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(54) **MEDIALLY TEXTURED FOOTBEDS FOR CONTROLLING LOWER EXTREMITY KINEMATICS AND KINETICS**

MITTIG STRUKTURIERTE FUSSBETTEN ZUR KONTROLLE DER KINEMATIK UND KINETIK DER UNTEREN EXTREMITÄTEN

SEMELLES TEXTURÉES SUR LE CÔTÉ MÉDIAL POUR CONTRÔLE CINÉMATIQUE ET CINÉTIQUE D'EXTRÉMITÉ INFÉRIEURE

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(56) References cited:
GB-A- 2 296 646
JP-U- 3 076 777
JP-U- 3 104 692
JP-U- S4 887 031
JP-U- S4 958 549
US-A- 5 664 342

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Description

FIELD OF THE INVENTION

[0001] The present invention relates generally to products and methods for controlling lower extremity motion, *e.g.*, by altering sensory input to the plantar surface of a foot to thereby affect lower extremity kinematics and/or kinetics.

BACKGROUND

[0002] Conventional articles of footwear, including athletic footwear, have included two primary elements, namely an upper member and a sole structure. The upper member provides a covering for the foot that securely receives and positions the foot with respect to the sole structure. In addition, the upper member may have a configuration that protects the foot and provides ventilation, thereby cooling the foot and removing perspiration. The sole structure generally is secured to a lower portion of the upper member and generally is positioned between the foot and a contact surface (which may include any foot or footwear contact surface, including but not limited to:

> ground, grass, dirt, sand, snow, ice, tile, flooring, carpeting, synthetic grass, artificial turf, and the like). In addition to attenuating contact surface reaction forces, the sole structure may provide traction and help control foot motion, such as pronation. Accordingly, the upper member and the sole structure operate cooperatively to provide a comfortable structure that is suited for a variety of ambulatory activities, such as walking and running.

[0003] The sole structure of athletic footwear, in at least some instances, will exhibit a layered configuration that includes a comfort-enhancing insole, a resilient midsole (*e.g.*, formed, at least in part, from a polymer foam material), and a contact surface-contacting outsole that provides both abrasion-resistance and traction. The midsole, in at least some instances, will be the primary sole structure element that attenuates contact surface reaction forces and controls foot motion. Suitable polymer foam materials for at least portions of the midsole include ethylvinylacetate ("EVA") or polyurethane ("PU") that compress resiliently under an applied load to attenuate contact surface reaction forces.

[0004] While some conventional sole structures have been useful to help control foot motion, some people have gait issues, such as excessive pronation or supination, arthritis issues, excessive inversion/eversion, and the like, that cannot be adequately addressed through conventional sole structures. Although the use of shoe inserts and orthotics has been shown to be successful in treating various ailments, their biomechanical effects on the body's lower extremities are less understood. Also, in certain instances, the use of an orthotic device underfoot becomes a crutch upon which the body may eventually come to depend. For each successive ailment, the crutch has to become more and more severe. Also, while wedge inserts for shoes have been used successfully to provide at least some relief or correction for certain gait issues, these wedges tend to become loose within the shoe resulting in discomfort and/or can be easily lost. Accordingly, there is room in the art for improvements on lower extremity motion control.

[0005] The document JP348087031U shows a footbed comprising: a first major surface for engaging all of a plantar surface of a user's foot, the first major surface including a lateral half and a medial half; a second major surface opposite the first major surface, the second major surface including a lateral half and a medial half; and plural texturing members on a portion of the medial half; wherein the lateral half is smooth and untextured such that when a plantar surface of a user's foot applies a substantially vertical force to the footbed, the lateral half feels smooth at the plantar surface and at least a portion of the medial half feels textured at the plantar surface.

SUMMARY

[0006] The present invention relates to new systems and methods for treating certain gait issues and overuse injuries that may be used by themselves, or in conjunction with other traditional methods, e.g., like those previously described. Furthermore, aspects of the present invention may provide long-term relief of specific movement related ailments as features of systems and methods of the invention do not, when used alone, provide a mechanical crutch.

[0007] More specific aspects of the present invention relate to controlling user motion and/or changing sensory input to the feet during ambulatory activities, such as walking or running, or during athletic or other activities that include walking, running, and/or other non-linear movements, such as cutting actions in basketball and tennis, etc., rapid stopping actions, rapid starting actions, etc., using selectively textured footbeds, such as insoles, sock-liners, interior footwear bootie members, socks, or other foot-receiving devices or portions thereof.

[0008] A first aspect of this invention relates to a footbed in accordance with claim 1 and an article of footwear in accordance with claim 15.

[0009] An additional aspect of this invention relates to a method of making an article of footwear in accordance with claim 12. Such methods may include providing, in some manner, a footbed of the types described above with an otherwise conventional shoe or other foot-receiving device product.

[0010] A further aspect of this invention relates to a method of affecting a wearer's kinematics or kinetics during ambulatory activities as defined in claim 5, using products in accordance with examples of this invention.

[0011] The above and other objects, features, and ad-

vantages of the present invention will be readily apparent and fully understood from the following detailed description, taken in connection with the appended drawings, in which:

Figs. 1A through 1C illustrate example footbed structures used in the Experimental Results section below, as well as example textured footbed structures in accordance with some aspects of this invention (Figs. 1B);

Fig. 2 illustrates an example article of footwear in accordance with some aspects of this invention;

Figs. 3A and 3B illustrate example articles of clothing, Figure 3B being in accordance with some aspects of this invention;

Fig. 4 illustrates an example footbed product including a footbed structure;

Figs. 5A through 7 provide charts and graphs relating to various walking studies performed using footbed structures in accordance with examples of this invention;

Figs. 8A through 14B provide charts and graphs relating to various running studies performed using footbed structures in accordance with examples of this invention; and

Figs. 15A through 15N illustrate additional example arrangements of texturing elements on footbeds of foot-receiving device products.

DETAILED DESCRIPTION

[0012] In the following description of various examples of the present invention, reference is made to the accompanying drawings, which form a part hereof, and in which are shown by way of illustration various structures, embodiments, and examples in which aspects of the invention may be practiced. It is to be understood that other embodiments may be utilized and structural and functional modifications may be made without departing from the scope of the present invention.

I. General Description of Aspects of the Invention

A. Products According to Examples of this Invention

[0013] Aspects of the present invention relate generally to controlling user motion and/or changing sensory input to the feet during ambulatory activities, such as walking or running, or during athletic or other activities that include walking, running, cutting actions, rapid stopping actions, rapid starting actions, etc., using selectively textured footbeds. More specific example aspects of this invention relate to foot-receiving devices, such as articles of footwear, that include: an upper member, a sole structure engaged with the upper member and a footbed for supporting a plantar surface of a user's foot located within the foot-receiving chamber and/or between the foot-covering member and the foot-supporting member. In these structures, lateral sides of the footbed will have a smooth or substantially smooth feel or surface while the opposite side will have a textured feel or surface, *e.g.*, by providing plural raised areas that define the textured feel or surface. In such structures, the footbed may be sized and arranged to engage all or substantially all of a plantar surface of a user's foot (*e.g.*, the term "substantially all," as used herein in this context, means that the footbed extends to cover or engage an area corresponding to at least 80% of the plantar surface of the wearer's foot, and when specifically noted, it may extend to cover or engage an area corresponding to at least 90% or even 95% of the plantar surface of the wearer's foot). The "textured feel or surface" is provided, sized, and/or arranged to at least predominantly cover a medial half of the footbed, and in at least some examples, to substantially cover the entire medial half of the footbed (*e.g.,* the term "substantially cover," as used herein in this context, means that the texture feel or surface extends to cover an area corresponding to at least 80% of the medial half of the footbed, and when specifically noted, it may extend to cover an area corresponding to at least 90% or even 95% of the medial half of the footbed). The term "substantially smooth," as used herein in this context, means that the smooth feel or surface extends to cover an area corresponding to at least 80% of the lateral half of the footbed, and when specifically noted, it may extend to cover an area corresponding to at least 90% or even 95% of the lateral half of the footbed.

[0014] The footbed may be provided in a variety of different ways without departing from this invention. For example, the footbed may be integrally formed as part of the foot-covering member and/or the foot-supporting member structure(s) (*e.g.*, integrally formed as part of the upper member and/or sole structure of an article of footwear). As another example, the footbed may be provided as a separate structure engaged with one or more of the foot-covering member and/or the foot-supporting member (*e.g.,* as part of an insole member, as part of a sock liner, as a separate insert member, etc.). As still additional examples, the footbed may be provided as an integral part of and/or attached to an article of clothing, such as a sock or other article of clothing (*e.g.*, within the interior or on the exterior of the sock or other article of clothing, etc.). As yet another example, if desired, the footbed may constitute a separate element directly engageable with a user's foot.

B. Methods of Making Products According to Examples of this Invention

[0015] An additional aspect of this invention relates to

a method of making articles of footwear including one or more of the various structures and/or features described above. Such a method includes, for example: (a) engaging an upper member with a sole structure and (b) providing a footbed for supporting a plantar surface of a user's foot with at least one of the upper member and/or the sole structure, wherein the lateral side of the footbed has a smooth or substantially smooth feel or surface, and the opposing side of the footbed has a textured feel or surface, *e.g.*, by providing plural raised areas defining the textured feel or surface. Any desired constructions, materials, or styles of the article of footwear (or other foot-receiving device) may be used without departing from the invention, including conventional constructions, materials, and styles that are known and used in the art. Also, the footbed may have any of the structures, arrangements, and/or constructions described above (and/or those described in more detail below).

C. Methods of Using Products According to Examples of this Invention

[0016] A further aspect of this invention relate to a method of affecting a wearer's kinematics or kinetics during ambulatory activities, using products in accordance with examples of this invention. Such methods may include:

(a) providing a footbed for engaging a plantar surface of a user's foot, wherein the lateral side of the footbed has a smooth or substantially smooth feel or surface, and the opposite side of the footbed has a textured feel or surface, *e.g.*, by providing plural raised elements defining the textured feel or surface; and (b) performing an ambulatory activity while having the plantar surface of the user's foot directly or indirectly engaged with the footbed. The footbed may be provided in a variety of ways without departing from this invention. For example, the footbed may be provided as a portion of an article of footwear, *e.g.*, as an insole member or a sock-liner, integrally formed as part of a sole structure of the article of footwear, integrally formed as part of an upper member of the article of footwear, provided as an independent structure inserted into an article of footwear or other foot-receiving device, etc. As additional examples, if desired, the footbed may be included as a part of a sock or other article of clothing, *e.g.*, integrally formed as part of the clothing structure (in the interior of the foot-receiving chamber or on the interior or exterior of the foot-receiving chamber), inserted into the clothing structure, attached to the exterior of the clothing structure, etc. The footbed also may constitute a separate structure that is directly attachable to a user's foot. The footbed also may have any of the various structures, constructions, arrangements, and/or characteristics described above (and/or those described in more detail below).

[0017] Various kinematic and/or kinetic characteristics of ambulatory activity may be affected using footwear or articles of clothing including footbeds of the types described above. For footbeds in which the lateral side of the footbed has a smooth or substantially smooth feel or surface and the medial side includes a textured feel or surface, examples of kinematic and/or kinetic characteristics of ambulatory activity that may be affected include the following: (a) reducing pronation while walking; (b) reducing a maximum amount of eversion while walking; (c) reducing a rearfoot range of motion while walking; (d) reducing eversion velocity while walking or running; (e) reducing plantarflexion while pushing off during a step while walking; (f) increasing maximum inversion at the end of the ground contact phase during a step while walking; (g) reducing inversion of a user's foot at heel strike while running; (h) reducing an eversion range of motion of a user's foot while running; (i) reducing an amount of inversion experienced by a user's foot at the end of a step phase while running; (j) reducing maximum internal tibial rotation while running; and (k) increasing peak active contact surface reaction force while running. Products in accordance with some examples of this invention also may be useful in treating knee pain (*e.g.*, when the textured feel or surface is on the medial side).

[0018] Given this general description of various features and aspects of the invention, more detailed descriptions of structures of products in accordance with this invention, as well as methods of making and using such products, follow.

II. Specific Examples of the Invention

[0019] While various aspects and features of the invention generally have been described above, the following provides more detailed, specific examples of products and methods in accordance with the invention. Those skilled in the art should understand, of course, that the following description constitutes descriptions of examples of the invention and should not be construed as limiting the invention in any way.

A. Example Products According to the Invention

[0020] Figs. 1A through 1C generally illustrate footbeds for engaging a plantar surface of a user's foot that were used in the experimental tests described below. More specifically, Fig. 1A (not in accordance with the present invention) illustrates a smooth or untextured plantar surface contacting footbed pair 100 used as a control in the various experiments described below. Fig. 1B illustrates a plantar surface contacting footbed pair 120 in accordance with some examples of this invention that includes a "textured" surface on the medial sides 122 and a smooth or untextured surface on the lateral sides 124. Fig. 1C illustrates a plantar surface contacting footbed pair 140 which is not in accordance with this invention that includes a "textured" surface on the lateral

sides 144 and a smooth or untextured surface on the medial sides 142. The "texturing" provided in these example footbed structures 120 and 140 constitutes small raised elements 150 (*e.g.,* hemispheres, parabolic surfaces, cylindrical structures, conical structures, cubic square structures, cubic rectangular structures, etc.) that extend upward from the base surface 152 of the footbeds 120 and 140 to contact the plantar surface of the wearer's foot.

[0021] The term "textured," as used herein, means structures of sufficient size and shape to be immediately felt by and to elicit an immediate conscious awareness to a wearer when located under the plantar surface of their foot (*e.g.*, with weight applied via the plantar surface). The texturing may take on a wide variety of different sizes and shapes without departing from this invention. For example, as illustrated in Figs. 1B and 1C, in this illustrated example, the texturing is provided as generally round, hemispherically raised elements 150 formed in or on the footbed base surface 152 and extending upward toward and to contact the plantar surface of a wearer's foot in use. Of course, the raised elements 150 may be of any desired shape (*e.g.,* including those noted above), size (length, width, and/or height), distribution, and/or construction without departing from this invention. Also, if desired, the raised elements 150 and/or other texturing structures, as well as the pattern of raised elements and/or other texturing structures, may vary or change in size and/or vary in pattern or arrangement over a given footbed surface and/or between footbed surfaces of a given pair without departing from this invention.

[0022] As another example or alternative, if desired, at least some of the raised elements may extend in a direction away from the surface of the footbed that contacts the plantar surface of the wearer's foot (and optionally extend from the surface of the footbed opposite the surface that contacts the wearer's foot), provided that the overall footbed structure (*e.g.*, insole member or sock-liner) is constructed such that the raised elements still can be felt by the wearer through the construction of the footbed.

[0023] The texturing also may be located at a variety of different positions and/or in a variety of arrangements or patterns without departing from this invention. According to the invention, the "textured surface" or the "texturing" is sized and arranged to at least predominantly cover a medial half of the footbed (optionally evenly distributed over the textured half), and in at least some examples, it will be sized and arranged to at least substantially cover the medial half of the footbed, optionally evenly distributed over the textured half of the footbed. Also footbed structures in accordance with examples of this invention may be sized and arranged to engage all or substantially all of the plantar surface of a user's foot.

[0024] The footbeds 120 may take on a wide variety of different forms, structures, and/or constructions without departing from this invention. For example, the footbeds 120 may be constructed as sock-liner or insole components that may be included in an article of footwear, *e.g.*, during manufacture of the article of footwear, at a later time, etc. The raised elements 150 may be provided in such sock-liner or insole components in various ways, for example: by including additional textile material as part of the sock-liner or insole component structure at the locations of the raised elements 150; by providing plastic elements in or on the sock-liner or insole component structure (*e.g.*, integrally forming the raised elements 150 in the sock-liner or insole structure during molding or other sock-liner or insole component forming processes, attaching the raised elements 150 (individually or in one or more groups) to a sock-liner or insole structure by adhesives, mechanical connectors, etc.); etc. As still additional examples, the footbeds 120 also may be constructed, at least in part, as air or other gas-filled bladders, optionally with the raised elements 150 integrally molded therein, attached thereto, etc. As yet additional examples, the raised elements 150 may be provided as part of a midsole or other structure underlying a conventional sock-liner or insole member, provided that the raised elements 150 are sized and shaped so as to be capable of being felt by the wearer through the sock-liner or insole member and/or provided that the raised elements extend into and/or through openings provided in the sock-liner or insole member up toward the foot's plantar surface so as to be felt by the wearer. Other footbed structures and/or arrangements also are possible.

[0025] Fig. 2 illustrates a partial view of an example article of footwear 200 that includes a footbed 120 or 140 of the types illustrated above in Figs. 1B and 1C. The article of footwear 200 includes an upper member 202 and a sole structure 204 engaged with the upper member. The overall article of footwear 200, the upper member 202, and the sole structure 204 may be provided in any desired construction or style, from any desired number of parts and/or materials, and joined together in any desired manner, without departing from the invention, including in conventional constructions and styles, with conventional parts and/or materials, and/or joined together in conventional manners, as are known and used in the footwear art. In some examples, the article of footwear 200 may be an athletic shoe, although other types of shoes also may take advantage of constructions and features of the invention.

[0026] In the specifically illustrated example, the sole structure 204 includes an outsole member 204a and a midsole member 204b, and the upper member 202 is lasted around and engaged between the midsole member 204b and the outsole member 204a. While the midsole member 204b is illustrated as internal to the footwear structure 200 in Fig. 2, if desired, at least some portions of the midsole member 204b may be external of the shoe chamber, and outside the upper member 202. Also, in this illustrated example structure 200, the footbed 120 is provided in the form of an insole or sock-liner component 120, which may constitute part of the upper member structure 202 and/or the sole structure 204. Alternatively,

if desired, the insole or sock-liner component 120 may be provided as a separate and/or independent structure, *e.g.*, one that is inserted into the foot-receiving chamber of an article of footwear, for example, as part of the manufacturing process, after manufacture is complete, etc. As still another example, if desired, the footbed 120, 140 may be provided as part of an interior bootie member or other structure integrally formed in and included as part of the footwear structure 200. Also, any of the various potential footbed structures and constructions described above in conjunction with Figs. 1B may be used in the footwear structure 200 of Fig. 2 without departing from the invention.

[0027] If desired, separate means may be provided to hold the footbed 120 in place with respect to the article of footwear 200. Examples of such means include, but are not limited to: mechanical connectors (such as snaps, straps, buckles, etc.); hook-and-loop type fasteners; adhesives; grooves or other retaining structures; etc.

[0028] Other footbed product structures and constructions are possible without departing from this invention. Fig. 2, as described above, illustrates example products in which the selectively textured footbed 120 is included as part of a footwear structure (*e.g.*, integrally formed as part of the footwear construction, inserted into the footwear construction, etc.). This is not a requirement. As another example, as illustrated in Fig. 3B, products in accordance with some examples of this invention may be provided as an article of clothing 300, 320, such as socks, stockings, pantyhose, pajamas, or other garments that contain and engage the plantar surface of a wearer's foot. The article of clothing 300, 320 includes a footbed surface 302 on which plural texture elements 304 are provided. Fig. 3A (not in accordance with the present invention) illustrates an example article of clothing 300 in which the texture elements 304 are provided on the lateral side 306 of the plantar-engaging surface (and none or substantially none on the medial side 308), while Fig. 3B illustrates an example article of clothing 320 in which the texture elements 304 are provided on the medial side 308 of the plantar-engaging surface (and none on the lateral side 306).

[0029] The texture elements 304 may be provided in an article of clothing 300, 320 in any desired manner without departing from the invention. For example, the texture elements 304 may be provided as areas of increased density of textile material integrally formed in the textile structure of the article of clothing (*e.g.*, during the knitting, weaving, or other formation processes). As another example, the texture elements 304 may be provided as individual plastic or textile nubs that are attached to the article of clothing's 320 interior and/or exterior surfaces. As still another example, if desired, the texture elements 304 may be provided as a separate component or element (akin to an insole element or sock-liner) that is inserted into the interior (*i.e.*, the foot-receiving chamber) of the article of clothing. Also, the texture elements 304 may have any of the various sizes, shapes, structures, constructions, and/or arrangement described above, *e.g.*, in conjunction with Figs. 1B and 2.

[0030] Fig. 4 illustrates another example structure 400 for providing a textured footbed in accordance with some examples of this invention. This structure 400 includes a base member 402 that defines a major surface for engaging a plantar surface 412 of a wearer's foot (*e.g.*, directly engaging the bare foot or indirectly engaging the foot, for example, through a sock, stocking, or other article of clothing 410, etc.). The base member 402 may have any desired construction, such as a fabric or textile construction, a sock-liner type construction, an insole member type construction, an air or gas-filled bladder construction, or the like, *e.g.,* as generally described above. One side of the base member 402 also may include texture elements 404 provided therein or thereon in any desired manner, including the various example manners described above in conjunction with Figs. 1B, 2, and 3. Of course, the texture elements 404 may be provided in or on the base member 402 in any sizes, shapes, structures, constructions, patterns, and/or arrangement, including the various sizes, shapes, structures, constructions, patterns, and/or arrangements described above.

[0031] This example footbed structure 400 additionally includes means for (at least partially) holding the footbed structure 400 in place with respect to an article of clothing 410 and/or a wearer's foot. While any desired means for holding the footbed structure 400 in place may be provided without departing from the invention, in this illustrated example structure 400, one or more elastic bands 406 are provided to wrap around the wearer's foot (*e.g.*, across the plantar surface and/or the instep portion of the foot) to at least partially secure the footbed structure 400 to the wearer's foot (optionally through a sock or other article of clothing 410). Of course, elastic bands 406 of the types illustrated in Fig. 4 may be provided in any desired sizes, in any desired shapes, and/or at any desired locations without departing from the invention. Additionally or alternatively, if desired, an elastic band or strap or other engaging system may be provided at the heel area (*e.g.*, to extend around the wearer's heel) to help keep the footbed structure 400 in place with respect to the heel. Also, insertion of the footbed structure 400 into an article of footwear (not shown) may be relied upon, if desired, to help hold the footbed structure 400 in place with respect to the wearer's foot. As still another alternative, if desired, the footbed structure 400 could be inserted into the interior chamber of the article of clothing 410 without departing from this invention (in that event, separate engaging means, such as elastic straps 406, may be unnecessary, although some engaging means still may be provided, if desired, to help keep the footbed structure 400 in place with respect to the wearer's foot).

[0032] A wide variety of structures or systems may be used as means for holding the footbed structure 400 in place (*e.g.*, with respect to a foot, article of clothing, or article of footwear) without departing from this invention.

For example, the footbed structure 400 may be held in place by hook-and-loop fasteners, snaps, straps, buckles, retaining grooves, other retaining structures, or other mechanical connector or fastener arrangements. As additional examples, the footbed structure 400 may be held in place by wrapping another element around both the footbed structure 400 and the article to which it is to be attached. This wrapping element may be an elastic bandage, tape or other adhesive, an additional sock member or article of clothing, etc. Adhesives also may be used to secure the footbed 400 to another article. Any desired manner of securing the footbed structure 400 with an article of clothing 410 or any other structure or member, including directly to a user's foot, may be used without departing from this invention.

[0033] While the specific example illustrated in Fig. 4 illustrates the footbed structure 400 engaged with an article of clothing 410, those skilled in the art will appreciate that it may be engaged with an article of footwear without departing from this invention. If desired, a means for securing the footbed structure 400 in place with respect to the article of footwear may be provided without departing from this invention. As more specific examples, hook-and-loop fasteners, snaps, straps, buckles, retaining grooves, other retaining structures, or other mechanical connector or fastener arrangements may be used; wrapping elements, such as an elastic bandage, tape or other adhesive, an additional sock member or article of clothing may be used; adhesives or cements may be used; etc.

[0034] Footbeds in accordance with some examples of this invention (*e.g.*, as separate elements, integrally formed with an article of footwear, integrally formed with an article of clothing, etc.) may be used in any desired manner without departing from the invention. Once provided in direct or indirect contact with the plantar surface of a wearer's foot in any desired manner (*e.g.*, by donning a sock or other article of clothing including the footbed, by donning an article of footwear or other foot-receiving device including the footbed, etc.), the wearer may walk, run, or otherwise conduct ambulatory activity with the textured surface of the footbed in contact (directly or indirectly) with the plantar surface of the foot. Stimulation of the wearer's foot via the textured surface induces motion control and/or changes the motion, kinematics, and/or kinetics associated with lower extremities in various ways, as will be described in more detail below.

[0035] The various example structures described above typically included footbed component pairs in which the left footbed component was a mirror image of the right footbed component. Of course, this is not a requirement. If desired, the footbed components of a pair may differ in texture element structures, arrangements, patterns, locations, numbers, etc. without departing from the invention, *e.g.*, depending on specific uses, gait issues being addressed, etc. In fact, if desired, one footbed component of a pair need not include any texturing.

B. Experimental Results

[0036] Various kinematic and kinetic experiments were conducted on the effects of changing sensory input to the plantar surface of a user's foot using textured footbed structures, *e.g.* , of the types illustrated in Figs. 1B and 1C.

1. Examining the Effects of Changing Sensory Input to Feet While Walking

[0037] This experiment examined changes in walking kinematics of various test subjects as a result of the presence of selectively textured footbeds of the types illustrated in Figs. 1B and 1C. In this experiment, 12 subjects (8 males and 4 females - mean height = 5'9", mean weight = 161 lb., shoe size 9M) were tested while walking along a 50 meter indoor pathway at a cadence of approximately 108 steps/minute. The subjects wore, at different times, a smooth (non-textured) sock-liner of the type illustrated in Fig. 1A as a control, as well as a pair of medially textured sock-liners of the type illustrated in Fig. 1B and a pair of laterally textured sock-liners of the type illustrated in Fig. 1C (the interventions were applied bilaterally, in a random order). In this experiment, the insoles or sock-liners were worn barefoot (*i.e.,* without shoes - the subjects wore nylon stockings), and an athletic wrap held the insole or sock liner to the subjects' feet. The term "textured," as used herein, means that the textures at the plantar contact surface were strong enough to elicit an immediate conscious awareness to the wearing subject but not reported to be painful.

[0038] A motion analysis system (240 Hz) and a Kistler force plate (1000 Hz) were used to monitor and capture data in these walking tests. Specifically, ankle joint kinematics (inversion, eversion, plantarflexion, dorsiflexion, tibial rotation, etc.) and vertical ground reaction forces were evaluated.

[0039] In these tests, some significant differences in rearfoot motion were observed in users while wearing the different footbed elements. For example, as illustrated in Figs. 5A, 6A, and 6B, the maximum eversion level experienced by wearers was significantly lower with the medially textured insole components as compared to the control (non-textured) and laterally textured insole components. More specifically, Fig. 5A provides "box plots" of Maximum Eversion Levels (based on Rearfoot Angle Measurements) during the ground contact phase while walking for the collection of subjects wearing the various insole structures (in these and other similar figures, unless otherwise noted, mean values are shown as a plus sign, with standard errors defining the height of the box, and the standard deviation range defined by the solid lines extending from the boxes). Fig. 5B provides box plots of Rearfoot Range of Motion measurements (rearfoot movement from touchdown to the point of maximum eversion) during the ground contact phase while walking for the collection of subjects wearing the various insole

structures. Figs. 6A and 6B illustrate mean "Rearfoot Motion" graphs for two of the subjects while wearing each of the three insole structures. The graphs of Figs. 6A and 6B (as well as other similar graphs included in the figures, unless otherwise noted) have been normalized in time from touchdown (at time t = 0) to takeoff (at time t = 1.0) during the ground contact phase.

[0040] As evident from these charts and graphs, the maximum eversion (the overall minimum point in Figs. 6A and 6B) was smaller for the medially textured insole samples as compared with the "non-textured" control samples, but the maximum eversion generally was smaller for the control samples than it was for the laterally textured insole samples (although this latter difference was not found to be statistically significant and may be due to the limited range of eversion motion at the ankle joint when walking). Overall rearfoot range of motion (rearfoot movement from touchdown to the point of maximum eversion) was significantly lower for the medially textured insole components as compared to the other two conditions. While the laterally textured insole components generally resulted in a higher range of motion than the non-textured control condition, this difference was not found to be statistically significant. No significant differences in inversion angles at touchdown were observed between the three test conditions (note Figs. 6A and 6B at time t = 0)

[0041] The collected data also indicated that the maximum amount of inversion that occurs late in the ground contact phase (toward time t = 1) was significantly higher for the medially textured insole structures as compared to the laterally textured insole structures. Eversion velocity was found to be significantly faster for the laterally textured insole structures when compared to both the medially textured insole structures and the non-textured insole structures. No significant differences in maximum inversion velocity toward the end of the stance phase were observed in these test subjects.

[0042] Studies also were conducted regarding the effects of use of the various selectively textured footbed structures on tibial motion while walking. The motion of the tibia is coupled with motion of the subtalar joint, and it generally would be expected that differences in rearfoot motion were reflected by differences in rotation of the tibia during the ground contact phase. However, as illustrated in Fig. 7 (which shows mean tibial rotation curves for a representative subject during ground contact using the three different footbed components), no significant differences were found in: (a) tibial rotation at foot strike (time t = 0), maximum internal rotation (the peak below the graph's abscissa), or maximum external rotation of the tibia (the peak above the graph's abscissa). This is not to suggest, however, that for some subjects, tibial rotation will not be affected by the use of textured shoe inserts, socks, sock-liners, or other textured footbed products in accordance with examples of this invention.

[0043] Other kinematic differences were observed depending on the structure of the insole components worn. For example, when the wearer's foot left the ground at the end of ground contact, subjects tended to have less plantarflexion while wearing the medially textured insole components as compared to when they were wearing the laterally textured insole components. This result may suggest that subjects were not pushing off the same way when wearing the different footbed components. No significant differences in sagittal plane ankle angles (*e.g.*, plantarflexion, dorsiflexion, etc.) at touchdown were observed in the subjects during this walking study.

[0044] Further differences were observed in the ground reaction forces experienced by wearers depending on the type of selectively textured footbed structure they were wearing. For example, the peak vertical loading rate experienced by wearers was observed to be significantly lower using the laterally textured insole components as compared to the control components (no significant differences in vertical loading rates were observed between use of the medially textured components and the control components). Recalling that the lateral heel generally is a wearer's first point of contact with the ground during a walking step, these results suggest that when a texture is placed under the lateral heel, some form of compensation occurs to alter the wearer's lower extremity motion and to reduce the loading rates during initial ground contact. It may be that increased eversion velocities observed during this time frame with the laterally textured footbed components helped to reduce the vertical loading rates.

[0045] These experimental results demonstrated that rearfoot motion can be influenced by altering sensory input to the plantar surface of the foot while walking. Additionally, as demonstrated by these tests, rearfoot motion can be modified without conventional mechanical interventions, such as wedges, dual density foams, or other prophylactics.

[0046] In general, the addition of texture to specific regions under the foot caused the foot to move away from the areas of increased sensory input. While wearing medially textured footbed components, subjects had significant reductions in rearfoot eversion (pronation). This may have been due to a conscious or subconscious attempt to keep the food from loading the medial portion of the shoe insert. Although not significant, a similar trend was seen as subjects tended to evert more when the lateral side of the shoe insert was textured.

[0047] Further support for this theory comes from the fact that subjects generally were more inverted (supinated) at the end of the stance phase while wearing the medially textured footbed components. Also, eversion velocity was significantly faster for subjects while wearing the laterally textured footbed components. As the lateral part of the foot generally is the first point of ground contact, this result may have been an attempt at moving away from the texture to load the medial side of the foot.

[0048] Influencing human motion with sensory inputs with the plantar surface of the foot, *e.g.,* in the manners described above, may have applications in a number of

products. For example, shoes (or insoles for shoes or other products, *e.g.*, like those described above) could be provided that supplement current motion control technologies using - textures to help limit excessive pronation. As another example, a manufacturer, health care provider, wearer, or other may consider the effects of adding textures to the lateral edge of basketball or other athletic footwear (*e.g.*, by including laterally textured insoles or sock-liners) to improve stability, *e.g.*, in cutting movements, when rapidly changing directions, starting, or stopping, etc.

2. Examining the Effects of Changing Sensory Input to Feet While Running

[0049] This experiment examined changes in running kinematics and kinetics of various test subjects as a result of the presence of selectively textured footbeds of the types illustrated in Figs. 1B and 1C. In this experiment, 11 subjects (7 males and 4 females - mean height = 5'9", mean weight = 161 lb., shoe size 9M) were tested while running along a 50 meter indoor pathway at a speed of 7.5 minutes per mile (±5%). The subjects wore, at different times, Air Pegasus running shoes (commercially available from NIKE, Inc. of Beaverton, Oregon, U.S.A) with insoles of the various types illustrated in Figs. 1A through 1C (the interventions were applied bilaterally, in a random order). Again, the term "textured," as used herein, means that the textures at the plantar contact surface were strong enough to elicit an immediate conscious awareness to the wearing subject but not reported to be painful.

[0050] A motion analysis system (240 Hz) and a Kistler force plate (1000 Hz) were used to monitor and capture data in these running tests. Specifically, ankle and knee joint kinematics and kinetics and vertical ground reaction forces were evaluated.

[0051] Various differences in rearfoot motion were observed under the various different test conditions. Fig. 8A contains box plots (mean, standard error, and standard deviation, as described above) showing mean rearfoot inversion angles at touchdown for the collection of test subjects under the three sets of test conditions, and Fig. 8B contains box plots showing mean eversion range of motion data for the collection of subjects under the three sets of test conditions. Figs. 9A and 9B illustrate mean rearfoot inversion/eversion graphs for two representative subjects running using the three footbed insert conditions.

[0052] As observable from the data contained in Figs. 8A, 9A, and 9B, subjects tended to be less inverted at heel strike while wearing the medially textured footbed components as compared to the other two shoe conditions. No significant differences in inversion angle at heel strike were observed between the laterally textured and smooth footbed conditions. Also, no significant differences were found in maximum eversion angle during the ground contact phase when using the various footbed components.

[0053] The eversion range of motion (rearfoot motion from touchdown (t = 0) to the point of maximum eversion) was significantly less for the medially textured footbed components as compared to the other two conditions. This difference may be due, at least in part, to the aforementioned differences in inversion at heel strike. At the end of the stance phase (toward time t = 1), subjects tended to be significantly less inverted when using the medially textured insole member as compared to the other two conditions.

[0054] Eversion velocity data also was evaluated during these tests. Maximum eversion velocity tended to be significantly slower during use of the medially textured footbed components as compared to both the laterally textured and non-textured conditions. The maximum eversion velocity collected during this test is summarized in Fig. 10, which illustrates box plots showing the mean eversion velocity while running with the three shoe insert conditions. Additionally, these tests revealed that using the laterally textured footbed components resulted in significantly faster peak eversion velocities than the non-textured conditions.

[0055] Tibial rotation data also was observed and collected during these experiments, and some of this collected data is summarized and/or illustrated in Figs. 11A, 11B, 12A, and 12B. Figs. 11A and 11B provide box plots illustrating mean peak internal tibial rotation (Fig. 11A) and external tibial rotation at takeoff (Fig. 11B) for the collected subjects under the various test conditions. Figs. 12A and 12B illustrate mean tibial rotation graphs with respect to time (normalized, as described above) for two representative subjects while running in the three insert conditions.

[0056] From these tests, no significant differences in tibial rotation at heel strike were noted between the three different footbed conditions. Maximum internal tibial rotation was significantly lower for the medially textured footbed condition as compared to the control condition. Conversely, peak internal tibial rotation was significantly greater for the laterally textured footbed condition as compared to the control and the medially textured conditions. Note Figs. 11A, 12A, and 12B. At takeoff, significantly greater external tibial rotation was observed while wearing the medially textured footbed components as compared to both of the other footbed conditions. Note Figs. 11B, 12A, and 12B.

[0057] The effects of the different test footbed conditions on the ankle joint also were evaluated during these experiments. Figs. 13A and 13B illustrate and summarize a portion of the collected data. More specifically, Fig. 13A provides box plots showing mean peak ankle plantarflexor moments while running using the three footbed test conditions. Fig. 13B illustrates mean sagittal plane ankle moments observed for one representative subject running under the three different test conditions. No significant differences in peak abduction or adduction moments or inversion or eversion moments at the ankle joint

were observed while running using the different footbed conditions. However, a small but significant reduction in peak plantar-flexor moments at the ankle joint was observed for users wearing the laterally textured footbed inserts as compared to the other two inserts.

[0058] The effects of the different test footbed conditions on the knee joint also were evaluated. Figs. 14A and 14B illustrate and summarize a portion of the collected data. More specifically, Fig. 14A provides box plots showing the mean peak knee abduction moments while running using the three footbed test conditions. Fig. 14B illustrates mean knee abduction moments observed for one representative subject running under the three test conditions. This testing showed that peak internal rotation moments were significantly lower when using the laterally textured footbed members as compared to the medially textured footbed members. Also, peak abduction moments at the knee were found to be significantly lower when using the laterally textured footbed members as compared with the other two footbed conditions. No significant differences were observed in the peak flexion moments at the knee.

[0059] The effects of the use of the various footbed conditions on vertical ground reaction forces while running also were evaluated during these tests. No significant differences in vertical impact peak were observed while running under the different footbed test conditions. However, a general reduction in impact peak was observed with the laterally textured footbed components as compared to the medially textured footbed components ($p = 0.11$). Peak vertical loading rates were found to be significantly lower while running using the laterally textured footbed components as compared to the medially textured footbed components. A similar trend was seen when comparing the laterally textured condition to the control (smooth) condition ($p = 0.12$). These findings may be related, at least in part, to the increased eversion velocities found while wearing the laterally textured footbeds. Also, a small, but significant increase in peak active ground reaction forces was observed when running with the medially textured footbed components as compared to the other two conditions.

[0060] Various observations can be made and/or conclusions can be drawn from the above test results. For example, as noted from the walking tests described above, stimulating the medial side of the plantar foot with textured materials tended to reduced eversion (or pronation) of the foot. In the running study, however, maximum eversion was not found to be affected during running with the textured insoles (although differences in rearfoot motion were observed during the running test, particularly at the beginning and end of stance or ground contact phase).

[0061] The slower eversion velocities observed during the running tests with the medially textured footbeds and the faster eversion velocities observed with the laterally textured footbeds support the hypothesis that the foot will attempt to limit the degree of loading on the textured surfaces. This finding, however, together with the results from the vertical ground reaction forces, is different than results typically found during running studies (typically, faster eversion velocities are associated with higher vertical loading rates). In this present running study, controlling eversion may have been associated with a motor pattern aimed at limiting loading the lateral textured areas of the foot. In other running studies, higher eversion rates may be considered a mechanical effect caused by the material properties of the midsole in the lateral heel of some running shoes.

[0062] Many observers believe that knee pain in runners, in at least some instances, may be a result of excessive internal rotation of the tibia during the ground contact phase of running. Because of strong coupling at the subtalar joint, the most common method of controlling tibial rotation is to limit eversion of the foot. Although definite reductions in eversion were not found during these tests, the present running tests indicated that the medially textured footbed did help limit internal rotation of the tibia. Conversely, these test results indicated that the laterally textured footbed conditions increased maximum internal rotation of the tibia. This knowledge provides a design for running shoes, intended to alleviate knee pain, *e.g.*, by providing a footbed, sock-liner, or insole in the shoes including medial texturing (or otherwise providing a medially textured footbed component).

[0063] It has been known for some time that lateral wedges under the foot can be used to reduce abductor moments at the knee and alleviate chronic knee pain associated with osteoarthritis. The present testing, however, demonstrates that these same motion control results can be achieved without a mechanical intervention underfoot. These facts lead to a footwear design for arthritic patients or others that includes laterally textured footbeds, sock-liners, insole members or other laterally textured structures.

[0064] These tests demonstrate that selectively textured footbeds for articles of footwear, clothing, and/or other foot-receiving devices also may be used to supplement current motion control technologies, such as dual density foams, foot bridges, midsole constructions, etc. Textured footbeds also may be added to specific and selective anatomical regions under foot in an attempt to improve dynamic stability in sports, such as in tennis or basketball shoes (*e.g.*, by providing laterally textured insole members for use in shoes for activities where rapid direction changes, cuts, quick lateral starts and stops, etc. are made).

[0065] While the results of these studies and the above remarks are based on the collected data, as described above, those skilled in the art will understand and appreciate that this data may not be 100% representative of everyone in a population. There may be "subject specific" responses to the textured elements that may indicate the need for tailoring the specific "feel" and/or location of the texturing when applied to a foot to obtain the desired results. Such tailoring may be accomplished through rou-

tine experimentation.

C. Additional Example Products According to the Invention

[0066] A wide variety of arrangements of texturing may be provided in footbed products without departing from the invention (*e.g.*, footbed products may be included as part of articles of footwear, such as insole members, sock-liners, interior bootie members, etc., and/or as part of other foot-receiving devices and/or articles of clothing that contain the foot (*e.g.*, socks, stockings, pajamas, pantyhose, etc.).

[0067] Figs. 15A through 15N illustrate various example arrangements of footbeds 1500 that include texturing elements at various locations or regions. In the footbed 1500 of Fig. 15A, the texturing elements are provided in the medial forefoot portion of the footbed 1500. In the footbed 1500 of Fig. 15B, the texturing elements are provided in the lateral forefoot portion of the footbed 1500. In the footbed 1500 of Fig. 15C, the texturing elements are provided in the medial midfoot or arch portion of the footbed 1500. In the footbed 1500 of Fig. 15D, the texturing elements are provided in the lateral midfoot or arch portion of the footbed 1500. In the footbed 1500 of Fig. 15E, the texturing elements are provided in the medial heel or rearfoot portion of the footbed 1500. In the footbed 1500 of Fig. 15F, the texturing elements are provided in the lateral heel or rearfoot portion of the footbed 1500. In the footbed 1500 of Fig. 15G, the texturing elements are provided in the medial heel and arch portions of the footbed 1500. In the footbed 1500 of Fig. 15H, the texturing elements are provided in the lateral heel and arch portions of the footbed 1500. In the footbed 1500 of Fig. 15I, the texturing elements are provided in the medial heel and forefoot portions of the footbed 1500 (with a smooth medial midfoot portion). In the footbed 1500 of Fig. 15J, the texturing elements are provided in the lateral heel and forefoot portions of the footbed 1500 (with a smooth medial midfoot portion). In the footbed 1500 of Fig. 15K, the texturing elements are provided in the medial arch and forefoot portions of the footbed 1500. In the footbed 1500 of Fig. 15L, the texturing elements are provided in the lateral arch and forefoot portions of the footbed 1500.

[0068] Figs. 15M and 15N illustrate examples of footbed arrangements 1500 in which some texturing elements are provided on both the lateral and medial sides of the footbed 1500, although at least one side (*e.g.*, the medial or lateral) of the footbed is predominantly smooth (or even substantially smooth) and the opposite side is predominantly textured (or even substantially textured). The features of Figs. 15M and 15N (including some texturing on both sides of the footbed 1500) also may be used in conjunction with any of the example footbed structures described above.

[0069] Of course, wide variations in combinations of textured area patterns, locations, regions, structures, and the like may be used without departing from this invention. Also, while Figs. 15A through 15N generally show the left and right footbeds as mirror images of one another, this is not a requirement. Rather, if desired, different texturing patterns, locations, regions, structures, and the like may be provided on one footbed of a pair as compared to the other. Also, if desired, one footbed of a pair may contain no texturing while the other footbed contains texturing.

III. Conclusion

[0070] While the invention has been described with respect to specific examples including presently preferred modes of carrying out the invention, those skilled in the art will appreciate that there are numerous variations and permutations of the above described systems and methods. For example various aspects of the invention may be used in different combinations and various different subcombinations of aspects of the invention may be used together in a single system or method without departing from the invention. Also, various method steps described above may be changed, changed in order, omitted, and/or additional steps may be added without departing from this invention. Thus, the invention should be construed broadly as set forth in the appended claims.

Claims

1. A footbed (120), comprising:

a first major surface (152) for engaging all of a plantar surface of a user's foot, the first major surface including a lateral half (124) and a medial half (122); a second major surface opposite the first major surface, the second major surface including a lateral half and a medial half; and
plural texturing members (150) on at least a predominant portion of the medial half;
wherein the lateral half is smooth and untextured such that when a plantar surface of a user's foot applies a substantially vertical force to the footbed, the lateral half feels smooth at the plantar surface and at least a predominant portion of the medial half feels textured at the plantar surface.

2. A footbed (120) according to claim 1, wherein the footbed constitutes an insole member.

3. A footbed (120) according to claim 1, wherein the footbed constitutes a sock liner.

4. A footbed (120) according to claim 1, wherein at least 80% of the medial half (124) feels textured at the plantar surface.

5. A method of affecting kinematics or kinetics during ambulatory activities, comprising:

providing a footbed (120) for engaging a plantar surface of a user's foot, wherein the lateral half (124) is smooth and untextured and at least a predominant portion of the medial half (122) of the footbed includes plural raised elements (150) defining a textured surface; and
performing an ambulatory activity while having the plantar surface of the user's foot engaged with the footbed.

6. A method according to claim 5, wherein the performing includes:

(1) walking, wherein pronation is increased during the walking as compared with walking on a completely smooth or non-textured footbed;
(2) walking, wherein a maximum amount of eversion is increased during the walking as compared with walking on a completely smooth or non-textured footbed;
(3) walking, wherein a rearfoot range of motion is increased during the walking as compared with walking on a completely smooth or non-textured footbed;
(4) walking, wherein an eversion velocity is increased during the walking as compared with walking on a completely smooth or non-textured footbed;
(5) running, wherein an eversion velocity is increased during the running as compared with running with a completely smooth or non-textured footbed;
(6) walking, wherein a peak vertical loading rate is reduced during the walking as compared with walking on a completely smooth or non-textured footbed;
(7) running, wherein a user experiences greater peak internal tibial rotation as compared with running on a completely smooth or non-textured footbed;
(8) running, wherein a user's ankle experiences reduced plantar-flexor moments as compared with running on a completely smooth or non-textured footbed;
(9) running, wherein a user's knee experiences reduced peak internal knee rotation moments as compared with running on a completely smooth or non-textured footbed;
(10) running, wherein a user's knee experiences reduced peak abduction moments as compared with running on a completely smooth or non-textured footbed;
(11) running, wherein a user experiences reduced peak impact as compared with running on a completely smooth or non-textured footbed; or
(12) running, wherein a user experiences reduced peak vertical loading as compared with running on a completely smooth or non-textured footbed.

7. A method according to claim 5, wherein the providing includes providing an article of footwear (200) including the footbed (120), wherein preferably the footbed is included as part of:

(1) an insole member of the article of footwear; or
(2) a sock liner for the article of footwear.

8. A method according to claim 7, wherein the footbed (120) is integrally formed as part of a sole structure (204) of the article of footwear (200).

9. A method according to claim 5, wherein the providing includes providing an article of footwear (200) and inserting an independent structure including the footbed (120) into a foot-receiving chamber of the article of footwear.

10. A method according to claim 5, wherein the providing includes donning an article of clothing (300) including the footbed (120) integrally formed therein or engaged therewith, wherein preferably the article of clothing is a sock.

11. A method according to claim 5, wherein the providing includes donning an article of clothing (300) and engaging a separate element including the footbed (120) with the article of clothing.

12. A method of making an article of footwear (200), comprising:

engaging an upper member (202) with a sole structure (204); and
providing a footbed (120) for supporting a plantar surface of a user's foot with at least one of the upper member and the sole structure, wherein the lateral half (124) of the footbed is smooth and untextured and a predominant portion of the medial half (122) of the footbed includes plural raised elements (150) defining a textured surface.

13. A method according to claim 12, wherein the providing includes:

(1) providing the footbed (120) as at least part of an insole member; or
(2) providing the footbed as at least part of a sock liner.

14. A method according to claim 12, wherein:

(1) the footbed (120) is provided as a portion of the sole structure (204);
(2) the providing includes inserting a structure including the footbed (120) into a foot-receiving chamber defined by at least one of the upper member (202) or the sole structure (204); or
(3) the footbed (120) is sized so as to substantially correspond to a foot-engaging surface of the article of footwear (200), wherein preferably the textured surface substantially covers the medial half of the footbed.

15. An article of footwear (200), comprising:

an upper member (202);
a sole structure (204) engaged with the upper member; and
a footbed (120) according to any one of claims 1 to 4.

Patentansprüche

1. Fußbett (120), welches aufweist:

eine erste große Oberfläche (152) zum Zusammengreifen mit einer gesamten Fußsohlenfläche eines Fußes eines Benutzers, wobei die erste große Oberfläche eine laterale Hälfte (124) und eine mediale Hälfte (122) aufweist;
eine zweite große Oberfläche gegenüber der ersten großen Oberfläche, wobei die zweite große Oberfläche eine laterale Hälfte und eine mediale Hälfte aufweist; und
mehrere Strukturierungsglieder (150) mindestens auf einem Hauptabschnitt der medialen Hälfte;
wobei die laterale Hälfte in der Weise glatt und unstrukturiert ist, dass, wenn eine Fußsohlenfläche eines Fußes eines Benutzers eine im Wesentlichen vertikale Kraft auf das Fußbett anwendet, die laterale Hälfte sich an der Fußsohlenfläche glatt anfühlt und mindestens ein Hauptabschnitt der medialen Hälfte sich an der Fußsohlenfläche strukturiert anfühlt.

2. Fußbett (120) gemäß Anspruch 1, bei dem das Fußbett ein Innensohlenglied bildet.

3. Fußbett (120) gemäß Anspruch 1, bei dem das Fußbett eine Einlegesohle bildet.

4. Fußbett (120) gemäß Anspruch 1, bei dem mindestens 80% der medialen Hälfte (124) sich an der Fußsohlenfläche strukturiert anfühlen.

5. Verfahren zum Beeinflussen von Kinematik oder Kinetik während Gangaktivitäten, umfassend:

Bereitstellung eines Fußbetts (120) zum Zusammengreifen mit einer Fußsohlenfläche eines Fußes eines Benutzers, wobei die laterale Hälfte (124) glatt und unstrukturiert ist und mindestens ein Hauptabschnitt der medialen Hälfte (122) des Fußbetts mehrere erhöhte Elemente (150) aufweist, die eine strukturierte Oberfläche bestimmen; und
Durchführung einer Gangaktivität, während die Fußsohlenfläche des Fußes des Benutzers mit dem Fußbett zusammengreift.

6. Verfahren gemäß Anspruch 5, bei dem die Durchführung aufweist:

(1) Gehen, wobei die Pronation während des Gehens, verglichen mit dem Gehen auf einem vollkommen glatten oder nichtstrukturierten Fußbett, erhöht ist;
(2) Gehen, wobei ein maximaler Eversionsbetrag während des Gehens, verglichen mit dem Gehen auf einem vollkommen glatten oder nichtstrukturierten Fußbett, erhöht ist;
(3) Gehen, wobei ein Rückfuß-Bewegungsbereich während des Gehens, verglichen mit dem Gehen auf einem vollkommen glatten oder nichtstrukturierten Fußbett, erhöht ist;
(4) Gehen, wobei eine Eversionsgeschwindigkeit während des Gehens, verglichen mit dem Gehen auf einem vollkommen glatten oder nichtstrukturierten Fußbett, erhöht ist;
(5) Laufen, wobei eine Eversionsgeschwindigkeit während des Laufens, verglichen mit dem Laufen mit einem vollkommen glatten oder nichtstrukturierten Fußbett, erhöht ist;
(6) Gehen, wobei eine Spitzen-Vertikalbelastungsrate während des Gehens, verglichen mit dem Gehen auf einem vollkommen glatten oder nichtstrukturierten Fußbett, reduziert ist;
(7) Laufen, wobei ein Benutzer, verglichen mit dem Laufen auf einem vollkommen glatten oder nichtstrukturierten Fußbett, größerer interner Spitzen-Tibiarotation unterliegt;
(8) Laufen, wobei ein Knöchel eines Benutzers, verglichen mit dem Laufen auf einem vollkommen glatten oder nichtstrukturierten Fußbett, reduzierten Plantarflexionsmomenten unterliegt;
(9) Laufen, wobei ein Knie eines Benutzers, verglichen mit dem Laufen auf einem vollkommen glatten oder nichtstrukturierten Fußbett, reduzierten internen Spitzen-Kniedrehmomenten unterliegt;
(10) Laufen, wobei ein Knie eines Benutzers, verglichen mit dem Laufen auf einem vollkommen glatten oder nichtstrukturierten Fußbett, reduzierten Spitzen-Abduktionsmomenten unterliegt;
(11) Laufen, wobei ein Benutzer, verglichen mit

dem Laufen auf einem vollkommen glatten oder nichtstrukturierten Fußbett, reduziertem Spitzen-Aufprall unterliegt; oder
(12) Laufen, wobei ein Benutzer, verglichen mit dem Laufen auf einem vollkommen glatten oder nichtstrukturierten Fußbett, reduzierter Spitzen-Vertikalbelastung unterliegt.

7. Verfahren gemäß Anspruch 5, bei dem die Bereitstellung eine Bereitstellung eines Schuhwerkartikels (200) aufweist, der das Fußbett (120) aufweist, wobei das Fußbett bevorzugt als Teil

(1) eines Innensohlenglieds des Schuhwerkartikels oder
(2) einer Einlegesohle für den Schuhwerkartikel

enthalten ist.

8. Verfahren gemäß Anspruch 7, bei dem das Fußbett (120) integral als Teil einer Sohlenstruktur (204) des Schuhwerkartikels (200) gebildet ist.

9. Verfahren gemäß Anspruch 5, bei dem die Bereitstellung eine Bereitstellung eines Schuhwerkartikels (200) und ein Einführen einer unabhängigen Struktur, die das Fußbett (120) aufweist, in eine Fußaufnahmekammer des Schuhwerkartikels aufweist.

10. Verfahren gemäß Anspruch 5, bei dem die Bereitstellung aufweist, ein Kleidungsstück (300) anzuziehen, das das integral darin gebildete oder damit zusammengreifende Fußbett (120) aufweist, wobei das Kleidungsstück bevorzugt ein Strumpf ist.

11. Verfahren gemäß Anspruch 5, bei dem die Bereitstellung aufweist, ein Kleidungsstück (300) anzulegen und ein separates Element, das das Fußbett (120) aufweist, mit dem Kleidungsstück in Zusammengriff zu bringen.

12. Verfahren zur Herstellung ein Schuhwerkartikels (200), umfassend:

In-Zusammengriff-Bringen eines Oberteilglieds (202) mit einer Sohlenstruktur (204) und
Bereitstellung eines Fußbetts (120) zum Stützen einer Fußsohlenfläche eines Fußes eines Benutzers mit mindestens entweder dem Oberteilglied oder der Sohlenstruktur, wobei die laterale Hälfte (124) des Fußbetts glatt und unstrukturiert ist und ein Hauptabschnitt der medialen Hälfte (122) des Fußbetts mehrere erhöhte Elemente (150) aufweist, die eine strukturierte Oberfläche bestimmen.

13. Verfahren gemäß Anspruch 12, bei dem die Bereitstellung aufweist:

(1) Bereitstellung des Fußbetts (120) als mindestens Teil eines Innensohlenglieds; oder
(2) Bereitstellung des Fußbetts als mindestens Teil einer Einlegesohle.

14. Verfahren gemäß Anspruch 12, bei dem:

(1) das Fußbett (120) als Abschnitt der Sohlenstruktur (204) bereitgestellt wird;
(2) die Bereitstellung ein Einführen einer Struktur, die das Fußbett (120) aufweist, in eine Fußaufnahmekammer, die durch mindestens entweder das Oberteilglied (202) oder die Sohlenstruktur (204) bestimmt ist, aufweist; oder
(3) das Fußbett (120) so bemessen ist, dass es im Wesentlichen einer Fuß-Zusammengriff-Oberfläche des Schuhwerkartikels (200) entspricht, wobei die strukturierte Oberfläche bevorzugt im Wesentlichen die mediale Hälfte des Fußbetts bedeckt.

15. Schuhwerkartikel (200), welcher aufweist:

ein Oberteilglied (202);
eine Sohlenstruktur (204), die mit dem Oberteilglied zusammengreift; und
ein Fußbett (120) gemäß einem der Ansprüche 1 bis 4.

Revendications

1. Assise plantaire (120) comprenant :

une première surface principale (152) destinée à venir ne prise avec la totalité de la surface plantaire du pied d'un utilisateur, cette première surface principale ayant une moitié latérale (124) et une moitié médiane (122),
une seconde surface principale opposée à la première surface principale, cette seconde surface principale ayant une moitié latérale et une moitié médiane, et
plusieurs éléments de structuration (150) sur au moins la plus grande partie de la moitié médiane,
la moitié latérale étant lisse et non structurée de sorte que, lorsque la surface plantaire du pied d'un utilisateur applique une force essentiellement verticale sur l'assise plantaire, la moitié latérale soit ressentie comme lisse au niveau de la surface plantaire, et au moins la plus grande partie de la moitié médiane soit ressentie comme structurée au niveau de la surface plantaire.

2. Assise plantaire (120) conforme à la revendication 1, constituant un élément de première intérieure.

3. Assise plantaire (120) conforme à la revendication 1, constituant une doublure de chausson.

4. Assise plantaire (120) conforme à la revendication 1, dans laquelle au moins 80% de la moitié médiane (124) est ressentie comme structurée au niveau de la surface plantaire.

5. Procédé d'attribution de propriété cinématique ou cinétique pendant des activités de déplacement comprenant des étapes consistant à :

se procurer une assise plantaire (120) destinée à venir en prise avec la surface plantaire du pied d'un utilisateur, la moitié latérale (124) de l'assise plantaire étant lisse et non structurée et au moins la plus grande partie de la moitié médiane (122) de l'assise plantaire comprenant une série d'éléments en relief (150) définissant une surface structurée, et
exécuter une activité de déplacement alors que la surface plantaire du pied de l'utilisateur est en prise avec l'assise plantaire.

6. Procédé conforme à la revendication 5, selon lequel l'étape d'exécution d'une activité de déplacement comprend des étapes consistant à :

(1) marcher, la pronation étant augmentée au cours de la marche en comparaison avec le fait de marcher sur une assise plantaire totalement lisse et non structurée,
(2) marcher, le taux maximum d'éversion étant augmenté au cours de la marche en comparaison avec le fait de marcher sur une assise plantaire totalement lisse ou non structurée,
(3) marcher, la plage de mouvement de l'arrière du pied étant augmentée au cours de la marche en comparaison avec le fait de marcher sur une assise plantaire totalement lisse ou non structurée,
(4) marcher, la vitesse d'éversion étant augmentée au cours de la marche, en comparaison avec le fait de marcher sur une assise plantaire totalement lisse ou non structurée,
(5) courir, la vitesse d'éversion étant augmentée pendant la course en comparaison avec le fait de courir avec une assise plantaire totalement lisse ou non structurée,
(6) marcher, le taux de charge verticale maximum étant réduit au cours de la marche en comparaison avec le fait de marcher sur une assise plantaire totalement lisse ou non structurée,
(7) courir, l'utilisateur ressentant une rotation du tibia interne maximum supérieure en comparaison avec le fait de courir sur une assise plantaire totalement lisse ou non structurée,
(8) courir, la cheville de l'utilisateur ressentant des couples de flexion plantaire réduits en comparaison avec le fait de courir sur une assise plantaire totalement lisse ou non structurée,
(9) courir, le genou de l'utilisateur ressentant des couples de rotation du genou interne maximum réduits en comparaison avec le fait de courir sur une assise plantaire totalement lisse ou non structurée,
(10) courir, le genou de l'utilisateur ressentant des couples d'abduction maximum réduits en comparaison avec le fait de courir sur une assise plantaire totalement lisse ou non structurée,
(11) courir, l'utilisateur ressentant des chocs maximum réduits en comparaison avec le fait de courir sur une assise plantaire totalement lisse ou non structurée, ou
(12) courir, l'utilisateur ressentant des charges verticales maximum réduites par comparaison avec le fait de courir sur une assise plantaire totalement lisse ou non structurée.

7. Procédé conforme à la revendication 5, selon lequel l'étape consistant à se procurer une assise plantaire comprend une étape consistant à se procurer un article chaussant (200) comprenant l'assise plantaire (120), et de préférence, l'assise plantaire constitue une partie :

(1) d'un élément de première intérieure de l'article chaussant, ou
(2) une doublure de chausson de l'article chaussant.

8. Procédé conforme à la revendication 7, selon lequel l'assise plantaire (120) est formée intégralement en tant que partie de la structure de la semelle (204) de l'article chaussant (200).

9. Procédé conforme à la revendication 5, selon lequel l'étape consistant à se procurer une assise plantaire comporte des étapes consistant à se procurer un article chaussant (200) et à introduire une structure indépendante comprenant l'assise plantaire (120) dans la chambre de réception de pied de l'article chaussant.

10. Procédé conforme à la revendication 5, selon lequel l'étape consistant à se procurer une assise plantaire comprend une étape consistant à enfiler un article d'habillement (300) comprenant l'assise plantaire (120) intégralement formée dans celui-ci ou en prise avec celui-ci, l'article d'habillement étant de préférence un chausson.

11. Procédé conforme à la revendication 5, selon lequel l'étape consistant à se procurer une assise plantaire comprend des étapes consistant à enfiler un article d'habillement (300) et à mettre en prise un élément

séparé comprenant l'assise plantaire (120) avec l'article d'habillement.

12. Procédé de fabrication d'un article chaussant (200) comprenant des étapes consistant à :

mettre en prise un élément de tige (202) avec une structure de semelle (204), et
se procurer une assise plantaire (120) destinée à supporter la surface plantaire du pied de l'utilisateur avec l'élément de tige et/ou l'élément de semelle, la moitié latérale (124) de l'assise plantaire étant lisse et non structurée et la plus grande partie de la moitié médiane (122) de l'assise plantaire comprenant plusieurs éléments en relief (150) définissant une surface structurée.

13. Procédé conforme à la revendication 12, selon lequel l'étape consistant à se procurer une assise plantaire comprend des étapes consistant à :

(1) se procurer l'assise plantaire (120) sous la forme d'au moins une partie d'un élément de première intérieure, ou
(2) se procurer l'assise plantaire sous la forme d'au moins une partie d'une doublure de chausson.

14. Procédé conforme à la revendication 12, selon lequel :

(1) l'assise plantaire (120) est fournie sous la forme d'une partie de la structure de semelle (204),
(2) l'étape consistant à se procurer une assise plantaire comprend une étape consistant à introduire une structure comprenant l'assise plantaire (120) dans une chambre de réception d'un pied définie par l'élément de tige (202) et/ou la structure de semelle (204), ou
(3) l'assise plantaire (120) est dimensionnée pour correspondre essentiellement à la surface venant en prise avec le pied de l'article chaussant (200), et de préférence la surface structurée recouvre essentiellement la moitié médiane de l'assise plantaire.

15. Article chaussant (200) comprenant :

un élément de tige (202),
une structure de semelle (204) en prise avec l'élément de tige, et
une assise plantaire (120) conforme à l'une quelconque des revendications 1 à 4.

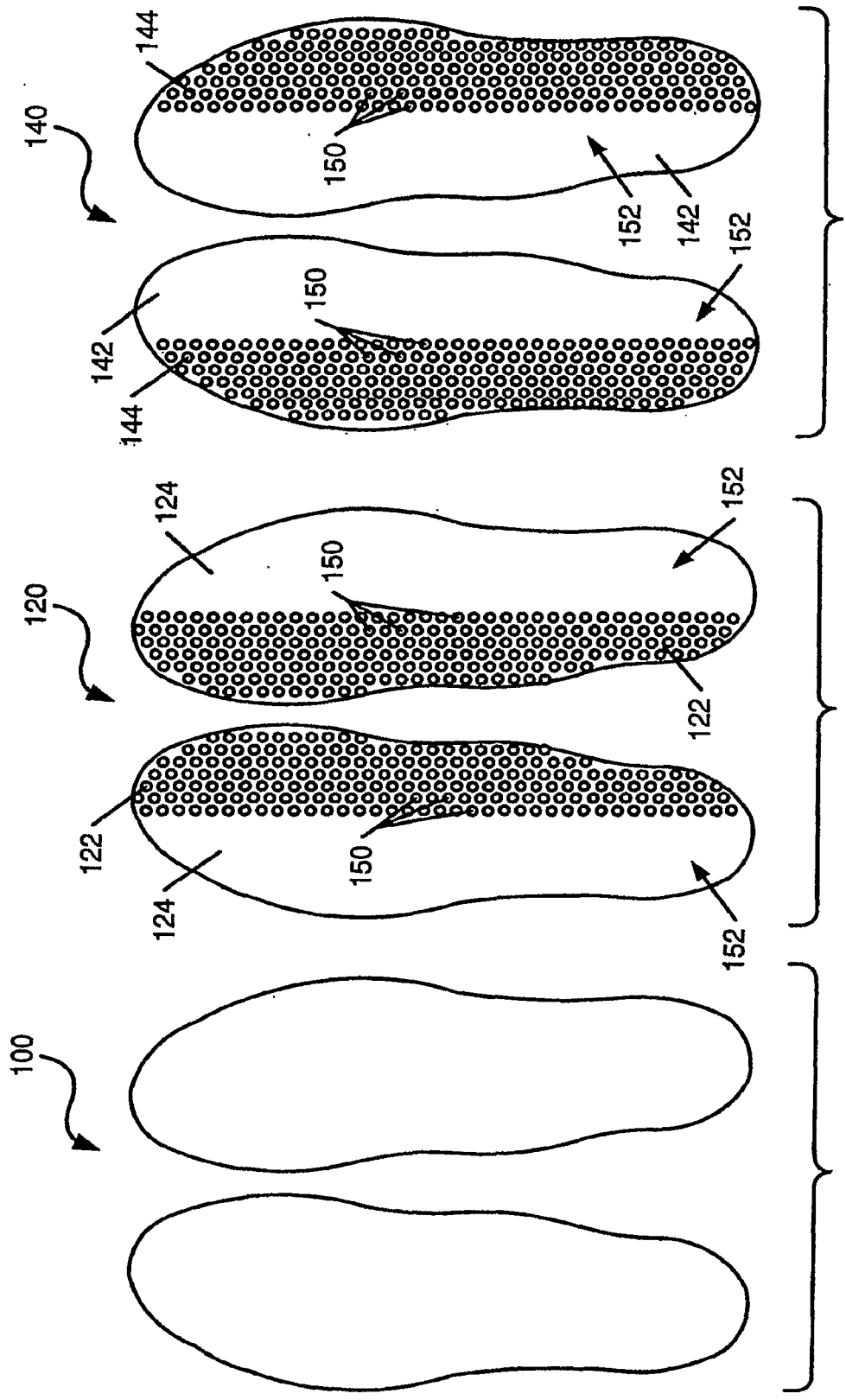

FIG. 1A FIG. 1B FIG. 1C

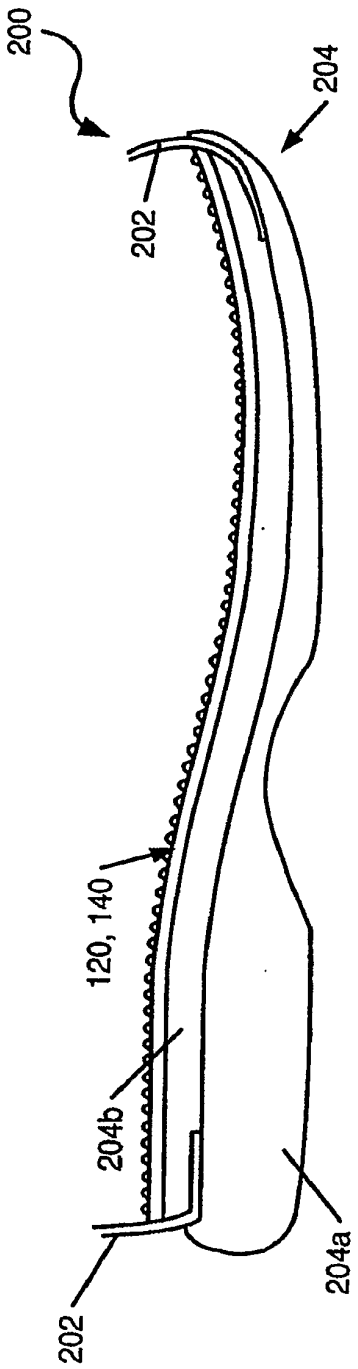

FIG. 2

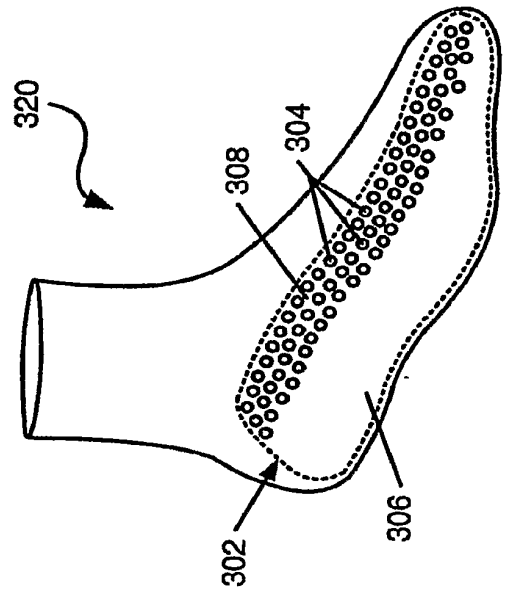

FIG. 3B

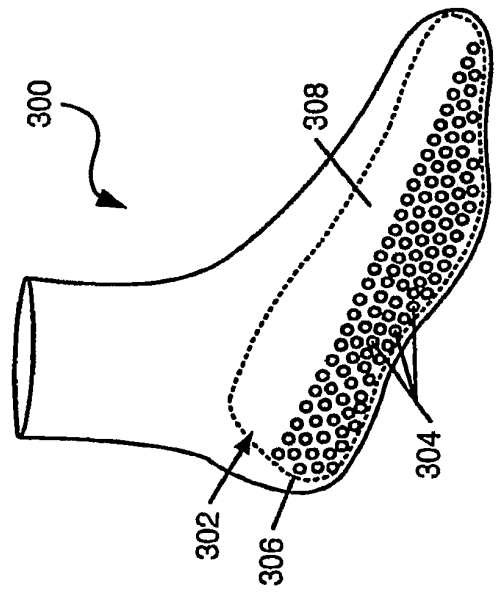

FIG. 3A

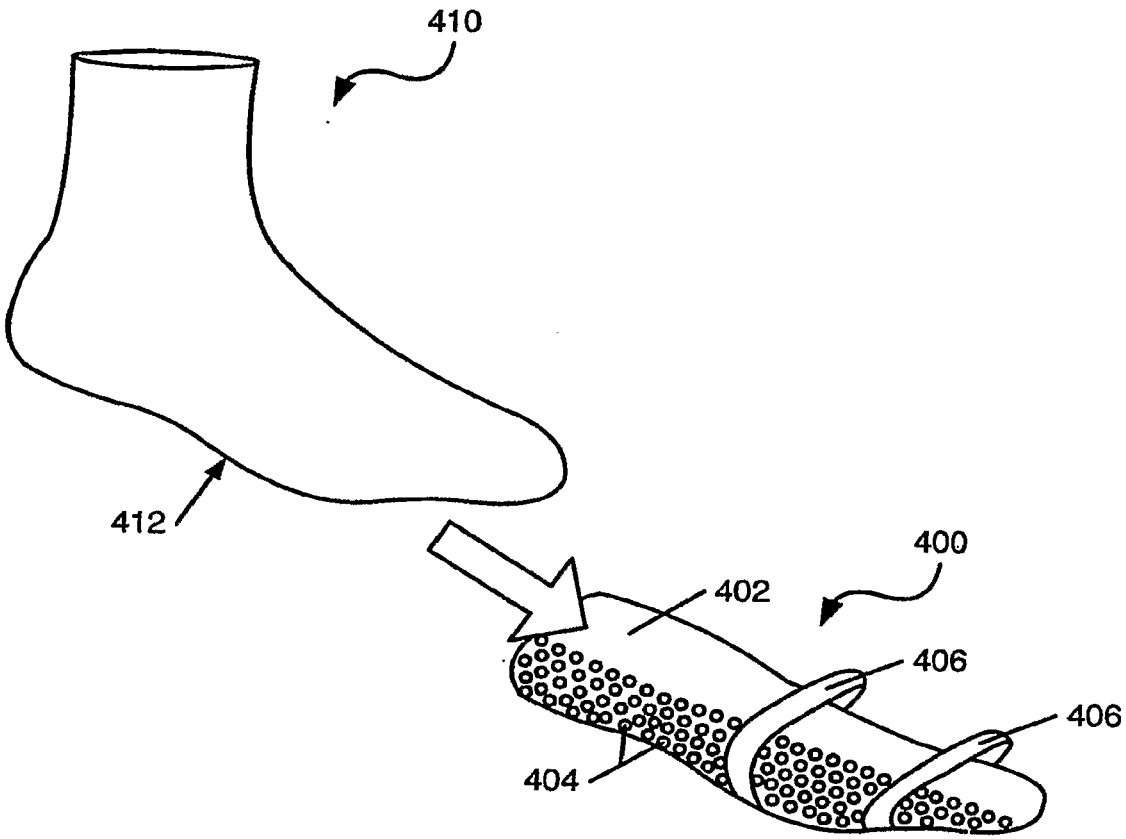

FIG. 4

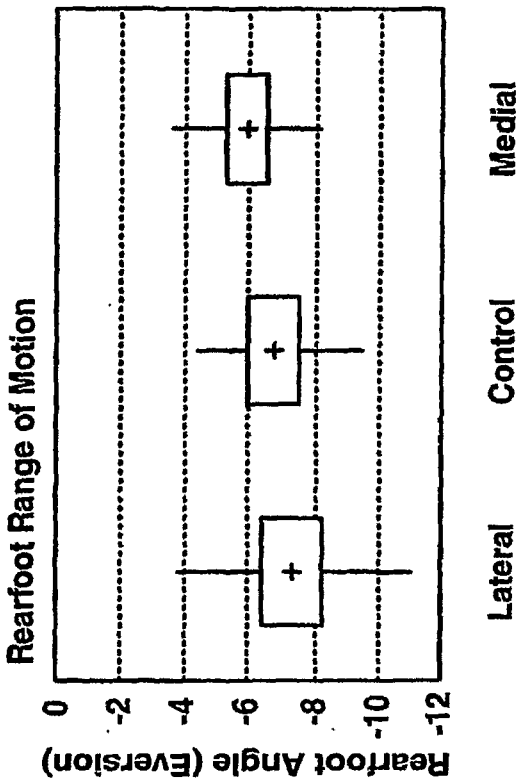
Rearfoot Range of Motion
Rearfoot Angle (Eversion)
0
-2
-4
-6
-8
-10
-12
Lateral
Control
Medial

FIG. 5B

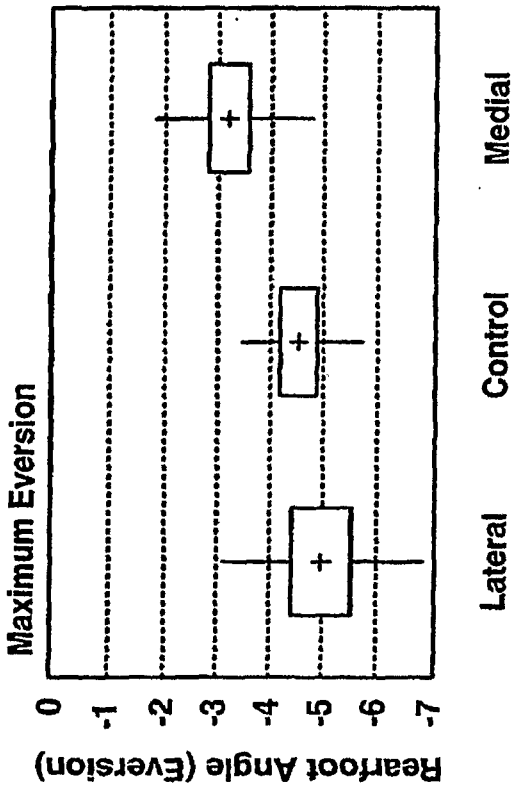
Maximum Eversion
Rearfoot Angle (Eversion)
0
-1
-2
-3
-4
-5
-6
-7
Lateral
Control
Medial

FIG. 5A

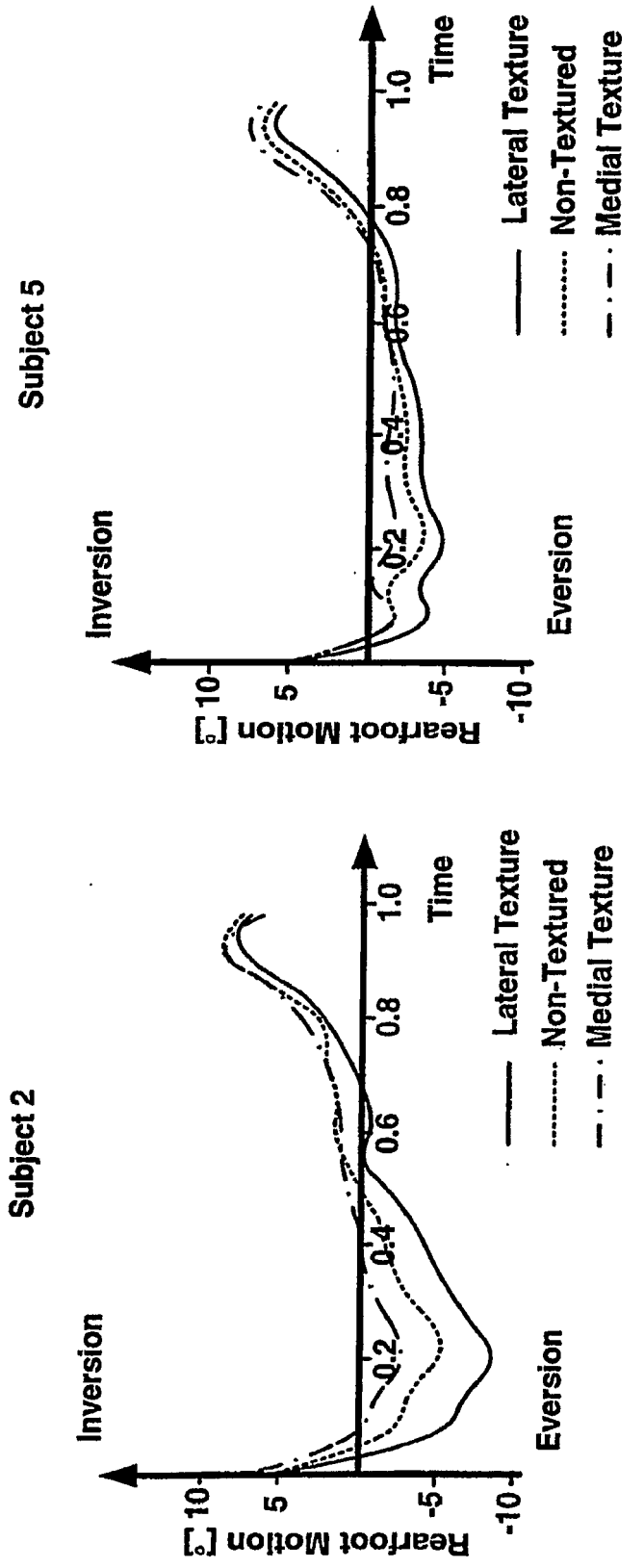
Subject 2
Inversion
Eversion
Rearfoot Motion [°]
10
5
-5
-10
0.2
0.4
0.6
0.8
1.0
Time
Lateral Texture
Non-Textured
Medial Texture

FIG. 6A

Subject 5
Inversion
Eversion
Rearfoot Motion [°]
10
5
-5
-10
0.2
0.4
0.6
0.8
1.0
Time
Lateral Texture
Non-Textured
Medial Texture

FIG. 6B

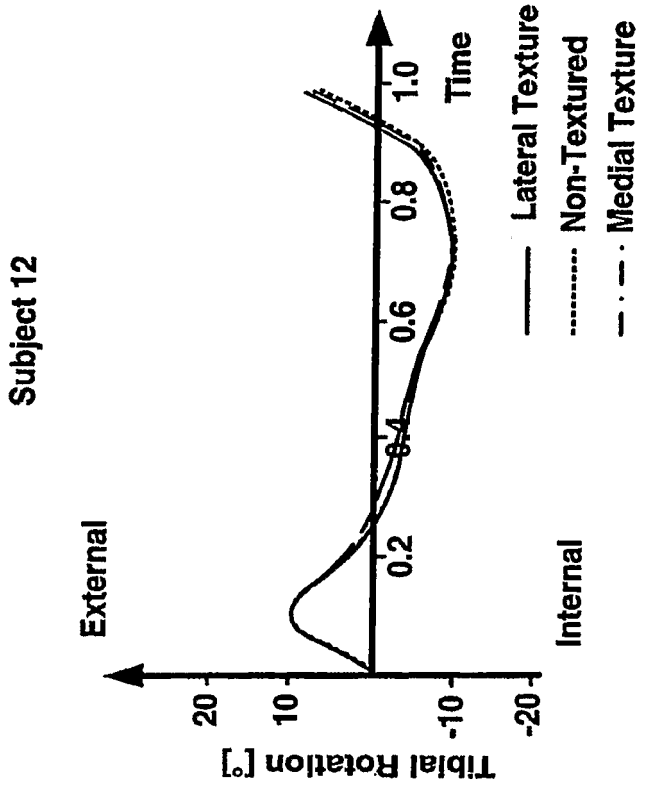
Subject 12
External
Internal
Tibial Rotation [°]
20
10
-10
-20
0.2
0.4
0.6
0.8
1.0
Time
Lateral Texture
Non-Textured
Medial Texture

FIG. 7

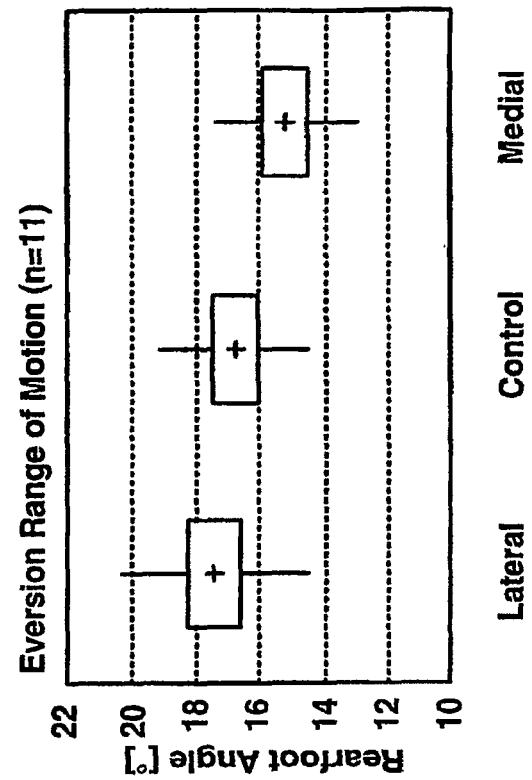
Eversion Range of Motion (n=11)
Rearfoot Angle [°]
22
20
18
16
14
12
10
Lateral
Control
Medial

FIG. 8B

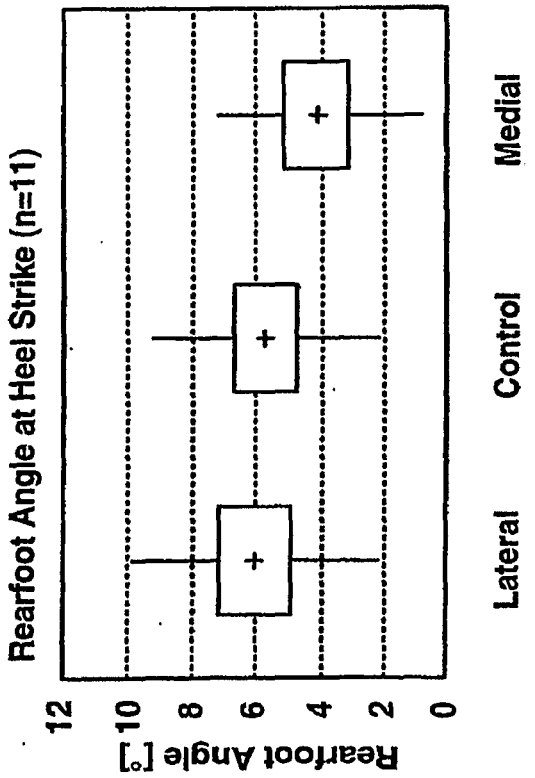
Rearfoot Angle at Heel Strike (n=11)
Rearfoot Angle [°]
12
10
8
6
4
2
0
Lateral
Control
Medial

FIG. 8A

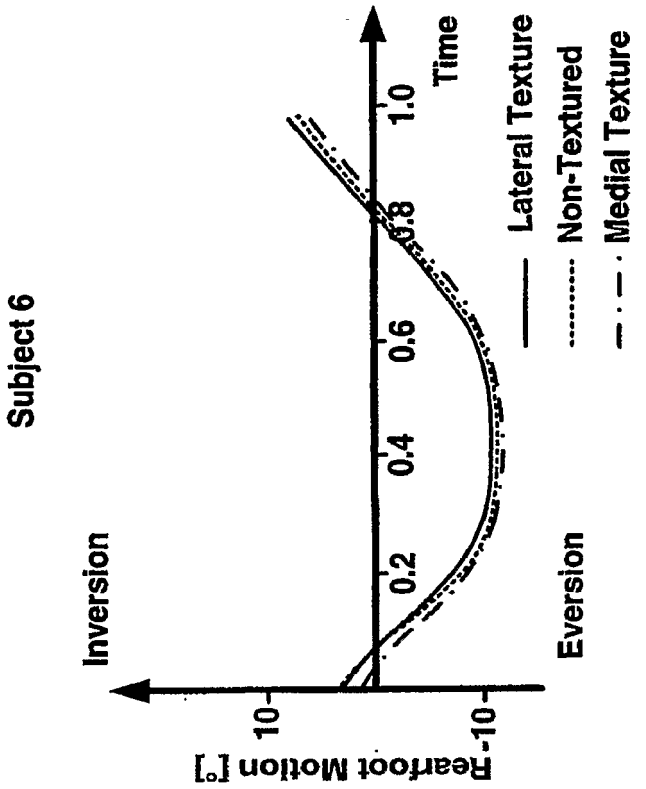
Subject 6
Inversion
Eversion
Rearfoot Motion [°]
10
-10
0.2
0.4
0.6
0.8
1.0
Time
Lateral Texture
Non-Textured
Medial Texture

FIG. 9B

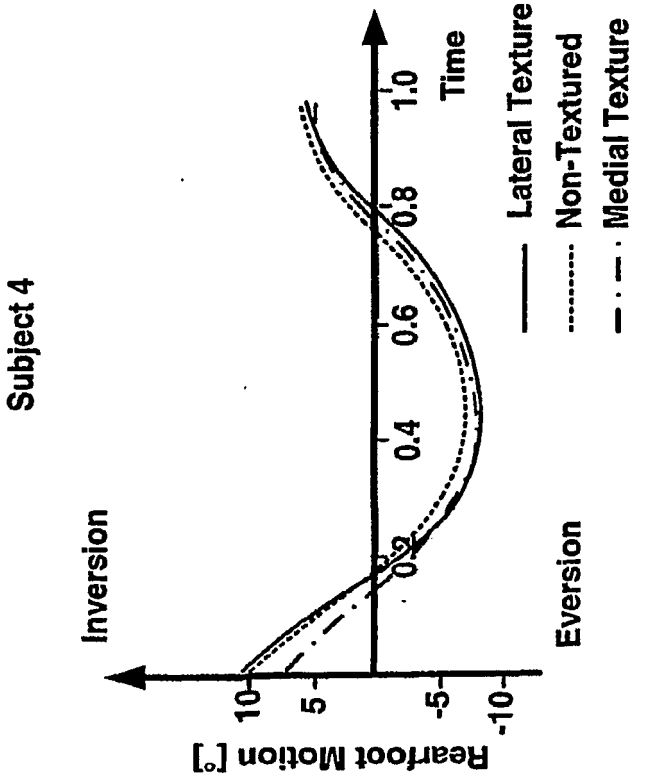
Subject 4
Inversion
Eversion
Rearfoot Motion [°]
10
5
-5
-10
0.2
0.4
0.6
0.8
1.0
Time
Lateral Texture
Non-Textured
Medial Texture

FIG. 9A

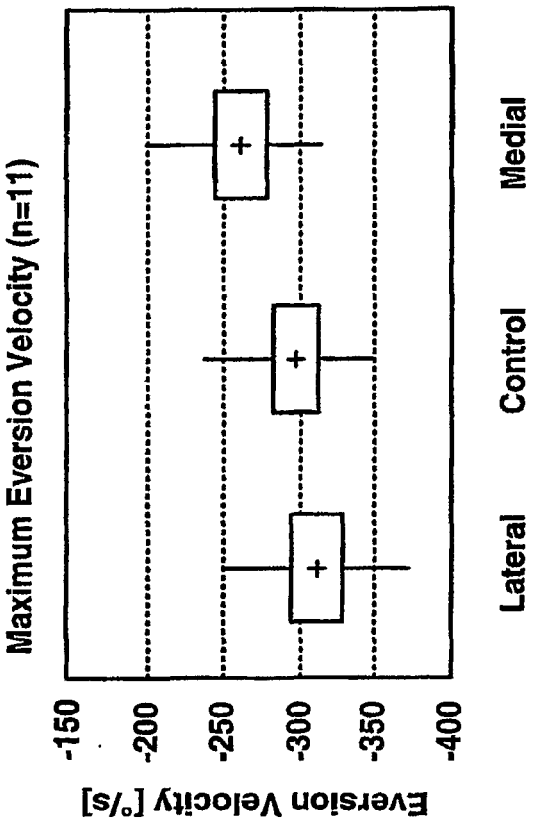
Maximum Eversion Velocity (n=11)
-150
-200
-250
-300
-350
-400
Eversion Velocity [°/s]
Lateral
Control
Medial

FIG. 10

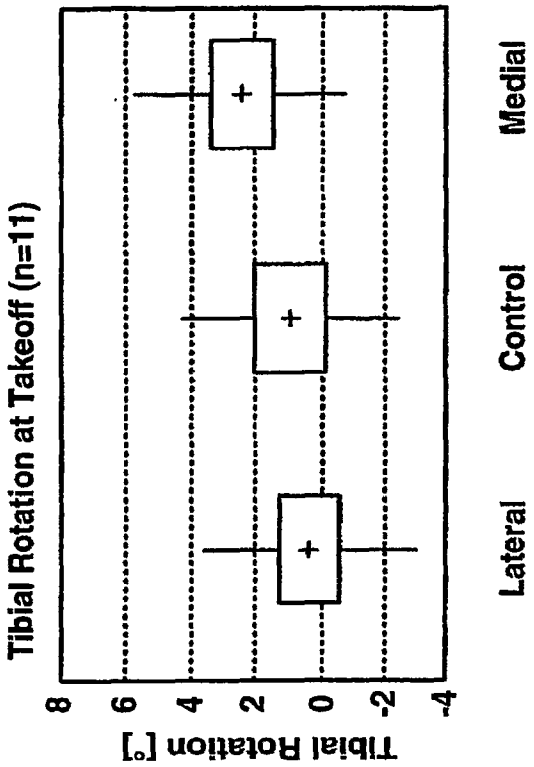

FIG. 11B

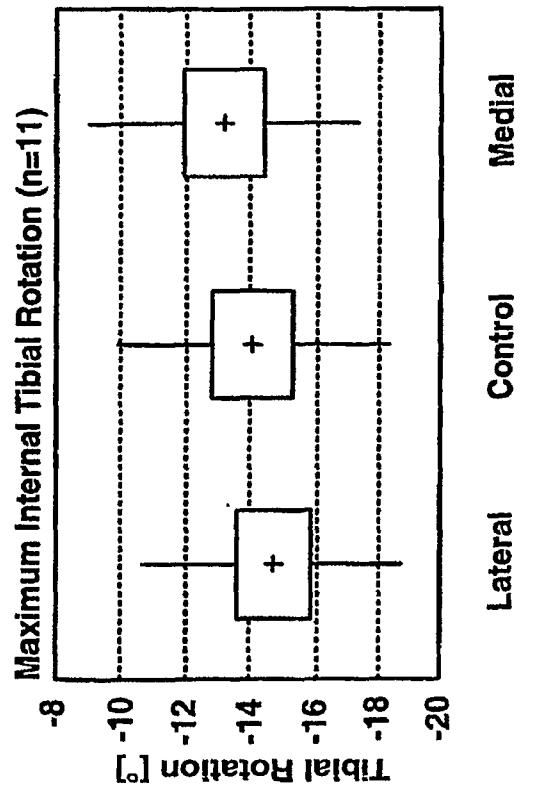

FIG. 11A

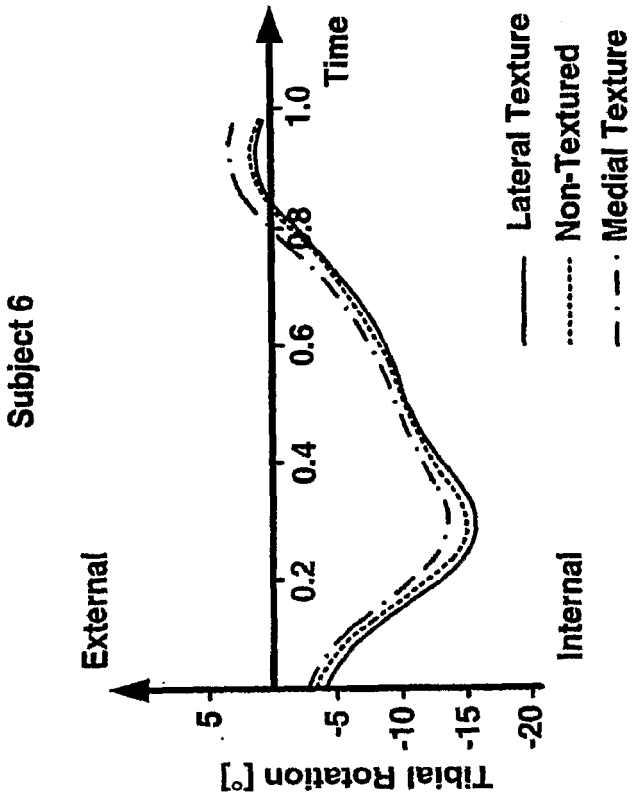

FIG. 12B

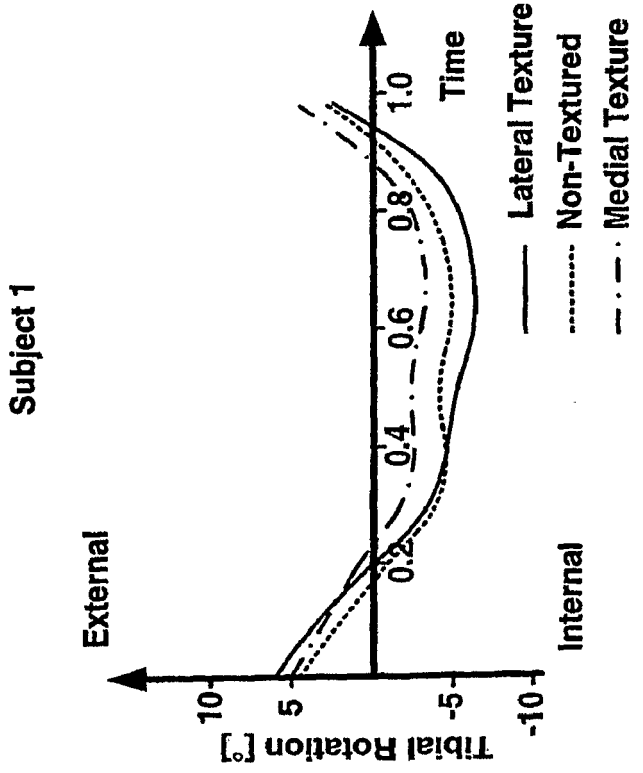

FIG. 12A

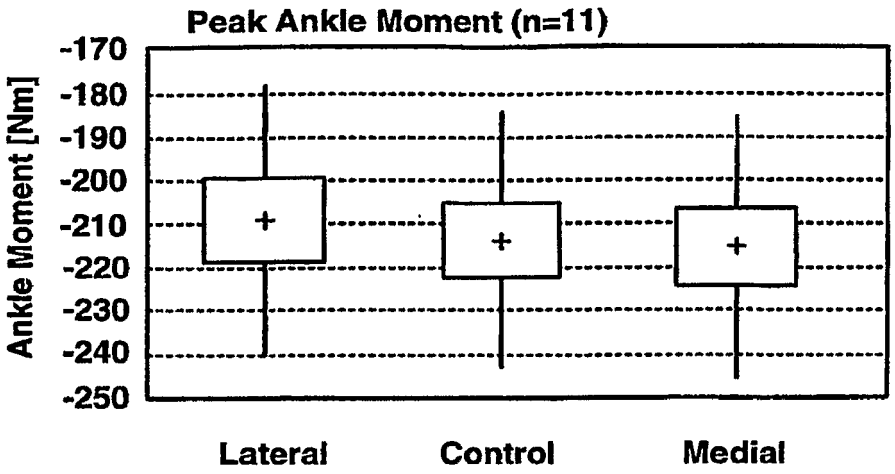

FIG. 13A

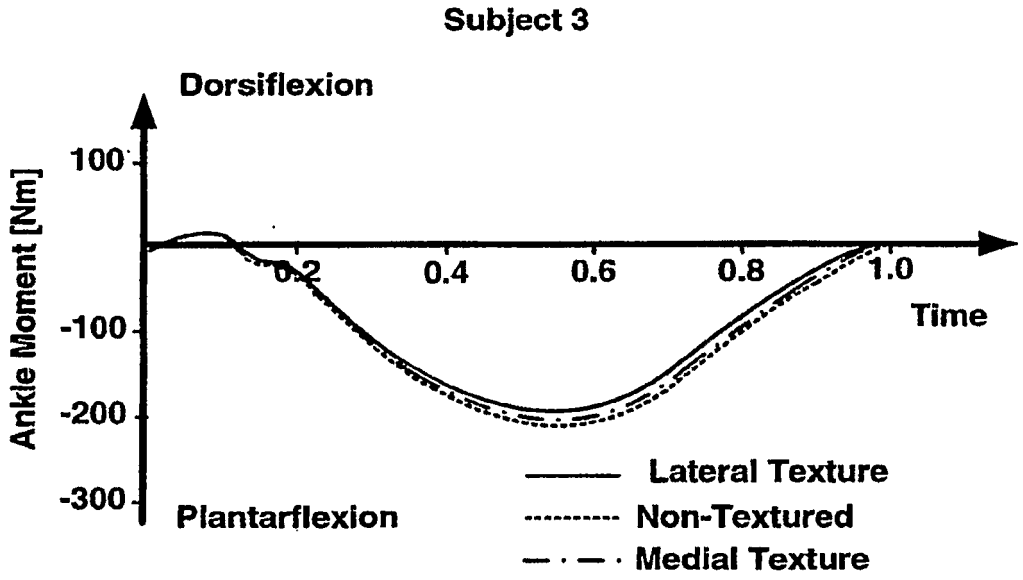

FIG. 13B

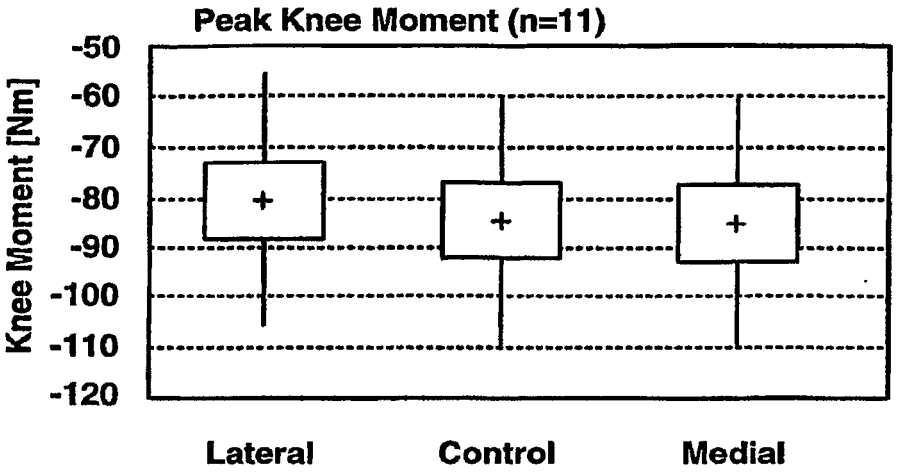

FIG. 14A

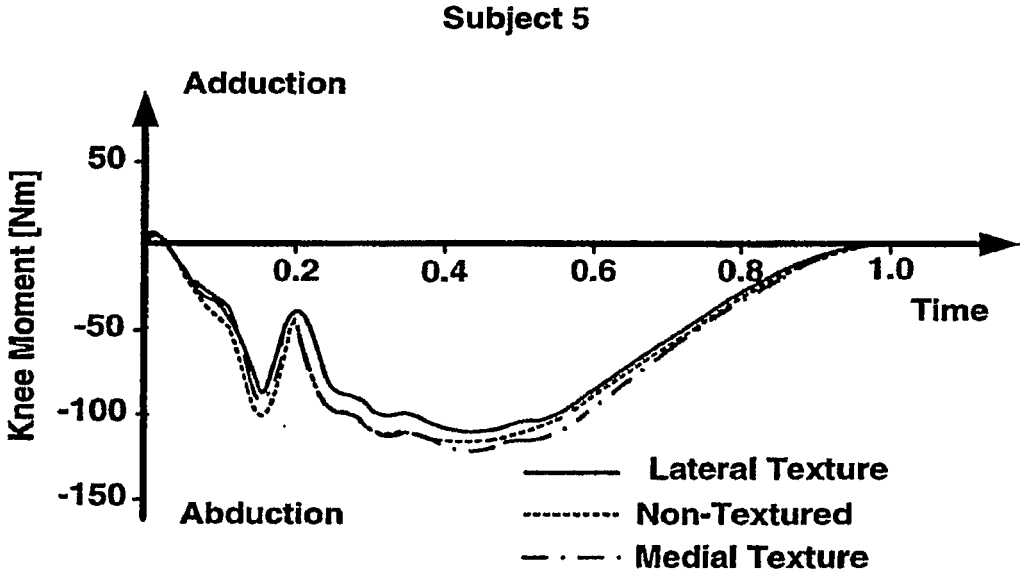

FIG. 14B

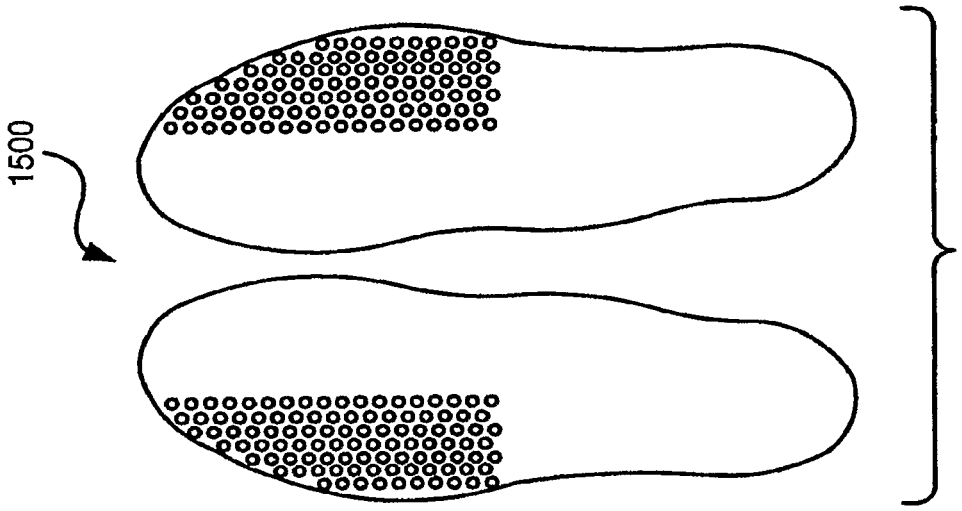

FIG. 15B

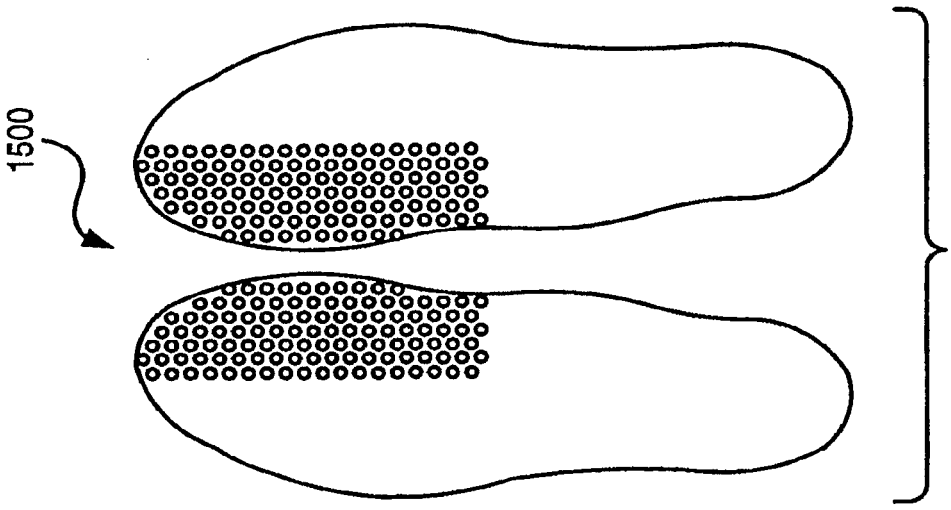

FIG. 15A

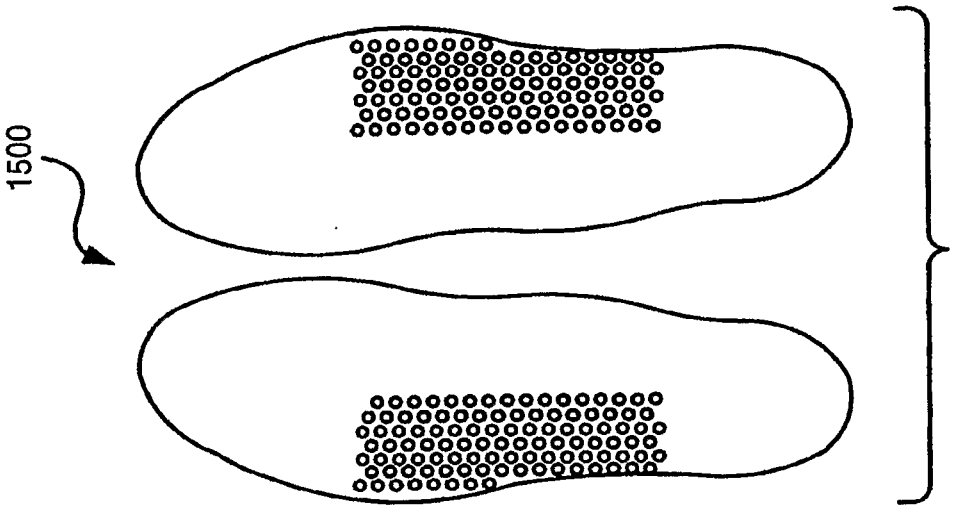

FIG. 15D

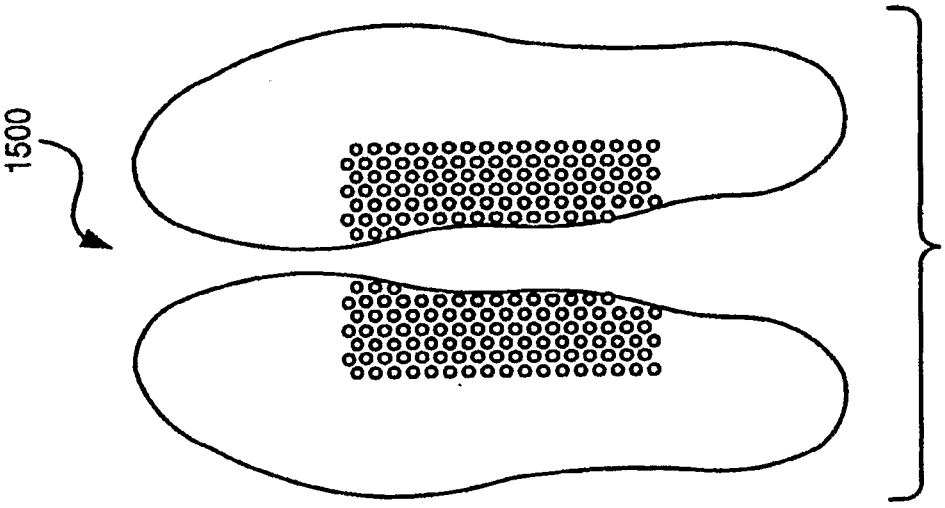

FIG. 15C

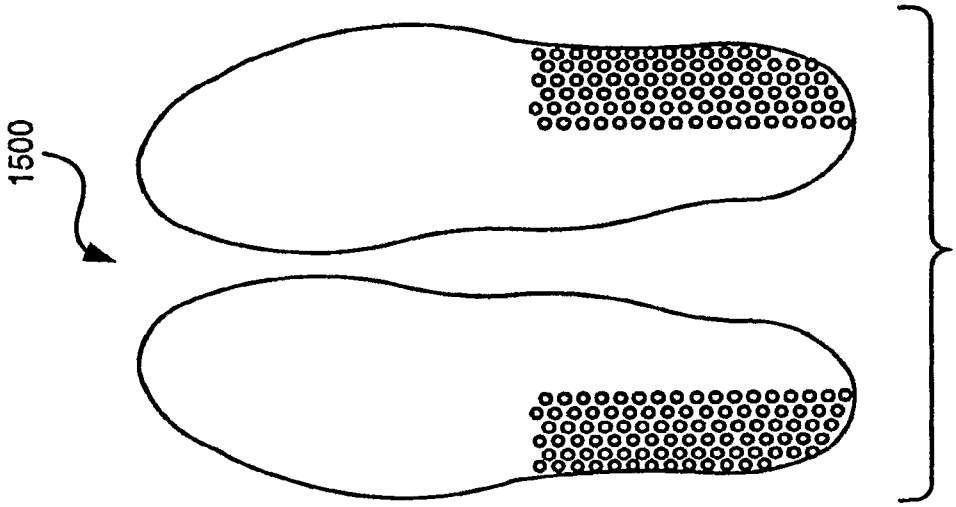

FIG. 15F

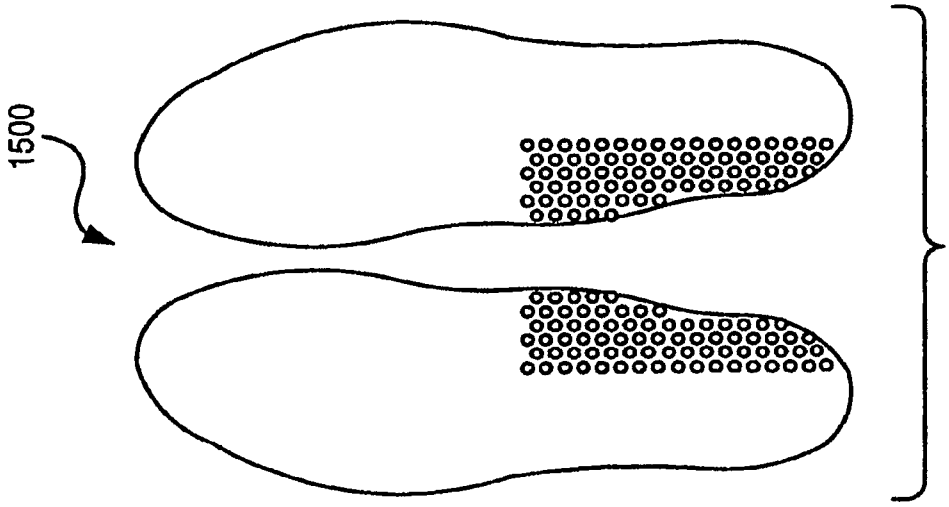

FIG. 15E

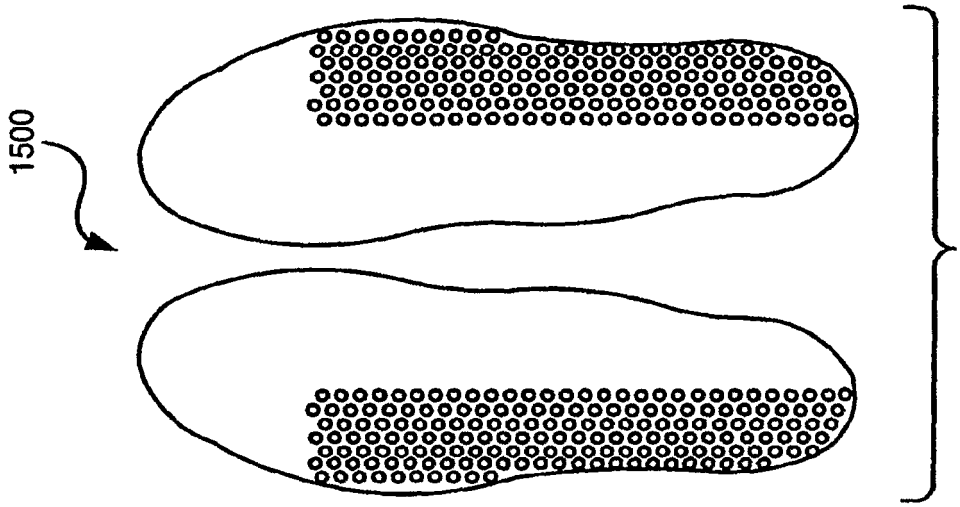

FIG. 15H

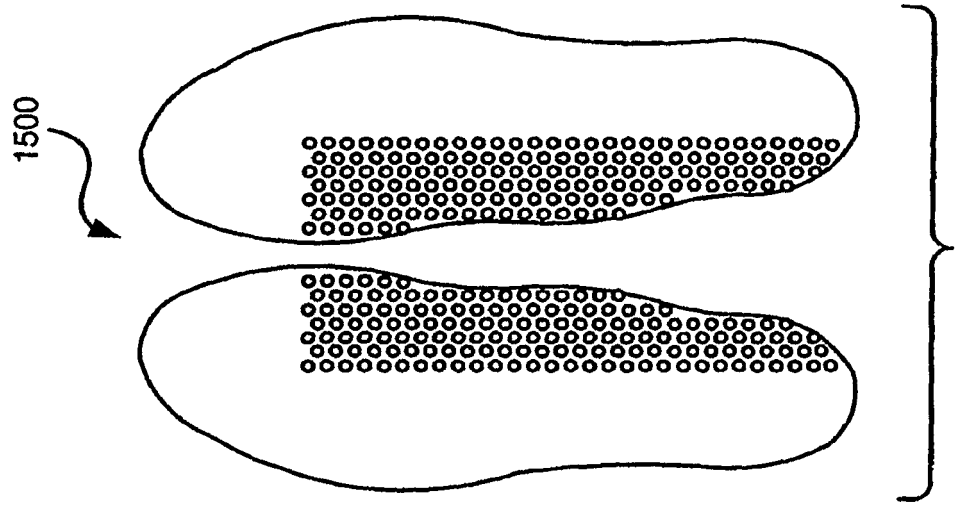

FIG. 15G

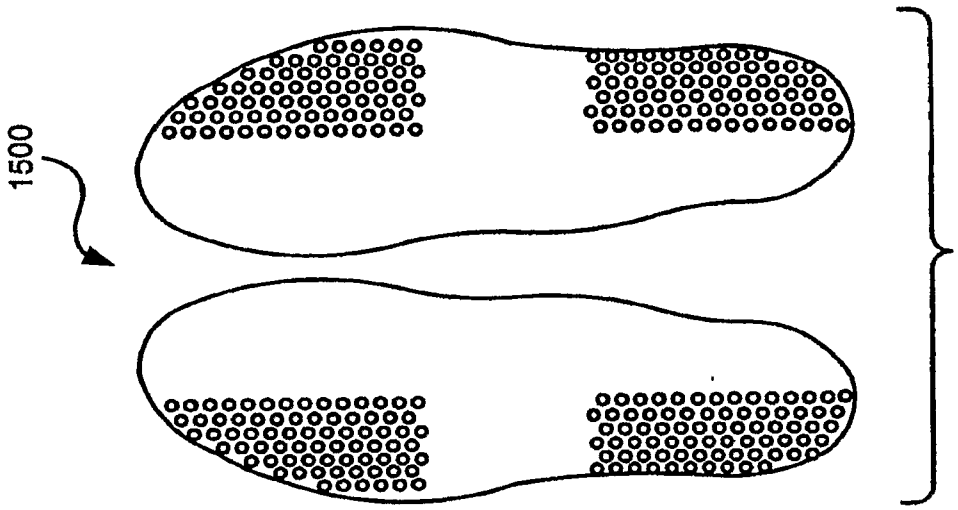

FIG. 15J

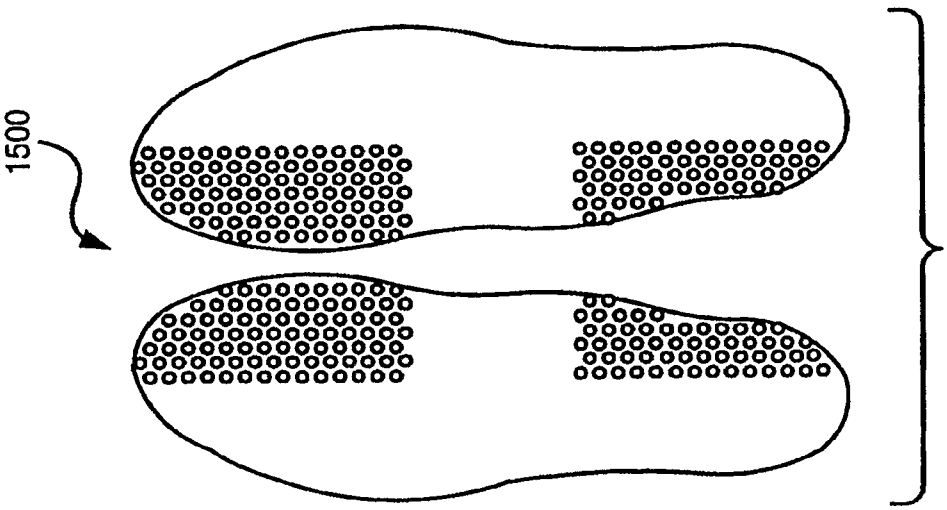

FIG. 15I

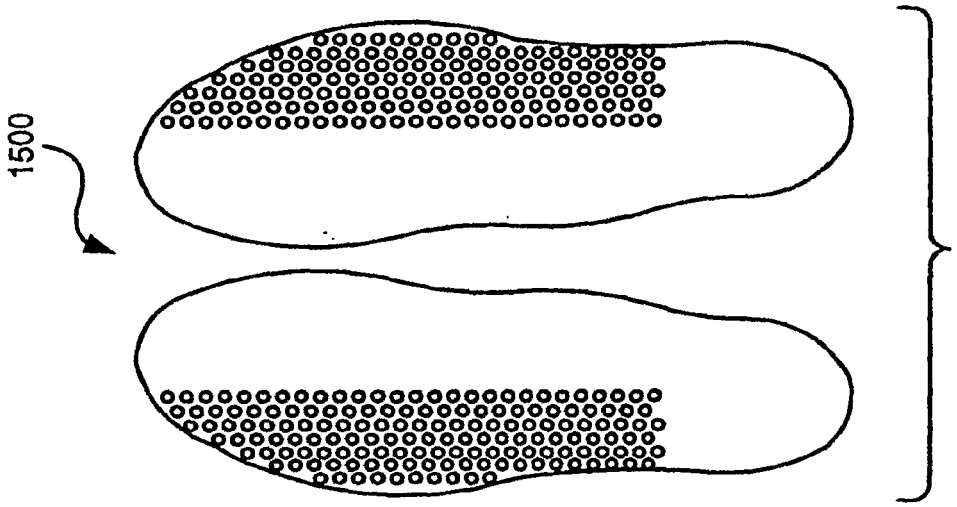

FIG. 15L

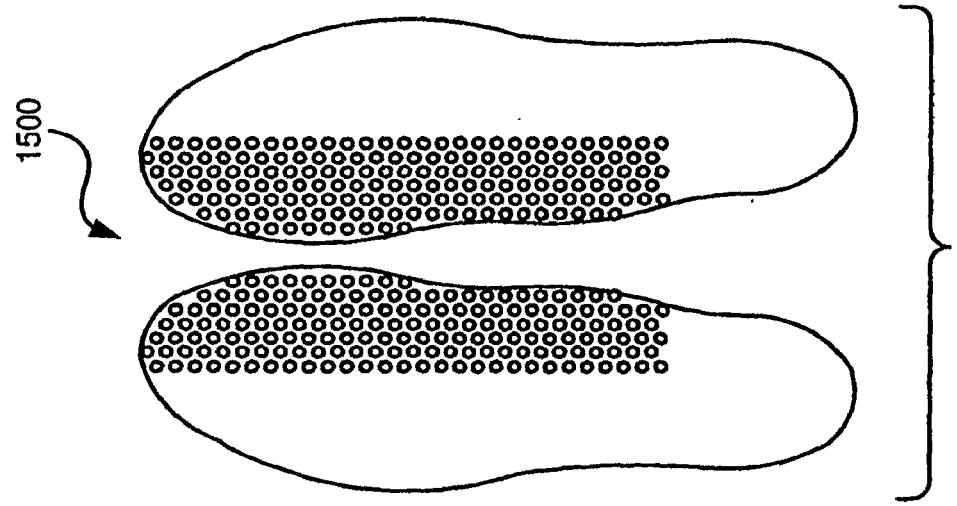

FIG. 15K

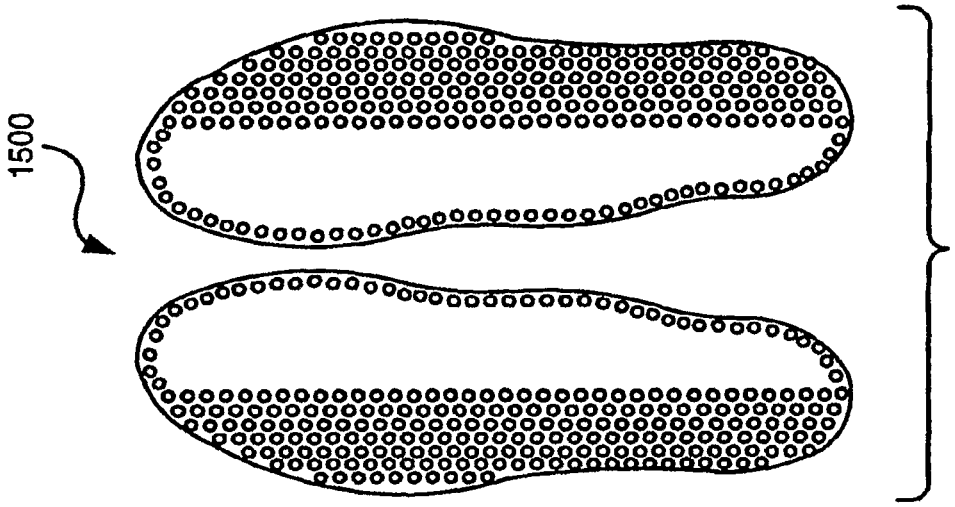

FIG. 15N

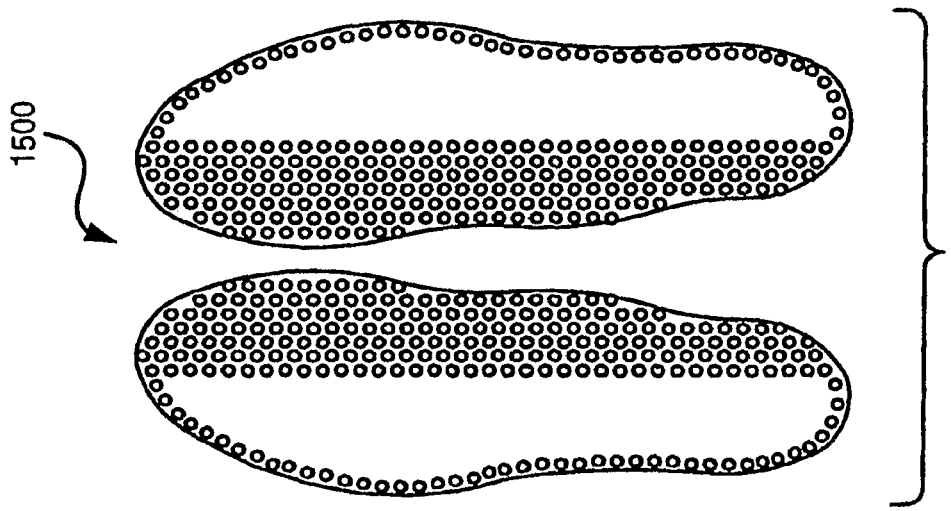

FIG. 15M

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 348087031 U **[0005]**

专利名称(译)	带有内侧纹理的脚踏板，用于控制下肢运动学和动力学		
公开(公告)号	EP3111792B1	公开(公告)日	2018-03-07
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当前申请(专利权)人(译)	NIKE INNOVATE C.V.		
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外部链接	Espacenet		

摘要(译)

用于接合穿着者脚的足底表面的脚垫（例如，在鞋类，袜子等中）包括具有光滑或基本光滑的感觉或表面的侧面或内侧中的一个，而相对侧具有纹理感觉或表面，例如通过提供限定纹理感觉或表面的多个凸起区域。取决于纹理的位置（侧面或内侧）和/或走动活动的类型（例如，跑步或行走），活动期间的下肢运动可能受到影响，例如，减少内旋，减少最大外翻，减少后足运动范围，降低外翻速度，减少步进时推迟时的跖屈，减少足跟着地时的反转，减少外翻运动范围，减少最大内部胫骨旋转，增加切割运动时的稳定性等。