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(54) Title: RESPONSIVE INSOLES

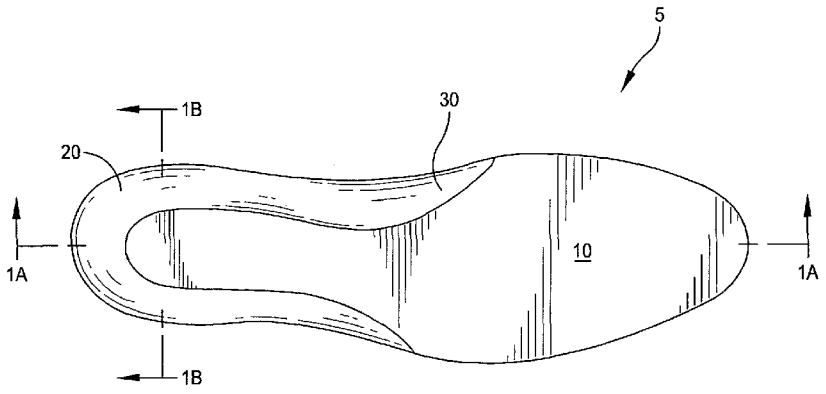

Figure 1

(57) Abstract: Disclosed here are insoles with one or more regions responsive to maintain a user's foot in a corrected position in the insole.

RESPONSIVE INSOLES

TECHNICAL FIELD

[0001] The present disclosure relates to insoles with one or more responsive regions that are constructed to maintain a user's foot in a corrected position in the insole.

RELATED CASES

[0002] Priority is claimed herein to U.S. Provisional Patent Application No. 61/294716, which was filed on January 13, 2010, and which is incorporated by reference herein in its entirety.

RELATED ART

[0003] Severe foot pain is a debilitating experience, which often results in an individual compensating for the foot pain by shifting the balance of weight from the foot in pain, to the other foot, which may be in less pain, or no pain. Compensation in such a manner can result in other symptoms and/or medical problems such as, for example, pronation, plantar fascitis, heel spurs, and the like.

[0004] To ease foot pain, many individuals use removable insoles in their shoes, which may be made of polymeric materials that provide cushioning. The cushioning properties of the insole provide some pain relief, and allow foot movement within the shoe.

[0005] To ease more severe foot pain, resulting from problems with poor posture, misalignment, and the like, custom orthotics may be used. In contrast to removable insoles, custom orthotics are made of rigid materials, and are useful for correcting problems with misalignment of feet, etc., because they force an individual's foot to move into a corrected position, and prevent movement of the foot to the original position which caused the problem and foot pain. While effective, orthotics are expensive, heavy, and often uncomfortable.

SUMMARY

[0006] The present disclosure is directed, in one embodiment, to an insole. The insole comprises a contoured surface selected to maintain a user's foot in a corrected position; a footbed comprising a footbed material; and a first responsive region defined in the footbed, the first responsive region comprising a first energy dispersive material, different from the footbed material; wherein the first energy dispersive material is substantially flexible in a first configuration such that the user's foot can move from the corrected position to an uncorrected position, and substantially rigid in a second configuration, such that upon impact by the user's foot, the first energy dispersive material becomes substantially rigid and forces the user's foot to move from the uncorrected position to the corrected position.

[0007] In another embodiment, the insole comprises a contoured surface selected to maintain a user's foot in a corrected position; a footbed comprising a footbed material; a first responsive region defined in the footbed, the first responsive region comprising a first energy dispersive material, different from the footbed material; a second responsive region defined in the footbed, the second responsive region comprising a second energy dispersive material different than the footbed material and the first energy dispersive material; wherein the second material comprises a first energy dispersive material that is substantially flexible in a first configuration such that the user's foot can move from the corrected position to an uncorrected position, and substantially rigid in a second configuration, such that upon impact by the user's foot, the first responsive region becomes substantially rigid and forces the user's foot to move from the uncorrected position to the corrected position; and wherein the first and second responsive regions are selected from the group consisting of an arch support, a heel cup, a heel pad, a metatarsal support, and combinations of the foregoing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Advantages, novel features, and uses of the disclosure will become more apparent from the following detailed description of non-limiting embodiments of the disclosure when considered in conjunction with the accompanying drawings, which are

schematic and which are not intended to be drawn to scale. In the figures, each identical or substantially similar component that is illustrated in various figures is typically represented by a single numeral or notation. For purposes of clarity, not every component is labeled in every figure, nor is every component of each embodiment of the disclosure shown where illustration is not necessary to allow those of ordinary skill in the art to understand the disclosure. In the drawings:

[0009] Figure 1 is a top plan view of one exemplary insole according to the present disclosure;

[0010] Figure 1A is a cross-sectional view of the insole of Figure 1 through line 1A-1A;

[0011] Figure 1B is a cross-sectional view of the insole of Figure 1 through line 1B-1B;

[0012] Figure 2 is a top plan view of another exemplary insole according to the present disclosure, comprising a heel pad;

[0013] Figure 2A is a cross-sectional view of the insole of Figure 1 through line 2A-2A;

[0014] Figure 2B is a cross-sectional view of the insole of Figure 1 through line 2B-2B;

[0015] Figure 3 is a top plan view of another exemplary insole according to the present disclosure, comprising a heel pad and a metatarsal pad;

[0016] Figure 3A is a cross-sectional view of the insole of Figure 1 through line 3A-3A;

[0017] Figure 3B is a cross-sectional view of the insole of Figure 1 through line 3B-3B; and

[0018] Figure 3C is a cross-sectional view of the insole of Figure 1 through line 3C-3C.

DETAILED DESCRIPTION

[0019] The present disclosure is directed to relatively lightweight footwear products, such as insoles, comprising various degrees of hardness and impact-resistance. The insoles may comprise one or more responsive regions that are designed to allow the

insole to conform to the shape of a foot, providing comfort when at rest, and when subjected to a stress, such as when a user is moving (i.e., walking, running, dancing, etc.), to stiffen and to keep the foot in the corrected position. A contoured insole made at least in part of a responsive material such as a shear thickening foam, may be soft to the touch, but can stiffen on impact to keep, for example, the heel and arch support of the insole properly aligned in relation to the foot. That is, the insole is soft enough to conform to the shape of a foot, providing comfort when at rest, but responsive to keep in the foot properly aligned on the insole and in footwear.

[0020] The size, shape and configuration of the insoles can be designed to provide suitable vibration dampening, impact absorption, friction reduction, as well as cushioning, which can be varied as desired or necessary to achieve the desired customized insole characteristics.

[0021] Reference will now be made in detail to exemplary embodiments of the disclosure, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts. The figures, when taken together, illustrate various embodiments of insoles, each comprising one or more responsive regions selected to provide varying degrees of vibration dampening, impact resistance or absorption, rebound, friction reduction, stabilization and/or cushioning, and the like, as determined by the needs of a particular user, such as heel pads, metatarsal pads, and the like, based on an evaluation of the needs of a particular individual or of a group of individuals with a common problem.

[0022] Figures 1-1B, when taken together, show one exemplary embodiment of an insole 5 according to the present disclosure, comprising a foot portion 10 (hereinafter "footbed 10") and two responsive regions defined in the footbed 10. It should be understood that although the illustrated embodiments comprise two or more responsive regions, as stated above, the present disclosure also encompasses one responsive region. In the present embodiment, the insole 5 comprises a responsive heel cup 20 (hereinafter "heel cup 20") and a responsive arch support 30 (hereinafter "arch support 30).

[0023] Insole 5 may be contoured to conform to the shape of a user's foot, or the desired corrected position for a user's foot. For example, heel cup 20 may be contoured to accommodate the user's heel (not illustrated), and arch support 30 may be contoured to accommodate the instep of the user's foot (not illustrated), both of which assist in properly locating or positioning the user's foot on the insole. The shape, size and configuration of the insole contours may be predetermined and standardized based on average foot shapes and sizes, as is common in the industry or, alternatively, the size, shape and configuration of the insole may be customized for a particular individual's foot. The insoles disclosed herein may be manufactured using a variety of techniques and equipment, including those disclosed in commonly owned and co-pending U.S. Patent Application No. 11/644,266, filed on December 23, 2006, the disclosure of which is incorporated herein by reference in its entirety.

[0024] Figures 2-2B, when taken together, show another exemplary embodiment of an insole 5' according to the present disclosure, comprising a responsive heel pad 40 (hereinafter "heel pad 40").

[0025] Figures 3-3B, when taken together, show another exemplary embodiment of an insole 5" according to the present disclosure, comprising a heel pad 40 and a metatarsal pad 50 (hereinafter "metatarsal pad 40").

[0026] In any of the foregoing embodiments, the insoles can comprise any materials comprising sufficient structural integrity to be formed into predetermined shapes; sufficient softness and/or pliability to provide comfort against a body; and that are capable of withstanding the environment in which it is intended to be used, without substantial degradation.

[0027] Suitable materials for the footbed portion 10 include, but are not limited to, polymeric materials, including foamed plastics, gel materials, such as silicone, elastomers, such as thermoplastic polyurethane ("TPU"), composite materials, and the

like. Examples of suitable polymeric materials include, but are not limited to, a thermosetting polymeric material, an elastomeric polymeric material, thermoplastic material, including a thermoplastic elastomeric material, and combinations comprising at least one of the foregoing. Some possible materials comprise polyurethane, silicone, and/or the like, and combinations comprising at least one of the foregoing materials.

In any of the foregoing embodiments, the one or more responsive regions (e.g., 20,30,40,50) can comprise any material comprising sufficient structural integrity to be formed into predetermined shapes; sufficient softness and/or pliability to provide comfort against a body, when at rest, and sufficient rigidity to cushion against shock when in use; and that is capable of withstanding the environment in which it is intended to be used, without substantial degradation.

[0028] Suitable materials for responsive regions include, but are not limited to, shear thickening or dilatant materials, and the like. As used herein, the term "shear thickening materials" is meant to cover all categories of shear thickening materials and combinations of shear thickening materials known to those skilled in the art. Examples of shear thickening or dilatant materials, include, but are not limited to, shear thickening fluids; shear thickening gels; encapsulated fluids or gels; shear thickening foams; shear thickening solids; shear thickening filaments; impregnated fibers (e.g., a fiber or yarn that has absorbed, and/or is coated with, a shear thickening material); impregnated fiber reinforced materials (e.g., a fabric that has absorbed, and/or is coated with, a shear thickening material, wherein the impregnated fiber reinforced material includes previously impregnated fibers woven together to form a fabric); shear thickening composites (e.g., a solid foamed synthetic polymer with an elastic, and/or an elastomeric matrix and a polymer-based dilatant different from the solid foamed synthetic polymer, in which the polymer-based dilatant is distributed through the matrix and incorporated therein during manufacture); and a solid, closed cell foam matrix with a polymer-based dilatant, different from the matrix, distributed through the matrix; shear thickening layers (e.g., a layer of material formed from one of, or a combination of, the above-categories of shear thickening materials).

[0029] Shear thickening or dilatant materials have properties that distinguish them from other materials. For example, when shear thickening materials are subjected to an increasing rate of shear deformation, they undergo an increase in viscosity and/or rigidity. For example, a shear thickening material may behave like a low viscosity fluid when not subjected to shear deformation or subjected to a low rate of shear deformation, but may behave like a highly viscous fluid when subjected to a high rate of shear deformation. Another shear thickening material may behave like a fluid when not subjected to shear deformation or subjected to a low rate of shear deformation, but may behave like a quasi-solid or solid when subjected to a high rate of shear deformation. Yet another a shear thickening material may behave like a quasi-solid or flexible solid when not subjected to shear deformation or subjected to a low rate of shear deformation, but may behave like a rigid solid when subjected to a high rate of shear deformation.

[0030] Shear thickening foam may be desirable to use for the regions. Such foams may be formed by trapping gas bubbles, produced using physical or chemical means, in a shear thickening fluid or gel, after which the material may be solidified. The interactions and mechanisms behind the shear thickening behavior of a shear thickening foam may be similar to those of other shear thickening materials. When the shear thickening foam is subjected to the energy of a sudden impact, its rigidity can increase. Before and after the impact, under normal conditions, the shear thickening foam can be relatively flexible. One suitable shear thickening foam is a polyurethane frothed foam that is commercially available from Rogers Corporation under the name PORON® XRD, which may be formed to have a variety of densities and properties. Other shear thickening foams may be used for the responsive regions are available from other manufacturers.

[0031] In any of the foregoing embodiments, the responsive regions may be molded together with the footbed in the same manufacturing operation, or formed separately. If desired, the responsive regions may be encapsulated or covered with another material, and inserted into the footbed using a variety of techniques, such as,

gluing, heat sealing, and the like. Also if desired, various additives and/or active agents may be included in the materials, as described in the '266 application.

[0032] To produce insoles customized for a particular individual or group of individuals, the size, shape and configuration of the responsive regions can be varied, as can the material and the material properties from which they are formed (e.g., density, durometer, rebound, elastic modulus, etc.). For example, the responsive regions of an insole can comprise the same or different materials, and they can comprise materials with graduated thickness, graduated density, or both. The configuration of the insole 5 can be customized to be responsive to the gait of an individual by using combinations of materials with different characteristics, such as gels, foams, particularly energy dispersive foams, and other materials, and combinations of the foregoing.

[0033] In one exemplary embodiment, in regions of the footbed in which relatively low rebound may be desirable, an energy dispersive foam with such low rebound characteristics may be used to form the responsive regions. Regions formed from such a low rebound material can feel soft when touched, but become hard when impacted. For example, it may be desirable to have low rebound in the perimeter of the heel cup 20 and/or the arch support 30. When walking, upon impact of the user's foot to the ground, the heel cup and arch support regions 20,30 will harden, thereby maintaining the proper location of the heel and arch within the insole. One suitable material that may be used for such regions is a microcellular urethane foam available under the product name Poron XRD, from Rogers Corporation. Poron XRD is available with varying levels of cushioning, impact resistance and rebound characteristics. Comparable materials are available from other manufacturers.

[0034] In another exemplary embodiment, it may be desirable to for certain regions to have relatively high rebound. For example, it may be desirable to have relatively high rebound in the heel pad 40 and/or metatarsal pad 50, such that when walking or running, the amount of "bounce" is relatively low. Again, Poron XRD may be a suitable material for such an application.

[0035] The insoles of the present disclosure can be advantageous because they are relatively lightweight, simple and inexpensive to manufacture in comparison to other custom orthotics.

[0036] Throughout the application, it should be noted that the terms "first," "second," and the like herein do not denote any order or importance, but rather are used to distinguish one element from another, and the terms "a" and "an" herein do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced items. Similarly, it is noted that the terms "bottom" and "top" are used herein, unless otherwise noted, merely for convenience of description, and are not limited to any one position or spatial orientation. In addition, the modifier "about" used in connection with a quantity is inclusive of the stated value and has the meaning dictated by the context (e.g., includes the degree of error associated with measurement of the particular quantity).

[0037] Compounds are described using standard nomenclature. For example, any position not substituted by an indicated group is understood to have its valency filled by a bond as indicated, or a hydrogen atom A dash ("-") that is not between two letters or symbols is used to indicate a point of attachment for a substituent. For example, - CHO is attached through carbon of the carbonyl group. Unless defined otherwise herein, all percentages herein mean weight percent ("wt.%"). Furthermore, all ranges disclosed herein are inclusive and combinable (e.g., ranges of "up to about 25 weight percent (wt.%), with about 5 wt.% to about 20 wt.% desired, and about 10 wt.% to about 15 wt.% more desired," are inclusive of the endpoints and all intermediate values of the ranges, e.g., "about 5 wt.% to about 25 wt.%, about 5 wt.% to about 15 wt.%", etc.). The notation "+/-10% means that the indicated measurement may be from an amount that is minus 10% to an amount that is plus 10% of the stated value.

[0038] Finally, unless defined otherwise, technical and scientific terms used herein have the same meaning as is commonly understood by one of skill in the art to which this disclosure belongs.

[0039] While the disclosure has been described with reference to an exemplary embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the disclosure. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the disclosure without departing from the essential scope thereof. Therefore, it is intended that the disclosure not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this disclosure, but that the disclosure will include all embodiments falling within the scope of the appended claims.

[0040] What is claimed is:

CLAIMS

1. An insole, comprising:

a contoured surface selected to maintain a user's foot in a corrected position;

a footbed comprising a footbed material;

a first responsive region defined in the footbed, the first responsive region comprising a first energy dispersive material, different from the footbed material;

wherein the first energy dispersive material is substantially flexible in a first configuration such that the user's foot can move from the corrected position to an uncorrected position, and substantially rigid in a second configuration, such that upon impact by the user's foot, the first energy dispersive material becomes substantially rigid and forces the user's foot to move from the uncorrected position to the corrected position.

2. The insole of Claim 1, further comprising a second responsive region defined in the footbed, the second responsive region comprising a second energy dispersive material different than the footbed material and the first energy dispersive material.

3. The insole of Claim 1, wherein the first responsive region is selected from the group consisting of an arch support, a heel cup, a heel pad, a metatarsal support, and combinations of the foregoing.

4. The insole of Claim 2, wherein the second responsive region is selected from the group consisting of an arch support, a heel cup, a heel pad, a metatarsal support, and combinations of the foregoing.

5. The insole of Claim 1, wherein the first responsive region further comprises a graduated density.

6. The insole of Claim 2, wherein the second responsive region further comprises a graduated density.

7. The insole of Claim 1, wherein the first responsive region further comprises a graduated thickness.

8. The insole of Claim 2, wherein the second responsive region further comprises a graduated thickness.

9. The insole of Claim 1, wherein the first energy dispersive material comprises a shear thickening foam.

10. The insole of Claim 2, wherein the second energy dispersive material comprises a shear thickening foam.

11. The insole of Claim 9, wherein the shear thickening foam comprises a urethane foam.

12. The insole of Claim 10, wherein the shear thickening foam comprises a urethane foam.

13. An insole, comprising:

a contoured surface selected to maintain a user's foot in a corrected position;

a footbed comprising a footbed material;

a first responsive region defined in the footbed, the first responsive region comprising a first energy dispersive material, different from the footbed material;

a second responsive region defined in the footbed, the second responsive region comprising a second energy dispersive material different than the footbed material and the first energy dispersive material;

wherein the second material comprises a first energy dispersive material that is substantially flexible in a first configuration such that the user's foot can move from the corrected position to an uncorrected position, and substantially rigid in a second configuration, such that upon impact by the user's foot, the first responsive region becomes substantially rigid and forces the user's foot to move from the uncorrected position to the corrected position; and

wherein the first and second responsive regions are selected from the group consisting of an arch support, a heel cup, a heel pad, a metatarsal support, and combinations of the foregoing.

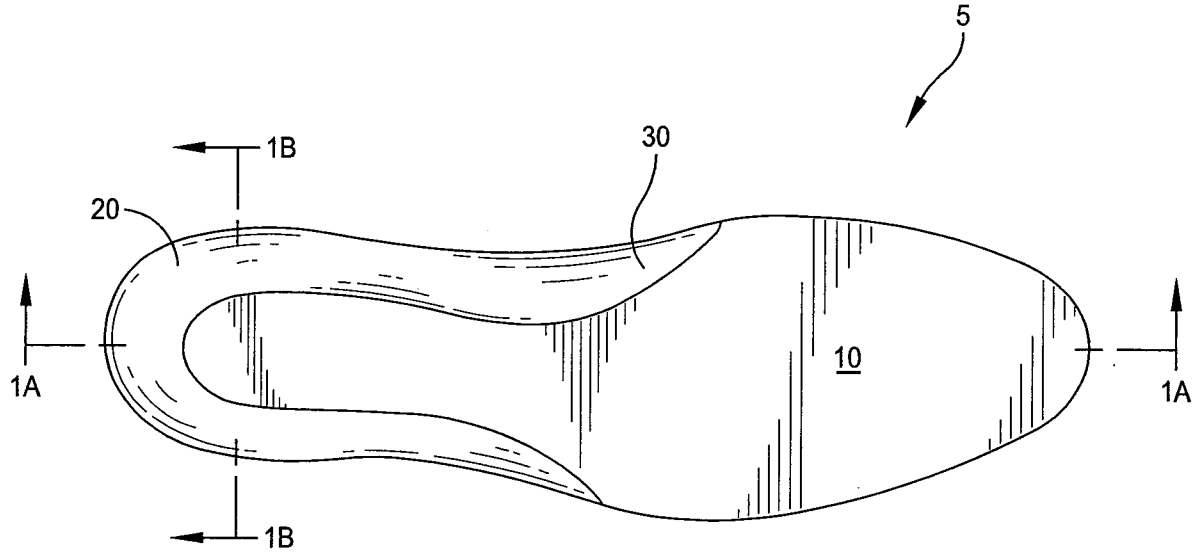

Figure 1

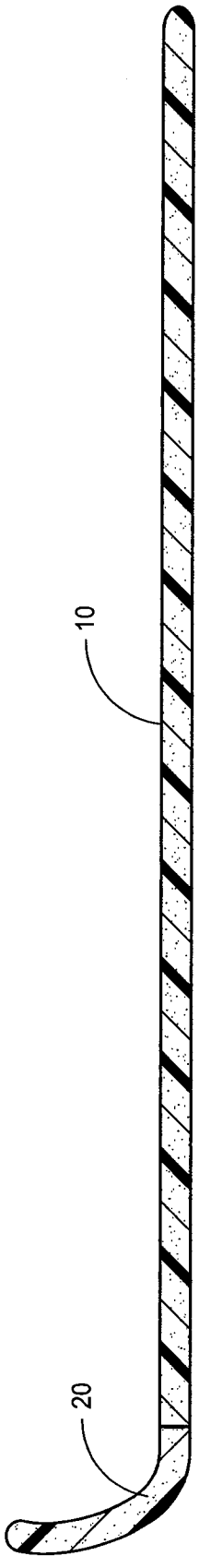

Figure 1A

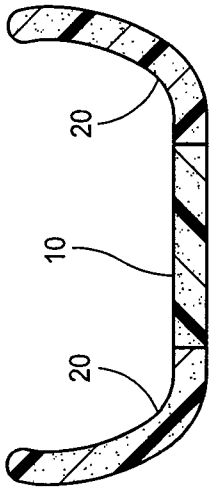

Figure 1B

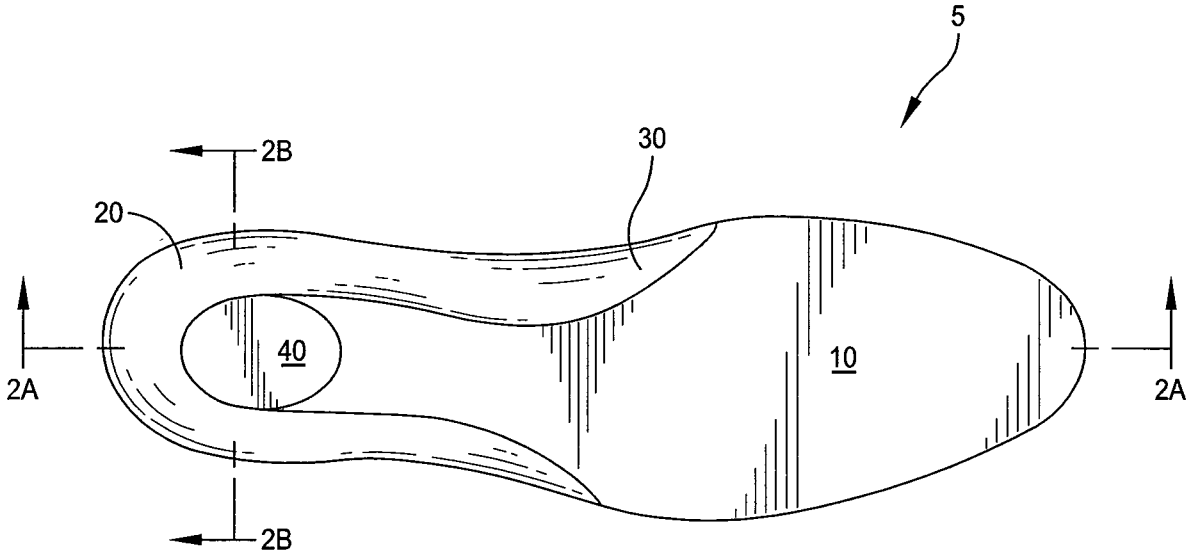

Figure 2

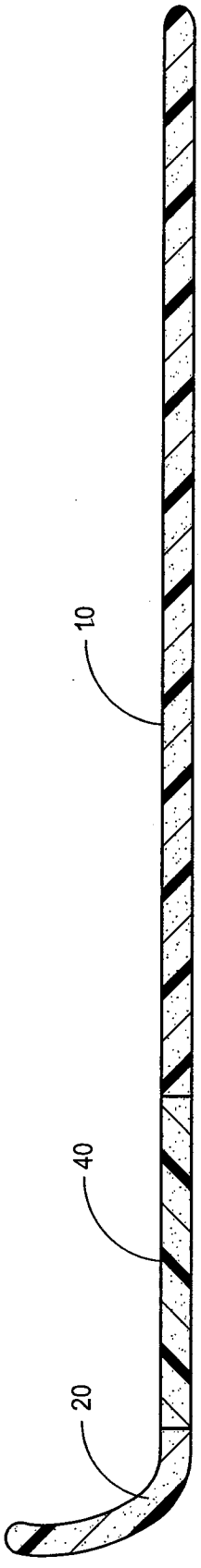

Figure 2A

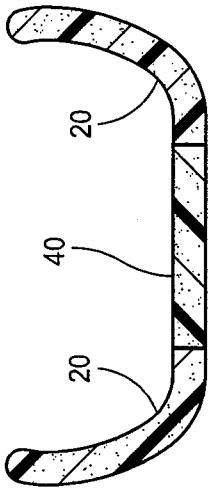

Figure 2B

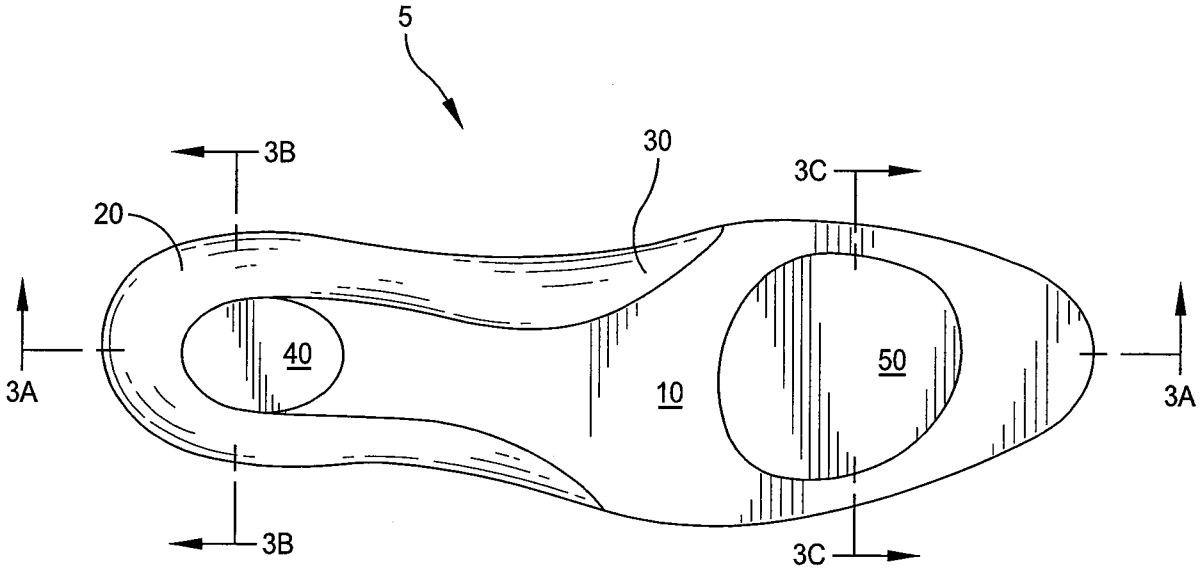

Figure 3

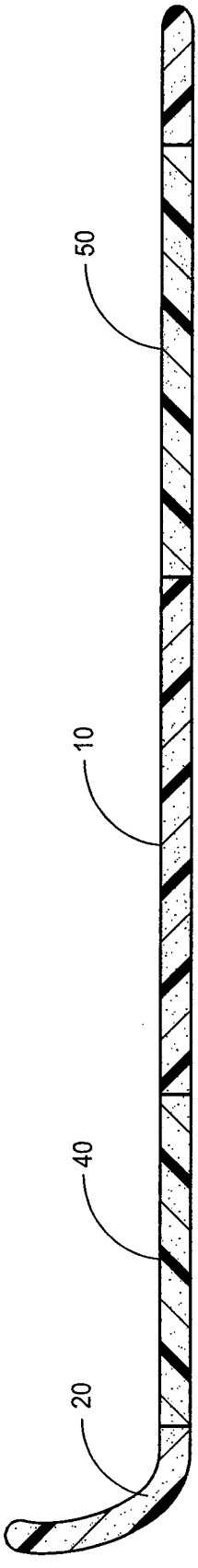

Figure 3A

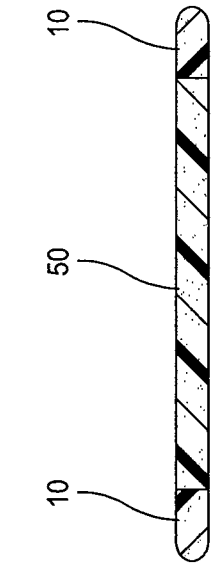

Figure 3C

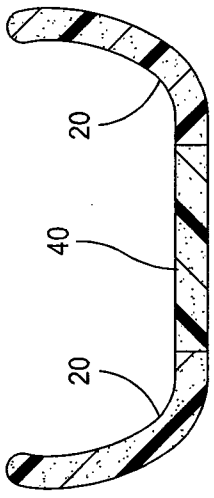

Figure 3B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/021111

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A43B 13/38 (2011.01)
USPC - 264/257
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A43B 13/00, 13/12, 13/38, 13/40, 13/42 (2011.01)
USPC - 36/1, 43; 264/1, 241, 257

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2008/0010861 A1 (KOSMAS) 17 January 2008 (17.01.2008) entire document	1-13
Y	US 2001/0001351 A1 (DIECKHAUS) 24 May 2001 (24.05.2001) entire document	1-13
Y	US 2002/0178621 A1 (DARBY) 05 December 2002 (05.12.2002) entire document	5, 6
A	US 2006/0277788 A1 (FUJII) 14 December 2006 (14.12.2006) entire document	1-13
A	US 2006/0075658 A1 (MITCHELL) 13 April 2006 (13.04.2006) entire document	5, 6

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
23 February 2011	17 MAR 2011
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)