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(54) **SHOE COMPONENTS HAVING VARYING MODULUS ZONES**

(71) Applicant: **Knitmasters, LLC**, Colfax, NC (US)

(72) Inventors: **Jeffrey W. Bruner**, Leasburg, NC (US); **Juan Aristizabal**, Greensboro, NC (US)

(73) Assignee: **Knitmasters, LLC**, Colfax, NC (US)

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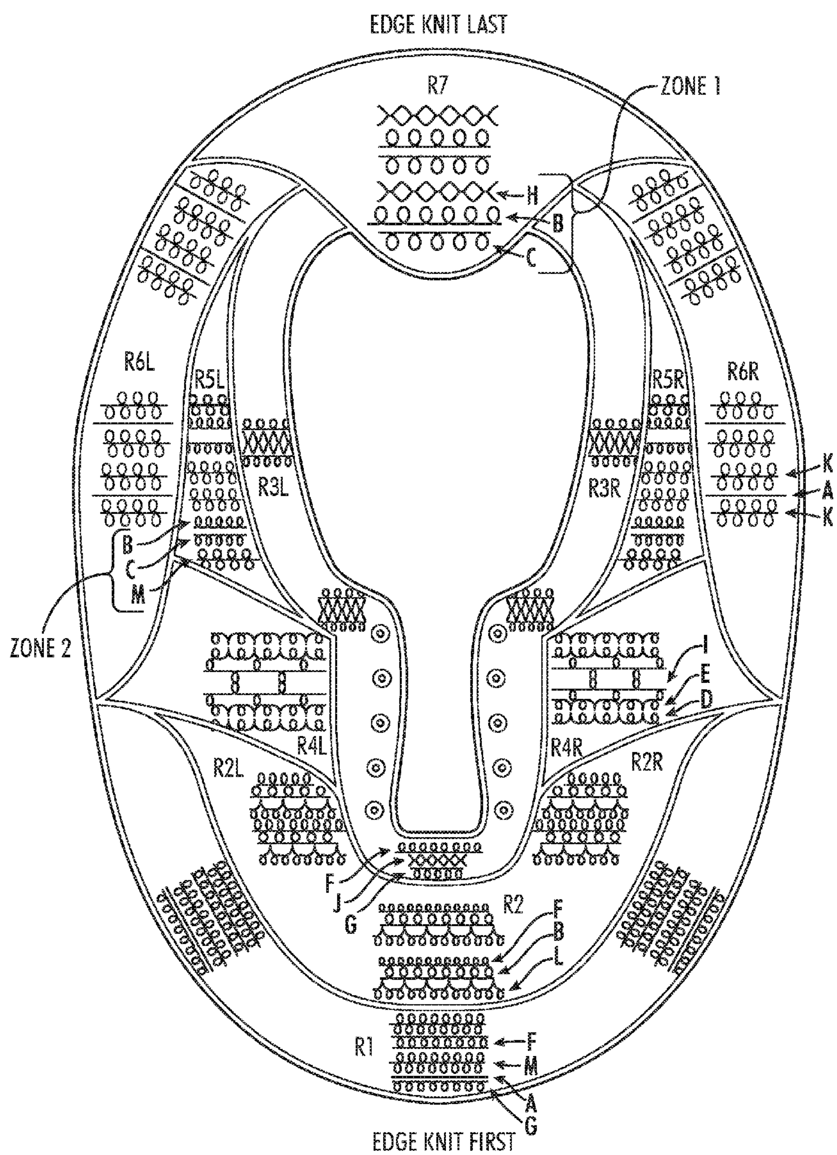
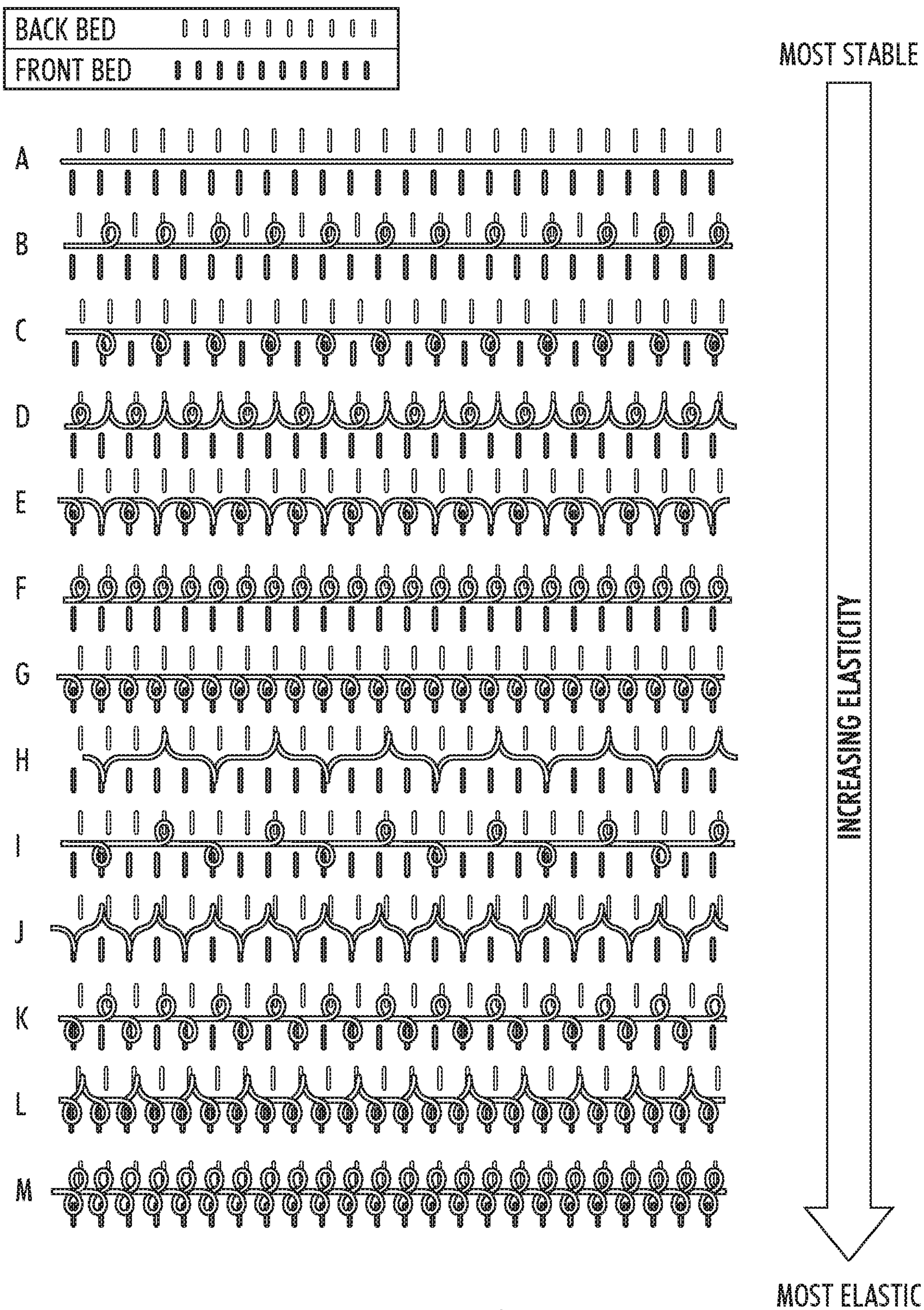
(57) **ABSTRACT**

In one aspect, a shoe component is described. The shoe component comprises a body of continuous fabric having at least a first zone and a second zone. The first zone of the fabric has a first modulus of elasticity and the second zone of the fabric has a second modulus of elasticity that is different than the first modulus of elasticity. More than two zones can be provided per shoe component, in some cases.




BACK BED
FRONT BED
MOST STABLE
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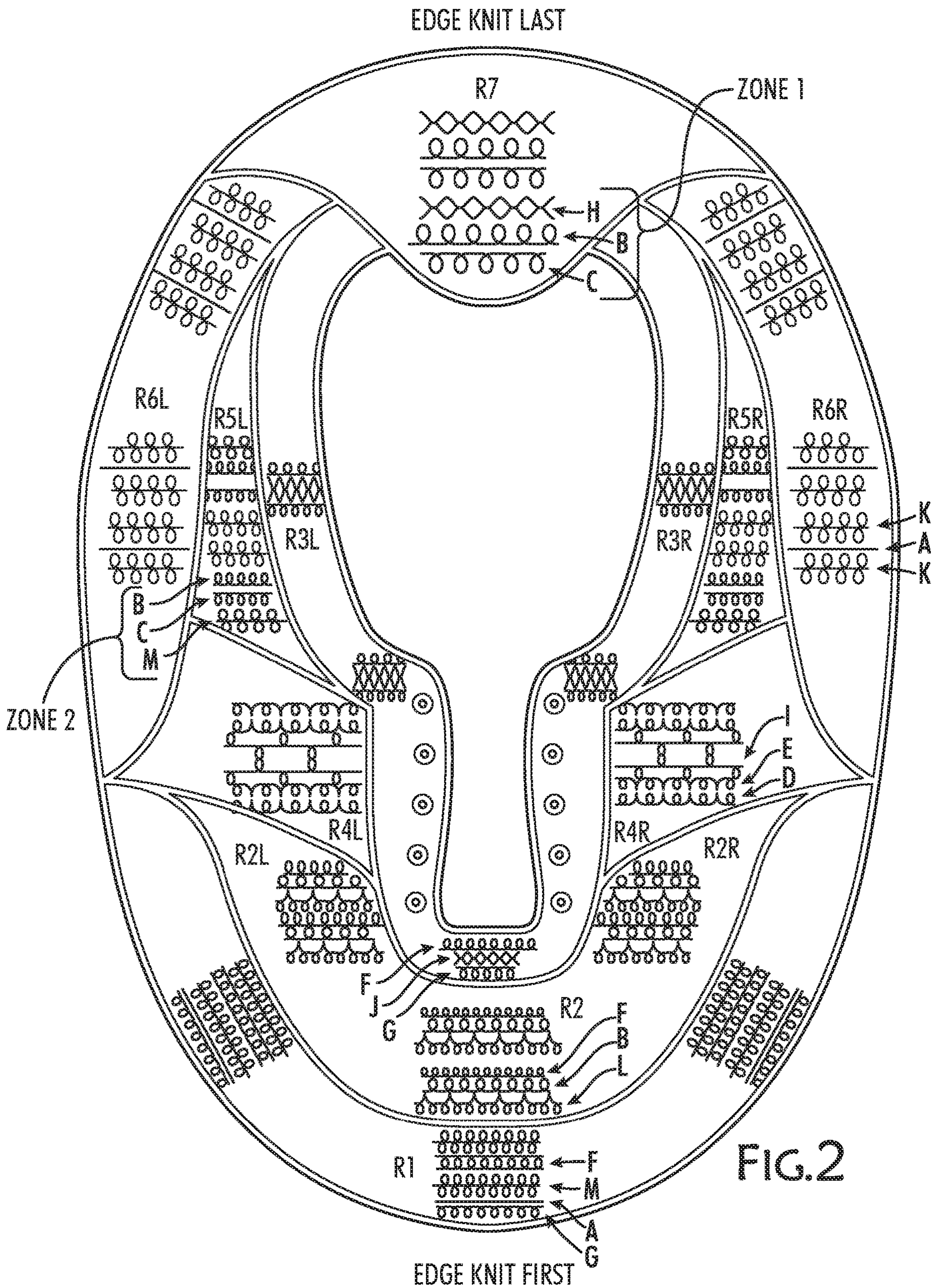
INCREASING ELASTICITY
MOST ELASTIC

FIG. 1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R5R
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B
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ZONE 2
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R4L
R4R
R2L
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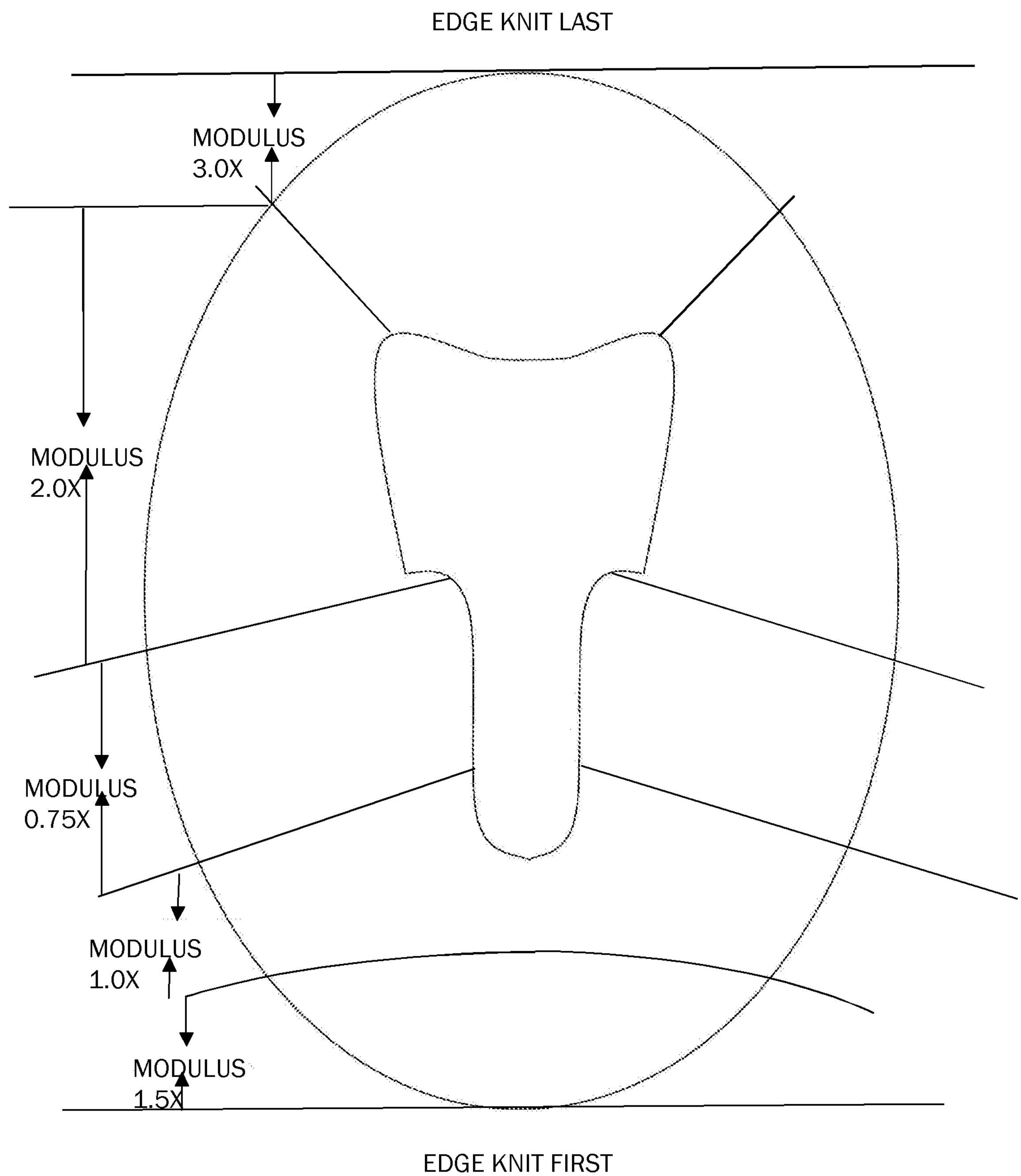
EDGE KNIT FIRST

FIG. 2


EDGE KNIT LAST
MODULUS
3.0X
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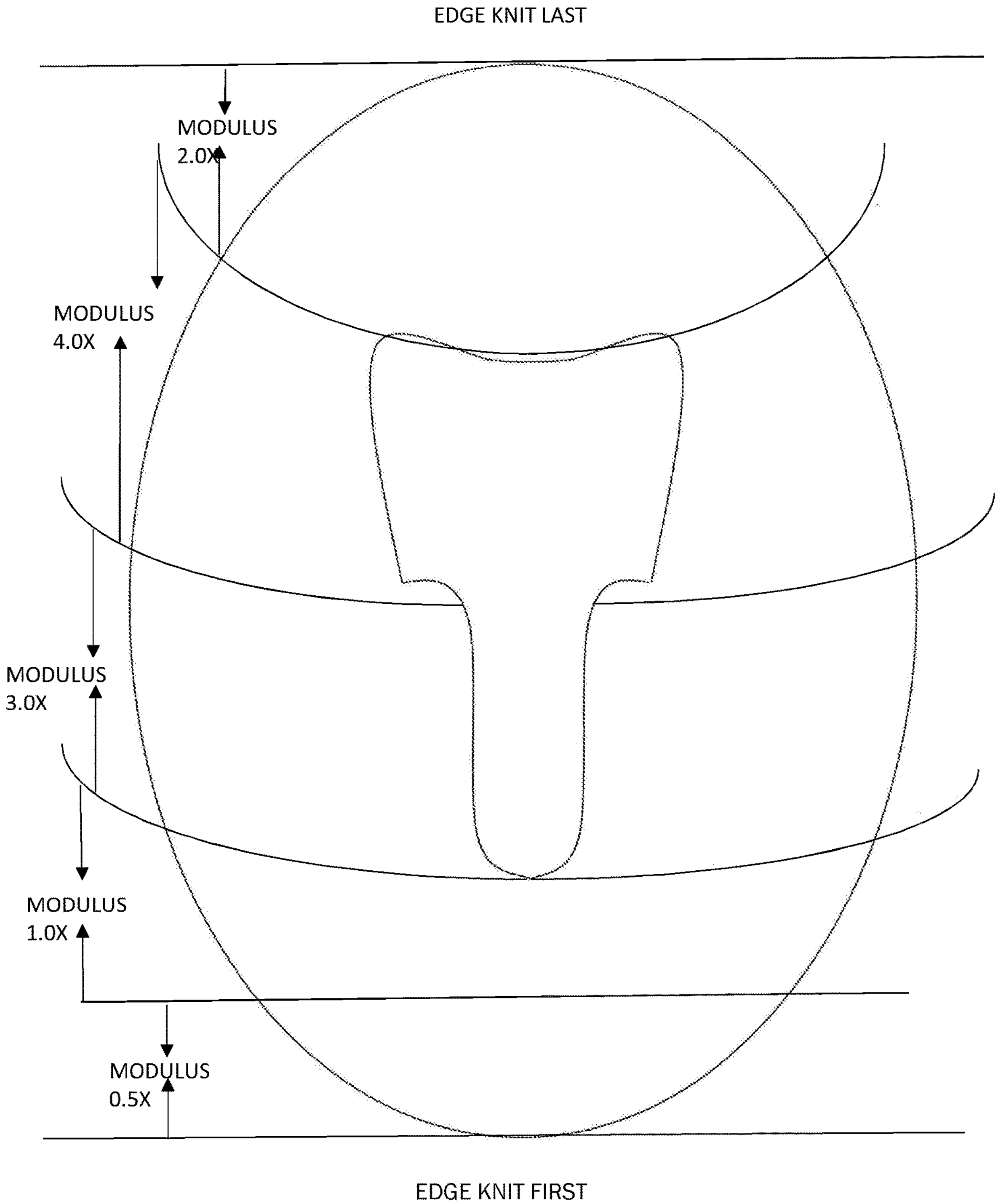
EDGE KNIT FIRST

FIG. 3A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EDGE KNIT FIRST

FIG. 3B

SHOE COMPONENTS HAVING VARYING MODULUS ZONES

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority pursuant to 35 U.S.C. § 119 to U.S. Provisional Patent Application Ser. No. 62/622,285, filed on Jan. 26, 2018, which is hereby incorporated by reference in its entirety.

FIELD

[0002] The present subject matter relates to shoe components and, in particular, to knitted shoe components having one or more of zones formed therein, such zones differing in elastic modulus, and methods of making the same.

BACKGROUND

[0003] Textiles and fabrics are used to form various components or portions of shoes and other footwear, including shoe uppers. However, existing shoe components are formed via stitching together a number of fabrics and/or materials, for example, to provide comfortable footwear that adequately supports the foot and/or to provide different areas in footwear that perform different functions or have different properties. The need to stitch together multiple fabrics and/or utilize different materials can substantially reduce the efficiency at which shoe components are manufactured while substantially increasing the cost.

[0004] Accordingly, a need exists for improved shoe components and methods of making shoe components, particularly to provide shoe components having multiple zones of differing properties or functions.

SUMMARY

[0005] Shoe components and methods of making the same are disclosed. The shoe components and related methods advantageously reduce the amount of materials and/or processing steps needed to manufacture shoe components and/or shoes. The components and methods described herein utilize a fabric comprised of multiple zones that differ in regards to elasticity, stiffness, modulus, and/or any other physical or chemical attribute not inconsistent with the objectives of the present invention.

[0006] In one aspect, a shoe component is described. The shoe component comprises a body of continuous fabric having at least a first zone and a second zone. The first zone of the fabric has a first modulus of elasticity and the second zone of the fabric has a second modulus of elasticity that is different than the first modulus of elasticity. More than two zones can be provided per shoe component, in some cases.

[0007] In some embodiments, the first zone of the fabric has a higher modulus of elasticity than the second zone of the fabric. For example, and in some cases, a ratio of the first modulus of elasticity to the second modulus of elasticity is around 2:1. The ratio of the first modulus of elasticity to the second modulus of elasticity can be any value not inconsistent with the objectives of the present invention. For example, the ratio of the first modulus of elasticity to the second modulus of elasticity can be about 1.5:1, 2.5:1, 3:1, 4:1, 3:2, 4:3, 5:4, or any other value not inconsistent with the instant disclosure. Alternatively, the first zone of the fabric can have a lower modulus of elasticity than the second zone of the fabric. In this regard, the ratio of the first modulus of elasticity to the second modulus of elasticity may be about 1:1.5, 1:2, 1:2.5, 1:3, 1:4, 2:3, 3:4, 4:5, or any other value not inconsistent with the instant disclosure.

[0008] In further aspects, the shoe components described herein comprise a fabric having more than two zones formed or disposed therein. At least two of the zones have a different respective modulus of elasticity. Two or more of the zones can, but do not have to, have the same or about the same modulus of elasticity. In some instances, the body of continuous fabric further comprises a third zone having a third modulus of elasticity. The third modulus of elasticity is different than the first modulus of elasticity and/or the second modulus of elasticity. In further instances, the body of continuous fabric can further comprise a fourth zone having a fourth modulus of elasticity. The fourth modulus of elasticity is different than at least one of the first modulus of elasticity, the second modulus of elasticity, and the third modulus of activity. In yet further instances, the body of continuous fabric further comprises an nth zone having an nth modulus of elasticity, where "n" is a whole number integer greater than 4. The nth modulus of elasticity is different than at least one of the first, second, third, and fourth moduli of elasticity.

[0009] Moreover, and in some aspects, the fabric forming the shoe components described herein is a knit fabric. The first zone can have a first knit construction and the second zone can have a second knit construction that is different than the first knit construction. For example, and in some embodiments, the first zone has a plain knit (single jersey) construction and the second zone has a double knit (rib) construction. Zones having interlock, pique, purl, and cable knit constructions, as well as many other constructions, some of which may include lay-in yarns, are also contemplated. Any knit construction not inconsistent with the instant disclosure can be used to form the fabric and/or first and second zones.

[0010] Moreover, in some cases, the first zone of the fabric is formed from one or more first fibers and the second zone of the fabric is formed from one or more second fibers. The one or more first fibers differ from the one or more second fibers. For example, the one or more first fibers and the one or more second fibers can have differing elasticity, tenacity, and/or percent elongation at break. In particular, in some preferred embodiments, the one or more first fibers and the one or more second fibers can have differing elongations at various set loads. Moreover, the differing elongations can correspond to elastic portions of the fibers.

[0011] Notably, providing one or more first fibers having differing elasticity, tenacity, percent elongation characteristics, etc., than one or more second fibers advantageously allows formation of a fabric having differing zones and/or regions for achieving a desired performance outcome for a desired application. For example, the first fibers may be knitted together to form a first zone or region of a shoe component and the second fibers may be knitted together to form a second zone or region of the shoe component that is adjacent to and/or an extension of the first zone, wherein the second zone has different properties than the first zone. A shoe component constructed or formed from differing zones is configured to achieve a desired and/or customized performance based upon the end application, such as, for example, improved support or compression resistance for athletic shoe components, improved stretch or elasticity for dance shoe components, or improved massaging capabilities for insole applications.

[0012] The one or more first fibers can also be formed from different polymers or other materials than the one or more second fibers. For example, the one or more first fibers can be formed from a hard polymer and the one or more second fibers can be formed from an elastomer. Any polymers and/or materials not inconsistent with the instant disclosure can be used to form the one or more first and second fibers and resultant fabric. The one or more first and second fibers may be natural or synthetic fibers, and be synthesized via any suitable method not inconsistent with the instant disclosure.

[0013] Additionally, and in further cases, the first zone of the fabric has a higher density and/or quantity of filaments per area than the second zone. Moreover, the first zone of the fabric can comprise a higher modulus zone formed from one or more yarns having a tenacity that is greater than about 9 grams per denier (gpd). The second zone of the fabric can optionally comprise a lower modulus zone formed from one or more yarns having a tenacity that is less than about 5 gpd. The fabric can be formed from any high and/or low tenacity fiber(s) not inconsistent with the instant disclosure.

[0014] Furthermore, the first zone of the fabric can comprises one or more yarns having a percent elongation at break that is greater than about 50% whereas the second zone of the fabric optionally comprises one or more yarns having a percent elongation at break that is less than about 20%. The fabric can be formed from any fibers having any differing physical, chemical, and/or or mechanical properties or characteristics not inconsistent with the instant disclosure.

[0015] The shoe components described herein can comprise shoe uppers, in certain embodiments. One or more of the fabric zones can be disposed within a heel region, a toe region, and/or a wing region of the shoe upper. In certain embodiments, the first zone comprises a higher modulus zone and the second zone comprises a lower modulus zone. The higher modulus zone can be located or disposed proximate to the wing region of the shoe upper, and the lower modulus zone can be disposed proximate to the toe region of the shoe upper. The first, second, and nth zones can be disposed at any spatial location on or over the shoe upper not inconsistent with the instant disclosure. The shoe components described herein can also be insoles, in some embodiments.

[0016] Further, and in some embodiments, the shoe components described herein can comprise spacer fabrics. For example, in some instances, the spacer fabric includes at least a first zone of fabric that has a higher modulus of elasticity than the second zone of the fabric for forming a spacer fabric having areas of improved stiffness, elasticity, and/or compression resistance. In certain embodiments, the first zone of the fabric is disposed proximate to a heel region or a ball region of a wearer's foot for improving the stiffness and/or compression resistance proximate such regions of the foot. The second zone of the fabric can be disposed proximate an arch region or a toe region of the wearer's foot for providing improved cushion, stretch, and/or elasticity proximate such regions of the foot. The shoe components described herein can also be insoles, in some embodiments.

[0017] In certain cases, the shoe components are seamless. The fabric used to form the shoe components can be a continuous, seamless knit fabric, in some embodiments.

[0018] Methods of making shoe components are also described. In one aspect, a method of making a shoe component comprises forming at least a first zone and a second zone in a continuous body of fabric. The first zone has a first modulus of elasticity and the second zone has a second modulus of elasticity that is different than the first modulus of elasticity.

[0019] Forming the first and second zones can comprise knitting the first and second zones. Shoe components formed using such a method can comprise a shoe upper, spacer fabric, or insert. Additional components, not limited to tongue or sole components, can be attached to the shoe upper, spacer fabric, or insert, where desired. Such additional components can be attached to the shoe upper, spacer fabric, or insert by sewing, gluing, welding, bonding or knitting, for example.

BRIEF DESCRIPTION OF THE FIGURES

[0020] FIG. **1** schematically illustrates various knit structures used to form one or more zones in a shoe component accordingly to some embodiments described herein.

[0021] FIG. **2** schematically illustrates a shoe component having a plurality of zones of varying modulus according to one embodiment described herein.

[0022] FIG. **3**A schematically illustrates a shoe component having a plurality of zones of varying modulus according to one embodiment described herein.

[0023] FIG. **3**B schematically illustrates a shoe component having a plurality of zones of varying modulus according to one embodiment described herein.

DETAILED DESCRIPTION

[0024] Embodiments described herein can be understood more readily by reference to the following detailed description, examples, and figures. Elements, apparatus, and methods described herein, however, are not limited to the specific embodiments presented in the detailed description, examples, and figures. It should be recognized that these embodiments are merely illustrative of the principles of the present invention. Numerous modifications and adaptations will be readily apparent to those of skill in the art without departing from the spirit and scope of the invention.

[0025] In addition, all ranges disclosed herein are to be understood to encompass any and all subranges subsumed therein. For example, a stated range of "1.0 to 10.0" should be considered to include any and all subranges beginning with a minimum value of 1.0 or more and ending with a maximum value of 10.0 or less, e.g., 1.0 to 5.3, or 4.7 to 10.0, or 3.6 to 7.9.

[0026] All ranges disclosed herein are also to be considered to include the end points of the range, unless expressly stated otherwise. For example, a range of "between 5 and 10" should generally be considered to include the end points 5 and 10.

[0027] The components and methods described herein can be formed or carried out using a knitting machine. Any knitting machine not inconsistent with the objectives of the present invention may be used, including both warp knitting and weft knitting machines. In some cases, for example, a V-bed knitting machine is used. In other cases, a four-bed flat knitting machine is used. Methods of making shoe components described herein, including seamless continuous fabric comprised of at least two zones used to form shoe components, can be carried out via knitting.

[0028] In certain embodiments, the knitting machines used to form components via the methods described herein are automated. For example, in some cases, an automated knitting machine is used to carry out a knitting process according to needle-by-needle or stitch-by-stitch instructions provided by a computer as a function of space and/or time. The computers associated with the automated knitting machines described herein can include at least one memory element and processor configured to respectively store and execute computer-readable program code portions that instruct the machines to knit in a desired sequence or manner.

[0029] As used herein, the term "fiber" refers to a fiber, a yarn, or a filament. It is to be understood that the shoe components and methods of making shoe components described herein can be carried out using any fibers not inconsistent with the objectives of the present invention, where "fibers" can refer collectively to fibers, yarns, and filaments.

[0030] Additionally, a "toe region" of a shoe component, for reference purposes herein, includes the toe box and the vamp of a shoe upper. A "vamp," for reference purposes herein, refers to the portion of a shoe upper that at least partially covers the top part of the foot of a wearer between the toes and the ankle. A shoe "upper," for reference purposes herein, refers to any portion of a shoe that is higher than the sole. Similarly, a "wing portion," for reference purposes herein, includes all or a portion of the medial or lateral portion of a shoe upper. Finally, an "insole" portion, for reference purposes herein, refers to a portion of fabric that defines the interior bottom of a shoe or a shoe component and can be positioned directly beneath the foot of a wearer of the shoe or shoe component.

I. Shoe Components

[0031] In one aspect, shoe components are described herein. Such components can comprise or be formed from a body of continuous fabric. As described in more detail below, the fabric may be formed via knitting. Notably, one or more "zones" are formed or disposed in the fabric either during or after the knitting process. Such zones are regions or areas of the fabric that differ from other zones in regards to stiffness, rigidity, elasticity, and/or other physical or chemical attribute to provide, for example, increased or decreased support, stretch, cushion, compression, or other desirable feature, to a wearer's foot.

[0032] In some cases, for example, the shoe components set forth herein comprise, consist, or consist essentially of fabric having at least a first zone and a second zone formed therein. The first zone of the fabric can have a first modulus of elasticity and the second zone of the fabric can have a second modulus of elasticity that is different than the first modulus of elasticity. The modulus of elasticity is known as, and may be referred to as the "elastic modulus" or "Young's modulus" or "initial modulus," in some cases.

[0033] In some instances, the first zone of the fabric has a higher modulus of elasticity than the second zone of the fabric. In some cases, a ratio of the first modulus of elasticity to the second modulus of elasticity is 2:1 or at least about 2:1. The ratio of the first modulus of elasticity to the second modulus of elasticity can be any value not inconsistent with the objectives of the present invention. For example, the ratio of the first modulus of elasticity to the second modulus of elasticity can be about 1.5:1, 2.5:1, 3:1, 4:1, 3:2, 4:3, 5:4, or any other value not inconsistent with the instant disclosure.

[0034] Alternatively, in some embodiments, the first zone of the fabric can have a lower modulus of elasticity than the second zone of the fabric. In this regard, the ratio of the first modulus of elasticity to the second modulus of elasticity may be about 1:1.5, 1:2, 1:2.5, 1:3, 1:4, 2:3, 3:4, 4:5, or any other value not inconsistent with the instant disclosure.

[0035] It should be understood that a ratio of the first zone's elastic modulus to the second zone's elastic modulus is calculated by first determining the elastic modulus of each zone (such as in a manner described further hereinbelow). The elastic modulus of a particular zone can then be compared as a ratio to the elastic modulus of a different zone.

[0036] It is further to be understood that the elastic modulus of a particular zone described herein is not necessarily the same as the total or overall elastic modulus of a shoe component having multiple zones Similarly, the elastic modulus of a particular zone described herein is not necessarily the same as the total or overall elastic modulus of a seamless fabric described herein. For example, in some cases, a particular zone can have an elastic modulus that is higher or lower than the total or overall elastic modulus of the shoe component or of a continuous fabric comprising or containing the zone.

[0037] In general, a modulus of elasticity of a zone (or fabric) described herein can be measured or determined in any manner not inconsistent with the objectives of the present disclosure. For example, in some cases, a zone's (or fabric's) elastic modulus can be determined according to ASTM standard D4848-98. Of course, for purposes of comparing the elastic modulus of one zone to the elastic modulus of another zone (qualitatively or quantitatively, as contemplated and described herein), it is to be understood that the compared elastic moduli are to be determined or measured using the same method or standard in a given instance.

[0038] The first and second zones, respectively, can differ in regard to any chemical, physical, or mechanical attribute not inconsistent with the objectives of the instant invention. For example, and in some embodiments, the first zone of the fabric has a higher quantity of fibers or filaments that the second zone Similarly, in some embodiments, the first zone of the fabric has a higher density of filaments per area than the second zone. The first and second zones of the fabric can differ in fiber tenacity, elongation, elongation at break, elastic modulus, stiffness, or any other aspect not inconsistent with the instant disclosure.

[0039] In certain embodiments, at least one of the first and second zones of the fabric comprise one or more high tenacity yarns, fibers, or filaments having a tenacity that is greater than 4 grams per denier (gpd), greater than 5 gpd, greater than about 9 gpd, greater than about 10 gpd, greater than about 20 gpd, or greater than about 30 gpd. Similarly, in some embodiments, at least one of the first and second zones of the fabric comprise one or more low tenacity yarns, fibers, or filaments having a tenacity that is less than about 5 gpd, less than about 4 gpd, less than 3 gpd, less than 2 gpd, or less than 1 gpd. In some instances, the first zone of the fabric has a tenacity of 3-4 gpd, and the second zone of the fabric has a tenacity of 7-9 gpd or greater than 9 gpd. Such high and low tenacity yarns, fibers, and/or filaments can be used together in a single zone or provided in separate, spatially discrete zones.

[0040] Additionally, at least one of the first and second zones of the fabric comprise one or more highly elastic yarns, fibers, or filaments having a percent elongation at break that is greater than about 50%, greater than about 100%, greater than about 200%, or greater than about 300%. Similarly, at least one of the first and second zones of the fabric comprise one or more non-elastic or substantially non-elastic yarns having a percent elongation at break that is less than about 20%, less than about 10%, less than about 5%, or less than about 2%. Elastic and non-elastic yarns, fibers, and/or filaments can be used together in a single zone or provided in separate, spatially discrete zones.

[0041] The first and second zones can occupy any size, shape, and/or spatial location over the fabric not inconsistent with the objectives of the present invention. The first zone can be directly adjacent to and optionally contact the second zone or be spaced apart therefrom. In some aspects, the first and second zones can partially overlap. Alternatively, in other embodiments, the first and second zones do not overlap. The knit structures and/or fibers defining the first and second zones can be customized depending on the application or provided in a repetitive pattern over the fabric. Some non-limiting examples of knit structure patterns are shown in FIG. **2**. The first and second zone can have the same or different shapes and sizes. In certain embodiments, the size and/or placement of the stiffer and/or more elastic zones can be customized for athletic or orthotic shoes for providing adequate support and stretch relative to the wearer's foot. Fabrics and shoe components comprised of more than two zones are also contemplated.

[0042] Moreover, a given "zone" of a fabric described herein can be distinguished from another zone of the fabric in one or more manners. For instance, as noted herein, differing zones can have different moduli of elasticity. Moreover, differing zones can be formed from different fibers and/or have different fiber configurations or arrangements. Such configurations or arrangements may include, without limitation, specific knit constructions that are obtained via fiber placement and manipulation during knitting on a knitting machine. Thus, the modulus of elasticity for a zone can be determined, in some embodiments, by one or more characteristics of the zone, including but not limited to fiber material, fiber quantity, fiber density, knit structure, or knit construction, such specific combinations of knit structures or specific patterns having multiple knit structures, or any combination thereof.

[0043] Additionally, it is also possible for differing zones in a single continuous fabric described herein to have the same modulus of elasticity and/or share other structural features, such as fiber and/or fiber configuration or arrangement. However, in such instances, it is to be understood that the differing zones are not immediately adjacent zones. Instead, such otherwise "identical" or "repeating" zones may be separated from one another by one or more other zones having different moduli of elasticity and/or different constructions. The various zones can be spatially disposed in the fabric.

[0044] It is to be understood that a single continuous fabric described herein can have more than two differing modulus zones. In some embodiments, for instance, the body of continuous fabric further comprises a third zone having a third modulus of elasticity. The third modulus of elasticity is different than the first modulus of elasticity and/or the second modulus of elasticity. Similarly, the body of continuous fabric can further comprise a fourth zone. The fourth zone of the fabric has a fourth modulus of elasticity, that is different than at least one of the first modulus of elasticity, the second modulus of elasticity, and the third modulus of activity.

[0045] More generally, in some cases, the body of continuous fabric further comprises an nth zone having an nth modulus of elasticity. The nth modulus of elasticity is different than at least one of the first, second, third, and fourth moduli of elasticity. The value of the integer "n" is greater than 4, but not particularly limited. In some embodiments, "n" is an integer between 5 and 100, between 5 and 50, between 5 and 30, between 5 and 20, between 5 and 15, or between 5 and 10. Moreover, it is further to be understood that any two of the "n" zones of a continuous body of fabric described herein can differ in any of the manners described herein for a "first" and "second" zone.

[0046] Further, in some embodiments, the fabric is a knit fabric. The first zone can have a first knit construction and the second zone can have a second knit construction that differs from the first knit construction. In certain embodiments, the first zone has a plain knit (single jersey) construction and the second zone has a double knit (rib) construction. Zones having interlock, pique, purl, and cable knit constructions, as well as many other constructions, some of which may include lay-in yarns, are also contemplated, and may be used alone or in combination with any other type or types of knit construction(s). Any knit construction not inconsistent with the instant disclosure can be used to form the fabric and/or first and second zones.

[0047] Moreover, and in certain embodiments the first zone of the fabric is formed from one or more first fibers and the second zone of the fabric is formed from one or more second fibers. The one or more first fibers can differ from the one or more second fibers, in terms of any physical, chemical, or mechanical attributes not inconsistent with the objectives of the instant disclosure. For example, the first fibers can be formed from a different polymer or material than the second fibers. The first fibers can also differ in regards to elastic modulus from the second fibers, and thus, differ in elasticity, rigidity, and/or stiffness. The first and second fibers can also have a differing tenacity or percent elongation at break.

[0048] The shoe components constructed or formed from the fabric described herein can comprise shoe uppers, spacer fabrics, or insoles. Where the shoe component is a shoe upper, one or more of the fabric zones can be disposed within a heel region, a toe region, or a wing region of the shoe upper. In certain embodiments, the first zone comprises a higher modulus zone and the second zone comprises a lower modulus zone. The higher modulus zone can be disposed proximate the wing region and the lower modulus zone can be disposed proximate the toe and/or heel regions. The fabric forming the shoe components described herein can comprise a continuous, seamless knit fabric.

[0049] Further, and in certain embodiments, the shoe components constructed or formed from the fabric described herein include spacer fabrics. Such fabrics can be positioned or disposed proximate a wearer's foot, in some instances. In some embodiments, a spacer fabric described herein comprises a knit construction formed from a fabric comprising or consisting of at least a first zone and a second zone. The first zone can comprise a higher modulus of elasticity than the second zone for increasing the amount of support or stiffness provided to a given portion of the foot. For example, and in some embodiments, the first zone of the spacer fabric having the higher modulus of elasticity is disposed proximate a heel region or a ball region of a wearer's foot. The second zone of the fabric can be disposed proximate an arch region or a toe region of the wearer's foot. More than two zones may be formed, disposed, or otherwise provided per the spacer fabric. The multiple zones of the spacer fabrics described herein can differ in regards to any desired material property not inconsistent with the objectives of the present subject matter, for example, and in some aspects, such zones differ in regards to the modulus of elasticity, knit construction, yarn material, tenacity, percent elongation at break, and/or thickness.

[0050] As noted above, the shoe components set forth herein are formed from one or more fibers, yarns, and/or filament. The type, composition, quantity, density, knit construction, or any other aspect of the fibers, yarns, and/or filaments can, but does not have to, differ per zone. The shoe components can, in some instances, comprise one or more zones formed from a single component yarn, a multi-component yarn (such as a bi-component yarn or a yarn having 3 or 4 or more components), or a combination of single and multi-component yarns. A multi-component yarn can have a sheath/core structure, a side-by-side structure, or an islands-in-the-sea structure. Other multi-component yarn structures can also be used. Further, in some embodiments, the shoe components comprise one or more zones formed from a monofilament yarn, a multifilament yarn, or a combination of monofilament and multifilament yarns. The yarn forming the shoe components described herein may also include separate filaments formed from different materials, or a plurality of filaments that are each formed from two or more different materials.

[0051] Additionally, in some instances, the shoe components described herein comprise one or more zones that are at least partially formed from an elastomeric yarn or a heat-fusible yarn. For example, in some embodiments, stable and elastic single component multifilament and/or monofilament yarns are used in one or more zones. In some such cases, the yarns can be formed from low melting point polymers, such as polymers having a melting point below about 200° C., 150° C., below about 100° C., or below about 80° C. In some embodiments, the yarns can be formed from polymers having a melting point between about 80° C. and about 150° C. Such yarns can be heated, with or without pressure, to cause the low melting components to melt and flow, thereby modifying the physical properties of the shoe component, including by serving as an adhesive. In other cases, stable and elastic multi-component (e.g., bi-component) multifilament and/or monofilament yarns are used. In some such embodiments, the yarns in one or more zones can be formed from low melting point polymers in combination with higher melting point polymers (such as polyester or nylon), such that the low melting point polymer components but not the higher melting point polymer components of the yarns can be made to melt and flow by the application of heat with or without pressure, thereby modifying the physical properties of the shoe component in a desired manner, including by providing an adhesive element and/or structural support.

[0052] The fiber, yarn, or filament or one or more portions of the fiber, yarn, or filament forming the shoe components and/or zones thereof as described here can comprise or be formed from any material not inconsistent with the objectives of the present invention. In some embodiments, for example, the fiber, yarn, or filament comprises or is formed from a synthetic material such as nylon or another polyamide, polyester, polyethylene, polypropylene, polybutylene, or another polyolefin, or polyacrylic. In other cases, the fiber, yarn, or filament comprises or is formed from a natural fiber material such as cotton, wool, or silk. Other fibers, yarns, and filament materials may also be used, such as regenerated cellulose or rayon.

[0053] In certain cases, the fiber, yarn, or filament comprises or is formed from a rate-sensitive material, such as a rate-sensitive thermoplastic elastomer. Such a "rate-sensitive" material can have a first property whose value changes non-linearly with a second property, the second property being a rate or frequency. In some embodiments, for example, a rate-sensitive material includes or comprises a rate-sensitive thermoplastic elastomer. Such materials exhibit different stiffness values at different rates or frequencies. For instance, rate-sensitive materials can be soft and flexible at lower rates or frequencies, but stiffen or harden under higher rates or frequencies. As described herein, such rate-sensitivity can provide increasing stability and performance under certain conditions of use of a fiber, yarn, filament, fabric, and/or shoe component described herein. One non-limiting example of a rate-sensitive material is D3O®, a DuPont™ Hytrel® thermoplastic elastomer.

[0054] The rate-sensitivity of a rate-sensitive material described herein, in some cases, is further influenced by an operational parameter. For example, in some embodiments, a rate-sensitive material can be temperature-sensitive. A change in temperature, in some cases, can affect the characteristics or properties of the rate-sensitive material. Such rate-sensitive materials that are temperature-sensitive can exhibit a significant shift in rate-sensitivity upon a change in temperature, and in some cases, upon a nominal change in temperature. For example, an increase or decrease in temperature can change the melt viscosity at certain shear rates. Thus, characteristics or properties of the rate-sensitive material, including mechanical properties, thermal properties, and electrical properties, in some cases, can vary at different temperatures in rate-sensitive materials. Some examples of such temperature sensitive materials include, but are not limited to, Dupont Hytrel® thermoplastic elastomers, such as Hytrel® G4074, Hytrel® 4056, Hytrel® 4069, Hytrel® 5526, Hytrel® 5556, Hyrel® 6356, and Hytrel® 7246. It should be understood that other temperature-sensitive materials are also contemplated.

[0055] In other embodiments, a rate-sensitive material can be pressure-sensitive. For example, a change in pressure or load, in some cases, can affect the characteristics or properties of the rate-sensitive material. Such rate-sensitive materials that are pressure-sensitive can exhibit a significant shift in rate-sensitivity upon a change in pressure or load, and in some cases, upon a nominal change in pressure or load. For example, an increase or decrease in pressure or load can change the flow length at certain melt flow rates. Thus, characteristics or properties, including mechanical properties, thermal properties, and electrical properties, in some cases, can vary at different values of pressure or load in rate-sensitive materials. One such example of a pressure sensitive material is Dupont Hytrel® 8833. It should be understood that other pressure-sensitive materials are also contemplated.

[0056] Rate-sensitive materials exhibit a variety of desirable characteristics or properties at different rates or frequencies. Non-limiting examples of desirable characteristics or properties that can vary in rate-sensitive materials include adhesion, water absorption, humidity absorption, hydrolysis resistance, tensile strength, compression strength, impact strength, fatigue resistance, heat absorption, light reflection, colorfastness, abrasion-resistance, friction resistance, tear resistance, flex-fatigue resistance, creep resistance, impact resistance, chemical resistance, heat-aging resistance, wet-squeak resistance, stress-cracking resistance, crack propagation resistance, ultraviolet radiation resistance, nuclear radiation resistance, breathability, gas permeability, ductility, elasticity, brittleness, conduction, shrinkage, flammability, antimicrobial properties, hardness, toughness, softness, flexibility, resilience, porosity, rigidity, density, and others. It should be understood that any rate-sensitive material, not inconsistent with the goals of the present disclosure can be used. Moreover, selection of certain characteristics or properties and/or profiles in rate-sensitive materials can vary by region or zone of shoe components described herein. Such rate-sensitive yarns and/or materials, in some cases, can be configured to adjust the stress and/or strain experienced by a wearer of a shoe component described herein, based on acceleration, speed, or movement of the wearer.

[0057] In still other cases, the fiber, yarn, or filament comprises or is formed from a metallic material such as stainless steel, copper, or a metal mixture or metal alloy. In some instances, the metallic material is electrically conductive. Other electrically conductive fibers, yarns, or filaments may also be used. Such electrically conductive materials can be used, in some cases, for the dissipation of static charge and/or for the formation of "smart" or electrically integrated materials. It is also possible for a fiber, yarn, or filament described herein to include or be formed from a shape memory material such as a shape memory polymer and/or a shape memory alloy, such as Nitinol.

[0058] In certain embodiments, the shape memory polymer and/or the shape memory alloy materials are configured to provide heating and/or massaging of the wearer's foot. In further instances, the fibers, yarns, or filaments described herein are formed from a combination of shape memory alloys and shape memory polymers (SMAP). The combined SMAP material may be configured to heat and/or massage a wearer's foot when constructed or formed into a shoe component.

[0059] In some cases, a shoe component configured to massage a wearer's foot can comprise a shape memory alloy and/or shape memory polymer material in a desired region of the shoe component, such as near a toe, heel, arch, or ball region, such that the desired region is massaged. For example, in some cases, such a massaging configuration can be achieved via a textured surface of the shoe component or a change in pressure applied to the wearer's foot within the region. In some instances, a surface can be textured according to the knit construction. Changes in pressure or texture, in some cases, can occur from shape changes of the shape memory material that are triggered by a specific stimulus, such as a change in temperature. For example, as a shape memory material changes in temperature, the shape of the material can change, which consequently can modify a texture and/or increase or decrease a pressure exerted upon the wearer from the shoe component at the location of the changing shape memory material. Such a shape memory material that responds to certain stimuli can elicit a massage sensation or effect massaging of a wearer's foot.

[0060] In some cases, a shoe component configured to heat a wearer's foot can comprise a shape memory alloy and/or shape memory polymer material in a desired region of the shoe component, such as near a toe, heel, arch, or ball region, such that the desired region is heated. For example, in some cases, a heating configuration can comprise insulation at a desired region of the shoe component. In other cases, such a heating configuration can include distributing, dispersing, or dissipating heat from a first region to a second region. In some instances, such a heating configuration can further complement or provoke massaging configurations as described above.

[0061] In some embodiments, a shoe component comprises a shape memory alloy and a shape memory polymer material in a desired region of the shoe component, such as near a toe, heel, arch, or ball region, such that the desired region is both heated and massaged. In some instances, changes in temperature can result in changes in shape. Wherein a region or zone of a shoe component can be configured to heat, the same region can also be configured to massage according to fluctuations in temperature within the region.

[0062] Further, the fiber, yarn, or filament described herein may be coated with one or more optional, additional materials for providing a desired property. In some cases, for instance, the fiber, yarn, or filaments forming the shoe components are coated with a fluorocarbon such as polytetrafluoroethylene. The fiber, yarn, or filament described herein can also optionally comprise one or more additives, including polymer additives, which can provide heat absorption and/or heat reflectivity properties. Additives comprising thermochromic, photochromic, hydrochromic, or pressure-chromic pigment and dye materials may also be used, in some cases. Such pigment and dye materials are configured to change color in response to exposure to heat, light, moisture, and/or pressure. It is also possible to incorporate one or more antimicrobial or antifungal materials into or onto the fiber, yarn, or filament forming the shoe components described herein.

[0063] As described above, a shoe component can comprise or be formed from various yarns and materials to create multiple zones. Wherein certain materials, such as shape memory materials or an additive as described above, can be uniquely responsive to a stimulus or change in environment, such as a change in temperature, a zone can also be uniquely responsive to a stimulus or a change in environment. For example, a first zone comprising a first responsive material can react according to properties of the first responsive material, and a second zone comprising a second responsive material can react according to properties of the second responsive material, such that the first and second zones react or respond according to their respective materials, which in some cases are not the same responsive material. In some cases, the stimulus eliciting the change can be the same for each zone, even though the response of each material in the first and second zones can differ.

[0064] Moreover, the fiber, yarn, or filaments forming the shoe components described herein can have any size, shape, and/or denier not inconsistent with the objectives of the present invention.

[0065] Further, the shoe components described herein can be seamless. For example, in some cases, a three-dimensional shoe upper has a continuous, repeating, and/or seamless construction throughout the entire upper or a portion of the upper, such as a heel portion.

II. Methods of Making Shoe Components

[0066] Methods of making shoe components are also disclosed. Such methods are used to make or construct any of the shoe components described in Section I above. Such methods obviate the need for stitching seams and/or cutting and stitching different fabrics together, in some aspects.

[0067] In one aspect, a method of making a shoe component comprises forming at least a first zone and a second zone in a continuous body of fabric. The first zone has a first modulus of elasticity and the second zone has a second modulus of elasticity that is different than the first modulus of elasticity, as described above.

[0068] In some embodiments, the method of making the shoe component comprises knitting the first and second zones. The shoe components can optionally be a seamless component constructed from a seamless knit fabric.

III. Shoes

[0069] In another aspect, shoes are described herein. A shoe described herein can be, but does not have to be, an athletic shoe or other athletic footwear, including a shoe or other footwear specifically designed for baseball, basketball, boating or other water sports, cross-training, football, hiking, hockey, running, soccer, dancing, gymnastics, or walking activities.

[0070] A shoe can also be a non-athletic shoe or other footwear, such as a deck shoe, dress boot, dress shoe, loafer, sandal, or work boot. Further, a shoe described herein can be formed by a method described hereinabove in Section II. Further, a shoe or component of a shoe can have any structure or construction not inconsistent with the objectives of the present invention, including any structure or construction described hereinabove in Section I.

[0071] In some embodiments, a shoe comprises a shoe component described hereinabove in Section I and one or more additional shoe components attached to the shoe component. Any additional shoe components not inconsistent with the objectives of the present invention may be used. In some cases, for instance, an additional shoe component comprises a tongue component. In other cases, an additional shoe component comprises a sole component, such as a midsole or outsole.

[0072] Some embodiments described herein are further illustrated in the following non-limiting examples. The following examples and the foregoing description are directed to the fabrication of various three-dimensional shoes and shoe components, including seamless shoes and shoe components. However, it should be noted that methods described herein, including methods of reducing the lateral separation distance between fabric portions, can be expanded and applied more generally to the knitting of other three-dimensional fabrics that are not necessarily a shoe component.

EXAMPLE 1

Formation of Zones via Varying Knit Structure

[0073] Fabric comprising at least first and second zones that differ in regards to the modulus and, thus, elasticity or stiffness can be provided via varying the knit structure disposed in each zone. FIG. **1** illustrates various knit structures used to form one or more zones in a shoe component. For example, knit structure "A" is the most stable and least elastic knit structure, while knit structure "M" is the most elastic knit structure. In some embodiments, any of the knit structures A to M can be used in a single zone. A zone can also comprise a combination of two or more of the knit structures A to M. Moreover, as understood by one of ordinary skill in the art, some of the knit structures A to M (such as A, D, E, H, J, and L) cannot be used alone to form a knit fabric or portion of a knit fabric but must instead be used in conjunction with another knit structure.

[0074] FIG. **2** is a schematic diagram of a shoe component comprising one or more zones formed thereon. Each zone can comprise a plurality of different knit structures disposed in a desired order or pattern. The zones can be disposed on or over the heel region, toe region, or wing region of the shoe component. As FIG. **2** illustrates, a single zone can be constructed of a combination of knit structures. Alternatively, one zone can be constructed of a single knit structure.

[0075] Additionally, the filament size, shape, type, or density of filaments in the different knit structures or constructions can, but do not have to differ. The denier, durometer ranges, shrink characteristics, mechanical properties, or modulus of the filaments provided in each knit structure or construction can also differ. Alternatively, the denier, durometer ranges, shrink characteristics, mechanical properties, or modulus of the filaments provided in each knit structure or construction can be the same.

EXAMPLE 2

Formation of Zones via Yarn Selection

[0076] In some embodiments, a fabric having one or more zones disposed therein is formed as a result of yarn selection. For example, combining various types of yarns and/or polymers in different patterns or locations of a fabric can result in a single fabric having multiple zones, wherein at least two of the zones have a different modulus of elasticity. Table 1 below includes exemplary data associated with various materials.

TABLE 1

Exemplary Yarn Properties

Material	Type	Tenacity (grams/ denier, gpd)	Elongation at Break (%)	Tenacity at 0.5% Elongation (gpd)	Elongation at 5 gpd (%)
Dyneema ®	UHWPE	30-35	2.7-3	4.3-4.8	1.2-1.7
Spectra ®	UHWPE	30-35	2.7-3	4.3-4.8	1.2-1.7
Vectran ™	LCP	26	3.1	3.3	0.8
Kevlar ®	Aramid, para	18-20	2.5-3.5	2-3	0.5-1.0

TABLE 1-continued

Exemplary Yarn Properties						
Material	Type	Tenacity (grams/ denier, gpd)	Elongation at Break (%)	Tenacity at 0.5% Elongation (gpd)	Elongation at 5 gpd (%)
Zylon ®	PBO	34	3.3	5.3	0.5
Hytrel ® (values depend on construction)	CoPE, 3 dpf	2.5	101	—	—
HT PET	Invista 840 den	9.5	14	0.5	10
HT PA	Invista T-715	8.6	21.6	0.22	11.1
PET, Textile	Typical	4.5	50	—	—
PA, Textile	Typical	4	55	—	—
Industrial, PP	Typical	3.5	60	—	—
HT PP	Innegra	9.3	9.8	0.7	3.9
Lycra ®	Spandex	1	>250	n/a	—
Rubber yarn	Typical	<1	>350	—	—

[0077] In regards to Table 1 above, it should be noted that all of the data is for reference purposes only, as some of the data can differ depending on yarn construction and other data is only average or typical data.

[0078] Notably, however, the material from which a given zone is constructed can be selected or chosen according to performance data of a particular yarn, such as the data contained in Table 1. Any type of data not inconsistent with the objectives of the present invention can be used to select the yarns for various zones. In certain instances, the continuous fabric is knitted using multiple different yarns that vary per zone. For example, a first zone can be formed from a SPECTRA® yarn and a second zone can be formed from a PET yarn. Alternatively, in some cases, a continuous fabric knitted from a single type of yarn, but having varied construction of the yarn, is contemplated. For example, a CoPE yarn in a core-sheath construction can be used to form a first zone and a CoPE yarn in a side-by-side construction can be used to form a second zone. In another example, a CoPE yarn in an 80:20 core-sheath construction can be used to form a first zone and a CoPE yarn in an 50:50 core-sheath construction can be used to form a second zone. A fabric constructed from any types and/or quantities of yarn types not inconsistent with the objectives of the present invention can be used to form a multi-zoned fabric.

[0079] Further, the yarn selected for use in a given zone can depend on whether that zone is to provide more stiffness or more elasticity to the wearer's foot. For example, a yarn having a higher tenacity, a lower elongation, and/or a higher modulus can be selected for a zone that requires more support and rigidity (e.g., a heel region, an arch region, etc.). Alternatively, yarn having less tenacity, greater elongation, and lower modulus can be selected for a zone that requires less support and more stretch (e.g., a toe region, a wing region, etc.).

[0080] In some embodiments, the shoe components set forth herein comprise one or more higher modulus, stiff zones being formed from a single component yarn produced from a single polymer material. Such zones can be constructed via knitting a stable filament or spun yarn formed from hard polymers, such as, without limitation, polyester, nylon, Kevlar®, Spectra®, Dyneema®, etc. Any other type of yarn, fiber, filament, polymer, and/or material not inconsistent with the objectives of the present invention may also be used to produce one or more stiff or substantially stiff zones in the shoe components described herein. For instance, a single type of multicomponent yarn (e.g., bicomponent), a covered yarn (e.g., single-covered or double-covered), an auxetic yarn, an intermingled yarn, or a twisted yarn can be used to form a relatively high stiffness zone.

[0081] One or more softer, more elastic and lower modulus zones can also be formed in the shoe components described herein. Such zones can be constructed using a single component yarn produced from a single polymer material. The lower modulus zones, in some cases, comprise or are formed from elastic filament yarns having one or more soft segments. Such materials include, without limitation, rubber, elastomers, elastomeric melt polymers, extrudable polymers, nylon, olefin, Lycra®, Spandex®, polyurethane, CoPolyester (CoPE), Hytrel®, etc. Any other type of yarn, fiber, filament, polymer, and/or material not inconsistent with the objectives of the present invention may also be used to produce one or more elastic zones in the shoe components described herein. For example, a single multicomponent yarn (e.g, bicomponent) can be used to form a relatively low stiffness zone.

[0082] More generally, it is to be understood that the zones being formed in the fabric for shoe components can comprise multi component yarns produced from multiple polymers. Such yarns may be core spun yarns, single covered yarns, double covered yarns, auxetic yarns having auxetic structures or materials, wrapped yarns, co-extruded yarns of two or more polymers, etc. Any yarn, fiber, filament, polymer, and/or material not inconsistent with the objectives of the present invention may be selected and used to produce one or more zones in the shoe components described herein.

[0083] Further, it is also possible to form zones having varying modulus in a shoe component described herein using a feeder blend. For example, a fabric or portion thereof can be formed from a first feeder using a regular tenacity fiber or yarn (such as a regular tenacity polyester yarn), a second feeder using a fusible fiber or yarn, and a third feeder using a high modulus fiber or yarn (such as a high modulus Kevlar®, Spectra®, or Dyneema® yarn). Other combinations or feeder blends may also be used.

EXAMPLE 3

Formation of Zones via Yarn Modulus Engineering

[0084] In further embodiments, a shoe component is constructed or formed from a fabric having differing modulus of elasticity zones engineered therein. The various zones being engineered within a shoe component can be expressed in terms of a relative modulus. For example, one zone can have an elastic modulus that is about 2.0×, 3.0×, or more than 3.0× greater than another zone Similarly, one zone can have an elastic modulus that is about one-half, one-quarter or three-quarters the modulus of another zone. Multiple zones having any combination of two or more relative moduli including, without limitation, an elastic modulus of 0.50×, 0.75×, 1.00×, 2.00×, 3.00×, etc., can be formed and disposed in a fabric to provide varying degrees of support and/or elasticity depending on the polymer blend and processing conditions during yarn processing.

[0085] Table 2 below includes data obtained from tensile testing various engineered yarns produced from 1600 denier DuPont™ Hytrel® thermoplastic elastomers. Any other type of material not inconsistent with the objectives of the present invention may also be used to produce engineered yarns or textiles. For example only, and without limitation, engineered yarns or textiles produced from any elastomer, thermoplastic, nylon or other polyamide, polyester, polyethylene, polypropylene, polybutylene or other polyolefin, polyacrylic polyester, or para-aramid not inconsistent with the instant application are contemplated.

[0086] Each yarn in Table 2 was engineered to exhibit a desired relative modulus; however, moduli other than those shown may also be obtained. For example, although not shown, yarns having a relative modulus of 1.5×, 2.5×, 3.5×, or other ratio, can also be produced and incorporated into a shoe component.

TABLE 2

Exemplary Yarn Properties
Engineered Yarn Tensile Properties

		Yarn Elastic Modulus				
		0.50x	0.75x	1.0x	2.0x	3.0x
Denier		1600	1600	1600	1600	1600
Load at	2%	47	61	93	175	366
Elongation,	4%	99	127	190	313	530
in grams (g)	6%	159	198	283	429	624
	10%	287	348	470	642	824
Elongation (%)	10 g	0.03%	0.04%	0.04%	0.03%	0.03%
at Load	20 g	0.71%	0.48%	0.35%	0.20%	0.09%
	40 g	1.63%	1.29%	0.83%	0.39%	0.20%
	60 g	2.56%	1.97%	1.27%	0.61%	0.28%
	80 g	3.35%	2.61%	1.71%	0.85%	0.37%
	100 g	4.07%	3.23%	2.14%	1.07%	0.45%
	200 g	7.34%	6.04%	4.22%	2.33%	0.94%
	400 g	13.00%	11.29%	8.53%	5.44%	2.29%

[0087] Table 3 below includes data obtained from tensile testing 800 denier monofilament yarn. Each yarn in Table 3 was engineered to exhibit a desired relative modulus of elasticity; however, moduli other than those shown may also be obtained.

TABLE 3

Exemplary Yarn Properties
Engineered Yarn Tensile Properties

		Yarn Elastic Modulus				
		0.50x	0.75x	1.0x	2.0x	3.0x
Denier		800	800	800	800	800
Load at	2%	24	31	47	88	183
Elongation,	4%	50	64	95	160	265
in grams (g)	6%	80	99	142	215	312
	8%	111	136	188	268	355
	10%	144	174	235	321	412
Elongation (%)	10 g	0.83%	0.65%	0.43%	0.23%	0.11%
at Load	20 g	1.67%	1.29%	0.85%	0.45%	0.22%
	40 g	3.20%	2.58%	1.70%	0.91%	0.44%
	60 g	4.80%	3.75%	2.55%	1.36%	0.66%
	80 g	6.00%	5.00%	3.37%	1.82%	0.87%
	100 g	7.50%	6.06%	4.21%	2.50%	1.09%
	200 g	13.89%	11.49%	8.50%	5.58%	3.02%
	400 g	27.78%	22.99%	17.02%	12.46%	9.71%

[0088] The yarns in Tables 2 and/or 3 can be incorporated into a single shoe component, for example, in regions or zones of a shoe component. A shoe upper can have multiple zones formed from different engineered yarns to provide more support and stability of foot movement in certain zones and also subtle and controlled support. Various modulus yarns can be engineered into a shoe component to provide maximum support and controlled movement of the foot in specific regions of the shoe component. Various embodiments of the present invention have been described in fulfillment of the various objectives of the invention. It should be recognized that these embodiments are merely illustrative of the principles of the present invention. Numerous modifications and adaptations thereof will be readily apparent to those skilled in the art without departing from the spirit and scope of the invention.

EXAMPLE 4

Zone Construction

[0089] Zones of a continuous fabric can be constructed according to Examples 1-3. The present Example illustrates exemplary zone constructions according to Examples 1-3, wherein a first zone comprises an elastic modulus that is greater than an elastic modulus of a second zone. Such exemplary zone constructions are shown in FIG. **3**A and FIG. **3**B, wherein each zone substantially corresponds to a specific region of the shoe component, such as a toe region, vamp region, heel region or wing region. Referring to FIG. **3**A, a first zone in a shoe vamp region can comprise a first modulus of 1.0×, while a second zone in a shoe heel region can comprise a second modulus of 3.0×. Furthermore, a third zone in a shoe toe region can comprise a third modulus of 1.5×; a fourth zone in shoe wing region can comprise a fourth modulus of 0.75×; a fifth zone in a shoe quarter region can comprise a fifth modulus of 2.0×. Referring to FIG. **3**B, a first zone in a shoe vamp region can comprise a first modulus of 1.0×, while a second zone in a shoe heel region can comprise a second modulus of 2.0×. Furthermore, a third zone in a shoe toe region can comprise a third modulus of 0.5×; a fourth zone in shoe wing region can comprise a fourth modulus of 3.0×; a fifth zone in a shoe quarter region can comprise a fifth modulus of 4.0×. Examples of knit structure combinations that can form one or more zones having such a modulus, as described above, are illustrated in FIG. **1** and FIG. **2**.

[0090] Some additional non-limiting, exemplary embodiments according to the descriptions provided herein above are as follows:

[0091] Embodiment 1. A shoe component comprising: a body of continuous fabric having at least a first zone and a second zone, wherein the first zone of the fabric has a first modulus of elasticity and the second zone of the fabric has a second modulus of elasticity that is different than the first modulus of elasticity.

[0092] Embodiment 2. The shoe component of embodiment 1, wherein the first zone of the fabric has a higher modulus of elasticity than the second zone of the fabric.

[0093] Embodiment 3. The shoe component of embodiment 2, wherein a ratio of the first modulus of elasticity to the second modulus of elasticity is at least 2:1.

[0094] Embodiment 4. The shoe component of any of the preceding embodiments, wherein:

[0095] the body of continuous fabric further comprises a third zone;

[0096] the third zone of the fabric has a third modulus of elasticity; and

[0097] the third modulus of elasticity is different than the first modulus of elasticity and/or the second modulus of elasticity.

[0098] Embodiment 5. The shoe component of embodiment 4, wherein:

[0099] the body of continuous fabric further comprises a fourth zone;

[0100] the fourth zone of the fabric has a fourth modulus of elasticity; and

[0101] the fourth modulus of elasticity is different than at least one of the first modulus of elasticity, the second modulus of elasticity, and the third modulus of elasticity.

[0102] Embodiment 6. The shoe component of embodiment 5, wherein:

[0103] the body of continuous fabric further comprises an nth zone having an nth modulus of elasticity;

[0104] the nth modulus of elasticity is different than at least one of the first, second, third, and fourth moduli of elasticity; and

[0105] n is an integer greater than 4.

[0106] Embodiment 7. The shoe component of any of embodiments 1-6, wherein:

[0107] the fabric is a knit fabric;

[0108] the first zone has a first knit construction;

[0109] the second zone has a second knit construction; and

[0110] the first knit construction and the second knit construction differ.

[0111] Embodiment 8. The shoe component of embodiment 7, wherein the first knit construction is a plain knit construction and the second knit construction is not a plain knit construction.

[0112] Embodiment 9. The shoe component of embodiment 7 or 8, wherein the first knit construction is a plain knit construction and the second knit construction is a double knit construction.

[0113] Embodiment 10. The shoe component of any of the preceding embodiments, wherein:

[0114] the first zone of the fabric is formed from one or more first fibers;

[0115] the second zone of the fabric is formed from one or more second fibers; and

[0116] the one or more first fibers differ from the one or more second fibers.

[0117] Embodiment 11. The shoe component of embodiment 10, wherein the one or more first fibers and the one or more second fibers have differing elasticity.

[0118] Embodiment 12. The shoe component of embodiment 10 or 11, wherein the one or more first fibers and the one or more second fibers have differing tenacity.

[0119] Embodiment 13. The shoe component of any of the preceding embodiments 10-12, wherein the one or more first fibers and the one or more second fibers have differing percent elongation at break.

[0120] Embodiment 14. The shoe component of any of the preceding embodiments 10-13, wherein the one or more first fibers and/or the one or more second fibers are formed from a shape memory alloy configured to heat and/or massage a wearer's foot.

[0121] Embodiment 15. The shoe component of any of the preceding embodiments 10-14, wherein the one or more first fibers and/or the one or more second fibers are formed from a shape memory polymer configured to heat and/or massage a wearer's foot.

[0122] Embodiment 16. The shoe component of any of the preceding embodiments 10-15, wherein the one or more first fibers and/or the one or more second fibers are formed from a combination of a shape memory alloy and a shape memory polymer (SMAP) material configured to heat and/or massage a wearer's foot.

[0123] Embodiment 17. The shoe component of any of the preceding embodiments 10-16, wherein the one or more first fibers and/or the one or more second fibers are formed from a rate-sensitive material configured to adjust a perceived stress and/or strain in response to the speed or movement of a wearer.

[0124] Embodiment 18. The shoe component of any of the preceding embodiments, wherein the first zone of the fabric has a higher density of filaments per area than the second zone.

[0125] Embodiment 19. The shoe component of any of the preceding embodiments, wherein the first zone of the fabric comprises one or more yarns having a tenacity that is greater than about 9 grams per denier (gpd).

[0126] Embodiment 20. The shoe component of any of the preceding embodiments, wherein the second zone of the fabric comprises one or more yarns having a tenacity that is less than about 5 grams per denier (gpd).

[0127] Embodiment 21. The shoe component of any of the preceding embodiments, wherein the first zone of the fabric comprises one or more yarns having a percent elongation at break that is greater than about 50%.

[0128] Embodiment 22. The shoe component of any of the preceding embodiments, wherein the second zone of the fabric comprises one or more yarns having a percent elongation at break that is less than about 20%.

[0129] Embodiment 23. The shoe component of any of the preceding embodiments, wherein the shoe component is a shoe upper.

[0130] Embodiment 24. The shoe component of embodiment 23, wherein one or more of the fabric zones are disposed within a heel region, a toe region, or a wing region of the shoe upper.

[0131] Embodiment 25. The shoe component of embodiment 23 or 24, wherein the first zone comprises a higher modulus zone and the second zone comprises a lower modulus zone, and wherein the higher modulus zone is disposed proximate the wing region and the lower modulus zone is disposed proximate the toe region.

[0132] Embodiment 26. The shoe component of any of embodiments 1-22, wherein the shoe component is a shoe insole.

[0133] Embodiment 27. The shoe component of any of embodiments 1-22, wherein the shoe component is a spacer fabric.

[0134] Embodiment 28. The shoe component of embodiment 27, wherein the first zone has a higher modulus of elasticity than the second zone, and wherein the first zone is disposed proximate a heel region or a ball region of a wearer's foot.

[0135] Embodiment 29. The shoe component of embodiment 28, wherein the second zone is disposed proximate an arch region or a toe region of the wearer's foot.

[0136] Embodiment 30. The shoe component of any of the preceding claims, wherein the fabric is a continuous, seamless knit fabric.

[0137] Embodiment 31. A method of making a shoe component, the method comprising: forming at least a first zone and a second zone in a continuous body of fabric, wherein the first zone has a first modulus of elasticity and the second zone has a second modulus of elasticity that is different than the first modulus of elasticity.

[0138] Embodiment 32. The method of embodiment 31, wherein forming the first and second zones comprises knitting the first and second zones.

[0139] Embodiment 33. The method of embodiment 31 or 32, wherein the shoe component is a seamless component.

[0140] Embodiment 34. The method of any of embodiments 31-33, wherein the shoe component formed by the method is the shoe component of any of embodiments 1-30.

[0141] Embodiment 35. A shoe component comprising:

[0142] a body of continuous fabric having at least a first zone having a first modulus of elasticity and a second zone having a second modulus of elasticity,

[0143] wherein the first modulus of elasticity is higher than the second modulus of elasticity,

[0144] wherein the first zone of the fabric is formed from one or more first fibers;

[0145] wherein the second zone of the fabric is formed from one or more second fibers;

[0146] wherein the one or more first fibers differ from the one or more second fibers, and

[0147] wherein the one or more first fibers and/or the one or more second fibers are formed from a shape memory alloy or a shape memory polymer configured to heat and/or massage a wearer's foot.

1. A shoe component comprising:

a body of continuous fabric having at least a first zone and a second zone,

wherein the first zone of the fabric has a first modulus of elasticity and the second zone of the fabric has a second modulus of elasticity that is different than the first modulus of elasticity;

wherein the first zone of the fabric has a higher modulus of elasticity than the second zone of the fabric; and

wherein a ratio of the first modulus of elasticity to the second modulus of elasticity is at least 2:1.

2. The shoe component of claims **1**, wherein:

the body of continuous fabric further comprises a third zone;

the third zone of the fabric has a third modulus of elasticity; and

the third modulus of elasticity is different than the first modulus of elasticity and/or

the second modulus of elasticity.

3. The shoe component of claim **2**, wherein:

the body of continuous fabric further comprises a fourth zone;

the fourth zone of the fabric has a fourth modulus of elasticity; and

the fourth modulus of elasticity is different than at least one of the first modulus of elasticity, the second modulus of elasticity, and the third modulus of activity.

4. The shoe component of claim **3**, wherein:

the body of continuous fabric further comprises an nth zone having an nth modulus of elasticity;

the nth modulus of elasticity is different than at least one of the first, second, third, and fourth moduli of elasticity; and n is an integer greater than 4.

5. The shoe component of claim **1**, wherein:

the fabric is a knit fabric;

the first zone has a first knit construction;

the second zone has a second knit construction; and

the first knit construction and the second knit construction differ.

6. The shoe component of claim **5**, wherein the first knit construction is a plain knit construction and the second knit construction is not a plain knit construction.

7. The shoe component of claim **5**, wherein the first knit construction is a plain knit construction and the second knit construction is a double knit construction.

8. The shoe component of claim **5**, wherein:

the first zone of the fabric is formed from one or more first fibers;

the second zone of the fabric is formed from one or more second fibers; and

the one or more first fibers differ from the one or more second fibers.

9. The shoe component of claim **8**, wherein the one or more first fibers and the one or more second fibers have differing elasticity.

10. The shoe component of claim **8**, wherein the one or more first fibers and the one or more second fibers have differing tenacity.

11. The shoe component of claim **8**, wherein the one or more first fibers and the one or more second fibers have differing percent elongation at break.

12. The shoe component of claim **8**, wherein the one or more first fibers and/or the one or more second fibers are formed from a shape memory alloy configured to heat and/or massage a wearer's foot.

13. The shoe component of claim **8**, wherein the one or more first fibers and/or the one or more second fibers are formed from a shape memory polymer configured to heat and/or massage a wearer's foot.

14. The shoe component of claim **8**, wherein the one or more first fibers and/or the one or more second fibers are formed from a combination of a shape memory alloy and a shape memory polymer (SMAP) material configured to heat and/or massage a wearer's foot.

15. The shoe component of claim **8**, wherein the one or more first fibers and/or the one or more second fibers are formed from a rate- sensitive material configured to adjust a perceived stress and/or strain in response to the speed or movement of a wearer.

16. The shoe component of claim **8**, wherein the first zone of the fabric has a higher density of filaments per area than the second zone.

17. The shoe component of any preceding claim, wherein the first zone of the fabric comprises one or more yarns having a tenacity that is greater than about 9 grams per denier (gpd).

18. The shoe component of claim **8**, wherein the second zone of the fabric comprises one or more yarns having a tenacity that is less than about 5 grams per denier (gpd).

19. The shoe component of claim **8**, wherein the first zone of the fabric comprises one or more yarns having a percent elongation at break that is greater than about 50%.

20. The shoe component of claim **8**, wherein the second zone of the fabric comprises one or more yarns having a percent elongation at break that is less than about 20%.

21. The shoe component of claim **8**, wherein the shoe component is a shoe upper.

22. The shoe component of claim **21**, wherein one or more of the fabric zones are disposed within a heel region, a toe region, or a wing region of the shoe upper.

23. The shoe component of claim **21**, wherein the first zone comprises a higher modulus zone and the second zone comprises a lower modulus zone, and wherein the higher modulus zone is disposed proximate the wing region and the lower modulus zone is disposed proximate the toe region.

24. The shoe component of claim **1**, wherein the shoe component is a shoe insole.

25. The shoe component of claim **1**, wherein the shoe component is a spacer fabric.

26. The shoe component of claim **25**, wherein the first zone has a higher modulus of elasticity than the second zone, and wherein the first zone is disposed proximate a heel region or a ball region of a wearer's foot.

27. The shoe component of claim **26**, wherein the second zone is disposed proximate an arch region or a toe region of the wearer' s foot.

28. The shoe component of claim **1**, wherein the fabric is a continuous, seamless knit fabric.

29. A method of making a shoe component, the method comprising:

forming at least a first zone and a second zone in a continuous body of fabric, wherein the first zone has a first modulus of elasticity and the second zone has a second modulus of elasticity that is different than the first modulus of elasticity.

30. The method of claim **29**, wherein forming the first and second zones comprises knitting the first and second zones.

31. The method of claim **29**, wherein the shoe component is a seamless component.

32. The method of claim **29**, wherein the shoe component formed by the method is the shoe component of claim **1**.

33. A shoe component comprising:

a body of continuous fabric having at least a first zone having a first modulus of elasticity and a second zone having a second modulus of elasticity,

wherein the first modulus of elasticity is higher than the second modulus of elasticity,

wherein the first zone of the fabric is formed from one or more first fibers;

the second zone of the fabric is formed from one or more second fibers;

the one or more first fibers differ from the one or more second fibers, and the one or more first fibers and/or the one or more second fibers are formed from a shape memory alloy or a shape memory polymer configured to heat and/or massage a wearer's foot.

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