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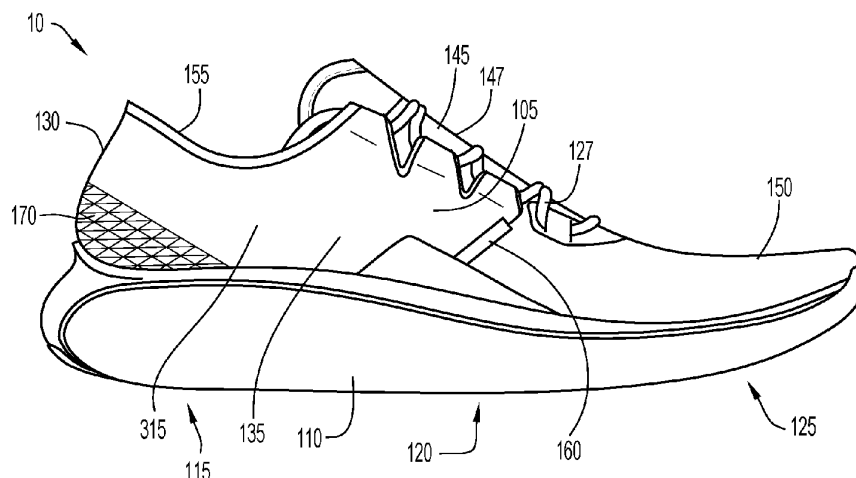
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(43) **Pub. Date: Sep. 28, 2017**(54) **FOOTWEAR UPPER WITH MOLDED GEOMETRY****Publication Classification**(71) Applicant: **Under Armour, Inc.**, Baltimore, MD (US)(51) **Int. Cl.**
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David Dombrow, Baltimore, MD (US)(52) **U.S. Cl.**
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(2013.01); **A43B 23/0255** (2013.01); **A43B 23/02** (2013.01)(21) Appl. No.: **15/619,796**(57) **ABSTRACT**(22) Filed: **Jun. 12, 2017**

An article of footwear includes a sole structure and an upper secured to the sole structure. The upper includes a heel section, lateral side section, medial side section, instep and toe cage that define an interior cavity operable to receive a foot of a wearer. At least a portion of the upper includes a laminate, where the laminate includes an inner layer facing the cavity, an outer layer forming an exterior of the shoe, and an intermediate layer disposed between inner and outer layers, the intermediate layer comprising a reinforcing layer having a rigidity that is greater than the rigidity of the inner and outer layers. The reinforcing layer extends from the lateral side section to the medial side section.

Related U.S. Application Data

(63) Continuation-in-part of application No. 14/458,712, filed on Aug. 13, 2014.

(60) Provisional application No. 62/348,430, filed on Jun. 10, 2016, provisional application No. 61/865,384, filed on Aug. 13, 2013.



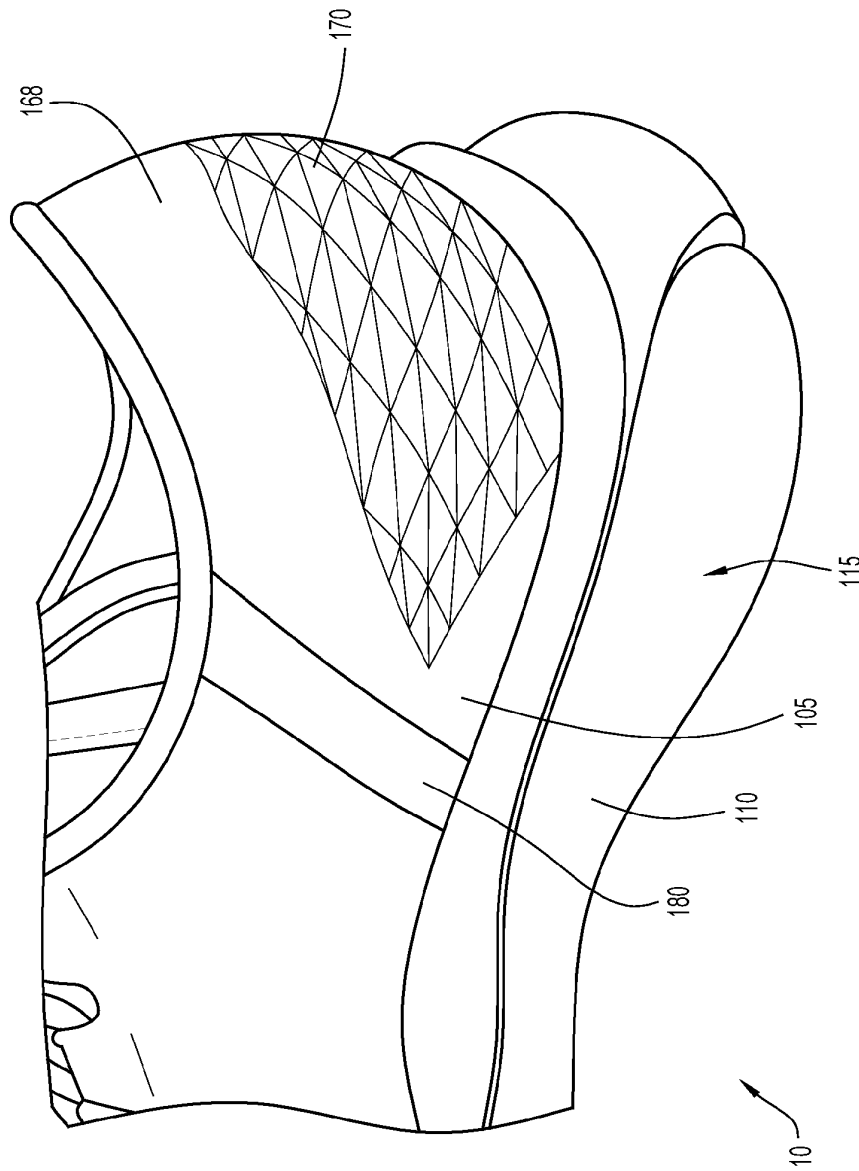


FIG. 1A

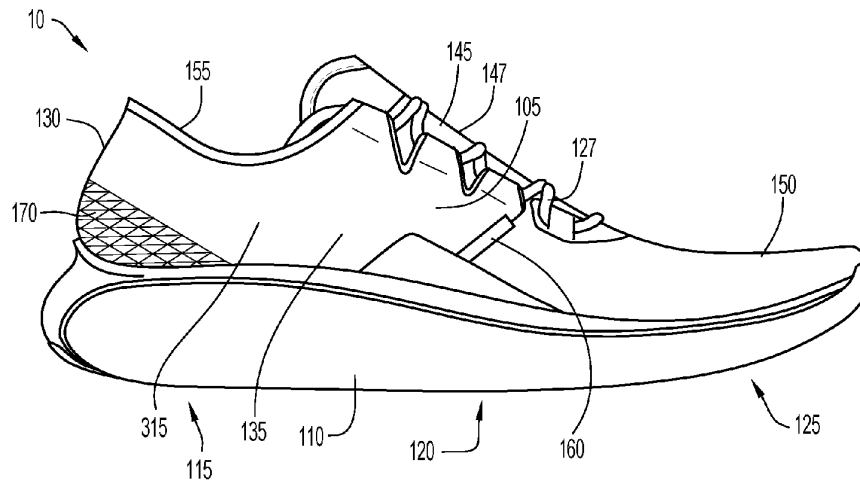


FIG.1B

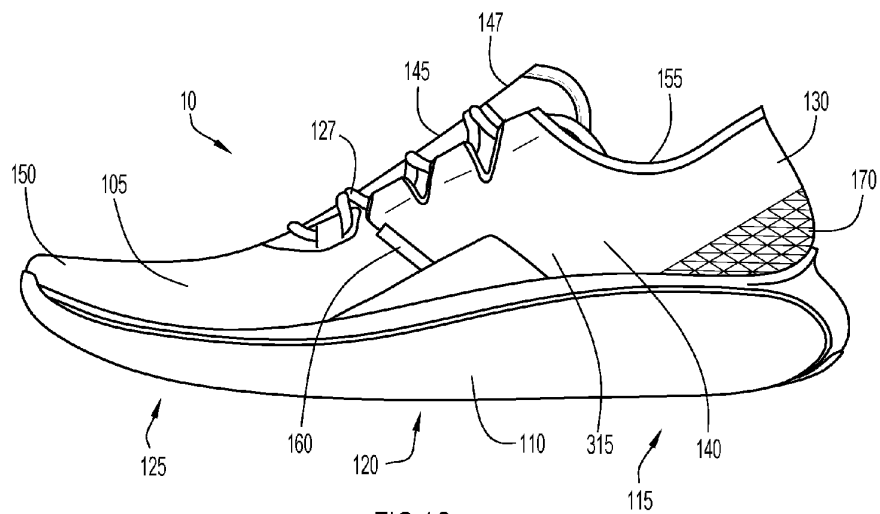


FIG.1C

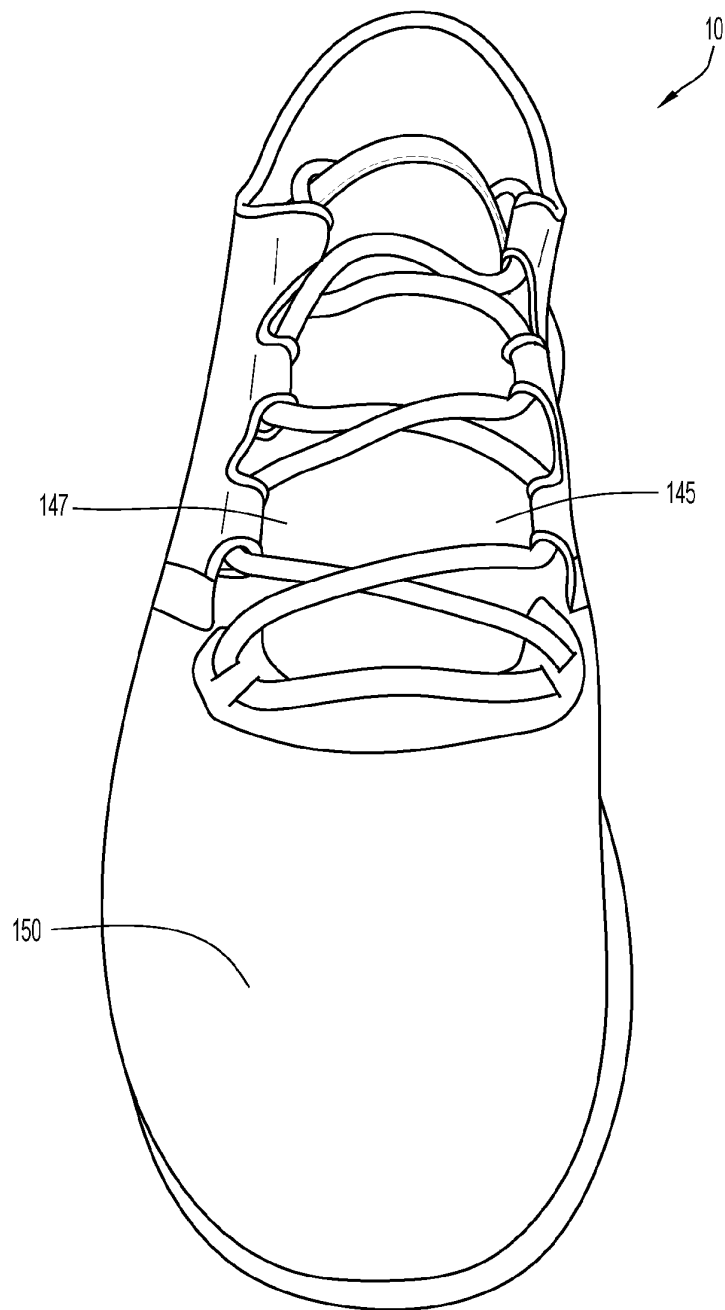


FIG.1D

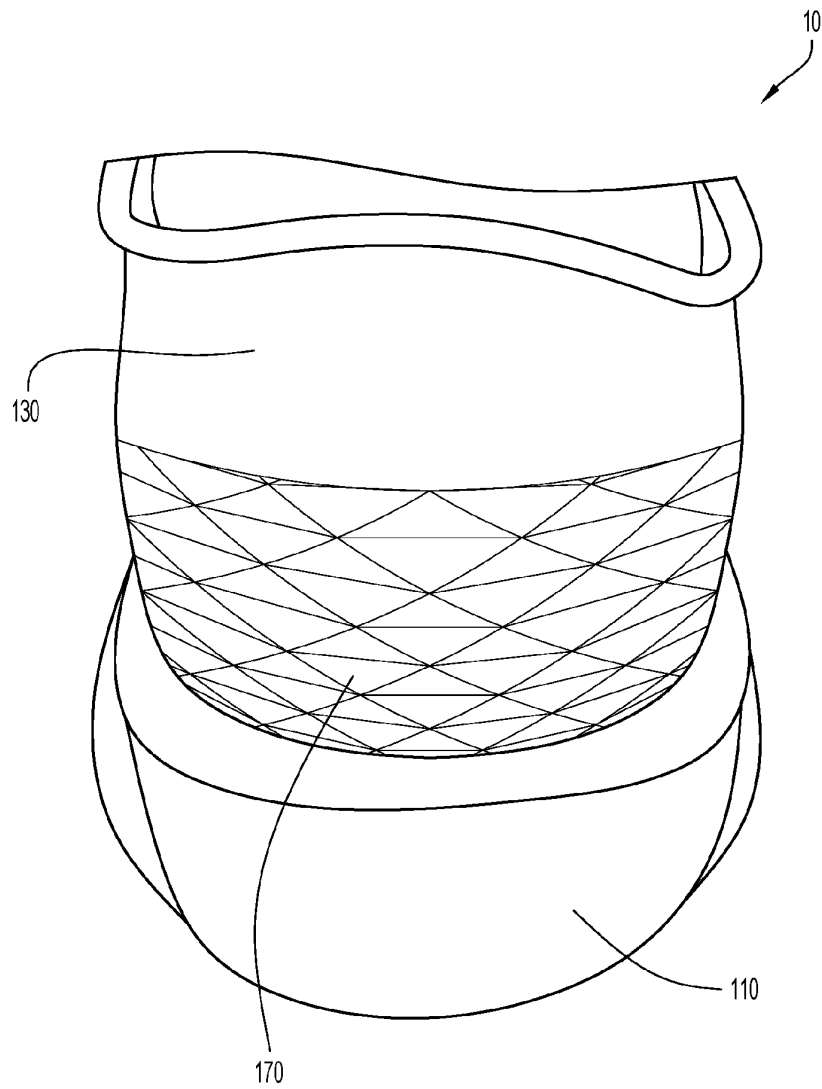


FIG. 1E

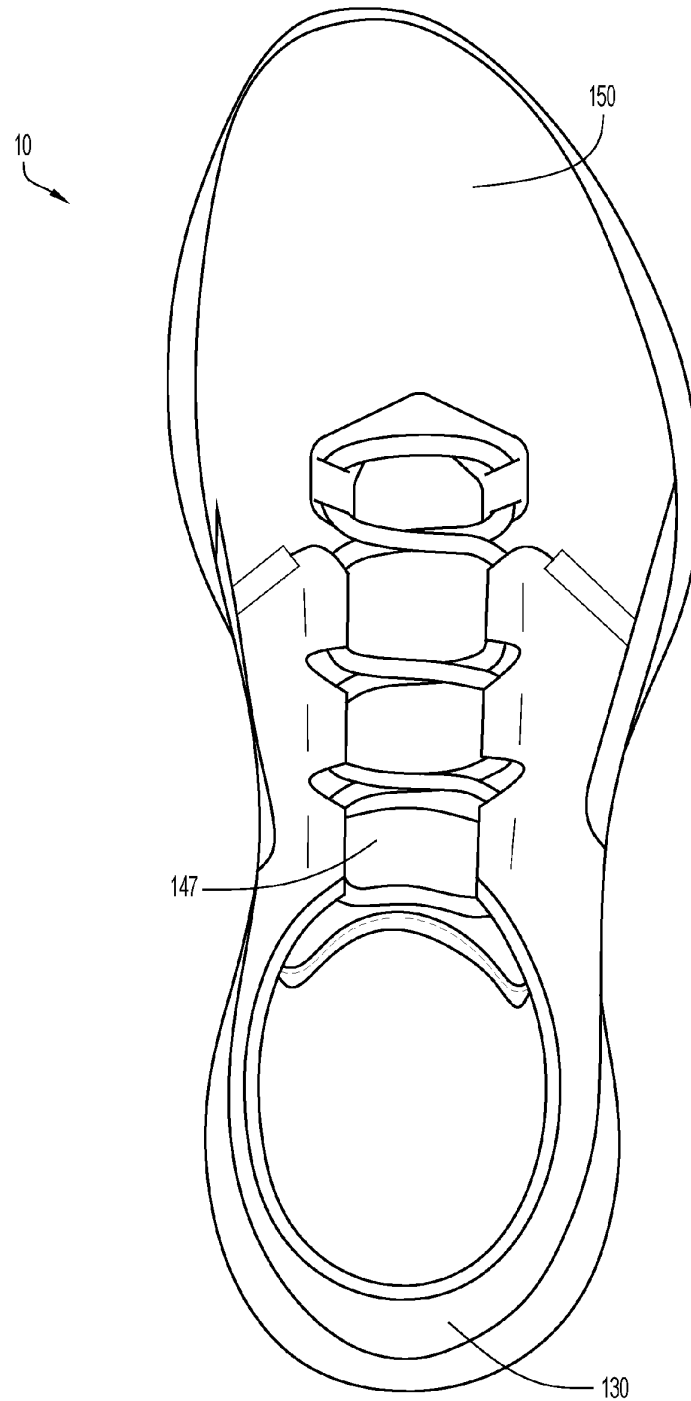
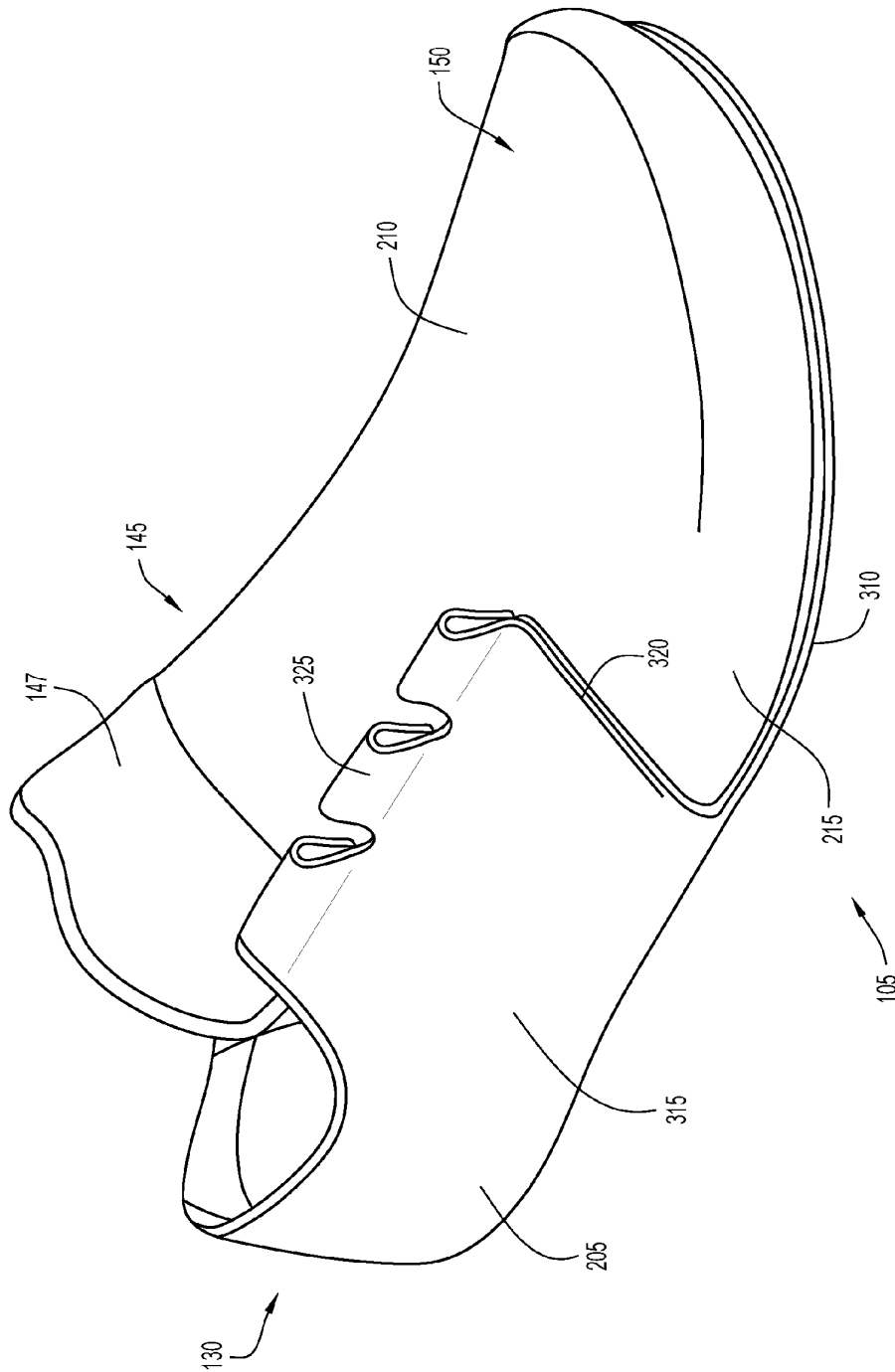


FIG.1F



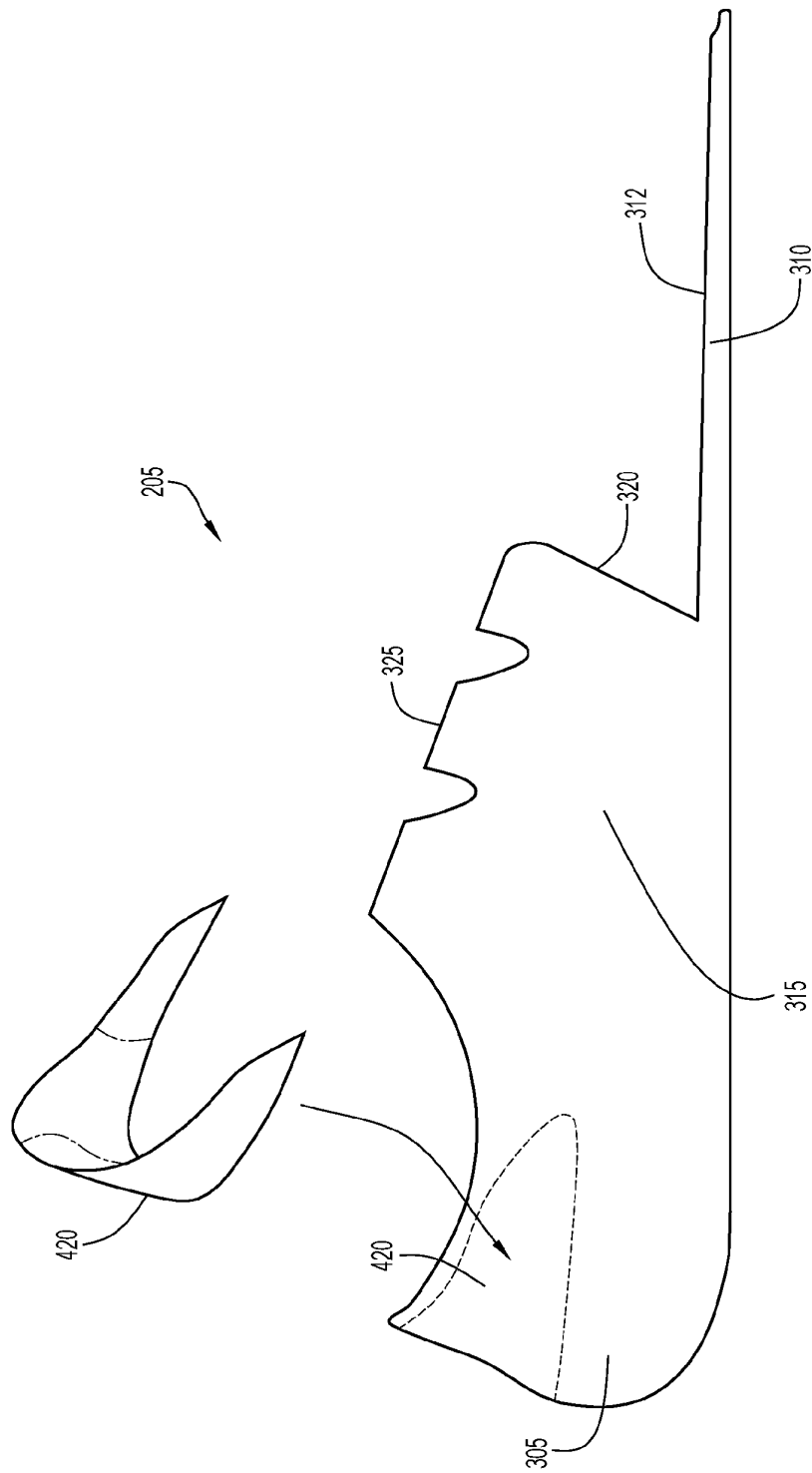


FIG.3

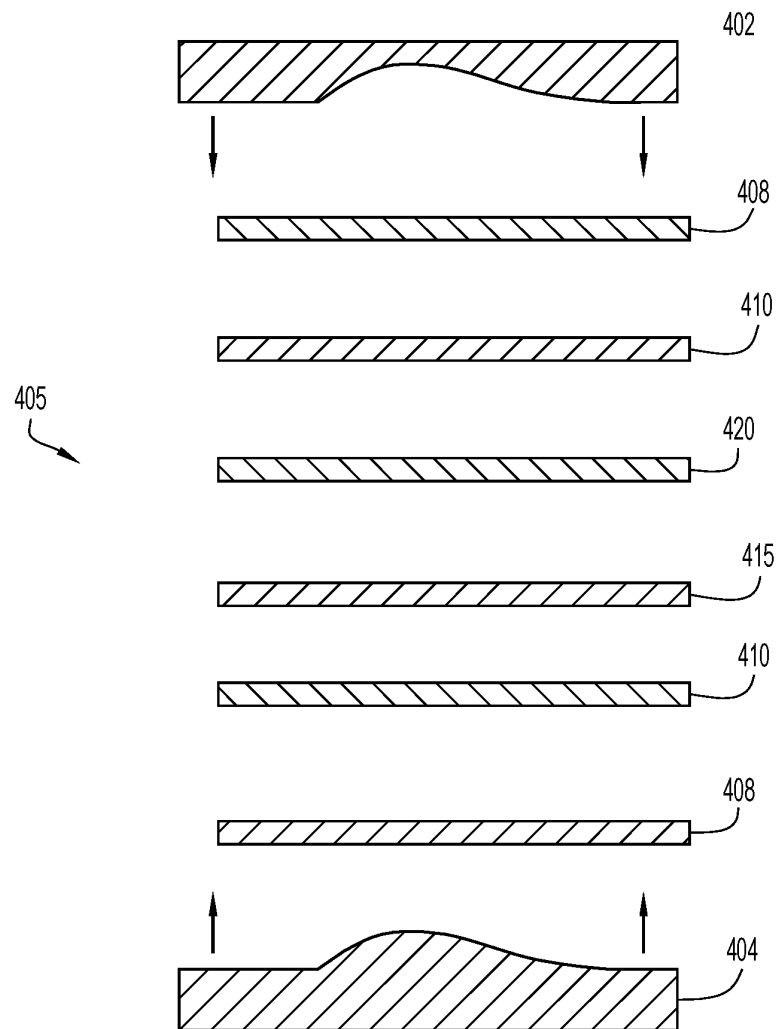


FIG.4

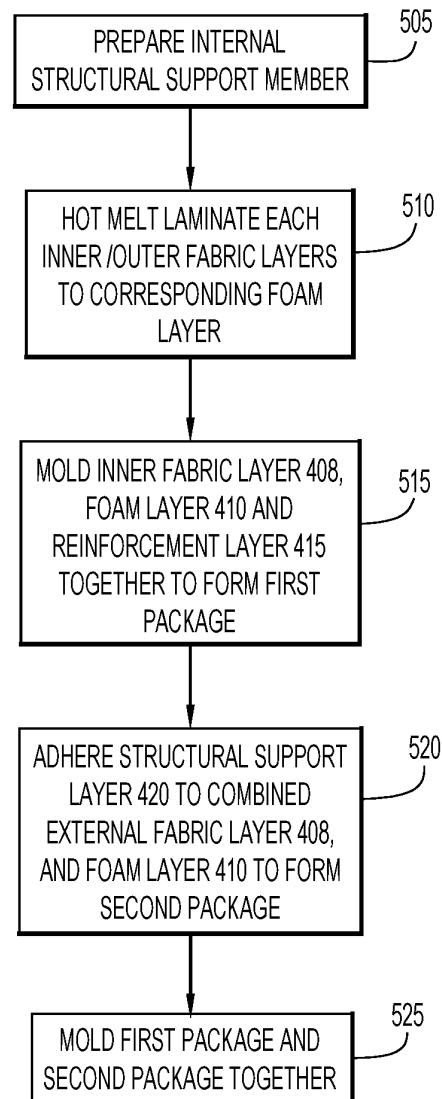


FIG.5

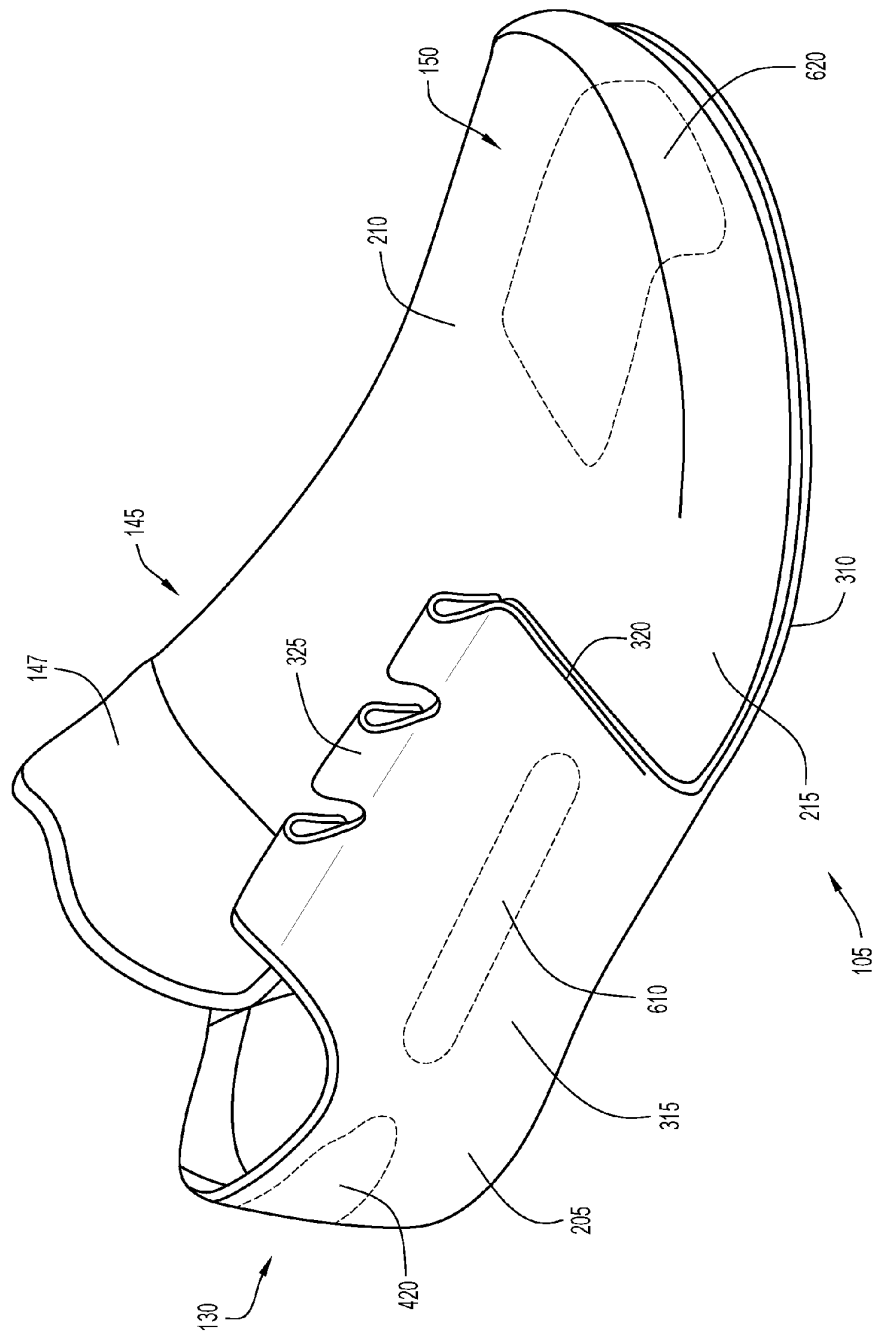


FIG. 6

FOOTWEAR UPPER WITH MOLDED GEOMETRY

FIELD OF THE INVENTION

[0001] The present invention relates to an article of footwear and, in particular, to a running shoe.

BACKGROUND

[0002] An article of footwear such as a running shoe is designed for comfort and durability. An article of footwear is typically constructed from a material or a combination of materials having insulative, moisture resistant and/or abrasion resistant characteristics. Processes for constructing performance footwear can be labor intensive, often requiring sophisticated and expensive stitching and/or injection molding equipment. For example, conventional uppers may be constructed via stitching, i.e., by cutting material according to a pattern to form a series of individual pieces, and then stitching the individual pieces of the pattern together to form the upper. The end result is a shoe having a significant number of seams. Seams, which are friction points, are located throughout the upper and, in particular, in the heel and bottom areas. In light of this, conventional footwear requires an insole or other covering to hide the stitched seam along the bottom of the upper.

[0003] Another conventional method for forming an article of footwear is via injection. This type of footwear is designed for harsh weather conditions (e.g. rubber boots). While generally seamless, this type of footwear is water and vapor impermeable, resulting in footwear lacking breathability. In the context of athletic footwear, this process results in wearer discomfort because airflow into and out of the shoe is prevented. Accordingly, heat and perspiration from the wearer cannot be evacuated to the ambient environment, resulting in wearer discomfort.

[0004] Thus, it would be desirable to provide an article of footwear that is lightweight, breathable, and durable, but avoids seams and/or stitches in the heel and/or footpad areas. It would also be desirable to provide some amount of rigidity or support in certain areas of the shoe (e.g., the heel section) while maintaining lightweight characteristics of the footwear.

SUMMARY OF THE INVENTION

[0005] In certain embodiments, an article of footwear comprises a sole structure and an upper secured to the sole structure. The upper includes a heel section, a lateral side section, a medial side section, an instep and a toe cage that cooperate to define an interior cavity operable to receive a foot of a wearer. At least a portion of the upper comprises a laminate comprising an inner layer facing the cavity, an outer layer forming an exterior of the shoe, and an intermediate layer disposed between inner and outer layers, the intermediate layer comprising a reinforcing layer having a rigidity that is greater than the rigidity of the inner and outer layers. The reinforcing layer extends from the lateral side section to the medial side section.

[0006] In other embodiments, an upper for an article of footwear comprises a heel section, a lateral side section, a medial side section, an instep and a toe cage that define an interior cavity operable to receive a foot of a wearer. At least a portion of the upper comprises a laminate comprising an inner layer facing the cavity, an outer layer forming an

exterior of the upper, and an intermediate layer disposed between the inner and outer layers, the intermediate layer comprising a reinforcing layer having a rigidity that is greater than the rigidity of the inner and outer layers.

[0007] In still further embodiments, a method of forming an upper for an article of footwear comprises combining a plurality of portions including a first portion with a second portion, the plurality of portions defining a heel section, a lateral side section, a medial side section, an instep and a toe cage that define an interior cavity of the upper operable to receive a foot of a wearer. The first portion is formed by a laminate, where the laminate is formed by combining a plurality of layers together, including an inner layer that faces the cavity with an outer layer forming an exterior of the upper and an intermediate layer disposed between the inner and outer layers, the intermediate layer comprising a reinforcing layer having a rigidity that is greater than the rigidity of the inner and outer layers.

[0008] The above and still further features and advantages of the present invention will become apparent upon consideration of the following detailed description of specific embodiments thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1A is a rear perspective view of a portion of an article of footwear in accordance with an embodiment of the invention (footwear configured for a right foot).

[0010] FIG. 1B is side view in elevation of the article of footwear shown in FIG. 1A, showing the lateral footwear side.

[0011] FIG. 1C is side view in elevation of the article of footwear shown in FIG. 1A, showing the medial footwear side.

[0012] FIG. 1D is front view in perspective of the article of footwear shown in FIG. 1.

[0013] FIG. 1E is rear view in elevation of a portion of the article of footwear shown in FIG. 1A.

[0014] FIG. 1F is top view in plan of the article of footwear shown in FIG. 1A.

[0015] FIG. 2 is a lateral side view in perspective of two main portions of the upper for the article of footwear shown in FIG. 1.

[0016] FIG. 3 is a lateral side view in elevation of one of the two main portions of the upper of FIG. 2.

[0017] FIG. 4 is a cross sectional view of compression molding apparatus showing upper formation and layers of a fabric laminate that form a portion of an upper of the article of footwear of FIG. 1A.

[0018] FIG. 5 is a flowchart illustrating an example process for compression molding an upper with multiple layers in accordance with the present invention.

[0019] FIG. 6 is a lateral side view in perspective of the two main portions of the upper for the article of footwear shown in FIG. 2 and further including a plurality of internal support structures for the upper separated from each other.

[0020] Like reference numerals have been used to identify like elements throughout this disclosure.

DETAILED DESCRIPTION

[0021] In the following detailed description, reference is made to the accompanying figures which form a part hereof wherein like numerals designate like parts throughout, and in which is shown, by way of illustration, embodiments that

may be practiced. It is to be understood that other embodiments may be utilized, and structural or logical changes may be made without departing from the scope of the present disclosure. Therefore, the following detailed description is not to be taken in a limiting sense, and the scope of embodiments is defined by the appended claims and their equivalents.

[0022] Aspects of the disclosure are disclosed in the accompanying description. Alternate embodiments of the present disclosure and their equivalents may be devised without parting from the spirit or scope of the present disclosure. It should be noted that any discussion herein regarding “one embodiment”, “an embodiment”, “an exemplary embodiment”, and the like indicate that the embodiment described may include a particular feature, structure, or characteristic, and that such particular feature, structure, or characteristic may not necessarily be included in every embodiment. In addition, references to the foregoing do not necessarily comprise a reference to the same embodiment. Finally, irrespective of whether it is explicitly described, one of ordinary skill in the art would readily appreciate that each of the particular features, structures, or characteristics of the given embodiments may be utilized in connection or combination with those of any other embodiment discussed herein.

[0023] Various operations may be described as multiple discrete actions or operations in turn, in a manner that is most helpful in understanding the claimed subject matter. However, the order of description should not be construed as to imply that these operations are necessarily order dependent. In particular, these operations may not be performed in the order of presentation. Operations described may be performed in a different order than the described embodiment. Various additional operations may be performed and/or described operations may be omitted in additional embodiments.

[0024] For the purposes of the present disclosure, the phrase “A and/or B” means (A), (B), or (A and B). For the purposes of the present disclosure, the phrase “A, B, and/or C” means (A), (B), (C), (A and B), (A and C), (B and C), or (A, B and C).

[0025] The terms “comprising,” “including,” “having,” and the like, as used with respect to embodiments of the present disclosure, are synonymous.

[0026] As described herein with reference to the example embodiment of FIGS. 1A-3, an article of footwear **10** in accordance with the invention includes an upper **105** coupled with a sole structure **110**. The article of footwear **10**, also referred to herein as a shoe, can be in the form of a running shoe or other type of athletic shoe. The shoe **10** defines several regions corresponding with various parts of a foot. Specifically, the shoe **10** defines a rear footwear region **115** generally corresponding with the rear of the foot (e.g., the hindfoot including the heel and ankle areas of the foot), an intermediate footwear region **120** disposed forward the rear region and generally corresponding with the midfoot (e.g., the arched, instep, and ball areas of the foot), and a forward footwear region **125** disposed forward of intermediate region and generally corresponding with the forefoot (e.g., the toes of the foot). The article of footwear **10** may further include a fastener **127** (e.g., a shoe lace). The upper **105** and sole structure **110** can be formed from any materials (described in more detail herein) suitable for their intended purposes.

[0027] The upper **105** includes a medial side **140** (which corresponds with the medial side of the shoe) that is oriented along the medial or big toe side of the user's foot, a lateral side **135** (which corresponds with the lateral side of the shoe) that is oriented along the lateral or little toe side of the user's foot (the medial and lateral sides being distinguished by a central, longitudinal axis), a toe (i.e., front) end **150** (also referred to as a toe cage or toe box) that corresponds with the toe end of the user's foot, and a heel (i.e., rear) end **130** that corresponds with the heel of the foot. The heel end **130** has a curved shape defining a heel cup that generally conforms to the user's heel and extends between the lateral and medial sides **135**, **140** of the upper **105**. The upper **105** further includes an instep **145** positioned between the lateral side and the medial side, where the instep **145** extends over the instep of the foot and generally includes a tongue **147**. The fastener **127** is disposed at the instep **145**.

[0028] The upper **105** defines a cavity such that, when secured to a portion of the sole structure **110** (as described herein), the upper receives, covers and protects the foot within the cavity. Specifically, the heel **130**, lateral side **135**, medial side **140**, instep **145**, and toe cage **150** cooperate to define portions of the hindfoot section, midfoot section and forefoot section of the shoe as well as an interior cavity into which a foot is inserted by way of an access opening or collar **155**. The collar **155** may be finished with, e.g., fabric tape applied via adhesive. In an embodiment, a strip of material is applied around an inside edge of collar **155** to allow the edge of collar to be finished without a binding to reduce fraying and/or to help collar adhere to the skin of the user. The material may be an elastomeric and/or tacky polymer such as, but not limited to, polyurethane, silicone, nylon, and polyester.

[0029] The sole structure **110** comprises a durable, wear-resistant component configured to provide cushioning as the shoe **10** impacts the ground. In certain embodiments, the sole structure **110** may include a midsole and an outsole. In additional embodiments, the sole structure **110** can further include an insole that is disposed between the midsole and the upper **105** when the shoe **100** is assembled. In other embodiments, the sole structure **110** may be a unitary and/or one-piece structure. The sole structure includes an upper facing side or portion that is configured to secure with the upper and an opposing ground-facing side that defines a generally planar surface and can further be textured and/or include ground-engaging or traction elements (e.g., as part of an outsole of the sole structure) to enhance traction of the shoe **10** on different types of terrains and depending upon a particular purpose in which the shoe is to be implemented. The ground-facing side of the sole structure **110** can also include one or more recesses formed therein, such as indentations or grooves extending in a lengthwise direction of the sole structure **110** and/or transverse the lengthwise direction of the sole structure, where the recesses can provide a number of enhanced properties for the sole structure (e.g., flexure/pivotal bending along grooves to enhance flexibility of the sole structure during use). The sole structure **110** may be formed of a single material or may be formed of a plurality of materials. In example embodiments in which the sole structure includes a midsole and an outsole, the midsole may be formed of one or more materials including, without limitation, ethylene vinyl acetate (EVA), an EVA blended with one or more of an EVA modifier, a polyolefin block copolymer, and a triblock copolymer, and a polyether block

amide (e.g., a PEBAX® material). The outsole may be formed of one or more materials including, without limitation, elastomers (e.g., thermoplastic polyurethane), siloxanes, natural rubber, and synthetic rubber.

[0030] Referring to the embodiment illustrated in FIGS. 2 and 3, the upper 105 includes a first or planum portion 205 (i.e., a portion of the upper that directly covers and/or engages a portion, e.g., a majority or entire portion, of a bottom side of a wearer's foot) and a second or dorsum portion (i.e., a portion of the upper that directly covers and/or engages a portion, e.g., a majority or entire portion, of an upper side of the wearer's foot). The planum portion 205 is coupled (e.g., connected) to the dorsum portion 210 at a coupling location (e.g., via stitching and/or a coupling member 160 as described herein).

[0031] The planum portion 205 may further include sub-portions extending from the rear foot region 115 to the forward foot region 125 to generally cover the heel and planum areas of the foot, as well as to cover portions of the lateral and medial sides of the upper. As depicted in FIG. 3, the planum portion 205 includes a heel cup 305 and a planum support 310 extending forward from the heel cup. The planum portion 205 further includes lateral and medial side portions 315 each of which extends forward from the heel cup 305 to an edge 320 that is located proximate the transition from the instep 145 to the toe cage 150 of the upper 105. In addition, the lateral and medial side portions 315 are the same or similar in shape and configuration. Each side portion 315 further extends upward from the planum support 310 so as to extend over a section of the dorsum portion 210 at the instep 145, and each side portion 315 also includes a plurality of fastener engaging elements 325 that extend from an upper edge of each side portion 315. Each fastener engaging element 325 can comprise a looped section of material that includes an opening configured to receive and retain a portion of the fastener 127. The planum support 310 extends the length of the upper 105 and defines a lower surface of the upper that couples with the sole structure 110.

[0032] The dorsum portion 210 extends from the forward footwear region 125 to the intermediate footwear region 120 and defines the toe cage 150 as well as most of or the entire instep 145, including the tongue 147, of the upper 105. The dorsum portion 210 further defines portions of the lateral and medial side portions 215 that define part of the toe cage 150 and extend so as to at abut and/or at least partially overlap with each of the lateral and medial side portions 315 of the planum portion 205. As described herein, the dorsum portion 210 couples with the planum portion 205 such that the lateral and medial side portions 315 are secured with lateral and medial side portions 215 and the planum portion 205 at the forward footwear region 125 further secures with the planum support 310.

[0033] The planum portion 205 may be connected to the dorsum portion 210 in a seamless and/or stitchless manner. In an example embodiment, each side 315 of the planum portion 205, including the edge 320, overlaps (or abuts) an edge or portion of a corresponding side 215 of the dorsum portion 210, where the overlapping (or abutting) parts of the dorsum and planum portions are secured in any suitable manner (e.g., via adhesive, stitching, etc.). For example, each planum portion side 315 can be secured at or near its edge 320 to the underlying dorsum portion side 215 via a suitable type of stitch (e.g., a zig-zag flatlock stitch). Further,

a suitable coupling member 160 can be provided to further couple the planum and dorsum portions together at or near the edge 320. The coupling member 160 can comprise a fabric tape member (e.g., BEMIS seam tape, available from Bemis Associates, Inc., Shirley, Mass.), where the coupling member 160 further can be used to cover the edge 320. In example embodiments, the coupling member 160 comprises fabric similar to fabric and/or other materials that form the upper (e.g., polyester, spandex, etc.). While the coupling member 160 is shown in the figures as being disposed on an external side of the upper 105, a similar coupling member can also be provided internally within the upper 105 at the join or connection between the portions 205, 210.

[0034] Thus, the coupling member 160 is applied such that the coupling member bridges the connection between the portions 205, 210, covering the stitching. The coupling member 160 can be effectively secured to these portions of the upper 105 by applying heat to the coupling member 160 to seal the seam. With this configuration, the coupling member 160 provides a seamless connection that minimizes and/or eliminates the friction caused by conventional (exposed) seams. That is, a seamless connection is provided because the coupling member 160 creates a generally uninterrupted and/or continuous surface along the interior surface and/or exterior surface of the upper 105.

[0035] The planum support 310 of the dorsum portion 205 further includes an edge 312 (e.g., at the forward footwear region 125 and/or part of the intermediate footwear region 120) that secures to a lower portion (e.g., edge portions) of the planum portion 210 in any suitable manner (e.g., stitching, adhesive bonding, etc.).

[0036] In alternative embodiments, the planum portion 205 and dorsum portion 210 may be connected at any or all locations without stitching, instead utilizing a thermoplastic film that traverses the seams between adjacent portions, bonding the portions 205, 210 together (e.g., utilizing SEW-FREE tape, available from Bemis Associates, Inc., Shirley, Mass.). In still further alternative embodiments, ultrasonic welding could be utilized. In an embodiment, individual pieces are joined by ultrasonic welding, and the weld is covered by a strip of heat sealable film.

[0037] In any of the described embodiments, the coupling member(s) used to secure the dorsum and planum portions together at various locations can have any suitable shapes and/or configurations, such as curved or undulating shapes to track the contours of the internal or external surfaces of the two portions of the upper.

[0038] The upper 105 (the planum and/or dorsum portions) may comprise any materials suitable for its described purpose. In particular, the upper 105 may be formed of material capable of forming the contours of the upper as well as any structures located on internal and/or external surfaces of the upper. The material is a thermoformable, textile laminate (also referred to herein as a fabric laminate) comprising a plurality of layers including one or more fabric (textile) layers, one or more foam layers, and at least one structural support layer disposed internally within the upper (i.e., located between two or more layers within the plurality of layers forming the upper), where the fabric laminate is capable of being shaped via compression molding.

[0039] The one or more fabric layers provided in the fabric laminate can comprise any suitable textile, herein defined as fabrics and other manufactured products made from strands such as fibers, filaments, and yarns. By way of example, the

textiles include knit, woven, nonwoven, embroidered, and braided constructions. The strands forming the fabric may include hard yarns or resilient yarns possessing stretch and recovery characteristics. Specifically, the hard yarns may include any one or combination of compounds selected from the group consisting of polyurethanes, polyesters (e.g., polyethylene terephthalate), polyolefins (e.g., polyethylene and polypropylene), polyamides (e.g., aliphatic or aromatic polyamide materials, such as nylon), and any suitable combinations or copolymers thereof. Regarding elastic yarns, the strands include elastomeric materials such as a polyester-polyurethane copolymer commercially available under the names elastane, LYCRA and SPANDEX.

[0040] A fabric layer can further be formed of synthetic or natural leather or may even further comprise a plurality of layers (e.g., a plurality of layers comprising waterproof and breathable properties, such as fabric layers commercially available under the name GORETEX). The fabric layers can include elastomers that provide any suitable degree of stretch (e.g., two way stretch or four way stretch) at any one or more locations of the upper.

[0041] The fabric layers may possess any thickness suitable for its described purpose. In example embodiments, the fabric layers can have thicknesses in the range of about 0.25 mm to about 4 mm, e.g., about 0.50 mm to about 3 mm.

[0042] The one or more foam layers provided in the fabric laminate can comprise any suitable one or more type(s) of open and/or closed cell foam materials that provide adequate cushioning and comfort for the intended purpose. In particular, an open-celled, thermoplastic foam may be utilized. Some examples of types of foam materials suitable for use in forming the upper include, without limitation, polyolefins (e.g., polyethylene or polypropylene) foam materials, ethylene vinyl acetate (EVA) foam materials and polyurethane (PU) foam materials. The foam materials can have a thickness that is greater than the fabric materials. In example embodiments, the foam materials can have thicknesses in the range of about 1 mm to about 10 mm, e.g., about 2 mm to about 8 mm (e.g., about 3 mm to about 6 mm). Foam layers can vary in thickness depending upon where such foam layers are located along the upper. For example, a foam layer provided in a laminate of the planum portion **25** can have a thickness that is greater than, e.g., the thickness of a foam layer provided in the dorsum portion **210** of the upper. In an example embodiment, a foam layer that is about 6.0 mm thick is provided between fabric layers in the planum portion **205** that serves as a cushioning foot bed for the wearer's foot.

[0043] The one or more internal structural support members provided within the fabric laminate that forms the upper can be formed of any suitable type(s) materials that deform during the compression molding process and provide structural support for the upper at the location(s) in which the support members are provided once the material cools. In particular, the materials used to form the internal structural support members can be formed so as to have a hardness value (e.g., as measured on a Shore A hardness scale, a Shore A hardness) that is greater than the hardness value (e.g., Shore A hardness) of the materials used to form the foam and fabric layers of the fabric laminate. Some examples of materials that can be used to form the internal structural support members include, without limitation, polyurethanes, polyolefins, polyamides (e.g., nylon), ethylene vinyl acetate (EVA), etc. In example embodiments, one or more internal

structural support members are formed from a thermoplastic polyurethane (TPU) material, such as a TPU material commercially available from Chemex Company Ltd. During the formation of the fabric laminate, the internal structural support member can be formed from a flat sheet that is contoured during the compression molding process. Alternatively, the internal structural support member can be formed from starting materials comprising a powder composition that is fused and hardened into a single, unitary member either prior to or during the compression molding process. The internal structural support member can have a thickness in the range of about 0.2 mm to about 2.0 mm (e.g., a thickness of about 1.0 mm).

[0044] As noted herein, the fabric laminate that forms the upper comprises a plurality of layers and can include any selected number of layers, where different fabric laminates including different types and/or numbers of layers can be provided at different locations of the upper. For example, some locations of the upper may include one or more internal structural support members while other locations do not, thus changing the structural configuration of the fabric laminate at different locations of the upper. As seen best in FIG. 4, the shoe **10** includes an internal structural support member in the form of an internal heel counter **420** located at the heel end **130** (i.e., at the heel cup **305**) of the upper. The heel counter spans continuously from the lateral side to the medial side of the upper, as well as from a point proximate the collar to a point proximate the sole structure. The heel counter contours with the heel cup, curving continuously from its upper edge to its lower edge, as well as from its lateral edge to its medial edge.

[0045] It is noted that an internal structural support member can also be provided at any other suitable locations (e.g., at the toe cage **150**) so as to add rigidity, hardness and/or support to the upper **105** at such locations.

[0046] The compression molding process used to form the fabric laminate of the upper comprises a method of molding in which the molding material is first placed in an open, heated mold cavity. The mold is closed with a top force or plug member, pressure is applied to force the material into contact with all mold areas, while heat and pressure are maintained until the molding material has cured. The temperatures and pressures used in the compression molding process will depend upon the materials used to form the various layers within the fabric laminate, where softening of one or more layers is required to ensure suitable adhesion of the layers together during the compression molding process. In particular, softening of the one or more layers comprises being heated to a temperature that is lower than the melting point of the materials forming the layers (e.g., the softening temperature is at least about 20° C. lower than the melting point of the materials forming the layers). Example softening temperatures used during the compression molding process can be in the range from about 130° C. to about 200° C. (e.g., about 140° C. to about 190° C.).

[0047] Example fabric laminate layers used to form portions of the upper for the shoe depicted in the figures include a series of layers as follows (from internal or foot facing side to external side of the upper): fabric layer/foam layer/reinforcing fabric layer/foam layer/fabric layer. For fabric laminate layers that include an internal structural support layer, the internal structural support member can be provided as a layer disposed at any location within the fabric laminate such that at least one layer is located on one side

of the internal structural support layer and at least one layer is located on the other side of the internal structural support layer.

[0048] Referring to FIG. 4, an example embodiment is depicted showing the formation of a fabric laminate used to form the heel end 130 of the upper 105. The fabric laminate 405 used to form the upper 105 at the heel end 130 includes a plurality of layers that are oriented or “stacked” in the following alignment (from interior or upper cavity/foot-facing side to exterior side of upper, or from right to left as shown in FIG. 4): (inner) fabric layer 408/foam layer 410/reinforcing fabric layer 415/internal structural support member layer 420/foam layer 410/(outer) fabric layer 408. However, the internal structural support member layer 420 can be provided at any other location within the plurality of layers (i.e., between the inner and outer fabric layers 408). The inner and outer fabric layers 408 can be formed of the same or different materials. In addition, the foam material layers 410 can also be formed of the same or different materials. The reinforcing fabric layer 415 can be formed of the same or different type(s) of materials as the inner and outer fabric layers 408. In further example embodiments, the reinforcing fabric layer 415 can further include one or more additional foam layers (e.g., including a foam layer/fabric layer laminate defining the reinforcing layer 415, or a foam layer/fabric layer/foam layer laminate defining the reinforcing layer 415).

[0049] In an example embodiment, one or more of the fabric layers 408, 415 can comprise polyester and/or an elastomer material (e.g., elastane), the foam layers 410 can comprise an open cell PU or EVA foam material, and the internal structural support member layer 420 can comprise a TPU plastic material. In a further example embodiment, one or both the inner and outer fabric layers 408 can comprise a fabric material including about 85% polyester and about 15% elastane (weight 215 g/m²), and the reinforcement fabric layer 415 can comprise a fabric including about 79% polyester and about 21% elastane (weight 210 g/m²). The outer and inner fabric layers may possess similar or different properties such as elongation properties. By way of example, the outer fabric layer may possess a greater degree of elongation or elasticity along one or more dimensions (e.g., along a length and/or width of the outer fabric layer) in comparison to the inner fabric layer. Alternatively, the inner fabric layer may possess a greater degree of elongation or elasticity along one or more dimensions (e.g., along a length and/or width of the inner fabric layer) in comparison to the outer fabric layer.

[0050] The compression mold equipment or apparatus used to secure the plurality of layers together to form the fabric laminate 405 includes a pair of molding portions 402, 404. In particular, the mold portions include a first or female molding portion 402 that includes a generally curved, concave surface and a second or male molding portion 404 that includes a generally curved, convex surface that is complementary to the concave surface of the female molding portion 402 so that the male molding portion 404 is configured to be received by and engage with the female molding portion 402. The compression mold apparatus is configured to shape the layers 408, 410, 425, 420 as they are pressed together between the female and male molding portions 402, 404 during the compression molding process. The molding of the layers can be performed in a single compression mold operation (e.g., combining all layers in their proper orien-

tation or “stacked” positions and then pressing together within the mold apparatus) or in a plurality of compression mold operations (e.g., press two or more layers together in the mold, following by pressing further layers together, etc. until the final fabric laminate is formed). The final fabric laminate formed by the compression mold apparatus will have a contour that is suitable for the location in which the fabric laminate is to be utilized for forming the upper. For example, each of the planum portion 205 and dorsum portion 210 can be formed with different compression molding portions such that they are formed of fabric laminates having the configuration shapes and contours as depicted in FIGS. 2 and 3.

[0051] An example compression molding process for forming a fabric laminate for the upper 105, in particular the heel cup 305 of the planum portion 205, is described with reference to FIG. 4 and the flowchart of FIG. 5. The materials used to form the layers are initially prepared. In particular, at 505, the material used to form the internal structural support member 410 is prepared by either die cutting a portion of a flat blank of the TPU plastic material or forming a solid TPU portion from a powder composition (heating/fusing the powder composition to form a unitary solid member that is generally flat). The material layer (the heel counter 420) can have a thickness of about 1 mm. At 510, each inner and outer fabric layer 408 is secured, via hot melt lamination, to a corresponding foam layer 410.

[0052] The other materials used to form the various layers can also be prepared, as necessary (e.g., by cutting each material from a blank to the appropriate size/dimensions for the mold apparatus). Each material portion forming the layer can be initially configured as a generally flat sheet of material. For example, in an embodiment in which the reinforcement fabric layer 415 includes both a fabric layer at least one additional foam layer (e.g., foam/fabric laminate, or foam/fabric/foam laminate), the reinforcement layer 415 can be prepared accordingly. For example, the reinforcement layer 415 can include a foam/fabric/foam laminate in which each foam layer is about 3 mm. The mold portions 402, 404 can further be heated to suitable temperatures for the mold process.

[0053] At 515, the inner fabric layer 408, foam layer 410 and reinforcement fabric layer 415 can be compression molded together to form a first package of combined layers in the following manner. The combined (via hot melt lamination) inner fabric layer 408 and foam layer 410 are placed against mold portion 404 (with the fabric layer 408 adjacent the mold portion 404). The reinforcement layer can have an adhesive sprayed on one or both of its sides and adhered against the foam layer 410. The mold portions 402 and 404 can be pressed together at a sufficient temperature (e.g., a temperature of the mold portions of about 190° C., imparting a sufficient heat to the layers such that the layers are at a temperature of about 150° C.) and for a sufficient time period (about 160 seconds). The first package of molded components can then be cooled for about 2 minutes and/or until reaching ambient temperature (about 24° C. to about 28° C.) and removed from the mold portions.

[0054] At 520, the internal structural support member layer 420 is adhered to the combined outer or external fabric layer 408/foam layer 410 to form a second package of combined layers in the following manner. The combined (via hot melt lamination) external fabric layer 408 and foam layer 410 are placed against mold portion 402 (with the

fabric layer 408 adjacent the mold portion 402). The internal structural support member layer 420 is heated for a suitable time (e.g., about 10 seconds) and at a sufficient temperature (e.g., about 150° C.) to soften the layer 420, and it is then pressed against the foam layer 410 of the combined external fabric layer 408/foam layer 410, resulting in layer 420 adhering to layer 410. The internal structural support member layer 420 is suitably aligned with the foam layer 410 before it is pressed against it so as to ensure that the internal structural support member 420 is aligned in the proper orientation and location of the fabric laminate 405 to be formed (and thus properly aligned within the heel cup 305 of the upper 105). In an example embodiment, the foam layer 410 can be provided with any suitable alignment indicators (indicia, one or more indentations, etc.) to facilitate appropriate alignment of the support member layer 420 against the foam layer 410.

[0055] At 525, the first package of the combined inner fabric layer 408/foam layer 410/reinforcement layer 415 is placed in mold portion 404 (with fabric layer 408 adjacent mold portion 404), while the second package of the combined outer fabric layer 408/foam layer 410/structural member layer 420 is placed in mold portion 402 (with fabric layer 408 adjacent mold portion 404). The mold portions 402, 404 are pressed together to compression mold all of the various layers together forming the fabric laminate 405. In an example embodiment, the compression molding process to secure all layers together (step 525) can be carried out at a temperature of the mold portions of about 190° C., imparting a sufficient heat to the layers such that the layers are at a temperature of about 150° C., and at a time of about 160 seconds. The molded fabric laminate 405 can then be cooled for about 2 minutes and/or until reaching ambient temperature (about 24° C. to about 28° C.) and removed from the mold portions. Optionally, an additional mold piece can be used that is contoured similar to the contours of the mold portions 402, 404 and to which the fabric laminate 405 is held against for a suitable time period to ensure the fabric laminate 405 maintains its molded shape during cooling.

[0056] Thus, the compression molding process forms a contoured portion of the upper 105 that is shaped in the form of the mold portions and which holds and maintains its shape. In particular, the planum portion 205 and/or dorsum portion 210 can each be formed via the compression molding process, with the same or different number and/or types of material layers. For example, the planum portion 205 can be formed via the compression molding process including the inner structural support member 420 which is an internal heel counter for the shoe, where the support member/heel counter 420 has a curved, general U-shape and is provided between the inner and outer fabric layers 408 of the fabric laminate 405 that forms a part of the upper 105 at the curved (rounded) heel cup location 305. The internal structural support member 420 (defining the internal heel cup) defines an internal reinforcing element for the upper that possesses rigidity that is equal to or greater than that of both the inner and outer fabric layers as well as most or all of the other layers (e.g., foam layers and reinforcing fabric layer) within the fabric laminate. In particular, the internal structural support member forms a reinforcing plate that provides additional support to the ankle, functioning as an internal heel counter.

[0057] Conventional shoes provide a heel counter that is external to the shoe (i.e., located adjacent an outer surface

portion and around the heel cup of the upper). The inner structural support member/heel counter 420 of the present invention is “hidden” (i.e., not externally exposed) but provides the same or similar benefits as a conventional heel counter in that it functions to strengthen the heel area of the upper, stabilize the user’s heel inside the shoe, provide support around the user’s ankle and/or control and stabilize the user’s heel inside the shoe and to minimize excessive supination or pronation of the foot. As previously noted, the internal structural support member can be formed of any suitably rigid materials that can have a hardness (e.g., a Shore A hardness value) that is greater than any of the other fabric or foam layers within the fabric laminate forming portions of the upper. The support member/heel counter 420 can be flexible, semi-rigid or rigid and can be formed, e.g., from a suitable thermoplastic elastomer material such as EVA or PU so as to provide suitable rearfoot stability, preventing injury and prolonging the life of the article of footwear.

[0058] As previously noted, one or more internal structural support members can also be provided at other locations of the upper, e.g., at the toe cage 150 (e.g., to protect the user’s toes) and/or along one or both of the lateral and medial sides 135 of the upper 105 (e.g., to provide support at different lateral and/or medial side locations of a user’s foot). An example embodiment of the upper 105 is depicted in FIG. 6 in which internal structural support members include the internal structural support member 420 located at the heel cup of the upper and defining an internal heel counter, an internal structural support 610 provided along a side surface (e.g., lateral side and/or medial side) of the upper 105 to provide a desired level of support, stiffness and/or rigidity at the side surface, and an internal structural support 620 provided at a portion of the toe cage 150 of the upper 105 to provide additional support, stiffness and/or rigidity at the toe cage (e.g., to provide a harder, more stiff structural support that absorbs forces and protects the wearer’s toes against impact from a surface or object). The compression molding process facilitates formation of the upper with one or more internal structures (either continuous or separated from each other within the upper) that are non-planar and contour along one or more portions of the upper. For example, as previously noted, the internal heel counter/structural support 420 can have a generally curved or U-shape that extends around the heel cup section 130 of the upper 105 to the lateral and/or medial sides of the upper. The toe cage structural support 620 can also have a curved configuration that conforms with a portion of the toe cage section 150 at the front or forefoot end of the upper 105 (e.g., a portion of the support 620 curves around the upper at the end of the wearer’s toes as shown in FIG. 6). The internal side support 610 can also have a slightly rounded or non-planar configuration that conforms to the contour of the side of the upper 105.

[0059] During compression molding of the different portions of the upper can be achieved using any selected number of different mold portions for the mold apparatus to achieve the varying contours of the upper portions (e.g., the contours of the dorsum and planum portions 205, 210 of the upper as depicted in FIGS. 2 and 3). In addition, certain layers form the fabric laminate (e.g., a laminate 405) can have different dimensions and/or shapes depending upon the configuration of the upper portion to be compression molded. In the embodiment depicted in the figures, the inner

structural support member/heel counter **420** (and/or any of the other internal structural support members, such as supports **610** and **620**) has a starting shape, dimensions and configuration that differs from the other fabric and foam layers since the counter **420** formed within the laminate **405** is only provided at the heel cup location **150**, whereas other layers (e.g., the inner and outer fabric layers **408**) extend further in dimensions along the fabric laminate **405** forming the planum portion **205**.

[0060] The formation of the upper in this manner results in a heel cup **305** defined by the planum portion **205** that is seamless. This differs from conventional footwear, which typically includes a seam (e.g., a welded seam or a stitched seam) within the heel cup. For example, a conventional heel cup includes a vertical seam along the connection between two heel halves (lateral and medial halves) and a longitudinal seam along the connection between the two halves of the footpad. In contrast, the heel cup **305** does not include a seam. Instead, the heel cup **305** is a unitary structure shaped to define a seamless, unitary heel cup. In a further embodiment, the entire planum portion **205** can be seamless, with the heel cup **305**, and the planum support **310** and lateral and medial sides **315** forming a unitary and/or one-piece structure.

[0061] Similarly, the dorsum portion **210** can also be a unitary, one-piece and seamless structure. In other words, the toe cage **150** and insole **145** (defined by the dorsum portion **210**) can both be seamless.

[0062] The compression molding process can further include mold portions having patterned depressions and/or protrusions that, when forming the fabric laminate, define a corresponding "mirror image" pattern of depressions and/or protrusions along a surface of the fabric laminate that defines an exterior surface portion of the upper. This facilitates the formation of macrostructure (the heel curvature) and/or microstructures on inner and/or outer surfaces of the upper. For example, the heel cup **305** of the upper **105** can include an external surface pattern **170** that forms an uneven contour of indentations and/or raised ridges (e.g., a pattern **170** having generally concave depressions, such as polygonal or diamond shaped depressions). The pattern **170** can further be formed on the outer surface of the outer fabric layer **408** or, alternatively, on another layer formed over the outer fabric layer **408**. For example, a further reinforcement layer **168** (shown in FIG. 1A) can be provided (e.g., a plastic material layer) that includes the pattern **170** disposed on it. In this embodiment, a coupling member **180** (e.g., fabric tape, as shown in FIG. 1A) can be provided at the join or connection between edges of the reinforcement layer **168** and the underlying portion of the upper (e.g., to provide a seamless and frictionless join or connection at these locations of the upper).

[0063] For example, protrusions can be formed at outer surface portions of the upper, via the compression molding process, that provide abrasion resistance or impact protection in specified areas of the upper. In addition, the protrusions may define contact areas configured to improve contact with a ball during game play (e.g., a soccer ball, kickball, etc.). When disposed on the inner surface of the upper, the protrusions can function as spacers to create air gaps or channels between the upper and the foot of the user, enabling airflow within the channels. The protrusions are integrated into the upper, being formed as the result of the shape of the mold portions. The protrusions may be any size

and shape suitable for their described purpose, and may be disposed in any predetermined pattern along a portion of the upper, or along the entire upper.

[0064] In other example embodiments, one or more layers forming the fabric laminate (which forms a portion of the upper) can include a patterned structure (e.g., protrusions and/or depressions) so as to function as an auxetic material. Generally, auxetics are materials that have a negative Poisson's ratio such that, when stretched, the auxetic materials become thicker perpendicular to the applied force. Imparting auxetic features within one or more layers (e.g., fabric, foam and/or internal structural support member layers) can provide the effect of enhancing the mechanical properties such as high energy absorption characteristics and greater ability to stretch without tearing/fracturing.

[0065] After the upper **105** is formed, the upper is coupled (e.g., mounted) at its lower end portion(s) to the sole structure **110** in any suitable manner, e.g., via an adhesive, welding (e.g., ultrasonic welding), etc.

[0066] Thus, the present invention facilitates the formation of an article of footwear in which the upper can be formed in one or more portions via a compression molding process, where an internal structural support member (e.g., an internal heel counter) can be provided within and between two or more layers of the upper to enhance the structural support at different locations of the upper.

[0067] While the invention has been described in detail and with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof. For example, while the example embodiments depicted in the figures show an article of footwear (shoe) configured for a right foot, it is noted that the same or similar features can also be provided for an article of footwear (shoe) configured for a left foot (where such features of the left footed shoe are reflection or "mirror image" symmetrical in relation to the right footed shoe).

[0068] The upper **105** can be formed of any one or more materials suitable for its described purpose, including conventional materials (e.g., woven or nonwoven textiles, knit textiles, leather, synthetic leather, rubber, etc.). The specific materials utilized to form the upper are generally selected to impart wear-resistance, flexibility, air-permeability, moisture control and/or comfort to the user wearing the shoe **10**.

[0069] Further, the upper **105** may possess any dimensions (size/shape) suitable for its described purpose. For example, the upper **105** may possess a "high top" configuration, in which a heel end **130** of the upper extends over and/or above at least a portion of a user's ankle. Alternatively, the upper **105** may possess a "mid top" configuration (in which the upper extends to slightly below or at the user's ankle), a low top configuration, or any other suitable configuration. The upper **105** can be coupled to the sole structure **110** in any suitable manner (e.g., via a strobil or, when no strobil is required due to an enclosed or sock-like configuration of the upper, via direct connection between a lower portion of the upper and an upper portion of the sole structure), where such coupling can be achieved in any conventional and/or other suitable manner (e.g., via any form of adhesion or bonding, via stitching, via one or more types of fasteners, etc.). For example, the upper can be completely or partially formed with fabric laminate portions via a compression molding process. Any selected number and/or types of material layers can be used to form a fabric laminate at portions of the

upper. The upper can be formed as a single, integral piece or component or, alternatively, as a plurality of pieces or components that are secured together via techniques as described herein. The upper can be provided with a single internal structural support member or a plurality of such support members at one or more locations of the upper.

[0070] Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents. It is to be understood that terms such as “top”, “bottom”, “front”, “rear”, “side”, “height”, “length”, “width”, “upper”, “lower”, “interior”, “exterior”, and the like as may be used herein, merely describe points of reference and do not limit the present invention to any particular orientation or configuration.

What is claimed:

1. An article of footwear comprising:
a sole structure; and
an upper secured to the sole structure;
wherein:
the upper includes a heel section, a lateral side section, a medial side section, an instep and a toe cage that define an interior cavity operable to receive a foot of a wearer; and
at least a portion of the upper comprises a laminate comprising an inner layer facing the cavity, an outer layer forming an exterior of the shoe, and an intermediate layer disposed between inner and outer layers, the intermediate layer comprising a reinforcing layer having a rigidity that is greater than the rigidity of the inner and outer layers, the reinforcing layer extending from the lateral side section to the medial side section.
2. The article of footwear of claim 1, wherein the reinforcing layer comprises a structural support member having a hardness value that is greater than the hardness value of the inner and outer layers.
3. The article of footwear of claim 2, wherein the inner and outer layers comprise fabric materials, and the structural support member comprises a plastic material.
4. The article of footwear of claim 3, wherein the structural support member comprises a thermoplastic polyurethane material or an ethylene vinyl acetate material.
5. The article of footwear of claim 3, further comprising a plurality of intermediate layers disposed between the inner layer and the outer layer, at least one of the intermediate layers comprising a foam layer.
6. The article of footwear of claim 5, wherein the laminate includes a first foam layer disposed between the structural support member and the inner layer and a second foam layer disposed between the structural support member and the outer layer.
7. The article of footwear of claim 3, wherein the structural support member comprises an internal heel counter located at the heel section of the upper.
8. The article of footwear of claim 7, wherein the internal heel counter has a generally U-shaped configuration.
9. The article of footwear of claim 1, wherein the upper comprises a first portion coupled with a second portion.
10. The article of footwear of claim 9, wherein the first portion comprises a planum portion that directly covers and/or engages a majority of a bottom side of the wearer's foot wherein the planum portion comprises the laminate, and

the second portion comprises a dorsum portion that directly covers and/or engages a majority of an upper side of the wearer's foot.

11. An upper for an article of footwear, the upper comprising:

a heel section, a lateral side section, a medial side section, an instep and a toe cage that define an interior cavity operable to receive a foot of a wearer;

wherein at least a portion of the upper comprises a laminate comprising an inner layer facing the cavity, an outer layer forming an exterior of the upper, and an intermediate layer disposed between the inner and outer layers, the intermediate layer comprising a reinforcing layer having a rigidity that is greater than the rigidity of the inner and outer layers.

12. A method of forming an upper for an article of footwear, the method comprising:

combining a plurality of portions including a first portion with a second portion, the plurality of portions defining a heel section, a lateral side section, a medial side section, an instep and a toe cage that define an interior cavity of the upper operable to receive a foot of a wearer, wherein the first portion is formed by a laminate, the laminate being formed by:

combining a plurality of layers together, including an inner layer that faces the cavity with an outer layer forming an exterior of the upper and an intermediate layer disposed between the inner and outer layers, the intermediate layer comprising a reinforcing layer having a rigidity that is greater than the rigidity of the inner and outer layers.

13. The method of claim 12, wherein the reinforcing layer comprises a structural support member having a hardness value that is greater than the hardness value of the inner and outer layers.

14. The method of claim 12, wherein the layers are combined to form the laminate by:

combining the layers in a mold and compressing the layers together while being heated to a temperature sufficient to soften at least one layer so as to adhere the layers together.

15. The method of claim 14, wherein the layers are compressed together while being heated to a temperature about 130° C. to about 200° C.

16. The method of claim 14, wherein the mold includes mold parts that compress the layers together in a shape to define a contoured curve portion of the upper.

17. The method of claim 16, wherein the layers are compressed within the mold to form a curved heel cup portion of the heel section of the upper, such that the reinforcing member is formed between the inner and outer layers as an internal heel counter of the upper having a generally U-shaped configuration.

18. The method of claim 12, wherein the plurality of layers includes further intermediate layers disposed between the inner layer and the outer layer, at least one of the further intermediate layers comprising a foam layer.

19. The method of claim 18, wherein the further intermediate layers include a first foam layer disposed between the inner layer and the reinforcing layer and a second foam layer disposed between the reinforcing layer and the outer layer.

20. The method of claim 12, wherein the first portion comprises a planum portion that directly covers and/or

engages a majority of a bottom side of the wearer's foot, and the second portion comprises a dorsum portion that directly covers and/or engages a majority of an upper side of the wearer's foot.

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