



(51) International Patent Classification:

A43B 17/00 (2006.01) A43B 7/14 (2006.01)  
A43B 17/02 (2006.01)

(21) International Application Number:

PCT/US2016/034184

(22) International Filing Date:

25 May 2016 (25.05.2016)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/167,753 28 May 2015 (28.05.2015) US  
62/181,995 19 June 2015 (19.06.2015) US  
62/214,577 4 September 2015 (04.09.2015) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available):

AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available):

ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

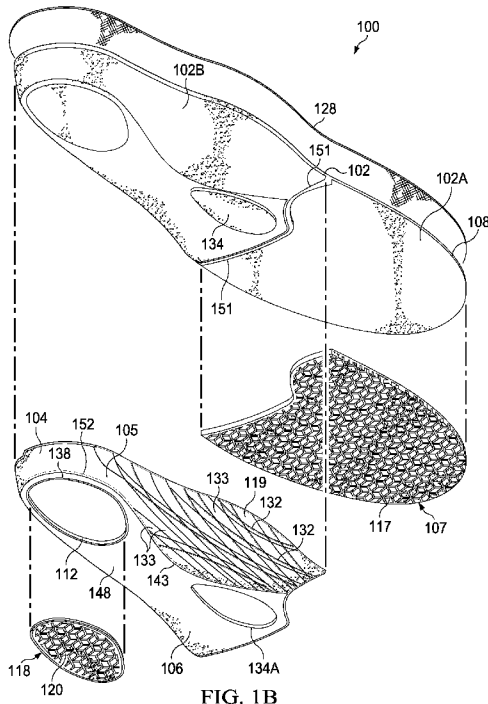
Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

[Continued on next page]

(54) Title: CONTOURED SUPPORT SHOE INSOLE

(57) Abstract: An insole having a top sheet and a base layer with three pieces that include a base layer, a forefoot pad made of a clear TPR gel and a mid-foot to heel cushion made of a supersoft polyurethane. The midfoot/heel surface has a raised arch with criss-crossing longitudinal curvilinear indentations, a flattened midfoot area with a metatarsal midfoot tear-drop raised area, and a heel cup that surrounds the exterior back of the heel. A heel pod opening goes through the entirety of the thickness of base layer of the insole body and a heel pad is affixed to the bottom surface of the base layer being made of a clear TPR gel or blown EVA. There is also a supersoft heel dome and a metatarsal raised dome on the top (foot contact) surface of the insole which would be directly above the heel pod and the metatarsal midfoot area, respectively.



WO 2016/191498 A1

**Published:**

— *with international search report (Art. 21(3))*

## CONTOURED SUPPORT SHOE INSOLE

### CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of United States Provisional Patent Application Serial No. 62/167,753 filed May 28, 2015, United States Provisional Patent Application Serial No. 62/181,995 filed June 19, 2015, and United States Provisional Patent Application Serial No. 62/214,557 filed September 4, 2015.

### STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

### TECHNICAL FIELD

[0003] The present invention relates in general to an improved shoe insole and more particularly to an insole providing improved cushioning and support to the foot of a wearer.

### BACKGROUND OF THE INVENTION

[0004] Insoles are inserted in the shoes of a user to provide one or more advantages to the comfort of the wearer or the support of the foot. Insoles are generally sold in pairs and one of each pair is adapted for use in a right shoe and the other adapted for use in a left shoe of a user. It is advantageous to provide appropriate structure to an insole so that it serves the purposes of the user.

[0005] The human foot is a very complex biological mechanism. The load on the foot at heel strike is typically about one and a half times a person's body weight when a person walks. When running or carrying extra weight, such as a backpack, loads on the foot can exceed three times the body weight. The many bones, muscles, ligaments, and tendons of the foot function to absorb and dissipate the forces of impact, carry the weight of the body and other loads, and provide forces for propulsion. Properly designed shoe insoles can assist the foot in performing these functions and protect the foot from injury.

[0006] Insoles may be custom made to address the specific needs of an individual. They may be made based on casts of the end user's foot or may be made of a thermoplastic material that is molded to the contours of the end user's foot. Like most custom made items, custom insoles tend to be expensive because of the low volume and extensive time

needed to make and fit them properly. As such, it is not practical to make such custom made insoles for the general public.

[0007] To be practical for distribution to the general public, an insole must be able to provide benefit to the user without requiring individualized adjustment and fitting. A first type of insole commonly available over-the-counter emphasizes cushioning the foot so as to maximize shock absorption. For typical individuals, cushioning insoles perform adequately while engaged in light to moderate activities, such as walking or running. That is, a cushioning insole provides sufficient cushioning and support for such activities. However, for more strenuous or technically challenging activities, such as carrying a heavy backpack or traversing difficult terrain, a typical cushioning insole will not be adequate. Under such conditions, a cushioning insole by itself would not provide enough support and control, and tends to bottom out during use by fully compressing the cushioning insole.

[0008] Another type of over-the-counter insole emphasizes control. Typically, such insoles are made to be relatively stiff and rigid so as to control the bending and twisting of the foot by limiting foot motion. The rigid structure is good at controlling motion, but is not very forgiving. As a result, when motion of the foot reaches a limit imposed by the rigid structure, the load on the foot tends to change abruptly and increases the load on the structures of the foot. Because biological tissues such as tendons and ligaments are sensitive to the rate at which they are loaded, the abrupt change in load causes injury or damage to the foot, ankle or leg.

[0009] In view of the foregoing, it would be desirable to provide an over-the-counter insole that provides both cushioning and control. It would also be desirable to provide an insole that provides both cushioning and control and is practical for use by the general public during cross-training or triathlon-related activities.

[0010] The Applicant has received patents for insoles having a support cushion and multiple pods located thereon. These patents include U.S. Patent Nos. 7,484,319; 7,665,169; 7,908,768; and, 8,250,784. These prior art patents, however, do not address the problems of enhanced cushioning and stability, possible movement of the insole during shoe operation, or establishing enhanced cushioning characteristics to address running and walking usages.

[0011] There is a need for insoles to be easier to construct and made of materials that can provide: (1) provide increased ankle and foot stability, (2) cushion the heel and forefoot during push-offs and landings, (3) custom-contour to the inside shape of all types of shoes, (4) be extremely light, (5) provide enhanced cushioning capabilities and (6) have essentially zero movement or sliding.

#### SUMMARY OF THE INVENTION

[0012] It is an object of the present invention to provide an insole that provides improved cushioning, support, and control and is practical for use by the general public. The above, and other objects and advantages of the present are provided by an insole that provides improved motion control, support and cushioning. The insole includes a system of interacting components that cooperate to achieve a desired combination of foot cushioning, support and motion control.

[0013] In accordance with principles of the present invention, the shoe insole 100 has a bottom surface formed of three pieces including: (1) a base layer extending from heel-to-toe, (2) a forefoot pad made of a clear TPR gel and positioned in a forefoot indentation on a forefoot base area of the insole, and, (3) a midfoot to heel stability cushion made of a soft polyurethane positioned in a midfoot to heel indentation. The forefoot pad and the midfoot/heel cushion are secured adjacent to one another on the bottom surface of the base layer.

[0014] There is a raised separation wall located on the base layer between the forefoot pad and the midfoot/heel support cushion, which is located laterally across the width of the insole between the metatarsal and forefoot areas on the insole. The insole has a top sheet layer that extends from heel to toe over the top surface of the base layer. There is a heel dome on the top surface of the insole and a metatarsal dome raised on the top surface of the insole, each of which respectively improves the cushioning characteristics of the insole at or near high impact points on the insole. The forefoot pad has a diamond shaped groove pattern on its bottom surface to improve forefoot cushioning characteristics, and improve traction and adhesion of the insole inside and along the interior bottom surface of the user's shoe.

[0015] The midfoot/heel cushion has a raised arch in the medial arch area and criss-crossing longitudinal curvilinear indentations positioned along at least two or more major

angles from the longitudinal axis, with the longitudinal axis extending from heel-to-toe on the insole. The midfoot/heel cushion also possesses a flattened midfoot area on the midfoot area and a metatarsal midfoot tear-drop raised area positioned in a metatarsal tear-drop aperture on the bottom surface of the support cushion. The flattened area on the midfoot area of the midfoot/heel cushion is bordered on the medial side by a medial side longitudinal ridge, on the lateral side by a lateral side longitudinal ridge, and around the exterior of the heel pod opening by a heel ridge. The midfoot/heel cushion also has a surrounding heel cup that supports the exterior back of the user's heel with the heel cup and extends to the raised arch area.

[0016] The heel pod opening extends through the entirety of the thickness of the midfoot/heel support cushion to position the heel pad on the bottom surface of the base layer. The heel pod opening is surrounded by opening border grooves, which surrounds the circumference of the heel pod opening. The heel pad is located on the bottom surface of the insole and is made of a clear TPR gel which extends through the full depth of the heel pod opening and is attached to the bottom surface of the base layer. The heel pad has a diamond shaped groove pattern and there is a supersoft heel dome on the top (foot contact) surface of the insole located above the heel pod in the bottom (shoe contact) surface.

[0017] A shoe insole with the following features: (1) a base of PU polyester glycol with a hardness of about 30 Asker  $\pm 3$  extending the length and width of the insole curving up in the medial arch area to form an arch support area and curving around the heel area to form a heel cup on the foot contact surface, with a separating wall between the base material and the forefoot pad indentation area on the bottom surface; a heel pad indentation under the calcaneal (heel) area on the bottom surface; a raised arch in the medial arch area with integrally formed longitudinal curvilinear indentations situated lengthwise, the curvilinear indentations formed in a criss-cross pattern alternating with interleaving and integrally formed raised gripping ridges in the medial arch area on the bottom surface; and a teardrop shaped indentation in the metatarsal area of the midfoot which curves upwardly (concave) from the bottom of the base bottom (shoe contact) surface and forms a collapsible metatarsal support which is convex on the top (foot contact) side of the base layer; (2) a forefoot pad of clear TPR gel which extends from the toe end of the insole to the midfoot area and from the lateral side to the medial side of the forefoot area with a diamond-cube pattern molded in the gel having pattern spacing of about 1 mm and a depth of about 1.5

mm, the TPR gel forefoot pad molded into the PU insole base distal to the separating wall on the base bottom surface with a knitted fabric layer secured between the TPR gel forefoot pad and the PU base material; (3) a heel pad on the bottom surface of the insole made of a clear TPR gel or pre-blown EVA with a hardness of approximately 20-35 Asker C  $\pm$ 3 having a modified oval shape that is wider on the proximal end of the heel pad and narrows on the distal end of the heel pad with a diamond-cube pattern molded in the EVA having pattern spacing of about 1 mm and a depth of about 1.5 mm and which is secured in the heel pad indentation of the base bottom surface; (4) a supersoft heel dome on the top (foot contact) surface of the insole which would be directly above the heel pad in the bottom (shoe contact) surface providing heel cushioning directly under a user's heel bone and also providing shock absorption on the insole bottom; and, (5) a top sheet of polyester covering the entire foot contact surface of the insole which is treated with an antimicrobial agent.

**[0018]** In a preferred embodiment, the insole invention has a base made of polyurethane polyester glycol (hardness 10-30 Asker  $\pm$ 3 – low density), a forefoot pad made of clear TPR gel (thermoplastic rubber - hardness 10-20 Asker  $\pm$ 3) (pattern spacing 1.0mm-1.50mm), a heel pad made of clear TPR gel or pre-blown EVA (hardness 20-35 Asker  $\pm$ 3) (pattern spacing 1.0mm-1.50mm) surrounded by a flat midfoot/heel surface and cupped along the back by a heel cup, nylon fabric between forefoot/heel pads and base (for adhesion of pads to PU), a raised oval heel pad on top dome on the foot-contact side made of super-soft low density PU, a medial arch that has raised and indented criss-cross curvilinear lines extending longitudinally along arch with vent holes, a groove depth on bottom 0.50 mm-1.5 mm, a top cloth made of 65% Nylon/ 35% polyester, a teardrop metatarsal pad on the top side is integrally formed as an upwardly-curved indentation from bottom surface, a diamond-shaped groove pattern on the forefoot pad and the heel pad, and a wall added between base and forefoot pad of approximately 1 mm.

**[0019]** Overall, the above features appear to be novel characteristics for this insole, and seem to be patentably distinct from the other insoles. The method of construction of the present insole is also a unique and novel feature of the present invention. In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff support cushion and a number of other pads to form an insole that provides greater cushioning, stability, and control than was conventionally known in the state of the art. The pads can have a different firmness than the base or the support cushion. The pads

and support cushion assist with prevention of supination, and the supplemental heel pad assists with the prevention of pronation. The current invention is an insole that provides a balanced approach to improving longitudinal arch support, prevention of pronation and prevention of supination by incorporation of the combination of the above elements.

[0020] The characteristics of the components, their size and shape, and their position are selected to provide a desired blend of improved cushioning and control, and more specifically to achieve a desired biomechanical function. The size and compression characteristics of the pads can be adjusted to address issues of over/under pronation, over/under supination, and other problems related to foot motion, including altering the size, shape, and material properties of the pads. The firmness of the pads and support cushion can be adjusted to address issues of over/under pronation, over/under supination, and other problems related to foot motion by altering the size, shape, and material properties of the pads. The present invention accomplishes the goals to: (1) improve ankle and foot stability, (2) cushion the heel and forefoot during push-offs and landings, (3) help prevent over pronation and over supination conditions, and (4) provide enhanced cushioning features to the heel, midfoot, arch and forefoot areas. In a preferred embodiment of the present invention, the components of an insole are permanently affixed to each other to create an insole designed for an intended type or category of activity. Many different insole designs can be made to address a broad range of different activities.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The above, and other objects and advantages of the present invention will be understood upon consideration of the following detailed description taken in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

[0022] FIG. 1A is a bottom perspective view of an illustrative embodiment of an insole in accordance with the principles of the present invention;

[0023] FIG. 1B is a exploded perspective view of an illustrative embodiment of an insole in accordance with the principles of the present invention;

[0024] FIG. 2 is a bottom planar view showing the base of the insole;

[0025] FIG. 3A and 3B are top (dorsal) views of the insole;

[0026] FIG. 4 is a medial (inner arch area) side view of the insole;

[0027] FIG. 5 is a lateral (outer) side view of the insole;

[0028] FIG. 6A and 6B are front (proximal) views of the insole; and,

[0029] FIG. 7A and 7B are rear (proximal) views of the insole.

#### DETAILED DESCRIPTION

[0030] In accordance with principles of the present invention, the present invention possesses: (1) a base of PU polyester glycol with a hardness of about 30 Asker  $\pm 3$  extending the length and width of the insole curving up in the medial arch area to form an arch support area and curving around the heel area to form a heel cup on the foot contact surface, with a separating wall between the base material and the forefoot pad indentation area on the bottom surface; a heel pad indentation under the calcaneal (heel) area on the bottom surface; a raised arch in the medial arch area with integrally formed longitudinal curvilinear indentations situated lengthwise, the curvilinear indentations formed in a criss-cross pattern alternating with interleaving and integrally formed raised gripping ridges in the medial arch area on the bottom surface; and a teardrop shaped indentation in the metatarsal area of the midfoot which curves upwardly (concave) from the bottom of the base bottom (shoe contact) surface and forms a collapsible metatarsal support which is convex on the top (foot contact) side of the base layer; (2) a forefoot pad of clear TPR gel which extends from the toe end of the insole to the midfoot area and from the lateral side to the medial side of the forefoot area with a diamond-cube pattern molded in the gel having pattern spacing of about 1 mm and a depth of about 1.5 mm, the TPR gel forefoot pad molded into the PU insole base distal to the separating wall on the base bottom surface with a knitted fabric layer secured between the TPR gel forefoot pad and the PU base material; (3) a heel pad on the bottom surface of the insole made of a clear TPR gel or pre-blown EVA with a hardness of approximately 20-35 Asker C  $\pm 3$  having a modified oval shape that is wider on the proximal end of the heel pad and narrows on the distal end of the heel pad with a diamond-cube pattern molded in the EVA having pattern spacing of about 1 mm and a depth of about 1.5 mm and which is secured in the heel pad indentation of the base bottom surface; (4) a soft heel dome on the top (foot contact) surface of the insole which would be directly above the heel pad in the bottom (shoe contact) surface providing heel cushioning directly under a user's heel bone and also providing shock absorption on the insole bottom; (5) a soft

metatarsal dome on the top (foot contact) surface providing cushioning directly over the metatarsal area of the foot; and, (6) a top sheet of polyester covering the entire foot contact surface of the insole which is treated with an antimicrobial agent.

**[0031]** The combination of the base, support cushion, and a heel pad specified herein provides a “degree” of medial longitudinal arch support, which provides a couple of degrees of improved pronation “control.” A “degree” of medial longitudinal arch support is approximately 1-2 degrees based on research evidence. By pronation “control,” we mean the increase in supination moments acting around the joints of the rearfoot and the decrease in the magnitude of pronation moments. The current invention is an insole 100 that provides a balanced approach to improving longitudinal arch support, prevention of pronation and prevention of supination.

**[0032]** Referring to FIG. 1A, 1B and 2, these views are perspective and top views of the bottom surface (shoe side) of an insole 100 according to the invention. The insole 100 extends from a heel end (proximal) to a toe end (distal) and has a medial border or side on the arch side of the foot, connecting said toe end to said heel end along the arch side of the insole and a lateral border or side on the other side (opposite side from medial side) thereof, connecting said toe end to said heel end on the other side of the insole.

**[0033]** The insole 100 also has a forefoot area that correlates with the metatarsal area and near the phalanges of the foot located over the forefoot pad 107 of the insole 100, a raised arch support 119 along the medial side, a heel area just forward of the heel cup 104, and a midfoot area 106 between the heel area and forefoot area 108. A user’s right shoe and left shoe are mirror images of one another as are the insoles adapted to be inserted in a right shoe and a left shoe respectively. Only the left insole is illustrated in the Figures. It will be understood by those of skill in the art that the right insole has a mirror image construction of the left insole.

**[0034]** The present invention is an insole that fits within the interior of a user’s shoe, and rests on the interior bottom surface of that shoe with the user’s foot being positioned over and on top of the insole. The insole 100 shown in Figure 1A, 1B and 2 has a bottom (shoe side) and a top (foot side) and the insole 100 comprises a base layer 102 having a contoured shape which receives and supports the foot of the user. The insole 100 is intended to be used inside a shoe and the bottom side thereof will contact the interior of a shoe after

insertion therein. In many cases, the insole will be used to replace an insole that previously was used in the shoe.

[0035] The base layer 102 has a heel end, a toe end, a lateral side and a medial side, said sides extending approximately from said heel end to said toe end. The lateral side lies adjacent the outer side of a user's foot in use and the medial side lies adjacent the inner side, or arch, of a user's foot in use, including the arch of the foot. The contoured shape includes an integrally formed raised arch support 119 that extends generally upwardly on the medial side of the insole. This upward extension arch support 119 allows the raised arch support to lie adjacent to a user's foot arch during use in the shoe.

[0036] As an example, approximate dimensions are given for a men's size 9 insole. Length and width of the insole are 28.1 cm (11.063 inches) and 9.7 cm (3.813 inches). The length and width will vary according to the shoe size for which the insole is intended. The total thickness of the insole can range from 6.8 millimeters near the toe area to 12 millimeters in the arch area. Arch height is about 15 millimeters. The forefoot and heel cushions have a thickness of approximately 4.0 millimeters. The preferred depth of the heel cup which is measured from the top side of the insole near the center of the heel area vertically to the top of the upraised heel area or heel raised edge is approximately 15-16 millimeters.

[0037] The base layer 102 has a base top surface and a base bottom surface. The base layer 102 defines a heel cup 104 adjacent said heel end, a contoured arch support 119 adjacent said medial side, a midfoot area 106 between said arch support 119 and the lateral midfoot area, a forefoot area 108 located between the metatarsal area to the toe end of the insole 100. There is a heel dome 118A on top surface of insole and a metatarsal dome 134 raised on the top surface of insole 100 (not shown), each of which respectively improves the cushioning characteristics of the insole at or near high impact points on the insole.

[0038] Base layer 102 is preferably made of foam or other material having suitable cushioning properties, including a fabric layer. Preferably, base layer 102 comprises an Ethylene vinyl acetate ("EVA") foam, which is a copolymer of ethylene and vinyl acetate, a Thermoplastic Rubber ("TPR")/EVA mix, or a blown EVA material. A blown EVA, EVA or TPR/EVA mix can have a durometer (hardness) of about Asker C 15-50. It is desirable to minimize the total weight of the insoles by selection of materials that promote the structural features of the insole. It is desirable that the total weight of the preferred

embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. The base layer may be formed from a gel material or made of polyurethane polyester glycol with a hardness 30 Asker  $\pm 3$ , or alternatively, can be made of a durable nylon fabric.

[0039] The base layer 102 is covered by a top sheet 128 that extends across the top surface of the base layer 102 from heel to toe end, and creates a top surface of the insole 100. The top sheet 128 is made of polyester or jadeite covering the entire foot contact surface of the insole, and is treated with an antimicrobial agent. Top sheet 128 is typically made of a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters, or preferably, top sheet 128 is made of a cooling fabric which contains a special low temperature jade obtained from a natural source.

[0040] The top sheet 128 bottom surface secured to base layer 102 top surface and a top sheet upper surface which contacts the foot of a user during use. The top sheet 128 is oriented to engage the user's foot on the top surface of the insole, and it serves an upper cooling and ventilation function, and the top sheet 128 can be made of suitable materials, such as a jadeite top cloth material. Preferably, the top sheet 128 is made of a low-friction fabric which prevents blisters on the user's foot. The top sheet 128 may also contain an antimicrobial treatment in order to keep bacteria from multiplying and therefore reduce odor. A suitable treatment is Silpure<sup>®</sup> antimicrobial treatment (Thomson Research Associates, Inc., Ontario, CA.).

[0041] In accordance with principles of the present invention and as shown in Figure 1A, 1B and 2, the shoe insole 100 has a bottom surface formed of three pieces including: (1) a base layer 102 extending from heel-to-toe, (2) a forefoot/pad layer 107 made of a clear TPR gel and positioned in a forefoot/pad indentation area 102A on a forefoot area 108 of the insole 100, and, (3) a midfoot-to-heel support cushion 105 made of a soft polyurethane positioned in a midfoot-to-heel indentation 102B. The three-piece bottom surface construction makes fabrication easier than known methods, and allows for different combinations of materials and cushioning characteristics and support by adjusting the materials used in the forefoot pad 107, base layer 102, the midfoot-to-heel support cushion 105, and the heel pad 118.

[0042] In a preferred embodiment, the insole 100 has a base layer 102, which can be a polyurethane or fabric sheet, coupled to: a midfoot-to-heel support cushion 105 made of polyurethane polyester glycol (hardness 10-30 Asker  $\pm 3$  – low density), a forefoot pad 107 made of clear TPR gel (thermoplastic rubber - hardness 10-20 Asker  $\pm 3$ ) (pattern spacing 1.0mm-1.50mm), a heel pad 118 made of pre-blown EVA (hardness 20-35 Asker  $\pm 3$ ) (pattern spacing 1.0mm-1.50mm) surrounded by a flat midfoot/heel surface and cupped along the back by a heel cup, nylon fabric between forefoot/heel pads and base (for adhesion of pads to PU), a raised oval heel dome 118A on top surface of the insole on the foot-contact side made of super-soft low density PU, a raised medial arch 119 that has raised and indented criss-cross curvilinear lines extending generally longitudinally along arch with vent holes, a groove depth on bottom 0.50 mm-1.5 mm, a top cloth made of 65% Nylon/ 35% polyester, a teardrop metatarsal dome 134 on top side is integrally formed as upwardly-curved indentation from bottom surface, a diamond-shaped groove pattern 117, 120 on the bottom surface of the forefoot pad 107 and the heel pad 118, respectively, and a separation wall 151 added between midfoot-to-heel cushion 105 and forefoot pad 107 of approximately 1 mm.

[0043] Forefoot pad 107 is shaped essentially the same as forefoot pad indentation area 102A and is secured therein. Forefoot pad 107 has a medial edge, a lateral edge, a proximal (back) edge and a distal (front) edge. The medial edge of forefoot pad 107 extends along a line spaced laterally from said medial border of said insole. The proximal edge extends from said medial edge laterally and proximally to said rear apex, laterally and distally towards the 3<sup>rd</sup> metatarsal head, then laterally and proximally to the lateral edge approximately along the 3<sup>rd</sup> through 5<sup>th</sup> metatarsal heads. The forefoot pad made of clear TPR gel (thermoplastic rubber), where said TPR gel has a hardness rating of 10-20 Asker  $\pm 3$ . The forefoot pad also has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.

[0044] The forefoot pad 107 is made of a clear TPR (thermoplastic rubber) gel which extends from the toe end of the insole to the lateral midfoot/arch area from the medial side to the lateral side of the forefoot area with a diamond-cube pattern molded in the gel having pattern spacing of about 1 mm and a depth of about 1.5 mm. The forefoot pad 107 is preferably made of clear TPR gel (thermoplastic rubber - hardness 10-20 Asker  $\pm 3$ ) (pattern spacing 1.0mm-1.50mm). The firmness of the forefoot pad 107 can be adjusted to address

issues of over/under pronation, over/under supination, and other problems related to foot motion by altering the size, shape, and material properties of the pads. The configuration, material and position of the forefoot pad 107 provides cushioning and works in association with other items to stabilize the ankle. The forefoot pads and heel pads are made of rubber or synthetic rubber, which includes being made of a neoprene synthetic rubber layer which is a polymer.

**[0045]** The lateral edge of the forefoot pad 107 connects said proximal edge to said top edge of said forefoot pad 107. In use, forefoot pad indentation area 102A and forefoot pad 107 underlie a portion of the big toe of a user's foot, and the "ball" of the foot, excluding the first metatarsal head or medial ball of the user's foot. The forefoot pad 107 provides cushioning and energy return on landing from a vertical jump. It serves as a propulsion pad and support for the metatarsal heads of a user's foot, especially the 1<sup>st</sup> and 2<sup>nd</sup> metatarsal heads. The forefoot pad 107 has a diamond shaped groove pattern 117 on its bottom surface to improve forefoot cushioning characteristics, which improves traction and adhesion of the insole inside and along the interior bottom surface of the user's shoe and improves durability and cushioning aspects of the forefoot pad over known materials.

**[0046]** The support cushion 105 is made of polyurethane polyester glycol (hardness 30 Asker  $\pm 3$  – low density). The support cushion indentation area 102B is located in the midfoot and heel areas of the bottom surface of the insole. The midfoot-to-heel support cushion indentation area 102B extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base layer 102 and from a distal edge slightly proximal of the forefoot pad indentation area 102A to a proximal edge approximate the heel end 104 of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1<sup>st</sup> metatarsal during toe off. Support cushion 105 is shaped essentially the same as midfoot-to-heel support cushion indentation area 102B and has a base facing surface and a shoe facing surface. The base facing surface is secured to said midfoot-to-heel support cushion indentation area 102B.

**[0047]** The midfoot/heel support cushion 105 has a raised arch 119 in the medial arch area and criss-crossing longitudinal curvilinear indentations 132,133 positioned along at least two or more major angles from the longitudinal axis, with the longitudinal axis extending from heel-to-toe on the insole 100. Longitudinal curvilinear indentations 132 extend in a first angled direction compared to the longitudinal axis of the insole 100, and longitudinal

curvilinear indentations 133 extend in a second angled direction compared to the longitudinal axis of the insole 100. The first and second angled directions are measured from the major axis lengths of the longitudinal curvilinear indentations 132 and longitudinal curvilinear indentations 133, respectively. The first angled direction is approximately 5 degrees to 65 degrees compared to the longitudinal axis, which is the lengthwise axis extending from heel to toe on the insole 100. The second angled direction is approximately 15 degrees to 85 degrees compared to the longitudinal axis, which is the lengthwise axis extending from heel to toe on the insole 100. The first and the second angles are not identical, so the pattern of the longitudinal curvilinear indentations 132 and 133 on the surface of the raised arch area 119 is a curvilinear formation. The criss-cross longitudinal curvilinear indentations 132, 133 in the raised arch area 119 provide additional rigidity to the raised arch support, which improves support raised arch 119 in the support cushion 105. These indentations 132, 133 in this criss-cross formation also promote polyurethane material flow in the area of the midfoot while assisting to minimize voids caused by air entrapment. The curvilinear indentations in the arch area also allow the arch area to collapse to fit the shoe thus providing a more accommodative design.

**[0048]** The midfoot/heel cushion 105 also possesses a flattened midfoot area 148 on the bottom surface of the insole 100 in midfoot area 106 and a metatarsal midfoot tear-drop raised area 134 positioned in a metatarsal tear-drop aperture 134A (e.g. metatarsal opening 134A) of the midfoot to heel support cushion 105. The flattened midfoot area 148 on the bottom surface of the insole 100 in the midfoot area 106 of the midfoot/heel cushion 105 is bordered on the medial side by a medial side longitudinal ridge 142 extending from midfoot to heel, on the lateral side by a lateral side longitudinal ridge 144 extending midfoot to heel, and around the exterior of the heel pod opening 112 by a heel ridge 152. This ridge 143, 142 and 152 improves the support and durability of the support cushion 105 and helps prevent pronation and supination rotations on the user's foot during use, which enhances and improves the performance of the insole. The midfoot/heel support cushion 105 also has a surrounding heel cup 104 that supports the exterior back of the user's heel with the heel cup 104 and extends to the raised arch area 119, which also improves the support provided to the user's foot during use.

**[0049]** Support cushion 105 has side and end walls that wrap up the sides and rear of base layer 102 to provide support for the foot by cupping the outside areas of the heel, providing

stability stiffness from the midfoot to the heel area, and providing an upward support in the medial arch area of the user's foot. Preferably, midfoot-to-heel support cushion 105 ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The first or second set of longitudinal indentations have a groove depth of approximately 0.50 mm-1.5 mm.

**[0050]** There is a raised separation wall 151 located on the base layer 102 between the forefoot pad 107 and the midfoot/heel support cushion 105, which is located laterally across the width of the insole 100 between the metatarsal and forefoot areas on the insole 100. The separation wall provides isolation of the forefoot pad 107 from the midfoot-to-heel support cushion 105, which improves the cushioning characteristics of those materials as well as improving the support of the insole 100. The separation wall located on the bottom surface of the base layer and is approximately 1 mm in height. At the beginning of the propulsion or toe off phase of a step, the heel begins to lift from the ground and weight shifts to the ball of the foot. Forefoot pad 107 is located under this part of the foot. Preferably, forefoot pad 107 is formed of a relatively resilient material so that energy put into compressing forefoot pad 107 is returned to help propel the foot at toe off.

**[0051]** During toe off, the first metatarsal naturally flexes downward. Preventing this natural downward flex of the first metatarsal causes the arch of the foot to flatten and the foot to over pronate, increasing stress on the ankles and knees. To accommodate the downward flex, the forefoot pad 107 extends rearward into a corresponding concave edge portion of the distal edge of separation wall 151. The shape of the forefoot pad 107 permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

**[0052]** The heel pod opening 112 extends through the entirety of the thickness of the midfoot/heel support cushion 105 to position the heel pad 118 on the bottom surface of the base layer 102. The heel pad aperture is surrounded by a flat midfoot/heel surface with surrounding grooves. The heel pod opening 112 is surrounded by heel pod opening border grooves 138, which surrounds the circumference of the heel pod opening 112. These grooves isolate the heel pad 118 from the midfoot-to-heel support cushion 105, which improves the performance of the heel pad 118. The heel pad 118 is located in the heel pod opening 112 and affixed to the bottom surface of the insole 100, and the heel pad 118 is made of a clear TPR gel or blown EVA with a diamond shaped groove pattern 120 to

improve heel cushioning characteristics and improve traction and adhesion of the insole inside and along the interior bottom surface of the user's shoe. The heel pad can be made from a TPR gel or made of pre-blown EVA (ethylene-vinyl acetate) material, and the heel pad has a hardness rating of 20-35 Asker  $\pm 3$ . The heel pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm. There is a soft heel dome on the top (foot contact) surface of the insole located above the heel pad 118 in the bottom (shoe contact) surface providing heel cushioning directly under a user's heel bone and also providing shock absorption on the insole bottom.

**[0053]** Insole production can be accomplished by an open-pour molding process. The process consists of pouring mixed polyurethane or TPR into an open mold. Once poured in the mold, the polyurethane mixture will expand to fill the cavity. Once cured, the base insole is removed from the mold. The forefoot cushion and heel cushion if employed can be secured to the indentations by adhesive or can be secured in place during the polyethylene pouring operation. Bonding occurs to a fabric that is bonded to the forefoot cushion or the heel cushion.

**[0054]** Alternatively, the forefoot pad 107 can be molded onto the bottom surface of the insole base layer 102 from the forefoot pad indentation 102A up to the separation wall 151 on the base bottom surface of the base layer 102. A fabric layer may be inserted between the forefoot pad 107 and the base layer 102 in the forefoot pad indentation 102A. And, the midfoot/heel cushion 105 can be molded onto the bottom surface of the insole base layer 102 from the indentation 102B up to the separation wall 151 on the base bottom surface of the base layer 102. A fabric layer may be inserted between the midfoot-to-heel support cushion 105 and the base layer 102 in the indentation 102B. Also, the heel pad 118 can be molded onto the bottom surface of insole base layer 102 in the heel pod opening 112. A fabric layer may be inserted between the heel pad 118 and the base layer 102 in the support cushion indentation area 102B. The forefoot pad 107, the heel pad 118, and the midfoot/heel support cushion 105 can also be secured adjacent to one another on the bottom surface of the base layer 102 with an adhesive that is suitable for creating a semi-permanent (or permanent) bond or adhesive, which may be liquid upon application but firms into a solid. The curvilinear indentations 132, 133 are preferably molded into the base during manufacture.

[0055] FIG. 3A and 3B illustrates the top (foot side) of an insole according to the invention, with Figure 3A showing the top side of the base layer 102 exposed without a top sheet 128 covering and Figure 3B showing the top side of the insole 100 with a top sheet 128 placed over the base layer 102. A heel dome 118A is located on the top surface of insole 100 and a metatarsal dome 134 raised on the top surface of insole 100, each of which respectively improves the cushioning characteristics of the insole at or near high impact points on the insole 100. The medial side of the base layer 102, the heel cup 104, and the lateral side of the base layer 102 are shown in Figures 3A and 3B. The teardrop metatarsal pad on top side is integrally formed as upwardly-curved indentation from bottom surface of the insole.

[0056] The heel dome 118A on the top (foot contact) surface of the insole 100 is located directly above the heel pad 118 in the bottom (shoe contact) surface of the base layer 102, and heel dome 118A provides heel cushioning directly under a user's heel bone and also providing shock absorption on the insole bottom from the top surface of the insole 100. A soft metatarsal dome 134 is located on the top (foot contact) surface providing cushioning directly over the metatarsal area of the foot.

[0057] The top sheet 128 is shown in Figure 3B, and the location where the top sheet would be positioned is shown in Figure 3A. The top sheet 128 covers the entire foot contact surface of the insole 100 which is treated with an antimicrobial agent. The top surface of the insole 100 is covered by a top sheet 128 that extend across the top surface from heel to toe end. Top sheet 128 is typically made of a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters, or preferably, top sheet 128 is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The top sheet can be made of 65% Nylon/ 35% polyester.

[0058] Referring to FIG. 4, the medial side view of the insole 100 is shown with curvilinear indentations 132, 133 shown in the raised arch area 119. Also illustrated is a forefoot pad 107 located in the forefoot area 108, a base layer 102, a support cushion 105, the heel cup 104, and a top sheet 128. Insole 100 preferably comprises a top sheet 128 and a base layer 102 having a top surface secured to said top sheet and an opposite bottom surface. Base layer 102 also defines a raised arch support 119 that extends upwardly along the medial side of the insole to provide extra cushion and support to the raised arch 119 of the foot. Also referring to FIG. 5, the insole 100 lateral side view is shown with the raised arch 119, the

metatarsal dome 134, a forefoot pad 107 located in the forefoot area 108, a base layer 102, a midfoot-to-heel support cushion 105, the heel cup 104, the lateral side of the support cushion 105, and a top sheet 128. Figure 5 shows insole 100 preferably comprises a top sheet 128 and a base 102 having a top surface secured to said top sheet 128 and an opposite bottom surface. Base layer 102 also defines a raised arch support 119 that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

**[0059]** As shown in Figures 4 and 5, the shoe insole 100 has a bottom surface formed of three pieces including: (1) a base layer 102 extending from heel-to-toe, (2) a forefoot pad 107 made of a clear TPR gel and positioned in a forefoot pad indentation area 102A on a forefoot base area 108 of the insole 100, and, (3) a midfoot-to-heel support cushion 105 made of a soft polyurethane positioned in a midfoot to heel indentation area 102B. The three-piece bottom surface construction makes fabrication easier than known methods, and allows for different combinations of materials and cushioning characteristics and support by adjusting the materials used in the forefoot pad 107, base layer 102, the support cushion 105, and the heel pad 118.

**[0060]** In a preferred embodiment, the insole 100 has a base layer 102, which can be a polyurethane or fabric sheet, coupled to: a support cushion 105 made of polyurethane polyester glycol (hardness 10-30 Asker  $\pm 3$  – low density), a forefoot pad 107 made of clear TPR gel (thermoplastic rubber - hardness 10-20 Asker  $\pm 3$ ) (pattern spacing 1.0mm-1.50mm), a heel pad 118 made of clear TPR gel or pre-blown EVA (hardness 20-35 Asker  $\pm 3$ ) (pattern spacing 1.0mm-1.50mm) surrounded by a flat midfoot/heel surface and cupped along the back by a heel cup 104. A raised medial arch 119 that has raised and indented criss-cross curvilinear lines 132, 133 extend longitudinally along raised arch 119 with vent holes, a groove depth on bottom 0.50 mm-1.5 mm, a top cloth made of 65% Nylon/ 35% polyester. A teardrop metatarsal dome 134 on top side of the insole 100 is integrally formed as from an upwardly-curved metatarsal raised area 134 from bottom surface, and a diamond-shaped groove pattern 117, 120 is located on the bottom surface of the forefoot pad 107. A separation wall 151 added between cushion 105 and forefoot pad 107 of approximately 1 mm.

**[0061]** The forefoot pad 107 is made of a clear TPR (thermoplastic rubber) gel which extends from the toe end of the insole to the lateral midfoot area and from the medial side to

the lateral side of the forefoot area with a diamond-cube pattern molded in the gel having pattern spacing of about 1 mm and a depth of about 1.5 mm. The forefoot pad 107 is preferably made from a forefoot pad made of clear TPR gel (thermoplastic rubber - hardness 20 Asker  $\pm 3$ ) (pattern spacing 1.0mm-1.50mm). The firmness of the forefoot pad 107 can be adjusted to address issues of over/under pronation, over/under supination, and other problems related to foot motion by altering the size, shape, and material properties of the pads. The configuration, material and position of the forefoot pad 107 provides cushioning and works in association with other items to stabilize the ankle. The forefoot pad 107 has a diamond shaped groove pattern 117 on its bottom surface to improve forefoot cushioning characteristics, which improves traction and adhesion of the insole inside and along the interior bottom surface of the user's shoe and improves durability and cushioning aspects of the forefoot pad 107 over known materials.

**[0062]** The midfoot/heel support cushion 105 has a raised arch 119 in the medial arch area and criss-crossing longitudinal curvilinear indentations 132,133 positioned along at least two or more major angles from the longitudinal axis, with the longitudinal axis extending from heel-to-toe on the insole 100. The midfoot support cushion 105 is made of polyurethane polyester glycol (hardness 30 Asker  $\pm 3$  – low density). As shown in Figure 4, longitudinal curvilinear indentations 132 extend in a first angled direction compared to the longitudinal axis of the insole 100, and longitudinal curvilinear indentations 133 extend in a second angled direction compared to the longitudinal axis of the insole 100. The first and the second angles are not identical, so the pattern of the longitudinal curvilinear indentations 132, 133 on the surface of the raised arch area 119 is a curvilinear formation. The criss-cross longitudinal curvilinear indentations 132, 133 in the raised arch area 119 provide additional rigidity to the raised arch support 119, which improves support provided by the raised arch 119 on the support cushion 105. These indentations 132, 133 in this criss-cross formation also promote polyurethane material flow in support cushion 105 formation while assisting to minimize voids caused by air entrapment. The curvilinear indentations in the arch area 119 also allow the arch area to collapse to fit the shoe thus providing a more accommodative design.

**[0063]** There is a raised separation wall 151 shown in Figures 4 and 5 located on the base layer 102 between the forefoot pad 107 and the midfoot-to-heel support cushion 105, which is located laterally across the width of the insole 100 between the metatarsal and forefoot

areas on the insole 100. The separation wall 151 provides isolation of the forefoot pad 107 from the midfoot-to-heel support cushion 105, which improves the cushioning characteristics of those materials as well as improving the support of the insole 100. At the beginning of the propulsion or toe off phase of a step, the heel begins to lift from the ground and weight shifts to the ball of the foot. Forefoot pad 107 is located under this part of the foot.

**[0064]** The top sheet 128 bottom surface is secured to base layer 102 top surface and a top sheet upper surface which contacts the foot of a user during use. The top sheet 128 is oriented to engage the user's foot on the top surface of the insole, and it serves an upper cooling and ventilation function, and the top sheet 128 can be made of suitable materials, such as a jadeite top cloth material. Preferably, the top sheet 128 is made of a low-friction fabric which prevents blisters on the user's foot. The top sheet 128 may also contain an antimicrobial treatment in order to keep bacteria from multiplying and therefore reduce odor.

**[0065]** Now referring to FIG. 6A and 6B show the front end view from the toe end looking toward the heel end 104, upraised heel area is visible at the heel end 104, raised arch support 119 is seen on the medial side, with the top sheet 128 shown in Figure 6B and removed in Figure 6A. These figures show forefoot pad 107 in forefoot area 108, base layer 102, raised arch area 119, and top sheet 128 (Figure 6B, placement shown where would be located in Figure 6A). Figure 7A and 7B show the heel end view of the insole 100 looking from the heel area towards the toe area, with the top sheet 128 shown in Figure 7B and removed in Figure 7A. From this view, one can see the features of insole 100 including heel cup 104, lateral side and medial side of the base layer 102, the raised arch 119 with criss-cross placement of curvilinear indentations 132, 133, and the top sheet 128 (Figure 7B, placement shown where would be located in Figure 7A).

**[0066]** As shown in Figures 6A, 6B, 7A and 7B, the shoe insole 100 has a bottom surface formed of three pieces including: (1) a base layer 102 extending from heel-to-toe, (2) a forefoot pad layer 107 made of a clear TPR gel and positioned in a forefoot pad indentation 102A on a forefoot base area 108 of the insole 100, and, (3) a midfoot-to-heel support cushion 105 made of a soft polyurethane positioned in a midfoot to heel indentation 102B. The three-piece bottom surface construction makes fabrication easier than known methods, and allows for different combinations of materials and cushioning characteristics and

support by adjusting the materials used in the forefoot pad 107, base layer 102, the support cushion 105, and the heel pad 118.

[0067] In a preferred embodiment, the insole 100 has a base layer 102, which can be a polyurethane or fabric sheet, coupled to: a support cushion 105 made of polyurethane polyester glycol (hardness 10-30 Asker  $\pm 3$  – low density), a forefoot pad 107 made of clear TPR gel (thermoplastic rubber - hardness 10-20 Asker  $\pm 3$ ) (pattern spacing 1.0mm-1.50mm), a heel pad 118 made of pre-blown EVA (hardness 20-35 Asker  $\pm 3$ ) (pattern spacing 1.0mm-1.50mm) surrounded by a flat midfoot/heel surface and cupped along the back by a heel cup 104. The midfoot/heel cushion 105 has a raised arch 119 in the medial arch area and criss-crossing longitudinal curvilinear indentations 132,133 positioned along at least two or more major angles from the longitudinal axis, with the longitudinal axis extending from heel-to-toe on the insole 100. The midfoot support cushion 105 is made of polyurethane polyester glycol (hardness 30 Asker  $\pm 3$  – low density). A teardrop metatarsal dome 134 shown in Figures 6A and 6B is located on top side of the insole 100 is integrally formed from the upwardly-curved metatarsal raised area 134 on the bottom surface, and a diamond-shaped groove pattern 117, 120 is located on the bottom surface of the forefoot pad 107. A separation wall 151 is added between cushion 105 and forefoot pad 107 of approximately 1 mm.

[0068] The forefoot pad 107 is made of a clear TPR (thermoplastic rubber) gel and extends from the toe end of the insole to the midfoot area and extends from the medial side to the lateral side of the forefoot area with a diamond-cube groove pattern molded in the gel having pattern spacing of about 1 mm and a depth of about 1.5 mm. The forefoot pad 107 is preferably made of clear TPR gel (thermoplastic rubber - hardness 20 Asker  $\pm 3$ ) (pattern spacing 1.0mm-1.50mm). The firmness of the forefoot pad 107 can be adjusted to address issues of over/under pronation, over/under supination, and other problems related to foot motion by altering the size, shape, and material properties of the pads. The configuration, material and position of the forefoot pad 107 provides cushioning and works in association with other items to stabilize the ankle. The forefoot pad 107 has a diamond shaped groove pattern 117 on its bottom surface to improve forefoot cushioning characteristics, which improves traction and adhesion of the insole inside and along the interior bottom surface of the user's shoe and improves durability and cushioning aspects of the forefoot pad 107 over known materials.

[0069] The midfoot/heel cushion 105 has a raised arch 119 in the medial arch area of the insole 100 and criss-crossing longitudinal curvilinear indentations 132,133 positioned along at least two or more major angles from the longitudinal axis, with the longitudinal axis extending from heel-to-toe on the insole 100. The support cushion 105 is made of polyurethane polyester glycol (hardness 30 Asker  $\pm 3$  – low density). As shown in Figure 7A and 7B, longitudinal curvilinear indentations 132 extend in a first angled direction compared to the longitudinal axis of the insole 100, and longitudinal curvilinear indentations 133 extend in a second angled direction compared to the longitudinal axis of the insole 100. The first and the second angles are not identical, so the pattern of the longitudinal curvilinear indentations 132 and 133 on the surface of the raised arch area 119 is a curvilinear formation. The criss-cross longitudinal curvilinear indentations in the raised arch 119 provide additional rigidity to the raised arch support, which improves support provided by the raised arch 119 in the support cushion 105. These indentations 132, 133 in this criss-cross formation also promote polyurethane material flow in the raised arch 119 of the base layer 102 while assisting to minimize voids caused by air entrapment. The curvilinear indentations in the arch area also allow the arch area to collapse to fit the shoe thus providing a more accommodative design.

[0070] The top sheet 128 bottom surface is secured to base layer 102 top surface and a top sheet upper surface which contacts the foot of a user during use. The top sheet 128 is oriented to engage the user's foot on the top surface of the insole, and it serves an upper cooling and ventilation function, and the top sheet 128 can be made of suitable materials, such as a jadeite top cloth material. Preferably, the top sheet 128 is made of a low-friction fabric which prevents blisters on the user's foot. The top sheet 128 may also contain an antimicrobial treatment in order to keep bacteria from multiplying and therefore reduce odor.

[0071] Foot contact with the ground is generally divided into three phases: heel strike, midfoot support, and toe off. During heel strike, the heel of the foot impacts the ground with significant force. Following the initial impact of the heel with the ground, the foot twists, or pronates, bringing the medial side of the heel into contact with the ground. The foot is sensitive to the amount of pronation as well as the rate at which the pronation occurs. Pronation is natural, and some degree of pronation is desirable because it serves to absorb

the stresses and forces on the foot during walking or running. However, an excessive amount or rate of pronation can result in injury.

[0072] To cushion the impact, the extended heel pad 112 and the supplemental heel pad 116 work in conjunction with the support cushion 105 to accomplish the goals of the invention, such as: (1) improving ankle and foot stability, (2) cushioning the heel and forefoot during push-offs and landings, (3) helping prevent over pronation and over supination conditions, and (4) providing enhanced cushioning features to the heel, midfoot, arch and forefoot areas. Support cushion 105 provides firm support along the medial portion of the foot, including the medial arch area and surrounding the heel area, to help control the amount of foot pronation.

[0073] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base layer 102 in the indentation areas defined by base layer 102 on the bottom surface are permanently affixed to base layer 102 using an appropriate means such as an adhesive. The components are secured during the molding process using techniques known in the art of molding insoles. The indentation areas are also lined with a cloth having a base surface and a pad surface, secured to said base layer 102 along said base surface and said pad along said pad surface. Alternatively, a cloth is secured to said pad and then the composite structure secured to the indentation area.

[0074] An improved insole 100 has been disclosed. It will be readily apparent that the illustrative embodiments of an insole thus disclosed may be useful in cushioning the foot and controlling pronation during activities such as hiking, backpacking, and the like. However, one will understand that the components of the insole system may be modified to accommodate other activities or to control other kinds of foot motion. Thus, the description provided herein, including the presentation of specific thicknesses, materials, and properties of the insole components, is provided for purposes of illustration only and not of limitation, and that the invention is limited only by the appended claims.

**CLAIMS**

1. A contoured insole used inside a shoe and having a top side that contacts the users foot, a bottom side that contacts the interior of a shoe after insertion therein, a lateral side that lies adjacent to the outer side of a user's foot in use and a medial side that lies adjacent the inner side, or arch, of a user's foot, said insole comprising:

a base layer having a contoured shape which receives and supports the foot of the user, a heel end, a toe end, a top surface, a bottom surface, a lateral side and a medial side, said lateral and medial sides extending approximately from said heel end to said toe end, said base layer having:

- (a) a forefoot pad indentation area on the bottom surface of the insole extending from the midfoot to the toe area of the base layer and supporting the insertion of a forefoot pad therein,
- (b) a midfoot-to-heel stability cushion indentation area on the bottom surface of the insole extending from the midfoot to the heel area of the insole and supporting the insertion of a stability cushion therein;
- (c) a heel dome on the top surface of the base layer and raised over the heel area of the insole;
- (d) a metatarsal dome on the top surface of base layer and raised over the metatarsal midfoot area of the insole;
- (e) separation wall on the bottom surface of the base layer and located between said forefoot pad indentation area and said midfoot-to-heel stability cushion indentation area

a stability cushion positioned on the bottom surface of the base layer in the stability cushion indentation area and having a raised arch support on the bottom surface of the insole in the medial arch area, a heel cup on the bottom surface of the insole and surrounding the heel end of the insole with vertical walls, a metatarsal arch dome raised up from the bottom surface of the insole, and a heel pad aperture on the bottom surface of the base layer in the heel area,

said raised arch support having a first set of curvilinear indentations on the bottom surface of the insole in medial arch area and extending generally lengthwise in a longitudinal toe-to-heel direction at a first angle of inclination from the longitudinal axis of the insole;

said raised arch support having a second set of curvilinear indentations on the bottom surface of the insole in medial arch area and extending generally lengthwise in a longitudinal toe-to-heel direction at a second angle of inclination from the longitudinal axis of the insole, said first angle of inclination and said second angle of inclination not being equal,

a forefoot pad positioned on the bottom surface of the insole in the forefoot indentation area;

a heel pad positioned in the heel pad aperture of the stability cushion, and extending through the stability cushion to be secured to the bottom surface of the base layer;

a top sheet that extends across the top surface of the base layer from the heel end to the toe end of the insole.

2. The insole of claim 1, wherein said first angle of inclination is 5-65 degrees compared to said longitudinal axis of said insole and said second angle of inclination is 15-85 degrees compared to said longitudinal axis of said insole.

3. The insole of claim 1, wherein said base layer is made of polyurethane polyester glycol with a hardness 10-30 Asker  $\pm 3$ .

4. The insole of claim 1, wherein said forefoot pad made of a clear TPR gel (thermoplastic rubber).

5. The insole of claim 4, wherein said TPR gel has a hardness rating of 10-20 Asker  $\pm 3$ .

6. The insole of claim 1, wherein said forefoot pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.

7. The insole of claim 1, wherein said heel pad is made of pre-blown EVA (ethylene-vinyl acetate) material.

8. The insole of claim 7, wherein said heel pad has a hardness rating of 20-35 Asker  $\pm 3$ .

9. The insole of claim 1, wherein said heel pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.
10. The insole of claim 1, wherein said heel pad aperture is surrounded by a flat midfoot/heel surface with surrounding grooves.
11. The insole of claim 1, wherein base layer is made of a durable nylon fabric.
12. The insole of claim 1, wherein said first longitudinal indentations have a groove depth of approximately 0.50 mm-1.5 mm.
13. The insole of claim 1, wherein said top sheet is made of 65% Nylon/ 35% polyester.
14. The insole of claim 1, wherein said metatarsal dome on the top side of the insole matches the upwardly-curved metatarsal arch dome on the bottom surface of the insole.
15. The insole of claim 1, wherein said separation wall located on the bottom surface of the base layer and is approximately 1 mm in height.
16. The insole of claim 1, wherein said forefoot and heel pads are made of rubber or synthetic rubber.
17. The insole of claim 1, wherein said forefoot and heel pads are made of a neoprene synthetic rubber.
18. A contoured insole used inside a shoe and having a top side that contacts the users foot, a bottom side that contacts the interior of a shoe after insertion therein, a lateral side that lies adjacent to the outer side of a user's foot in use and a medial side that lies adjacent the inner side, or arch, of a user's foot, said insole comprising:

a base layer having a contoured shape which receives and supports the foot of the user, a heel end, a toe end, a top surface, a bottom surface, a lateral side and a medial side, said lateral and medial sides extending approximately from said heel end to said toe end, said base layer having:

- (a) a forefoot pad area on the bottom surface of the insole extending from the midfoot to the toe area of the base layer and supporting the insertion of a forefoot pad therein,

(b) a midfoot-to-heel stability cushion area on the bottom surface of the insole extending from the midfoot to the heel area of the insole and supporting the insertion of a stability cushion therein;

a stability cushion positioned on the bottom surface of the base layer in the stability cushion area and having a raised arch support on the bottom surface of the insole in the medial arch area, a heel cup on the bottom surface of the insole and surrounding the heel end of the insole with vertical walls, a metatarsal arch dome raised up from the bottom surface of the insole, and a heel pad aperture on the bottom surface of the base layer in the heel area,

said raised arch support having a first set of curvilinear indentations on the bottom surface of the insole in medial arch area and extending generally lengthwise in a longitudinal toe-to-heel direction at a first angle of inclination from the longitudinal axis of the insole;

said raised arch support having a second set of curvilinear indentations on the bottom surface of the insole in medial arch area and extending generally lengthwise in a longitudinal toe-to-heel direction at a second angle of inclination from the longitudinal axis of the insole, said first angle of inclination and said second angle of inclination not being equal,

a forefoot pad positioned on the bottom surface of the insole in the forefoot area;

a heel pad positioned in the heel pad aperture of the stability cushion, and extending through the stability cushion to be secured to the bottom surface of the base layer;

a top sheet that extends across the top surface of the base layer from the heel end to the toe end of the insole.

19. The insole of claim 18, wherein said base layer has separation wall on the bottom surface of the base layer and located between said forefoot pad indentation area and said midfoot-to-heel stability cushion indentation area.

20. The insole of claim 19, wherein said separation wall located on the bottom surface of the base layer and is approximately 1 mm in height.

21. The insole of claim 18, wherein said base layer has a heel dome on the top surface of the base layer and raised over the heel area of the insole.
22. The insole of claim 18, wherein said base layer has a metatarsal dome on the top surface of base layer and raised over the metatarsal midfoot area of the insole.
23. The insole of claim 18, wherein base layer is made of a durable nylon fabric.
24. The insole of claim 18, wherein said first angle of inclination is 5-65 degrees compared to said longitudinal axis of said insole and said second angle of inclination is 15-85 degrees compared to said longitudinal axis of said insole.
25. The insole of claim 18, wherein said base layer is made of polyurethane polyester glycol with a hardness 10-30 Asker  $\pm 3$ .
26. The insole of claim 18, wherein said forefoot pad is made of clear TPR gel (thermoplastic rubber) gel.
27. The insole of claim 26, wherein said TPR gel has a hardness rating of 10-20 Asker  $\pm 3$ .
28. The insole of claim 18, wherein said forefoot pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.
29. The insole of claim 18, wherein said heel pad made of pre-blown EVA (ethylene-vinyl acetate) material.
30. The insole of claim 29, wherein said heel pad has a hardness rating of 20-35 Asker  $\pm 3$ .
31. The insole of claim 18, wherein said heel pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.
32. The insole of claim 18, wherein said heel pad aperture is surrounded by a flat midfoot/heel surface with surrounding grooves.
33. The insole of claim 18, wherein said first longitudinal indentations have a groove depth of approximately 0.50 mm-1.5 mm.
34. The insole of claim 18, wherein said top sheet is made of 65% Nylon/ 35% polyester.

35. The insole of claim 18, wherein said metatarsal dome on the top side of the insole matches the upwardly-curved metatarsal arch dome on the bottom surface of the insole.
36. The insole of claim 18, wherein said forefoot and heel pads are made of rubber or synthetic rubber.
37. The insole of claim 18, wherein said forefoot and heel pads are made of a neoprene synthetic rubber layer which is a polymer.
38. A method of making a contoured insole to be used inside a shoe and having a top side that contacts the users foot, a bottom side that contacts the interior of a shoe after insertion therein, a lateral side that lies adjacent to the outer side of a user's foot in use and a medial side that lies adjacent the inner side, or arch, of a user's foot, said insole comprising:

providing a base layer with a contoured shape which receives and supports the foot of the user, said base layer having a heel end, a toe end, a top surface, a bottom surface, a lateral side and a medial side, said lateral and medial sides extending approximately from said heel end to said toe end, and said base layer having:

- (a) a forefoot pad indentation area on the bottom surface of the insole extending from the midfoot to the toe area of the base layer and supporting the insertion of a forefoot pad therein,
- (b) a midfoot-to-heel stability cushion indentation area on the bottom surface of the insole extending from the midfoot to the heel area of the insole and supporting the insertion of a stability cushion therein;
- (c) a heel dome on the top surface of the base layer and raised over the heel area of the insole;
- (d) a metatarsal dome on the top surface of base layer and raised over the metatarsal midfoot area of the insole;
- (e) separation wall on the bottom surface of the base layer and located between said forefoot pad indentation area and said midfoot-to-heel stability cushion indentation area

positioning a stability cushion on the bottom surface of the base layer in the stability cushion indentation area, said stability cushion having a raised arch support on the bottom surface of the insole in the medial arch area, a heel cup on the bottom surface of the insole and surrounding the heel end of the insole with vertical walls, a metatarsal arch dome raised up from the bottom surface of the insole, and a heel pad aperture on the bottom surface of the base layer in the heel area,

said raised arch support having a first set of curvilinear indentations on the bottom surface of the insole in medial arch area and extending generally lengthwise in a longitudinal toe-to-heel direction at a first angle of inclination from the longitudinal axis of the insole;

said raised arch support having a second set of curvilinear indentations on the bottom surface of the insole in medial arch area and extending generally lengthwise in a longitudinal toe-to-heel direction at a second angle of inclination from the longitudinal axis of the insole, said first angle of inclination and said second angle of inclination not being equal,

positioning a forefoot pad on the bottom surface of the insole in the forefoot indentation area;

positioning a heel pad in the heel pad aperture of the stability cushion, and extending the heel pad through the stability cushion to be secured to the bottom surface of the base layer;

placing a top sheet that extends across the top surface of the base layer from the heel end to the toe end of the insole.

39. The method of making the insole of claim 38, wherein said first angle of inclination is 5-65 degrees compared to said longitudinal axis of said insole and said second angle of inclination is 15-85 degrees compared to said longitudinal axis of said insole.

40. The method of making the insole of claim 38, wherein said base layer is made of polyurethane polyester glycol with a hardness 10-30 Asker  $\pm 3$ .

41. The method of making the insole of claim 38, wherein said forefoot pad made of a clear TPR gel (thermoplastic rubber).

42. The method of making the insole of claim 41, wherein said TPR gel has a hardness rating of 10-20 Asker  $\pm 3$ .
43. The method of making the insole of claim 38, wherein said forefoot pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.
44. The method of making the insole of claim 38, wherein said heel pad is made of pre-blown EVA (ethylene-vinyl acetate) material.
45. The method of making the insole of claim 44, wherein said heel pad has a hardness rating of 20-35 Asker  $\pm 3$ .
46. The method of making the insole of claim 38, wherein said heel pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.
47. The method of making the insole of claim 38, wherein said heel pad aperture is surrounded by a flat midfoot/heel surface with surrounding grooves.
48. The method of making the insole of claim 38, wherein base layer is made of a durable nylon fabric.
49. The method of making the insole of claim 38, wherein said first longitudinal indentations have a groove depth of approximately 0.50 mm-1.5 mm.
50. The method of making the insole of claim 38, wherein said top sheet is made of 65% Nylon/ 35% polyester.
51. The method of making the insole of claim 38, wherein said metatarsal dome on the top side of the insole matches the upwardly-curved metatarsal arch dome on the bottom surface of the insole.
52. The method of making the insole of claim 38, wherein said separation wall located on the bottom surface of the base layer and is approximately 1 mm in height.
53. The method of making the insole of claim 38, wherein said forefoot and heel pads are made of rubber or synthetic rubber.
54. The method of making the insole of claim 38, wherein said forefoot and heel pads are made of a neoprene synthetic rubber.
55. The method of making the insole of claim 38 wherein said steps of positioning include forming the material by molding in place.



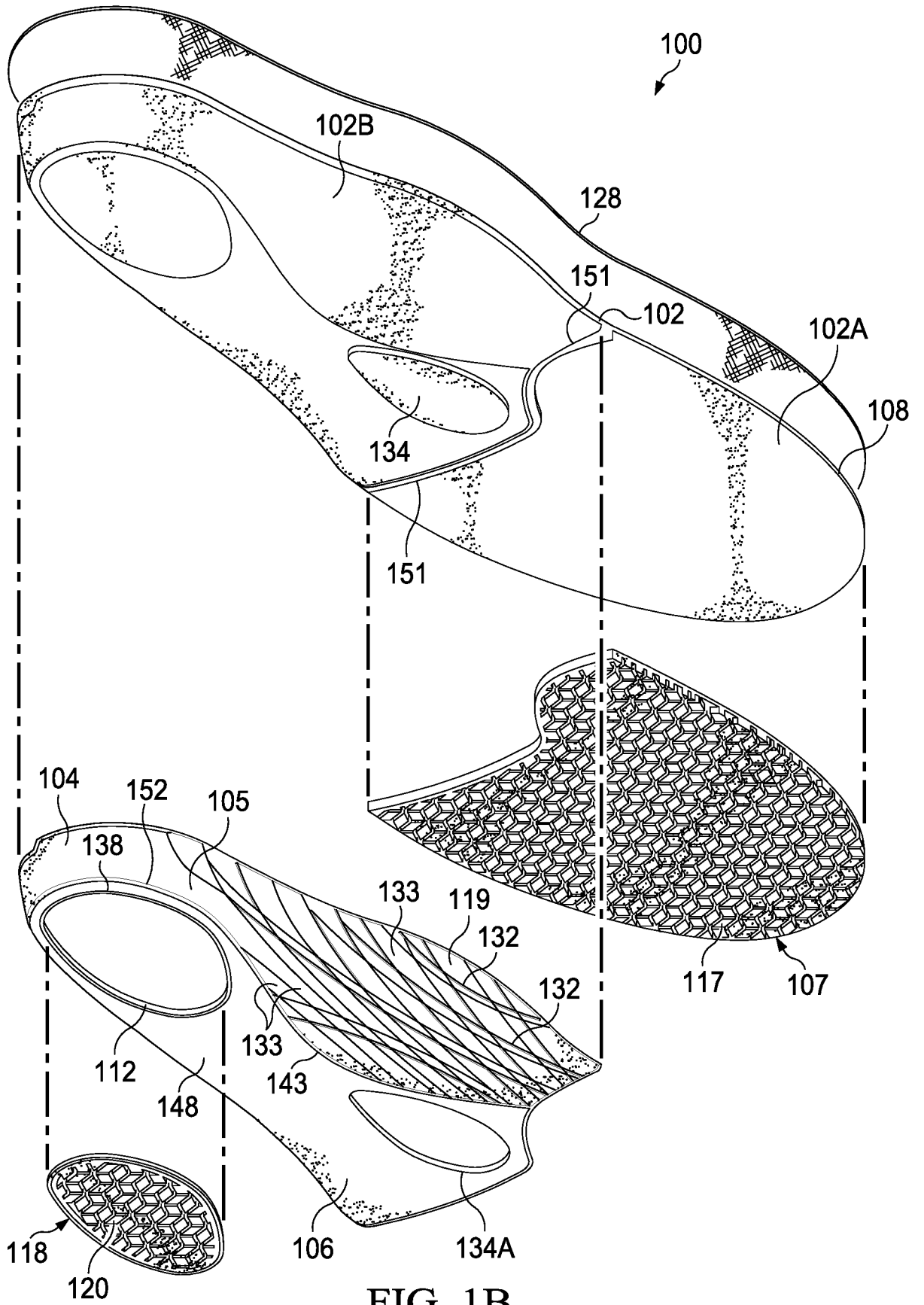


FIG. 1B

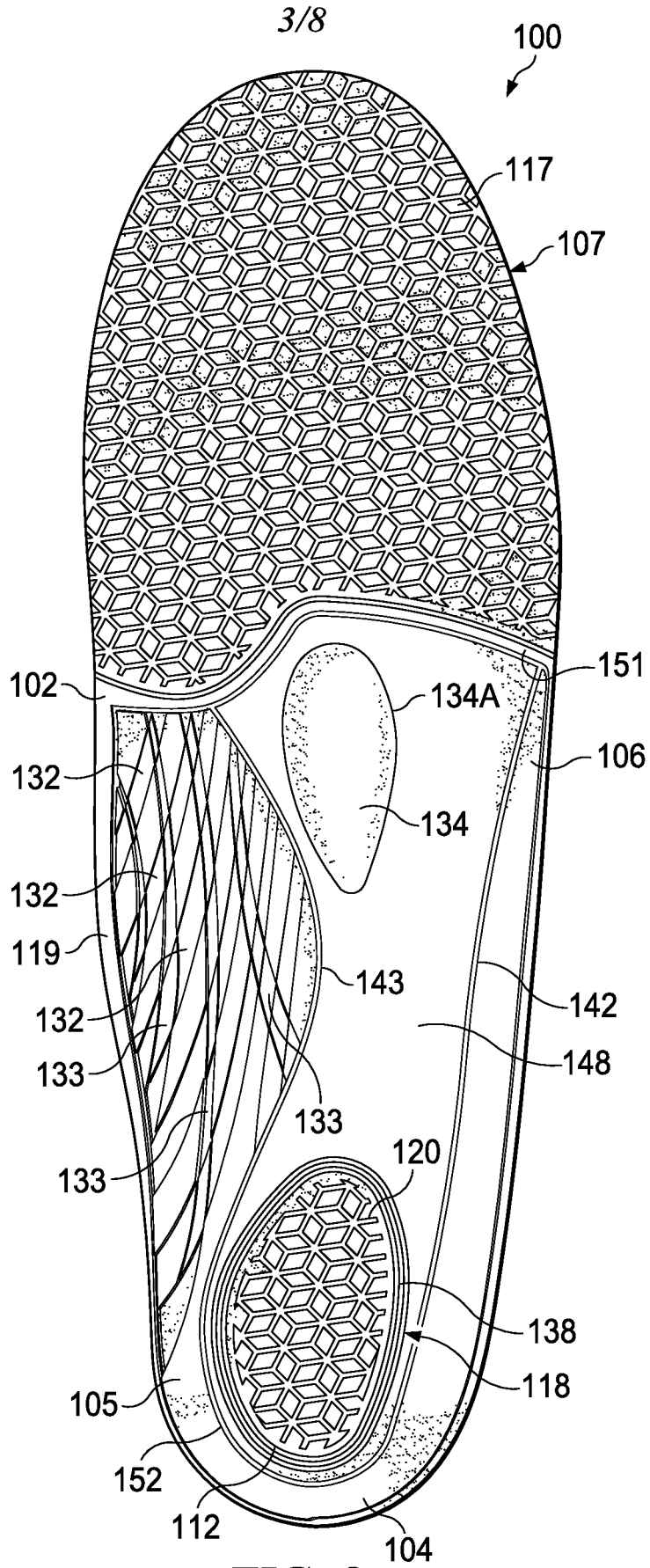


FIG. 2

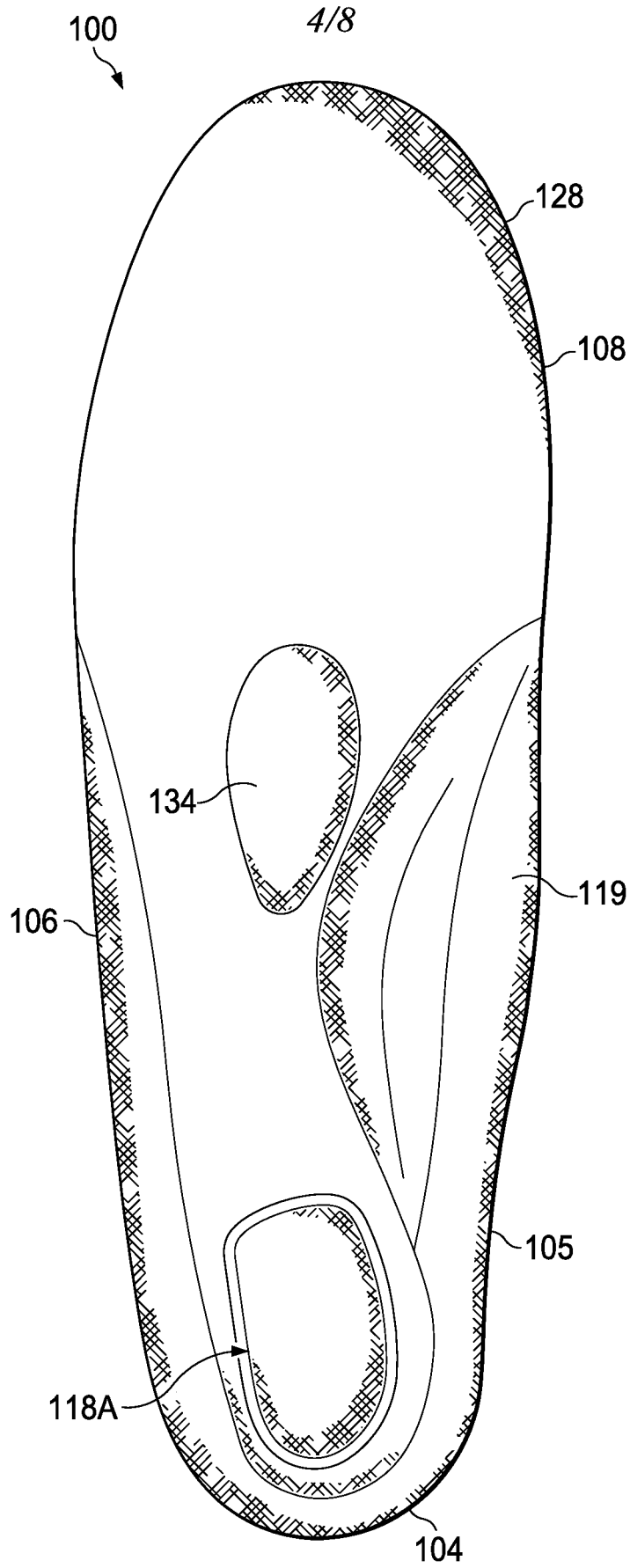


FIG. 3A

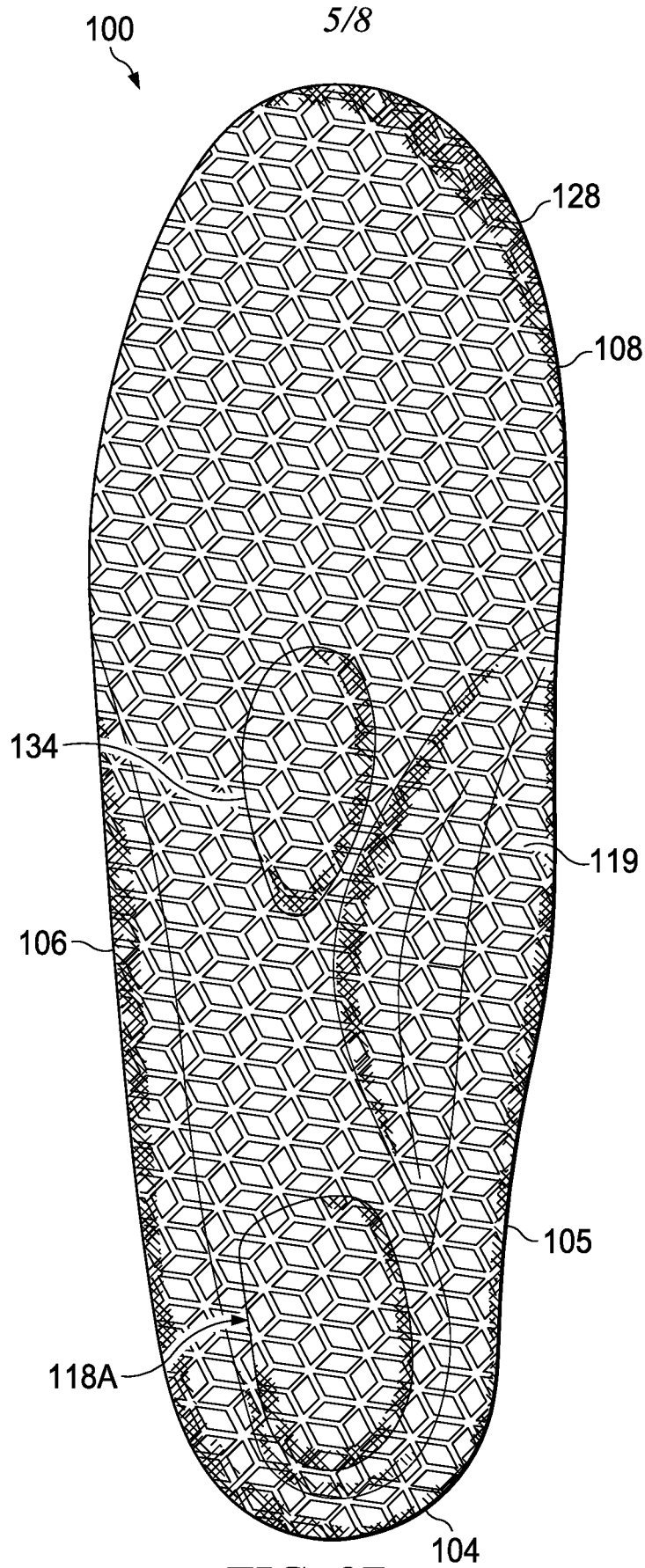


FIG. 3B

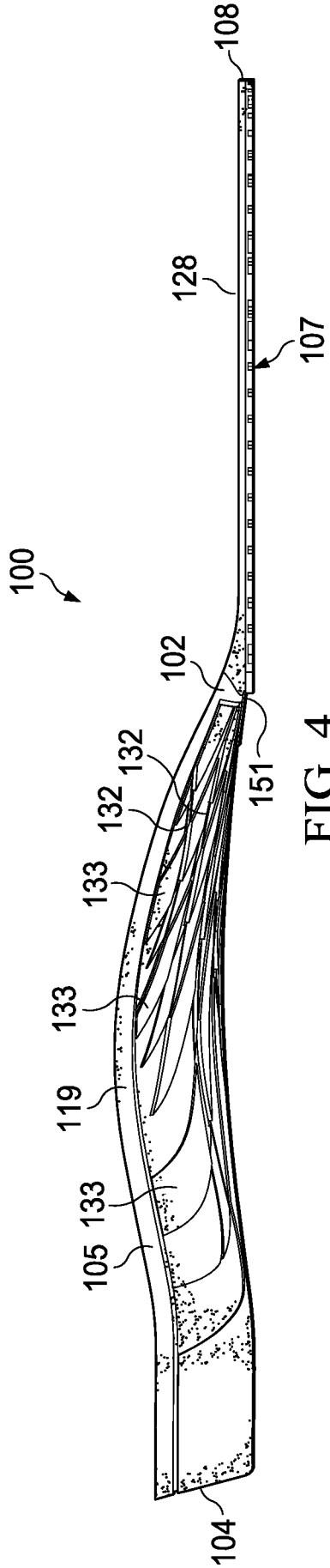


FIG. 4

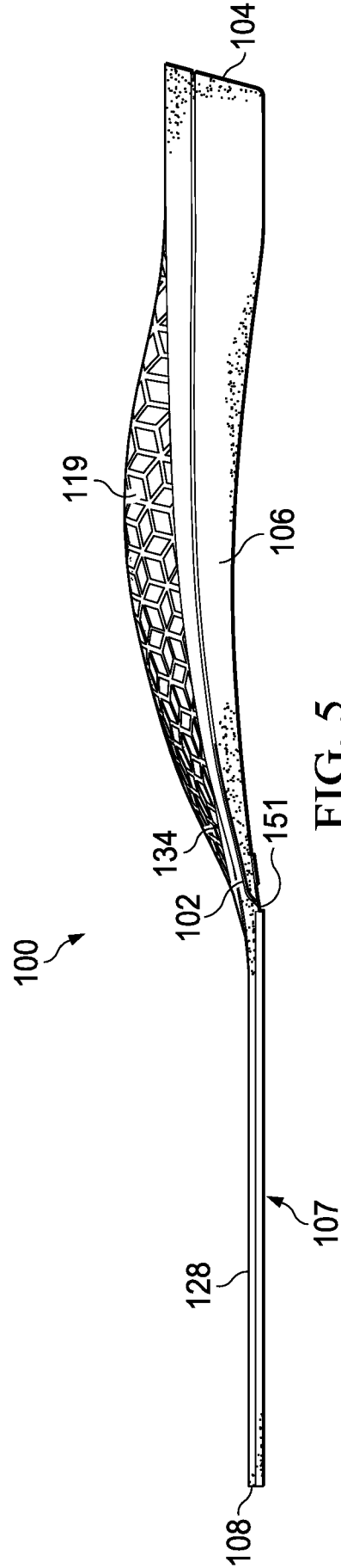
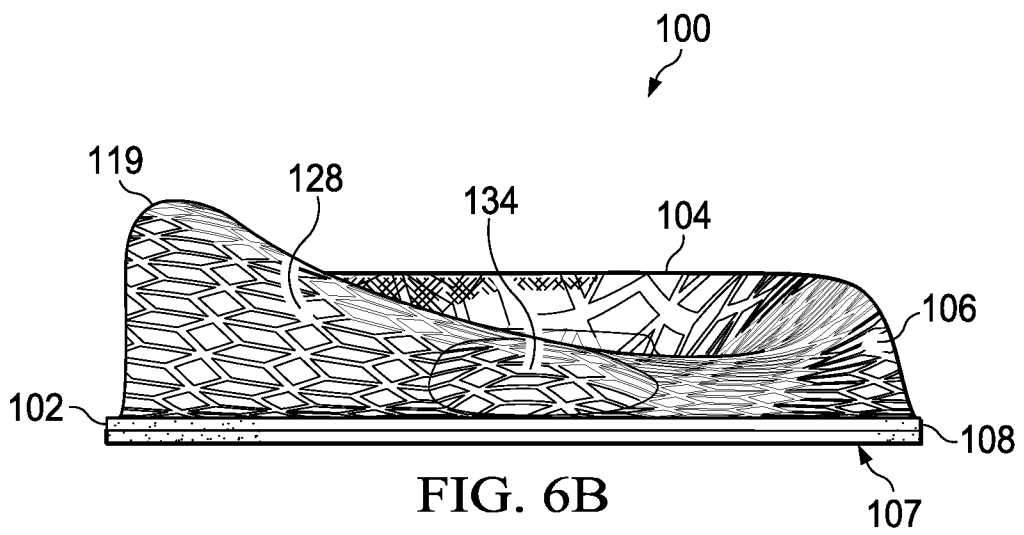
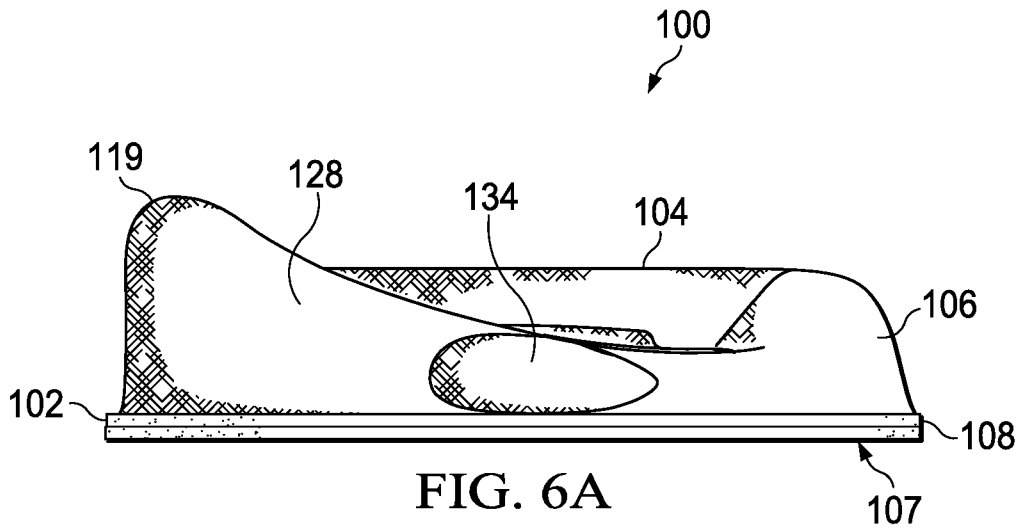


FIG. 5



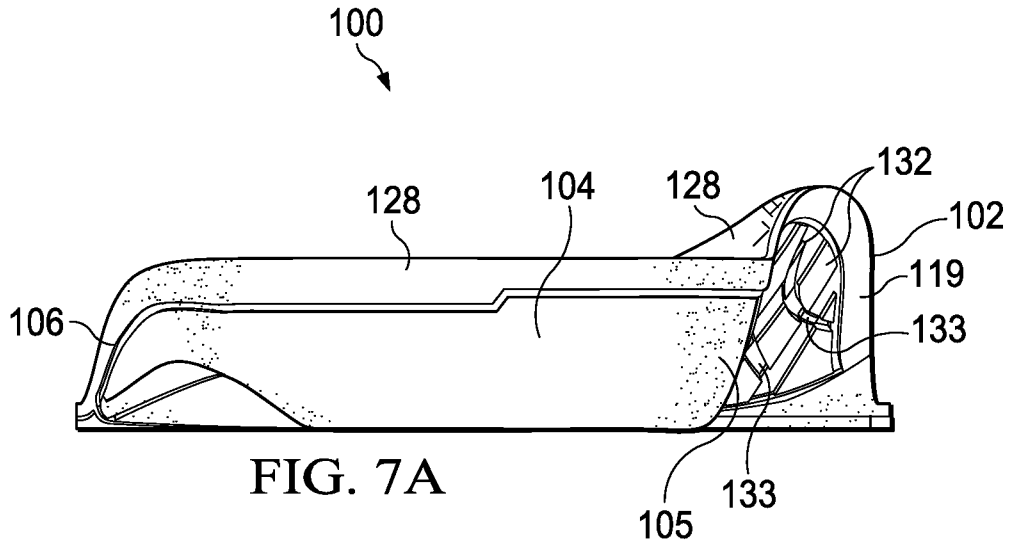


FIG. 7A

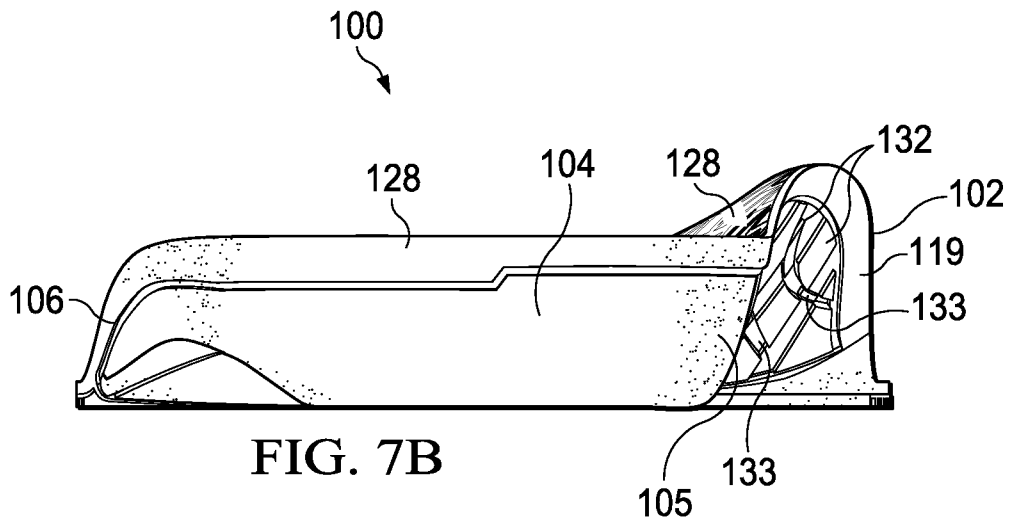


FIG. 7B

**A. CLASSIFICATION OF SUBJECT MATTER****A43B 17/00(2006.01)I, A43B 17/02(2006.01)I, A43B 7/14(2006.01)I**

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)  
A43B 17/00; A43B 7/14; A43B 13/38; A61F 5/14; A43B 7/22; A43B 13/26; A43B 17/02Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
Korean utility models and applications for utility models  
Japanese utility models and applications for utility modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
eKOMPASS(KIPO internal) & Keywords: contoured insole, base layer, stability cushion, curvilinear indentation, angle, inclination, heel dome, metatarsal dome, forefoot pad, separation wall, arch dome, heel cup**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2009-0049712 A1 (STESZYN, MICHAEL et al.) 26 February 2009 See abstract; claims 1-23; paragraphs [0040]-[0045]; and figures 1-8.	1-55
A	KR 10-1472734 B1 (FOOTHEALTH CO., LTD.) 15 December 2014 See abstract; claims 1, 2; and figures 2-5	1-55
A	WO 2014-201423 A1 (WAKELAND, DAN et al.) 18 December 2014 See abstract; claims 1-28; and figures 1-9.	1-55
A	US 2011-0041360 A1 (TORRANCE, TONY L. et al.) 24 February 2011 See abstract; claims 1-27; and figures 1-3.	1-55
A	US 2004-0194344 A1 (TADIN, ANTHONY G.) 07 October 2004 See abstract; claims 1-27; and figures 1-13.	1-55

 Further documents are listed in the continuation of Box C. See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

08 September 2016 (08.09.2016)

Date of mailing of the international search report

**09 September 2016 (09.09.2016)**

Name and mailing address of the ISA/KR

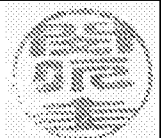
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**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2016/034184**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009-0049712 A1	26/02/2009	CN 201440994 U EP 2185021 A1 EP 2185021 B1 JP 2010-536505 A JP 5526028 B2 KR 10-1557782 B1 KR 10-2010-0074110 A KR 10-2014-0130554 A US 8453346 B2 WO 2009-029546 A1	28/04/2010 19/05/2010 18/04/2012 02/12/2010 18/06/2014 19/10/2015 01/07/2010 10/11/2014 04/06/2013 05/03/2009
KR 10-1472734 B1	15/12/2014	CN 105310180 A	10/02/2016
WO 2014-201423 A1	18/12/2014	EP 3007578 A1 US 2014-0366399 A1	20/04/2016 18/12/2014
US 2011-0041360 A1	24/02/2011	EP 1952714 A1 US 2008-0178493 A1 US 2014-0165424 A1 US 7770309 B2 US 8667716 B2	06/08/2008 31/07/2008 19/06/2014 10/08/2010 11/03/2014
US 2004-0194344 A1	07/10/2004	None	