some cases, the outsole may comprise one or more integrated traction elements. In other cases, the outsole may comprise one or more cleats or spikes and/or one or more receptacles for receiving the one or more cleats or spikes.

[0240] In some embodiments, the method may comprise assembling the outsole to the midsole to form the sole assembly. In some cases, at least a portion or a section of the bottom surface of the midsole may be bonded to a top surface of the outsole (e.g., using adhesives, glues, cements, or fasteners, or by co-molding the midsole and outsole).

[0241] In some embodiments, the method may comprise attaching the sole assembly to the upper. In some cases, prior to attachment to the sole assembly, the upper may be pulled onto a last, and a lasting board may be attached to the upper with an adhesive. The lasting board may then be attached to the sole assembly (e.g., with an adhesive, glue, or cement) to form the recyclable golf shoe.

[0242] In some alternative embodiments, the method

may comprise attaching a material onto an open bottom of the upper, effectively closing off the open bottom to create a sock-like construction. In such embodiments, the sock-like construction may be directly or indirectly attached to the midsole or the sole assembly.

[0243] In some embodiments, the method may comprise integrating an insole component with the shoe. In some embodiments, the insole component may comprise an insole board or insole footbed. In some embodiments, the insole board or insole footbed may be bonded to the top surface of the midsole. In some cases, the insole board or insole footbed may be attached or otherwise fixed or coupled to a portion of the midsole using a lasting process (e.g., a single or double lasting process), a Strobel construction method, and/or a gasket hotmelt procedure.

Molding

[0244] In some embodiments, the recyclable golf shoes described herein (and any components or sub-assemblies thereof) may be manufactured using one or more molding processes. In some embodiments, various different components, parts, sections, or layers of the recyclable shoe can be molded together or separately in order to produce the recyclable shoe. In some embodiments, various different components, parts, sections, or layers of the recyclable shoe can be co-molded together to produce the recyclable shoe. The various different components, parts, sections, or layers of the recyclable shoe may include, for example, a mesh layer, a membrane layer, a hot melt backer layer, a saddle, a support frame, an internal structure, a support/moderator plate, or a foam layer of the recyclable shoe.

[0245] In some embodiments, the method may involve molding (e.g., injection molding or compression molding) the various different components, parts, sections, or layers of the recyclable shoe. In some embodiments, a molding agent and/or a foaming agent may be provided to a mold by way of a single shot operation (e.g., a single shot injection) or a multi-shot operation (e.g., a multi shot injection). In some embodiments, the molding agent and/or the foaming agent may be poured or flowed into the mold. In some embodiments, the molding agent and/or the foaming agent may be injected into a single location or region in the mold. In other embodiments, the molding agent and/or the foaming agent may be injected into multiple locations or regions in the mold. In some cases, the molding agent and/or the foaming agent may be injected into the multiple locations or regions in the mold simultaneously or concurrently. In other cases, the molding agent and/or the foaming agent may be injected into multiple locations or regions in the mold in series or in succession.

[0246] In some embodiments, at least a portion of the recyclable golf shoe may comprise two or more distinct parts that are formed and/or integrated together in one or more molding operations. The two or more distinct

parts may include, for example, a component, section, layer, or subassembly of the recyclable golf shoe. In some cases, the two or more distinct parts may comprise parts that have different material properties. In some cases, the two or more distinct parts may comprise parts that are made of different materials and/or made at different times or using different processes.

Stock Fitting

[0247] In some non-limiting embodiments, the various components, parts, sections, and/or layers of the recyclable shoe can be integrated by way of a stock fitting process. In some cases, the stock fitting process may involve a manual integration of two or more components, parts, sections, and/or layers. In other cases, the stock fitting process may involve an automated or semi-automated integration of the components, parts, sections, and/or layers of the recyclable shoe. In some embodiments, the stock fitting process may involve coupling two or more components, parts, sections, and/or layers using one or more adhesives.

[0248] In some non-limiting embodiments, the various components, sections, layers, or portions of the recyclable golf shoe may be assembled by way of a stocking fitting process. For example, a first component, part, section, and/or layer can be manufactured and stock fit with a second component, part, section, and/or layer to produce either an intermediate assembly or a final part (e.g., a recyclable high performance shoe that is optimized to enhance a particular subject's anatomy and/or swing biomechanics).

[0249] All patents, publications, test procedures, and other references cited herein, including priority documents, are fully incorporated by reference to the extent such disclosure is not inconsistent with this technology and for all jurisdictions in which such incorporation is permitted. It is understood that the shoe materials, designs, constructions, and structures; shoe components; and shoe assemblies and sub-assemblies described and illustrated herein represent only some embodiments of the technology. It is appreciated by those skilled in the art that various changes, optimizations, and additions can be made to such products and materials without departing from the spirit and scope of the present disclosure. It is intended that all such embodiments be covered by the claims presented herewith.

Claims

1. A golf shoe, comprising:
an upper and a sole assembly connected to the upper, wherein the upper comprises:

a membrane layer configured to at least partially surround or enclose a foot of a subject wearing the golf shoe;

- an internal A-shaped frame structure attached or coupled to the membrane layer to structurally support or stiffen the upper;
 a mesh layer comprising a first side and a second side, the first side attached or coupled to the membrane layer and the internal A-shaped frame structure; and
 a saddle connected to the second side of the mesh layer,
 wherein the membrane layer, the internal A-shaped frame structure, the mesh layer, and the saddle each comprise one or more thermoplastic urethane (TPU) materials,
 wherein the upper and the sole assembly comprise 100% TPU by weight or mass,
 wherein the one or more TPU materials comprise a material derived from a recycled shoe comprising at least one recyclable TPU material, and
 wherein the one or more TPU materials are processable into another golf shoe comprising the at least one recyclable TPU material.
2. The golf shoe of claim 1, wherein the internal A-shaped frame structure is positioned between (i) the membrane layer and (ii) the mesh layer or the saddle.
 3. The golf shoe of claim 1, wherein the mesh layer is positioned between (i) the saddle and (ii) the internal A-shaped frame structure or the membrane layer.
 4. The golf shoe of claim 1, wherein the mesh layer and the internal A-shaped frame structure are positioned between (i) the membrane layer and (ii) the saddle.
 5. The golf shoe of any of claims 1-4, wherein the membrane layer is configured as a hotmelt backer for the mesh layer, wherein the hotmelt backer comprises one or more non-laminated regions having one or more mechanical or laser perforations.
 6. The golf shoe of any of claims 1-5, wherein the membrane layer comprises one or more regions with one or more surface features or perforations to facilitate a movement of a fluid through or across the membrane layer, wherein the one or more regions comprise one or more non-laminated regions that are decoupled or detached from the mesh layer to enhance breathability.
 7. The golf shoe of any preceding claim, wherein the membrane layer comprises a microporous membrane.
 8. The golf shoe of any preceding claim, wherein the internal A-shaped frame structure comprises one or more truss-like members extending between (i) a midfoot or rearfoot region of the golf shoe and (ii) a forefoot region of the golf shoe.
 9. The golf shoe of any preceding claim, wherein the internal A-shaped frame structure is asymmetric with different frame configurations on a medial and lateral side of the golf shoe.
 10. The golf shoe of any preceding claim, further comprising a first cement or adhesive for the sole assembly and a second cement or adhesive for the upper, wherein the first or second cement or adhesive comprises a solvent based cement or primer, a water based cement or primer, a hotmelt cement or primer, or a TPU based cement or primer.
 11. The golf shoe of claim 10, wherein the first or second cement or adhesive is configured to evaporate during a chemical recycling process that yields said at least one recyclable TPU material from the one or more TPU materials.
 12. The golf shoe of any preceding claim, further comprising a stability clip configured to control a movement or a deformation of a midsole portion of the sole assembly in response to one or more forces exerted on the golf shoe.
 13. The golf shoe of claim 12, wherein the stability clip comprises a sidewall and a beam extending laterally from the sidewall, wherein the beam comprises a tapered end or a pointed edge.
 14. The golf shoe of any preceding claim, further comprising a removable insole or tag coupled to the upper or the sole assembly, wherein the removable insole or tag comprises a different material than the upper or the sole assembly.
 15. The golf shoe of any preceding claim, further comprising one or more laces comprising a plurality of welded TPU layers.

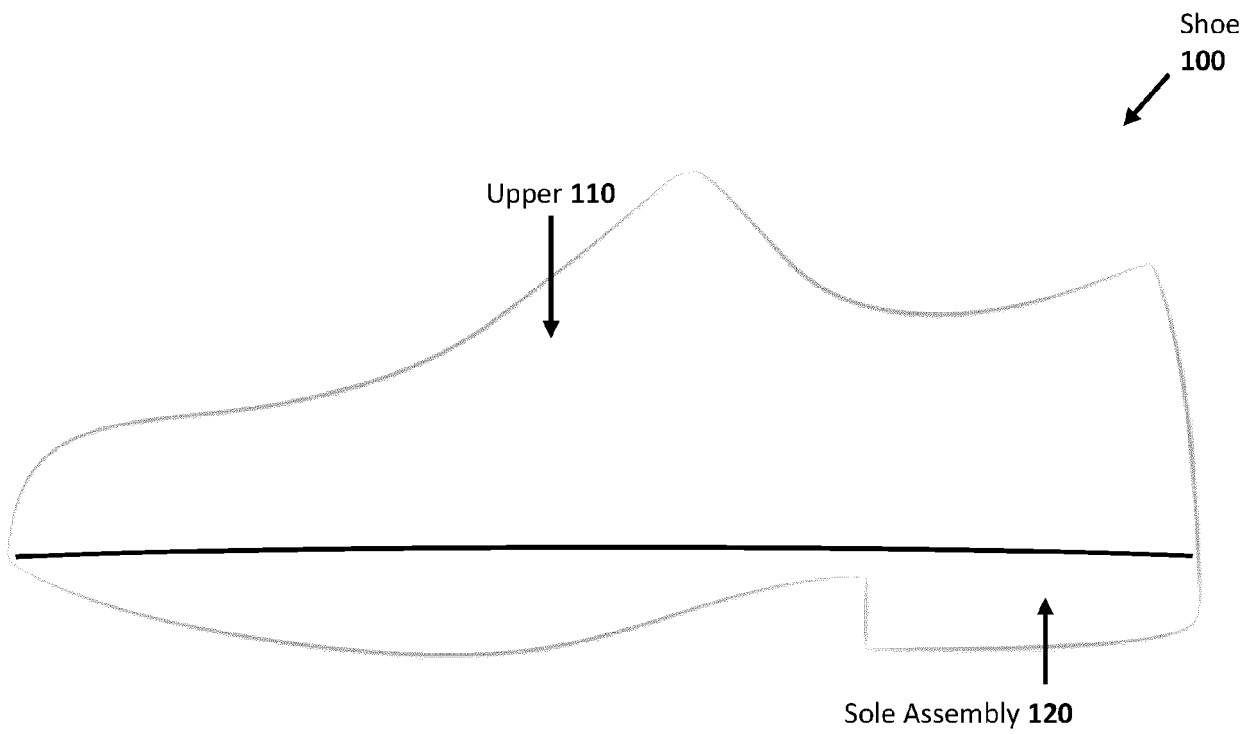
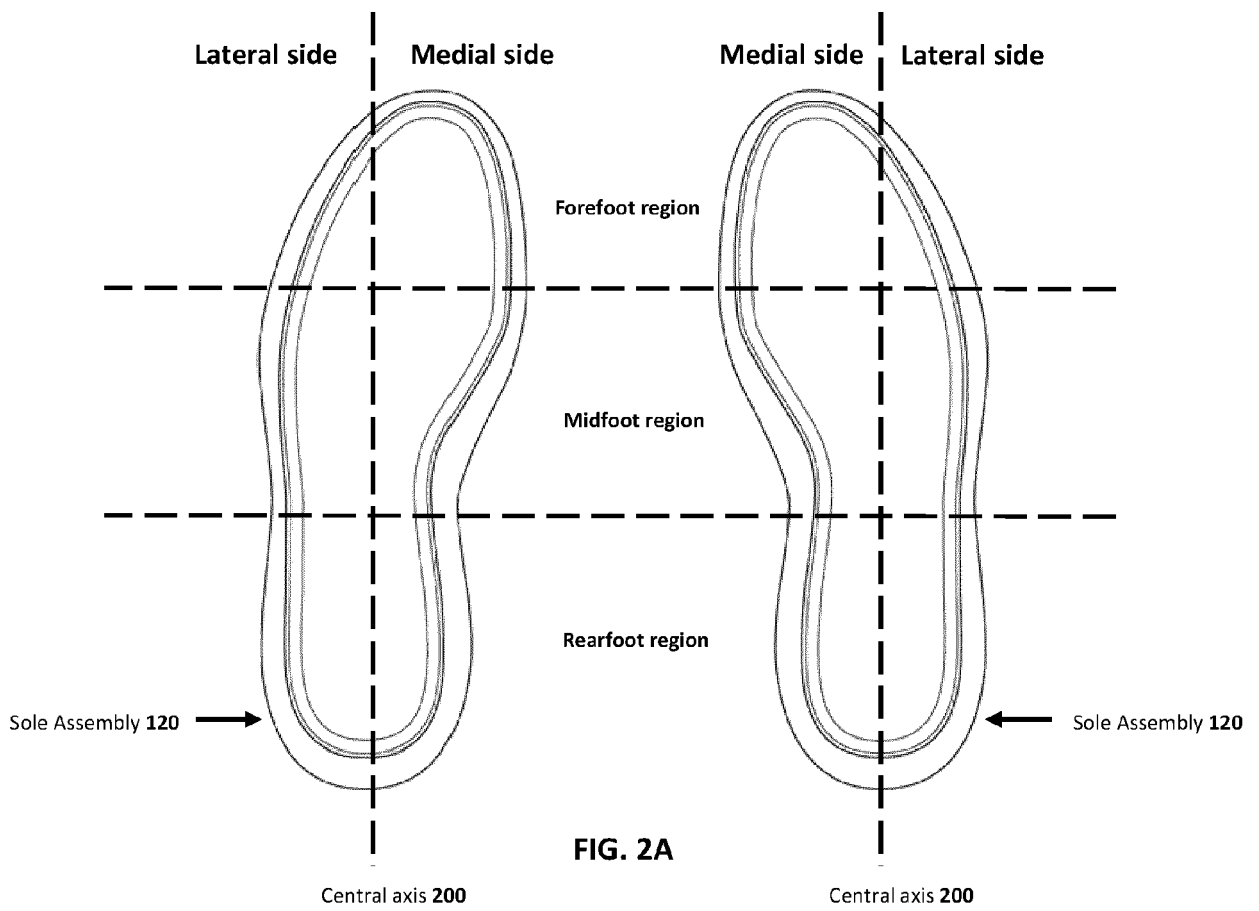


FIG. 1



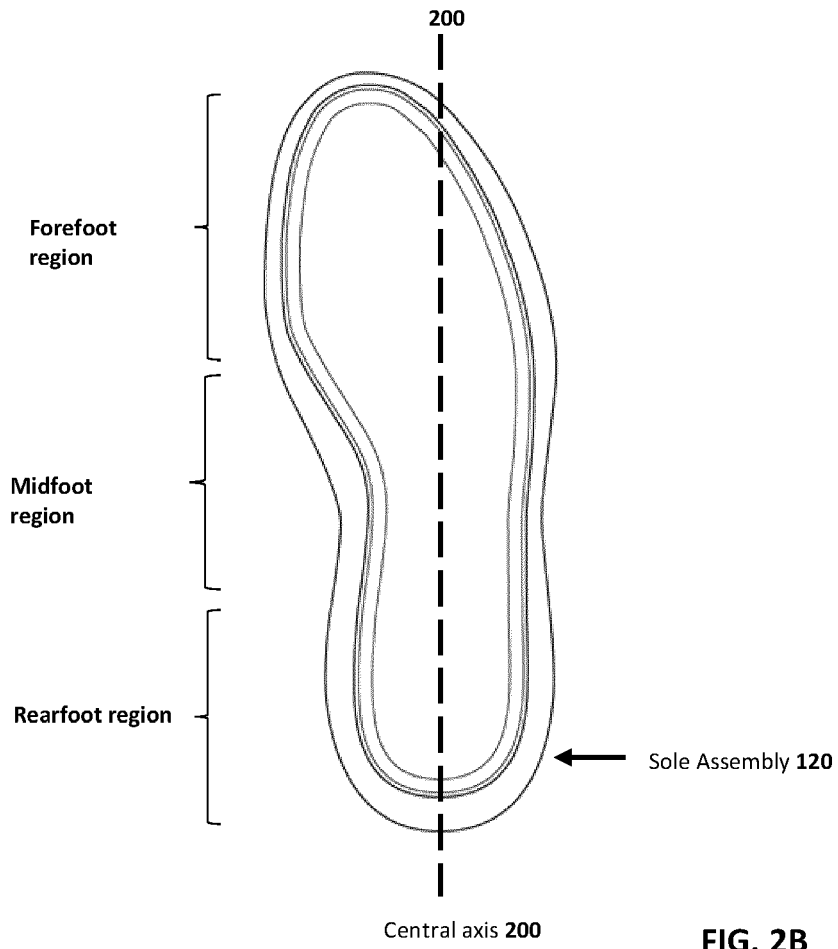


FIG. 2B

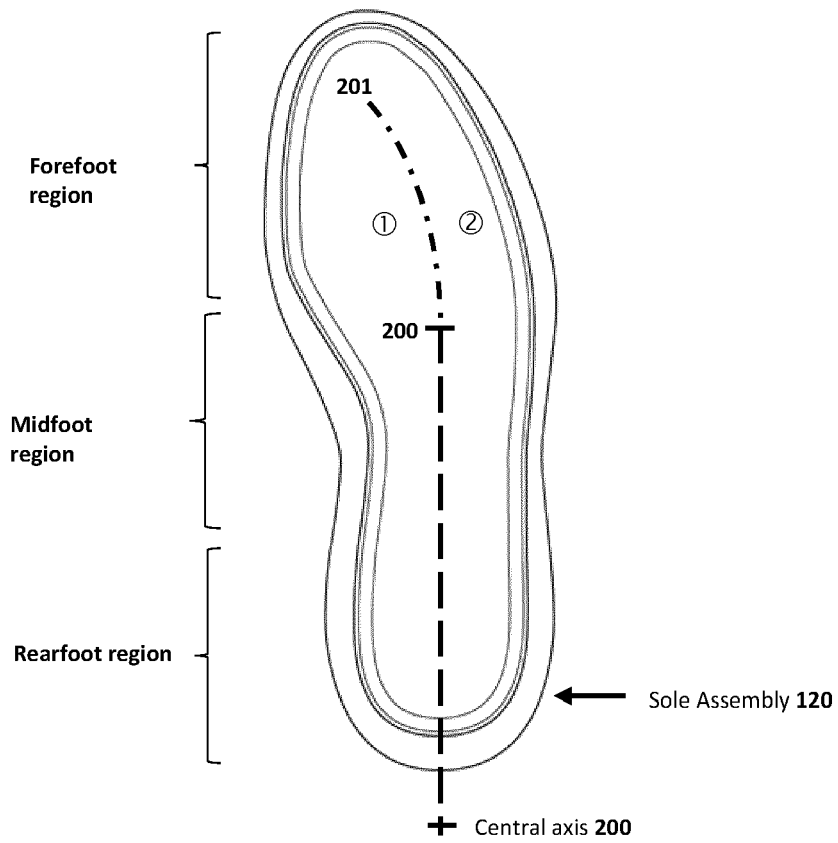


FIG. 2C

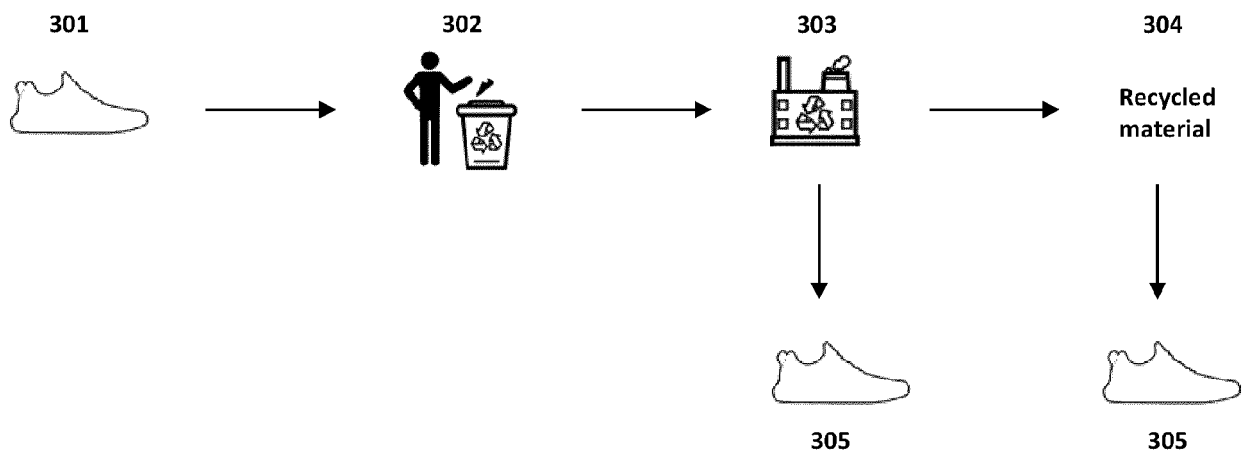


FIG. 3

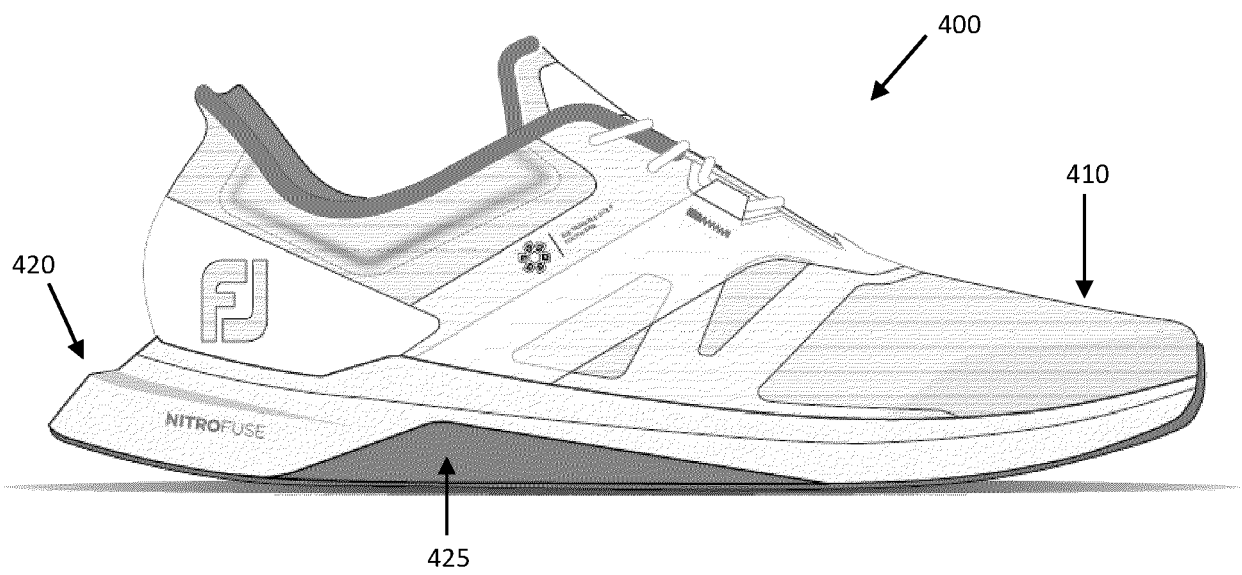


FIG. 4

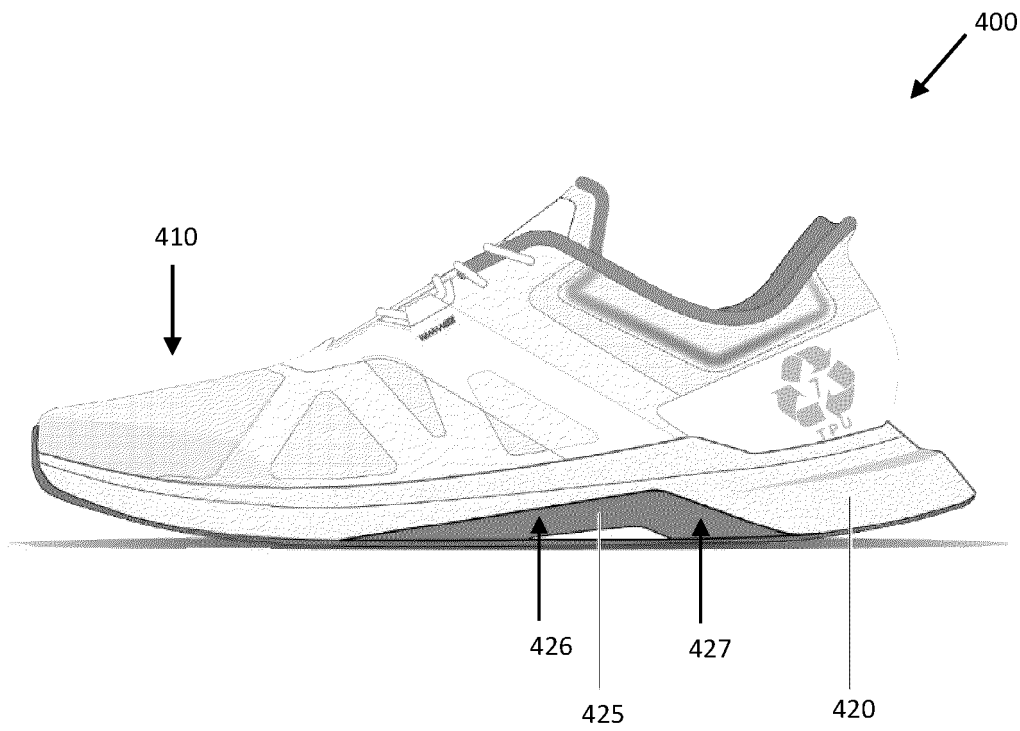


FIG. 5

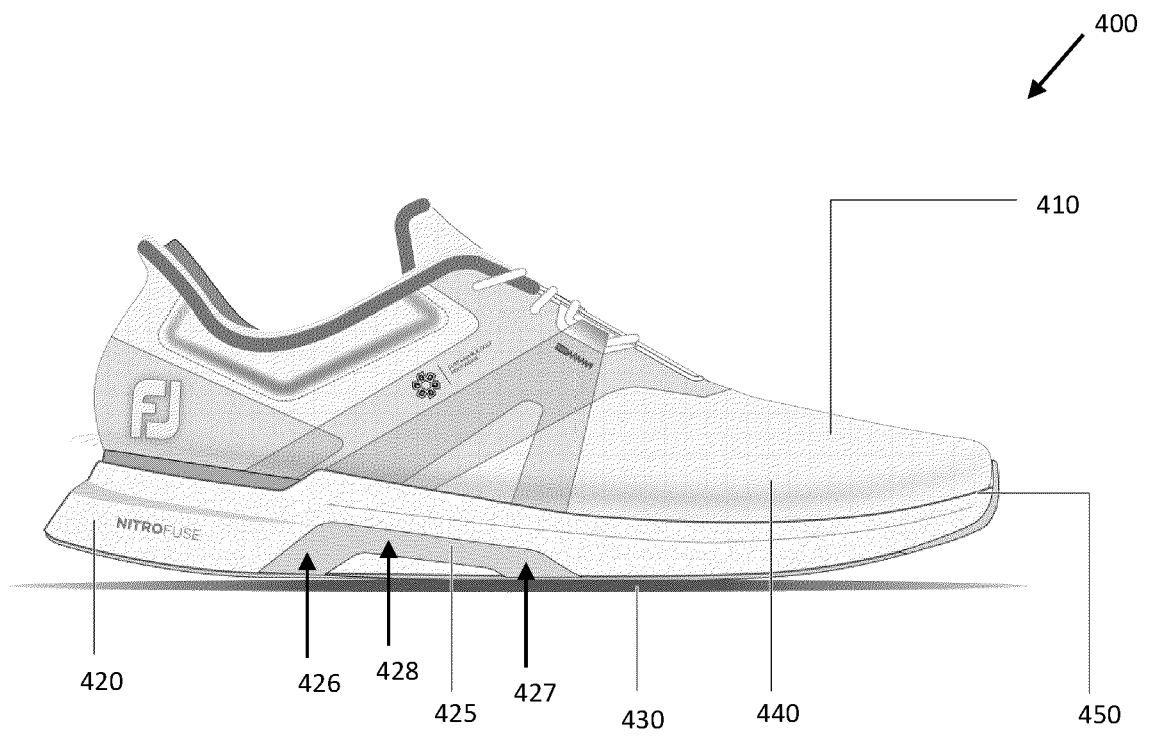


FIG. 6A

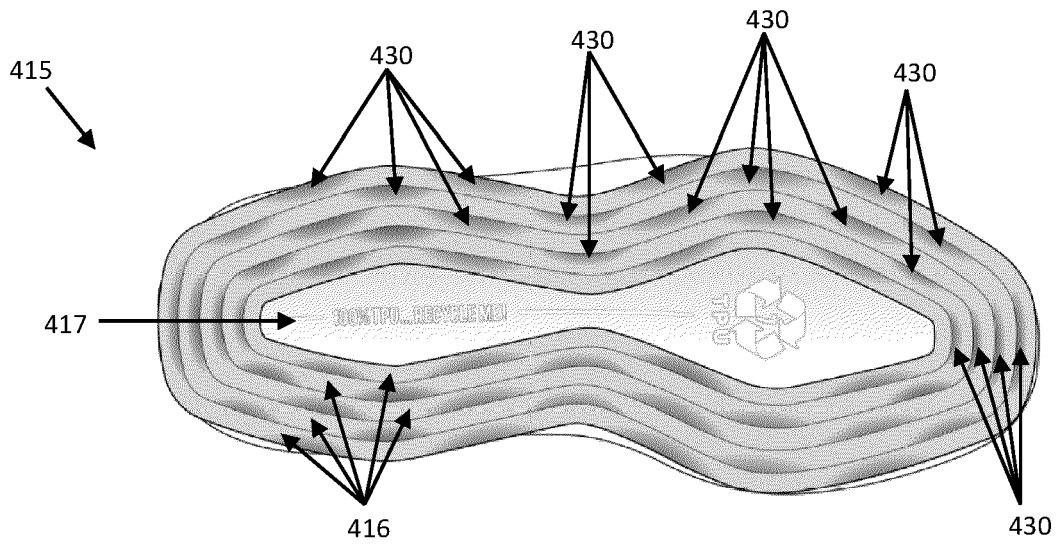


FIG. 6B

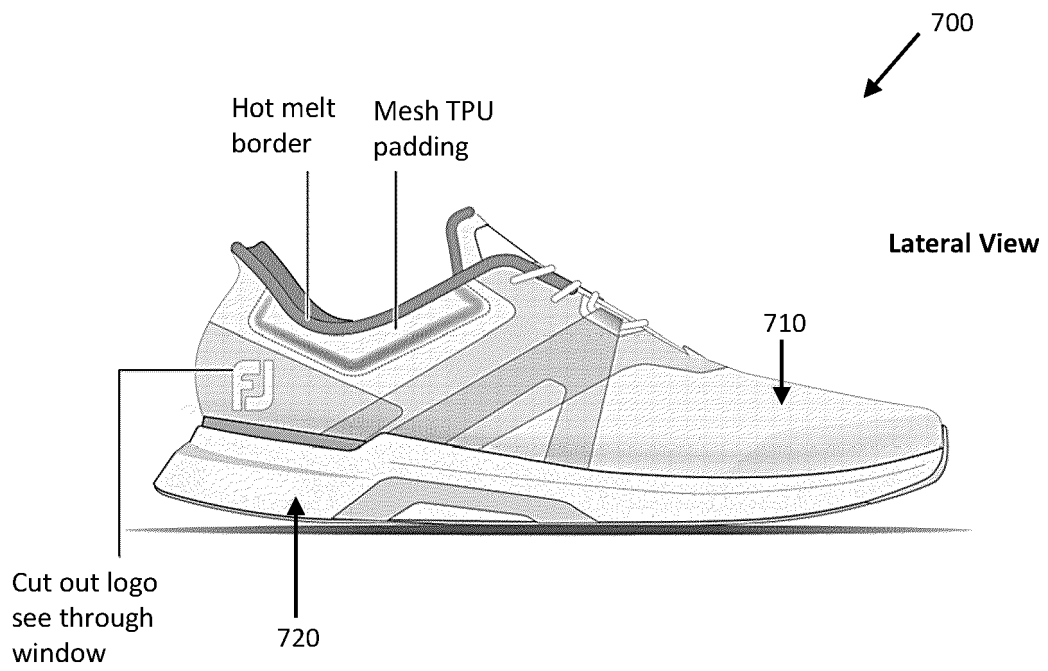


FIG. 7A

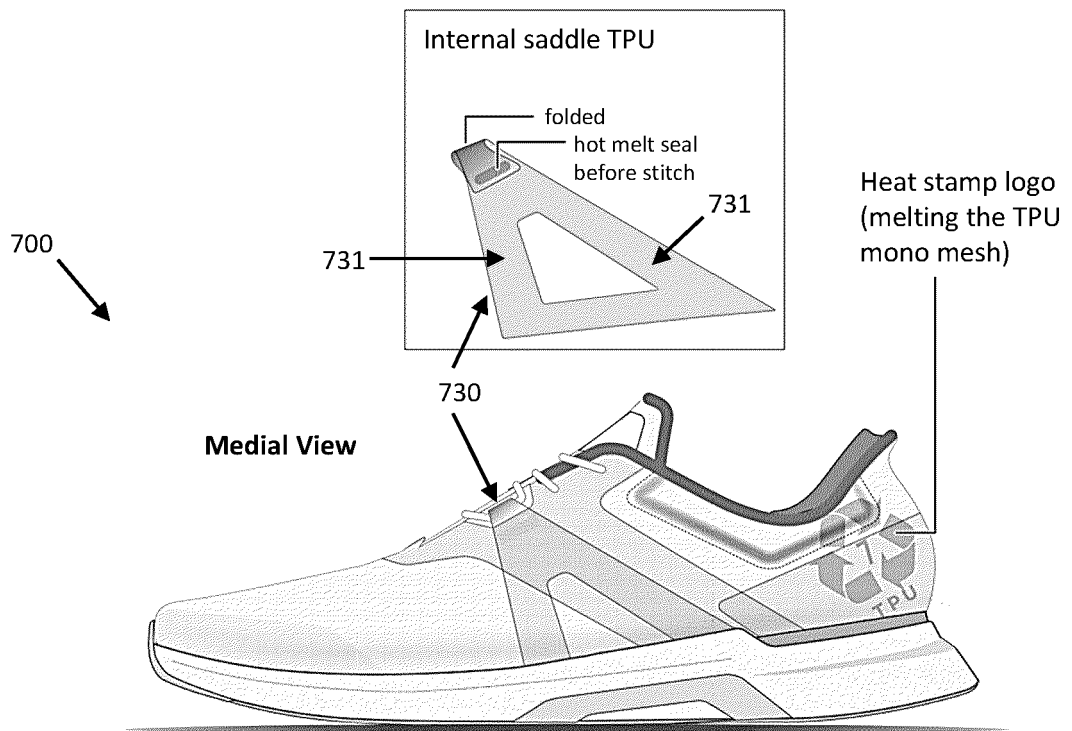


FIG. 7B

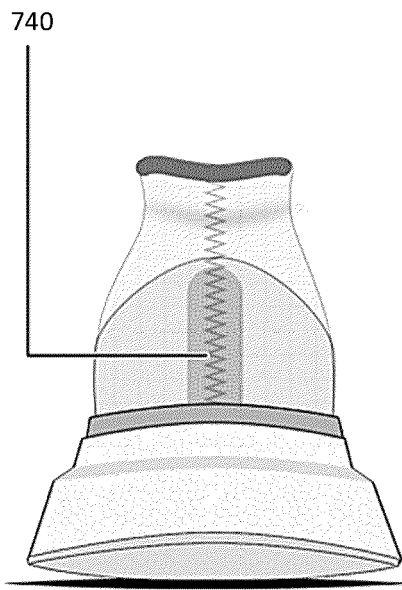


FIG. 7C

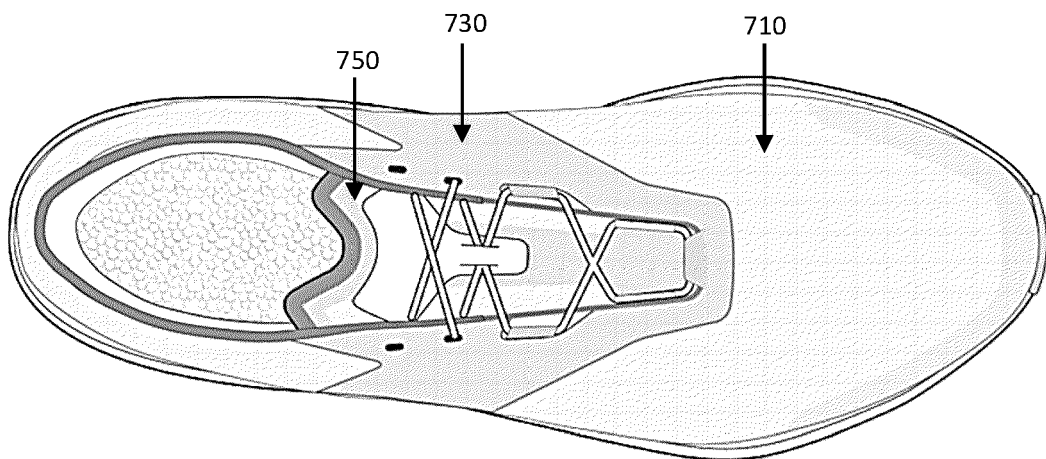


FIG. 7D

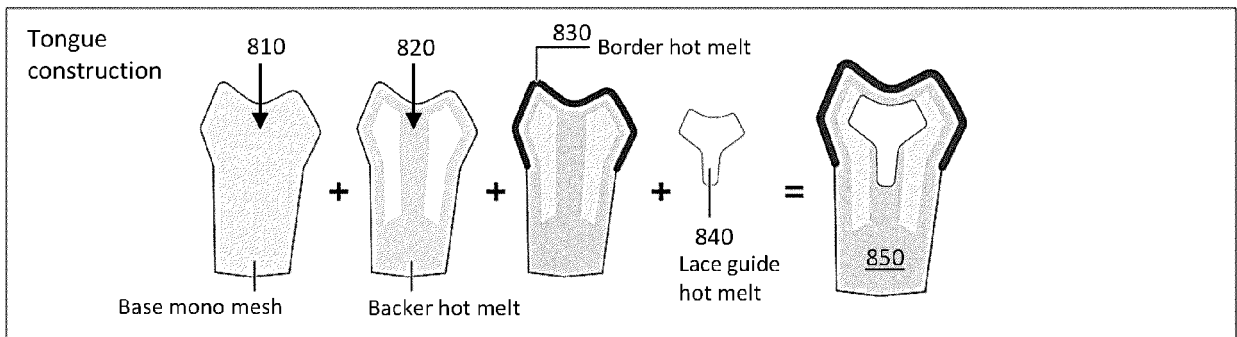


FIG. 8

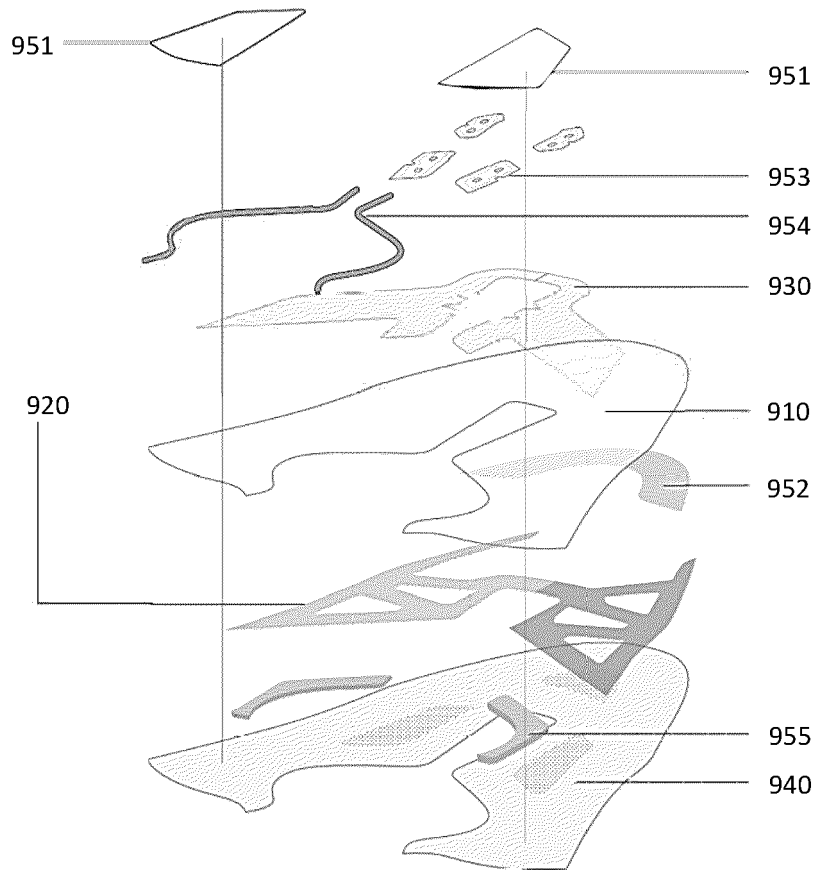


FIG. 9

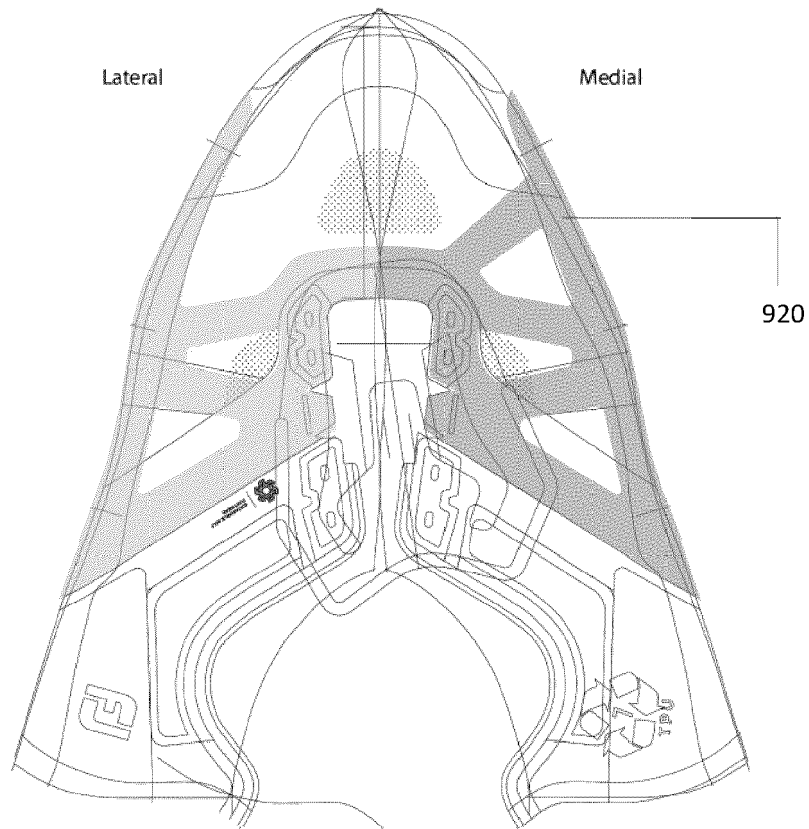




FIG. 10

Shell Details

-  Inner hot melt pattern
-  Laser cut vent holes

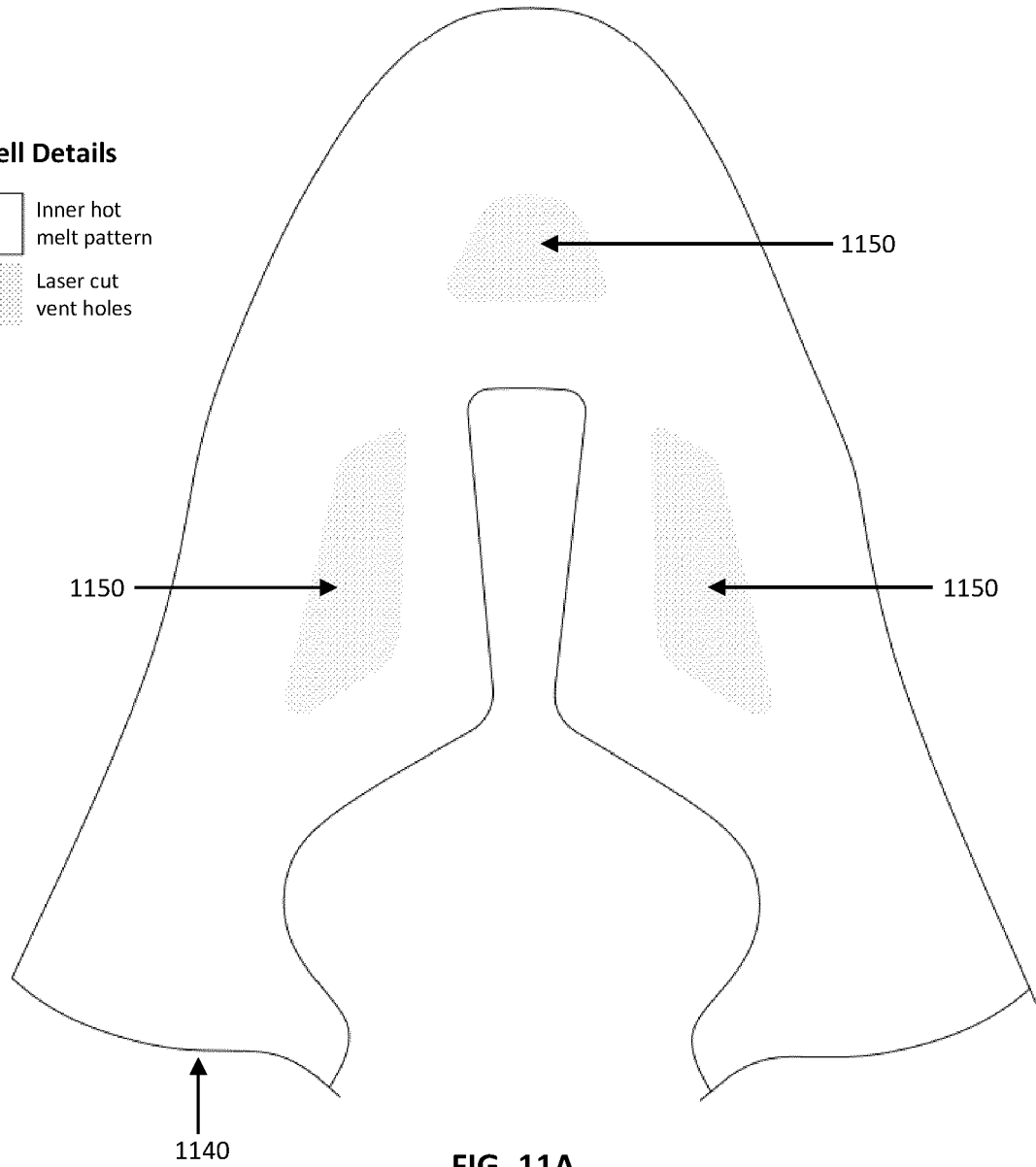





FIG. 11A

Shell Details

-  Inner hot melt pattern
-  Laser cut vent holes
-  Wax paper cover before hot melt process (to prevent hot melt bonding in this location)

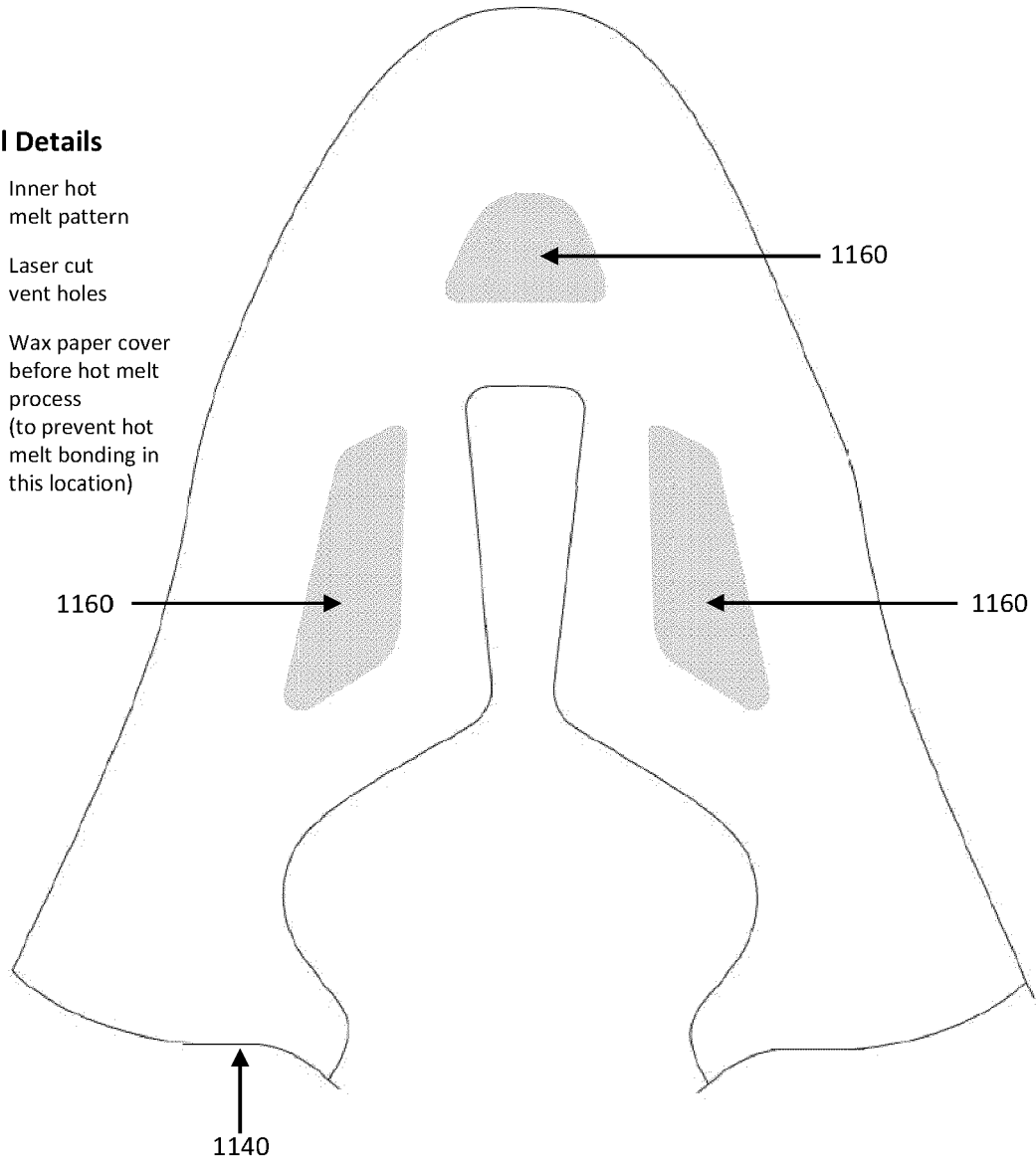
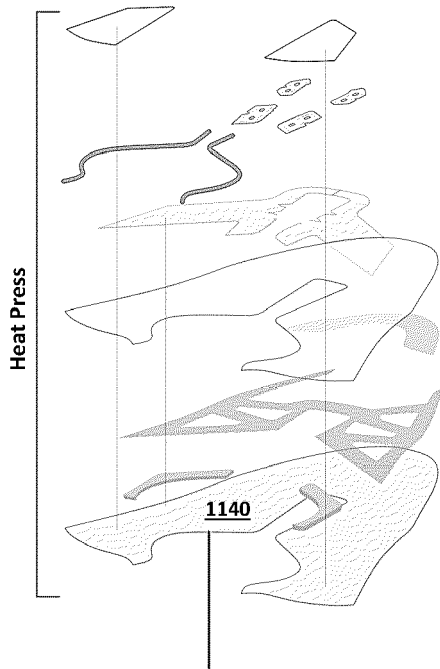
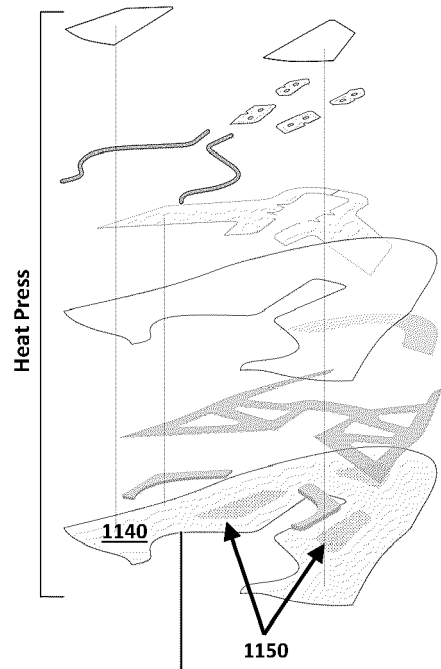


FIG. 11B



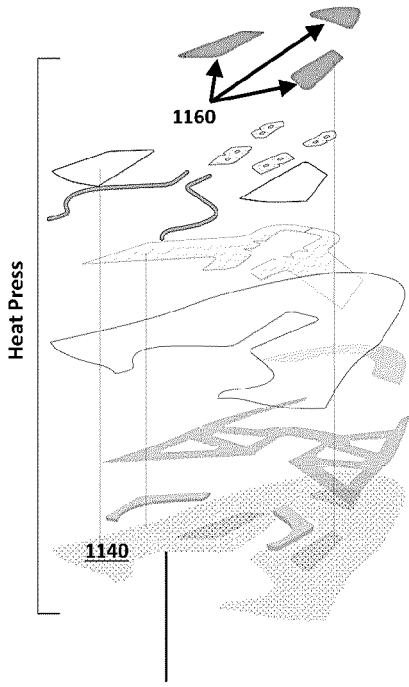
Full TPU hotmelt base without perforations – this would be waterproof but non breathable

FIG. 11C



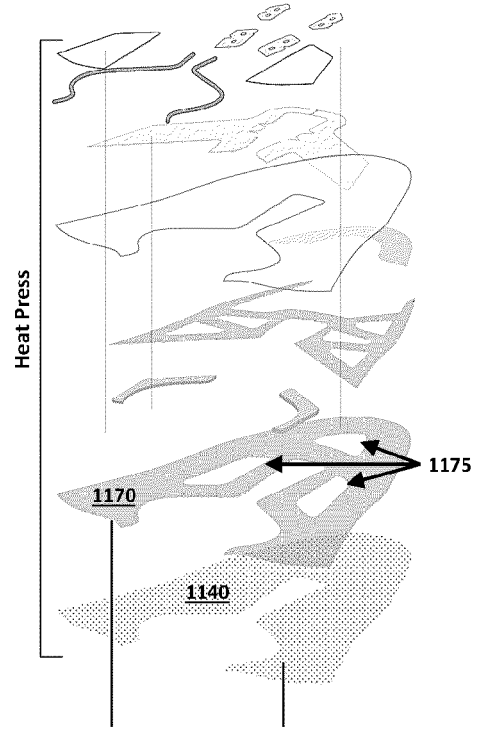
TPU hotmelt base with localized laser perforations – this would be waterproof and breathable

FIG. 11D



Full microporous TPU membrane base
+
Wax paper or silicone patches to preserve
the micropores (in specific areas) during
heat press

FIG. 11E



Hotmelt layer with die cut
apertures or windows layered
over the microporous TPU
membrane base

FIG. 11F

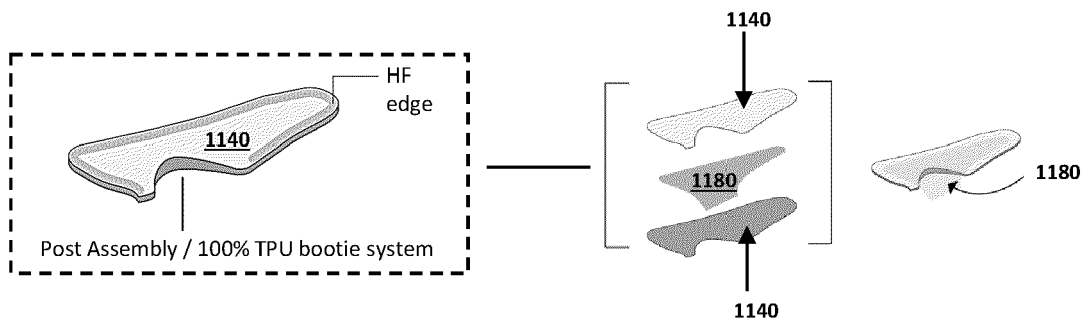


FIG. 11G

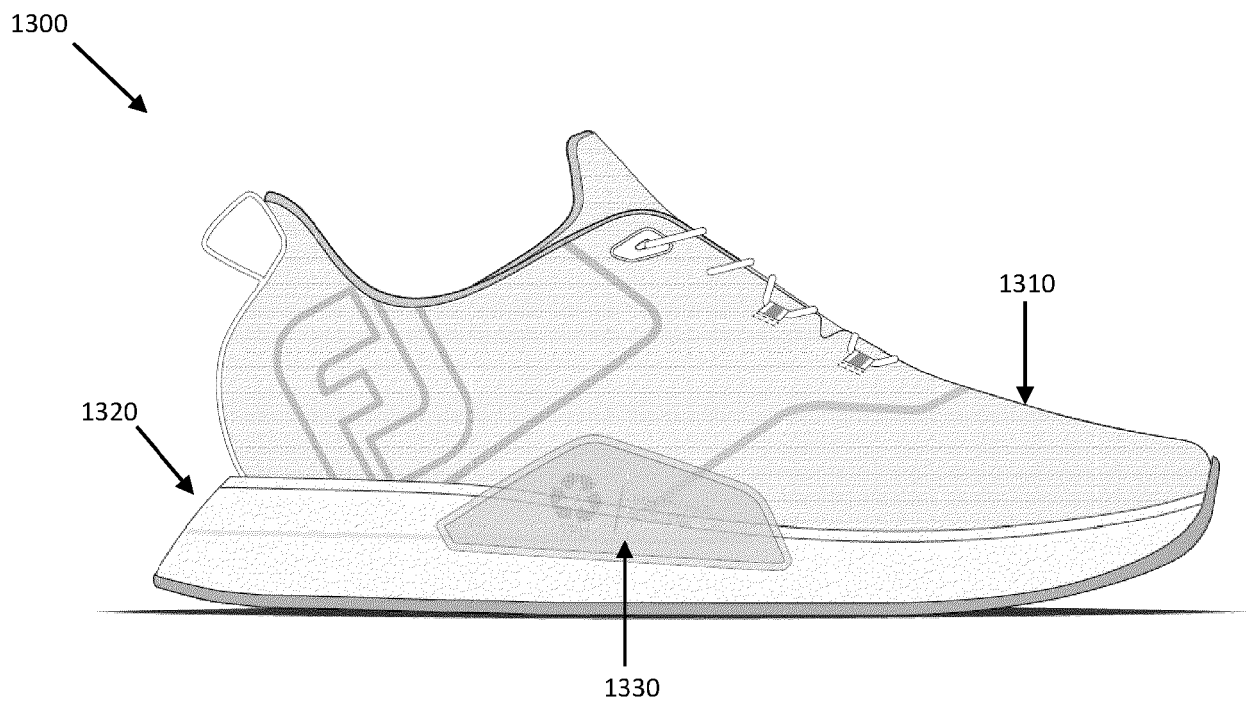


FIG. 12

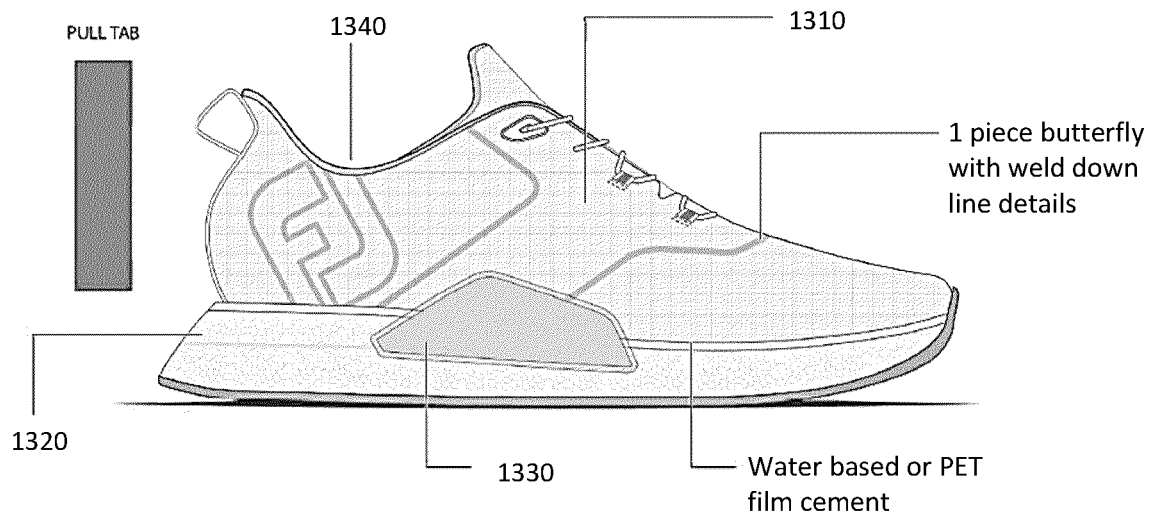


FIG. 13

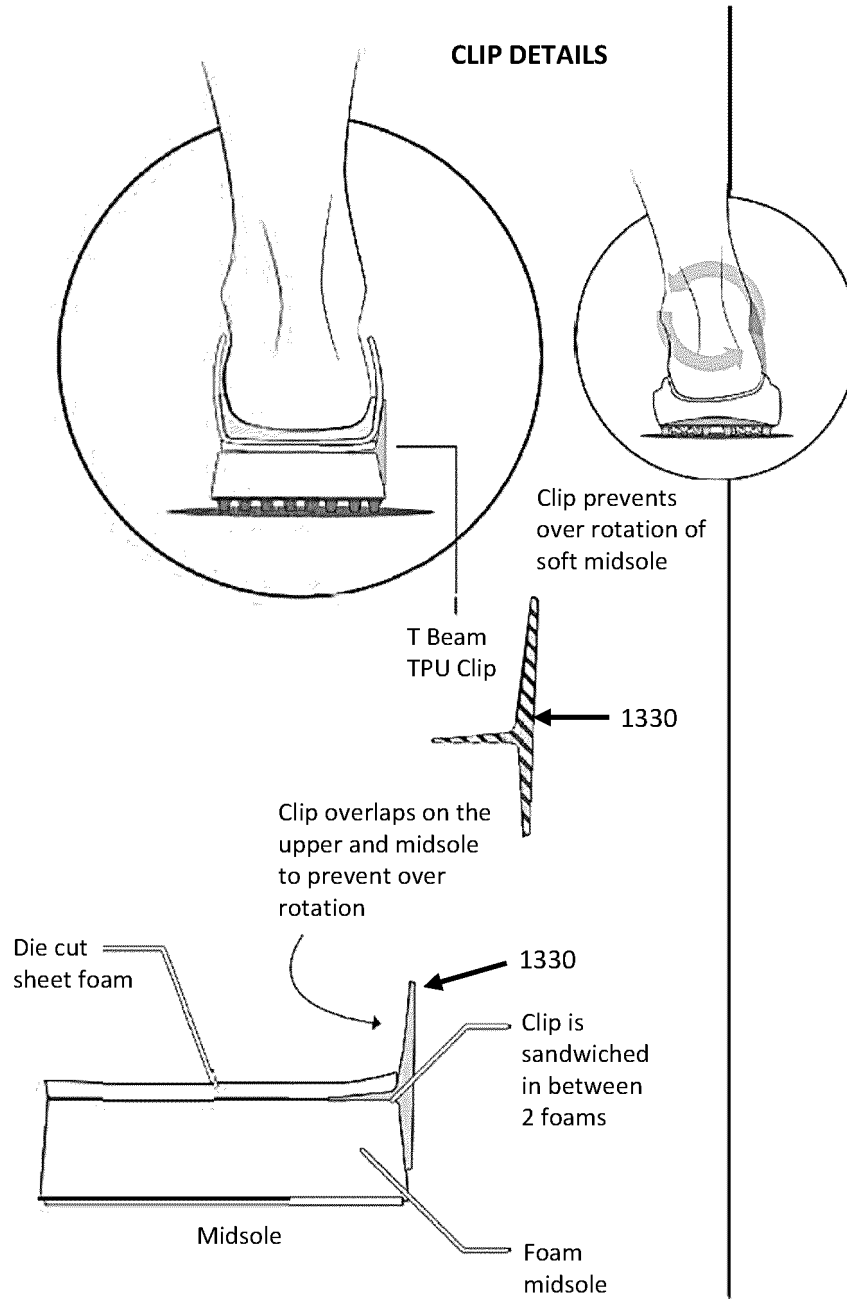


FIG. 14

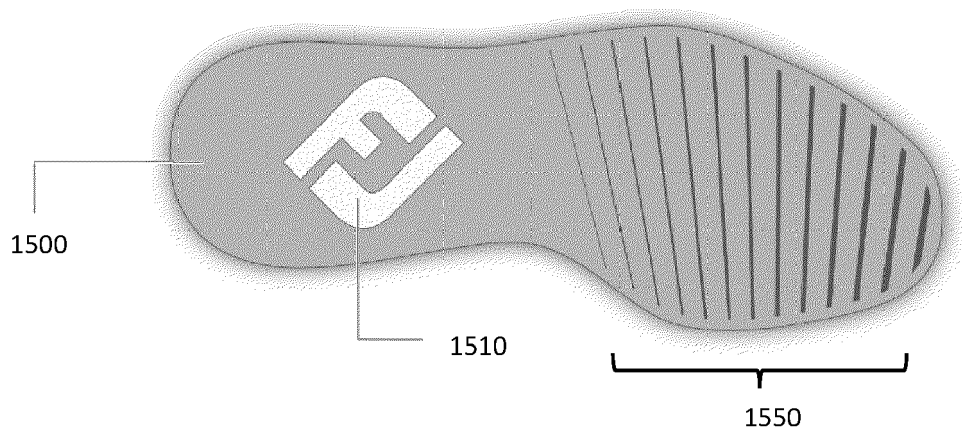


FIG. 15

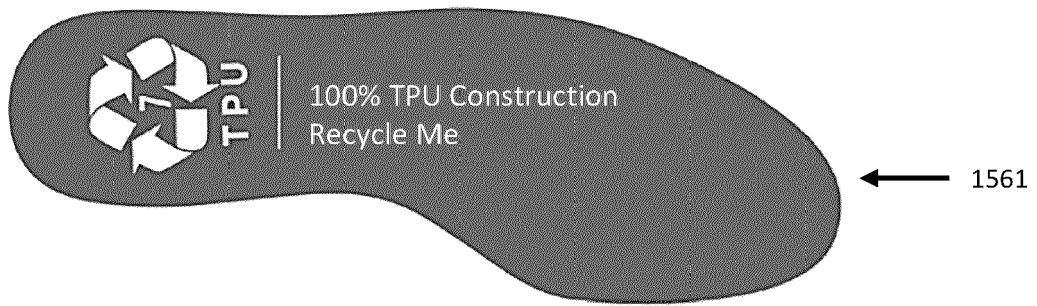


FIG. 15A

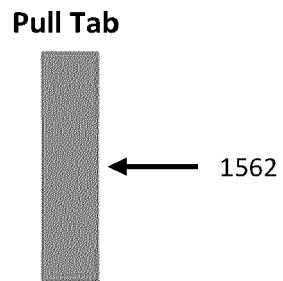


FIG. 15B

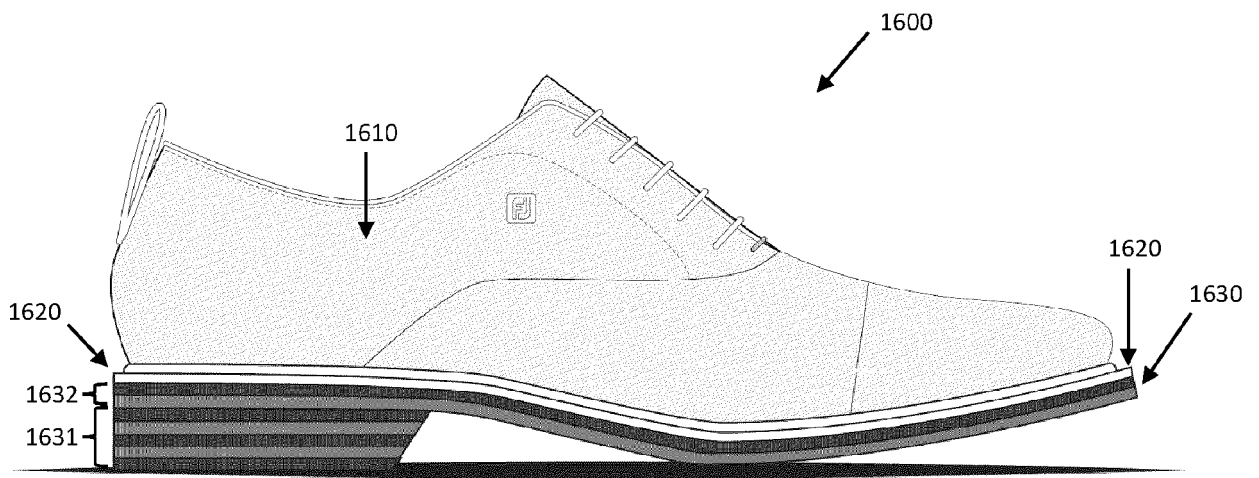


FIG. 16

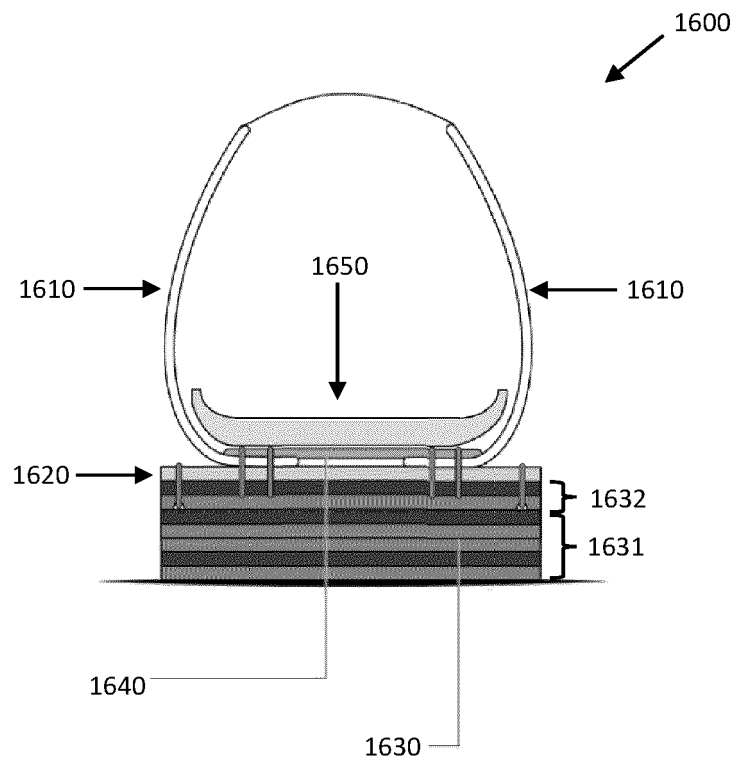


FIG. 17

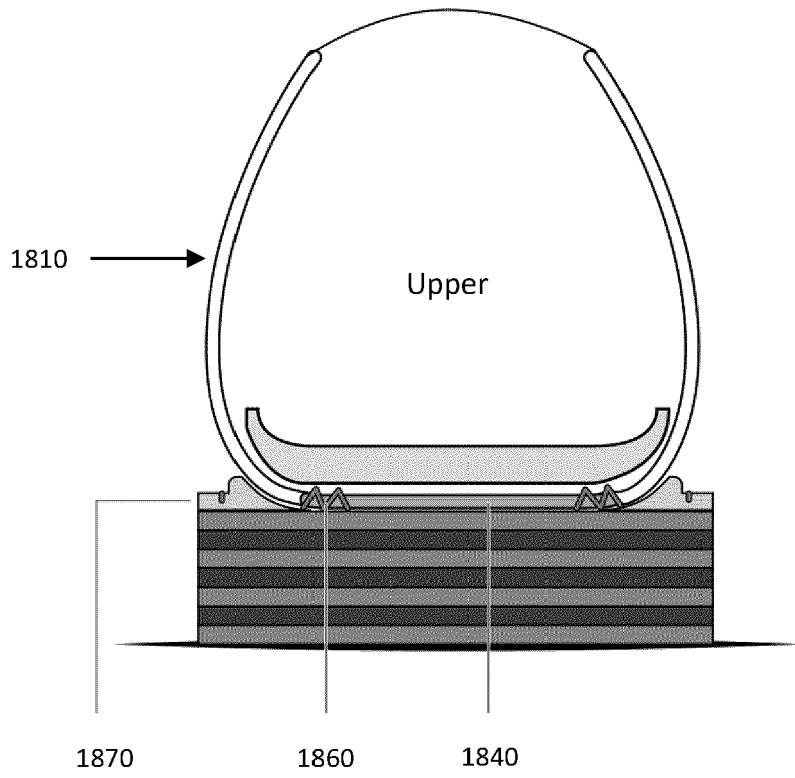


FIG. 18A

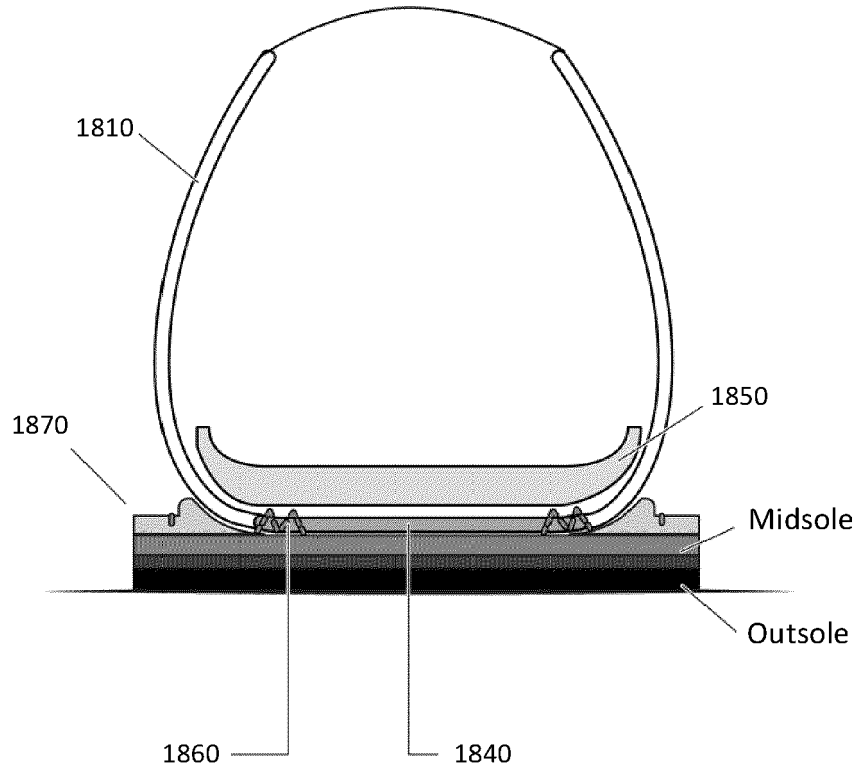


FIG. 18B

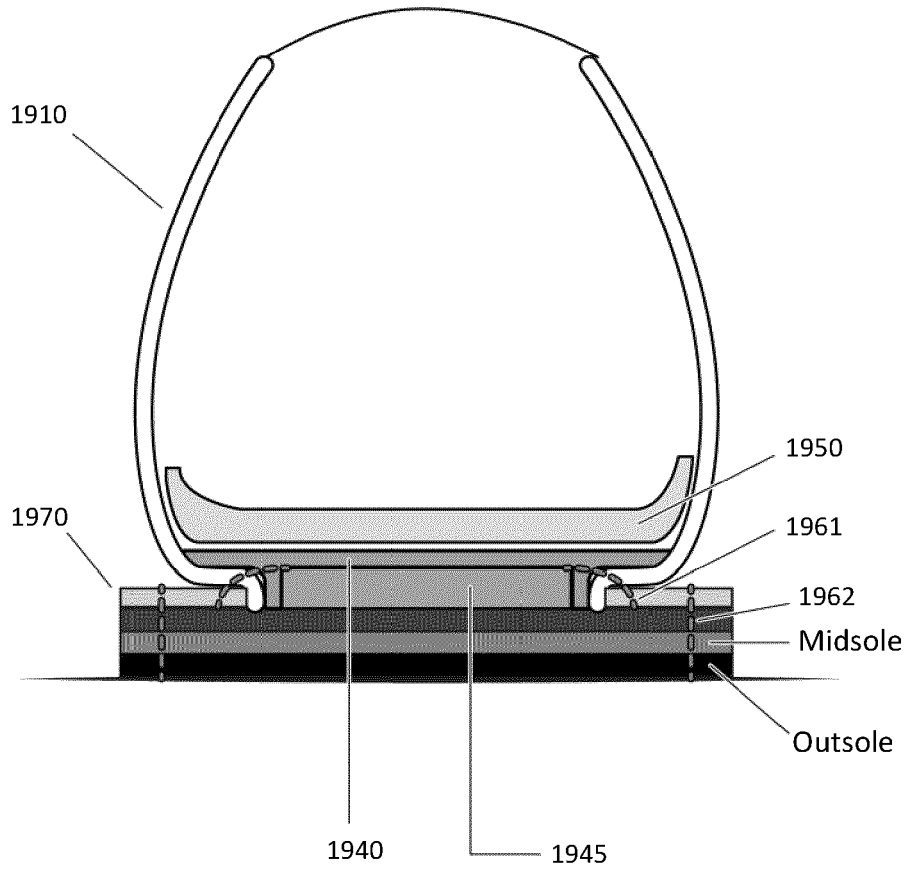


FIG. 19

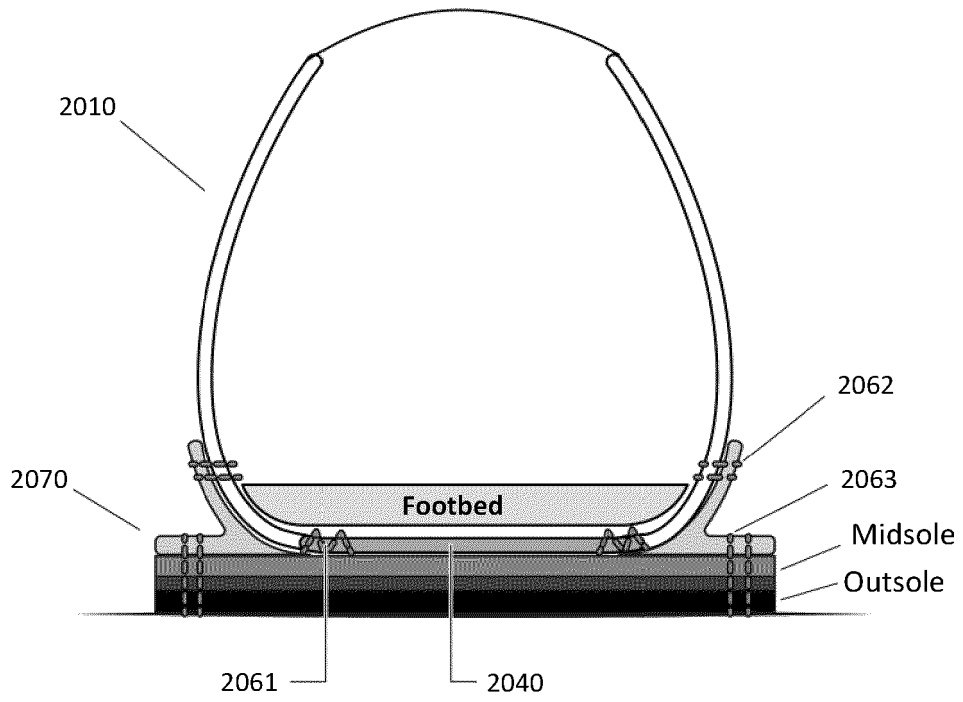


FIG. 20A

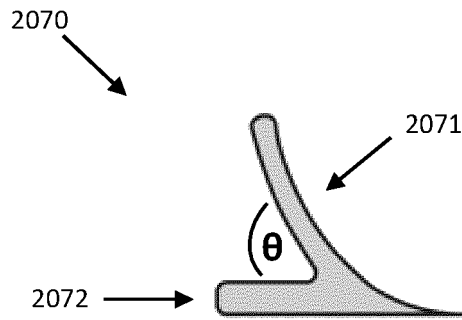


FIG. 20B

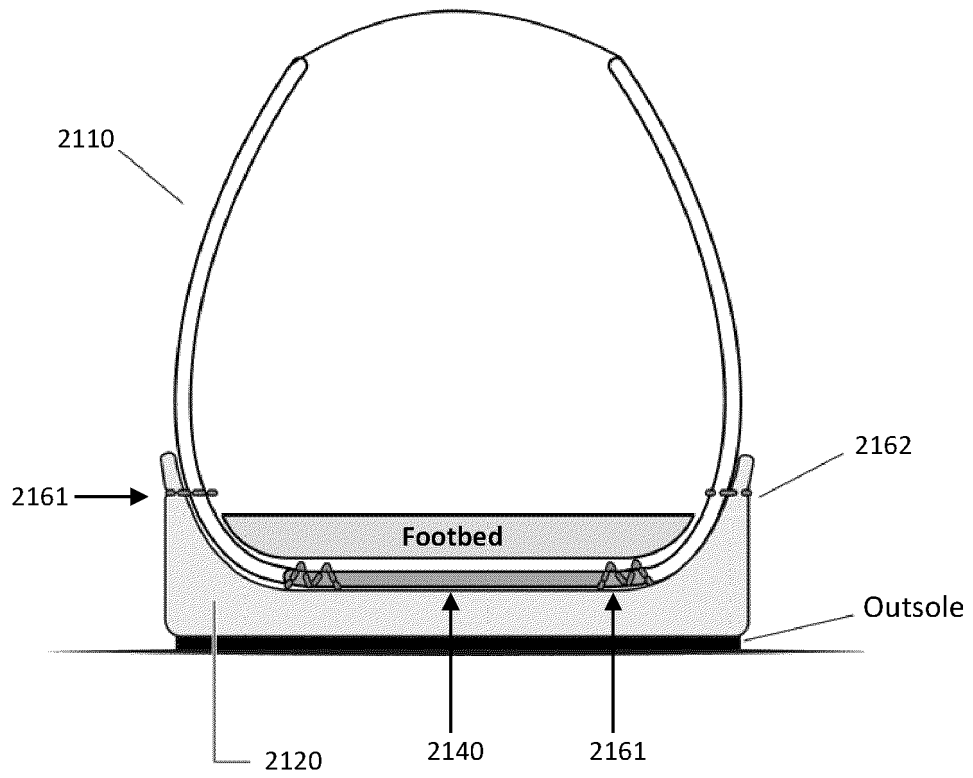


FIG. 21



EUROPEAN SEARCH REPORT

Application Number

EP 24 17 1400

5

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	US 2020/329819 A1 (DURAND THOMAS [US]) 22 October 2020 (2020-10-22) * paragraph [0040] - paragraph [0042] * * paragraph [0048] * * paragraph [0037] * * figures 1,2,5 * -----	1-15	
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The present search report has been drawn up for all claims

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Place of search The Hague	Date of completion of the search 15 August 2024	Examiner Ariza De Miguel, Jon
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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