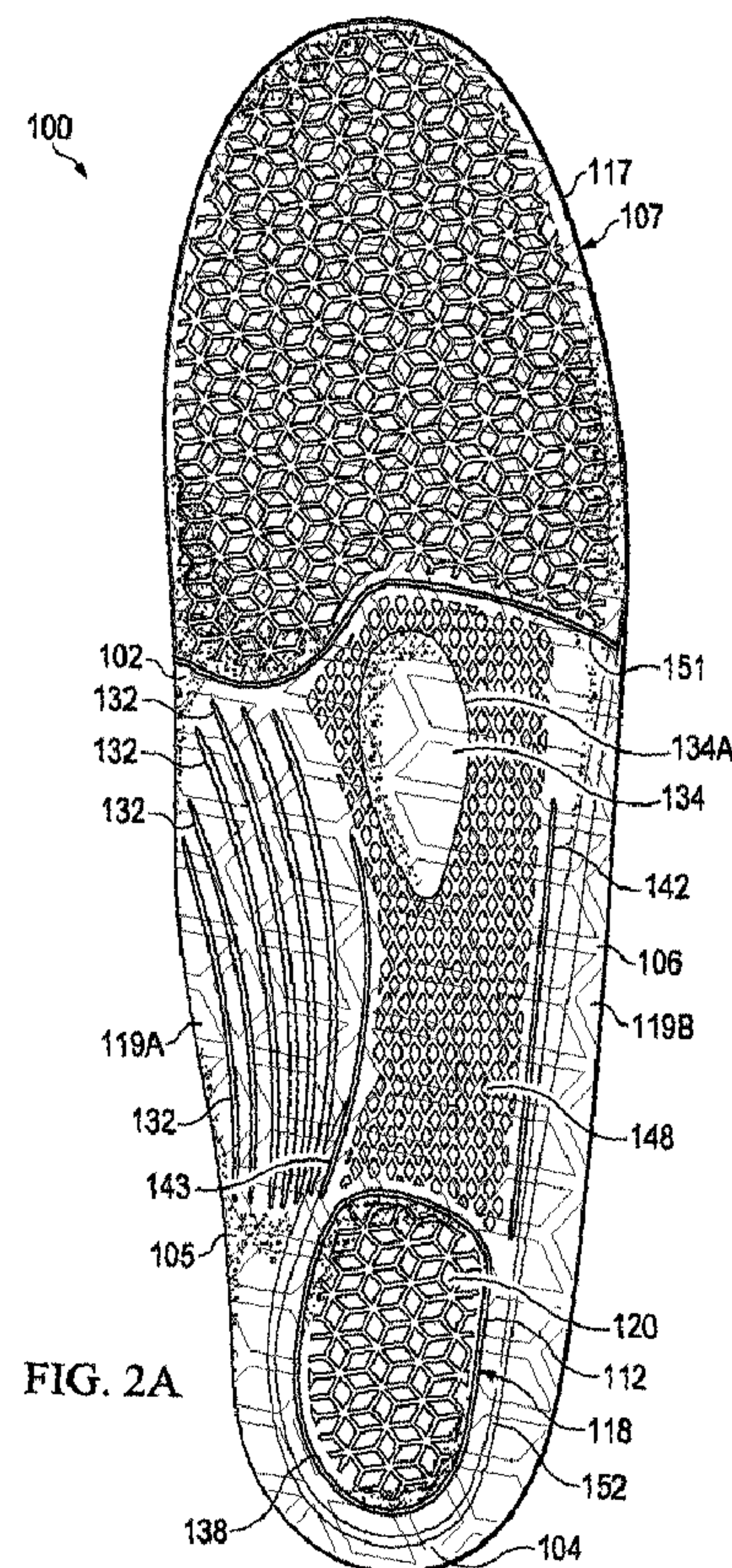




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(54) Title: CONTOURED SUPPORT SHOE INSOLE



(57) Abrégé/Abstract:

An insole having a top sheet, a base layer, a forefoot pad, a heel cushion, and support cushion, as well as a strength layer inserted between those components to strengthen and enhance the durability of the insole. The forefoot pad can be made a blown EVA or



(57) **Abrégé(suite)/Abstract(continued):**

other material, and the heel cushion can be made of a clear TPR, soft polyurethane or blown EVA. The support cushion has a raised lateral arch and a raised medial arch, the later of which has longitudinal curvilinear indentations, a flattened central midfoot area with a metatarsal mid-foot tear-drop raised area and longitudinal ridges on the flat midfoot area. A heel cup surrounds the exterior back by a heel cup, and a heel pod opening goes through the entirety of the thickness of base layer of the insole body for placement of the heel pad so the heel pad is affixed to the bottom surface of the base layer. There is also a supersoft metatarsal raised dome on the top (foot contact) surface of the insole which would be directly above the metatarsal midfoot area.

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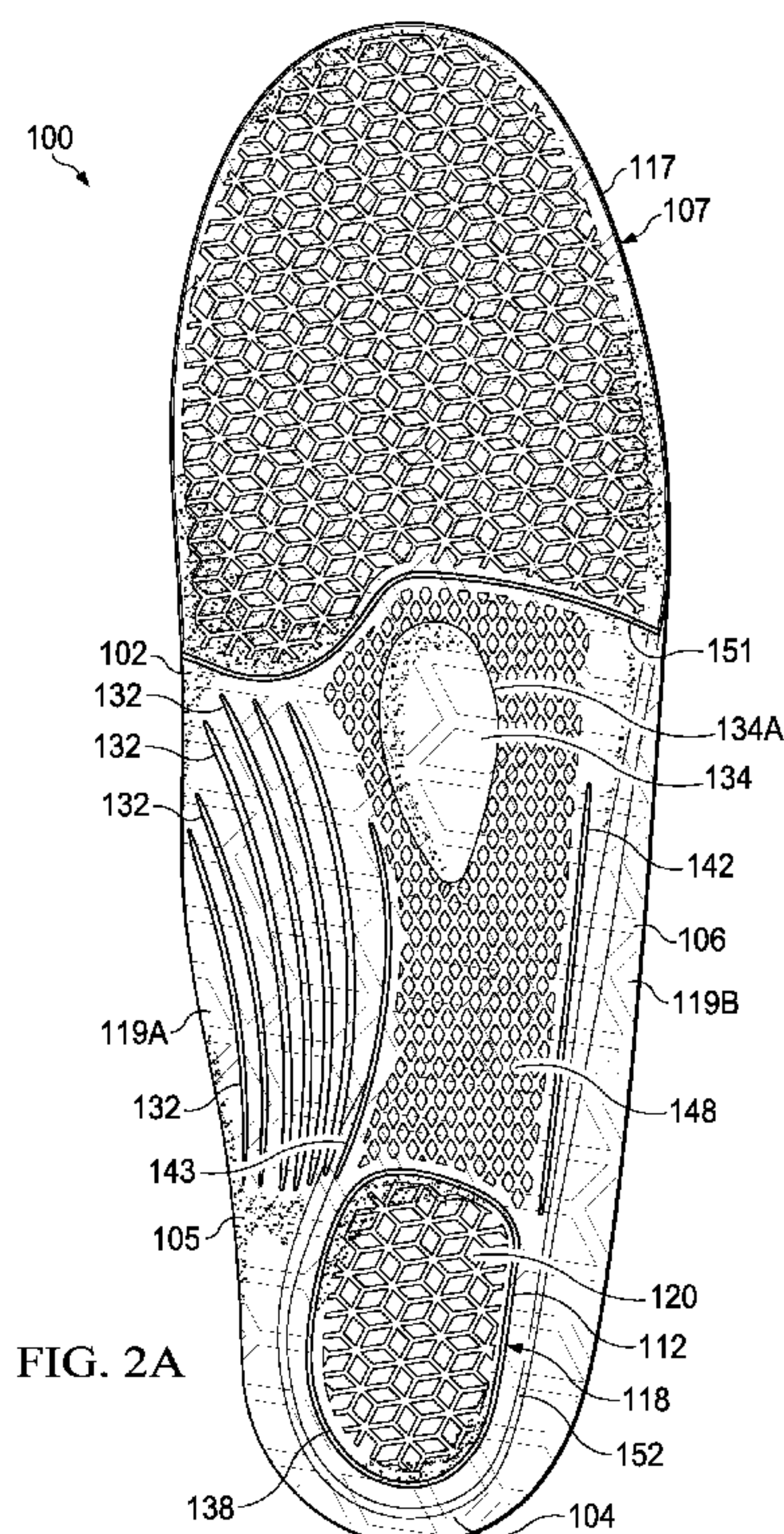
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[Continued on next page]

(54) Title: CONTOURED SUPPORT SHOE INSOLE



(57) Abstract: An insole having a top sheet, a base layer, a forefoot pad, a heel cushion, and support cushion, as well as a strength layer inserted between those components to strengthen and enhance the durability of the insole. The forefoot pad can be made a blown EVA or other material, and the heel cushion can be made of a clear TPR, soft polyurethane or blown EVA. The support cushion has a raised lateral arch and a raised medial arch, the later of which has longitudinal curvilinear indentations, a flattened central midfoot area with a metatarsal mid-foot tear-drop raised area and longitudinal ridges on the flat midfoot area. A heel cup surrounds the exterior back by a heel cup, and a heel pod opening goes through the entirety of the thickness of base layer of the insole body for placement of the heel pad so the heel pad is affixed to the bottom surface of the base layer. There is also a supersoft metatarsal raised dome on the top (foot contact) surface of the insole which would be directly above the metatarsal midfoot area.

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CONTOURED SUPPORT SHOE INSOLE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of United States Provisional Patent Application Serial No. 62/167,797 filed May 28, 2015, United States Provisional Patent Application Serial No. 62/182,162 filed June 19, 2015, United States Provisional Patent Application Serial No. 62/214,595 filed September 4, 2015, and United States Provisional Patent Application Serial No. 62/216,496 filed September 10, 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: (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) are extremely light-weight, (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 has 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/toe layer made of a clear TPR gel and positioned in a forefoot/toe 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/toe insert and the midfoot/heel cushion are secured adjacent to one another on the bottom surface of the base layer. A strength layer composed of a woven fabric, a composite material or an enhanced fabric is also inserted between those components to strengthen and enhance the durability of the insole.

[0014] The insole has a base layer is made of clear TPR gel having a hardness of about 24 Asker ± 3 (range 10-30 Asker ± 3) extending the length and width of the insole with an integrally formed indentation to receive a support cushion in area of the medial arch and encompassing the heel; an integrally formed forefoot pad extending from the medial to the lateral sides from the toe end of the insole to the medial arch/midfoot area having a diamond-cube pattern with a pattern spacing of about 1 mm and a depth of about 2.0 mm; an integrally formed support cushion with a diamond shaped honeycomb pattern in the lateral midfoot area with a pattern spacing of about 1 mm and a depth of about 0.5 mm; and a teardrop shaped indentation in the metatarsal area of the support cushion 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.

[0015] The support cushion is made of clear TPR gel having a hardness of about 70 Asker ± 3 (range 50-80 Asker ± 3) dimensioned to fit in the support cushion indentation integrally formed in the base layer in the medial arch area to heel area with integrally formed longitudinal curvilinear indentations extending lengthwise in the medial arch area and an integrally formed heel pad opening or aperture in the heel area to receive a heel pad under the calcaneal (heel) bone.

[0016] The heel pad is made of TPR gel having a hardness of 20 Asker ± 3 (range 10-30 Asker ± 3) having an integrally formed diamond-cube pattern with a pattern spacing of 1.5 mm and a depth of about 2 mm dimensioned to fit in the heel pad indentation of the support cushion. The insole also possesses a strength support layer with a minimum pull strength of 2 pounds laminated to the underside of the top sheet and secured to the top side of TPR base, and the strength support layer can be positioned above or below the base layer. There is a raised separation wall located on the base layer between the forefoot/toe layer 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.

[0017] The insole also has a top sheet of knitted or woven polyester covering the entire foot contact surface of the insole which is treated with an antimicrobial agent. The insole has a top sheet layer that extends from heel to toe over the top surface of the insole. The forefoot pad has a diamond cube or 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.

[0018] The present invention is an insole having a top sheet, a base layer, a forefoot pad, a heel cushion, support cushion, and a strength layer inserted between those components to strengthen and enhance the durability of the insole. The forefoot pad can be made of a blown EVA or other material, and the heel cushion can be made of a clear TPR, soft polyurethane or blown EVA. The support cushion has a raised arch with longitudinal curvilinear indentations, a flattened midfoot area with a metatarsal mid-foot tear-drop raised area and longitudinal ridges on the flat midfoot area. A heel cup surrounds the exterior back of the heel, and a heel pad opening goes through the entirety of the thickness of base

layer of the insole body for placement of the heel pad so the heel pad is affixed to the bottom surface of the base layer. There is a supersoft metatarsal raised dome on the top (foot contact) surface of the insole which would be directly above the metatarsal midfoot area.

[0019] The forefoot pad and the midfoot/heel support cushion are secured adjacent to one another on the bottom surface of the base layer. In one preferred embodiment the base bottom surface has indentations dimensioned to receive cushions and pads. In an alternative embodiment the base bottom surface has cushions and pads molded into the base bottom surface. A thin layer of nylon fabric may be positioned in the forefoot pad indentation between the forefoot pad and the material of the base bottom surface to increase the adhesion of the forefoot pad to the base material when the forefoot pad and base bottom surface are made of differing materials.

[0020] The midfoot/heel support cushion has a raised arch in the medial arch area and longitudinal curvilinear indentations positioned along a major angle compared to the longitudinal axis of the insole, with the longitudinal axis extending from heel-to-toe on the insole. The midfoot/heel support cushion also has a lateral midfoot arch that offers additional support to the lateral midfoot area. The midfoot/heel cushion also possesses a flattened central midfoot area on the midfoot area with a square grid pattern and a metatarsal midfoot tear-drop raised area positioned in a metatarsal tear-drop aperture of the midfoot to heel 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 heel cup that supports the exterior back of the user's heel with the heel cup and extends to the raised arch area.

[0021] 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 surround 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, blown EVA or other suitable material and 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, but can be have a flat un-patterned surface.

[0022] A shoe insole with a base layer made of lightweight materials such as low density polyurethane memory foam, ethylene glycol polyurethane, ethylene vinyl acetate (EVA), pre-blown EVA, polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material with hardness of the molded base material ranging from less than 10 Asker ± 3 to greater than 30 Asker ± 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. A raised medial arch on the support cushion is located in the medial arch area with integrally formed longitudinal curvilinear indentations situated lengthwise, integrally formed raised gripping ridges in the medial arch area on the bottom surface; and, a teardrop shaped indentation is located 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.

[0023] The forefoot pad can be made of clear TPR gel (thermoplastic rubber), where said TPR gel has a hardness rating of 10-20 Asker ± 3 . Alternatively, the forefoot pad can be made of molded pre-blown ethylene vinyl acetate (EVA), polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material, so that it extends from the toe end of the insole to the midfoot area and from the medial side to the lateral side of the forefoot area with a hardness of approximately 10-30 Asker C ± 3 . If the forefoot pad has a patterned surface, the pattern spacing is about 1 mm, groove depth of approximately 1 mm, and a thickness of the forefoot pad of about 1.5 mm ± 0.5 mm. The forefoot pad is molded into the PU insole base distal to the separating wall on the base bottom surface with a knitted fabric layer secured between the forefoot pad and the PU base material.

[0024] A heel pad on the bottom surface of the insole is made of clear TPR (thermoplastic rubber) or pre-blown ethylene vinyl acetate (EVA), molded of EVA, polyurethane (PU), or other suitable material with a hardness of approximately 10-35 Asker C ± 3 , a thickness of approximately 3.0 mm ± 0.5 mm, or alternatively, integrally formed in the material of the base bottom surface of the insole. The heel pad can have 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, with groove depth of approximately 1 mm, and a thickness of the heel pad of about 1.5 mm ± 0.5 mm. This heel pad is secured on the bottom surface of the base layer. In an alternate

embodiment, the heel pad has a honeycomb-shaped pattern. In yet another embodiment, the heel pad has a texturized un-patterned surface, and a thin layer of nylon fabric may be positioned in the heel pad indentation between the heel pad and the material of the base bottom surface to increase the adhesion of the heel pad to the base material when the heel pad and base bottom surface are made of differing materials.

[0025] A supersoft metatarsal dome shaped like a teardrop is located on the top (foot contact) midfoot surface of the insole which would normally be located below the foot metatarsal bones. And, a top sheet of polyester covers the entire foot contact surface of the insole which is treated with an antimicrobial agent.

[0026] In a preferred embodiment, the heel pad is 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 medial arch that has raised and indented 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 dome 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 separation wall added between base and forefoot pad of approximately 1 mm.

[0027] 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.

[0028] 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

[0029] 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:

[0030] FIG. 1A and 1C are bottom perspective views of an illustrative embodiment of an insole in accordance with the principles of the present invention;

[0031] FIG. 1B is a exploded perspective view of an illustrative embodiment of an insole in accordance with the principles of the present invention;

[0032] FIG. 2A-2C are bottom planar views showing the base of the insole;

[0033] FIG. 3A and 3B are top (dorsal) views of the insole;

[0034] FIG. 4A and 4B are medial (inner arch area) side views of the insole;

[0035] FIG. 5A and 5B are lateral (outer) side views of the insole;

[0036] FIG. 6A and 6B are front (proximal) views of the insole; and,

[0037] FIG. 7A and 7B are rear (proximal) views of the insole.

DETAILED DESCRIPTION

[0038] Referring to FIG. 1A, 1B, 1C, 2A, 2B and 2C, these views are perspective and bottom 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. Figures 1A, 1B and 2A and 2B show the heel pad 118 with a diamond cube heel 120 pattern; Figures 1A, 1B and 2A and 2C having clear TPR gel support cushion 105 and forefoot pads 107, and Figures 1C and 2B show a non-gel material used in the support cushion 105 and forefoot pad 107, and Figure 2C show a gel material support cushion 105 and forefoot pad 107 with a diamond shaped heel 120 pattern.

[0039] The insole 100 surface is generally foot-shaped extending longitudinally along an axis from the toe end to the heel end and from the medial side to the lateral side of the insole. In one preferred embodiment, the base layer 102 surface has indentations dimensioned to receive cushioning pads. In an alternative embodiment, the base bottom surface has cushioning pads molded into the base bottom surface.

[0040] The invention possesses a base layer 102, a support cushion 105 and a forefoot pad 107 that can be made of molded or lightweight materials such as low density polyurethane memory foam, ethylene glycol polyurethane, ethylene vinyl acetate (EVA), pre-blown EVA, polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material. Hardness of the molded base material can range from less than 10 Asker ± 3 to greater than 30 Asker ± 3 . The insole 100 encompasses support and cushioning features for the following functional areas: forefoot cushioning area; medial arch support area, metatarsal support area, and a heel cushioning area. In a preferred embodiment, the base layer 102 has a forefoot pad indentation 102B in the forefoot area dimensioned to receive a forefoot pad 107, and/or a support cushion indentation area 102A in the midfoot-to-heel area dimensional to receive the support cushion 105. In an alternate embodiment, the forefoot pad 107 and the support cushion 105, as well as the heel pad 118 are molded directly onto the base layer 102.

[0041] Preferably, the insole 100 has a base layer 102 made of clear TPR gel having a hardness of about 24 Asker ± 3 (range 10-30 Asker ± 3) extending the length and width of the insole 100 with an integrally formed indentation 102B to receive a support cushion 102 in the medial arch area and encompassing the heel; an integrally formed forefoot pad 107 positioned in a forefoot pad indentation 102A and extending from the medial to the lateral sides from the toe end of the insole to the medial arch/midfoot area having a diamond-cube pattern with a pattern spacing of about 1 mm and a depth of about 2.0 mm; an integrally formed support cushion 105 with a diamond shaped honeycomb pattern in the central midfoot area with a pattern spacing of about 1 mm and a depth of about 0.5 mm; and a teardrop shaped indentation 134 in the metatarsal area of the support cushion 105 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 102.

[0042] The support cushion 105 is made of clear TPR gel having a hardness of about 70 Asker ± 3 (range 50-80 Asker ± 3) dimensioned to fit in the support cushion indentation 102B integrally formed in the base layer 102 in the medial arch area to heel area with integrally formed longitudinal curvilinear indentations 132 extending lengthwise in the medial arch area and an integrally formed heel pad opening or aperture 112 in the heel area to receive a heel pad 118 under the calcaneal (heel) bone.

[0043] The heel pad 118 is made of TPR gel having a hardness of 20 Asker ± 3 (range 10-30 Asker ± 3) having an integrally formed diamond-cube pattern with a pattern spacing of 1.5 mm and a depth of about 2 mm dimensioned to fit in the heel pad indentation of the support cushion 105. The insole 100 also possesses a strength support layer 103 with a minimum pull strength of 2 pounds laminated to the underside of the top sheet and secured to the top side of TPR base layer 102, and the strength support layer 103 can be positioned above or below the base layer.

[0044] The insole 100 also has a top sheet 128 of knitted or woven polyester covering the entire foot contact surface of the insole 100, which is treated with an antimicrobial agent. The insole has a top sheet 128 that extends from heel to toe over the top surface of the insole 100. The forefoot pad 107 has a diamond cube or 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.

[0045] The insole 100 having a top sheet 128, a base layer 102, a forefoot pad 107, a heel pad 118, a support cushion 105, and a strength layer 103 inserted between those components to strengthen and enhance the durability of the insole. The forefoot pad 107 can be made of a blown EVA or other material, and the heel cushion 118 can be made of a clear TPR, soft polyurethane or blown EVA. The support cushion 105 has a raised arch with longitudinal curvilinear indentations, a flattened midfoot area 148 with a metatarsal mid-foot tear-drop raised area 134 extending through a metatarsal opening 134A and longitudinal ridges 142, 143 on the flat midfoot area and a heel ridge 152 extending around the heel pad opening 112. A heel cup 104 surrounds the exterior back of the heel, and a heel pod opening 112 goes through the entirety of the thickness of base layer 102 of the insole 100 for placement of the heel pad 118 so the heel pad 118 is affixed to the bottom surface of the base layer 102. There is a supersoft metatarsal raised dome 134 on the top (foot contact) surface of the insole 100 which would be directly above the metatarsal midfoot area.

[0046] The forefoot pad 107 and the midfoot/heel support cushion 105 are secured adjacent to one another on the bottom surface of the base layer 102. In one preferred embodiment the base bottom surface has indentations dimensioned to receive cushions and pads. In an alternative embodiment the base bottom surface has cushions and pads molded into the base layer 102. A thin layer of nylon fabric may be positioned in the forefoot pad indentation 102A between the forefoot pad 107 and the material of the base layer 102 to increase the adhesion of the forefoot pad 107 to the base layer 102 when the forefoot pad and base bottom surface are made of differing materials.

[0047] The midfoot/heel support cushion 105 has a raised arch 119A in the medial arch area and longitudinal curvilinear indentations 132 positioned along a major angle compared to the longitudinal axis of the insole, with the longitudinal axis extending from heel-to-toe on the insole. The midfoot/heel support cushion 105 also has a lateral midfoot arch 119B that offers additional support to the lateral midfoot area. The midfoot/heel cushion 105 also possesses a flattened central midfoot area 148 on the midfoot area with a square grid pattern and a metatarsal midfoot tear-drop raised area 134 positioned in a metatarsal tear-drop aperture 134A of the midfoot to heel support cushion. The flattened area 148 on the midfoot area of the midfoot/heel cushion 105 is bordered on the medial side by a medial side longitudinal ridge 143, on the lateral side by a lateral side longitudinal ridge 142, and

around the exterior of the heel pod opening by a heel ridge 152. The midfoot/heel cushion 105 also has a heel cup 104 that supports the exterior back of the user's heel with the heel cup and extends to the raised arch area 119A.

[0048] The heel pod opening 112 is surrounded by heel pod opening border grooves 138, which surround the circumference of the heel pod opening. The heel pad 118 is located on the bottom surface of the insole 100 and is made of a clear TPR gel, blown EVA or other suitable material and extends through the full depth of the heel pod opening and is attached to the bottom surface of the base layer. The heel pad 112 has a diamond shaped groove pattern, but can be have a flat un-patterned surface.

[0049] A shoe insole 100 with a base layer 102 made of lightweight materials such as low density polyurethane memory foam, ethylene glycol polyurethane, ethylene vinyl acetate (EVA), pre-blown EVA, polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material with hardness of the molded base material ranging from less than 10 Asker ± 3 to greater than 30 Asker ± 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. A raised medial arch 119A on the support cushion is located in the medial arch area with integrally formed longitudinal curvilinear indentations 132 situated lengthwise, integrally formed raised gripping ridges in the medial arch area on the bottom surface; and, a teardrop shaped indentation 134 is located in the metatarsal area of the midfoot which curves upwardly (concave) from the bottom of the base layer 102 (shoe contact) surface and forms a collapsible metatarsal support which is convex on the top (foot contact) side of the base layer 102.

[0050] The forefoot pad 107 can be made of clear TPR gel (thermoplastic rubber), where said TPR gel has a hardness rating of 10-20 Asker ± 3 . Alternatively, the forefoot pad 107 can be made of molded pre-blown ethylene vinyl acetate (EVA), polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material, so that it extends from the toe end of the insole to the midfoot area and from the medial side to the lateral side of the forefoot area with a hardness of approximately 10-30 Asker C ± 3 . If the forefoot pad 107 has a patterned surface, the pattern spacing is about 1 mm, groove depth of approximately 1 mm, and a thickness of the forefoot pad of about 1.5 mm ± 0.5 mm. The forefoot pad 107 is molded into the PU insole base distal to the separating wall on the base bottom surface with a knitted fabric layer secured between the forefoot pad and the PU base material.

[0051] A heel pad 118 on the bottom surface of the insole is made of clear TPR (thermoplastic rubber) or pre-blown ethylene vinyl acetate (EVA), molded of EVA, polyurethane (PU), or other suitable material with a hardness of approximately 10-35 Asker C ± 3 , a thickness of approximately 3.0 mm ± 0.5 mm, or alternatively, integrally formed in the material of the base bottom surface of the insole. The heel pad 118 can have a modified oval shape that is wider on the proximal end of the heel pad 118 and narrows on the distal end of the heel pad with a diamond-cube pattern 120 molded in the EVA having pattern spacing of about 1 mm, with groove depth of approximately 1 mm, and a thickness of the heel pad of about 1.5 mm ± 0.5 mm shown differently in Figures 1A-C and 2A-2B, and alternatively in Figure 2C. This heel pad 118 is secured on the bottom surface of the base layer 102. In an alternate embodiment, the heel pad 118 has a honeycomb-shaped pattern. In yet another embodiment, the heel pad 118 has a texturized un-patterned surface, and a thin layer of nylon fabric may be positioned in the heel pad indentation 112 between the heel pad 118 and the bottom surface of the base layer 102 to increase the adhesion of the heel pad 118 to the base layer 102.

[0052] A supersoft metatarsal dome 134 shaped like a teardrop is located on the top (foot contact) midfoot surface of the insole which would normally be located below the foot metatarsal bones. And, a top sheet 128 of polyester covers the entire foot contact surface of the insole which is treated with an antimicrobial agent.

[0053] In a preferred embodiment, the heel pad 118 is surrounded by a flat midfoot/heel surface 148 and cupped along the back by a heel cup 104, nylon fabric between forefoot/heel pads 105, 107 and base layer 102 (for adhesion of pads to PU), a medial arch 119A has raised and indented curvilinear lines 132 extending longitudinally along arch with vent holes, a groove depth on bottom 0.50 mm-1.5 mm, a top cloth 128 made of 65% Nylon/ 35% polyester, a teardrop metatarsal dome 134 on the top side is integrally formed as an upwardly-curved indentation from bottom surface, a diamond-shaped groove pattern 117, 120 on the forefoot pad 107 and the heel pad 128, and a separation wall 151 added between base layer 102 and forefoot pad 107 of approximately 1 mm.

[0054] A strength layer 103 is positioned above the base layer 102, or alternatively, positioned between the base layer 102 and the forefoot pad 107 and/or support cushion 105, and it is composed of a woven fabric, a composite material or a fortified or enhanced fabric is also inserted between those components to strengthen and enhance the durability of the

insole. Alternatively, this strength layer 103 can be made of knitted or woven high-strength fabric secured to the top surface of the EVA base material, but this strength layer 103 should be made of material that retains its shape upon use without significant shrinkage or deformation from heat or pressure of normal use. The strength layer 103 may extend from heel-to-toe across the entire surface of the insole 100, or alternatively, may only extend across the heel area, the heel to mid-foot area, or the forefoot to toe area.

[0055] The forefoot pad 107 and the midfoot/heel support cushion 105 are secured adjacent to one another on the bottom surface of the base layer 102. In one preferred embodiment, the base bottom surface has indentations 102A, 102B dimensioned to receive cushioning pads 105, 107. In an alternative embodiment, the bottom surface of the base layer 102 has cushions 105 and pads 107 molded into the base bottom surface. A thin layer of nylon fabric may also be positioned in the forefoot pad indentation 102B between the forefoot pad and the material of the base bottom surface to increase the adhesion of the forefoot pad 107 to the base layer 102 material when the forefoot pad 107 and base layer 102 bottom surface are made of differing materials. Or, a thin fabric can also be positioned in a similar manner between the support cushion 105 and the base layer 102 in the support cushion indentation 102A.

[0056] There is a raised separation wall 151 located on the base layer 102 between the forefoot pad 107 and the midfoot support cushion 105, which is located laterally across the width of the insole between the metatarsal and forefoot areas on the insole. The insole 100 has a top sheet 128 that extends from heel to toe over the top surface of the base layer 102, or alternatively, over the strength layer 103 (which may be placed above or below the base layer 102). There is a metatarsal dome 134 raised on the top surface of the insole, which respectively improves the cushioning characteristics of the insole at or near high impact points on the insole. The forefoot pad 107 has a diamond cube groove pattern 117 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. In an alternate embodiment, the forefoot pad 107 has a honeycomb-shaped pattern 117. In yet another embodiment, the forefoot pad 107 has a texturized un-patterned surface 117.

[0057] The midfoot/heel cushion 105 has a raised arch 119A in the medial arch area and a raised lateral arch 119B on the lateral mid-foot side on the bottom surface of the insole 100.

These raised arches 119A and 119B support the midfoot arch and lateral areas of the user's foot, and can assist with preventing and minimizing pronation or supination conditions.

[0058] Longitudinal curvilinear indentations 132 positioned along a major angle compared to the longitudinal axis of the insole, with the longitudinal axis extending from heel-to-toe on the insole. The midfoot/heel cushion 105 also possesses a flattened central midfoot area 148 on the midfoot area with a square grid pattern and a metatarsal midfoot tear-drop raised area 134 positioned in a metatarsal tear-drop aperture of the midfoot-to-heel support cushion 105. The flattened area 148 on the central midfoot area of the midfoot/heel cushion 105 is bordered on the medial side by a medial side longitudinal ridge 143, on the lateral side by a lateral side longitudinal ridge 142, and around the exterior of the heel pod opening by a heel ridge 152. The midfoot/heel cushion 105 also has a surrounding heel cup 104 that supports the exterior back of the user's heel with the heel cup and extends to the raised arch area 119.

[0059] 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 pod opening 112 is surrounded by opening border grooves 138, which surrounds the circumference of the heel pod opening 112. The heel pad 118 is located on the bottom surface of the insole 100 and is made of a clear TPR gel, blown EVA or other suitable material and extends through the full depth of the heel pod opening 112 and is attached to the bottom surface of the base layer 102. The heel pad 118 has a diamond shaped groove pattern 120, but can be have a flat un-patterned surface 120. Figures 1A-1C and 2A-2B show the heel pad 118 with a diamond cube pattern 120, and Figure 2C shows the same insole design with a small diamond patten surface 120 on heel pad 118.

[0060] A shoe insole 100 with a base layer 102 made of lightweight materials such as low density polyurethane memory foam, ethylene glycol polyurethane, ethylene vinyl acetate (EVA), pre-blown EVA, polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material with hardness of the molded base layer 102 material ranging from less than 10 Asker ± 3 to greater than 30 Asker ± 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. A raised arch 119 on the support cushion 105 is located in the medial arch 119 with integrally formed longitudinal curvilinear indentations 132 situated lengthwise, integrally formed with raised gripping ridges in the medial arch

119 on the support cushion 105; and, a teardrop shaped indentation 134 is located in the metatarsal area of the midfoot which curves upwardly (concave) from the bottom of the insole 100 (shoe contact) and forms a collapsible metatarsal support which is convex on the top (foot contact) of the insole 100.

[0061] The forefoot pad 107 can be made of clear TPR gel (thermoplastic rubber), where said TPR gel has a hardness rating of 10-20 Asker ± 3 . Alternatively, the forefoot pad 107 can be made of molded pre-blown ethylene vinyl acetate (EVA), polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material, so that it extends from the toe end of the insole to the midfoot area and from the medial side to the lateral side of the forefoot area with a hardness of approximately 10-30 Asker C ± 3 . If the forefoot pad 107 has a patterned surface 117, it has a pattern spacing of about 1 mm, groove depth of approximately 1 mm, and a thickness of the forefoot pad of about 1.5 mm ± 0.5 mm. The forefoot pad 107 can also be molded into the PU insole base distal to the separation wall 151 on the base layer 102 with a knitted fabric layer secured between the forefoot pad 107 and the base layer 102.

[0062] A heel pad 118 on the bottom surface of the insole 100 is made of clear TPR (thermoplastic rubber) or pre-blown ethylene vinyl acetate (EVA), molded of EVA, polyurethane (PU), or other suitable material with a hardness of approximately 10-35 Asker C ± 3 , a thickness of approximately 3.0 mm ± 0.5 mm, or alternatively, integrally formed in the material of the base bottom surface of the insole 100. The heel pad 118 can have 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-shaped groove pattern 120 molded in the EVA having pattern spacing of about 1 mm, with groove depth of approximately 1 mm, and a thickness of the heel pad of about 1.5 mm ± 0.5 mm. This heel pad 118 surface of the base layer 102. In an alternate embodiment, the heel pad 118 has a honeycomb-shaped pattern 120. In yet another embodiment, the heel pad 118 has a small diamond shaped texture, which are shown in Figure 2C. Embodiments showing a diamond cube pattern on the heel pad 118 can be seen in Figures 1A, 1B, 1C and 2A-2B.

[0063] A thin layer of nylon fabric may be positioned in the heel pad indentation 102B between the heel pad 118 and the material of the base layer 102 to increase the adhesion of the heel pad to the base material when the heel pad 118 and base layer 102 are made of differing materials. A supersoft metatarsal dome 134 shaped like a teardrop is located on the top (foot contact) midfoot surface of the insole 100 which would normally be located

below the foot metatarsal bones. And, a top sheet 128 of polyester covers the entire foot contact surface of the insole which is treated with an antimicrobial agent.

[0064] In a preferred embodiment, the heel pad 118 is surrounded by a flat midfoot/heel surface 148 and cupped along the back by a heel cup 104. Nylon fabric can be placed between support cushion 105 or forefoot pad 107 and the base layer 102 (for adhesion of pads to PU). A medial arch 119 has raised and indented curvilinear lines 132 extending longitudinally along arch with vent holes, and the grooves on the flat area 148 of the support cushion 105 have a groove depth on bottom of approximately 0.50 mm-1.5 mm. The top sheet 128 can be made of 65% Nylon/ 35% polyester, and a teardrop metatarsal dome 134 on the top side of the insole 100 is integrally formed as an upwardly-curved indentation. The separation wall 151 added between base and forefoot pad is approximately 1 mm in height.

[0065] 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-shaped groove pattern 117 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 ± 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.

[0066] In accordance with principles of the present invention, the present invention is a shoe insole having a base bottom (shoe contact) surface with cushioning and supporting elements in the arch, metatarsal, forefoot and heel areas, and a top (foot contact) surface with cushioning and supporting elements in the heel and metatarsal areas. The shoe insole fits securely in the bottom of a user's shoe to provide support and cushioning to the user's foot.

[0067] The base layer 102 extends the length and width of the insole curving up in the medial arch area to form an arch support 119 and curving around the heel area to form a heel cup 104 on the foot contact surface, with a separating wall 151 between the forefoot pad indentation 102B on the bottom surface and the midfoot-to-heel support cushion indentation 102A under the calcaneal (heel) area on the bottom layer 102B; a raised arch

119 in the medial arch area with integrally formed longitudinal curvilinear indentations 132 situated lengthwise, the curvilinear indentations 132 integrally forming raised gripping ridges in the medial arch 119 on the bottom surface of the support cushion 105; and a teardrop shaped metatarsal indentation 134 on the bottom surface of the insole 100 that curves upwardly (concave) from the bottom of the base layer 102 (shoe contact) surface and forms a collapsible metatarsal support having a convex dome shape on the top (foot contact) side of the base layer 102.

[0068] A forefoot pad 107 extends from the toe end of the insole 100 to the midfoot area and from the medial side to the lateral side of the forefoot area with a diamond-shaped groove pattern 117 having pattern spacing of about 1 mm and a depth of about 1.5 mm. The forefoot pad 107 can be molded into the PU insole base distal to the separating wall on the base bottom surface with a knitted fabric layer secured between the forefoot pad and the base layer 102 material. This insole 100 also has: (1) a heel pad 118 on the bottom surface of the insole made of pre-blown EVA, polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material with a hardness of approximately 10-35 Asker C ± 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 or diamond-shaped groove 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; (2) a soft metatarsal dome 134 on the top (foot contact) surface providing cushioning directly over the metatarsal area of the foot (shown in Figures 3A, 3B, 5A, 5B, 6A and 6B); and, (3) a top sheet 128 of polyester covering the entire foot contact surface of the insole 100 which is treated with an antimicrobial agent (shown in Figures 1B, 3A, 4A, 5A, 6A and 7A).

[0069] 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 102 extending from heel-to-toe, (2) a forefoot pad 107 positioned in a forefoot/toe indentation on a forefoot base area 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. A strength layer 103 is positioned above the base layer 102, or alternatively, positioned between the base layer 102 and the forefoot pad 107 and/or support cushion 105, and it is composed of a woven fabric, a composite material or a fortified or enhanced fabric is also inserted between those components to strengthen and enhance the durability of the insole. Alternatively, this

strength layer 103 can be made of knitted or woven high-strength fabric secured to the top surface of the EVA base material, but this strength layer 103 should be made of material that retains its shape upon use without significant shrinkage or deformation from heat or pressure of normal use. The strength layer 103 may extend from heel-to-toe across the entire surface of the insole 100, or alternatively, may only extend across the heel area, the heel to mid-foot area, or the forefoot to toe area.

[0070] The combination of the base layer 102, support cushion 105, strength layer 103, and a heel pad 118 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.

[0071] 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 119A along the medial arch side, a raised arch support 119B on the lateral midfoot side, a heel area just forward of the heel cup 104, and a midfoot area 106 between the heel area and forefoot area. 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.

[0072] In one preferred embodiment, the base layer 102 has indentations 102A, 102B dimensioned to receive the support cushion 105 and forefoot pad 107, respectively. In an alternative embodiment, the base layer 102 can have the support cushion 105 and/or the forefoot pad 107 molded directly onto the base layer 102. The base layer 102 may be molded of lightweight materials such as low density polyurethane memory foam, ethylene glycol polyurethane, ethylene vinyl acetate (EVA), pre-blown EVA, polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material. Hardness of the molded base layer 102 material can range from less than 10 Asker ± 3 to greater than 30 Asker ± 3 .

[0073] 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-1C and 2A-2C 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 100 will be used to replace an insole that previously was used in the shoe.

[0074] 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 100. 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.

[0075] 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.

[0076] 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 to the arch on the medial side, a midfoot area 106 between said arch support 119 and the lateral midfoot area, and a forefoot area located between the metatarsal area to the toe end of the insole 100. There is a metatarsal dome 134 raised on the top surface of insole 100 (shown in Figures 3A, 3B, 5A, 5B, 6A and 6B), which improves the cushioning characteristics of the insole at or near high impact points on the insole 100.

[0077] 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 preferred blown EVA, EVA or TPR/EVA mix has a durometer (hardness) of about Asker C 45-50. It is desirable to minimize the total weight of the insoles 100 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 100 (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 102 may be formed from a gel material (e.g. TPR gel) or made of polyurethane polyester glycol with a hardness 30 Asker ± 3 , or alternatively, can be made of any durable nylon fabric.

[0078] 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.

[0079] The top sheet 128 bottom surface is secured to base layer 102 top surface and a top sheet 128 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[®] antimicrobial treatment (Thomson Research Associates, Inc., Ontario, CA.).

[0080] In accordance with principles of the present invention and as shown in Figure 1A, 1B, 1C and 2A, 2B and 2C, 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

positioned in a forefoot pad indentation area 102A on a forefoot area 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.

[0081] 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 low density polyurethane memory foam, ethylene glycol polyurethane, ethylene vinyl acetate (EVA), pre-blown EVA, polyurethane (PU), thermoplastic rubber (TPR) or other suitable material having a hardness of the molded base material ranging from less than 10 Asker ± 3 to greater than 30 Asker ± 3 ; a forefoot pad 107 made of lightweight materials such as low density polyurethane memory foam, ethylene glycol polyurethane, ethylene vinyl acetate (EVA), pre-blown EVA, polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material (hardness 10-35 Asker ± 3) (groove pattern 117 spacing 1.0mm-1.50mm), a heel pad 118 made of pre-blown EVA, PU, or other suitable material (hardness 10-35 Asker ± 3) (pattern spacing 1.0mm-1.50mm) surrounded by a flat midfoot/heel surface 148 and cupped along the back by a heel cup 104, nylon fabric between forefoot/heel pads and base (for adhesion of pads to PU), a raised medial arch 119A that has raised and indented curvilinear lines 132 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 raised lateral side arch 119A in the lateral midfoot area, 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.

[0082] 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 102 extending from heel-to-toe, (2) a forefoot pad 107 positioned in a forefoot/toe indentation on a forefoot base area 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. A strength layer 103 is positioned above the base layer 102, or alternatively, positioned between the base layer 102

and the forefoot pad 107 and/or support cushion 105, and it is composed of a woven fabric, a composite material or a fortified or enhanced fabric is also inserted between those components to strengthen and enhance the durability of the insole. Alternatively, this strength layer 103 can be made of knitted or woven high-strength fabric secured to the top surface of the EVA base material, but this strength layer 103 should be made of material that retains its shape upon use without significant shrinkage or deformation from heat or pressure of normal use. The strength layer 103 may extend from heel-to-toe across the entire surface of the insole 100, or alternatively, may only extend across the heel area, the heel to mid-foot area, or the forefoot to toe area.

[0083] The metatarsal support 134 is formed in a metatarsal support aperture 134A, which is integrally formed in the bottom surface of the support cushion 105 on the bottom surface of the insole and it has a concave surface oriented toward the bottom (shoe contact) surface and a convex surface oriented toward the top (foot contact) surface. The metatarsal support 134 is positioned in the midfoot area of the insole 100 to provide cushioning and support in the area approximately under the second and third metatarsal bones. The metatarsal support 134 is compressible with the convex top surface being compressed by foot pressure downward toward the concave portion of the base bottom surface allowing the support provided to vary with the pressure of the user's foot.

[0084] In a preferred embodiment, the metatarsal support 134 is teardrop shaped with the wider part of the shape oriented distally to the insole under the second and third metatarsal bones and the narrow part of the shape oriented proximally towards the tarsal bones. In an alternate embodiment, the metatarsal support may have another shape, such as diamond, rectangle or other shape suitable for providing metatarsal support in the midfoot area of the insole.

[0085] The metatarsal support 134 is integrally formed in the material forming the base bottom surface of the insole 100 which is preferably molded of low density polyurethane memory foam, but may also be ethylene glycol polyurethane, ethylene vinyl acetate (EVA), pre-blown EVA, polyurethane (PU), thermoplastic rubber (TPR) or other suitable material. Hardness of the molded base material can range from less than 10 Asker ± 3 to greater than 30 Asker ± 3 .

[0086] 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 3rd metatarsal head, then laterally and proximally to the lateral edge approximately along the 3rd through 5th metatarsal heads.

[0087] The forefoot pad 107 generally extends from the proximal region of the metatarsal head area to the distal toe end of the insole and extends from the medial side to the lateral side of the insole. In one embodiment, the forefoot pad is secured within a forefoot pad 107 indentation 102A. The forefoot pad 107 has a thickness of approximately $1.5 \text{ mm} \pm 0.5 \text{ mm}$. In another embodiment, the forefoot pad 107 is integrally formed in the material of the base layer 102 of the insole 100. The forefoot pad 107 is preferably molded of pre-blown ethylene vinyl acetate (EVA). The forefoot pad 107 may also be molded of EVA, polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material.

[0088] Preferably, the forefoot pad 107 has a diamond-cube pattern 117 on the forefoot pad 107 surface to provide traction, compressive cushioning and lateral movement support to the forefoot area. The diamond cube pattern 117 has a depth of approximately $1.0 \text{ mm} \pm 0.5 \text{ mm}$ and has a surface pattern spacing of about 1.0 mm to about 1.5 mm. In an alternate embodiment, the forefoot pad 107 has a honeycomb-shaped pattern 117. In yet another embodiment, the forefoot pad 107 has a texturized un-patterned surface 117. A thin layer of nylon fabric may be positioned in the forefoot pad indentation 102A between the forefoot pad 107 and the material of the base layer 102 to increase the adhesion of the forefoot pad 107 to the base layer 102 when the forefoot pad 107 and base layer 102 are made of differing materials.

[0089] The forefoot pad 107 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 having pattern spacing of about 1 mm and a depth of about 1.5 mm. The forefoot pad 107 made of molded of lightweight materials such as low density polyurethane memory foam, ethylene glycol polyurethane, ethylene vinyl acetate (EVA), pre-blown EVA, polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material (hardness 10-35 Asker ± 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.

[0090] 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 1st and 2nd 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.

[0091] The support cushion 105 is made of polyurethane polyester glycol (hardness 10-30 Asker ± 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 1st 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.

[0092] The midfoot/heel support cushion 105 has a raised arch 119A in the medial arch area and curvilinear indentations 132 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. The first angled direction is measured

compared to the major axis lengths of the longitudinal curvilinear indentations 132. 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 longitudinal curvilinear indentations 132 in the raised arch area 119A provide additional rigidity to the raised arch support, which improves support raised arch 119A in the support cushion 105. These indentations 132 in this formation also promote polyurethane material flow in the area of the midfoot while assisting to minimize voids caused by air entrapment. The curvilinear indentations 132 in the arch area also allow the arch area to collapse to fit the shoe thus providing a more accommodative design.

[0093] 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 has a square groove pattern and 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 143 extending midfoot to heel, and around the exterior of the heel pod opening 112 by a heel ridge 152. The ridges 143, 142 and heel ridge 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 119A and the lateral arch 119B, which also improves the support provided to the user's foot during use.

[0094] 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.

[0095] 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 151 located on the bottom surface of the base layer 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.

[0096] 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 permits the first metatarsal to flex more naturally and thereby encourages loading of the great toe during toe off.

[0097] 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 circumferentially 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 by isolating the heel pad 118 and preventing migration of the cushioning effect laterally (cushioning effect absorbs directional impact force better with supporting grooves). 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 that extends from the proximate end of the heel (calcaneal bone) area to an area adjacent the proximal portion of the medial arch support area. In a preferred embodiment, the heel cushioning area has a heel pad 118 secured within a heel pad aperture or opening 112 formed in the support cushion 105 of the insole, with said heel pad 118 being secured to

the base layer 102. The heel pad opening 112 has a groove pattern 138 surrounding its periphery, which assists with durability of the insole 100 and enhances the cushioning capabilities of the heel pad 118.

[0098] The heel pad 118 has a thickness of approximately $3.0 \text{ mm} \pm 0.5 \text{ mm}$. In an alternate embodiment, the heel pad 118 is integrally formed in the material of the base bottom surface of the insole. The heel pad 118 provides compressive cushioning and support under the heel (calcaneal) bone. Preferably, the heel pad 118 has a diamond-cube pattern 120 on the heel pad 118 surface to provide compressive cushioning and support to the heel area. The diamond cube pattern 120 has a depth of approximately $1.5 \text{ mm} \pm 0.5 \text{ mm}$ and has a surface pattern spacing of about 1.0 mm to about 1.5 mm. In an alternate embodiment, the heel pad 118 has a honeycomb-shaped pattern, and, in yet another embodiment, the heel pad 118 has a texturized un-patterned surface.

[0099] The heel pad 118 is preferably molded of pre-blown ethylene vinyl acetate (EVA). The heel pad 118 may also be molded of EVA, polyurethane (PU), or thermoplastic rubber (TPR) or other suitable material. A thin layer of nylon fabric may be positioned in the heel pad 118 between the heel pad 118 and the material of the base layer 102 to increase the adhesion of the heel pad 118 to the base layer 102 when the heel pad 118 and base layer 102 are made of differing materials.

[00100] The heel pad 118 has 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 118 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 10-35 Asker ± 3 . The heel pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.

[00101] Insole 100 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.

[00102] Alternatively, the forefoot pad 107 can be molded onto the bottom surface of the insole base layer 102 from the forefoot pad 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 forefoot pad 107 and the base layer 102 in the forefoot pad indentation 102B. And, the midfoot/heel cushion 105 can be molded onto the bottom surface of the insole base layer 102 from the support cushion 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 midfoot-to-heel support cushion 105 and the base layer 102 in the indentation 102A. 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 are preferably molded into the support cushion 105 during manufacture.

[00103] FIG. 3A illustrates the top (foot side) of an insole 100 according to the invention with a top sheet 128 covering the top side of the insole 100, which is placed over the base layer 102. Figure 3B shows the insole 100 without the top sheet 128 in place and a midfoot to toe area 108 shown in both Figures 3A and 3B. 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 134 on top side is integrally formed as upwardly-curved indentation from bottom surface of the insole.

[00104] On the foot contact surface of the insole 100, the base layer 102 has a raised metatarsal dome 134. The metatarsal dome 134 is positioned under the heel bone to provide additional cushioning to the user's heel while walking or standing. The metatarsal dome 134 curves upward from the insole 100 top (foot contact) surface to make a dome-like contact surface under the metatarsal area of the foot. The metatarsal dome 134 is preferably molded as a cushion separate from the base layer 102 and is secured to the top side of the base layer 102. The metatarsal dome 134 is covered by the top sheet 128 providing a

continuous contact surface to the user's foot on the top (foot contact) surface of the insole. In an alternative embodiment, the metatarsal dome 134 is integrally formed in the material comprising the top side of the base layer 102.

[00105] The metatarsal dome 134 is preferably formed of super soft low density polyurethane, but may be formed of polyurethane memory foam, ethylene glycol polyurethane, ethylene vinyl acetate (EVA), pre-blown EVA, polyurethane (PU), thermoplastic rubber (TPR) or other suitable material. Hardness of the metatarsal dome 134 material can range from less than 10 Asker ± 3 to greater than 30 Asker ± 3 .

[00106] A soft metatarsal dome 134 is located on the top (foot contact) surface providing cushioning directly over the metatarsal area of the foot. The top sheet 128 is shown in Figure 3A, and the exposed top view of the insole 100 is shown in Figure 3B without the top sheet 128. 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 extends 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.

[00107] Referring to FIG. 4A, the medial side view of the insole 100 is shown with curvilinear indentations 132 shown in the raised arch area 119. Figure 4B shows the insole 100 without the top sheet 128 in place. 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 119A that extends upwardly along the medial side of the insole to provide extra cushion and support to the raised arch 119 of the foot.

[00108] A strength layer 103 is composed of a woven fabric, a composite material or an enhanced fabric is also inserted between the base layer 102 and the forefoot pad 107 and/or support cushion 105 to strengthen and enhance the durability of the insole. A portion of the strength layer 103 can be seen in Figure 1B. Alternatively, this strength layer 103 can be made of knitted or woven high-strength fabric secured to the top surface of the EVA base

material, but this strength layer 103 should be made of material that retains its shape upon use without significant shrinkage or deformation from heat or pressure of normal use. The strength layer 103 may extend from heel-to-toe across the entire surface of the insole 100, or alternatively, may only extend across the heel area, the heel to mid-foot area, or the forefoot to toe area.

[00109] Also referring to FIG. 5A and 5B, the insole 100 lateral side view is shown with the raised lateral arch 119B, the metatarsal dome 134, a forefoot pad 107 located in the forefoot area 108, a base layer 102, the heel cup 104, the lateral side of the support cushion 105, and a top sheet 128 (shown in Figure 5A only). The top sheet 128 is not shown in Figure 5B. Figure 5A and 5B shows that 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.

[00110] As shown in Figures 5A and 5B, 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 positioned in a forefoot pad indentation area 102A (shown in Figure 1B) on a forefoot base area 108 of the insole 100, and, (3) a midfoot-to-heel support cushion 105 positioned in a midfoot to heel indentation area 102B (shown in Figure 1B). 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.

[00111] The forefoot pad 107 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 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 cube groove pattern 117 (shown in Figures 1A-1C and 2A-2C) 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.

[00112] The midfoot/heel support cushion 105 has a raised arch 119A in the medial arch area and a lateral arch 119B, which has longitudinal curvilinear indentations 132 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. There is a raised separation wall 151 shown in Figures 5A and 5B 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.

[00113] 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.

[00114] Now referring to FIG. 6A and 6B, these figures show the front end view of the insole 100 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 6A and not shown in Figure 6B. Figure 6A shows forefoot pad 107 in forefoot area 108, base layer 102, raised arch area 119, and top sheet 128. Figures 7A and 7B shows 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 7A and not shown in Figure 7B. 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 placement of curvilinear indentations 132, and the top sheet 128.

[00115] 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 positioned in a forefoot pad indentation 102B (shown in Figure 1B) on a forefoot base area 108 of the insole 100, and, (3) a midfoot-to-heel support cushion 105 positioned in a midfoot to heel indentation 102A (shown in Figure 1B). 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 (shown in Figures 1A-1C and 2A-2C).

[00116] Also shown in these figures, a strength layer 103 is composed of a woven fabric, a composite material or an enhanced fabric is also inserted between the base layer 102 and the forefoot pad 107 and/or the support cushion 105 to strengthen and enhance the durability of the insole. A portion of the strength layer 103 is shown in Figure 1B. Alternatively, this strength layer 103 can be made of knitted or woven high-strength fabric secured to the top surface of the EVA base material, but this strength layer 103 should be made of material that retains its shape upon use without significant shrinkage or deformation from heat or pressure of normal use. The strength layer 103 may extend from heel-to-toe across the entire surface of the insole 100, or alternatively, may only extend across the heel area, the heel to mid-foot area, or the forefoot to toe area.

[00117] In a preferred embodiment, the insole 100 has a base layer 102, a forefoot pad 107, a heel pad 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 119A in the medial arch area and longitudinal curvilinear indentations 132 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, as well as a lateral arch 119A in the midfoot area. A teardrop metatarsal dome 134 shown in Figures 6A and 6B and 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 located between cushion 105 and forefoot pad 107 with an approximate height of 1 mm.

[00118] The forefoot pad 107 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 117 molded in the gel having pattern spacing of about 1 mm and a depth of about 1.5 mm. The forefoot pad 107 has a firmness that 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.

[00119] The midfoot/heel cushion 105 has a raised arch 119A in the medial arch area of the insole 100 and longitudinal curvilinear indentations 132 positioned along at least one major angle of inclination from the longitudinal axis, with the longitudinal axis extending from heel-to-toe on the insole 100. 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.

[00120] 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.

[00121] To cushion the impact the components described above to work in conjunction with each other 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.

[00122] 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.

[00123] 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 metatarsal dome on the top surface of base layer and raised over the metatarsal midfoot area of the insole;
- (d) separation wall on the bottom surface of the base layer and located between said forefoot pad indentation area and said mid-foot-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) a raised medial arch support on the bottom surface of the insole in the medial arch midfoot area,
- (b) a raised lateral arch support on the bottom surface of the insole in the lateral midfoot area,
- (c) a heel cup on the bottom surface of the insole and surrounding the heel end of the insole with vertical walls,

- (d) a metatarsal arch dome raised up from the bottom surface of the insole,
- (e) one or more longitudinal ridges on the bottom surface of the support cushion, and
- (f) 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;

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 base layer is formed of a gel material.
3. The insole of claim 1 further comprising a strength layer affixed to said base layer and at least partially extending from heel to toe across said insole.
4. The insole of claim 1, wherein said base layer is made of polyurethane polyester glycol with a hardness 10-30 Asker ± 3 .
5. The insole of claim 1, wherein said forefoot pad made of a clear TPR gel (thermoplastic rubber).
6. The insole of claim 5, wherein said TPR gel has a hardness rating of 10-20 Asker ± 3 .
7. The insole of claim 1, wherein said forefoot pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.
8. The insole of claim 1, wherein said heel pad is made of pre-blown EVA (ethylene-vinyl acetate) material.

9. The insole of claim 8, wherein said heel pad has a hardness rating of 10-35 Asker ± 3 .
10. The insole of claim 1, wherein said heel pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.
11. The insole of claim 1, wherein said heel pad aperture is surrounded by heel aperture grooves.
12. The insole of claim 1, wherein base layer is made of a durable nylon fabric.
13. The insole of claim 1, wherein said first curvilinear indentations have a groove depth of approximately 0.50 mm-1.5 mm.
14. The insole of claim 1, wherein said top sheet is made of 65% Nylon/ 35% polyester.
15. 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.
16. 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.
17. The insole of claim 1, wherein said forefoot and heel pads are made of rubber or synthetic rubber.
18. The insole of claim 1, wherein said forefoot and heel pads are made of a neoprene synthetic rubber.
19. 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) a raised medial arch support on the bottom surface of the insole in the medial arch midfoot area,
- (b) a raised lateral arch support on the bottom surface of the insole in the lateral midfoot area,
- (c) a heel cup on the bottom surface of the insole and surrounding the heel end of the insole with vertical walls,
- (d) a metatarsal arch dome raised up from the bottom surface of the insole,
- (e) one or more longitudinal ridges on the bottom surface of the support cushion, and
- (f) 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;

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.

20. The insole of claim 19, 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 mid-foot-to-heel stability cushion indentation area.
21. The insole of claim 19 further comprising a strength layer affixed to said base layer and at least partially extending from heel to toe across said insole.
22. 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.
23. The insole of claim 19, 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.
24. The insole of claim 19, wherein base layer is made of a durable nylon fabric.
25. The insole of claim 19, wherein said base layer is formed from a gel material.
26. The insole of claim 19, wherein said base layer is made of polyurethane polyester glycol with a hardness 30 Asker ± 3 .
27. The insole of claim 19, wherein said forefoot pad is made of clear TPR gel (thermoplastic rubber) gel.
28. The insole of claim 27, wherein said TPR gel has a hardness rating of 10-20 Asker ± 3 .
29. The insole of claim 19, wherein said forefoot pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.
30. The insole of claim 19, wherein said heel pad made of pre-blown EVA (ethylene-vinyl acetate) material.
31. The insole of claim 30, wherein said heel pad has a hardness rating of 10-35 Asker ± 3 .
32. The insole of claim 19, wherein said heel pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.
33. The insole of claim 19, wherein said heel pad aperture is surrounded by heel pad aperture grooves.

34. The insole of claim 19, wherein said first curvilinear indentations have a groove depth of approximately 0.50 mm-1.5 mm.
35. The insole of claim 19, wherein said top sheet is made of 65% Nylon/ 35% polyester.
36. The insole of claim 19, 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.
37. The insole of claim 19, wherein said forefoot pad and support cushion are made of rubber or synthetic rubber.
38. The insole of claim 19, wherein said forefoot pad and support cushion are made of a neoprene synthetic rubber layer which is a polymer.
39. 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 metatarsal dome on the top surface of base layer and raised over the metatarsal midfoot area of the insole;
- (d) separation wall on the bottom surface of the base layer and located between said forefoot pad indentation area and said mid-foot-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) a raised medial arch support on the bottom surface of the insole in the medial arch midfoot area,
- (b) a raised lateral arch support on the bottom surface of the insole in the lateral midfoot area,
- (c) a heel cup on the bottom surface of the insole and surrounding the heel end of the insole with vertical walls,
- (d) a metatarsal arch dome raised up from the bottom surface of the insole,
- (e) one or more longitudinal ridges on the bottom surface of the support cushion, and
- (f) a heel pad aperture on the bottom surface of the base layer in the heel area,

said raised medial 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;

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.

40. The method of making the insole of claim 39, wherein said base layer is formed of a gel material.

41. The method of making the insole of claim 39, further comprising the step of:
positioning a strength layer onto said base layer and at least partially extending from heel to toe across said insole.
42. The method of making the insole of claim 39, wherein said base layer is made of polyurethane polyester glycol with a hardness 10-30 Asker ± 3 .
43. The method of making the insole of claim 39, wherein said forefoot pad made of a clear TPR gel (thermoplastic rubber).
44. The method of making the insole of claim 43, wherein said TPR gel has a hardness rating of 10-20 Asker ± 3 .
45. The method of making the insole of claim 39, wherein said forefoot pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.
46. The method of making the insole of claim 39, wherein said heel pad is made of pre-blown EVA (ethylene-vinyl acetate) material.
47. The method of making the insole of claim 46, wherein said heel pad has a hardness rating of 10-35 Asker ± 3 .
48. The method of making the insole of claim 39, wherein said heel pad has a groove pattern with a width spacing of approximately 1.0mm-1.50mm.
49. The method of making the insole of claim 39, wherein said heel pad aperture is surrounded by heel pad aperture grooves.
50. The method of making the insole of claim 39, wherein base layer is made of a durable nylon fabric.
51. The method of making the insole of claim 39, wherein said first curvilinear indentations have a groove depth of approximately 0.50 mm-1.5 mm.
52. The method of making the insole of claim 39, wherein said top sheet is made of 65% Nylon/ 35% polyester.
53. The method of making the insole of claim 39, 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.
54. The method of making the insole of claim 39, wherein said separation wall located on the bottom surface of the base layer and is approximately 1 mm in height.

55. The method of making the insole of claim 39, wherein said forefoot pad and support cushion are made of rubber or synthetic rubber.

56. The method of making the insole of claim 39, wherein said forefoot pad and support cushion are made of a neoprene synthetic rubber.

57. The method of making the insole of claim 39 wherein said steps of positioning include forming the material by molding in place.

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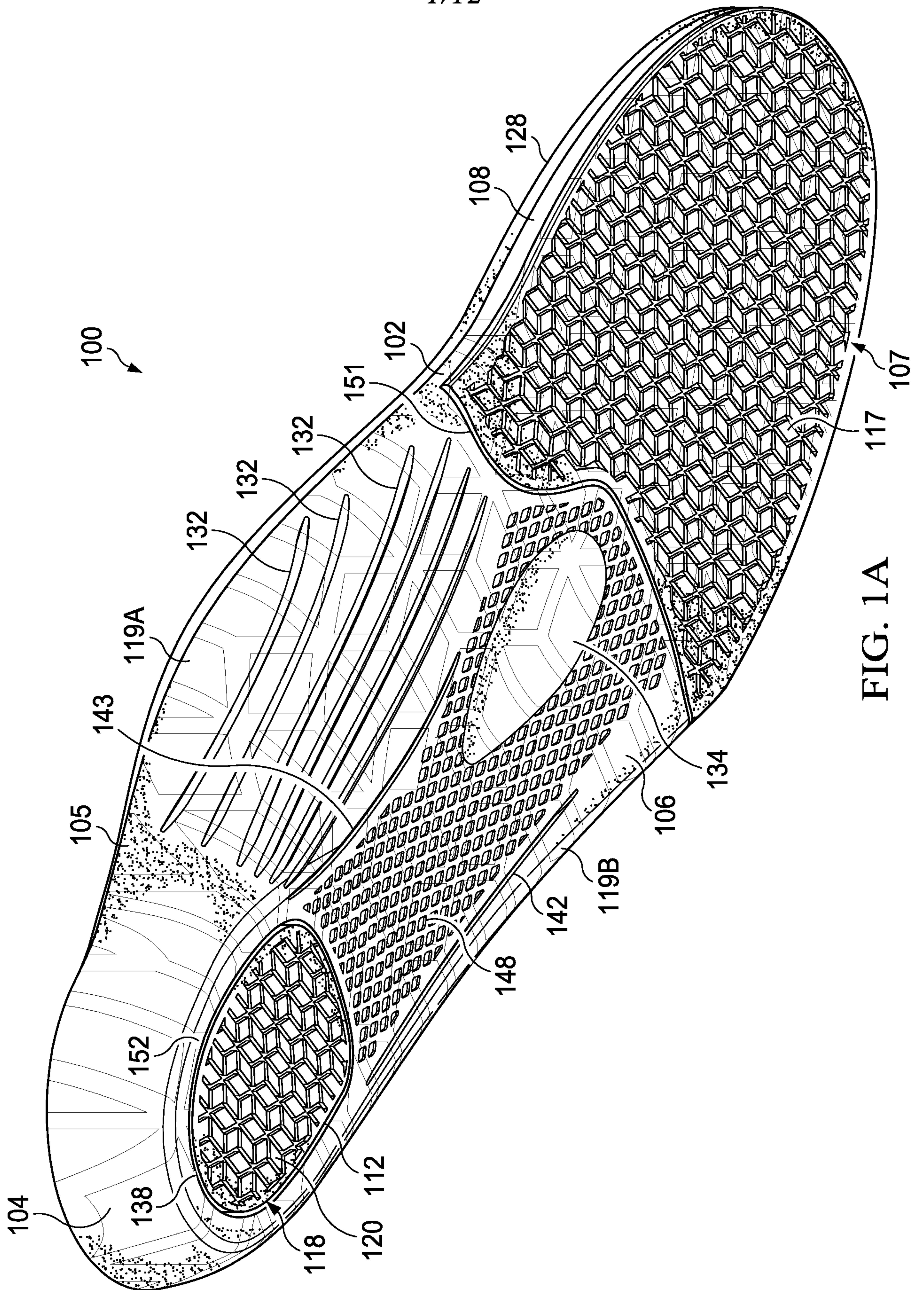
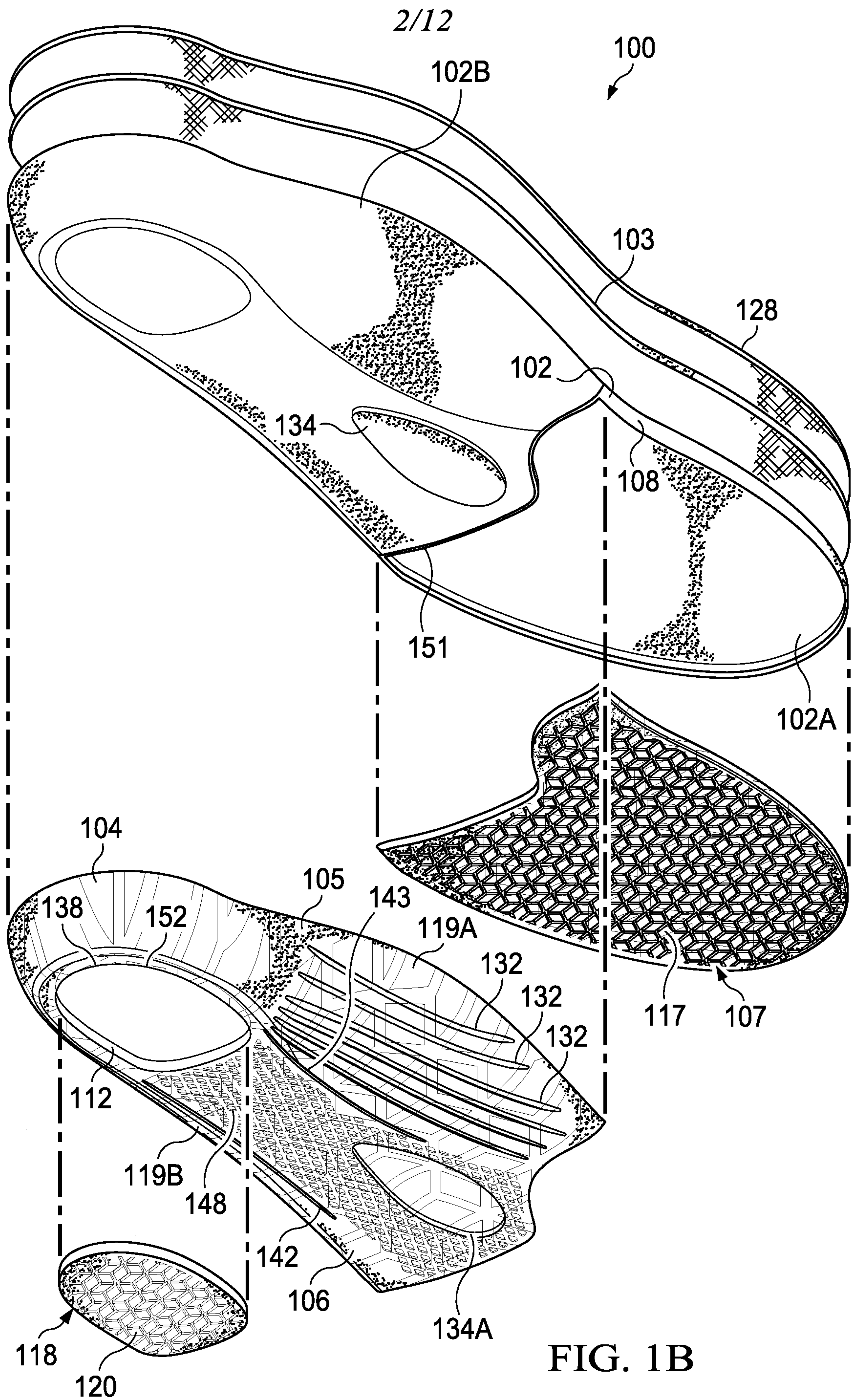


FIG. 1A



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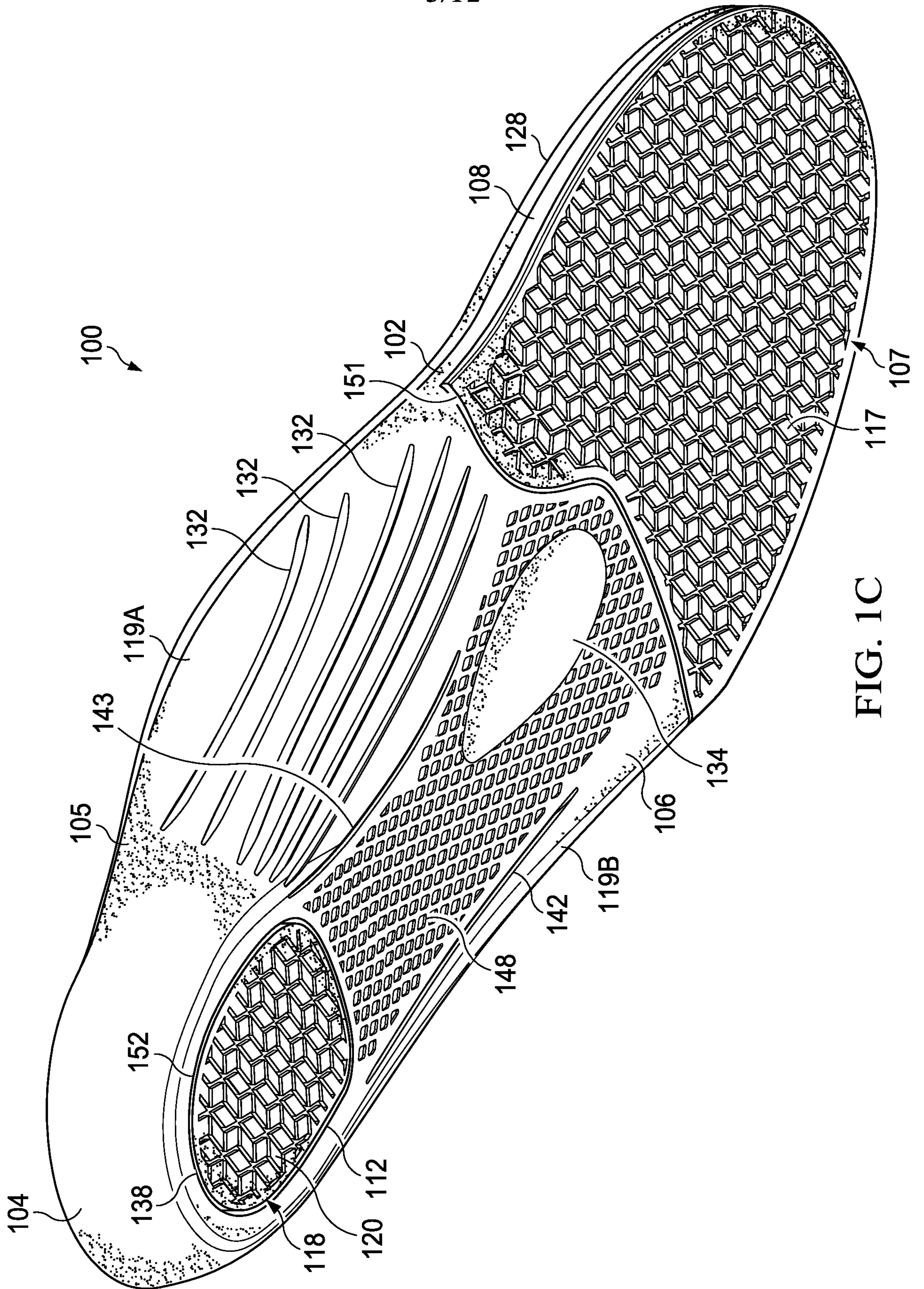
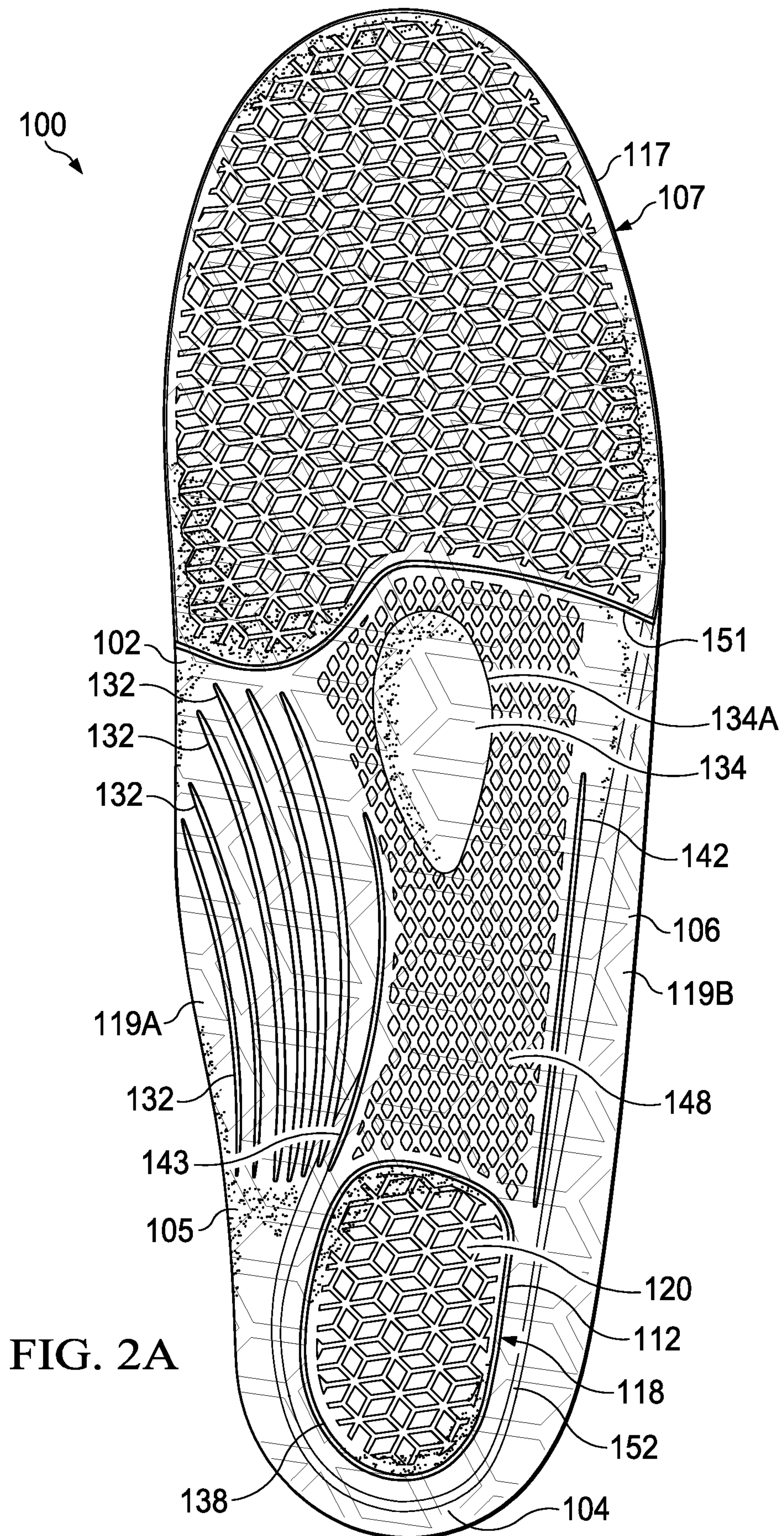


FIG. 1C

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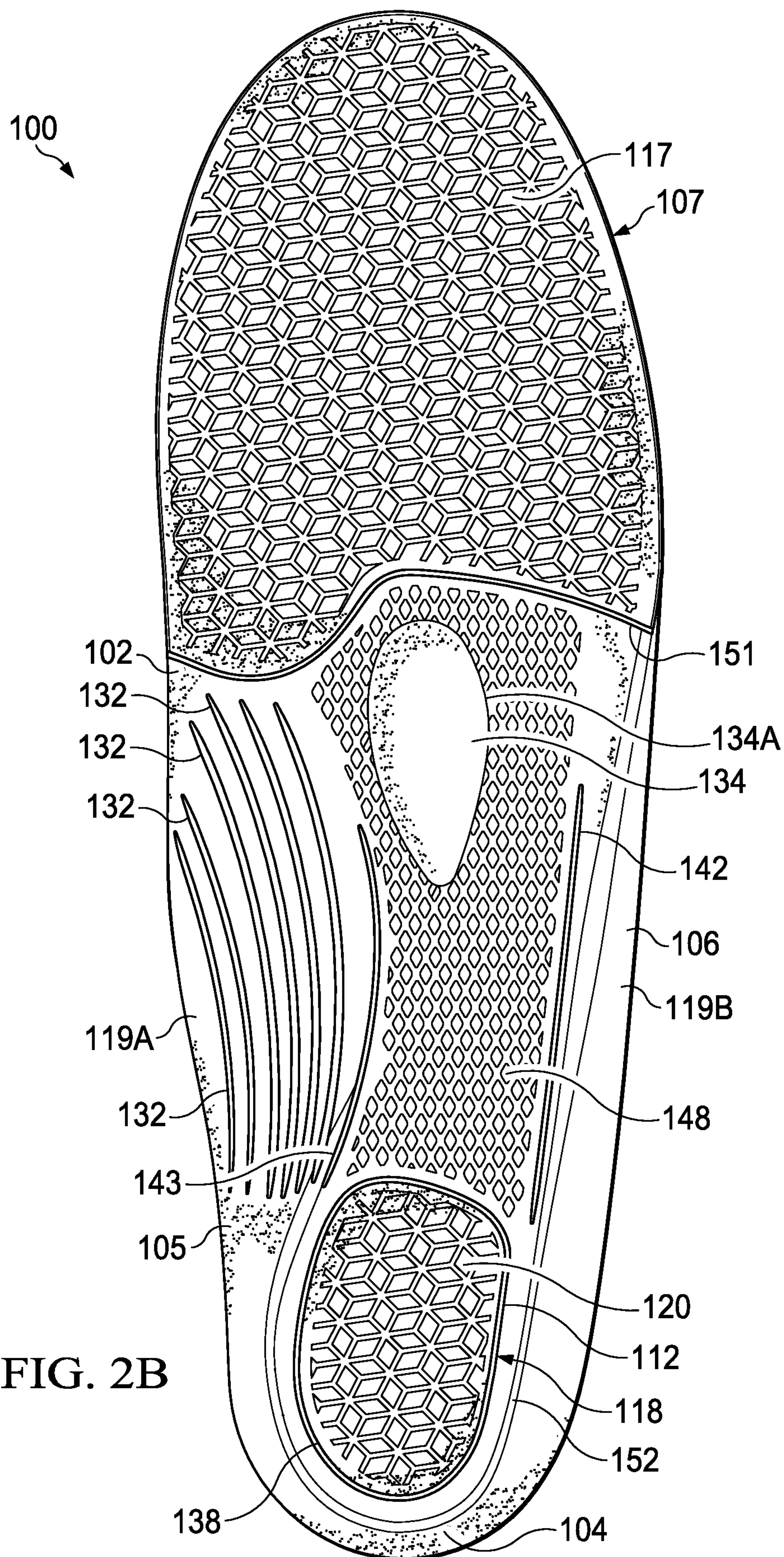
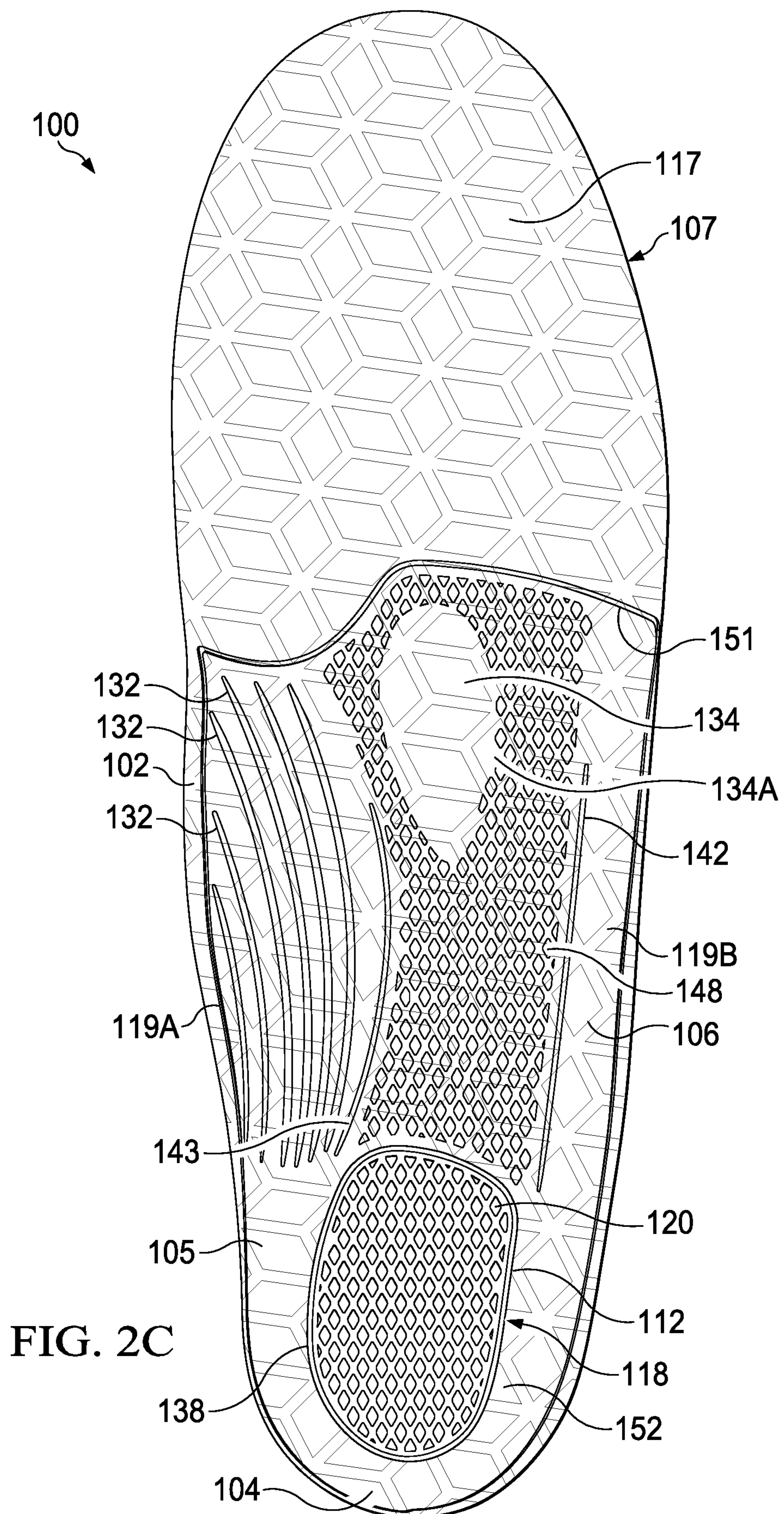


FIG. 2B

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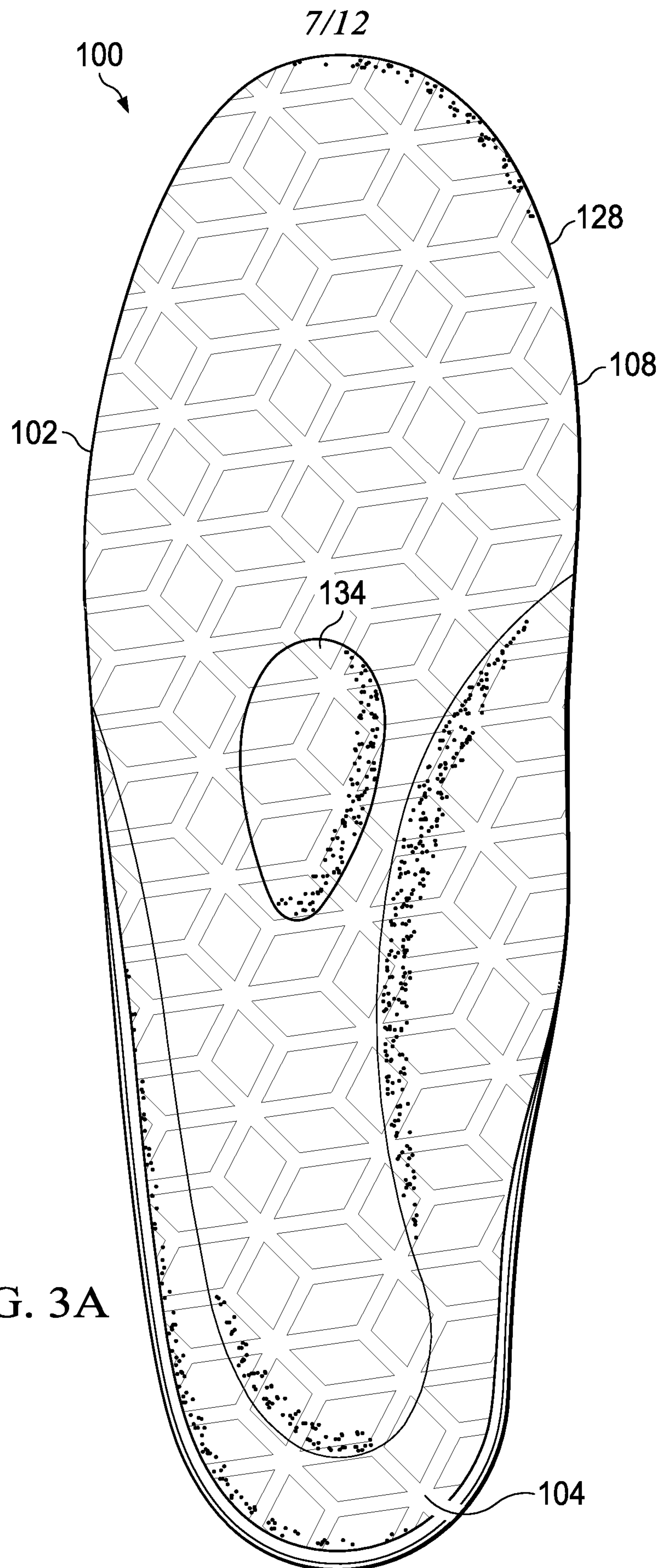


FIG. 3A

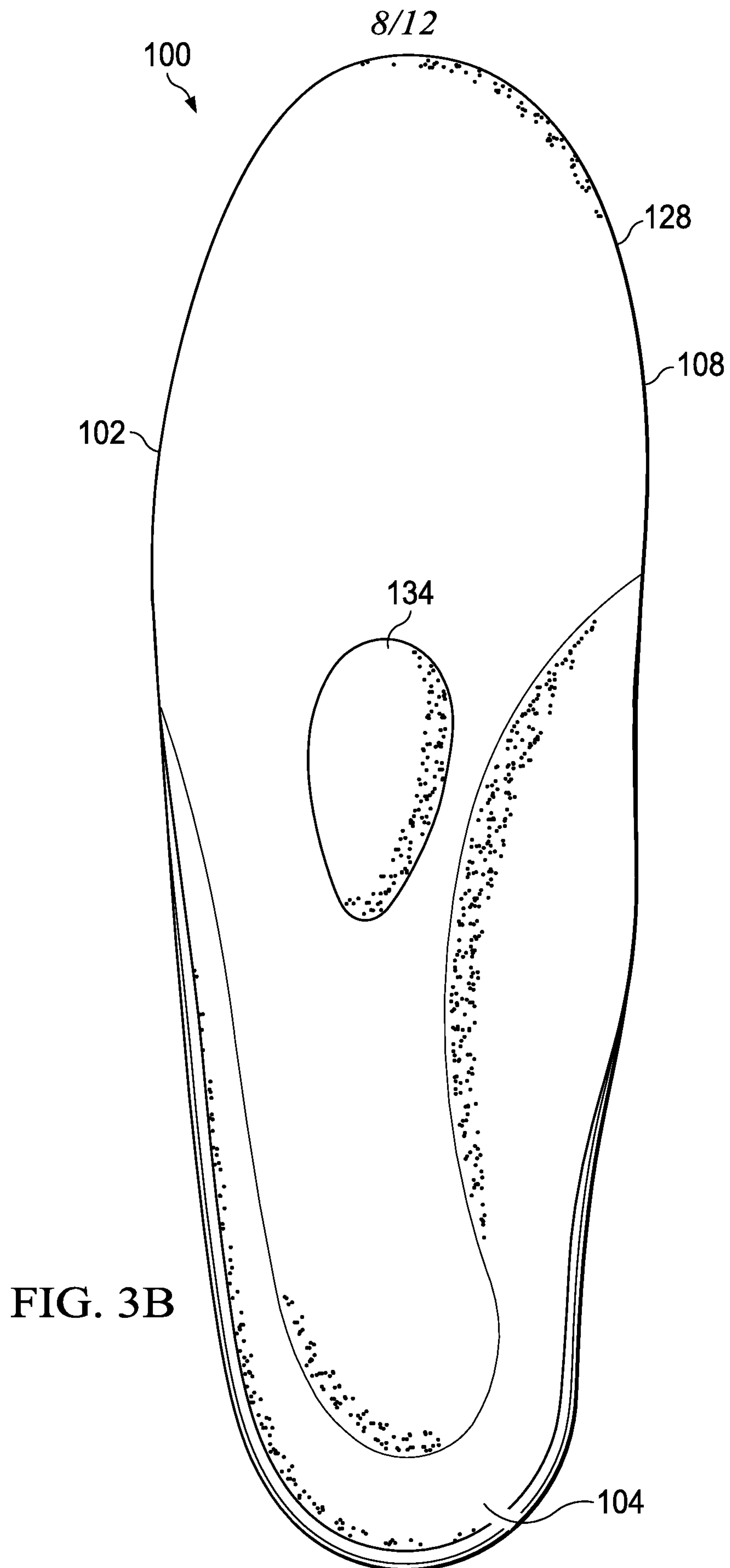
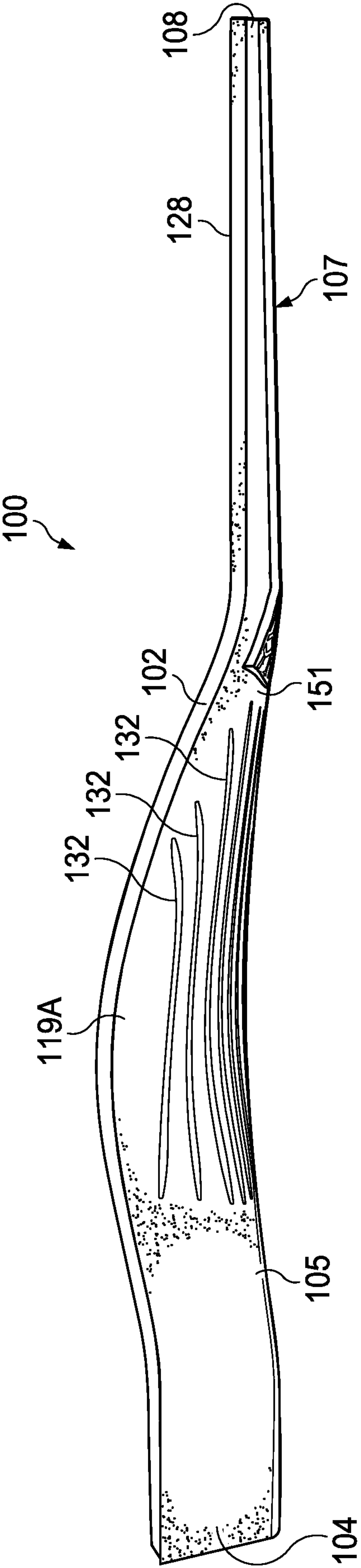
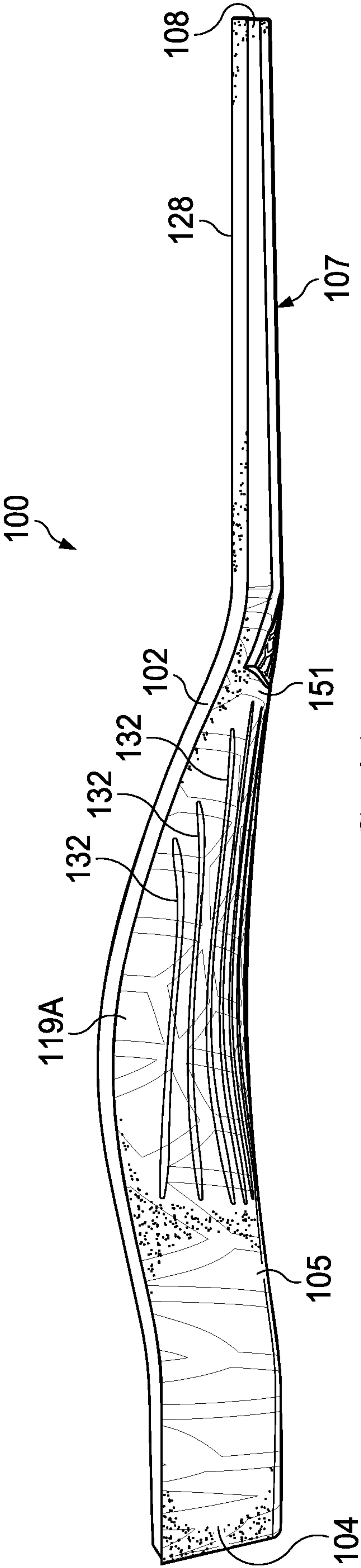
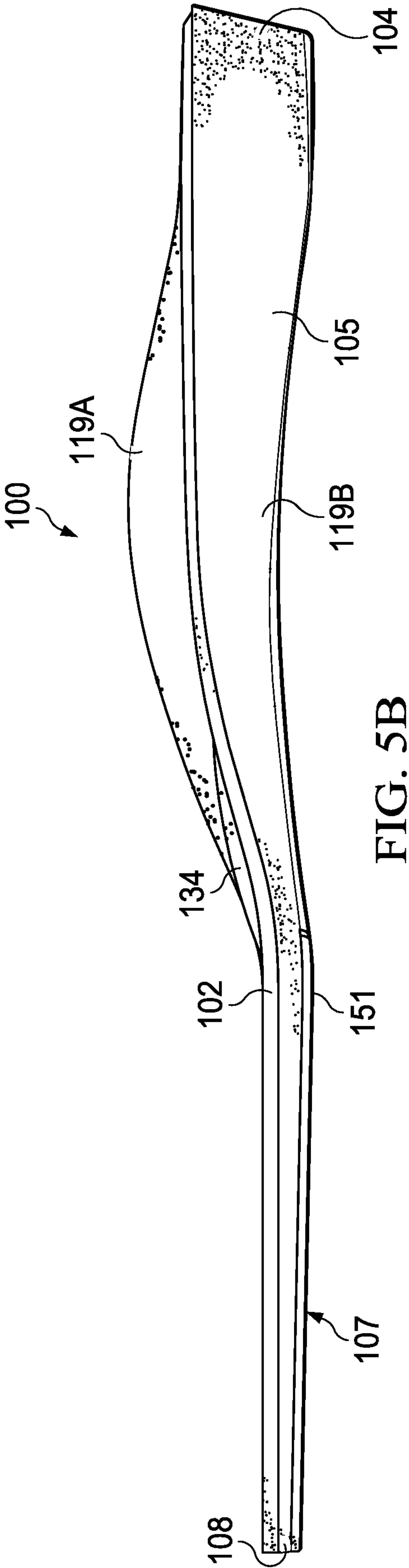
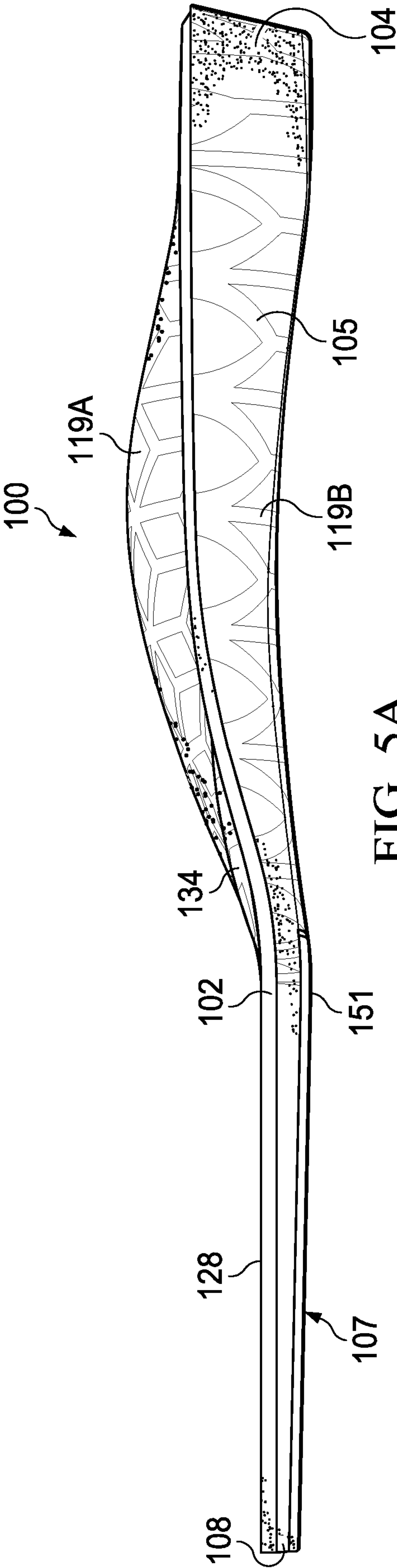
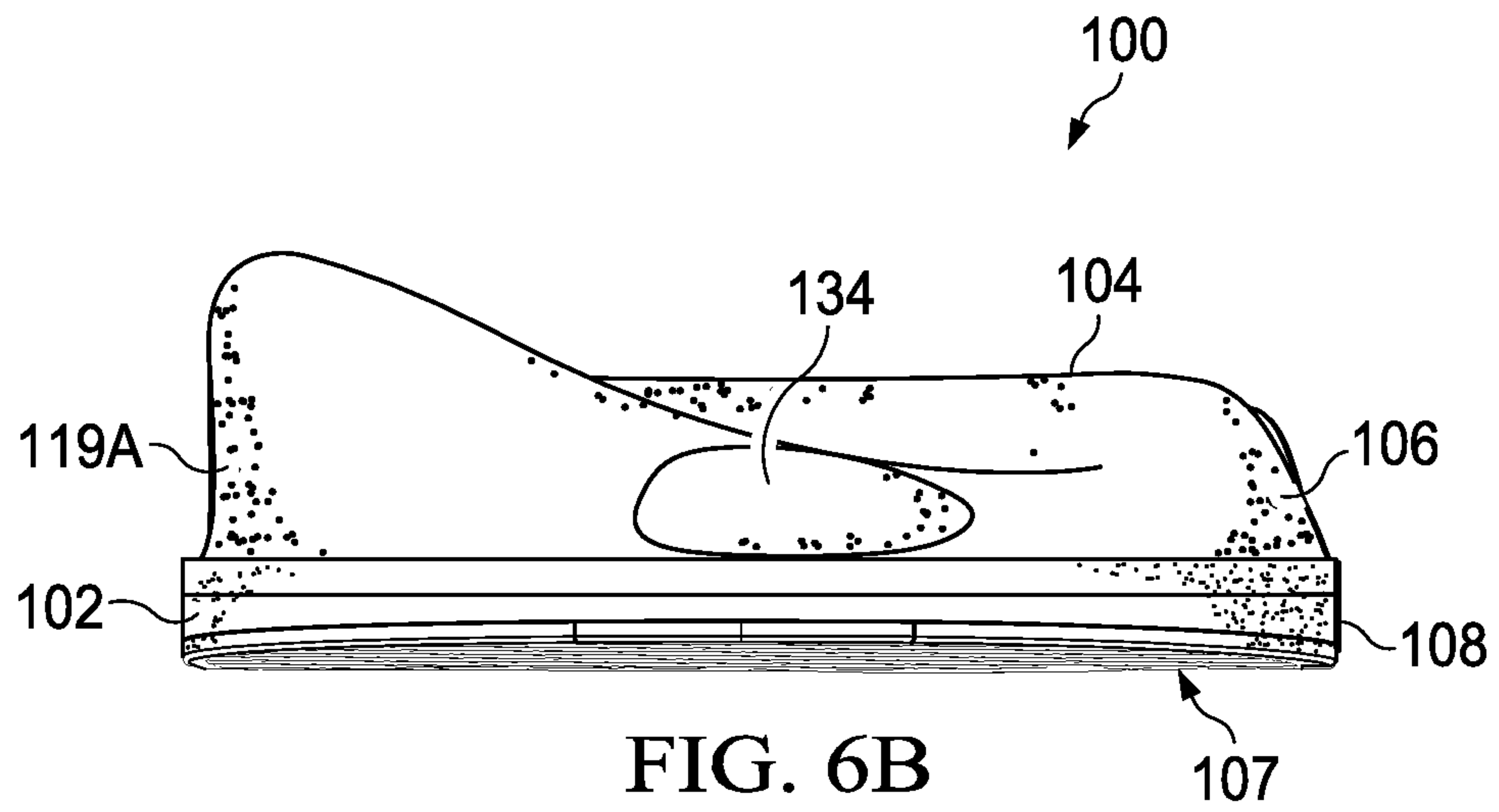
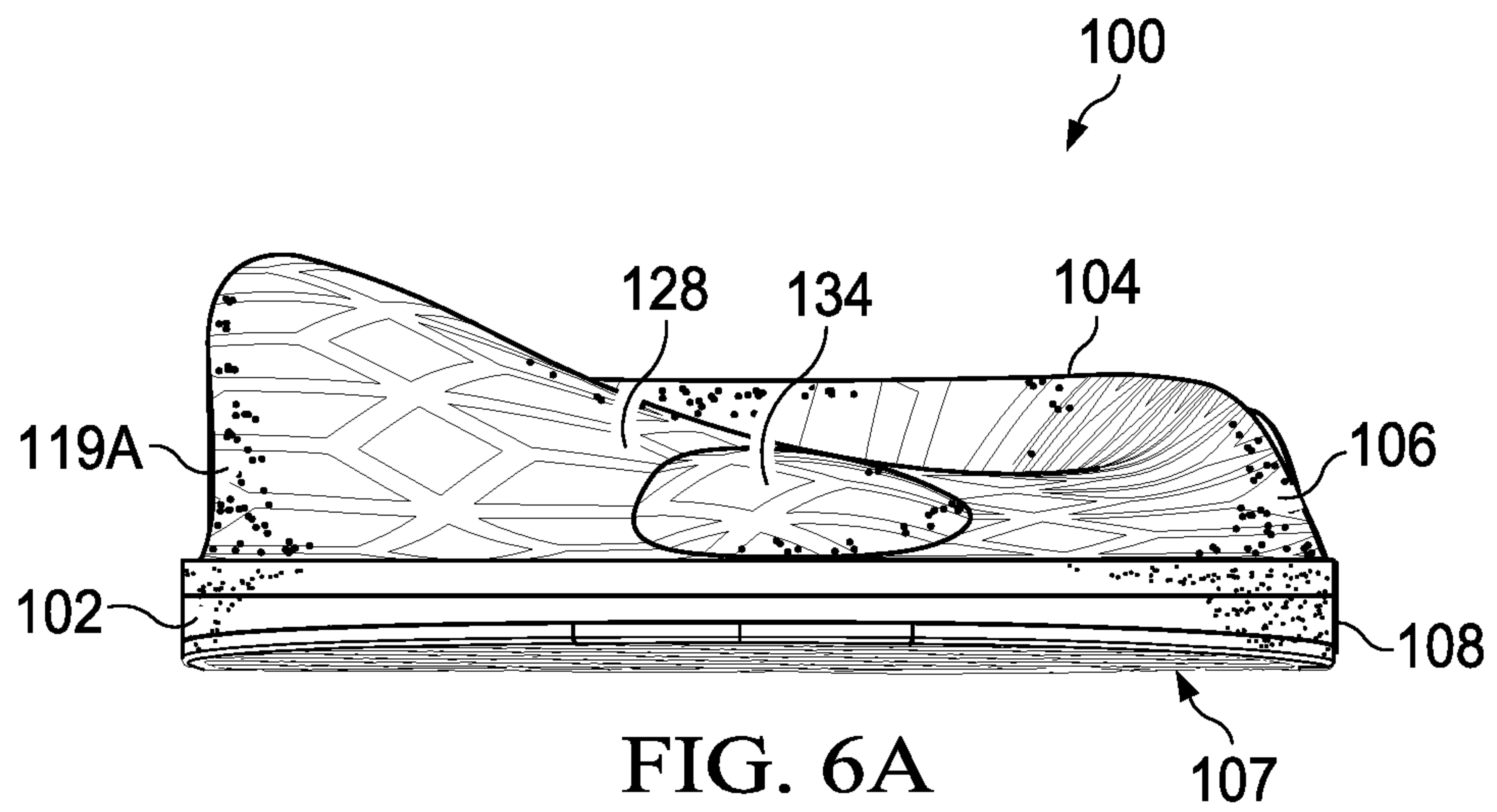


FIG. 3B





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