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Berrian et al.

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(54) **ARTICLE OF FOOTWEAR HAVING A KNITTED COMPONENT WITH A FOREFOOT PORTION AND A HEEL PORTION**

(58) **Field of Classification Search**

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A43B 23/088

See application file for complete search history.

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ABSTRACT

In one aspect, the present disclosure provides a knitted component. The knitted component may have a forefoot portion with a top layer and a bottom layer, where a void is formed between the top layer and the bottom layer, and where the top layer is secured to the bottom layer via at least one common knit structure. A heel area may extend from the bottom layer of the forefoot portion in a longitudinal direction and may be secured to the bottom layer of the forefoot portion via at least one common knit structure. At least one extension may extend from the heel area in a second direction, the second direction being different than the longitudinal direction.

18 Claims, 6 Drawing Sheets

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This patent is subject to a terminal disclaimer.

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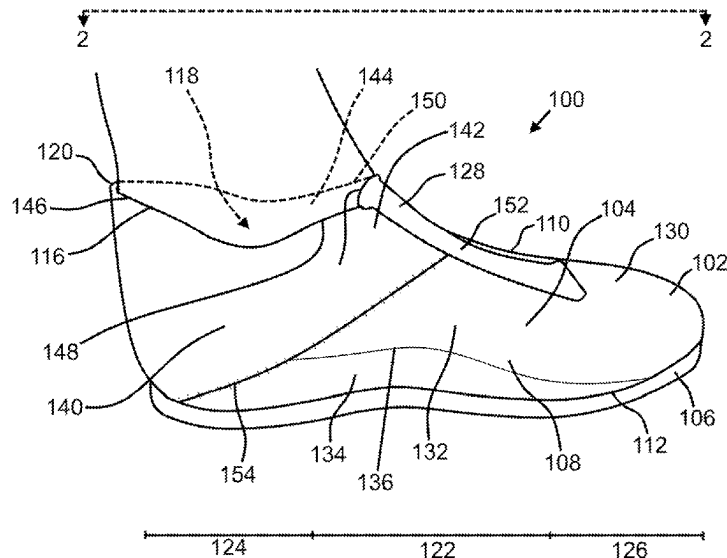
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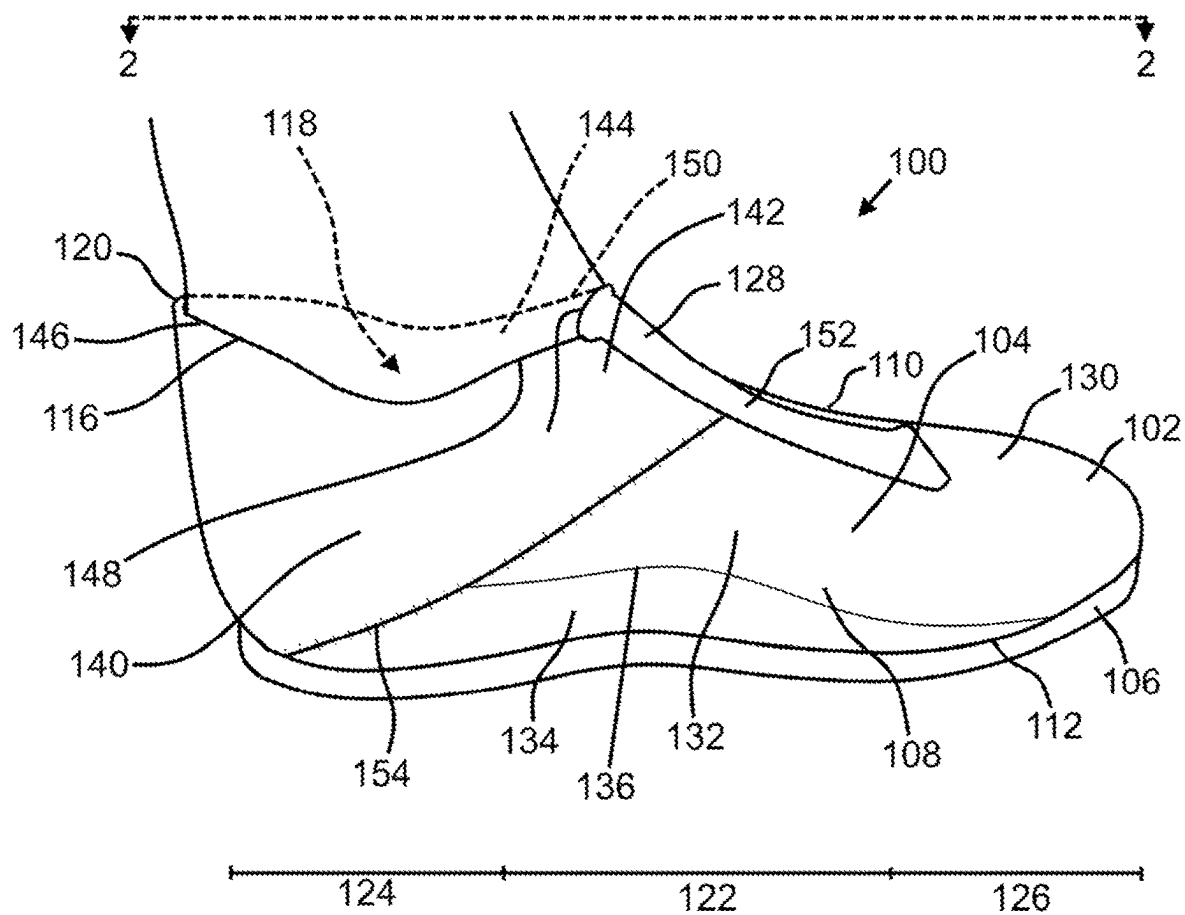
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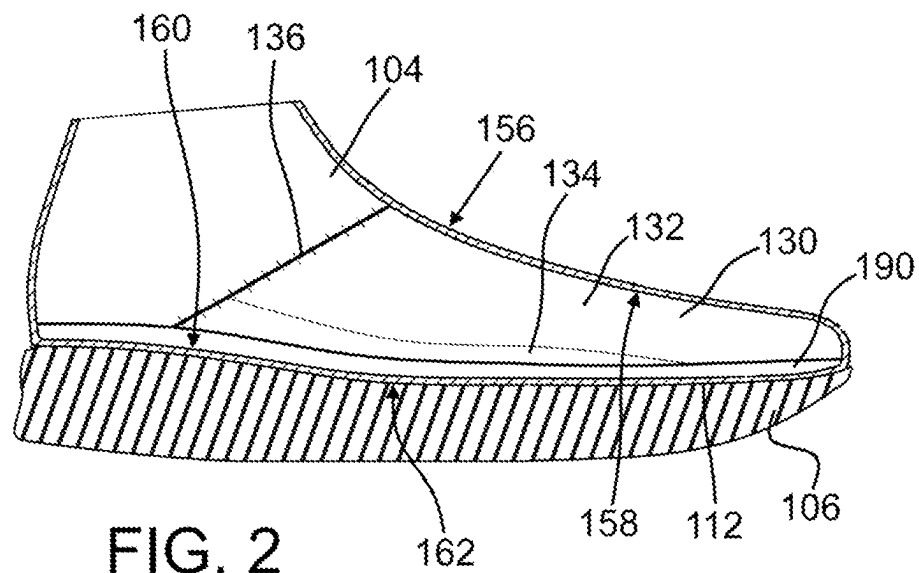
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FIG. 1





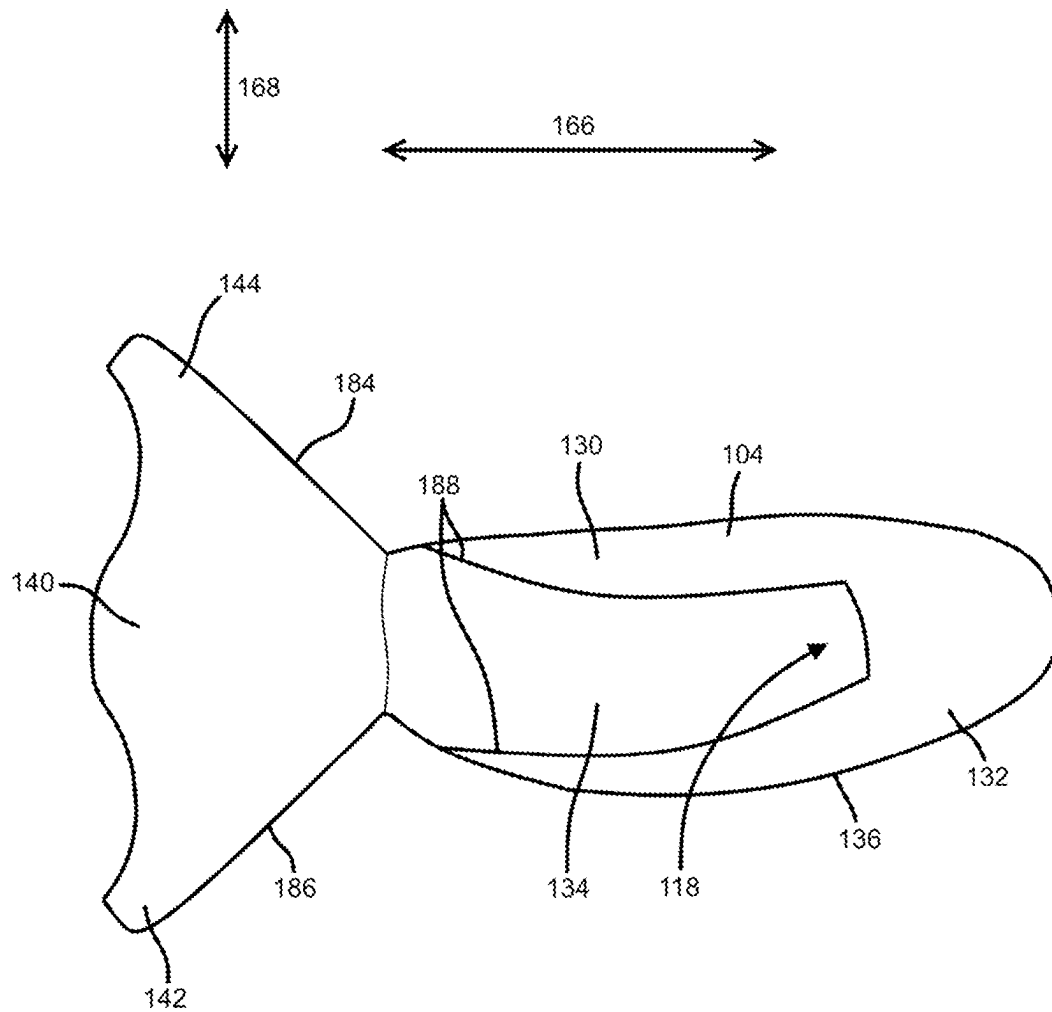
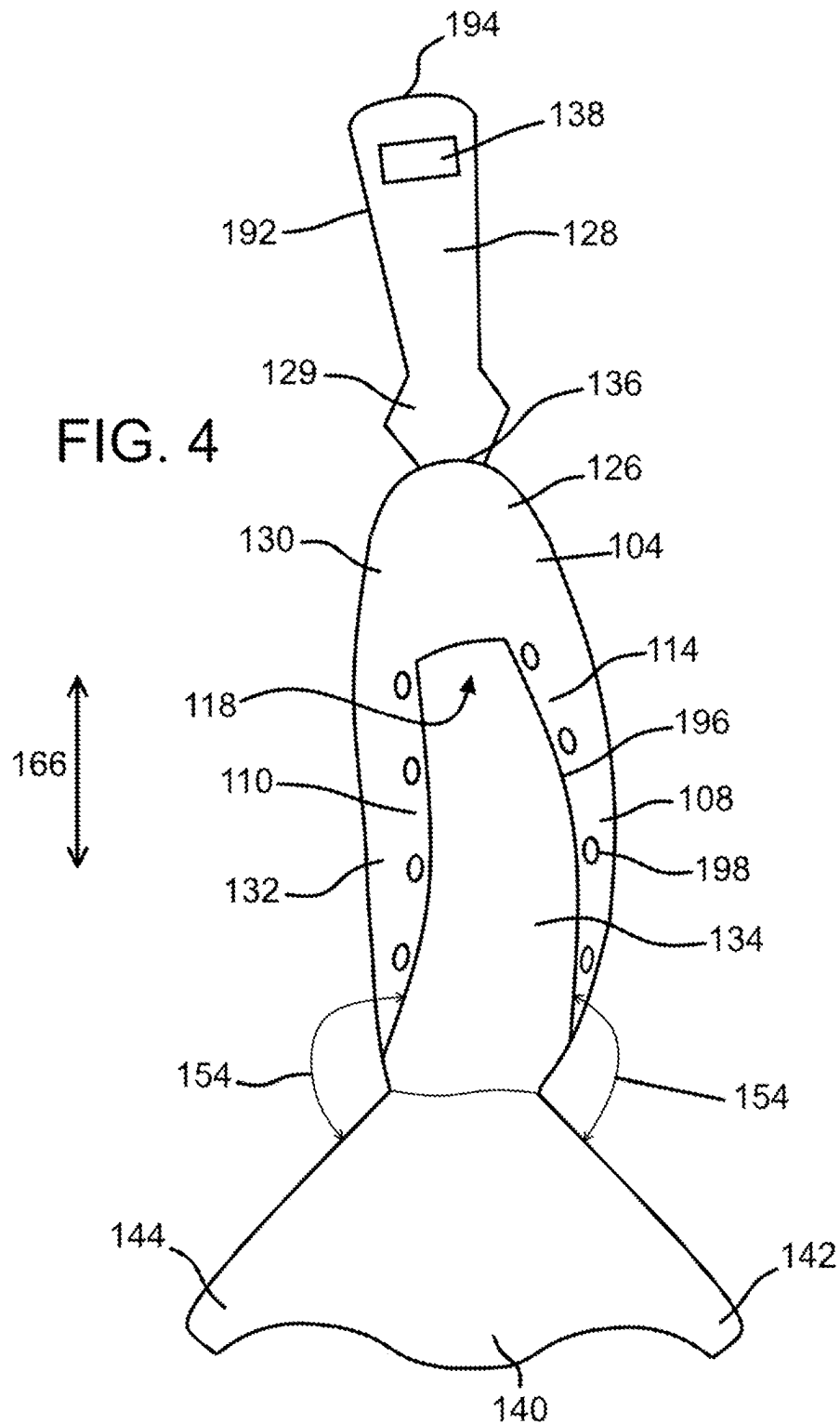


FIG. 3

FIG. 4



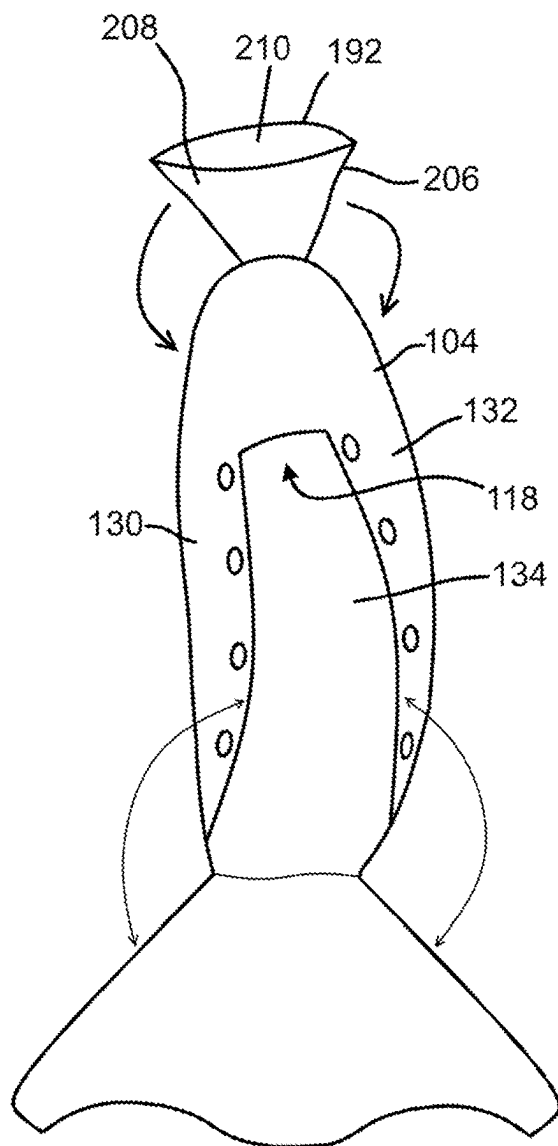


FIG. 5A

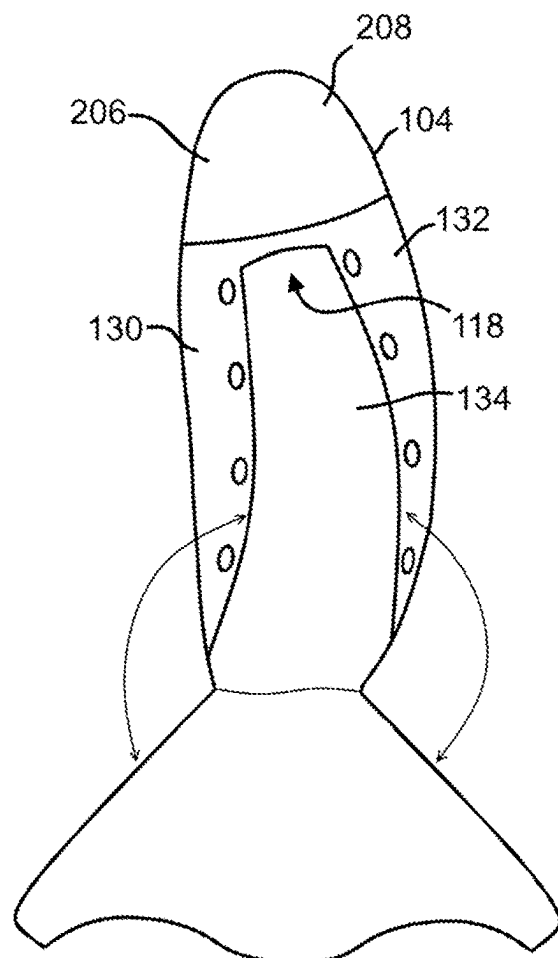
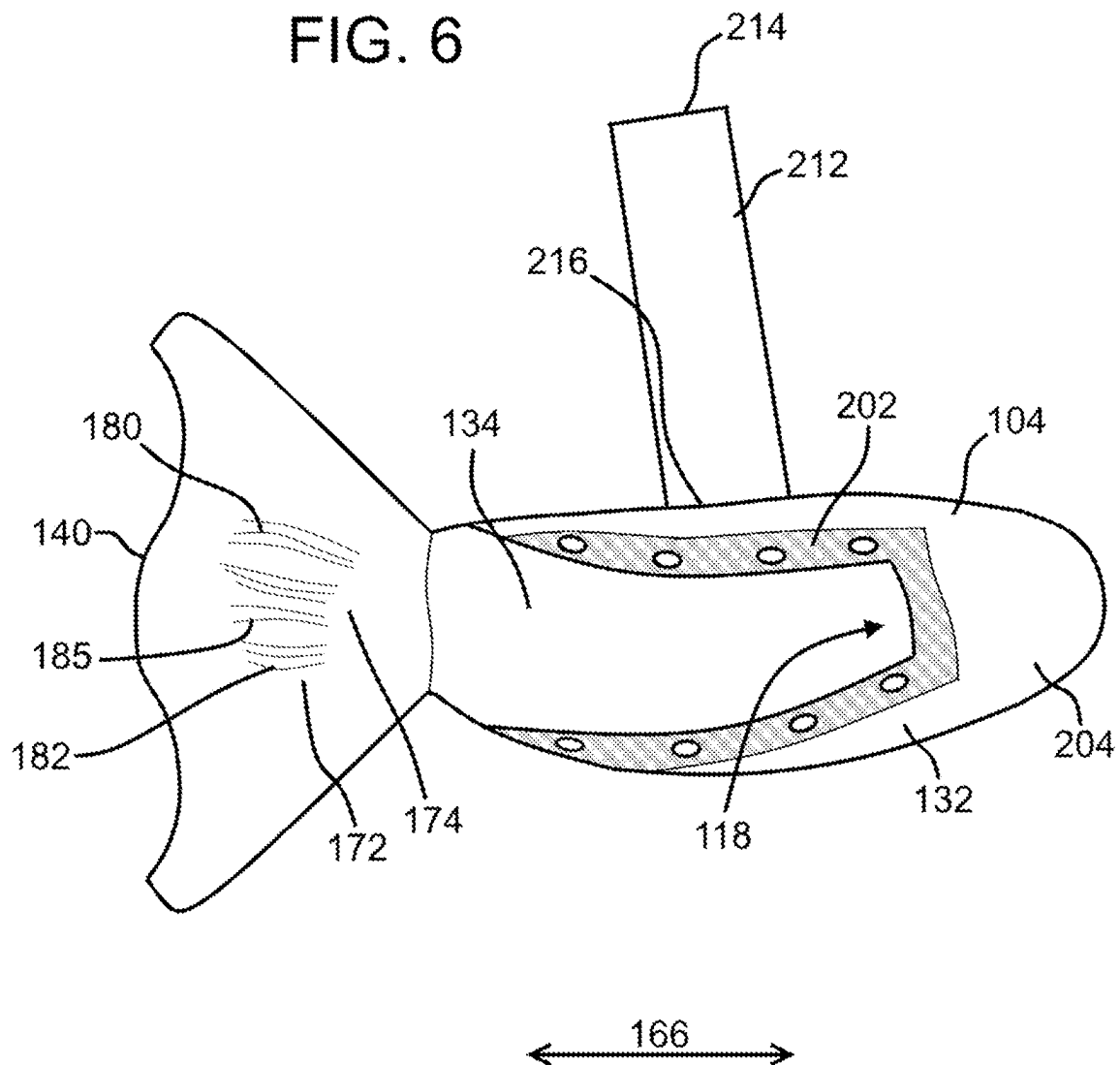


FIG. 5B

FIG. 6



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ARTICLE OF FOOTWEAR HAVING A KNITTED COMPONENT WITH A FOREFOOT PORTION AND A HEEL PORTION

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a divisional of U.S. Non-Provisional application Ser. No. 17/488,902 entitled "Article of Footwear Having a Knitted Component with a Forefoot Portion and a Heel Portion" and filed on Sep. 29, 2021, issued as U.S. Pat. No. 11,957,201, which is a divisional of Ser. No. 16/054,150, entitled "Article of Footwear Having a Knitted Component with a Forefoot Portion and a Heel Portion" and filed on Aug. 3, 2018, issued as U.S. Pat. No. 11,154,110, which claims the benefit of U.S. Provisional Application No. 62/541,495, entitled "Article of Footwear Having a Knitted Component with a Forefoot Portion and a Heel Portion" and filed on Aug. 4, 2017, the entirety of both are hereby incorporated by reference.

BACKGROUND

Conventional articles of footwear generally include two primary elements: an upper and a sole structure. The upper is generally secured to the sole structure and may form a void within the article of footwear for comfortably and securely receiving a foot. The sole structure is generally secured to a lower surface of the upper so as to be positioned between the upper and the ground. In some articles of athletic footwear, for example, the sole structure may include a midsole and an outsole. The midsole may be formed from a polymer foam material that attenuates ground reaction forces to lessen stresses upon the foot and leg during walking, running, and other ambulatory activities. The outsole may be secured to a lower surface of the midsole and may form a ground-engaging portion of the sole structure that is formed from a durable and wear-resistant material.

The upper of the article of footwear generally extends over the instep and toe areas of the foot, along the medial and lateral sides of the foot, and around the heel area of the foot and in some instances under the foot. Access to the void in the interior of the upper is generally provided by an ankle opening in and/or adjacent to a heel region of the footwear. A lacing system is often incorporated into the upper to adjust the fit of the upper, thereby facilitating entry and removal of the foot from the void within the upper. In addition, the upper may include a tongue that extends under the lacing system to enhance adjustability of the footwear, and the upper may incorporate other structures such as, for example, a heel counter to provide support and limit movement of the heel.

BRIEF DESCRIPTION OF THE DRAWINGS

The embodiments of the present disclosure may be better understood with reference to the following drawings and description. The components in the figures are not necessarily to scale, with emphasis instead being placed upon illustrating the principles of the present disclosure.

Moreover, in the figures, like referenced numerals designate corresponding parts throughout the different views and arrangements.

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FIG. 1 is an illustration showing an article of footwear with a knitted component in accordance with certain aspects of the present disclosure.

FIG. 2 is an illustration showing a side cutout view about line 2-2 of FIG. 1.

FIG. 3 is an illustration showing a knitted component for the article of footwear as it may appear after a knitting process in accordance with certain aspects of the present disclosure.

FIG. 4 is an illustration showing a knitted component for the article of footwear including a forefoot extension extending from a toe region in accordance with certain aspects of the present disclosure.

FIG. 5A is an illustration showing the article of footwear with a forefoot extension that forms toecap in accordance with certain aspects of the present disclosure.

FIG. 5B is an illustration showing the embodiment of FIG. 5A when the toecap is inverted after a knitting process.

FIG. 6 is an illustration showing the article of footwear with a side extension in accordance with certain aspects of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

Various aspects are described below with reference to the drawings in which like elements generally are identified by like numerals. The relationship and functioning of the various elements of the aspects may better be understood by reference to the following detailed description. However, aspects are not limited to those illustrated in the drawings or explicitly described below. It also should be understood that the drawings are not necessarily to scale, and in certain instances details may have been omitted that are not necessary for an understanding of aspects disclosed herein, such as conventional fabrication and assembly.

Certain aspects of the present disclosure relate to uppers configured for use in an article of footwear and/or other articles, such as articles of apparel. When referring to articles of footwear, the disclosure may describe basketball shoes, running shoes, biking shoes, cross-training shoes, football shoes, golf shoes, hiking shoes and boots, ski and snowboarding boots, soccer shoes, tennis shoes, and/or walking shoes, as well as footwear styles generally considered non-athletic, including but not limited to dress shoes, loafers, and sandals.

In one aspect, the present disclosure provides a knitted component. The knitted component may have a forefoot portion with a top layer and a bottom layer, where a void is formed between the top layer and the bottom layer, and where the top layer is secured to the bottom layer via at least one common knit structure. A heel area may extend from the bottom layer of the forefoot portion in a longitudinal direction and may be secured to the bottom layer of the forefoot portion via at least one common knit structure. At least one extension may extend from the heel area in a second direction, the second direction being different than the longitudinal direction.

In another aspect, the present disclosure provides an article of footwear. The article of footwear may include a forefoot portion having a top layer and a bottom layer, where a void is formed between the top layer and the bottom layer. A heel area may be secured to the bottom layer of the forefoot portion, and the heel area may form a first portion of a collar. At least one extension may extend from the heel area, where the at least one extension is secured to an edge

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of the top layer of the forefoot portion, and where the extension forms at least a second portion of the collar.

In another aspect, the present disclosure provides a method. The method may include forming a forefoot portion of a knitted component on a knitting machine, the forefoot portion having a top layer and a bottom layer, where a void is formed between the top layer and the bottom layer, and where the top layer is secured to the bottom layer via at least one common knit structure. The method may further include forming a heel area of the knitted component on the knitting machine, the heel area being secured to the bottom layer of the forefoot portion via at least one common knit structure. The method may further include forming at least one extension of the knitted component on the knitting machine, the at least one extension being attached to the heel area, and securing to the extension to an edge of the top layer of the forefoot portion.

In another aspect, the present disclosure provides an article of footwear with a knitted component, the knitted component having a heel area. The heel area may include a medial side, a lateral side, and a rear portion between the medial side and the lateral side, where at least one of the medial side and the lateral side of the knitted component includes a concave area on an outer surface of the knitted component.

In another aspect, the present disclosure provides an article of footwear with a knitted component, the knitted component having a heel area. The heel area may include a medial side, a lateral side, and a rear portion between the medial side and the lateral side, where at least one of the medial side and the lateral side of the knitted component includes a convex area on an inner surface of the knitted component, the inner surface defining a void.

FIG. 1 is an illustration showing an article of footwear **100** in accordance with certain aspects of this disclosure. Referring to FIG. 1, the article of footwear **100** may include an upper **102**. Optionally, the upper **102** may be substantially formed as a textile component. The textile component may be any suitable type of textile, and in some embodiments it may be formed as a knitted component **104**. As shown, the upper **102** may be secured to a sole structure **106**. The upper **102** may include a lateral side **108** and a medial side **110**. The area where the sole structure **106** joins the upper **102** may be referred to as a biteline **112**. The upper **102** may be joined to the sole structure **106** in a fixed manner using any suitable technique, such as through the use of an adhesive, by sewing, etc. The upper **102** may extend partially or completely around a foot of a wearer and/or may be integral with the sole structure **106**, and a sockliner may or may not be used. In some embodiments, the sole structure **106** may include a midsole and an outsole.

The upper **102** may additionally include a throat area **114** extending from an ankle opening **116** leading to the void **118**, and a collar **120** may at least partially surround the ankle opening **116**. The void **118** of the article of footwear **100** may be configured (e.g., sized and shaped) to receive and accommodate a foot of a person. The throat area **114** may be generally disposed in a midfoot area **122** of the upper **102**. The midfoot area **122** of the upper **102** may be located between a heel area **124** and a toe area **126**. In some embodiments, a tongue **128** may be disposed at least partially in the throat area **114**. If the tongue **128** is included, the tongue **128** may be any type of tongue, such as a gusseted tongue or a burrito tongue. If a tongue **128** is not included, the lateral and medial sides of the throat area **114** may be joined together.

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While the upper **102** is described herein as being formed primarily of the knitted component **104**, a knitted component is optional, and it alternatively or additionally could include a textile component formed by a process other than knitting (e.g., weaving) and may also include other materials including, but not limited to, leather, plastics, rubbers, and any other materials. Forming the upper **102** with the knitted component **104** may provide the upper **102** with advantageous characteristics including, but not limited to, a particular degree of elasticity (for example, as expressed in terms of Young's modulus), breathability, bendability, strength, moisture absorption, weight, abrasion resistance, and/or a combination thereof. These characteristics may be accomplished by selecting a particular single layer or multi-layer knit structure (e.g., a ribbed knit structure, a single jersey knit structure, or a double jersey knit structure), by varying the size and tension of the knit structure, by using one or more yarns formed of a particular material (e.g., a polyester material, a relatively inelastic material, or a relatively elastic material such as spandex), by selecting yarns of a particular size (e.g., denier), and/or a combination thereof. The knitted component **104** may also provide desirable aesthetic characteristics by incorporating yarns having different colors, textures or other visual properties arranged in a particular pattern.

Further, the yarns themselves and/or the knit structure of the knitted component **104** may be varied at different locations such that the knitted component **104** has two or more portions with different properties (e.g., a portion forming the throat area **114** of the upper **102** may be relatively elastic while another portion may be relatively inelastic). Additionally or alternatively, in some embodiments, the knitted component **104** may incorporate one or more materials with properties that change in response to a stimulus (e.g., temperature, moisture, electrical current, magnetic field, or light). For example, the knitted component **104** may include yarns formed of one or more thermoplastic polymer materials (including material composites) that transition from a solid state to a softened or liquid state when subjected to certain temperatures at or above the melting point and then transitions back to a solid state when cooled. The thermoplastic polymer material(s) may provide the ability to heat and then cool a portion of the knitted component **104** to thereby form an area of bonded or continuous material (herein referred to as a "fused area") that exhibits certain advantageous properties including a relatively high degree of rigidity, strength, and water resistance, for example. Non-limiting examples of thermoplastic polymer materials are polyurethanes, polyamides, polyolefins, and/or certain nylons.

The knitted component **104** of the article of footwear **100** may include a forefoot portion **130** having a top layer **132** and a bottom layer **134**, and the void **118** may be formed between the top layer **132** and the bottom layer **134**. Thus, in the forefoot portion **130**, the bottom layer **134** may form an underfoot portion associated with a plantar aspect of the foot (also known as the sole or bottom of the foot), and the top layer **132** may form an overfoot portion associated with the dorsal surface of the foot (also known as the foot's top surface). The bottom layer **134** may extend just above, and/or be secured to, the sole structure **106**. In some embodiments, the top layer **132** and the bottom layer **134** may meet at the biteline **112**, but that is optional, and they meet at a boundary **136** above the biteline **112** in FIG. 1.

The knitted component may additionally include a heel portion **140**. A bottom side of the heel portion **140** may be secured to the sole structure **106**. As described in more detail

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below, the heel portion **140** may be secured to the bottom layer **134** of the forefoot portion **130** via a common knit structure, and a first extension **142** and/or second extension **144** may extend from the heel portion **140** and secure to the top layer **132** of the forefoot portion **130** (e.g., via stitching).

The heel portion **140** may form a first collar portion **146** of the collar **120**, and the first extension **142** and second extension **144** may form a respective second collar portion **148** and third collar portion **150** of the collar **120** on medial and lateral sides of the first collar portion **146**.

In some embodiments, the first extension **142** and/or the second extension **144** may extend from the heel area **124** towards the throat area **114**, and in some embodiments may extend to a location adjacent to the throat **152**. A seam **154** may secure the first extension **142** to the forefoot portion **130**, and specifically the top layer **132** of the forefoot portion **130**. Optionally, the seam **154** may extend from adjacent to the throat to approximately the biteline **112**, but other seam orientations/locations are also contemplated. As described in more detail below, the seam **154** may be formed after the knitted component is formed on a knitting machine.

FIG. 2 shows a side cutout view of the article of footwear **100** about line 2-2 of FIG. 1. As shown in FIG. 2, the knitted component **104** may include the forefoot portion **130** having at least two separable layers: a top layer **132** and a bottom layer **134**. The top layer **132** and the bottom layer **134** may have distinct, opposite-facing surfaces. For example, a first surface **156** of the top layer **132** may form an outer surface of the article of footwear **100** and a second surface **158** of the top layer **132** may face the void **118**. With respect to the bottom layer **134**, a third surface **160** may face the void **118** and a fourth surface **162** may face the sole structure **106** (shown in FIG. 1).

The void **118** may be formed between the top layer **132** and the bottom layer **134**. The top layer **132** and the bottom layer **134** may be formed together on a knitting machine, and may converge at a boundary **136** (e.g., at a sewn seam as described in more detail below). The attachment at the boundary **136** may be provided by a common knit structure, such as a common course, loop, wale, and/or yarn extending between the top layer **132** and the bottom layer **134**, and the common knit structure may be formed on the knitting machine when the top layer **132** and the bottom layer **134** are formed. Other attachment devices and/or methods are also contemplated (e.g., the top layer **132** and the bottom layer **134** may be sewn together after the knitting process, secured via an adhesive, etc.).

FIG. 3 shows the knitted component **104** as it may appear after knitting (e.g., on a flat knitting machine), but in an unfolded state before being lasted or otherwise manipulated into a wearable shape in the depicted article of footwear **100** of FIGS. 1-2. To form the multi-layer knitted component **104**, the top layer **132** may primarily be formed on a front needle bed of a knitting machine and the bottom layer **134** may primarily be formed on a back needle bed (or vice versa), and the boundary **136** may be formed where knit structures cross between the front and back needle beds. If the top layer **132** and the bottom layer **134** are separable and define a pocket (void **118**) therebetween, the layer formed on the front needle bed and/or the layer formed on the back needle bed may have a single jersey knit incorporating needles from only one bed.

Other knitting techniques may be additionally or alternatively used to form a multi-layer structure. For example, it is contemplated that both layers could utilize needles from each bed during the knitting process to enhance the ability to integrate functional and/or visual features within each

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layer. For example, one or more consecutive courses of the top layer **132** may utilize needles from both needle beds to provide the top layer **132** with a particular multi-bed knit structure. Then, prior to or during knitting one or more courses of the bottom layer **134**, all loops of the top layer **132** may be transferred to a first needle bed to free the needles on the second needle bed to form the bottom layer **134** (and to prevent the top layer **132** from binding to the bottom layer **134**). The bottom layer **134** may then be knitted on the second bed alone or may utilize needles on both needle beds (particularly if the top layer **132** leaves some needles on the first needle bed unoccupied). If the bottom layer **134** is formed on both beds, once it is time to resume knitting courses of the top layer **132**, all loops associated with the bottom layer **134** may be transferred to the second bed to free the first bed for again forming the top layer **132** (and to prevent the bottom layer **134** from binding with the top layer **132**). This process may be repeated as necessary.

If necessary, when knitting the top layer **132** and/or the bottom layer **134**, certain needles on each bed may be skipped by the top layer **132** and/or the bottom layer **134** to leave needles unoccupied for knitting the other layer. Thus, the top layer **132** and/or the bottom layer **134** may have a reduced gauge and/or stitch density when compared to a full gauge portion (e.g., such as the heel portion **140** as described in more detail below). In some embodiments, a gauge of the top layer **132** and/or the bottom layer **134** (defined by the ratio of the number of needles used to the total number of needles available) may be at least 25% less than a gauge of the heel portion **140**, at least 50% less, or even less. In one non-limiting embodiment, the gauge of the top layer **132** and the bottom layer **134** is about 50% of the gauge of the heel portion **140**.

Additionally or alternatively, the top layer **132** and the bottom layer **134** may include a yarn referred to as a “fusible yarn,” which in this disclosure refers to a yarn having a thermoplastic polymer material with a melting point of less than 120° C. In one exemplary embodiment, the fusible yarn of the top layer **132** and the bottom layer **134** may be a yarn having a polyester yarn surrounded by a thermoplastic polymer material or composite with a melting point of less than 100° C. (e.g., approximately 60° C.). After the knitting process, the knitted component **104** can be heated and then cooled such that the thermoplastic polymer material fuses and rigidifies to provide sufficient structure (e.g., rigidity) to the top layer **132** and bottom layer **134**, particularly when the gauge of the top layer **132** and/or the bottom layer **134** is relatively low. In some embodiments, a second yarn may be included in at least one of the top layer **132** and the bottom layer **134** that is not configured to melt or fuse when subjected to the above-described heat (e.g., where melting or decomposition points of the second yarn are higher than the highest processing temperature of the knitted component **104**). The second yarn may be any type of yarn, such as a polyester yarn suitable for providing comfort-related characteristics and/or desirable visual characteristics. Further, it may be advantageous to use a relatively thin yarn such that the top layer **132** and/or the bottom layer **134** have a desirable net-like appearance (at least in low-gauge areas), which may be made possible by the inclusion of the above-described fusible yarn.

The heel portion **140** may extend from the bottom layer **134** of the forefoot portion **130** in a longitudinal direction **166**. Thus, when the knitted component **104** is initially removed from the knitting machine, the heel portion **140** may be only indirectly attached to the top layer **132** through the bottom layer **134**. The heel portion **140** may be secured

to the bottom layer of the forefoot portion **130** via at least one common knit structure (e.g., at least one common connecting course).

The knitted component **104** may further include a first extension **142** and a second extension **144** that extend from the heel portion **140**. The first extension **142** and the second extension **144** may extend at least partially in a second direction **168** from the heel portion **140** (at least if the knitted component **104** is forced into a flattened state), where the second direction **168** is different than the longitudinal direction **166**. For example, the second direction **168** may be approximately perpendicular to the longitudinal direction **166** (e.g., within 30% with respect to true perpendicular, or less, such as within 15%). More specifically, the first extension **142** may extend in a lateral direction and the second extension **144** may extend in a medial direction (or vice versa) with respect to the foot when the knitted component **104** is incorporated into an article of footwear **100**. The first extension **142** and the second extension **144** may be formed on the knitting machine with the remainder of the knitted component **104**, and thus they may share a common knit structure with the heel portion **140**. When the knitted component **104** is initially removed from the knitting machine, the first extension **142** and the second extension **144** may be indirectly secured to the bottom layer **134** by way of the heel portion **140**, and indirectly secured to the top layer **132** by way of the heel portion **140** and the bottom layer **134**.

When the knitted component **104** is generally knitted in the longitudinal direction **166**, the heel portion **140** may be knitted substantially before or substantially after the formation of the top layer **132** and the bottom layer **134** of the forefoot portion **130**. The same can be said of the first extension **142** and the second extension **144**. Advantageously, this may provide the opportunity for the heel portion **140** and the extensions **142**, **144** to utilize the full capacity of both needle beds of the knitting machine during its formation. Thus, the heel portion **140** and the extensions **142**, **144** may be fully or primarily formed of a double jersey knit structure. Herein, a “double jersey knit structure” is defined generally as any knit structure formed on two needle beds and utilizing at least one needle from each bed. Utilizing two beds of a flat knitting machine to provide a double jersey knit structure may enhance the ability to include certain knit or non-knit features, particularly since utilizing two beds (instead of one) significantly increases the ability to selectively include visual designs, physical properties, and other features formed by a particular knitted structure, a particular yarn or combination of yarns, or a combination thereof. To illustrate, one yarn type (e.g., a thermoplastic polymer material yarn for forming a rigid fused area) may be located on an outer-facing surface, and a different yarn type (e.g., a polyester yarn) may be located on an opposite-facing surface (i.e., the inner surface) to provide comfort-related characteristics.

Still referring to FIG. 3, the first extension **142** may include a first edge **184**, which may be located on its side closest to the forefoot portion **130**. The first edge **184** may be a free edge when the knitted component **104** is initially removed from the knitting machine. Similarly, the second extension **144** may include a second edge **186**. After the knitting process, the first edge **184** and/or the second edge **186** may be manipulated such that they are adjacent to a third edge **188** of the top layer **132** of the forefoot portion **130**. Then, the first edge **184** and/or the second edge **186** may be secured to the third edge **188**. The securement may be accomplished by any suitable means, such as by sewing, bonding via adhesive, etc. In some embodiments, this

securement may occur when the knitted component **104** is located on a supporting foot-shaped last during a lasting process. One example of a lasting process is described in U.S. patent application Ser. No. 12/848,352, filed Aug. 2, 2010, and issued as U.S. Pat. No. 8,595,878, which is herein incorporated by reference in its entirety.

Once the securement is complete (or potentially before this securement), the knitted component **104** may be attached to other components of the article of footwear **100**. For example, referring back to FIG. 2, the sole structure **106** may be attached to the bottom surface **162** of the bottom layer **134**, and a midsole **190** may be placed within the void **118**. If a midsole **190** is included, the midsole **190** may be within the void **118** and in contact with the top surface **160** of the bottom layer **134** during normal use, but it may be freely removable by a user. However, the midsole **190** may alternatively be secured to the top surface of the bottom layer **134** via any suitable device or method (e.g., sewing or adhesive bonding).

Referring to FIG. 4, in some embodiments, the knitted component **104** may include a forefoot extension **192** that extends from a toe area **126** of the forefoot portion **130**. The forefoot extension **192** may share a common knit structure (e.g., a common course, loop, wale, and/or yarn) with the forefoot portion **130**, and particularly at least one of the top layer **132** and the bottom layer **134**. In some embodiments, the forefoot extension **192** may be secured to the forefoot portion **130** at the boundary **136** of the top layer **132** and the bottom layer **134**. Advantageously, if the knitting direction is in the longitudinal direction **166**, the forefoot extension **192** may be formed just before or after the formation of the forefoot portion **130** such that both needle beds of the knitting machine are focused on the forefoot extension **192**. Thus, the formation of the forefoot extension **192** may utilize the full capacity of two needle beds of a knitting machine when formed, which may provide the ability for the forefoot extension **192** to have an enhanced complexity for providing certain physical and/or visual characteristics (e.g., a relatively strong, inelastic, and durable structure). The forefoot extension **192** may include a double-jersey knit structure, for example. Optionally, the forefoot extension **192** may include at least one pocket **138** (e.g., formed by two separable knit layers) for receiving other elements, such as a cushioning element (not shown). It is contemplated that the pocket **138** may have at least one inlaid floating yarn with relatively high softness to provide the cushioning. As one skilled in the art will understand, such an embodiment may be accomplished when two needle beds are available, which is an advantage provided by the layout of the knitted component **104**.

As shown in FIG. 4, the forefoot extension may optionally be configured to form the tongue **128** of the article of footwear **100**, and may additionally or alternatively include a toecap portion **129** for providing additional protection to the toes of a user. When the knitted component **104** is manipulated into its wearable shape, a forefoot portion **130** of the forefoot extension **192** may be pulled back (e.g., towards the heel portion **140**) to form the upper end **194** of the tongue **128** (also shown in FIG. 1). As depicted in FIG. 1 (and as described in more detail below), the knitted component **104** may be inverted with respect to its orientation depicted in FIG. 4 when in its wearable orientation. Thus, referring to FIG. 4, the forefoot extension **192** forming the tongue **128** may be located at least partially outside the void **118** immediately after the knitting process, but within the void **118** between the top layer **132** and the bottom layer **134** when in its wearable orientation. Advantageously, the

tongue **128** may provide additional protection to the top of the foot and, when a lacing system is used, may prevent laces from rubbing against the foot. A user may also pull on the tongue **128** putting on the article of footwear **100** to help ensure a proper fit. While the tongue **128** is described primarily herein as a portion of the knitted component **104**, the tongue **128** may alternatively be formed separately and then secured to the knitted component **104** after the knitted component **104** is formed on the knitting machine.

When the knitted component **104** is inverted, the step of inverting the knitted component **104** may occur after the knitted component **104** is removed from the knitting machine, but before the first extension **142** and/or the second extension **144** are secured at the seam **154** (illustrated by arrows) to the top layer **132**. Advantageously, the relatively amenable knitted component **104** (before forming the seam) may be more easily inverted and may be less susceptible to damage due to inversion. However, in other embodiments, the seam **154** may be formed prior to the inversion. This may be advantageous when the outer portion of the seam **154** ties or other remnants from its formation that are initially more easily isolated to the outside, but can be flipped inside so they are not wearable when the knitted component **104** is manipulated into its wearable state.

In some embodiments, and as depicted in the embodiment of FIG. 4, the top layer **132** of the forefoot portion **130** may include a throat opening **196** in the throat area **114**. The throat opening **196** may be formed during the knitting process, or knitted material may be cut from the top layer **132** after the knitting process. One or more apertures **198** may be located on the respective lateral side **108** and medial side **110** of the throat opening **196** for receiving a fastening element, such as a shoelace. Advantageously, the throat opening **196** may enhance the ability of the top layer **132** to adjust around the foot (e.g., in response to pulling on a shoelace, for example).

The tongue **128**, formed by the forefoot extension **192**, may still remain to provide full protection to the top of the foot. Optionally, the tongue may be secured (e.g., via sewing) along its medial and lateral sides such that it remains in place when the article of footwear **100** is not worn, but this is not required. Further, in other embodiments (whether with a tongue or not), the throat opening may be absent, and the top layer **132** may substantially cover the top of the foot when worn.

The forefoot extension **192** can additionally or alternatively form elements other than a tongue. For example, referring to FIG. 5A and FIG. 5B, the forefoot extension **192** may be a two-separable-layer knitted extension that forms a toecap **206**, where the toecap **206** has an overfoot layer **208** and an underfoot layer **210**. When the forefoot extension **192** includes separable layers (shown in FIG. 5A), the two layers may be formed using any suitable technique, such as any of the techniques described above with respect to knitting the top layer **132** and the bottom layer **134** of the forefoot portion **130**. After the knitting process and referring to FIG. 5B, the toecap **206** may be inverted with respect to its orientation in FIG. 5A such that the overfoot layer **208** covers, and is coextensive with, the toe area of the top layer **132**, and such that the underfoot layer **210** covers, and is coextensive with, the toe area of the bottom layer **134**. The toecap **206** may then be secured to the top layer **132** and/or the bottom layer **134** using any suitable device or method (e.g., a sewn seam, an adhesive, by heat-treating thermoplastic polymer yarns to fuse the two elements together, etc.). Advantageously, the toecap **206** may provide an additional knitted structure for protecting the toe of a wearer

and/or providing other desirable functions related to additional knitted layers. Optionally, the knitted component **104** may be inverted (as described in more detail above) such that the toecap **206** is moved to within the void **118** between the top layer **132** and the bottom layer **134**. In other embodiments, the toecap **206** may remain outside the void **118**.

FIG. 6 is an illustration showing the knitted component **104** with a side extension **212**. Like the forefoot extension described above, the side extension **212** may extend from the boundary where the top layer **132** and the bottom layer **134** meet. Thus, when knitting in the longitudinal direction **166**, the side extension **212** will extend beyond the needles that are used to form the top layer **132** and the bottom layer **134** on the needle bed, and therefore the side extension **212** may be formed with the full capacity of both needle beds, which is associated with the advantages described above. As shown, the side extension **212** may be in the form of a strap **214**. The strap **214** may be configured to wrap around the foot of a wearer to provide tightening (e.g., in lieu of laces) and/or for additional medial-to-lateral support. When the knitted component **104** is inverted, the side extension **212** may move from outside the void **118** to inside the void **118** (or vice versa). Thus, the strap **214** may be within the void when the knitted component **104** is in its wearable state. It is also contemplated that the side extension **212** may be formed as a tubular structure with components inserted therein. When formed as a tubular structure, it is further contemplated that the strap may be pulled from outside the void **118** to within the void **118** through its end **216** while inverting the side extension **212** with respect to itself.

Advantageously, the strap **214** may therefore be knitted outside the void **118**, pulled to within the void **118**, and then again moved out of the void **118** when the top layer **132** and the bottom layer **134** are inverted during post-knit processing.

As described above, the knitted component **104** may have zonal properties. For example, in one non-limiting exemplary embodiment, the top layer **132** of the forefoot portion may have a first zone **202** in the throat area **114** and a second zone **204** adjacent to the first zone **202**. The first zone **202** and the second zone **204** may have different knit structures such that, when subjected to the same stretching force, the first zone **202** stretches less than the amount the second zone **204** stretches. The differences in elasticity can be tested by applying an equal tension force on both zones and then measuring the displacement (per unit of initial length). For example, the first zone **202** may have a knit structure that has a higher gauge than the second zone **204** such that it has a higher stitch density (i.e., knitted loops per unit area), which may provide a lower elasticity.

Additionally or alternatively, the first zone **202** may be formed of yarns with different materials, or may be treated differently during post-knit processing, to provide the first zone with lower elasticity. For example, the first zone **202** may include a thermoplastic polymer material with a relatively low melting point that melts when heat is applied and then cools into a fused state when cooled, thus forming a relatively rigid structure. The thermoplastic polymer material in the first zone **202** may be the same thermoplastic polymer material described above with respect to the “fusible yarn,” but optionally it may be a different thermoplastic polymer material provided by a separate yarn and with a different (e.g., higher) melting point (and the fusible yarns are not necessarily excluded from the first zone **202** or the second zone **204** in this embodiment). For example, in one non-limiting exemplary embodiment, both the first zone **202**

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and the second zone **204** include the above-described fusible yarns. The first zone **202** may additionally include an amount of a second thermoplastic polymer, which may be a thermoplastic polyurethane with a melting point of between about 80° C. and about 200° C., such as from about 100° C. to about 125° C. based on atmospheric pressure at sea level. This second thermoplastic polymer material may provide a relatively high rigidity after heat processing. Any suitable amount of the second thermoplastic polymer material may be included. While zonal properties are primarily described with respect to the depicted zones **202**, **204** of the top layer **132**, other areas of the knitted component **104** may additionally or alternatively include different zones with different physical and/or visual properties.

Another advantage of forming the heel portion **140** on two needle beds (as described above) is the ability to provide the heel portion **140** with a natural tendency to curve due to a specific knit structure. For example, the heel portion **140** of the knitted component **104** may include a medial heel side **170**, a lateral heel side **172**, and a rear portion **174** between the medial heel side **170** and the lateral heel side **172**, where at least one of the medial heel side **170** and the lateral heel side **172** includes a convex area on the inner surface **176** of the knitted component **104**. For example, as shown, the medial heel side **170** includes a first convex area **180** on the inner surface **178** and the lateral heel side **172** includes a second convex area **182** on the inner surface **178**. Oppositely, with respect to the outer surface (which is hidden in FIG. 6), the medial heel side **170** and the lateral heel side **172** each include a concave area. Thus, the medial heel side **170** and the lateral heel side **172** may at least partially surround the achilles tendon of a wearer, which may enhance the fit of the article of footwear **100** for providing more support, less slippage, and overall better footwear performance. The rear portion **174** may include a concave area **185** on the inner surface **178** and convex on the outer surface, which matches the natural profile of the achilles tendon on the heel of a typical wearer.

The tendency to curve may be formed using any suitable knitting process. For example, in one embodiment, and referring to the medial heel side **170** and the lateral heel side **172** (and opposite the rear portion **174**), more tension may be included on the outer surface than on the inner surface **178** of the heel portion **140** during the knitting process. This may be the result of more loops being formed on the inner surface **178** than the outer surface (e.g., in a two-bed knit structure), by varying the tension in the respective yarns/loops with tension-affecting components of the knitting machine, by using yarns having different elasticities and/or deniers, etc. Specific examples of methods of forming a knit structure with a natural tendency to curve are included in U.S. patent application Ser. No. 15/454,034, filed Mar. 9, 2017, which is herein incorporated by reference in its entirety. Further, the tendency to curve may be amplified through certain post-processing steps such as steaming, which may for example, tighten the yarns of the knitted component **104**, which may enhance the effect of a disparity between the amounts of tension on respective surfaces of the knitted component **104**.

All of the structures and methods disclosed and claimed herein can be made and executed without undue experimentation in light of the present disclosure. While this disclosure may be embodied in many different forms, there are described in detail herein specific aspects of the disclosure. The present disclosure is an exemplification of the principles of the disclosure and is not intended to limit the disclosure to the particular aspects illustrated. In addition, unless

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expressly stated to the contrary, use of the term “a” is intended to include “at least one” or “one or more.” For example, “a yarn” is intended to include “at least one yarn” or “one or more yarns.”

Any ranges given either in absolute terms or in approximate terms are intended to encompass both, and any definitions used herein are intended to be clarifying and not limiting. Notwithstanding that the numerical ranges and parameters setting forth the broad scope of the disclosure are approximations, the numerical values set forth in the specific examples are reported as precisely as possible. Any numerical value, however, inherently contains certain errors necessarily resulting from the standard deviation found in their respective testing measurements. Moreover, all ranges disclosed herein are to be understood to encompass any and all subranges (including all fractional and whole values) subsumed therein.

Furthermore, the disclosure encompasses any and all possible combinations of some or all of the various aspects described herein. It should also be understood that various changes and modifications to the aspects described herein will be apparent to those skilled in the art. Such changes and modifications can be made without departing from the spirit and scope of the disclosure and without diminishing its intended advantages. It is therefore intended that such changes and modifications be covered by the appended claims.

What is claimed is:

1. A method, comprising:

forming a forefoot portion of a knitted component on a knitting machine, the forefoot portion having a top layer and a bottom layer, wherein a void is formed between the top layer and the bottom layer, and wherein the top layer is secured to the bottom layer via at least one common knit structure;

forming a heel portion of the knitted component on the knitting machine, wherein the heel portion is secured to the bottom layer of the forefoot portion via at least one common knit structure, wherein the heel portion comprises a medial heel side, a lateral heel side, and a rear portion between the medial heel side and the lateral heel side, wherein at least one of the medial heel side, the lateral heel side, and the rear portion comprises a convex area on an inner surface of the heel portion; and forming at least one extension of the knitted component on the knitting machine, the at least one extension being attached to the heel portion.

2. The method of claim 1, wherein the at least one extension includes a first edge configured for securing to a second edge of the top layer of the forefoot portion.

3. The method of claim 1, wherein a first extension and a second extension each extend from the heel portion and are configured for securing to at least one edge of the top layer of the forefoot portion, wherein the first extension extends in a lateral direction from the heel portion, and wherein the second extension extends in a medial direction from the heel portion.

4. The method of claim 1, wherein the heel portion comprises a knit structure that has a greater density than respective knit structures of the top layer and the bottom layer of the forefoot portion.

5. The method of claim 1, further comprising forming a knitted forefoot extension on the knitting machine, the knitted forefoot extension extending from a boundary located between the top layer and the bottom layer of the forefoot portion.

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6. The method of claim 5, wherein the knitted forefoot extension comprises multiple separable layers.

7. The method of claim 5, wherein the knitted forefoot extension is at least partially coextensive with the top layer and the bottom layer.

8. The method of claim 1, wherein the knitted component comprises a side extension extending from a boundary between the top layer and the bottom layer of the forefoot portion.

9. The method of claim 8, wherein the side extension forms a strap for surrounding a foot of a wearer when incorporated into an article of footwear.

10. A method of manufacturing an upper for an article of footwear, the method comprising:

forming a forefoot portion on a knitting machine, the forefoot portion having a top layer and a bottom layer, and a void formed between the top layer and the bottom layer; and

forming a heel portion on the knitting machine, the heel portion being secured to the bottom layer of the forefoot portion and indirectly secured to the top layer through the bottom layer of the forefoot portion, the heel portion forming a first portion of a collar, wherein the heel portion comprises a medial heel side, a lateral heel side, and a rear portion between the medial heel side and the lateral heel side, wherein at least one of the medial heel side, the lateral heel side, and the rear portion comprises a convex area on an inner surface of the heel portion.

11. The method of claim 10, wherein the top layer is secured to the bottom layer via at least one common knit structure.

12. The method of claim 11, further comprising a side extension extending from a boundary located between the top layer and the bottom layer of the forefoot portion.

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13. The method of claim 10, wherein the heel portion is secured to the bottom layer of the forefoot portion via a common knit structure.

14. The method of claim 10, further comprising forming a side extension on the knitting machine, the side extension extending from a boundary located between the top layer and the bottom layer of the forefoot portion.

15. The method of claim 14, wherein the side extension forms a strap for surrounding a foot of a wearer when incorporated into the article of footwear.

16. The method of claim 10, further comprising forming a knitted forefoot extension on the knitting machine, the knitted forefoot extension extending from a boundary between the top layer and the bottom layer of the forefoot portion.

17. The method of claim 16, wherein the knitted forefoot extension is a two-layer knitted extension.

18. A method of manufacturing an article of footwear, the method comprising:

forming a forefoot portion of an upper on a knitting machine, the forefoot portion having a top layer and a bottom layer;

forming a heel portion of the upper on the knitting machine, the heel portion secured to the bottom layer of the forefoot portion and indirectly secured to the top layer through the bottom layer of the forefoot portion, the heel portion forming a portion of a collar of the upper, wherein the heel portion comprises a medial heel side, a lateral heel side, and a rear portion between the medial heel side and the lateral heel side, wherein at least one of the medial heel side, the lateral heel side, and the rear portion comprises a convex area on an inner surface of the heel portion; and attaching the upper to a sole structured.

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