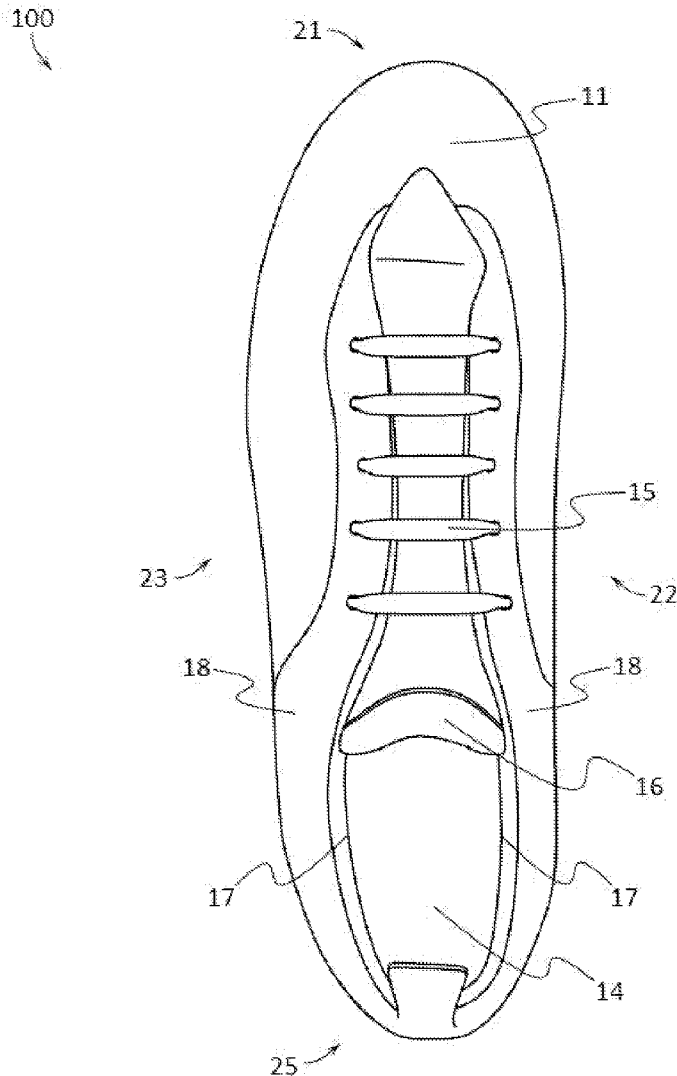




US 20150033588A1

(19) **United States**(12) **Patent Application Publication**
Lai(10) **Pub. No.: US 2015/0033588 A1**(43) **Pub. Date: Feb. 5, 2015**(54) **ARTICLE OF FOOTWEAR WITH A
DYNAMICALLY RESPONSIVE ELEMENT
FOR KICKING A BALL**(71) Applicant: **William Lai**, Hong Kong (HK)(72) Inventor: **William Lai**, Hong Kong (HK)(21) Appl. No.: **14/520,691**(22) Filed: **Oct. 22, 2014****Publication Classification**(51) **Int. Cl.**
A43B 5/02 (2006.01)(52) **U.S. Cl.**
CPC **A43B 5/025** (2013.01)
USPC **36/133**(57) **ABSTRACT**

An article of footwear with a dynamically responsive element for kicking a ball is disclosed. In preferred embodiments, an article of footwear comprises a sole element, an upper element, and a ball contacting element. The ball contacting element comprises a first layer configured to contact a ball and a second layer, with the first layer contiguously coupled with a portion of the second layer. The first layer and second layer may be configured to form a ball contacting element on a portion of the upper element. The first layer may comprise a Non-Newtonian material and the second layer may comprise a Newtonian layer, or the first layer may comprise a Newtonian material and the second layer may comprise a Non-Newtonian layer. In further preferred embodiments, a ball contacting element may comprise a third layer, which may be contiguously coupled with a portion of the second layer.



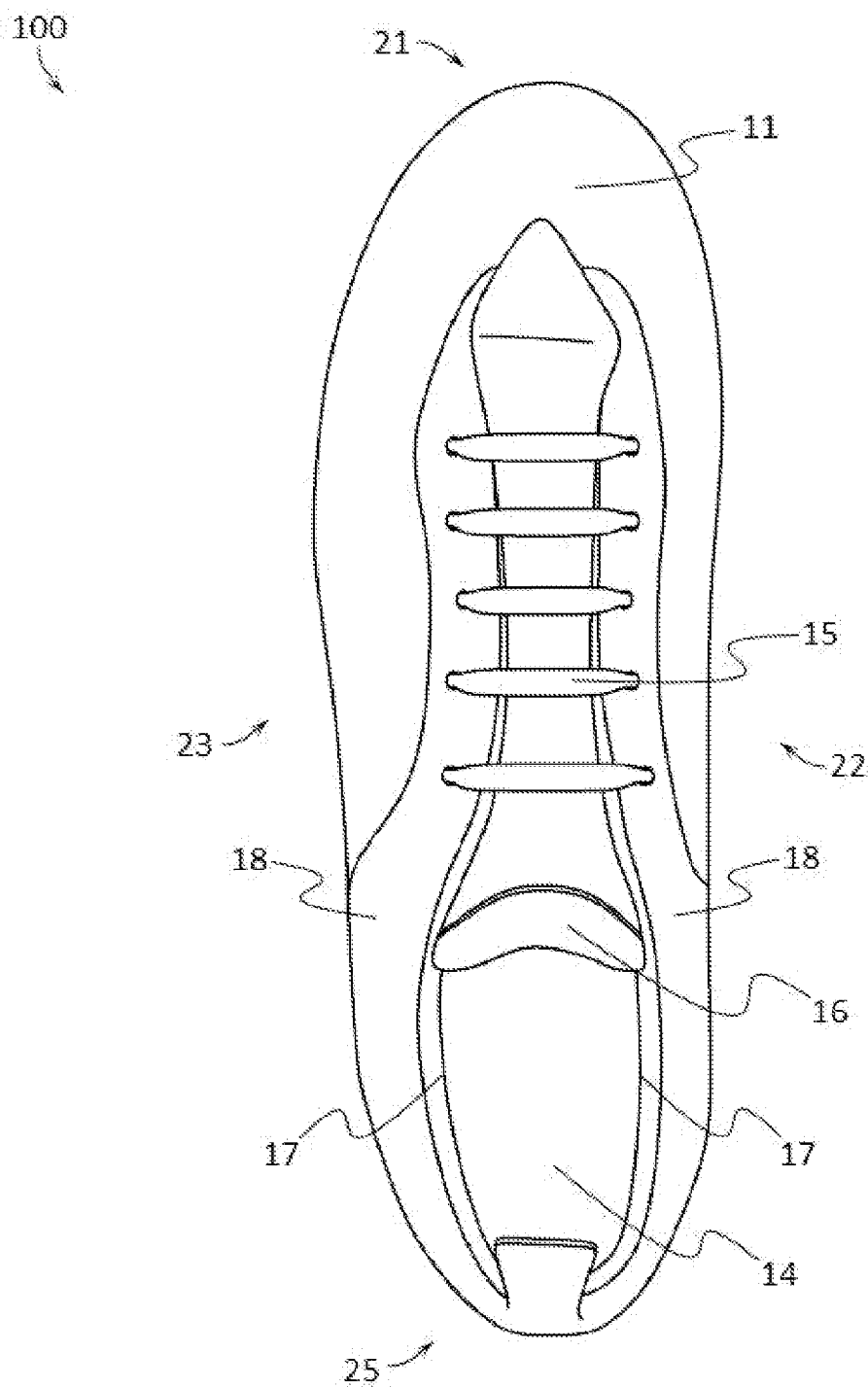


FIG. 1

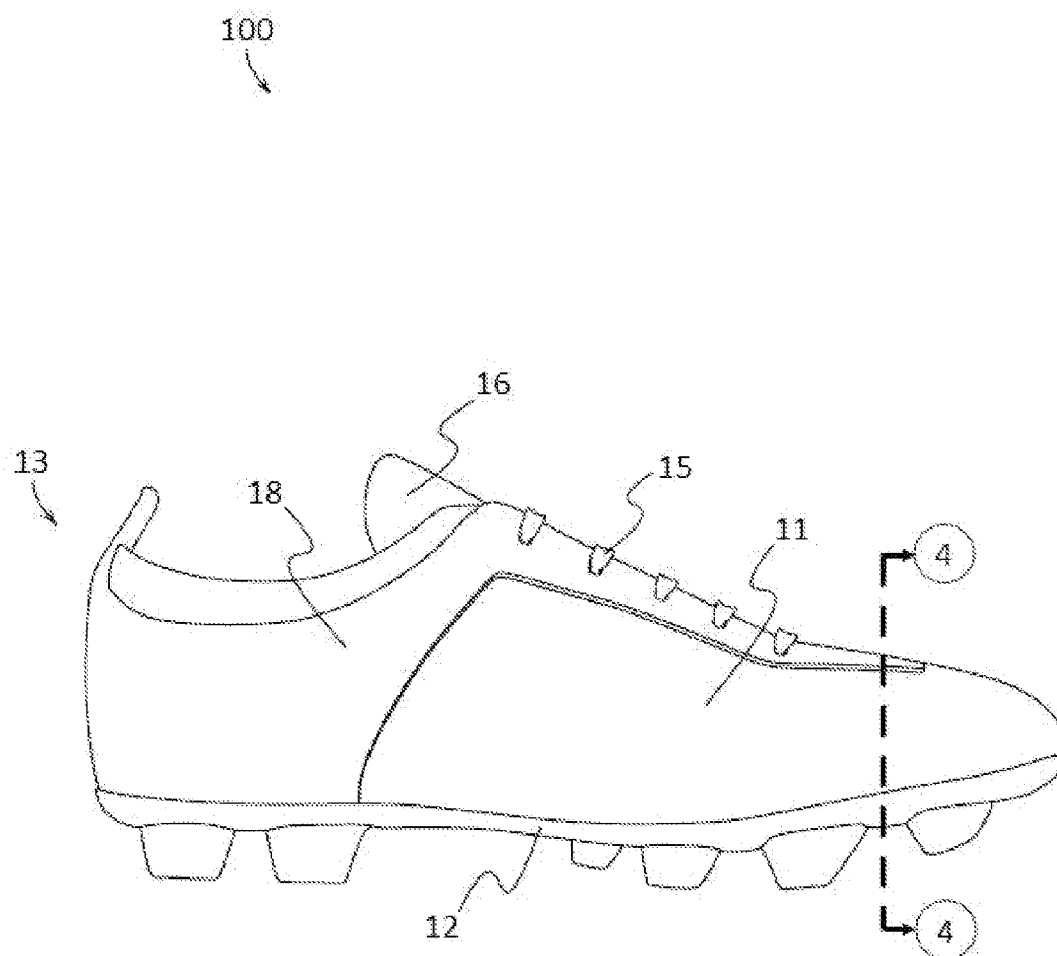


FIG. 2

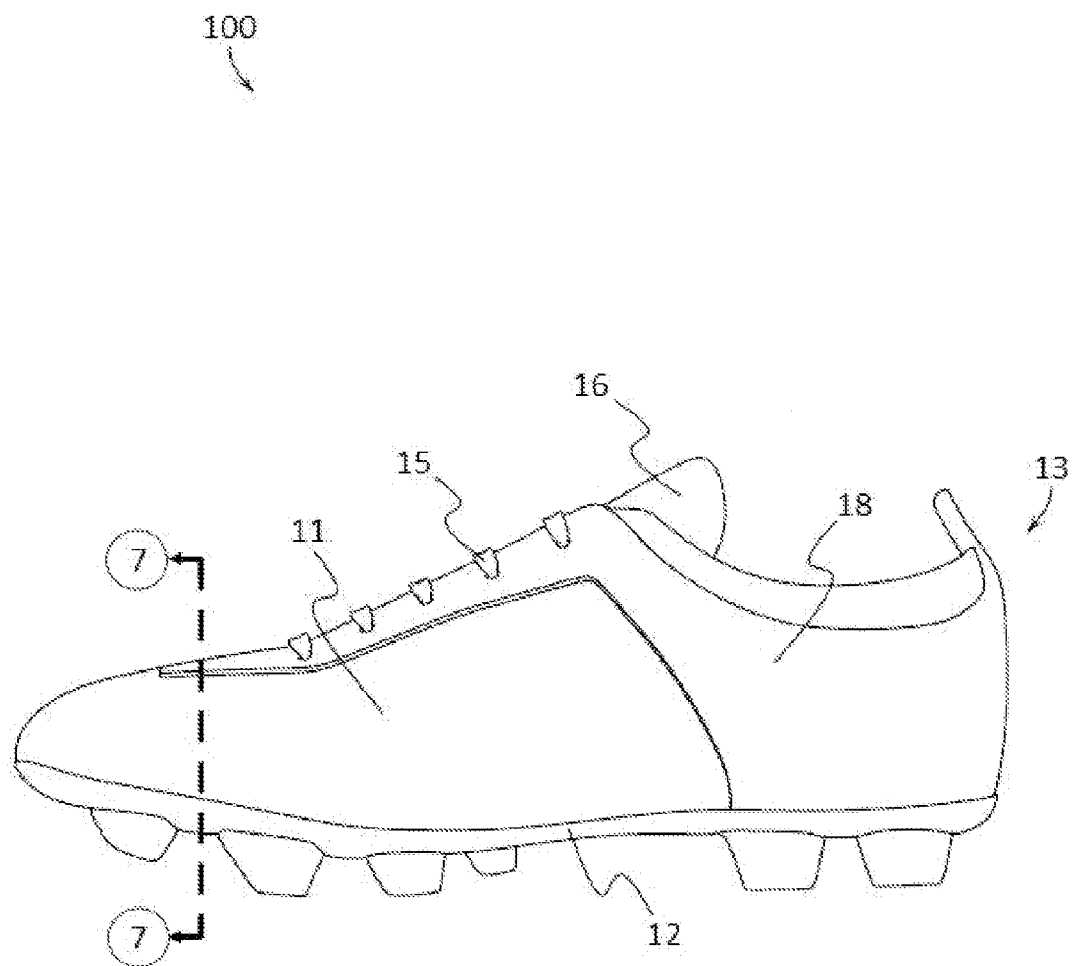


FIG. 3

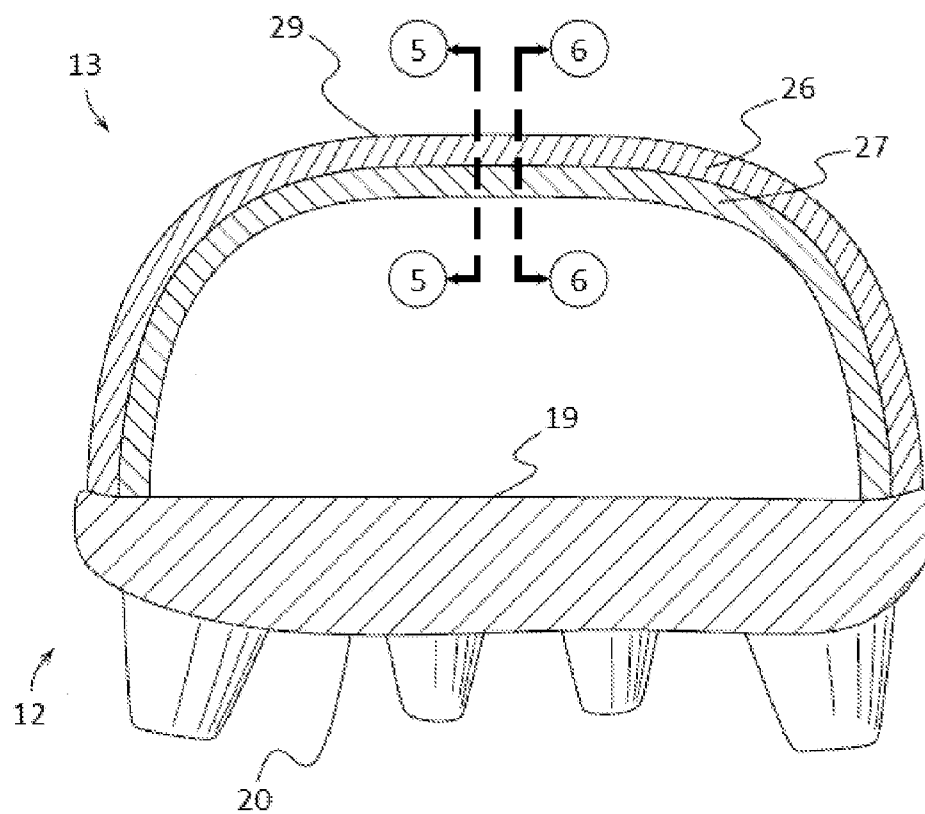


FIG. 4

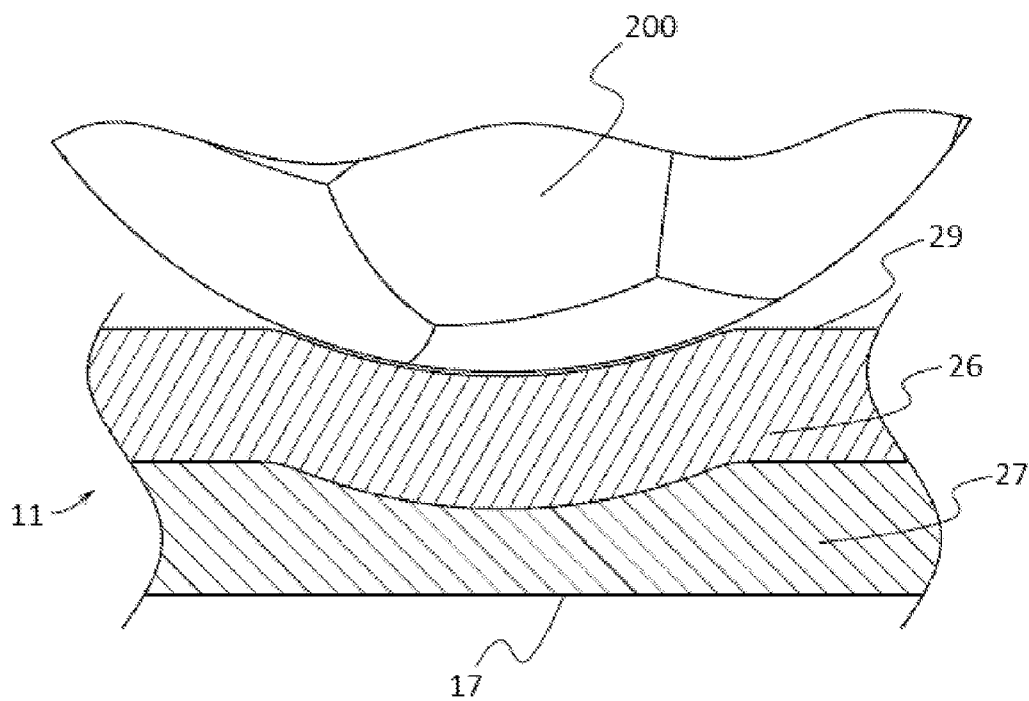


FIG. 5

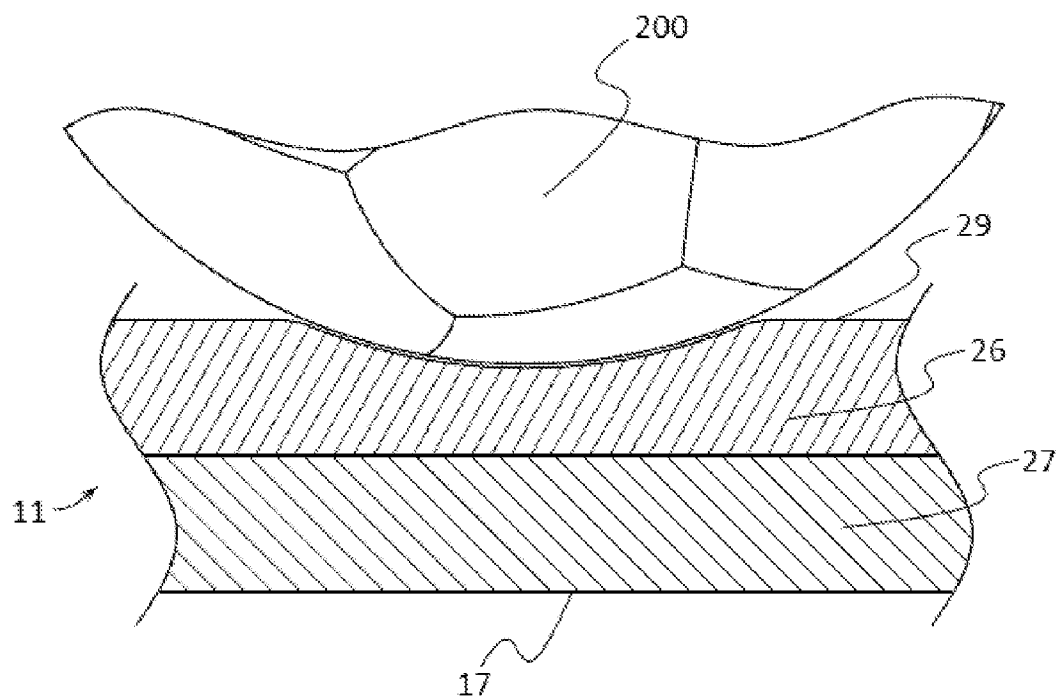


FIG. 6

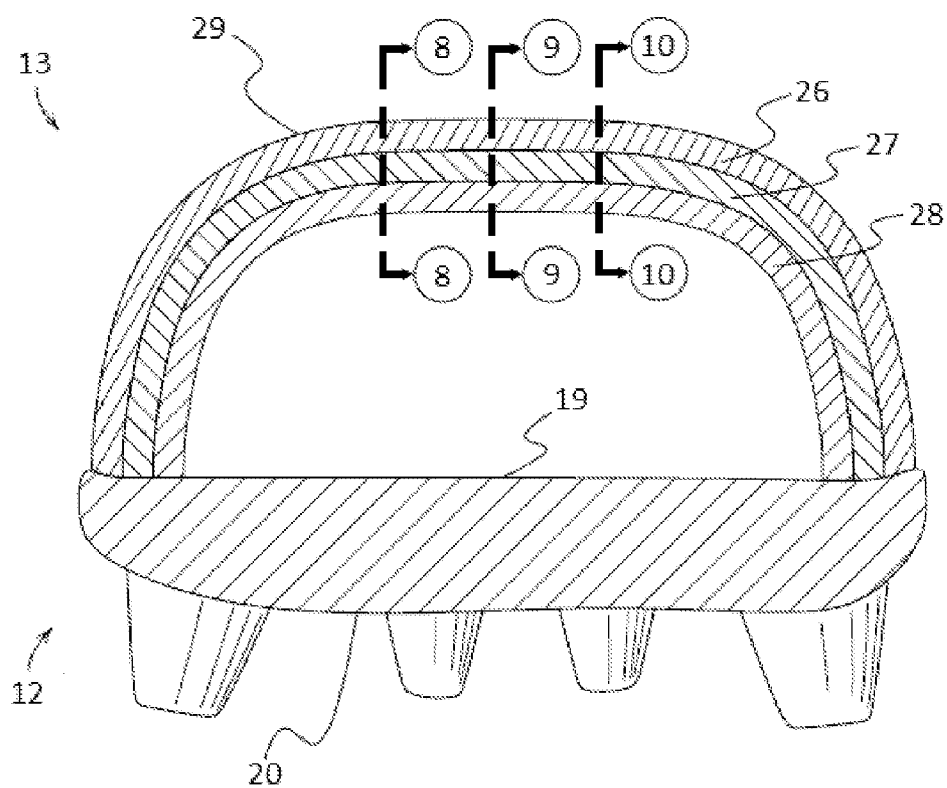


FIG. 7

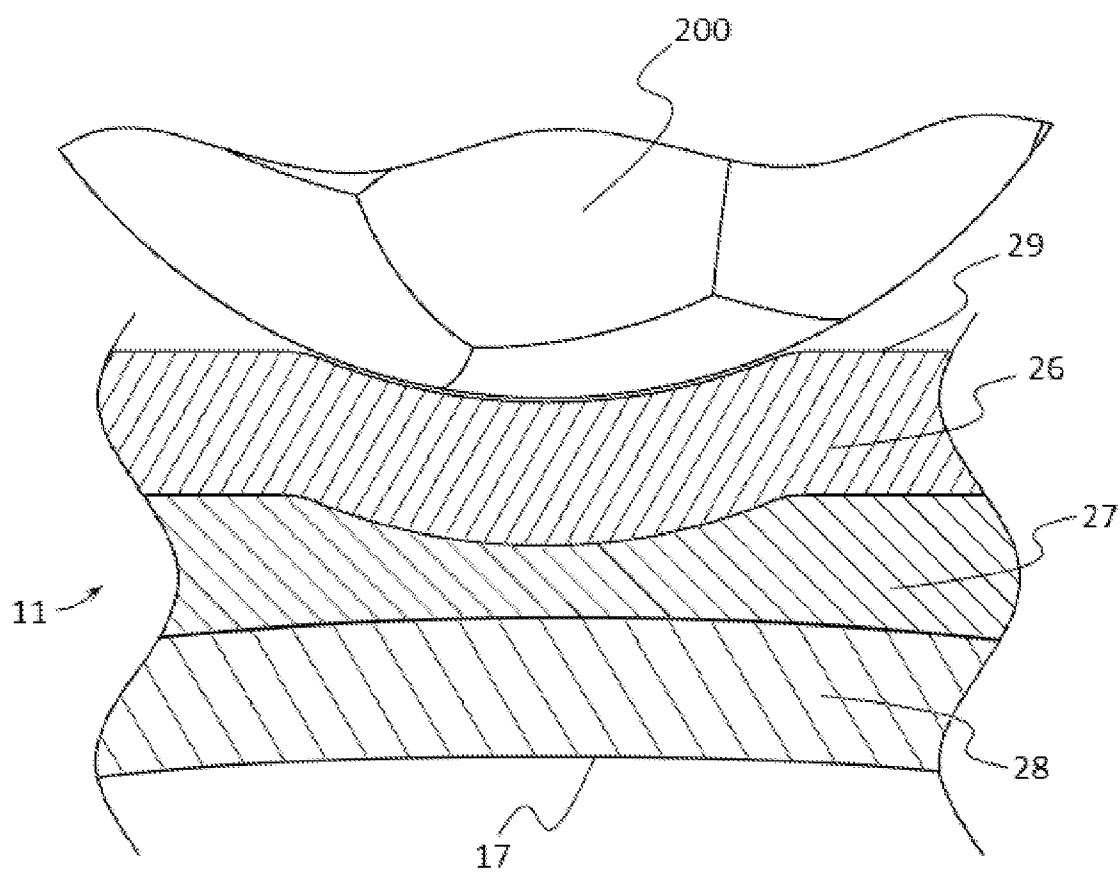


FIG. 8

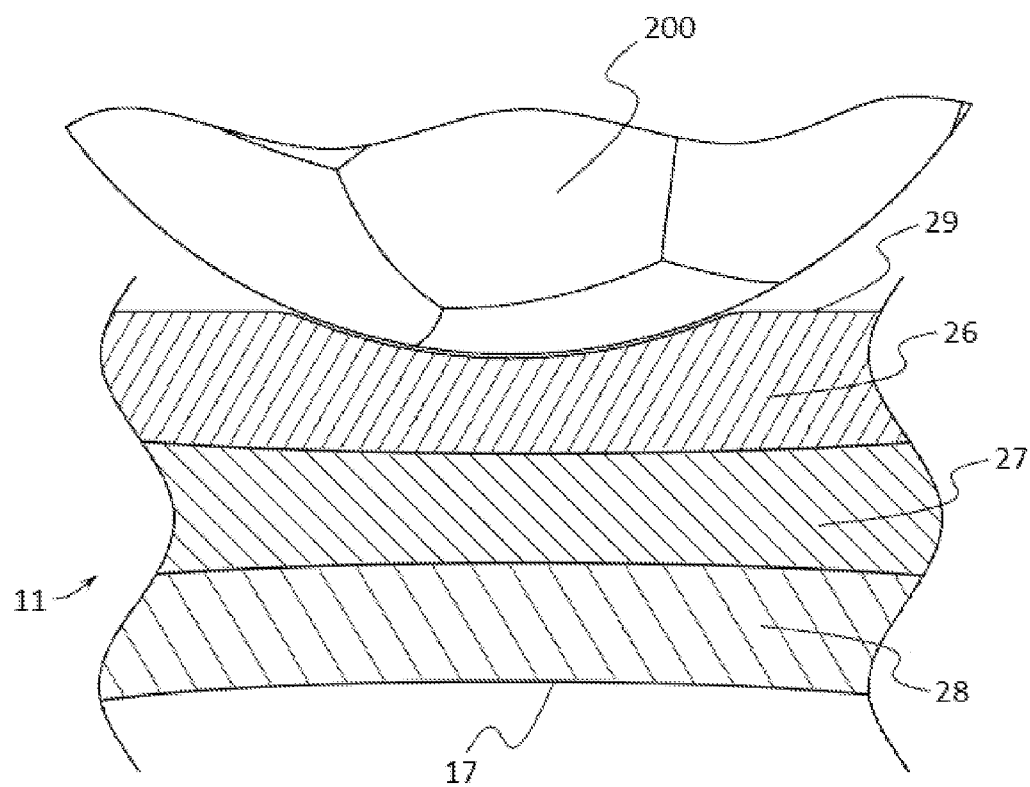


FIG. 9

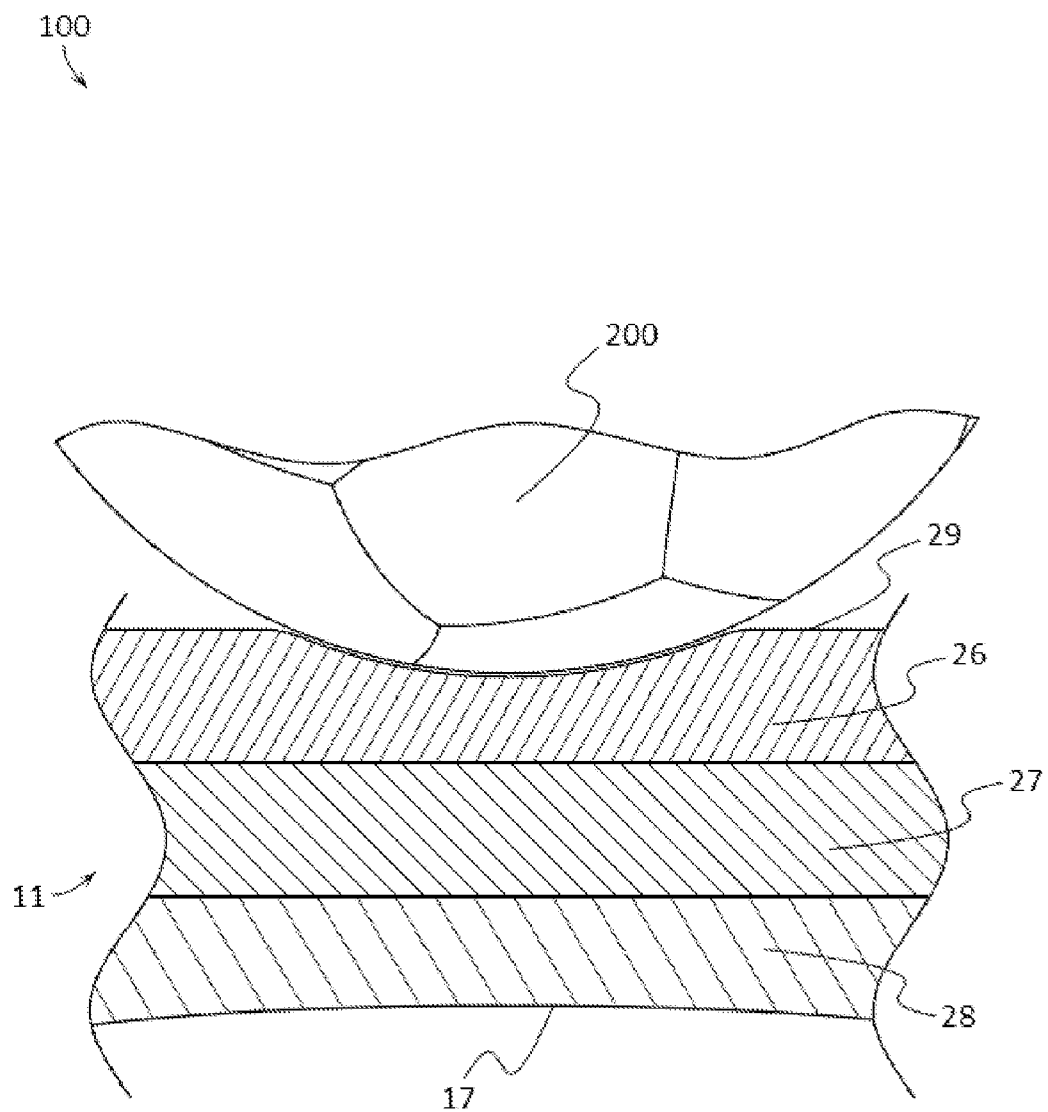


FIG. 10

ARTICLE OF FOOTWEAR WITH A DYNAMICALLY RESPONSIVE ELEMENT FOR KICKING A BALL

FIELD OF THE INVENTION

[0001] This patent specification relates to the field of articles of ball sport footwear. More specifically, this patent specification relates to an article of footwear with a dynamically responsive element for kicking a ball.

BACKGROUND

[0002] There are many athletic ball sports activities that involve kicking a ball. Examples of such sports include soccer, rugby, football, Australian-rules football and kickball. Articles of footwear such as soccer shoes are often used by the wearer for such athletic sports activities.

[0003] In kicking a ball, it is beneficial to have a comfortable soccer shoe that enables the wearer to manipulate a ball through a range of motions from one extreme of providing optimal control and spin to another extreme of providing optimal power to the ball as it is kicked.

[0004] Features in soccer shoes to optimize providing control and spin by increasing contact between the ball and the shoe have previously been proposed. In U.S. Pat. No. 6,681,503 B2 to Morle, an external tongue has upon it rubberized ball agitators for applying spin to a soccer ball. In U.S. Pat. No. 3,191,321 to Brutting, rubber projections are inserted through holes in the toe portion and medial and lateral vamp portions of the soccer shoe upper to form a ball control surface. Whereas rubberized ball agitators of the external tongue of U.S. Pat. No. 6,681,503 B2 and rubber projections of the shoe of U.S. Pat. No. 3,191,321 are such as to help improve ball contact and control, they may have the adverse effect of dampening a wearer's power kick due to the compressibility and cushioning of the material contacting the ball.

[0005] Furthermore, features in soccer shoes to optimize increasing power in kicking a ball by using stiff materials have previously been proposed. In U.S. Pat. No. 6,523,282 B1 to Johnston, an article of footwear includes a core layer of a very thin layer of high tensile metal or plastic. Whereas high tensile metal or plastic of the core layer of U.S. Pat. No. 6,523,282 B1 are such as to help provide increased power to the ball, they may have the adverse effect of reducing a wearer's control of the ball as well as increasing discomfort to the wearer due to the stiffness of the material.

[0006] In order to have improved ball control and spin through increased cushioning and to provide improved power kicking through increased stiffness in one shoe, there is a requirement for having a shoe that is both flexible and compressible to allow cushioning and unhindered movement while also being stiff and resilient to allow transmission of power in kicking. Previous designs cannot simultaneously or dynamically provide both features of optimal ball control and optimal power kicking because the required impact forces are specific to the extreme ranges of compressibility and stiffness. In providing a more compressible material, the material is less able to provide power in kicking. Conversely, in providing a stiffer material, the material is less able to provide control and spin as well as comfort to the wearer.

[0007] A dynamically responsive element is a system or device that is automatically sensitive to a broad range of impact force magnitudes to provide the wearer with an equally broad range of outcomes varying from optimal con-

trol to maximum power when kicking a ball. Such a system will be dynamically responsive by imparting greater control or increased power, depending on the required impact force needed to manipulate the ball.

[0008] The problem for soccer shoe designers has been the use of a combination of materials that provide a cushioning system for increased ball control together with a harder and resilient material for increased power kicking whilst remaining comfortable and flexible enough to allow unencumbered movement and overall agility of the wearer's feet. This problem is illustrated by either wearing a high tensile metal boot, which provides optimal power kicking but no cushioning and controlling of the ball plus limited comfort and movement; or wearing a highly flexible and compressible material wrapped around the contours of the foot, which provides optimal cushioning and ball control but no power kicking due to limited stiffness of the material. Previous designs of soccer shoes have incorporated varying systems in between these illustrated extremes. Whereas combining an outer layer of a soft and pliable rubber that deforms easily with a core layer of high tensile metal or plastic of U.S. Pat. No. 6,523,282 B1, this system is not dynamically responsive and, more specifically, not dynamically responsive at the extreme ranges of providing increased control of the ball and providing increased power to the ball.

[0009] One solution is the use of a system comprising two or more materials with different, narrowly prescribed physical properties, which, when used together, produce a dynamic, continuous, and proportional response over a wide range of impact forces. The two materials comprise a first material that exhibits generally Newtonian behavior to impact forces and a second material that exhibits generally non-Newtonian behavior to impact forces.

[0010] Non-Newtonian materials are often a fluid, foam, gel, or gel-like solid in which the stiffness of the material changes with the applied strain rate. These materials are commonly described as either dilatant or pseudo-plastic. Dilatant, or shear thickening, materials demonstrate significant increases in stiffness as loading rate increases. Pseudo-plastic, or shear thinning, materials exhibit the opposite response, i.e. their stiffness decreases as loading rate increases.

[0011] Newtonian materials as we define them for the purposes of this invention, are compliant materials with predominantly linear load displacement characteristics. That is, they generally deform proportionally with the amount of impact force applied. Any distinctly non-Newtonian behavior of these materials can be explained by bottoming out, or, by extreme physical deformation of the material, and not by the fundamental physical and chemical properties that create the character of truly non-Newtonian materials.

[0012] Features of apparel and footwear using non-Newtonian materials have previously been proposed for use in the sole of a shoe. In U.S. Pat. No. 8,276,296 B2 to Frederick, a dynamically moderated shock attenuation system for footwear and/or apparel produces a dynamic, continuous, and proportional response over a wide range of impact forces. Whereas the system of U.S. Pat. No. 8,276,296 B2 is such as to provide protection, they do not suggest or describe any features in kicking and controlling a ball. Furthermore, the dynamically moderated shock attenuation system of U.S. Pat. No. 8,276,296 B2 is applied particularly to the base of the shoe that includes the shoe insoles, shoe midsoles and removable shoe insoles, i.e. the parts of the foot under the heel and ball of the foot, specifically to combat forces involved in

extreme sports such as skateboarding. They do not apply to other parts of the footwear, i.e. the ball contacting surfaces of articles of footwear such as soccer shoes that is generally the material surface of a soccer shoe upper element which may include a forefoot region, a heel region, and a midfoot region disposed between the forefoot region and the heel region.

[0013] Therefore, a need exists for an article of footwear that provides a dynamically responsive system for contacting a ball using both non-Newtonian and Newtonian materials, which permits a range of ball manipulation outcomes from the extremes of increasing the ball contact and cushioning area to allow more control and of increasing the amount of stiffness to gain more power when kicking a ball.

BRIEF SUMMARY OF THE INVENTION

[0014] In preferred embodiments, an article of footwear comprises a sole element, an upper element, and a ball contacting element. The ball contacting element may comprise a first layer configured to contact a ball and a second layer, with the first layer contiguously coupled with a portion of the second layer. The first layer and second layer may be configured to form a ball contacting element on a portion of the upper element. The first layer may comprise a Non-Newtonian material and the second layer may comprise a Newtonian layer, or the first layer may comprise a Newtonian material and the second layer may comprise a Non-Newtonian layer.

[0015] In further preferred embodiments, a ball contacting element covers 2% to 100% of the upper element.

[0016] In further preferred embodiments, the first layer may be contiguously coupled with 2% to 100% of the second layer.

[0017] In still further embodiments, a ball contacting element may comprise a third layer wherein the third layer contains a Non-Newtonian material. The third layer may be contiguously coupled with a portion of the second layer on a side of the second layer that is opposite to the side contiguously coupled to the first layer.

[0018] In further preferred embodiments, the third layer may be contiguously coupled with 2% to 100% of the second layer.

[0019] In further preferred embodiments, a sole element may be coupled to an upper element and a ball contacting element may also be coupled to the upper element.

[0020] In still further preferred embodiments, a ball contacting element may form one or more portions of an upper element and one or more portions of a ball contacting element may be coupled to the sole element.

[0021] In further preferred embodiments, a ball contacting element may form 2% to 100% of the upper element.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Some embodiments of the present invention are illustrated as an example and are not limited by the figures of the accompanying drawings, in which like references may indicate similar elements and in which:

[0023] FIG. 1 depicts a top plan view of an example of an article of footwear comprising a ball contacting element according to various embodiments described herein.

[0024] FIG. 2 illustrates a left elevation view of the example of an article of footwear comprising a ball contacting element depicted in FIG. 1 according to various embodiments described herein.

[0025] FIG. 3 shows a right elevation view of the example of an article of footwear comprising a ball contacting element depicted in FIG. 1 according to various embodiments described herein.

[0026] FIG. 4 depicts a sectional, through line 4-4 shown in FIG. 2, elevation view of an example of an article of footwear comprising a ball contacting element according to various embodiments described herein.

[0027] FIG. 5 illustrates a sectional, through line 5-5 shown in FIG. 4, elevation view of an example of a ball contacting a ball contacting element according to various embodiments described herein.

[0028] FIG. 6 shows a sectional, through line 6-6 shown in FIG. 4, elevation view of an example of a ball contacting a ball contacting element according to various embodiments described herein.

[0029] FIG. 7 depicts a sectional, through line 7-7 shown in FIG. 3, elevation view of an example of an article of footwear comprising a ball contacting element according to various embodiments described herein.

[0030] FIG. 8 illustrates a sectional, through line 8-8 shown in FIG. 7, elevation view of an example of a ball contacting a ball contacting element according to various embodiments described herein.

[0031] FIG. 9 shows a sectional, through line 9-9 shown in FIG. 7, elevation view of an example of a ball contacting a ball contacting element according to various embodiments described herein.

[0032] FIG. 10 depicts a sectional, through line 10-10 shown in FIG. 7, elevation view of an example of a ball contacting a ball contacting element according to various embodiments described herein.

DETAILED DESCRIPTION OF THE INVENTION

[0033] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items. As used herein, the singular forms “a,” “an,” and “the” are intended to include the plural forms as well as the singular forms, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises” and/or “comprising,” when used in this specification, specify the presence of stated features, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, steps, operations, elements, components, and/or groups thereof.

[0034] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one having ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and the present disclosure and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0035] In describing the invention, it will be understood that a number of techniques and steps are disclosed. Each of these has individual benefit and each can also be used in conjunction with one or more, or in some cases all, of the other disclosed techniques. Accordingly, for the sake of clarity, this description will refrain from repeating every possible combination of the individual steps in an unnecessary fashion.

ion. Nevertheless, the specification and claims should be read with the understanding that such combinations are entirely within the scope of the invention and the claims.

[0036] New articles of footwear and ball contacting elements are discussed herein. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be evident, however, to one skilled in the art that the present invention may be practiced without these specific details.

[0037] The present disclosure is to be considered as an exemplification of the invention, and is not intended to limit the invention to the specific embodiments illustrated by the figures or description below.

[0038] The present invention will now be described by example and through referencing the appended figures representing preferred and alternative embodiments. FIGS. 1-3 illustrate an example of an article of footwear (the “footwear”) 100 comprising a ball contacting element 11 according to various embodiments. In this example, the footwear 100 comprises a sole element 12 coupled to an upper element 13. A sole element 12 may extend between the foot and the ground when footwear 100 is worn, and it may include different components such as an outsole, a midsole, and/or an insole. In some embodiments, one or more of these components may be optional. A sole element 12 may be made from or comprise any suitable material, including a material that includes, but is not limited to, elastomers, siloxanes, plastics, natural rubber, other synthetic rubbers, aluminum, steel, other metals and metal alloys, natural leather, synthetic leather, or plastics.

[0039] An upper element 13 may generally refer to a portion of the footwear 100 configured to receive and secure a foot of a wearer to the sole element 12. In some embodiments, an upper element 13 may include an entry hole or opening 14 allowing access to the interior of the upper element 13 configured to receive a foot of a wearer, shoe laces 15 or the like, and a tongue 16. An upper element 13 may include a forefoot region, a heel region, and a midfoot region disposed between the forefoot region and the heel region. It should be understood that an upper element 13 may include other elements that are known in the art for assisting in walking, running or other athletic maneuvers. For purposes of clarity, the interior of an article of footwear 100 is configured to be in close proximity to user's foot and may be defined by the interior surface of the upper element 17 (FIGS. 4-10) which is coupled to the interior surface of the sole element 19 (FIGS. 4 and 7). The exterior of an article of footwear 100 is configured to protect a user's foot and may be defined by the exterior surface of the upper element 18 (FIGS. 2, 3, 4, and 7) which is coupled to the exterior surface of the sole element 20.

[0040] Generally, an upper element 13 may refer to any type of footwear upper and may be configured in any design, shape, size and/or color. In preferred embodiments, an upper element 13 may be configured for a ball sport such as soccer, rugby, football, Australian-rules football, kickball, and the like and may comprise one or more ball contacting elements 11. In some embodiments, the entire exterior surface of the upper element 18 may define the ball contacting region of an article of footwear 100. An upper element 13 may be made from or comprise any suitable material, including Newtonian and Non-Newtonian materials. In some embodiments, an upper element 13 may comprise any suitable knitted, woven, or non-woven material such as fabrics.

[0041] In preferred embodiments, an upper element 13 may comprise a ball contacting element 11 that may cover a substantial amount of the exterior surface of the upper element 18. In other embodiments, an upper element 13 may comprise two, three, four, five, or more ball contacting elements 11 that may cover a substantial amount of the exterior surface of the upper element 18. A substantial amount of the exterior surface of the upper element 18 may refer to approximately 33% to 100% of the surface area of the exterior surface of the upper element 18. In other embodiments, an upper element 13 may comprise a ball contacting element 11 that may cover approximately 2% to 33% of the exterior surface of the upper element 18. In further embodiments, an upper element 13 may comprise two, three, four, five, or more ball contacting elements 11 that may cover approximately 2% to 100% of the exterior surface of the upper element 18. Preferably, one or more ball contacting elements 11 may be positioned on portions of a toe area 21, portions of a right side area 22, portions of a left side area 23, portions of a tongue 16, and/or portions of a heel area 25 of an article of footwear 100.

[0042] In alternative preferred embodiments, a ball contacting element 11 may form a substantial amount of an upper element 13. In other embodiments, an upper element 13 may comprise two, three, four, five, or more ball contacting elements 11 that may form a substantial amount of an upper element 13. A substantial amount of an upper element 13 may refer to approximately 33% to 100% of the surface area of the upper element 13. In other embodiments, an upper element 13 may comprise a ball contacting element 11 that may form approximately 2% to 33% of an upper element 13. In further embodiments, an upper element 13 may comprise two, three, four, five, or more ball contacting elements 11 that may form approximately 2% to 100% of an upper element 13. Preferably, one or more ball contacting elements 11 may form portions of a toe area 21, portions of a right side area 22, portions of a left side area 23, portions of a tongue 16, and/or portions of a heel area 25 of an article of footwear 100.

[0043] Turning now to FIG. 4 a sectional, through line 4-4 shown in FIG. 2, elevation view of an example of the article of footwear 100 shown in FIG. 2 comprising a ball contacting element 11 according to various embodiments described herein is depicted. The ball contacting element 11 generally comprises a ball contacting surface 29 which is configured to contact or impact objects such as balls, other players, and the like. In some embodiments and in the present example, an upper element 13 or portions of an upper element 13 may be formed by a ball contacting element 11 with portions of a ball contacting element 11 optionally configured to receive and secure a foot of a wearer to the sole element 12.

[0044] The ball contacting element 11 may comprise one or more, but preferably two or more, layers of material with one or more layers coupled to an upper element 13 and/or a sole element 13. In preferred embodiments, a ball contacting element 11 may comprise a first layer 26 comprising a Non-Newtonian material coupled to a second layer 27 comprising a Newtonian material. In alternative preferred embodiments, a ball contacting element 11 may comprise a first layer 26 comprising a Newtonian material coupled to a second layer 27 comprising a Non-Newtonian material.

[0045] In embodiments, where the ball contacting element 11 comprises two layers as shown in FIGS. 4-6, the first layer 26 may be contiguous with the second layer 27, with one or more portions of the second layer 27 contiguously coupled to a side of the first layer 26. In further embodiments, where the

ball contacting element 11 comprises two layers, the first layer may be contiguously coupled with 2% to 100% of the second layer. In still further embodiments, where the ball contacting element 11 comprises two layers, the first layer 26 and second layer 27 may be coupled to the sole element 12.

[0046] In embodiments, where the ball contacting element 11 comprises three layers as shown in FIGS. 7-10, the first layer 26 may be contiguous with the second layer 27, and one or more portions of the first layer 26 may be contiguously coupled to a first side of the second layer 27. The third layer 28 may be contiguous with portions of a second side of second layer 27, with one or more portions of the second layer 27 contiguously coupled to a side of the third layer 28. In further embodiments, where the ball contacting element 11 comprises three layers, the third layer may be contiguously coupled with 2% to 100% of the second layer. In still further embodiments, where the ball contacting element 11 comprises three layers, the first layer 26, second layer 27, and third layer 28 may be coupled to the sole element 12.

[0047] In some embodiments, a ball contacting element 11 may comprise a first layer 26 comprising a dynamically responsive material such as a Non-Newtonian material coupled to a second layer 27 comprising a cushioning material such as a Newtonian material with portions of the second layer 27 and/or first layer 26 forming portions of the upper element 13. In alternative preferred embodiments, a ball contacting element 11 may comprise a first layer 26 comprising a Newtonian material coupled to a second layer 27 comprising a Non-Newtonian material with portions of the second layer 27 and/or first layer 26 forming portions of the upper element 13.

[0048] Newtonian materials refer to generally compliant or flexible materials with predominantly linear load displacement characteristics. Such materials are described as generally exhibiting Newtonian behavior in response to impact force. That is, they generally deform proportionally with the amount of force or size of impact applied. Any distinctly non-Newtonian behavior of these materials can be explained by bottoming out or by extreme physical deformation of the material, and not by the fundamental physical and chemical properties that create the character of truly non-Newtonian materials. Newtonian materials are essentially an array or a combination of different materials preferably comprising cushioning properties which may be used in articles of footwear that include, but not limited to, roughened leathers, natural leathers, synthetic leathers, rubbers, silastics, silicones, plastics, foam, aluminium, steel, other metals and metal alloys, carbon fiber, glass fibers, nylon or any synthetic or natural elastomeric material such as styrene-butadiene, or polyurethane.

[0049] Dynamically responsive materials which sometimes include or consist of Non-Newtonian materials wherein Non-Newtonian materials refer to generally a fluid, foam, fabric, gel, or gel-like solid, in which the stiffness of the material changes with the applied strain rate. Such materials are described as generally exhibiting non-Newtonian behavior in response to impact force. These materials are commonly described as either dilatant or pseudo-plastic. Non-Newtonian or dilatant, and shear thickening materials demonstrate significant increases in stiffness as loading rate increases. Non-Newtonian materials may be constructed using materials including, but not limited to, dilatant materials like polyborosiloxanes and yield dilatant materials, rheopectic materials, thixotropic materials, pseudo-plastics,

Bingham plastic materials, anelastic materials, yield pseudo-plastic, viscoplastic, Maxwell material, and Kelvin materials. Commercially available Non-Newtonian products include D3O ST®, D3O XT®, D3O Shock+®, D3O Aero®, D3O Decell®, D3O Lite®, D3O Milicell®, D3O Pulse®, D3O Smart Skin®, DEFLEXION™ DOW Corning Active Protection System, Sofshell ID Flex Technology™, and PORON products XRD® materials. These Non-Newtonian materials have properties that distinguish themselves from other materials and may be adapted to create biomechanically defined dynamically responsive systems for kicking a ball. Non-Newtonian materials are pliable in unstressed or low impact states. However, in a stressed state such as during an impact, these materials lose their pliability and become increasingly viscous as the rate of shear strain increases.

[0050] As perhaps best shown by FIG. 5, a sectional, through line 5-5 shown in FIG. 4, elevation view of an example of a ball 200 contacting a ball contacting surface 29 of a ball contacting element 11 such as when a player kicks a ball 200 with an article of footwear 100 (FIGS. 1-3) comprising a ball contacting element 11 according to various embodiments described herein is shown. When kicking a ball 200 there are two illustrative extremes of how the ball 200 moves based on the forward momentum of the ball 200 and the angular momentum of the ball 200. One extreme is when the ball 200 has optimum or large angular momentum, i.e. the spin of the ball 200, and minimal forward momentum, i.e. the speed of the ball 200. Similarly, the other extreme is when the ball 200 has optimum or large forward momentum and minimal angular momentum.

[0051] The extreme where the ball 200 is kicked to produce optimal or large angular momentum is what provides the wearer with ball control. Typically, the angle of contact between the article of footwear 100 and ball 200 is increased while the impact force is decreased, which also increases the contact area between the article of footwear 100 and ball 200. The increased angle of contact relative to the direction of the kick produces a relatively lower impact force, thereby reducing the forward momentum of the ball 200 while increasing the control or spin of the ball 200.

[0052] The other extreme where the ball 200 is kicked to produce optimal or large forward momentum and minimal angular momentum is what provides the wearer with kicking power. The angle of contact between the article of footwear 100 such as a soccer shoe and ball 200 is narrowed so that there is minimal angular momentum, while the impact force is increased. This narrowed angle in contacting the ball 200 relative to the direction of the kick produces a relatively higher impact force, thereby increasing the forward momentum of the ball 200 while decreasing the control or spin of the ball 200.

[0053] In the embodiment depicted in FIG. 5, the ball contacting element 11 may comprise a first layer 26 which comprises a Newtonian material and a second layer 27 which comprises a Non-Newtonian material in an illustrative example where the ball 200 is kicked to produce optimal angular momentum with a lower impact force. Preferably, during a low impact force collision with a ball 200, portions of a first layer 26 comprising a Newtonian material and portions of a second layer 27 comprising a Non-Newtonian material may both deform to provide increased cushioning that contributes to greater ball control and user comfort. In low impact forces, such as dribbling, passing, and manipulating the ball 200 by kicking with the article of footwear 100 such as a

soccer shoe, the deformation of the first layer 26 and second layer 27 of the ball contacting element 11 provides compressibility, pliability and flexibility to the wearer so as to not impede the wearer's movement by being too inflexible, stiff or cumbersome.

[0054] FIG. 6 shows a sectional, through line 6-6 shown in FIG. 4, elevation view of an example of a ball 200 contacting a ball contacting surface 29 of a ball contacting element 11 such as when a player kicks a ball 200 with an article of footwear 100 (FIGS. 1-3) comprising a ball contacting element 11 according to various embodiments described herein. Similarly to FIG. 5, in this embodiment, the ball contacting element 11 may comprise a first layer 26 which comprises a Newtonian material and a second layer 27 which comprises a Non-Newtonian material. However in this illustration, the ball 200 is kicked to produce optimal forward momentum and minimal angular momentum with a higher impact force. During a high impact force collision with a ball 200, portions of a first layer 26 comprising a Newtonian material may deform to provide some cushioning that contributes to ball control and user comfort, while portions of a second layer 27 comprising a Non-Newtonian material will not deform or will deform to a lesser degree than the Newtonian material to provide increased resilience and stiffness that contributes to greater kicking power. Almost instantaneously after this action, the Non-Newtonian material may become pliable and flexible in its unstressed state thus contributing to user comfort.

[0055] In the examples shown in FIGS. 5 and 6, by comprising a first layer 26 comprising a Newtonian material and a second layer 27 comprising a Non-Newtonian material, the ball contacting element 11 is configured to be dynamically responsive to varying impact forces to provide increased resilience and stiffness that contributes to greater kicking power where the ball 200 is kicked to produce a high impact force collision, and to provide decreased resilience and increased cushioning that contributes to greater ball control where the ball 200 is kicked to produce optimal angular momentum with a lower impact force.

[0056] In other embodiments, ball contacting element 11 may comprise a first layer 26 which comprises a Non-Newtonian material and a second layer 27 which comprises a Newtonian material so that the first layer 26 comprising a Non-Newtonian material is configured to contact a ball 200. Similarly to the examples shown in FIGS. 5 and 6, by comprising a first layer 26 comprising a Non-Newtonian material and a second layer comprising a Newtonian material, the ball contacting element 11 is configured to be dynamically responsive to varying impact forces to provide increased resilience and stiffness that contributes to greater kicking power where the ball 200 is kicked to produce a high impact force collision, and to provide decreased resilience and increased cushioning that contributes to greater ball control where the ball 200 is kicked to produce optimal angular momentum with a lower impact force or when dribbling and passing the ball.

[0057] Turning now to FIG. 7, a sectional, through line 7-7 shown in FIG. 3, elevation view of an example of an article of footwear 100 shown in FIG. 3 comprising a ball contacting element 11 according to various embodiments described herein is depicted. The ball contacting element 11 generally comprises a ball contacting surface 29 which is configured to contact or impact objects such as balls, other players, and the like. In some embodiments and in the present example, an

upper element 13 or portions of an upper element 13 may be formed by a ball contacting element 11 with portions of a ball contacting element 11 configured to receive and secure a foot of a wearer to the sole element 12. A ball contacting element 11 may comprise three or more layers of material with one or more layers coupled to an upper element 13 and/or a sole element 13.

[0058] In this preferred alternative embodiment, a ball contacting element 11 may comprise a first layer 26 comprising a Newtonian material coupled to a second layer 27 comprising a Non-Newtonian material and a third layer 28 comprising a Newtonian material also coupled to a second layer 27. In other embodiments, a ball contacting element 11 may comprise a first layer 26 comprising a Newtonian material coupled to a second layer 27 comprising a Newtonian material and a third layer 28 comprising a Non-Newtonian material also coupled to a second layer 27. In further embodiments, a ball contacting element 11 may comprise a first layer 26 comprising a Newtonian material coupled to a second layer 27 comprising a Non-Newtonian material and a third layer 28 comprising a Non-Newtonian material also coupled to a second layer 27. In even further embodiments, a ball contacting element 11 may comprise a first layer 26 comprising a Non-Newtonian material coupled to a second layer 27 comprising a Newtonian material and a third layer 28 comprising a Non-Newtonian material also coupled to a second layer 27. In still further embodiments, a ball contacting element 11 may comprise a first layer 26 comprising a Non-Newtonian material coupled to a second layer 27 comprising a Non-Newtonian material and a third layer 28 comprising a Newtonian material also coupled to a second layer 27.

[0059] One of reasonable skill in the art will recognize that a ball contacting element 11 may comprise one or more layers comprising a Non-Newtonian material coupled to one or more layers comprising a Newtonian material with the layers ordered in as many permutations as the number of layers permits to provide varying dynamic responsiveness. In alternative embodiments, a ball contacting element 11 may comprise one or more layers comprising a Non-Newtonian material coupled to an upper element 13 comprising one or more layers of a Newtonian material with the layers ordered in as many permutations as the number of layers permits to provide varying dynamic responsiveness. In further alternative embodiments, a ball contacting element 11 may comprise one or more layers comprising a Newtonian material coupled to an upper element 13 comprising one or more layers of a Non-Newtonian material with the layers ordered in as many permutations as the number of layers permits to provide varying dynamic responsiveness.

[0060] In preferred embodiments, one or more of a ball contacting element 11, a sole element 12, an upper element 13, a first layer 26, a second layer 27, an optional third layer 28, and/or any additional layers or other elements may be coupled by being connected, removably connected, or integrally formed or molded with an article of footwear 100. In some embodiments, one or more of a ball contacting element 11, a sole element 12, an upper element 13, a first layer 26, a second layer 27, an optional third layer 28, and/or any additional layers or other elements may be coupled or connected together with heat bonding, chemical bonding, adhesives, clasp type fasteners, clip type fasteners, rivet type fasteners, threaded type fasteners, other types of fasteners, or any other suitable joining method.

[0061] In other embodiments, one or more of a ball contacting element 11, a sole element 12, an upper element 13, a first layer 26, a second layer 27, an optional third layer 28, and/or any additional layers or other elements may be coupled or removably connected by being press fit or snap fit together, by one or more fasteners such as magnetic type fasteners, sealable tongue and groove fasteners, snap fasteners, clip type fasteners, clasp type fasteners, ratchet type fasteners, a push-to-lock type connection method, a turn-to-lock type connection method, slide-to-lock type connection method or any other suitable temporary connection method as one reasonably skilled in the art could envision to serve the same function.

[0062] In further embodiments, one or more of a ball contacting element 11, a sole element 12, an upper element 13, a first layer 26, a second layer 27, an optional third layer 28, and/or any additional layers or other elements may be coupled by being one of connected to and integrally formed with another element of an article of footwear 100.

[0063] FIG. 8 illustrates a sectional, through line 8-8 shown in FIG. 7, elevation view of an example of a ball 200 contacting a ball contacting surface 29 of a ball contacting element 11 such as when a player kicks a ball 200 with an article of footwear 100 (FIGS. 1-3) comprising a ball contacting element 11 according to various embodiments described herein. In this embodiment, the ball contacting element 11 may comprise a first layer 26 which comprises a Newtonian material, a second layer 27 which comprises a Non-Newtonian material, and a third layer 28 which comprises a Newtonian material contacting the interior surface of the upper element 17 illustrated in an example where the ball 200 is kicked to produce optimal angular momentum with a lower impact force. Preferably, during a low impact force collision with a ball 200, portions of a first layer 26 comprising a Newtonian material, portions of a second layer 27 comprising a Non-Newtonian material, and portions of a third layer 28 comprising a Newtonian material may all deform to provide increased cushioning that contributes to greater ball control and user comfort. In low impact forces, such as dribbling, passing, and manipulating the ball 200 by kicking with the article of footwear 100 such as a soccer shoe, the deformation of the first layer 26, second layer 27, and third layer 28 of the ball contacting element 11 provides compressibility, pliability and flexibility to the wearer so as to not impede the wearer's movement by being too inflexible, stiff or cumbersome.

[0064] Referring now to FIG. 9, a sectional, through line 9-9 shown in FIG. 7, elevation view of an example of a ball 200 contacting a ball contacting surface 29 of a ball contacting element 11 such as when a player kicks a ball 200 with an article of footwear 100 (FIGS. 1-3) comprising a ball contacting element 11 according to various embodiments described herein. Similarly to FIG. 8, in this embodiment, the ball contacting element 11 may comprise a first layer 26 which comprises a Newtonian material, a second layer 27 which comprises a Non-Newtonian material, and a third layer 28 which comprises a Newtonian material contacting the interior surface of the upper element 17. In this illustration, the ball 200 is kicked to produce a degree of forward momentum and a degree of angular momentum with a moderate impact force. Preferably, during a moderate impact force collision with a ball 200, portions of a first layer 26 comprising a Newtonian material and portions of a third layer 28 comprising a Newtonian material may deform to provide some cushioning that contributes to ball control and user comfort, while portions of

a second layer 27 comprising a Non-Newtonian material may not deform or deform to a lesser degree than the first 26 and third 28 layers to provide resilience and stiffness that contributes to increased kicking power. Almost instantaneously after this action, the Non-Newtonian material may become pliable and flexible in its unstressed state thus contributing to user comfort.

[0065] FIG. 10 depicts an elevation view of an example of a ball 200 contacting a ball contacting surface 29 of a ball contacting element 11 such as when a player kicks a ball 200 with an article of footwear 100 (FIGS. 1-3) comprising a ball contacting element 11 according to various embodiments described herein. Similarly to FIGS. 8 and 9, in this embodiment, the ball contacting element 11 may comprise a first layer 26 which comprises a Newtonian material, a second layer 27 which comprises a Non-Newtonian material, and a third layer 28 which comprises a Newtonian material contacting the interior surface of the upper element 17. In this illustration, the ball 200 is kicked to produce optimal forward momentum and minimal angular momentum with a higher impact force. Preferably, during a high impact force collision with a ball 200, portions of a first layer 26 comprising a Newtonian material and portions of a third layer 28 comprising a Newtonian material may deform to provide some cushioning that contributes to ball control and user comfort, while portions of a second layer 27 comprising a Non-Newtonian material may not deform or deform to a lesser degree than the Newtonian material to provide increased resilience and stiffness that contributes to greater kicking power. Almost instantaneously after this action, the Non-Newtonian material may become pliable and flexible in its unstressed state thus contributing to user comfort.

[0066] In the examples shown in FIGS. 8, 9, and 10, by comprising a first layer 26 comprising a Newtonian material, a second layer comprising a Non-Newtonian material, and a third layer 28 comprising a Newtonian material, the ball contacting element 11 is configured to be dynamically responsive across a range of impact forces to provide increased resilience and stiffness that contributes to greater kicking power when the ball 200 is kicked to produce a high impact force collision, to provide decreased resilience and increased cushioning that contributes to greater ball control where the ball 200 is kicked to produce optimal angular momentum with a lower impact force, and to provide varying degrees of resilience and cushioning when subjected to varying degrees of impact forces between high and low impacts.

[0067] Although the present invention has been illustrated and described herein with reference to preferred embodiments and specific examples thereof, it will be readily apparent to those of ordinary skill in the art that other embodiments and examples may perform similar functions and/or achieve like results. All such equivalent embodiments and examples are within the spirit and scope of the present invention, are contemplated thereby, and are intended to be covered by the following claims.

REFERENCES INCORPORATED HEREIN BY REFERENCE

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- [0069] U.S. Pat. No. 3,191,321 Brutting
- [0070] U.S. Pat. No. 6,523,282 B1 Johnston
- [0071] U.S. Pat. No. 8,276,296 B2 Frederick

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[0072] Graham, Budden, Defense and Comfort: New Advancement in Impact-Protection Textiles; T3 Technical Textile Technology, April 2006, U.S.

[0073] Dow Corning, Active Protection System Information.

1. An article of footwear comprising a sole element, and an upper element, the upper element comprising

dynamically responsive material that exhibits non-Newtonian behavior in response to an impact force.

2. The article of footwear of claim 1, wherein the upper element further comprises a ball contacting element, the ball contacting element having a first layer and a second layer, wherein the first layer is configured to contact a ball and comprises a material that exhibits Newtonian behavior in response to the impact force and wherein the second layer comprises a dynamically responsive material that exhibits non-Newtonian behavior in response to the impact force.

3. The article of footwear of claim 2, wherein the ball contacting element covers 2% to 100% of the upper element.

4. The article of footwear of claim 2, where in the first layer is contiguously coupled with a portion of the second layer.

5. The article of footwear of claim 4, wherein the first layer is contiguously coupled with 2% to 100% of the second layer.

6. The article of footwear of claim 2, wherein the upper element comprises a third layer.

7. The article of footwear of claim 6, wherein the third layer comprises a dynamically responsive material that generally exhibits Non-Newtonian behavior in response to the impact force.

8. The article of footwear of claim 7, wherein the third layer is contiguously coupled with a portion of the second layer.

9. The article of footwear of claim 7, wherein the third layer is contiguously coupled with 2% to 100% of the second layer.

10. The article of footwear of claim 2, wherein the first layer, and the second layer are coupled to the sole element.

11. The article of footwear of claim 7, wherein the first layer, second layer, and third layer are coupled to the sole element.

12. An article of footwear comprising a sole element, an upper element, and a ball contacting element, wherein the ball contacting element comprises:

a) a first layer configured to contact a ball, wherein the first layer comprises a material that exhibits Newtonian behavior in response to an impact force; and

b) a second layer coupled to the first layer, wherein the second layer comprises a dynamically responsive material that exhibits Non-Newtonian behavior in response to impact force, wherein the first layer and second layer are configured to form a ball contacting element on a portion of the upper element.

13. The article of footwear of claim 12, wherein the ball contacting element covers 2% to 100% of the upper element.

14. The article of footwear of claim 12, wherein the first layer is contiguously coupled with a portion of the second layer.

15. The article of footwear of claim 12, wherein the first layer is contiguously coupled with 2% to 100% of the second layer.

16. The article of footwear of claim 12, wherein the upper element comprises a third layer.

17. The article of footwear of claim 16, wherein the third layer comprises a cushioning material that exhibits Newtonian behavior in response to impact force.

18. An article of footwear configured to provide dynamically responsive resistance to a ball when being employed in a kicking motion, the article of footwear comprising:

a) a sole element;

b) an upper element coupled to said sole element and wherein said upper element is adapted to cover portions of a person's heel, toes, sole, inside foot, outside foot; and

c) wherein the upper element comprises: a first layer configured to contact a ball, wherein the first layer comprises a first material that exhibits Newtonian behavior in response to an impact force; and a second layer comprising a second material that exhibits dynamically responsive non-Newtonian behavior in response to an impact force.

19. The article of footwear of claim 18, wherein the first material is a Newtonian material selected from one of natural leather and synthetic leather.

20. The article of footwear of claim 19, wherein the second material is a non-Newtonian material selected from one of a dilatant material and a pseudo-plastic material.

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