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(54) **Title**: SEAMLESS UPPER FOR FOOTWEAR AND METHOD FOR MAKING THE SAME

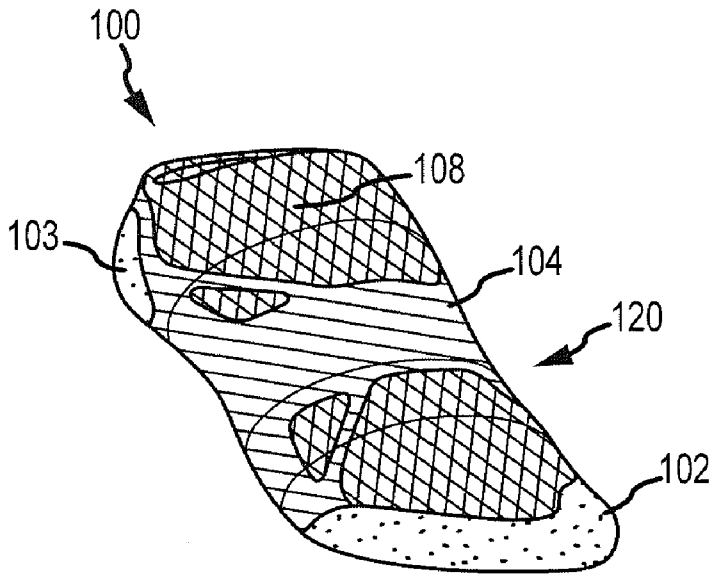

FIG.1A

(57) **Abstract**: This invention relates generally to footwear and methods for making the same, more particularly to a seamless upper for footwear and methods for making a seamless upper. In one aspect of the invention, the upper is seamless and/or is of unitary construction that defines an interior void for comfortably receiving a foot.

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SEAMLESS UPPER FOR FOOTWEAR AND METHOD FOR MAKING THE SAME

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application No. 61/473,473, entitled "SEAMLESS UPPER FOR FOOTWEAR AND METHOD FOR MAKING THE SAME" filed on April 8, 2011, the entire disclosure of which is incorporated by reference herein.

FIELD OF INVENTION

This invention relates generally to an upper for footwear, more particularly to a seamless upper for footwear and method for making the same.

BACKGROUND OF THE INVENTION

The upper portion of footwear vary in composition and design based on several design parameters, to include function/performance, weight, cost, aesthetics, comfort and ease of manufacture. Athletic shoes, for example, typically emphasize performance as dictated by the sport. A running shoe is commonly of lighter-weight than a tennis shoe, for example, given a running shoe generally does not require the lateral support of a tennis shoe. Given the particular cost-competitive nature of footwear and the volumes involved, ease of manufacture is another important consideration. Furthermore, any footwear must be comfortable.

Typically, athletic footwear comprises an upper portion and a sole portion. The upper provides a covering for the foot that securely receives and positions the foot with respect to the sole structure. In addition, the upper may have a configuration that protects the foot and provides ventilation, thereby cooling the foot and removing perspiration. The sole structure is typically secured to a lower surface of the upper and is generally positioned between the foot and the ground. The upper and the sole structure operate cooperatively to provide a comfortable structure that is suited for a wide variety of ambulatory activities, such as walking and running.

The materials forming the upper may be selected based upon the properties of wear-resistance, flexibility, stretchability, and air-permeability, for example. With regard to the exterior layer, the toe area and the heel area may be formed of leather, synthetic leather, or a rubber material to impart a relatively high degree of wear-resistance. Leather, synthetic leather, and rubber materials, however, may not exhibit the desired degree of flexibility and air-permeability. Accordingly, various other areas of the exterior layer of

the upper may be formed from a synthetic or natural textile material. The exterior layer of the upper may be formed, therefore, from numerous material elements that each impart different properties to specific portions of the upper. Similarly, the interior layer of the upper may be formed of a moisture-wicking textile that removes perspiration from the area immediately surrounding the foot. In traditional articles of athletic footwear, the various layers may be joined with an adhesive, and stitching may be utilized to join elements within a single layer or to reinforce specific areas of the upper.

Frequently, a fabric or a textile is used as a shoe upper of an athletic shoe. It is said that proper elasticity inherent in the shoe upper made of a fabric is advantageous in that it does not give a sense of oppression and a sense of fatigue. With respect to the shoe upper made of a fabric having such elasticity, U.S. Pat. Nos. 3,793,750 and 4,043,058 (both incorporated by reference for all purposes) each propose a shoe upper having a multi-layer sandwich construction prepared by interposing a plastic foam layer, such as a polyurethane layer, between an outer fabric layer and an inner fabric layer and bonding them. However, the above-mentioned shoe upper having a plastic foam layer interposed therein is not necessarily satisfactory in air permeability. Therefore, this causes problems such that the inside of the shoe becomes stuffy and hot because of abnormal temperature increase attributable to the sweating and generation of heat from feet during exercise, which brings about a discomfort. Further, although the above-mentioned resin foam layer has elasticity, it is large in resistance to the movement between the outer and inner fabric layers, because it is bonded to each of the outer and inner fabric layers with an adhesive, which leads to a large resistance of the shoe upper per se to bending. This inhibited the effect of alleviating a sense of oppression and a sense of fatigue for the feet. Textiles used in footwear uppers generally provide a lightweight, air-permeable structure that is flexible and comfortably receives the foot. Commonly, knitting materials have heightened movement and flexibility. A textile may be defined as any manufacture from fibers, filaments, or yarns characterized by flexibility, fineness, and a high ratio of length to thickness. However, the prior art use of fabrics and/or textiles in footwear uppers typically require seams. Seams introduce difficulties and limitations, to include difficulties in manufacture and freedom of design, and unintended abrasion to the user causing, for example, blisters and thereby compromising athletic performance.

In order to impart other properties to the footwear, including durability and stretch-resistance, additional materials are commonly combined with the textile, including leather, synthetic leather, or rubber, for example. With regard to durability, U.S. Pat. No.

4,447,967 to Zaino discloses an upper formed of a textile material that has a polymer material injected into specific zones to reinforce the zones against abrasion or other forms of wear. Regarding stretch resistance, U.S. Pat. No. 4,813,158 to Brown and U.S. Pat. No. 4,756,098 to Boggia both disclose a substantially inextensible material that is secured to the upper, thereby limiting the degree of stretch in specific portions of the upper. U.S. Pat. Nos. 4,447,967; 4,813,158; and 4,756,098 are incorporated by reference for all purposes.

It is desirable to minimize the number and types of materials in footwear, particularly athletic footwear. Fewer materials reduce costs and increase efficiency, given that shoe manufacture is a labor intensive process. The typical shoe manufacturing process encompasses the steps of cutting the upper material, reducing the thickness of the joining edges ("skiving"), reducing the thickness of the upper pieces ("splitting"), cementing the interlining to the upper pieces ("interlining"), forming the eyelets, stitching the upper pieces together, shaping the upper over a last ("lasting") and cementing, molding or sewing the bottom of the shoes to the upper ("bottoming"). Modern footwear designs, particularly athletic shoe designs, require numerous upper pieces and complicated manufacturing steps, leading to high labor costs. In addition, incorporating separate materials into an upper may involve multiple distinct manufacturing steps requiring multiple individuals. Employing multiple materials, in addition to textiles, may also detract from the breathability of footwear. Additionally, a new pattern is required and the manufacturing process must be retooled for every new design and style and for each desired shoe size.

In an effort to reduce labor costs, published PCT application WO 90/03744, incorporated herein by reference for all purposes, describes the use of heat embossing to minimize the number of manufacturing steps. The published application describes a process of manufacturing shoe components, including an entire one-piece upper, in which a multi-layered upper material is heat embossed in a compression mold to reduce the thickness of the material, to close or seal the edges, to incorporate a functional design or pattern lines, and for strain management. After the embossing step, the backsides of the embossed upper material are stitched together by means of a back strip and the upper material is lasted and bottomed to form the completed shoe. This process greatly reduces the cutting and stitching steps and can eliminate the skiving, splitting and interlining steps of the typical shoe manufacturing process. However, this shoe manufacturing process does not greatly reduce the assembly time and costs associated with creating new patterns and retooling the manufacturing process for new designs, new styles and different shoe sizes.

Rather, a new pattern and a new embossing mold must be created for each change in design and a separate embossing mold must be used for each desired shoe size. Similarly, numerous upper materials, in varying colors and textures must be kept in inventory to accommodate desired changes in style.

From the perspective of manufacturing, utilizing multiple materials to impart different properties to an article of footwear may be an inefficient practice. For example, the various materials utilized in a conventional upper are not generally obtained from a single supplier. Accordingly, a manufacturing facility must coordinate the receipt of specific quantities of materials with multiple suppliers that may have distinct business practices or may be located in different regions or countries. The various materials may also require additional machinery or different assembly line techniques to cut or otherwise prepare the material for incorporation into the footwear. In addition, incorporating separate materials into an upper may involve a plurality of distinct manufacturing steps requiring multiple individuals. Employing multiple materials, in addition to textiles, may also detract from the breathability of footwear. Leather, synthetic leather, or rubber, for example, are not generally permeable to air. Accordingly, positioning leather, synthetic leather, or rubber on the exterior of the upper may inhibit air flow through the upper, thereby increasing the amount of perspiration, water vapor, and heat trapped within the upper and around the foot.

The prior art uppers for footwear typically utilize multiple components or materials and require multiple manufacturing steps. Furthermore, the prior art uppers traditionally require one or more seams. Thus, existing uppers result in reduced footwear performance, increased manufacturing complexity, time and cost, and limited freedom of design. Therefore, there is a need for a seamless upper for footwear and process for making the same.

SUMMARY OF THE INVENTION

Certain embodiments of the present disclosure relate to an upper for footwear and methods for making the footwear upper. The invention involves application of a knitting process to the production of footwear uppers and entire footwear. In one preferred embodiment, a knitting process is disclosed to create a completely seamless upper portion of a shoe. The process can form the seamless footwear upper in a single step. In another embodiment, an entire seamless article of footwear, including the upper portion, is formed. Some benefits of this process include ease and efficiency of production, reduction of assembly time, maximum comfort through reduction of seams, and freedom of design.

The methods can include weaving and/or knitting the upper. The knitting process typically includes forming upper by interconnecting a series of stitches or loops.

Although many of the embodiments are focused on athletic footwear, other applications are available. Such applications include activities in which one or more of increased footwear performance, decreased manufacturing complexity, time and cost, and greater freedom of design is desired. Further, the use of the disclosed seamless uppers for footwear have applications beyond footwear, to include clothing, protective wrappings or covers, medical care such as for use as wrappings for burn-victims, geriatric care, and any application where seamless covering is desired.

Furthermore, the concepts disclosed with respect to footwear and footwear uppers may be applied to footwear styles that are specifically designed for a variety of other athletic activities, including basketball, baseball, football, soccer, walking, and hiking, for example, and may also be applied to various non-athletic footwear styles. Accordingly, one skilled in the relevant art will recognize that the concepts disclosed herein may be applied to a wide range of footwear styles and are not limited to the specific embodiments discussed below and depicted in the figures.

The concepts also may be applied to footwear styles that are generally considered to be non-athletic, including dress shoes, loafers, sandals, and work boots. The concepts disclosed herein apply, therefore, to a wide variety of footwear styles. Also, aspects of this invention may be used in conjunction with other portions of a footwear structure, such as a layer within an upper member structure, an interior lining for a footwear product (such as a sock liner), and a bootie member (optionally for inclusion in a footwear structure).

As used herein, the term “a” or “an” entity refers to one or more of that entity. As such, the terms “a” (or “an”), “one or more” and “at least one” can be used interchangeably herein. It is also to be noted that the terms “comprising”, “including”, and “having” can be used interchangeably.

As used herein, “at least one”, “one or more”, and “and/or” are open-ended expressions that are both conjunctive and disjunctive in operation. For example, each of the expressions “at least one of A, B and C”, “at least one of A, B, or C”, “one or more of A, B, and C”, “one or more of A, B, or C” and “A, B, and/or C” means A alone, B alone, C alone, A and B together, A and C together, B and C together, or A, B and C together.

As used herein, the term, “innersole” refers to a removable portion of the sole of an article of footwear, which is inserted into the article of footwear from the opening in the

upper and which is designed to provide support to the wearer's foot, depending upon the wearer's anatomy and the intended use of the article of footwear.

As used herein, the term, "midsole" refers to that portion of the sole of an article of footwear sandwiched between the innersole and the outsole, to which is attached the outsole.

As used herein, the term, "outsole" refers to that portion of the sole of an article of footwear that is furthest from the upper.

As used herein "knit construction" refers to one or both of the knit stitch and the yarns and/or threads comprising the knit stitch. As used herein, the terms "knit element", "knit structure", "textile" and "textile element" refer to the material used in constructing the upper.

As used herein, the term, "vamp" refers to a part of a shoe upper that covers any portion on the top part of the foot between where the toes and the legs connect to the foot.

As used herein, the term, "upper" refers to any portion of the shoe above the sole.

As used herein, the terms "shoe" and "footwear" refer to an article to be worn by a user's foot.

By way of providing additional background, context, and to further satisfy the written description and enablement requirements of 35 U.S.C. § 112, the following references are incorporated by reference in their entireties for the express purpose of explaining the nature of uppers for footwear and knitting and to further describe the various tools and other apparatus commonly associated therewith: U.S. Patent Publication No. 2011/0059288 entitled "Flannel Sheeting Fabric for Use in Home Textiles"; U.S. Patent Publication No. 2011/0067455 entitled "Knitting Machine"; U.S. Patent Publication No. 2011/0067455 entitled "Warp Knitted Fabric, Method of Manufacturing the Same, and Knit Structure of Warp Knitted Fabric; U.S. Patent Publication No. 2011/0056248 to Sato entitled "Shoe and Method of Manufacturing the Same"; U.S. Patent Publication No. 2009/0241374 to Oya entitled "Garment"; U.S. Patent Publication No. 2009/0064721 entitled "Warp Knitting Fabric And Its Manufacturing Method; U.S. Patent No. 7,770,271 Entitled "Method And Device For Operating A Creel Designed For A Winding System And Corresponding Creel; U.S. Patent No. 7,536,761 entitled "Device And Method For Spreading A Carbon Fiber Hank; U.S. Patent No. 7,458,236 entitled "Device For Feeding Fiber Bands To A Knitting Machine"; U.S. Patent No. 7,332,836 entitled "Guide Bar Drive In A Knitting Machine", U.S. Patent No. 7,331,200 entitled "Knitting Machine"; U.S. Patent No. 7,299,660 entitled "Knitting Machine"; U.S. Patent No. 7,120,976 entitled

"Process And Apparatus For Laying Fiber Bands Of Filaments"; U.S. Patent No. 6,993,939 entitled "Method And System For Producing A Multi-Layer, Pre-Fixed Thread Or Fiber Arrangement"; U.S. Patent No. 6,691,535 entitled "Fabric For The Formation Of Garment Pieces, The Garment Pieces Obtained Therefrom And The Garments Produced Therewith"; U.S. Patent No. 6,651,420 entitled "Method And Device For Treating Filament Yarn With Air"; U.S. Patent No. 6,354,069 entitled "Method And Device For Treating Filament Yarn With Air"; U.S. Patent No. 6,322,255 entitled "Joint Bearing Between Two Structural Elements Of Warp Knitting Machines"; U.S. Patent No. 6,253,583 entitled "Warp Knitting Machine With Pattern"; U.S. Patent No. 6,247,337 entitled "Gripping Breadth Holders In A Warp Knitting Machine"; U.S. Patent No. 6,233,798 entitled "Warping Machine And Process For Producing Pattern Warps"; U.S. Patent No. 6,212,915 entitled "Warp Knitting Machine With Thread Sheet Turning Arrangement"; U.S. Patent No. 6,151,929 entitled "Device For Fastening Active Components To The Bar Of A Wrap Knitting Machine And Accompanying Tool For Removing And Installing The Active Components"; U.S. Patent No. 6,151,923 entitled "Apparatus for Supplying A Multi-Layer, Multi-Axial Layer Of Yarn To The Knitting Site Of A Warp Knitting Machine"; U.S. Patent No. 6,009,729 entitled "Process For A Knitting Machine Employing Thread Processing Elements Embedded In Carrier"; U.S. Patent Publication No. 2010/0146823 to Yoshihiro entitled "Sold and Method of Manufacturing Sole"; U.S. Patent Publication No. 2010/0011479 to Onoda, entitled "Sportswear"; U.S. Patent Publication No. 2009/0241377 to Kita entitled "Sole Structure for a Shoe"; U.S. Patent Publication No. 2008/0120871 to Sato entitled "Upper Structure for a Shoe"; U.S. Patent No. 7,886,461 to Sato Entitled "Midfoot Structure of a Sole Assembly for a Shoe"; U.S. Patent No. 7,051,460 to Orei et al. entitled "Light Weight Shoes"; U.S. Patent Publication No. 2008/0179030 to O'Connor entitled "Subassembly for Industrial Fabrics"; U.S. Patent Publication No. 2004/0237599 to Kondou et al. entitled " Elastic Knitting Fabric Having Multilayer Structure"; U.S. Patent No. 7,552,604 to Waldrop et al. entitled "Double Needle Bar Elastomeric Spacer Knit"; U.S. Patent Publication No. 2009/0056857 to Heinrich et al. entitled "Method for Producing a Multidirectional Fabric Web"; U.S. Patent Publication No. 2007/0224897 to Shimazaki entitled "Fabric and Textile Product"; U.S. Patent No. 7,070,845 to Thomas et al. entitled "Fluid-Filled Bladder For An Article Of Footwear."

In addition, by way of providing additional background, context, and to further satisfy the written description and enablement requirements of 35 U.S.C. § 112, the

following references are incorporated by reference in their entireties for the express purpose of explaining the nature of uppers for footwear and knitting and to further describe the various tools and other apparatus commonly associated therewith: U.S. Patent Publication No. 2012/0055044, U.S. Patent Publication No. US2005/0193592; U.S. Patent Publication No. U.S. 2010/0325916; U.S. Patent Publication No. US2012/0005922; U.S. Patent Publication No. U.S. 2008/0196181; U.S. Patent Publication No. 2012/0079743; U.S. Patent Publication No. 2012/0079741; U.S. Patent Publication No. 2009/0084142; U.S. Patent Publication No. 2010/0107590; U.S. Patent Publication No. 2010/0107383; U.S. Patent Publication No. 2010/0107382; U.S. Patent Publication No. 2011/0214313; U.S. Patent Publication No. 2012/0005923; U.S. Patent Publication No. 2012/0011744; U.S. Patent No. 4,785,558; U.S. Patent No. 5,377,430; U.S. Patent No. 6,393,620; U.S. Patent No.6,533,885; U.S. Patent No. 7,347,011; U.S. Patent No. 7,814,598; U.S. Patent No.8,042,288; U.S. Patent No. 8,128,457; U.S. Patent No. 8,133,824; U.S. Patent No. 8,132,340; U.S. Patent No. 8,104,197; U.S. Patent No. 8,100,532; U.S. Patent No. 8,099,797; U.S. Patent No. 8,099,796; U.S. Patent No. 8,095,996; U.S. Patent No. 8,042,289; U.S. Patent No. 8,029,715; U.S. Patent No. 8,028,440; U.S. Patent No. 7,992,226; U.S. Patent No. 7,945,343; U.S. Patent No. 7,941,945; U.S. Patent No. 7,941,869; U.S. Patent No. 7,870,682; U.S. Patent No. 7,845,023; U.S. Patent No. 7,845,022; U.S. Patent No. 7,814,687; U.S. Patent No. 7,814,574; U.S. Patent No. 7,788,827; U.S. Patent No. 7,784,111; U.S. Patent No. 7,774,956; U.S. Patent No. 7,752,772; U.S. Patent No. 7,637,032; U.S. Patent No. 7,636,950; U.S. Patent No. 7,565,703; U.S. Patent No. 7,562,471; U.S. Patent No. 7,555,851; U.S. Patent No. 7,543,397; U.S. Patent No. 7,386,946; U.S. Patent No. 7,278,173; U.S. Patent No. 7,131,296; U.S. Patent No. 7,076,891; U.S. Patent No. 7,070,845; U.S. Patent No. 6,986,269; U.S. Patent No. 6,931,762; U.S. Patent No. 6,910,288; U.S. Patent No. 6,654,964; U.S. Patent No. 6,484,419; U.S. Patent No. 7,331,363 and U.S. Patent No. 5,271,101.

In one embodiment of the invention, an upper for an article of footwear comprises a textile element formed with a knitting machine. In one aspect of the invention, the upper is seamless and/or is of unitary construction. The knitting machine may have a configuration that forms the textile element through either warp knitting or weft knitting.

Another aspect of the invention involves a method of manufacturing an article of footwear. The method includes a step of mechanically-manipulating a yarn with a circular knitting machine, for example, to form a cylindrical textile structure. In addition, the

method involves removing at least one textile element from the textile structure, and incorporating the textile element into an upper of the article of footwear so as to form a seamless upper and/or entire footwear that is seamless.

In another aspect of the invention, an article of footwear has a seamless upper and a sole structure secured to the upper. The upper incorporates a textile element formed with a knitting machine. The textile element is removed from a textile structure that includes an outline of the textile element, and the textile element has edges that are joined together to define at least a portion of a void for receiving a foot.

In one embodiment, an upper is at least partially formed from a textile element that defines an interior void for comfortably receiving a foot and securing a position of the foot relative to sole structure. Various edges of textile element are then secured together to form the shape of upper. In some embodiments, textile element may form all of upper, substantially all of upper, or textile element may only be a portion of an upper.

Various materials may be utilized in manufacturing the upper of footwear. The upper of an article of athletic footwear, for example, may be formed from multiple material layers that include an exterior layer, an intermediate layer, and an interior layer. The materials forming the exterior layer of the upper may be selected based upon the properties of wear-resistance, flexibility, and air-permeability, for example. With regard to the exterior layer, the toe area and the heel area may be formed of leather, synthetic leather, or a rubber material to impart a relatively high degree of wear-resistance. Leather, synthetic leather, and rubber materials may not exhibit the desired degree of flexibility and air-permeability. Accordingly, various other areas of the exterior layer of the upper may be formed from a synthetic or natural textile. The exterior layer of the upper may be formed, therefore, from numerous material elements that each impart different properties to specific portions of the upper.

This disclosure provides methods for seamlessly knitting a tubular upper for a shoe. Circular knitting and warp knitting are examples of processes for forming the upper portion. Warp knitting is a family of knitting methods in which the yarn zigzags along the length of the fabric, i.e., following adjacent columns ("wales") of knitting, rather than a single row ("course"). The circular or weft knitting process includes knitting one yarn around the perimeter of a circular tube. Woven fabrics usually offer dimensional stability, whereas weft knitted fabrics are typically more elastic. Warp knitted fabrics combine these two properties: they can be produced as dimensionally stable, elastic as well as highly

elastic. Warp knit fabrics are typically used for athletic apparel, swimwear, and intimate apparel where a more durable knit fabric is needed

An intermediate layer of the upper may be formed from a lightweight polymer foam material that provides cushioning and protects the foot from objects that may contact the upper. Similarly, an interior layer of the upper may be formed of a moisture-wicking textile that removes perspiration from the area immediately surrounding the foot. In some articles of athletic footwear, the various layers may be joined with an adhesive, and stitching may be utilized to join elements within a single layer or to reinforce specific areas of the upper.

Although the materials selected for the upper vary significantly, textile materials often form at least a portion of the exterior layer and interior layer. A textile may be defined as any manufacture from fibers, filaments, or yarns characterized by flexibility, fineness, and a high ratio of length to thickness.

Textiles generally fall into two categories. The first category includes textiles produced directly from webs of filaments or fibers by randomly interlocking to construct non-woven fabrics and felts. The second category includes textiles formed through a mechanical manipulation of yarn, thereby producing a woven fabric, for example.

Yarn is the raw material utilized to form textiles in the second category. In general, yarn is defined as an assembly having a substantial length and relatively small cross-section that is formed of at least one filament or a plurality of fibers. Fibers have a relatively short length and require spinning or twisting processes to produce a yarn of suitable length for use in textiles. Common examples of fibers are cotton and wool. Filaments, however, have an indefinite length and may merely be combined with other filaments to produce a yarn suitable for use in textiles. Modern filaments include a plurality of synthetic materials such as rayon, nylon, polyester, and polyacrylic, with silk being the primary, naturally-occurring exception. Yarn may be formed of a single filament, which is conventionally referred to as a monofilament yarn, or a plurality of individual filaments grouped together. Yarn may also include separate filaments formed of different materials, or the yarn may include filaments that are each formed of two or more different materials. Similar concepts also apply to yarns formed from fibers. Accordingly, yarns may have a variety of configurations that generally conform to the definition provided above.

The various techniques for mechanically manipulating yarn into a textile include interweaving, intertwining and twisting, and interlooping. Interweaving is the intersection

of two yarns that cross and interweave at right angles to each other. The yarns utilized in interweaving are conventionally referred to as warp and weft. Intertwining and twisting encompasses procedures such as braiding and knotting where yarns intertwine with each other to form a textile. Interlooping involves the formation of a plurality of columns of intermeshed loops, with knitting being the most common method of interlooping.

At least some of advantages of warp knit over circular knit are: durabilty; greater range of design construction; ability to create mesh type and size; location and type of compress, stretch and thichness; ability to change yarns along at least the warp of the material; ability to change the yarns between the front and back of the knitted tube; creation of a substantially seamless structure; and the ability to create a substantially seamless structure in a footwear construction/format. For example, the upper can be knitted to have areas of cushioning, compression, breathability, color, and yarn content.

Flat knitting, when used in example structures according to this invention, can provide various advantages. For example, flat knitting can be used to provide textile structures for use in footwear uppers of a final desired shape such that textile cutting steps can be avoided (which eliminates waste, avoids the need to finish cut edges, saves time, saves money, etc.). Flat knitted elements also can be formed directly in desired three dimensional shapes, which can help avoid the need to use additional support structures in the overall footwear construction (which also saves time, money, etc.; produces a lighter and/or more flexible product; may eliminate seams and at least some sewing, etc.; etc.). By selectively placing multiple different yarns and/or stitch patterns at multiple different locations in the overall structure during the knitting process, flat knitted products may have multiple different physical properties (e.g., different stretchability, different moisture management capabilities, etc.) at multiple different locations or zones within a single, unitary construction (e.g., different properties at different zones or locations within a single footwear structure). Additionally, flat knitting can be used to produce pockets, tunnels, or other layered structures in the final product.

Textile elements may be formed through a flat knitting process. In general, flat knitting is a method for producing knitted material in which the material is turned periodically (i.e., the material is knitted from alternating sides). The two sides (otherwise referred to as "faces") of the material are conventionally designated as the "right side" (i.e., the side that faces outwards, towards the viewer) and the "wrong side" (i.e., the side that faces inwards, away from the viewer). Flat knitting may be contrasted with circular knitting, in which the fabric is always knitted from the same side. Various circular knitting

techniques are known, for example, narrow tube circular knitting and wide tube circular knitting. More specific examples of circular knitting techniques are described in U.S. Published Patent Publication No. 2005/0193592, which publication is entirely incorporated herein by reference. In contrast with circular knitting, flat knitting may be more complicated because the same stitch (as seen from the right side) is produced by two different movements when knitted from the right and wrong sides. Accordingly, a knit stitch (as seen from the right side) may be produced by a knit stitch on the right side or by a purl stitch on the wrong side. In flat knitting, the fabric is usually turned after every row. Although flat knitting provides a suitable manner for forming textile elements, other types of knitting may also be utilized, including wide tube circular knitting, narrow tube circular knit jacquard, single knit circular knit jacquard, double knit circular knit jacquard, and warp knit jacquard, for example. An advantage of flat knitting over various other types of knitting is that the flat knitting process may be utilized to form generally three-dimensional structures or structures wherein layers of material overlap each other (i.e., are at least partially coextensive) to form loops or other overlapping configurations. More particularly, the flat knitting process may make structures wherein layers are joined to each other such that opposite sides of one layer are formed of unitary construction with the other layer. In addition, flat knitting may be utilized to form areas with different types of stitches and areas with different types of yarns. For example, a forward portion of an upper may be configured so as to stretch to a different degree than non-ribbed configurations of center portions and/or rearward portions. Moreover, textile elements may be formed from a less stretchable type of stitch than forward portion and the yarn selected for selected textile elements may be more wear-resistant than the yarn selected for a forward portion. As another example, the knit/yarn combination utilized for rearward portion may be selected to impart stretch and recovery to ankle opening. Accordingly, the flat knitting process may be utilized to form a generally three-dimensional or overlapping structure having areas with different properties that are produced from combinations of different types of stitches and different types of yarns. Also this feature reduces waste and saves time and money in the manufacturing process.

In one embodiment, the upper is formed from a textile element and may also include laces or other elements associated with a conventional upper for footwear. The textile element is a single material element that is formed to exhibit a unitary (i.e., one-piece) construction, and textile element is formed or otherwise shaped to extend around

the foot. The textile element may be formed as a part of a larger textile element. The textile element is then removed from the larger textile element to form the shape of upper.

The textile element is a single material element with a unitary construction, as discussed above. As defined for purposes of the present invention, unitary construction and/or "seamless" is intended to express a configuration wherein portions of a textile element are not joined together by seams or other connections. The textile element is primarily formed from one or more yarns that are mechanically-manipulated through either an interweaving, intertwining and twisting, or interlooping process, for example. As discussed, interweaving is the intersection of two yarns that cross and interweave at right angles to each other. The yarns utilized in interweaving are conventionally referred to as warp and weft. Intertwining and twisting encompasses procedures such as braiding and knotting where yarns intertwine with each other to form a textile. Interlooping involves the formation of a plurality of columns of intermeshed loops, with knitting being the most common method of interlooping. Textile element may, therefore, be formed from one of these processes for manufacturing a textile.

A variety of mechanical processes have been developed to manufacture a textile. In general, the mechanical processes may be classified as either warp knitting or weft knitting. With regard to warp knitting, various specific sub-types that may be utilized to manufacture a textile include tricot, raschel, and double needle-bar raschel (which further includes jacquard double needle-bar raschel). With regard to weft knitting, various specific sub-types that may be utilized to manufacture a textile include circular knitting and flat knitting. Various types of circular knitting include sock knitting (narrow tube), body garment (seamless or wide tube), and jacquard.

The textile element may be formed through any of the mechanical processes discussed above. Accordingly, textile element may be formed on either a warp knitting machine or a weft knitting machine. As an example, not intending to limit the disclosure, one suitable knitting machine for forming textile element is a circular knit jacquard machine. In one embodiment, a textile element as formed via a circular knit jacquard machine has various areas of cushioning, compression, breathability, color, and yarn content.

Another suitable knitting machine for forming textile element is a wide-tube circular knitting machine that is produced in the Lonati Group by Santoni S.p.A. of Italy under the SM8 TOP1 model number. A wide-tube circular knitting machine, as produced by Santoni S.p.A., forms a generally cylindrical textile structure and is capable of forming

various types of stitches within a single textile structure. In general, the wide-tube circular knitting machine may be programmed to alter the design on the textile structure through needle selection. That is, the type of stitch that is formed at each location on the textile structure may be selected by programming the wide-tube circular knitting machine such that specific needles either accept or do not accept yarn at each stitch location. In this manner, various patterns, textures, or designs may be selectively and purposefully imparted to the textile structure.

Textile structure may be formed with a wide-tube circular knitting machine, as discussed above. The types of stitches that form textile structure may be varied to form an outline of one or more textile elements on textile structure. That is, the wide-tube circular knitting machine may be programmed to form different types of stitches in textile structure so as to outline one or more textile elements. The yarn forming textile element may be generally defined as an assembly having a substantial length and relatively small cross-section that is formed of at least one filament or a plurality of fibers.

As another example, not intending to limit the disclosure, of a suitable knitting machine for forming textile element is that of U.S. Patent No. 8,132,431. The disclosure provides a knitting machine that includes a shogging drive, a swing-through drive, and at least one guide bar, which is moveable by the shogging drive in a shogging direction and by the swing-through drive perpendicular to the shogging direction. The sequence of movements of the guide bar is controlled such that in a loop formation the guide bar is moved once back and once forth in a shogging direction. (The shogging direction is the direction that corresponds to the longitudinal extension of the guide bar, i.e., the direction in which all of the guides of the guide bar are arranged one behind the other.) Further, a slide surface pairing has two slide surfaces oriented perpendicularly to the shogging direction, and the shogging drive acts on the guide bar via the slide surface pairing. In accordance with embodiments, the shogging drive can include a transfer element guided in the shogging direction, which supports one of the slide surfaces of the slide surface pairing. The transfer element may be formed as an actuator rod. U.S. Patent No. 8,132,431 is incorporated by reference for all purposes.

Without intending to limit the invention, in order to provide the stretch and recovery properties to upper and/or textile element a yarn that incorporates an elastane fiber may be utilized. Such elastane fibers are available from E.I. duPont de Nemours Company under the Lycra trademark. Such fibers may have the configuration of covered Lycra, wherein the fiber includes a Lycra core that is surrounded by a nylon sheath. One

suitable yarn, for example, includes a 70 denier elastane core that is covered with nylon having a 2 ply, 80 denier, 92 filament structure. Other fibers or filaments exhibiting elastic properties may also be utilized, to include but not limited to spandex, elaspan, creora, roica, dorlastan, linel and espa.

As discussed above, a yarn that incorporates elastane fibers is suitable for textile element. A plurality of other yarns, whether elastic or inelastic, are also suitable for the textile element. The characteristics of the yarn selected for textile element depend primarily upon the materials that form the various filaments and fibers. Cotton, for example, provides a soft hand, natural aesthetics, and biodegradability. Elastane fibers, as discussed above, provide substantial stretch and recoverability. Rayon provides high luster and moisture absorption. Wool also provides high moisture absorption, in addition to insulating properties. Polytetrafluoroethylene coatings may provide a low friction contact between the textile and the skin. Nylon is a durable and abrasion-resistant material with high strength. Finally, polyester is a hydrophobic material that also provides relatively high durability. Accordingly, the materials comprising the yarn may be selected to impart a variety of physical properties to textile element, and the physical properties may include, for example, strength, stretch, support, stiffness, recovery, fit, and form.

In addition to varying the stitch types to form textures, the type of yarn utilized in various areas of textile elements may be changed to impart different properties. Yarn may be formed from cotton, wool, elastane, rayon, nylon, and polyester, for example. Each of these yarn types may impart differing properties. For example, elastane may be utilized to impart stretch, wool may be utilized for insulation, and nylon may be utilized for durability. Accordingly, different yarn types may be utilized to impart different properties. The types of knitting that may be utilized to form different zones with different properties (e.g., yarn characteristics, textures, etc.) may vary significantly to include the various warp knitting and weft knitting processes discussed earlier, such as tricot, raschel, double needle-bar raschel, circular knitting, and flat knitting, for example.

Textile element is depicted as having a generally smooth, non-varied stitch configuration. That is, similar stitches are utilized throughout textile element to impart a common texture to the various portions of textile element. As discussed above, however, a wide-tube circular knitting machine is generally capable of forming various types of stitches within a single textile structure. The wide-tube circular knitting machine may, therefore, vary the stitches within textile element to produce various patterns, designs, or

textures, for example. Various types of stitches may also be formed with other types of knitting machines.

Many conventional articles of footwear incorporate uppers with various material elements that each exhibit different properties. For example, a first material element may be smooth, and a second material element may be textured. The first and second material elements are then stitched together to form a portion of the conventional upper. Textile element also exhibits smooth and textured areas. In contrast with the conventional upper, however, first texture and second texture are incorporated into a single, unitary element of textile, rather than two separate elements that are stitched or otherwise joined together.

Various warp knitting or weft knitting processes may be utilized to form textile element, or the various other textile elements discussed above. An advantage of this process is that various stitches may be incorporated into specific locations of textile element to modify the physical properties or aesthetics of textile element. Whereas a conventional upper includes various elements that stitched or adhesively joined, textile element is a single, unitary element of material. From the perspective of manufacturing, utilizing multiple materials to impart different properties to an article of footwear may be an inefficient practice. By forming textile element to be a single, unitary element of material, however, efficiency is increased in that upper may include a single textile element, rather than numerous joined elements.

A variety of knitting processes may be utilized to form textile element, as discussed above. As a specific example, a jacquard double needle-bar raschel knitting machine may be utilized to form a flat textile structure, and may also be utilized to form the textile structure to have the configuration of a spacer mesh textile. Unlike textile structure, which exhibits a generally cylindrical configuration, the textile structure formed with the jacquard double needle-bar raschel knitting machine will have a flat configuration. Like textile structure, however, an outline of a textile element may be imparted to the textile structure formed with the jacquard double needle-bar raschel knitting machine. That is, differences in the stitches within the textile structure may form an outline with the shape and proportions of the intended textile element. Accordingly, the textile element may be removed from the textile structure and incorporated into footwear. In addition, the jacquard double needle-bar raschel knitting machine may be utilized to impart various textures, different properties, or different yarn types to the textile element. Similarly, other types of knitting, such as a flat knitting, may be utilized within the scope

of the present invention to impart various textures, different properties, or different yarn types to the textile element.

A double needle-bar raschel is one example of a warp knit machine which can knit two sides of fabric at one time. It is possible to use this type of machine to knit a warp knit tube by stitching the two sides of the fabric together during the knitting process. A warp knitting machine can engineered to knit a shaped tube by utilizing a jacquard double needle bar machine. A electronic jacquard double needle bar can make a shaped tube with an engineered construction. There are a number of possibilities for upper design and performance. The following can be adjusted in order to create uppers for a specific applications: yarn types (such as, elastic, non-eleastic, yarn size, fiber type (such as denier, composition, polyester, nylon, etc.)), stitch construction (such as mexh, more closed or open for breathability and/or durability), for stretch and/or elastic propertis, rigidty (for support and fit), size (for shoe fit).

In one embodiment, a shoe upper is knitted using a knitting machine such as a tricot knitting machine or a raschel knitting machine. The knitting may be stepwise conducted through a step of knitting one or more knit layers or types (such as, for example, an outer and inner knit fabric layer) and a step of connecting the one or more knit layers or types with crossing threads. Alternatively, the knitting may be constructed using a double raschel knitting machine which can knit a shoe upper simply in one step because it can simultaneously conduct the two above-mentioned steps.

Any desired type of cutting operation may be utilized without departing from the invention, including, for example, die cutting, laser cutting, hand cutting, and the like. Also, any desired type of material may be used without departing from this invention. The material may be a material having a higher modulus of elasticity (e.g., more resistant to tensile stretching forces and/or providing a higher compression force) as compared to that of the fabric elements making up other portions of the upper and/or footwear structure (e.g., compared to the stretch resistance or compressive force applying capability for the spandex, cotton, polyester, or other fabric elements making up the structure). As some more specific examples, material may be materials commonly used in tackle twill production, a canvas type material, a polyester type material, a thermoplastic polyurethane adhesive material, for example.

In some embodiments, a seamless upper component formed via warp knitting and/or circular knitting is configured to fit a shoe last and heat set into shape. The seamless upper is then attached to a shoe sole, for example, to create a finished shoe. In

some embodiments the upper can be knitted and/or jointed to a structural element to form the shoe where one or both of the upper and structural element include support structure(s), form an exoskeleton, a cinching or closer system. Some embodiments include an insole insert.

In one embodiment, the knitted fabrics of the upper are not of substantially uniform thickness, but instead form contours, ridges, or patterns.

In one embodiment, only the upper of the footwear is of seamless knit. In another embodiment, the entire footwear, to include the upper, is of seamless knit.

In one embodiment, the textile element is a "dimensionalized" structure, as disclosed in U.S. Patent No. 8,133,824, which is incorporated by reference for all purposes.

In one embodiment, the upper comprises one or more knitted eyelets that are seamless and/or integrally and/or simultaneously constructed with the construction of the upper.

In one embodiment, the upper is constructed of a single type of knit construction. In one embodiment, the upper is constructed of a single layer and/or is constructed of a single stitch configuration. In one embodiment, the upper is constructed such that it does not have longitudinal edges.

In one embodiment, the upper is constructed to incorporate a single type of textile having a plurality of knit constructions. In one embodiment, the upper is constructed to incorporate a single type of textile having a single type of knit construction. In one embodiment, the upper is constructed with a circular knitting machine to form a cylindrical textile structure that incorporates a single type of textile having a plurality of knit constructions.

In one embodiment, the upper is constructed with a weft-knitted textile element that incorporates a single type of textile having a single knit construction. In one embodiment, the upper is constructed with a weft-knitted textile element that incorporates a single layer and/or is constructed of a single stitch configuration.

In one embodiment, the knitting element is constructed during a knitting process.

In one embodiment, the upper does not feature an overlapped configuration of knitted material and/or layers.

In one embodiment, the upper is constructed of a knitted element that is not a woven element. In one embodiment, the upper is not constructed of a woven element and/or not constructed of an element substantially formed on a loom.

In one embodiment, an article of footwear comprises an upper and a sole structure attached to the upper.

In one embodiment, an article of footwear comprises an upper and a sole structure attached to the upper, the upper comprises lace-receiving elements and/or eyelets and the upper does not comprise strands that extend proximal to the lace-receiving elements to an area proximal to the sole structure.

In one embodiment, the upper comprises a knitted element having a lateral side and an opposite medial side, the knitted element defining at least one lateral channel formed between two spaced-apart knitted layers and located on the lateral side and at least one medial channel formed between two spaced-apart knitted layers and located on the medial side, each of the lateral channel and the medial channel being formed of unitary construction.

The preceding is a simplified summary of the invention to provide an understanding of some aspects of the invention. This summary is neither an extensive nor exhaustive overview of the invention and its various embodiments. It is intended neither to identify key or critical elements of the invention nor to delineate the scope of the invention but to present selected concepts of the invention in a simplified form as an introduction to the more detailed description presented below. As will be appreciated, other embodiments of the invention are possible utilizing, alone or in combination, one or more of the features set forth above or described in detail below.

The present disclosure, in various embodiments, configurations, or aspects, includes components, methods, processes, systems and/or apparatus substantially as depicted and described herein, including various aspects embodiments, configurations, sub-combinations, and subsets thereof. Those of skill in the art will understand how to make and use the various aspects, embodiments, configurations, sub-combinations, and subsets of the present disclosure after understanding the disclosure. The present disclosure, in various aspects, embodiments, and configurations, includes providing devices and processes in the absence of items not depicted and/or described herein or in various aspects, embodiments, or configurations hereof, including in the absence of such items as may have been used in previous devices or processes, e.g., for improving performance, achieving ease and\or reducing cost of implementation.

The foregoing discussion of the disclosure has been presented for purposes of illustration and description. The foregoing is not intended to limit the disclosure to the form or forms disclosed herein. In the foregoing Detailed Description for example,

various features of the disclosure are grouped together in one or more aspects, embodiments, or configurations for the purpose of streamlining the disclosure. The features of the aspects, embodiments, or configurations of the disclosure may be combined in alternate aspects, embodiments, or configurations other than those discussed above. This method of disclosure is not to be interpreted as reflecting an intention that the claims require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive aspects lie in less than all features of a single foregoing disclosed aspect, embodiment, or configuration. Thus, the following claims are hereby incorporated into this Detailed Description, with each claim standing on its own as a separate preferred embodiment.

Moreover, though the description of the disclosure has included description of one or more aspects, embodiments, or configurations and certain variations and modifications, other variations, combinations, and modifications are within the scope of the invention, e.g., as may be within the skill and knowledge of those in the art, after understanding the present disclosure. It is intended to obtain rights which include alternative aspects, embodiments, or configurations to the extent permitted, including alternate, interchangeable and/or equivalent structures, functions, ranges or steps to those claimed, whether or not such alternate, interchangeable and/or equivalent structures, functions, ranges or steps are disclosed herein, and without intending to publicly dedicate any patentable subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are incorporated into and form a part of the specification to illustrate several examples. These drawings, together with the description, explain the principles of the invention(s). The drawings simply illustrate preferred and alternative examples of how the invention(s) can be made and used and are not to be construed as limiting the invention(s) to only the illustrated and described examples.

Further features and advantages will become apparent from the following, more detailed, description of the various embodiments of the invention(s), as illustrated by the drawings referenced below.

Fig. 1A is a perspective view of one embodiment of a seamless upper for footwear;

Fig. 1B is a bottom-view of the embodiment of a seamless upper for footwear of Fig. 1A;

Fig. 1C is a top-view of the embodiment of a seamless upper for footwear of Fig. 1A;

Fig. 1D is a lateral three-fourths view of the embodiment of a seamless upper for footwear of Fig. 1A;

Fig. 1E is a medial three-fourths view of the embodiment of a seamless upper for footwear of Fig. 1A;

Fig. 2 is a schematic of weaving, weft knitting and warp knitting;

Fig. 3 depicts one method of the formation of a plurality of footwear uppers;

Fig. 4 depicts another method of the formation of a plurality of footwear uppers;

Fig. 5 is a perspective view of another embodiment of a seamless upper for footwear;

Fig. 6 is a perspective view of another embodiment of a seamless upper for footwear in which the footwear undergoes a plastic dip step;

Fig. 7A is a perspective view of one embodiment of knitted eyelets;

Fig. 7B is a perspective view of another embodiment of knitted eyelets;

Fig. 8A is a perspective view of another embodiment of a seamless upper for footwear;

Fig. 8B is a top view of the embodiment of a seamless upper for footwear of Fig. 8A;

Fig. 9 is a top-view of one method of the formation of the embodiment of a seamless upper for footwear of Fig. 8A;

Fig. 10A is a perspective view of another embodiment of a seamless upper for footwear;

Fig. 10B is a top-view of the embodiment of a seamless upper for footwear of Fig. 10A in which the toe cap reinforcement portion is unassembled to the seamless upper;

Fig. 10C is a top-view of the embodiment of a seamless upper for footwear of Fig. 10A in which the vamp reinforcement portion is unassembled to the seamless upper;

Fig. 10D is a top-view of the embodiment of a seamless upper for footwear of Fig. 10A in which the heel cap reinforcement portion is unassembled to the seamless upper;

Fig. 11 is a side view of another embodiment of a seamless upper for footwear with a mid-sole portion;

Fig. 12 is a cut-away side-view of further describing the embodiment of a seamless upper for footwear with a mid-sole portion of Fig. 11;

Fig. 13 is a perspective view of another embodiment of a seamless upper for footwear;

Fig. 14 is a perspective view of another embodiment of a seamless upper for footwear;

Fig. 15A is a cut-away side view of another embodiment of a seamless upper for footwear;

Fig. 15B is a cut-away side view of another embodiment of a seamless upper for footwear; and

Fig. 16 is a perspective view of another embodiment of a seamless upper for footwear.

DETAILED DESCRIPTION

The present disclosure relates to an upper for footwear and methods for making the footwear upper. The invention involves application of a knitting process to the production of footwear uppers. In one preferred embodiment, a knitting process is disclosed to create a completely seamless upper portion of a shoe. The process can form the footwear upper in a single step. Some benefits of this process include ease and efficiency of production, reduction of assembly time, maximum comfort through reduction of seams, and freedom of design. The methods can include weaving and/or knitting the upper. The knitting process typically includes forming upper by interconnecting a series of stitches or loops.

In the following description, and for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the various aspects of the invention. It will be understood, however, by those skilled in the relevant arts, that the present invention may be practiced without these specific details. In other instances, known structures and devices are shown or discussed more generally in order to avoid obscuring the invention. In many cases, a description of the operation is sufficient to enable one to implement the various forms of the invention, particularly when the operation is to be implemented in software. It should be noted that there are many different and alternative configurations, devices and technologies to which the disclosed inventions may be applied. The full scope of the inventions is not limited to the examples that are described below.

The following description will typically be with reference to specific structural embodiments and methods. It is to be understood that there is no intention to limit the invention to the specifically disclosed embodiments and methods but that the invention may be practiced using other features, elements, methods and embodiments. Preferred

embodiments are described to illustrate the present invention, not to limit its scope, which is defined by the claims. Furthermore the embodiments of discussed may be combined with any one or more other embodiments described explicitly or impliedly herein. Those of ordinary skill in the art will recognize a variety of equivalent variations on the description that follows. Like elements in various embodiments are commonly referred to with like reference numerals.

In one embodiment of the invention, an upper for an article of footwear comprises a textile element formed with a knitting machine. In one aspect of the invention, the upper is seamless and/or is of unitary construction. The knitting machine may have a configuration that forms the textile element through either warp knitting or weft knitting.

Another aspect of the invention involves a method of manufacturing an article of footwear. The method includes a step of mechanically-manipulating a yarn with a circular knitting machine, for example, to form a cylindrical textile structure. In addition, the method involves removing at least one textile element from the textile structure, and incorporating the textile element into an upper of the article of footwear so as to form a seamless upper and/or entire footwear that is seamless.

In another aspect of the invention, an article of footwear has a seamless upper and a sole structure secured to the upper. The upper incorporates a textile element formed with a knitting machine. The textile element is removed from a textile structure that includes an outline of the textile element, and the textile element has edges that are joined together to define at least a portion of a void for receiving a foot.

In one embodiment, an upper is at least partially formed from a textile element that defines an interior void for comfortably receiving a foot and securing a position of the foot relative to sole structure. Various edges of textile element are then secured together to form the shape of upper. In some embodiments, textile element may form all of upper, substantially all of upper, or textile element may only be a portion of an upper.

Referring now to Figures 1-16, several representations and configurations of the present invention are shown. In regard to Figs. 1A-E, one embodiment of a seamless upper for footwear is depicted. Footwear 100 is shown with bottom portion 130 and top portion (herein also referred to as the "upper" or "upper portion") 120. Footwear 100 comprises heel portion 103, toe portion 102, vamp portion 104, and upper covering 108. In the embodiment of the footwear 100 shown in Figs. 1A-E, the footwear 100 is depicted with three types of knit. More specifically, heel portion 103 and toe portion 102 are shown with an abrasive resistant knit, vamp portion 104 with a supportive knit, and remaining

portions such as upper covering 108 and bottom 130 of a breathable/open knit. The supportive knit of vamp portion 104 is generally of tighter knit than the breathable/open knit of upper covering 108 and bottom 130. However, the various knits are constructed so as to be substantially or completely seamless. Fig. 1A depicts the footwear 100 as worn by a user (not shown). In the configuration of Fig. 1A, the upper forms 130 a void on the interior of the footwear 100 for receiving a user's foot. In contrast, Fig. 1C depicts a top-view of the footwear 100 when not worn by a user, such that the aforementioned void is nearly or completely closed. In one embodiment, another knit with elastic properties is fitted to an upper portion of the upper covering 108 so as to expand sufficiently to allow the aforementioned void to form and enable the interior of the footwear 100 to receive a user's foot. In other embodiments of the footwear 100 and/or upper portion 120 is comprised of substantially the same knit material, while in other embodiments of the footwear 100 and/or upper portion 120 is comprised of a plurality of knits.

The knitted upper can have one or more support and/or tightening zones. The knit construction of the one or more support and/or tightening zones may include elastomeric yarns and/or a knit that more constrictive within the tightening zone(s) than in non-tightening zones. Furthermore, the support and/or tightening zone(s) may comprise a knit construction that is stronger, tougher and/or more capable of carrying a load than the knit construction of the non-tightening zone(s). One or more zones of the upper can comprise an open knit. Preferably, the open knit is a knit construction that is substantially "breathable". As used herein a "breathable" refers to permeability to one or more of air, oxygen, and water vapor.

One or more zones of the upper can comprise a cushioning knit. Preferably, the cushioning knit is a knit construction has at least some shock absorbing properties. As used herein "shock absorbing" refers to smoothing out, damping and/or dissipating impact and/or impulse energy, as for example the impact energy when a person's foot strikes a surface when running or walking. The cushioning knit is typically positioned about one or more of tightening zone(s) and the insole.

Preferably, one or more zones of the upper are substantially abrasion resistant. More preferably, the abrasion resistant zone(s) comprise a knit construction that is substantially durable to abrasion. As used herein "abrasion resistance" refers to rubbing and/or scrapping away by mechanical and/or frictional action. Even more preferably, the one or more abrasion resistant zones comprise an abrasion resistant knit construction.

Non-limiting examples of abrasion resistant knit construction comprise one or both of a high density knit and abrasion resistant yarns and/or threads.

It can be appreciated that the knitted upper can optionally have one or more breathable zones, one or more tightening and/or support zones; one or more cushioning zones; and optionally one or more abrasion resistant zones. Furthermore, any one of the optional one or more breathable, tightening and/or support, cushioning and abrasion resistant zones can include in addition to its corresponding knit construction, knit constructions corresponding to the breathable, tightening and/or support, cushioning and abrasion resistant knit constructions. That is for example, the breathable zone, in addition to including a breathable knit construction, may also include, in some embodiments, a cushioning knit construction.

In regard to Fig. 2, a schematic of weaving, weft knitting and warp knitting is provided. More specifically, a basket weave is depicted as well as a weft knit and warp knit. In one embodiment, the footwear 100 and/or upper portion 120 are comprised of one or more of weft knitting and warp knitted material.

Various warp knitting or weft knitting processes may be utilized to form textile element, or the various other textile elements discussed above. An advantage of this process is that various stitches may be incorporated into specific locations of textile element to modify the physical properties or aesthetics of textile element. Whereas a conventional upper includes various elements that stitched or adhesively joined, textile element is a single, unitary element of material. From the perspective of manufacturing, utilizing multiple materials to impart different properties to an article of footwear may be an inefficient practice. By forming textile element to be a single, unitary element of material, however, efficiency is increased in that upper may include a single textile element, rather than numerous joined elements.

A variety of knitting processes may be utilized to form textile element, as discussed above. As a specific example, a jacquard double needle-bar raschel knitting machine may be utilized to form a flat textile structure, and may also be utilized to form the textile structure to have the configuration of a spacer mesh textile. Unlike textile structure, which exhibits a generally cylindrical configuration, the textile structure formed with the jacquard double needle-bar raschel knitting machine will have a flat configuration. Like textile structure, however, an outline of a textile element may be imparted to the textile structure formed with the jacquard double needle-bar raschel knitting machine. That is, differences in the stitches within the textile structure may form

an outline with the shape and proportions of the intended textile element. Accordingly, the textile element may be removed from the textile structure and incorporated into footwear. In addition, the jacquard double needle-bar raschel knitting machine may be utilized to impart various textures, different properties, or different yarn types to the textile element. Similarly, other types of knitting, such as a flat knitting, may be utilized within the scope of the present invention to impart various textures, different properties, or different yarn types to the textile element.

In regard to Figs. 3 and 4, depictions of methods of formation and/or cutting of footwear and/or upper portions 302 are shown. In each of Figs. 3 and 4, the top-most area represents a single knitted sheet 301 as output from a knitting machine (not shown). Fig. 3 depicts that in some embodiments a plurality of knitted uppers 302 be formed in a single knitted sheet 301. It can be can be appreciated that a process which forms a plurality of knitted uppers in knitting process is preferable to a process which forms individual knitted uppers and/or to a process which forms a woven upper. Fig. 4 depicts that in some embodiments the uppers 302 can be knitted on a single knitted sheet 301 in a configuration to substantially reduce waste of knitted sheet that is not part of the knitted upper.

In regard to Fig. 5, a perspective view of another embodiment of a seamless upper for footwear 500 is depicted. Fig. 5 depicts that in some embodiments the knit direction 501 can wrap around a wearer's foot in a medial/lateral direction. In other embodiments, the knit direction 501 can wrap around a wearer's foot in the anterior (toe) / posterior (heel) direction. It can be appreciated that embodiments having the knit direction 501 in a medial/lateral direction can further include one or more support and/or tightening zones that wrap around a wearer's foot in the medial/lateral direction. In some embodiments, the knit elements 501 can can carry stress around the wearer's foot, as for example without limitation stresses from a lacing system for securing the shoe on a wearer's foot.

In some embodiments, the knitted upper 504 can include a knitted toe 502. The toe knit construction 502 can be one or more of breathable, tightening and/or support, cushioning and abrasion resistant knit constructions. The one or more of breathable, tightening and/or support, cushioning and abrasion resistant knit constructions can be formed by the knit stitching or by one or more yarns forming the knit stitching.

In other embodiments, the knitted upper 504 can include a knitted heel 503. The heel knit construction 504 can be one or more of breathable, tightening and/or support, cushioning and abrasion resistant knit constructions. The one or more of breathable,

tightening and/or support, cushioning and abrasion resistant knit constructions can be formed by the knit stitching or by one or more yarns forming the knit stitching.

In regard to Fig. 6, a perspective view of another embodiment of a seamless upper for footwear 600 is depicted. In one embodiment, Figure 6 depicts that a shoe 600 comprising a knitted upper can be coated with a material such as, but not limited to, a plastic dip 610. The plastic dip may provide an aspect to the shoe such as but limited to abrasion resistance, water resistance, one or more team colors, a decorative element or such. Fig. 6 depicts the toe 602 and heel 603 being coated with the plastic dip. In some embodiments the plastic dip is applied by the owner of the shoe, in other embodiments the plastic dip may be applied by one of shoe. The "plastic" dip may be any material known to one skilled in the art to have abrasion resitance characteristics, to include, for example, natural rubber, latex, synthetic rubber, and other fiber-encased resinous materials, synthetic materials, polymers, and natural materials.

In regard to Fig. 7, perspective views of two embodiments of knitted eyelets of the knitted upper 700 are shown. In the embodiment Fig. 7A, an eyelet void 701 is formed in an upper surface. In the embodiment of Fig. 7B, an eyelet loop 702 is formed in the upper 700. The eyelets may comprise any knitted construction formed any knit stitching known within the art.

In regard to Figs. 8A-B and 9, another embodiment of a seamless upper for footwear is shown. Fig. 8A is a perspective view and Fig. 8B is a top view the embodiment of a seamless upper 801. Fig. 9 is a top-view of one method of the formation of the embodiment of a seamless upper 801, depicting the seamless upper 801 and knitted vamps (or sides) 802 as manufactured by a knitting machine (whose knitted output rolls are depicted as the upper and lower parallel dashed lines. The knitted upper 801 can be knitted with one or more knitted side 802, toe 803 and heel 804 wings. The knitted side 802, toe 803 and heel 804 wings can comprise any knit construction. Furthermore, the knit constructions of the side 802, toe 803 and heel 804 can be the same or can differ. In some embodiments the one or more knitted side 802, toe 803 and heel 804 wings can comprise one or both of a different knit stitching and a differing yarns than the knitted upper 801. While not wanting to be limited by example, the one or more knitted side 802, toe 803 and heel 804 wings can comprise a reinforcing and/or abrasion resistance knit stitching and/or yarn different from the knit stitching and/or yarn(s) of the knitted upper 801. In some embodiments the knitted side 802, toe 803 and heel 804 wings can comprise

a tubular knit construction 805. By way of a non-limiting example, the tubular knit construction 805 can form a spacer knit to wrap around the wearer's foot.

In regard to Figs. 10A-D, another embodiment of a seamless upper 801 for footwear is shown. Fig. 10A is a perspective view of this embodiment. Figs. 10B-D depict top-views in which the respective toe cap reinforcement portion 803, vamp (side) reinforcement 802 and heel cap 804 portions are unassembled to the seamless upper 801. In this embodiment, the knitted side wings (vamps) 802 form a shoe quarter. The knitted side wings/vamps 802 can be in the form of a space mesh that can wrap around the shoe quarter to give a more traditional shoe upper aesthetic.

In one embodiment, the knitted upper has one or more medial and/or lateral side wings 802. The side wings may be wrapped around the knitted upper 801 about one or both of medial and lateral side of the knitted upper 801. Preferably, the side wings 802 further support the medial and lateral sides of the upper and/or a foot positioned within the knitted upper 801. Preferably one or both of the knitted toe 802 and heel 804 wings comprises an abrasion resistance knit construction.

In regard to Fig. 11, a side view of another embodiment of a seamless upper for footwear 1100 is depicted. Fig. 11 depicts footwear 1100 comprising a knitted upper 1102 having a knitted mid-sole 1101. The knitted mid-sole 1101 is positioned between the upper 1102 and the sole 1103. Preferably, the knitted mid-sole 1101 joins the upper 1102 to the sole 1103. The knitted mid-sole 1101 can comprise a knit construction differing form the knitted upper 1102 knit construction. In one embodiment, the knitted mid-sole 1101 is formed by molding and/or adhesively joining the sole 1103 to the knitted upper 1102. More specifically, during the molding of the sole 1103 to the upper 1102, when a resin is injected into a mold to form the sole 1103, the injected resin impregnates at least some of the knitted upper 1102 to form the knitted mid-sole 1101. In the case of adhesively joining the sole 1103 to the knitted upper 1102, it can be appreciated that the adhesive will impregnate the knitted upper to form the knitted mid-sole 1101.

In regard to Fig. 12, a cut-away side view of another embodiment of a seamless upper for footwear is depicted. Fig. 12 depicts footwear comprising a knitted upper joined to a sole 1201 by passing a quarter or vamp wing 1205 of the knitted upper through a void 1204 of the sole 1201. The sole 1201 comprises a mid-sole 1202 and an outer sole 103, the void 1204 is preferably position about the mid-sole 1201.

In regard to Fig. 13, a perspective view of another embodiment of a seamless upper for footwear 1300 is depicted. Fig. 13 depicts knitted footwear 1300 comprising a knitted

upper 1301 joined to a footwear sole 1303. The knitted footwear upper 1300 can comprise a plurality of voids 1302. The knitted footwear 1300 can be one of a sandal, slipper, water, or such footwear item. The sole 1303 can be one of adhesively joined, molded and formed by knitted composition to knitted upper 1301.

In regard to Fig. 14, a perspective view of another embodiment of a seamless upper for footwear 1400 is depicted. Fig. 14 depicts shoe / footwear 1400 comprising a knitted upper 1401 interconnected to a sole 1403 and frame 1402. The frame 1402 may or may not be interconnected to the knitted upper 1401. Preferably, the frame 1402 is one of interconnect or bonded to the frame 1402. The frame 1402 may comprise any rigid or semi-rigid material. As used herein "semi-rigid" refers to any material that has at least some degree of flexibility when a stress is applied but does not fracture and/or permanently distort due to the stress. The stress applied being within the stress typically encounter by footwear. Non-limiting examples of footwear categories are footwear for street, casual, athletic, industrial, professional, work, dress, and formal use. Preferably, the frame comprises a polymeric material.

In regard to Figs. 15A-B, cut-away side views of another embodiment of a seamless upper for footwear 1500 is depicted. Fig. 15 depicts a cross-sectional plan view of shoe / footwear 1500 comprising a sole 1501 and a knitted upper 1502. The knitted upper 1052 has one or more knitted upper voids (not depicted). The sole 1501 comprises at least one arm 105 interconnecting the inner-sole 1503 and outer-sole 1504 elements. The knitted upper is interconnected to the sole 1501 by passing the inner-sole 1503 element through the one or more knitted upper voids (not depicted). It can be appreciated that the one or more knitted upper voids are preferably formed by knitting the one or more voids in the knitted upper 1502.

In regard to Fig. 16, a perspective view of another embodiment of a seamless upper for footwear 1600 is depicted. Fig. 16 depicts a shoe 1600 having a plurality of channels 1602 knitted in upper 1601. Preferably, each of the plurality of channels 10602 are configured to accept a member 1603. Each of the members 1603 can vary in one or both of shape and physical properties. For example some members may be more or less flexible and/or rigid than other members 1603. Furthermore, some members may have a differing contour, width, length, thickness or combination thereof. In some embodiments, a wearer of the shoe 1600 selects the plurality of members 1603 to configure the shoe 1600 to his or her needs and/or foot. The members 1603 can comprise any material. Preferably, the members 1603 comprise a polymeric material.

While various embodiment of the present disclosure have been described in detail, it is apparent that modifications and alterations of those embodiments will occur to those skilled in the art. However, it is to be expressly understood that such modifications and alterations are within the scope and spirit of the present disclosure, as set forth in the following claims.

The foregoing discussion of the disclosure has been presented for purposes of illustration and description. The foregoing is not intended to limit the disclosure to the form or forms disclosed herein. In the foregoing Detailed Description for example, various features of the disclosure are grouped together in one or more embodiments for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed disclosure requires more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive aspects lie in less than all features of a single foregoing disclosed embodiment. Thus, the following claims are hereby incorporated into this Detailed Description, with each claim standing on its own as a separate preferred embodiment of the disclosure.

Moreover, though the present disclosure has included description of one or more embodiments and certain variations and modifications, other variations and modifications are within the scope of the disclosure, e.g., as may be within the skill and knowledge of those in the art, after understanding the present disclosure. It is intended to obtain rights which include alternative embodiments to the extent permitted, including alternate, interchangeable and/or equivalent structures, functions, ranges or steps to those claimed, whether or not such alternate, interchangeable and/or equivalent structures, functions, ranges or steps are disclosed herein, and without intending to publicly dedicate any patentable subject matter.

CLAIMS

We claim:

1. An article of footwear comprising an upper portion, the upper portion comprising a seamless knitted material and configured with a foot-receiving portion, the foot-receiving portion defining a void for receiving a foot of a user.

2. The article of footwear of claim 1, wherein the seamless knitted material is selected from the group consisting of interloop knit, interweave knit, warp knit, weft knit, circular knit and flat knit.

3. The article of footwear of claim 1, wherein the seamless knitted material comprises at least one of rayon, polyester, polyacrylic, silk, cotton, wool and elastane.

4. The article of footwear of claim 1, wherein the upper portion comprises at least one of an end cap portion, a vamp portion and a heel portion.

5. The article of footwear of claim 4, wherein at least one of an end cap portion, a vamp portion and a heel portion comprises an elastomeric material.

6. The article of footwear of claim 1, wherein the upper portion is configured to engage a footwear sole.

7. The article of footwear of claim 1, wherein the upper portion is configured to engage with one or more structural inserts in communication with a vamp portion of the upper.

8. The article of footwear of claim 1, wherein the upper portion forms an article of footwear.

9. The article of footwear of claim 1, wherein the upper further comprises a plurality of knitted eyelets.

10. The article of footwear of claim 1, wherein the knitted material has a plurality of different knitted textures formed by varying at least one of a stitch type and a yarn type.

11. A method of manufacturing an upper for an article of footwear, comprising: forming a seamless knitted material that includes a foot-receiving portion; forming an opening for receiving a foot of a user in the foot-receiving portion during the knitting process; and forming the upper.

12. The method recited in claim 11, wherein the forming includes utilizing a double needle knitting process to form the knitted element.

13. The method recited in claim 11, wherein the upper further comprises a plurality of knitted eyelets.

14. The method recited in claim 11, wherein the upper portion is configured to engage a footwear sole.

15. A method of manufacturing an article of footwear, the method comprising: knitting a textile element with a surrounding textile structure, the knitted textile element configured to form a seamless footwear upper; removing the knitted textile element from the surrounding knitted textile structure; forming the knitted textile element into an article of footwear upper.

16. The method of claim 15, wherein the knitted textile element has a substantially planar configuration upon removal from the surrounding knitted textile structure.

17. The method of claim 15, wherein the knitted textile element has a plurality of different knitted textures formed by varying at least one of a stitch type and a yarn type.

18. The method of claim 15, wherein simultaneously knitting a textile element with a surrounding textile structure includes utilizing a jacquard double needle-bar raschel knitting machine.

19. The method recited in claim 15, wherein the upper further comprises a plurality of knitted eyelets.

20. The method recited in claim 15, wherein the upper portion is configured to engage a footwear sole.

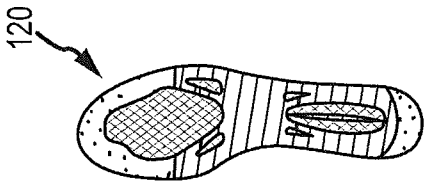

FIG.1C

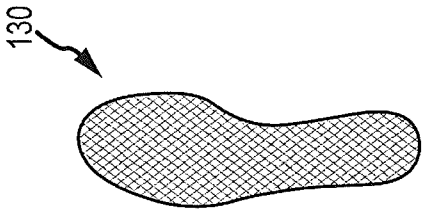

FIG.1B

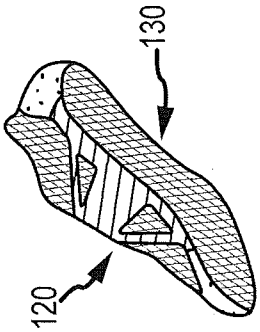

FIG.1E

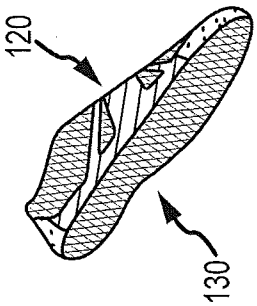

FIG.1D

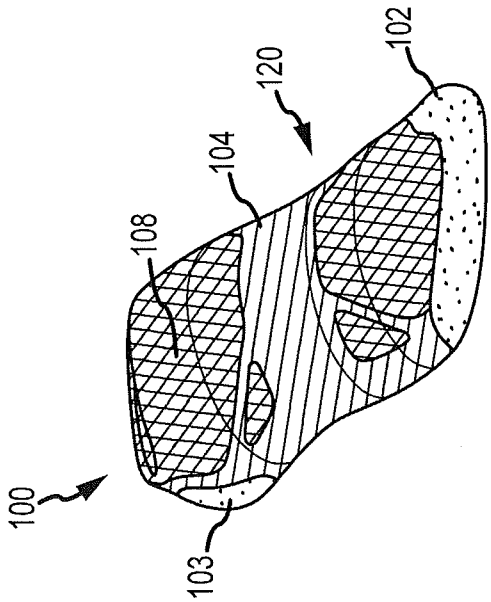

FIG.1A

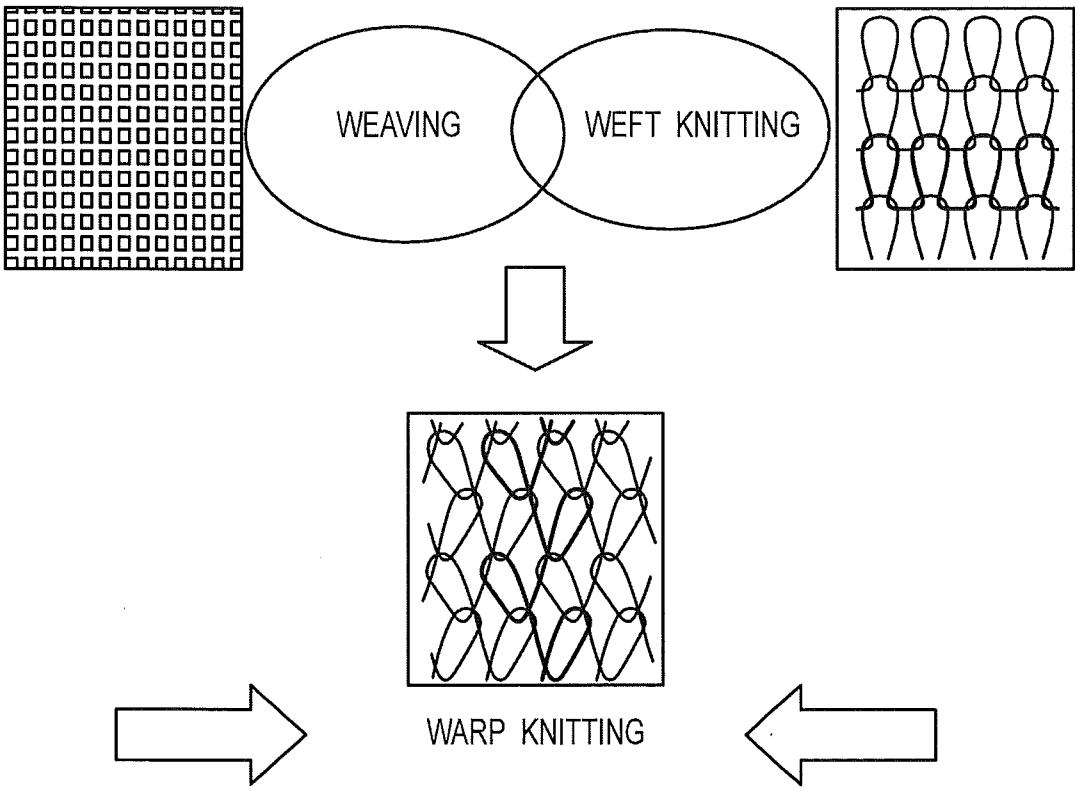

FIG.2

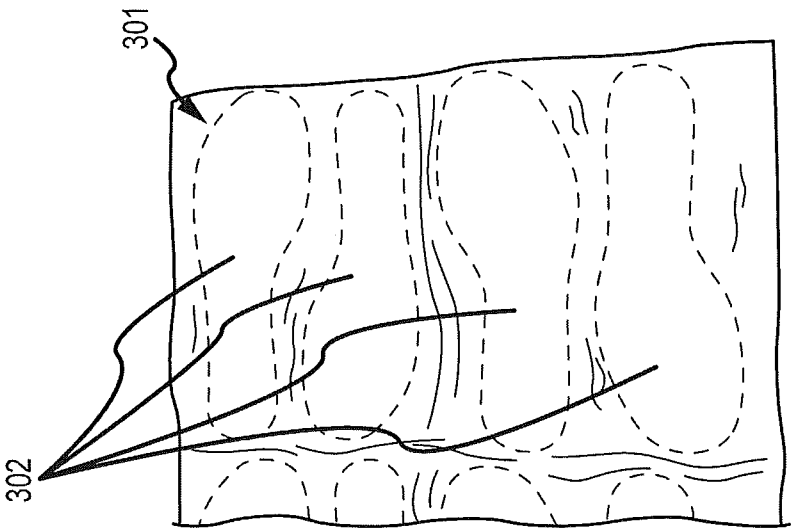

FIG.4

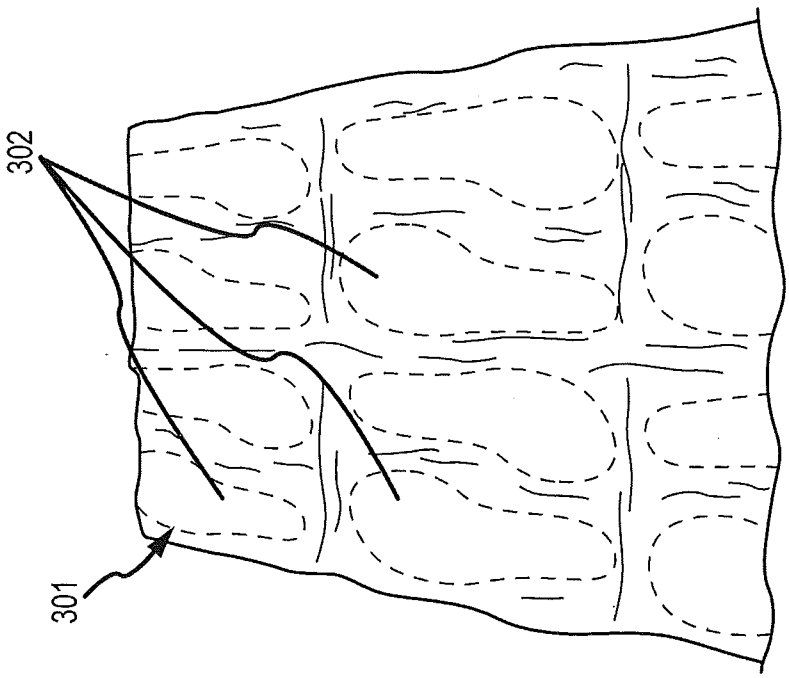

FIG.3

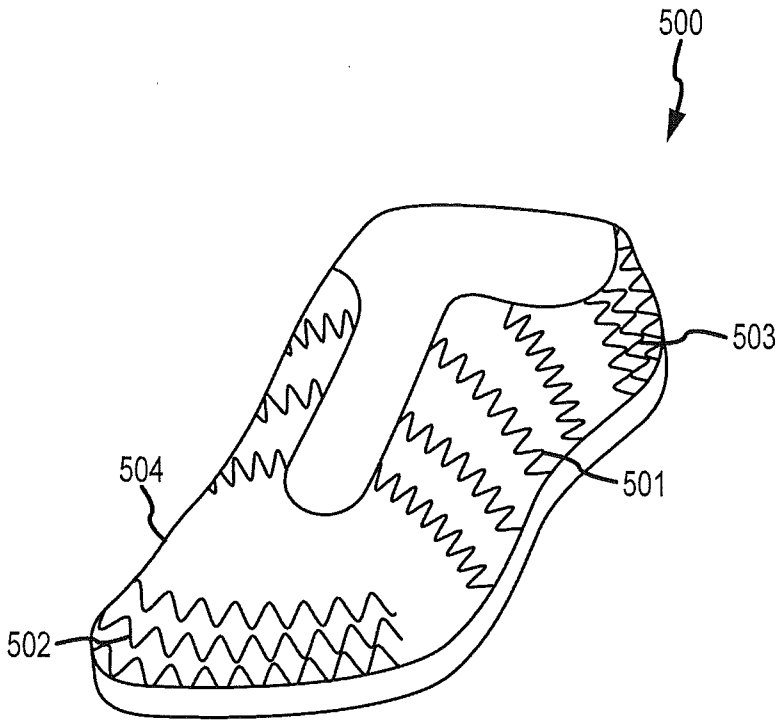

FIG.5

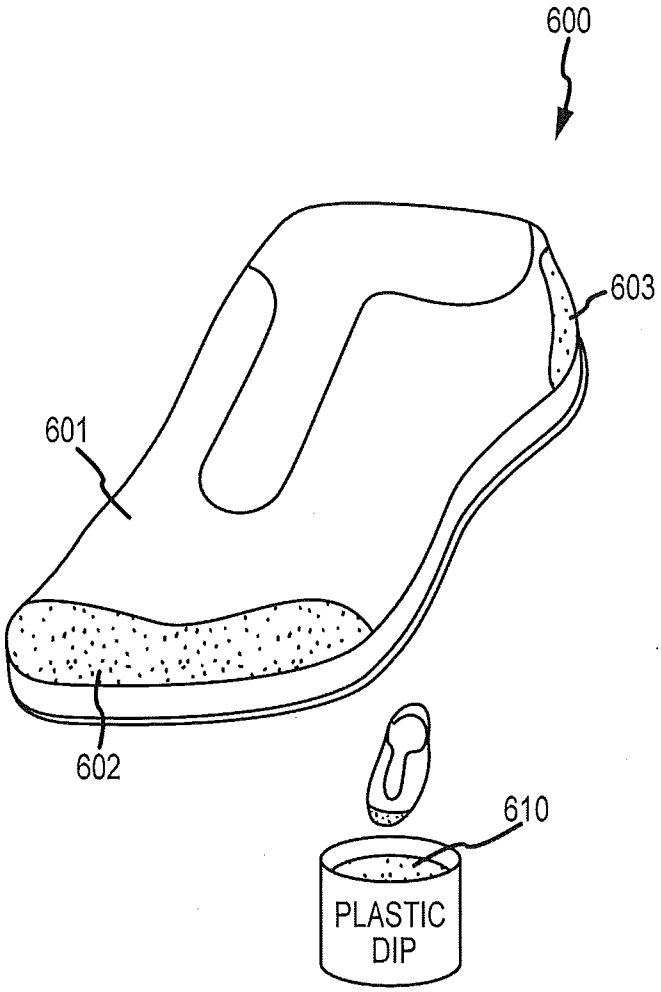

FIG.6

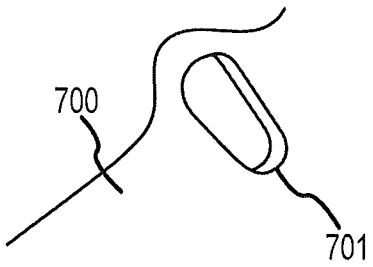

FIG.7A

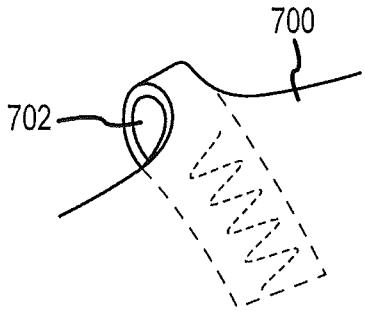

FIG.7B

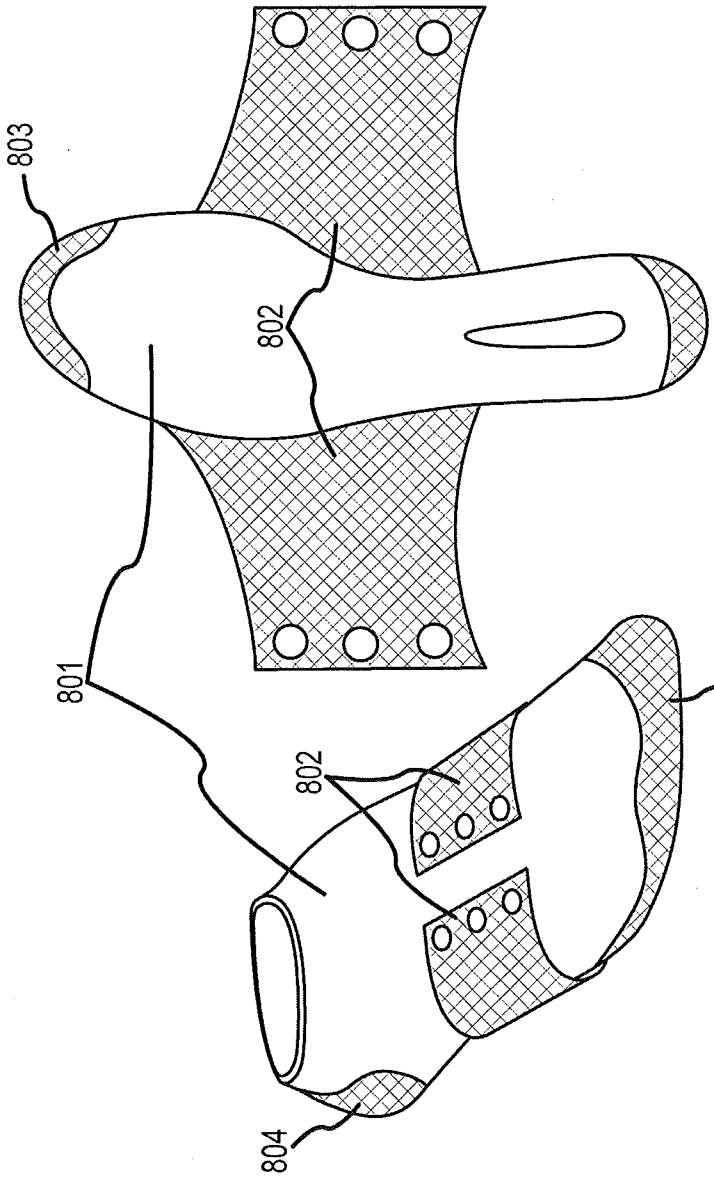

FIG.8B

FIG.8A

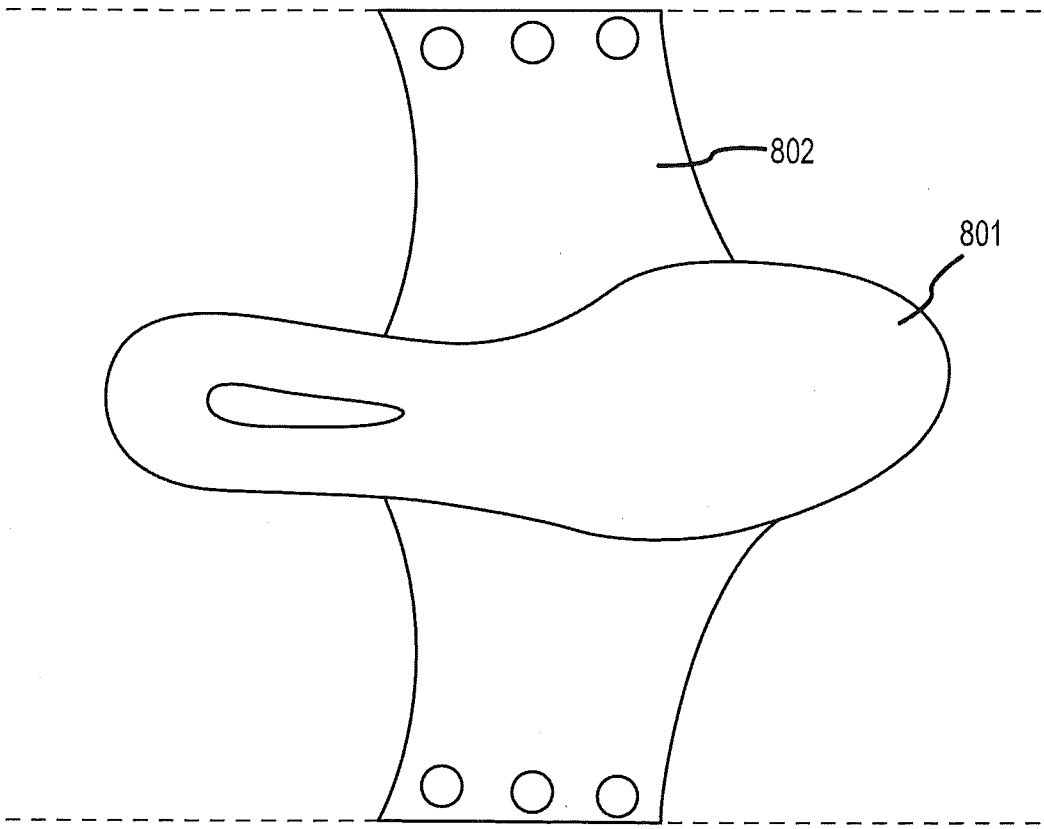

FIG.9

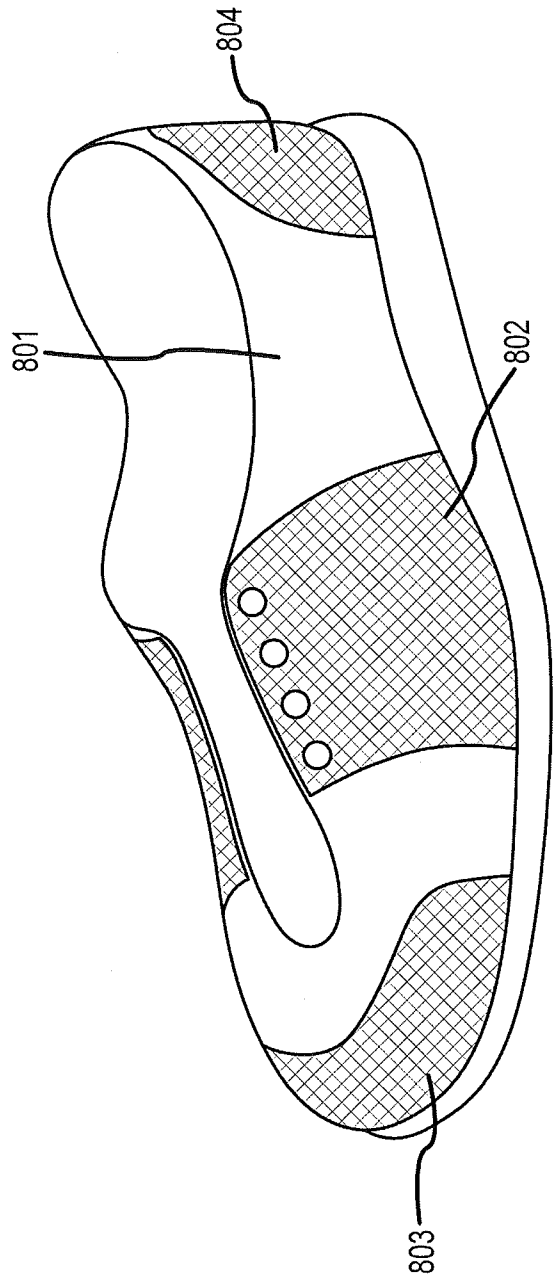

FIG.10A

FIG.10D

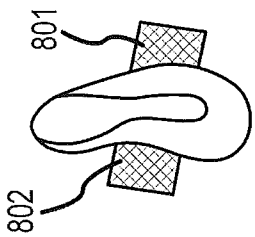

FIG.10C

FIG.10B

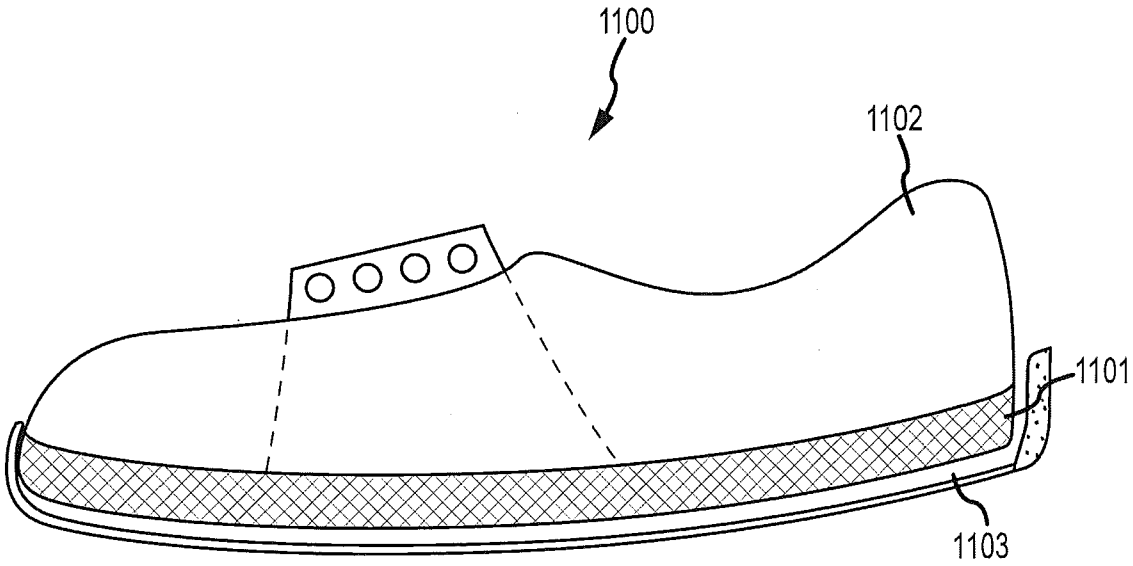

FIG.11

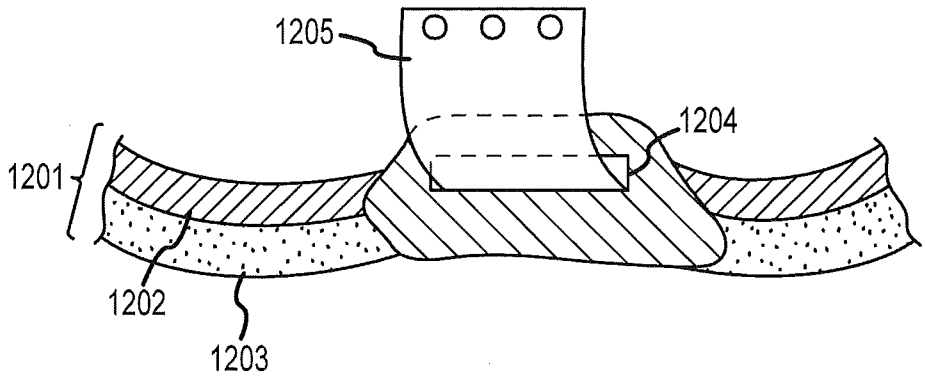

FIG.12

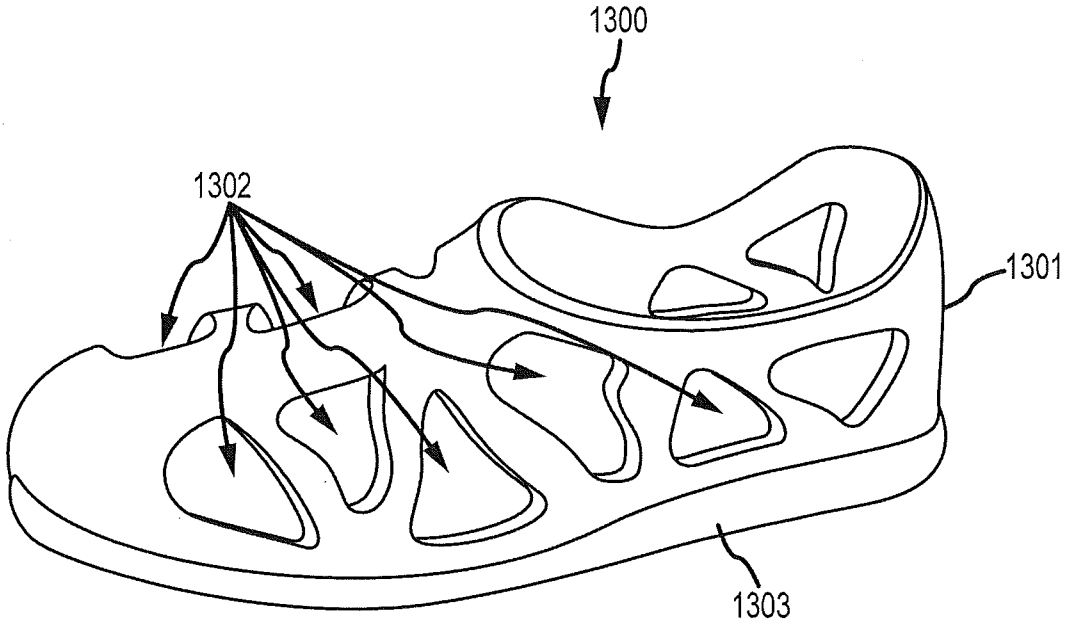

FIG.13

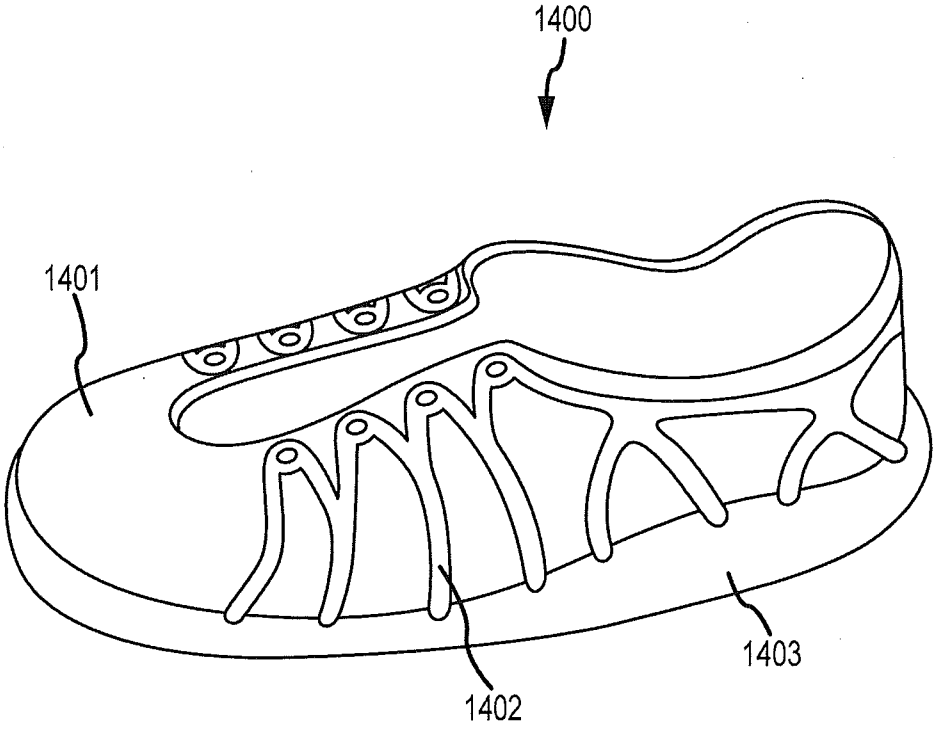

FIG.14

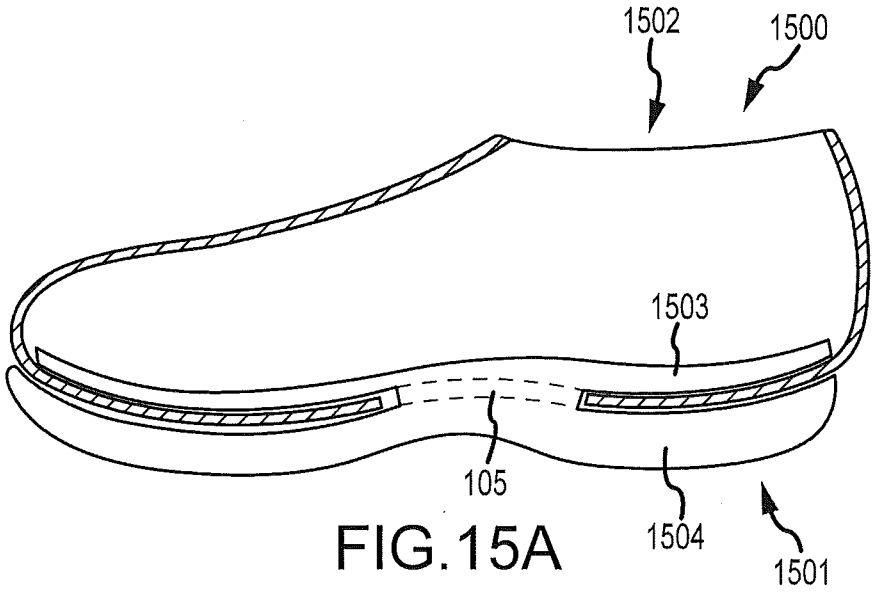

FIG.15A

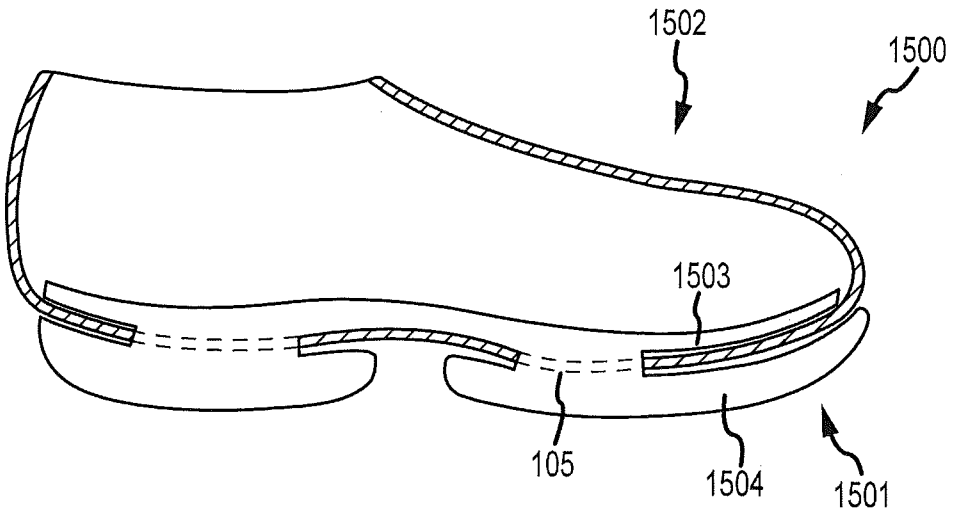

FIG.15B

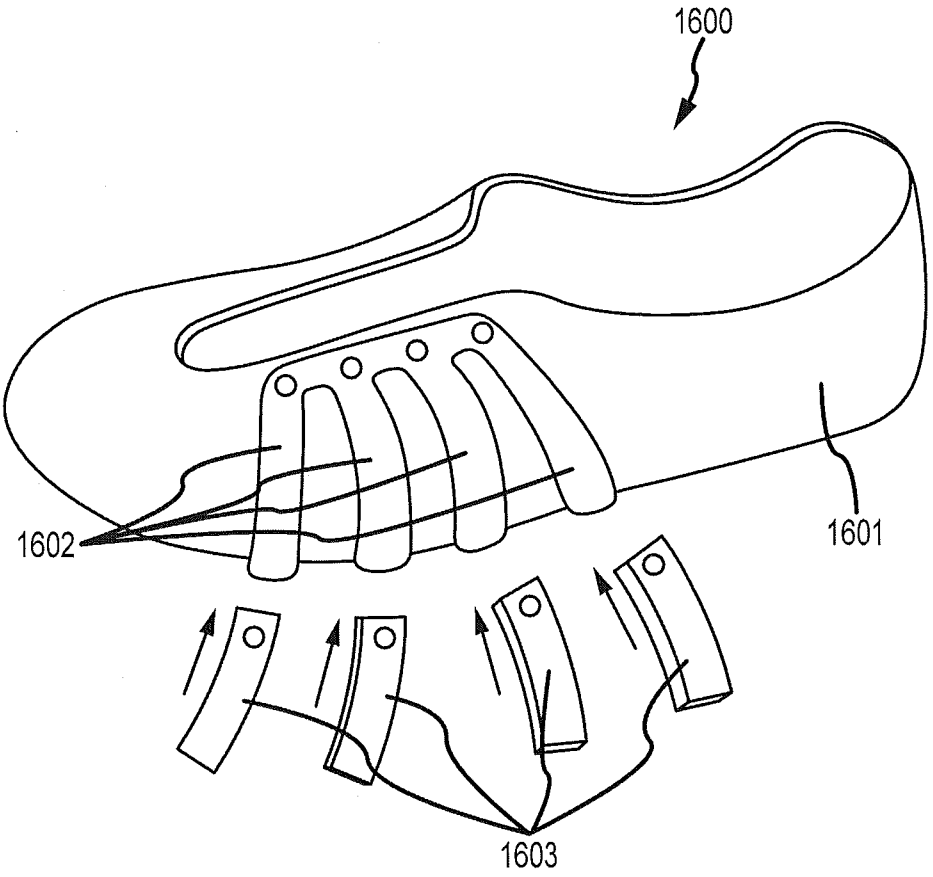

FIG.16

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/032709

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A43B 1/04 (2012.01)
USPC - 36/45
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A43B 1/04, 9/00, 23/02 (2012.01)
USPC - 12/142R,146C; 36/3R,9R,45,47; 66/170,202

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 2005/0115284 A1 (DUA) 02 June 2005 (02.06.2005) entire document	1-4, 6-8, 10, 11, 14 ---------- 5, 9, 12, 13, 15-20
Y	US 3,484,881 A (KRIEGER) 23 December 1969 (23.12.1969) entire document	5
Y	US 2004/0118018 A1 (DUA) 24 June 2004 (24.06.2004) entire document	9, 13, 19
Y	US 2005/0193592 A1 (DUA et al) 08 September 2005 (08.09.2005) entire document	12, 15-20

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 June 2012	29 JUN 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774