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(54) **TRIATHLON INSOLE**

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(73) Assignee: **Spenco Medical Corporation**, Waco, TX (US)

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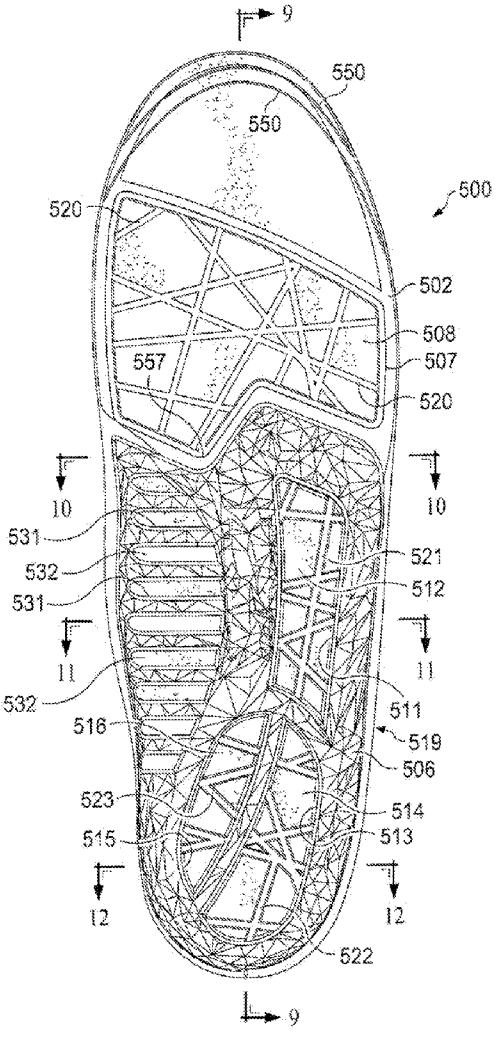
A43B 17/02 (2006.01)

(52) **U.S. Cl.**
CPC ***A43B 7/141*** (2013.01); ***A43B 7/148*** (2013.01); ***A43B 17/02*** (2013.01)

(57) **ABSTRACT**

An insole which provides cushioning and support to a user's foot subjected to ground forces and/or differing weather conditions encountered during active sports, for example triathlons, is herein disclosed. The insole comprises a base having a bottom side which defines recesses adapted to receive pads and pods having particular properties. The location and materials of the various pads and pods work together to provide ankle and foot stabilization, enhanced cushioning features, and resistance to insole movement during shoe operation.



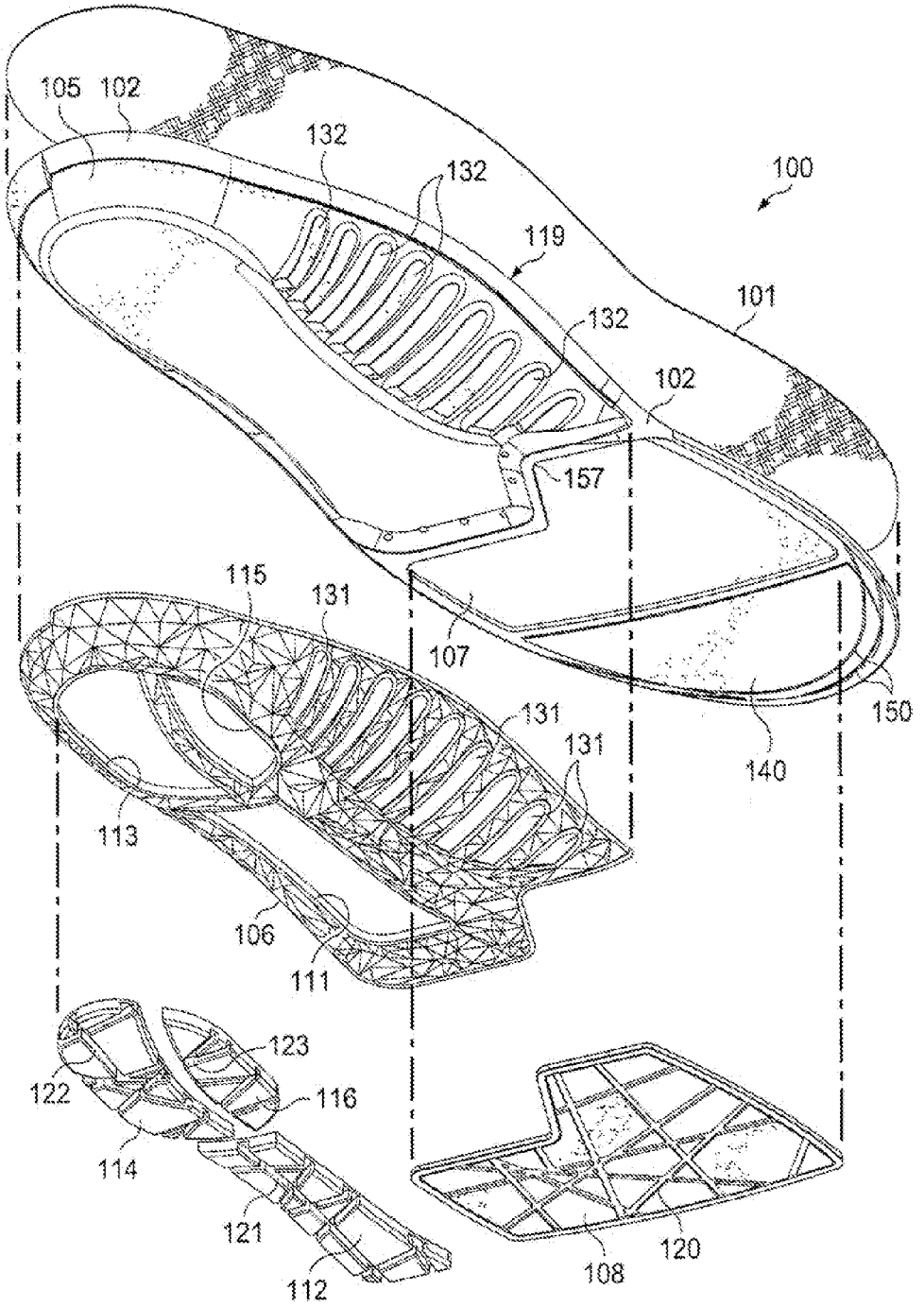

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FIG. 1

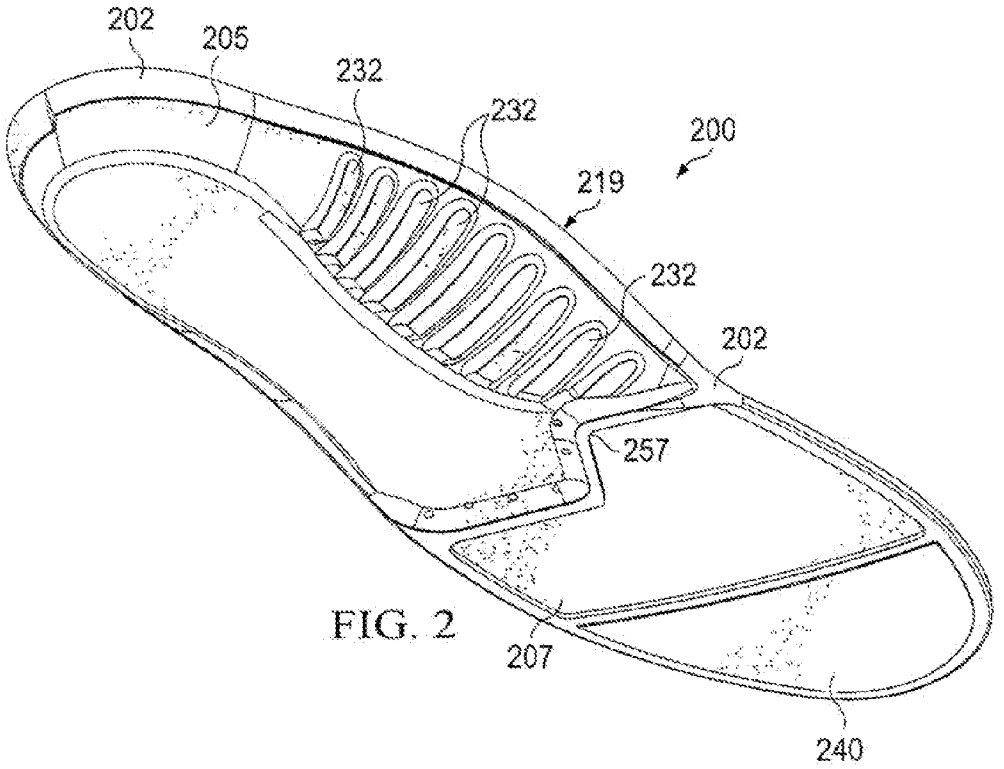
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FIG. 2

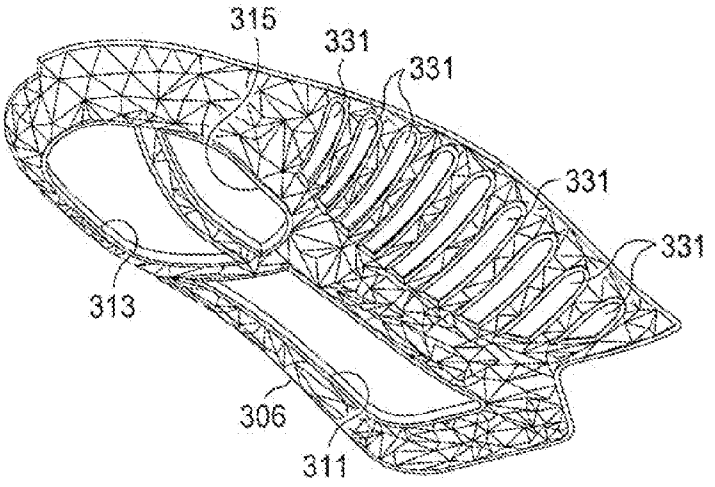
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FIG. 3B

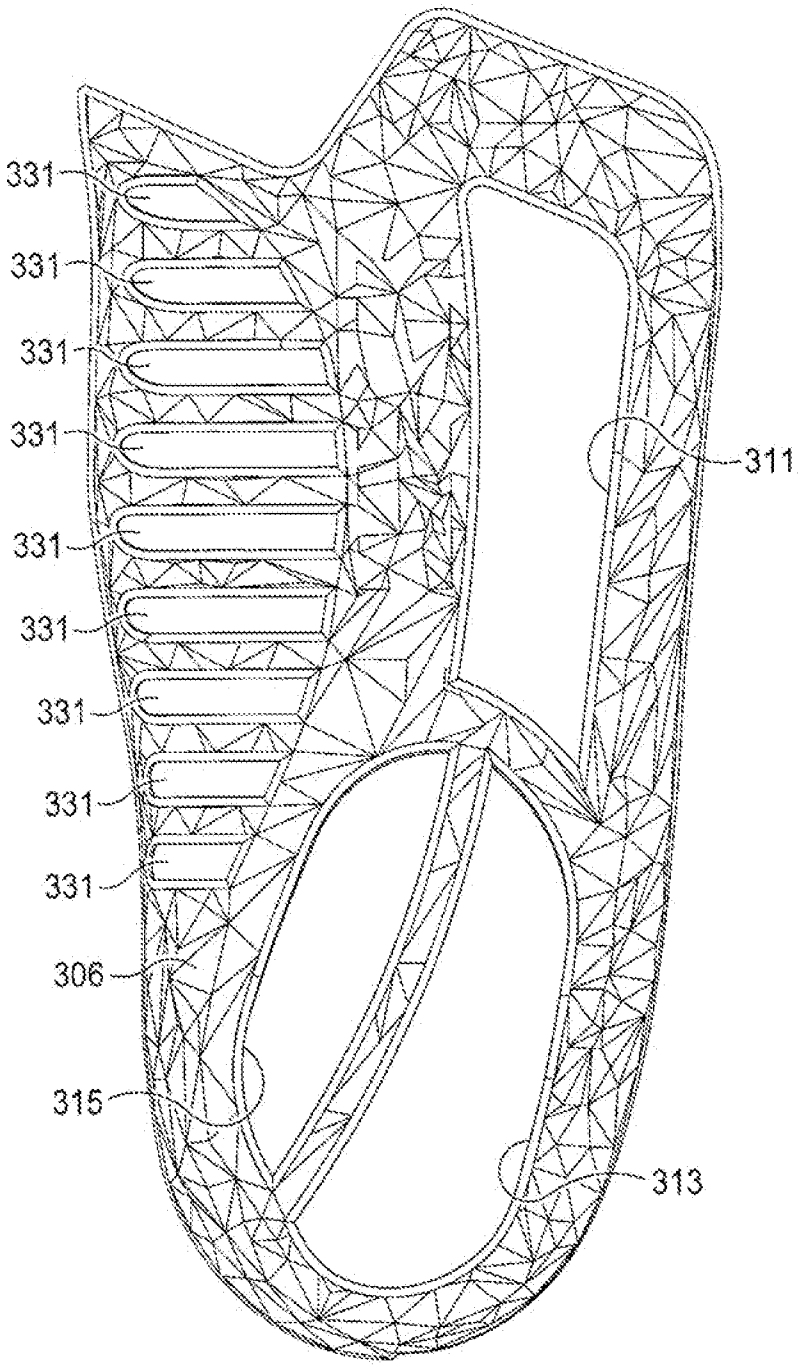

FIG. 3A

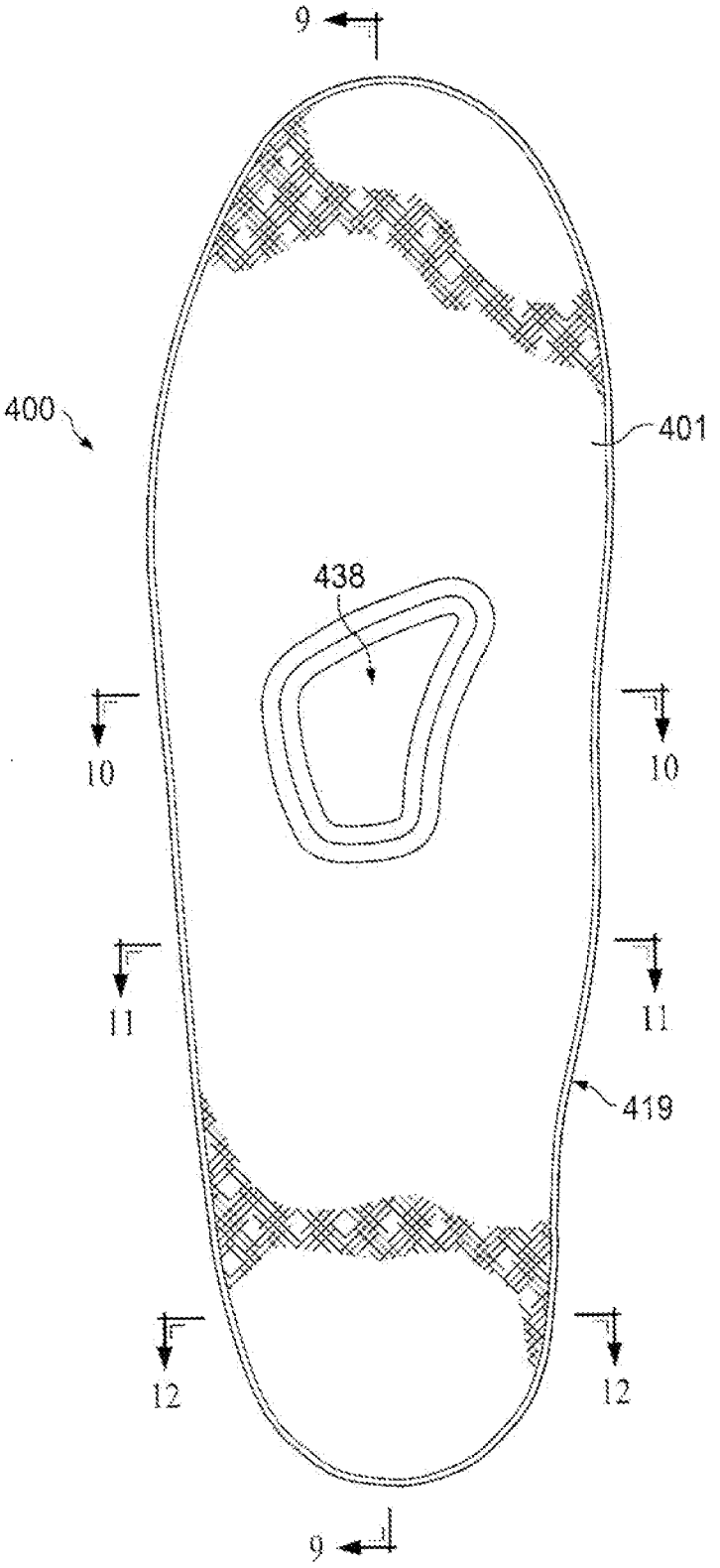

FIG. 4

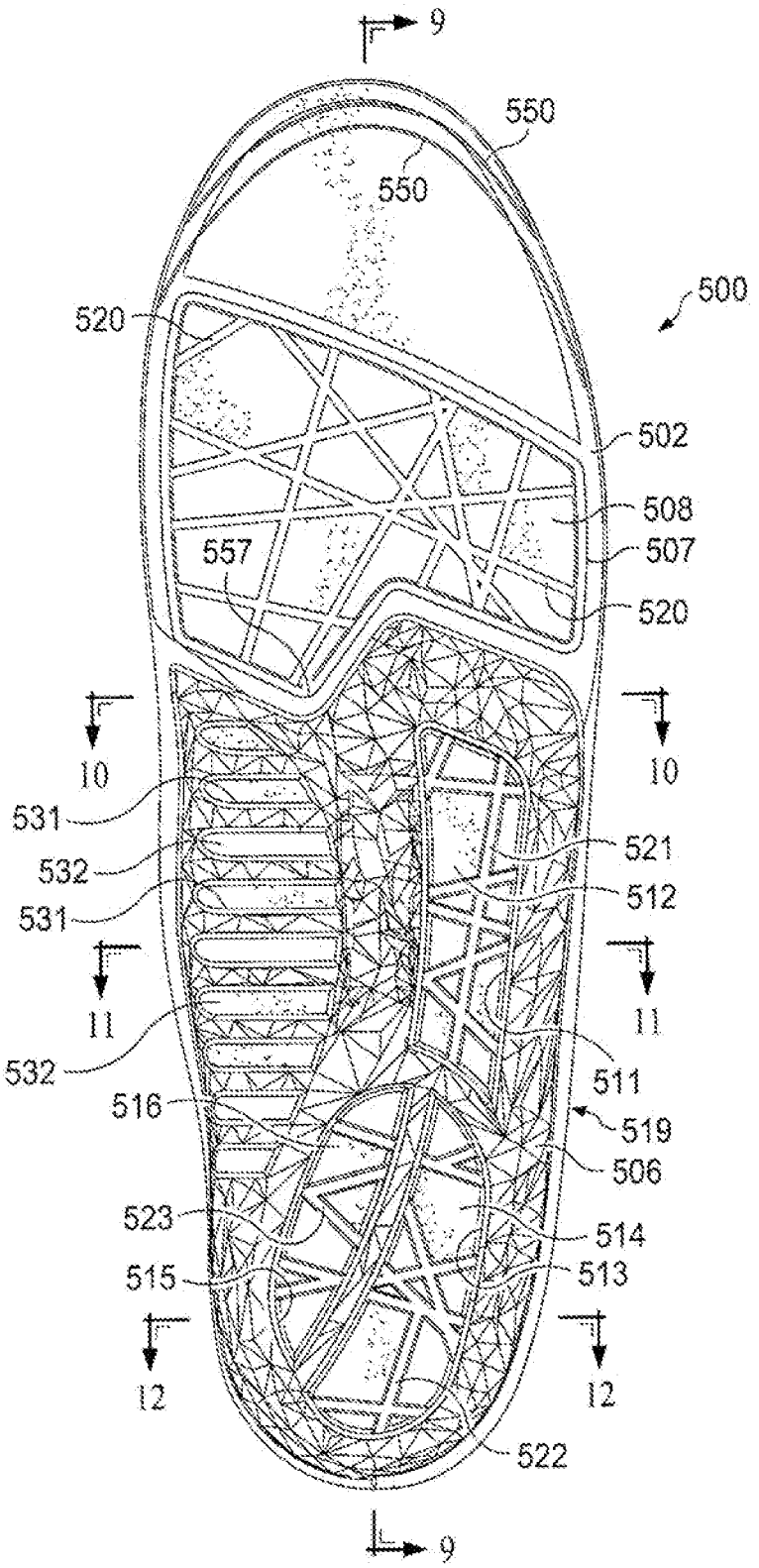
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FIG. 5

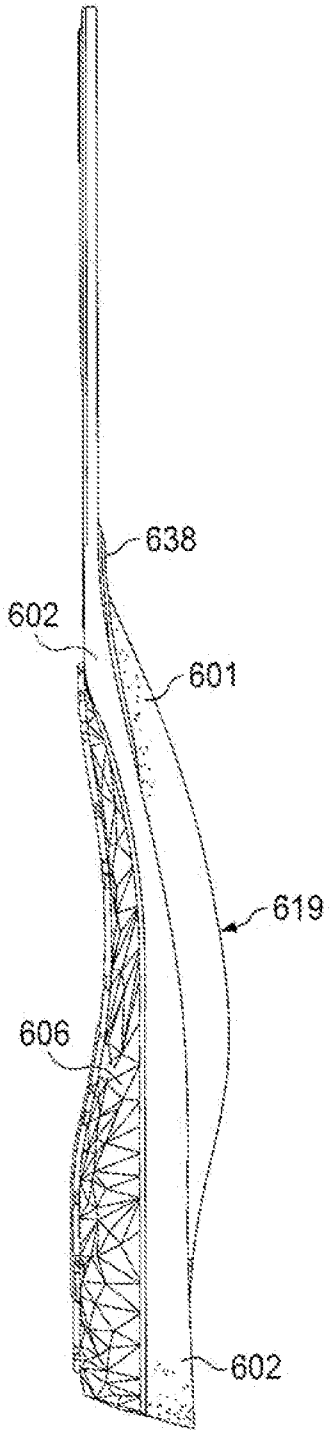

FIG. 6

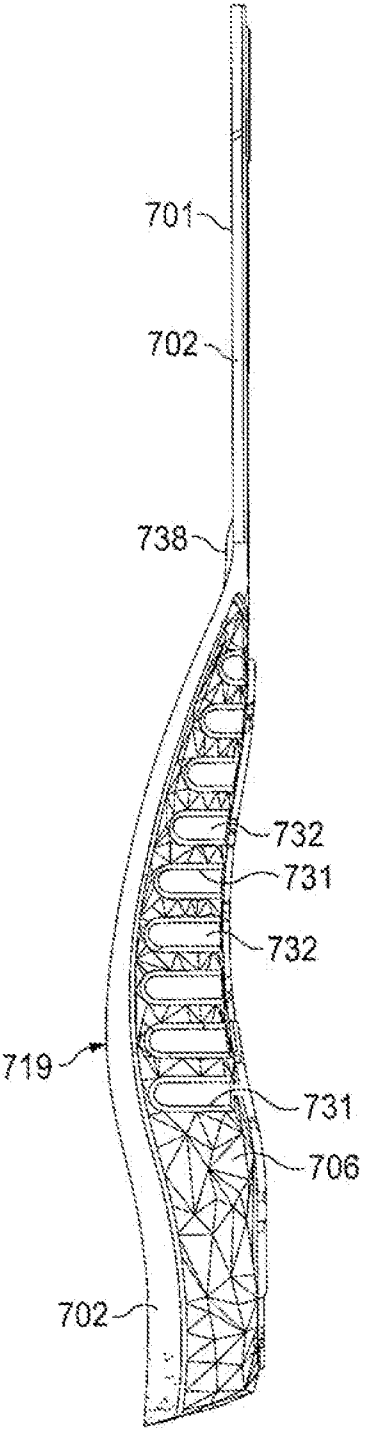

FIG. 7

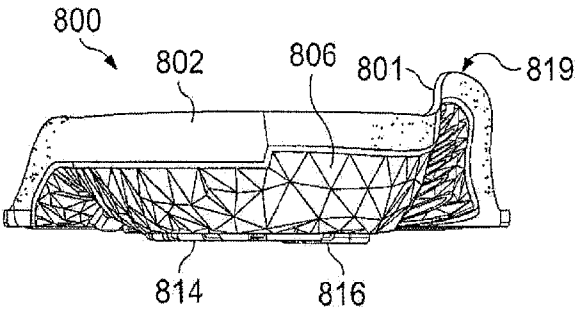

FIG. 8

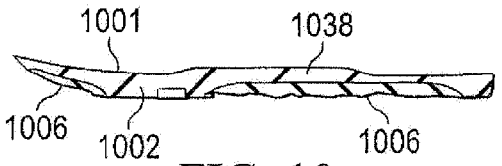

FIG. 10

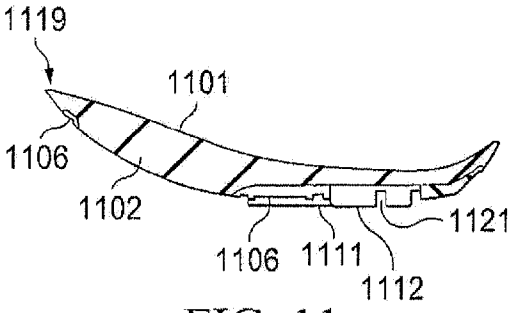

FIG. 11

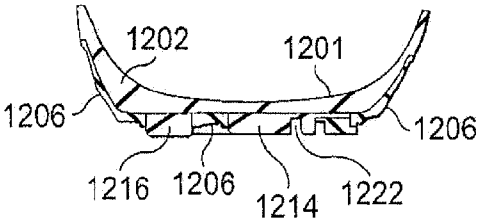

FIG. 12

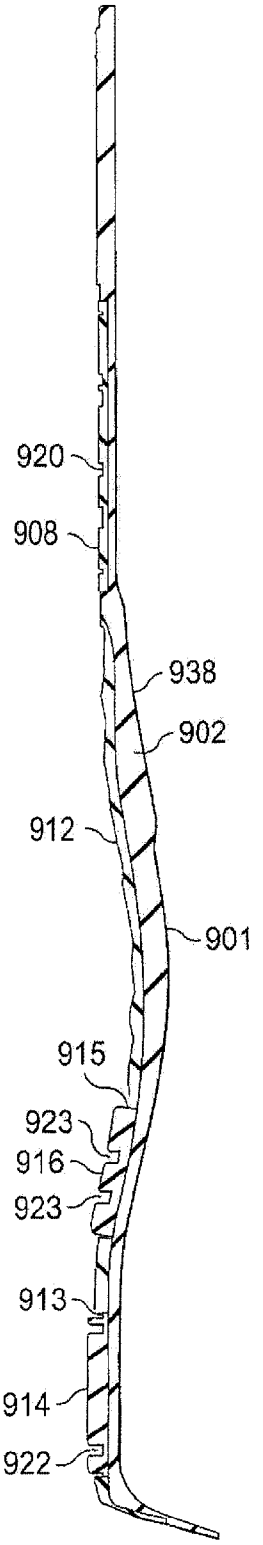

FIG. 9

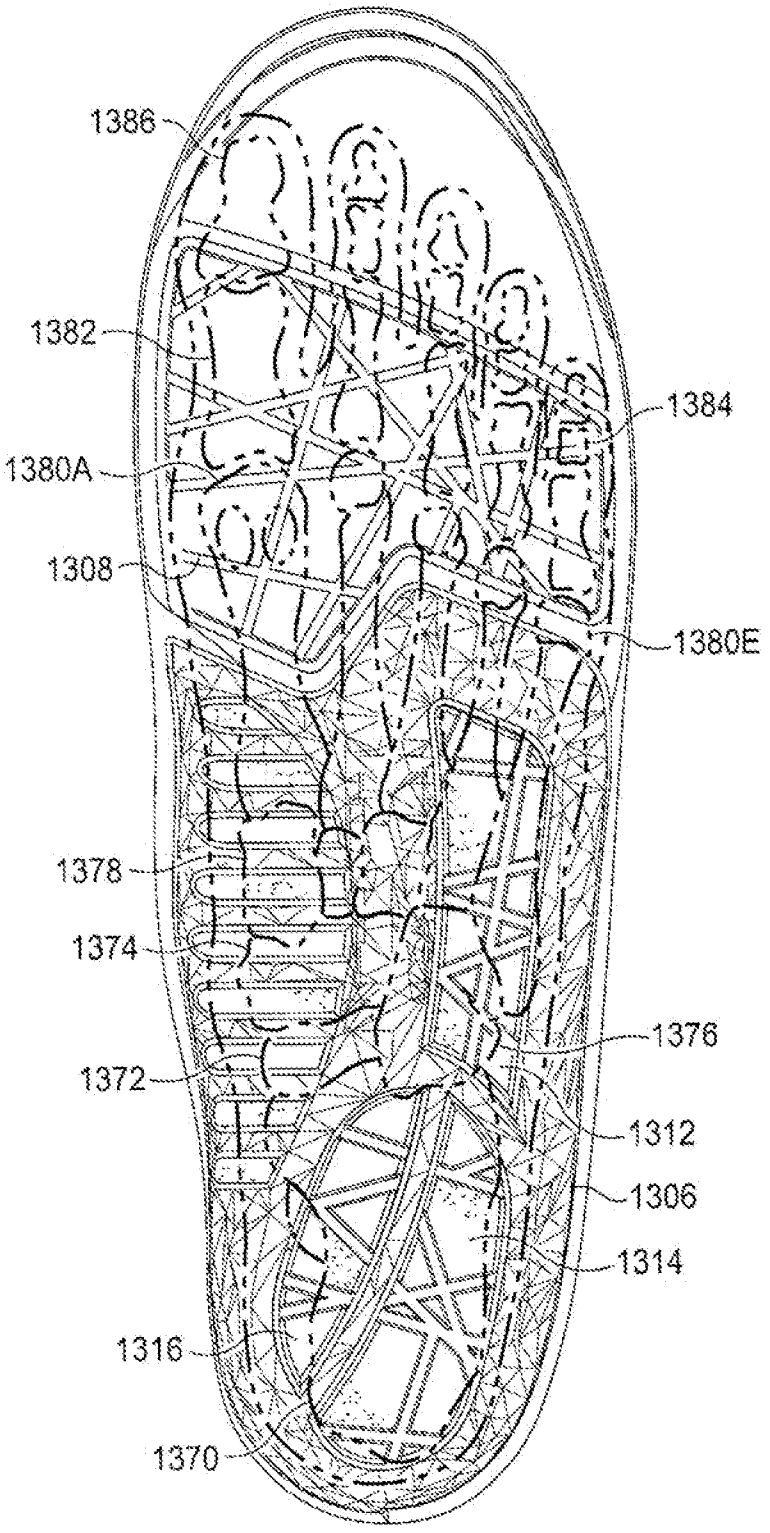
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FIG. 13

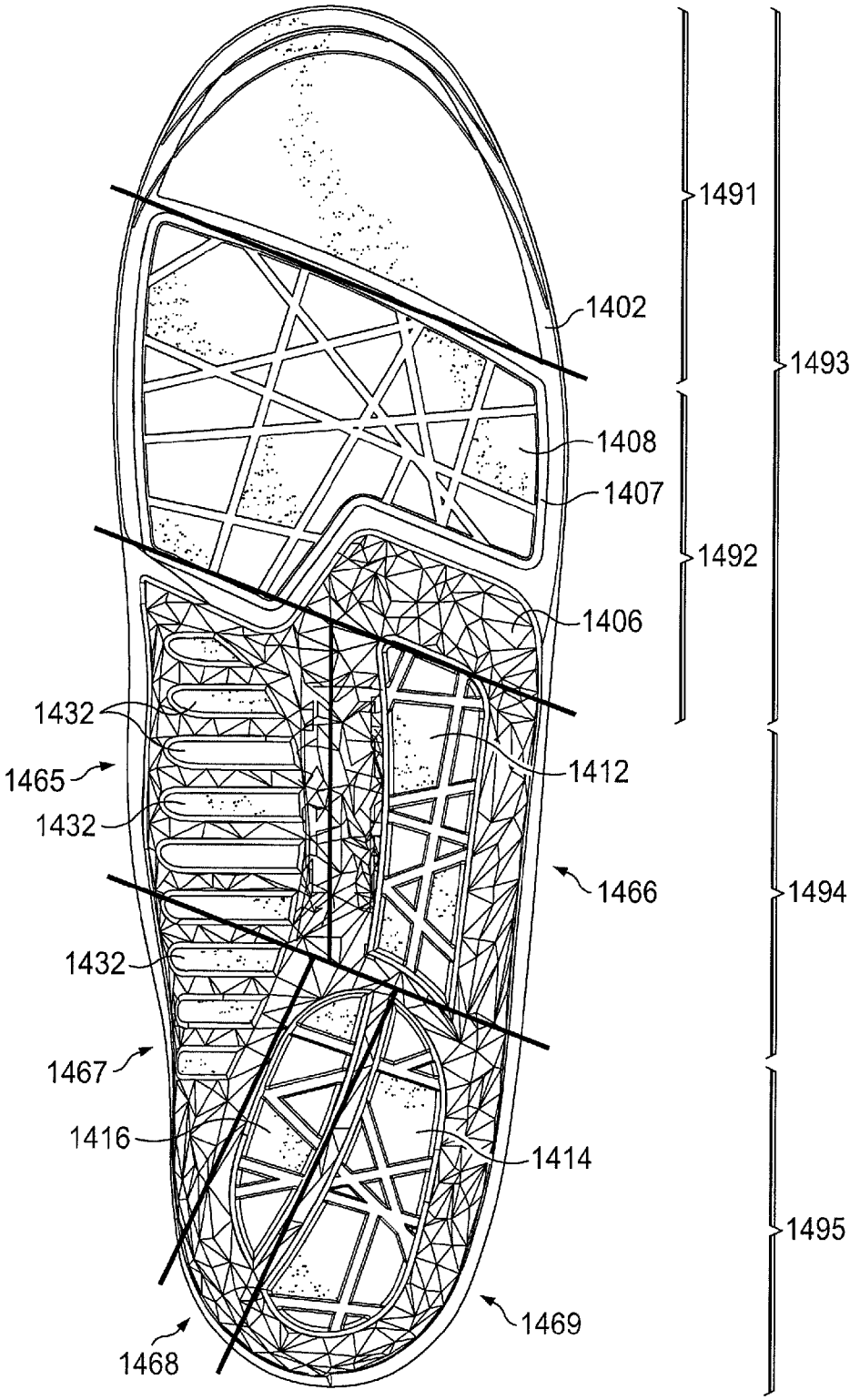
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FIG. 14

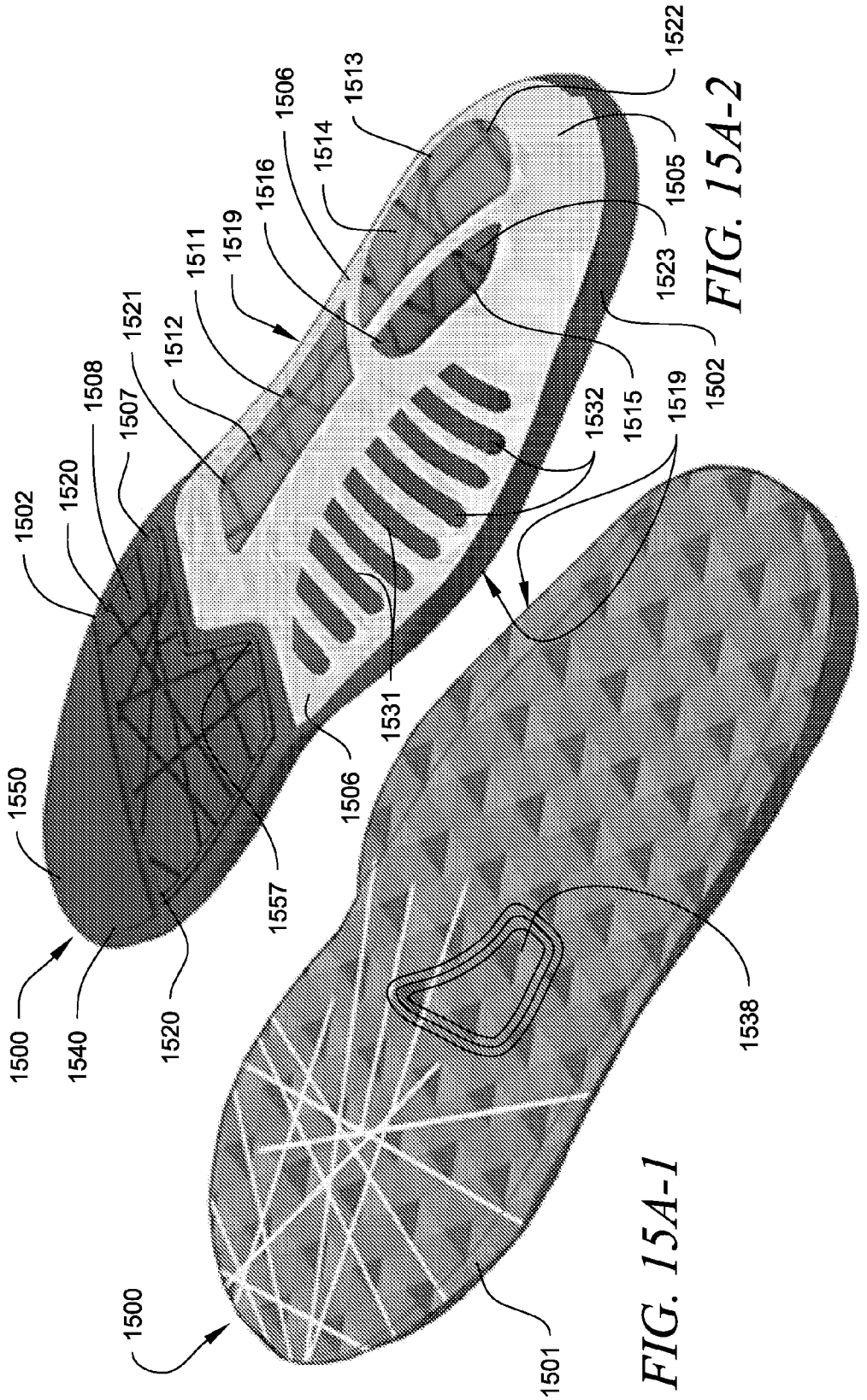


FIG. 15A-1

FIG. 15A-2

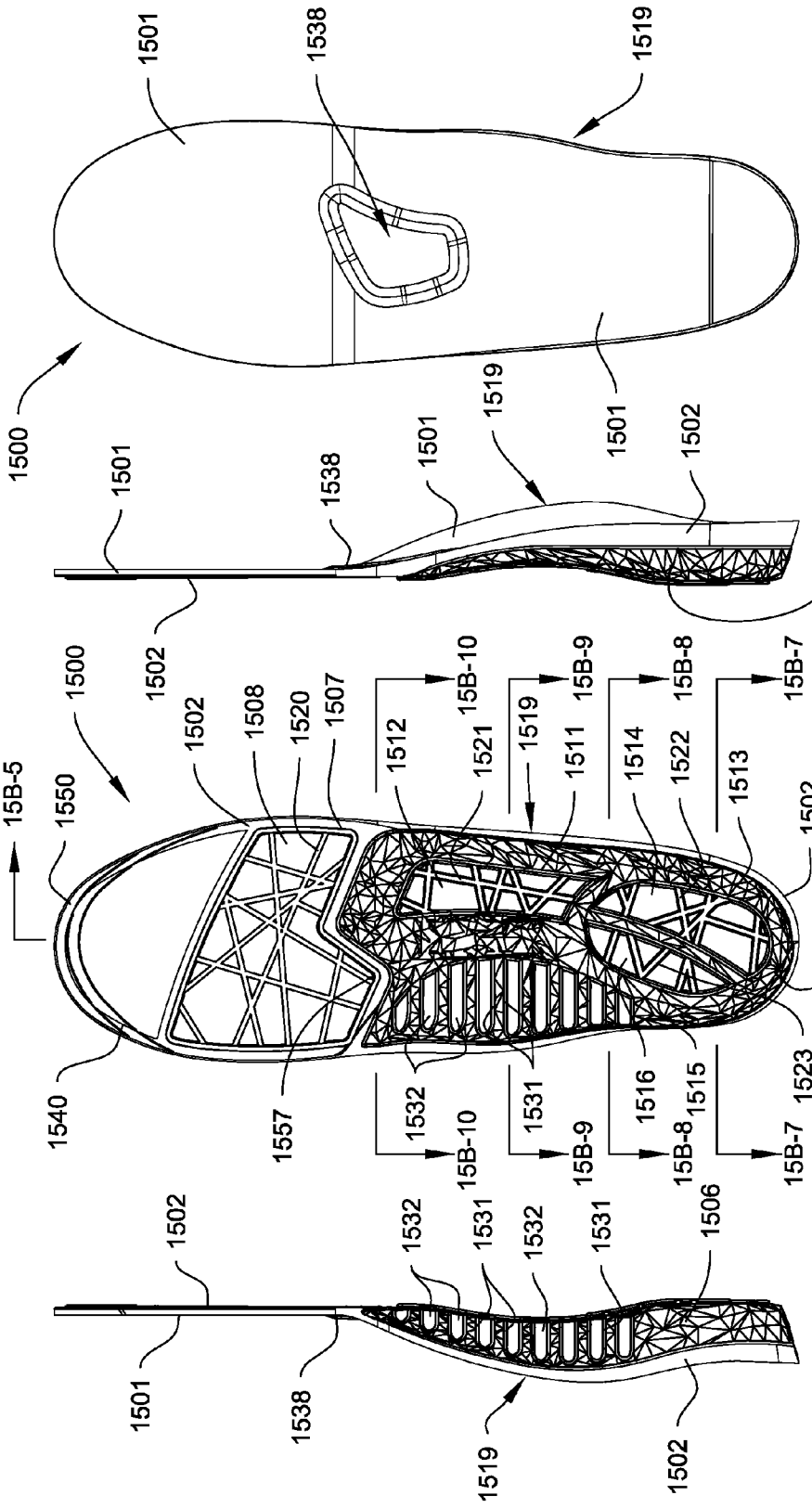


FIG. 15B-1 FIG. 15B-2 FIG. 15B-3 FIG. 15B-4

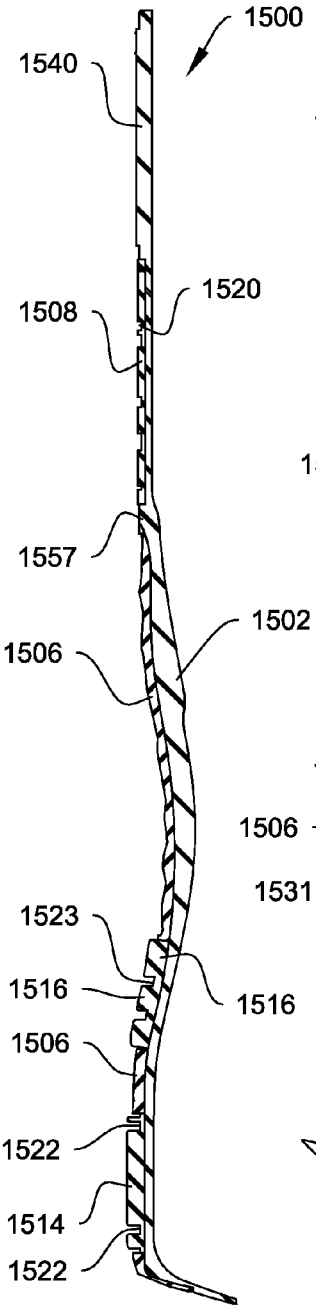


FIG. 15B-5

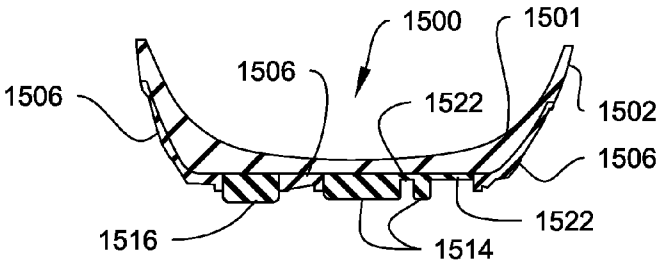


FIG. 15B-7

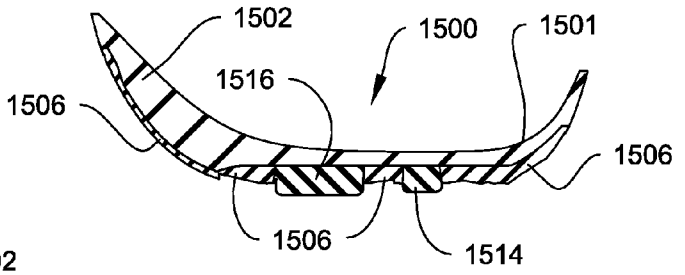
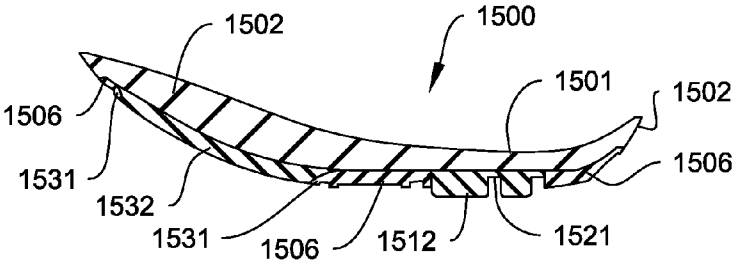


FIG. 15B-8



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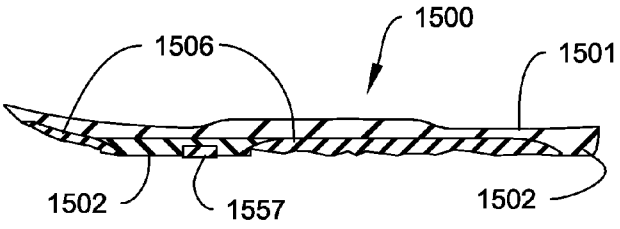

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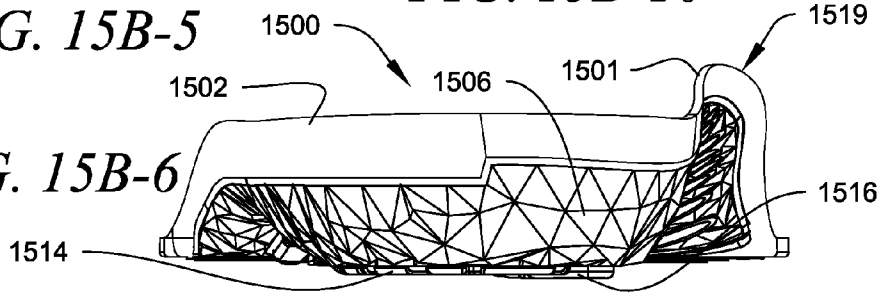

FIG. 15B-6

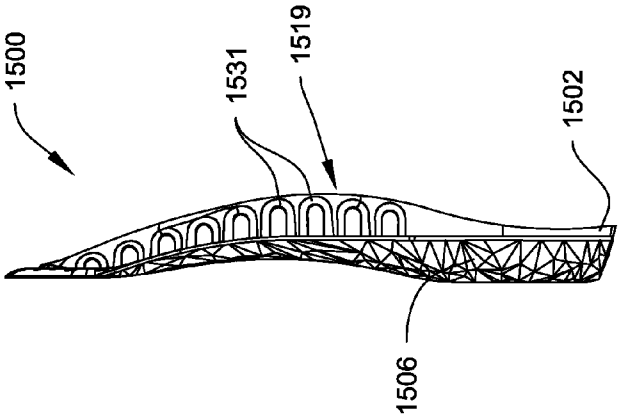

FIG. 15C-3

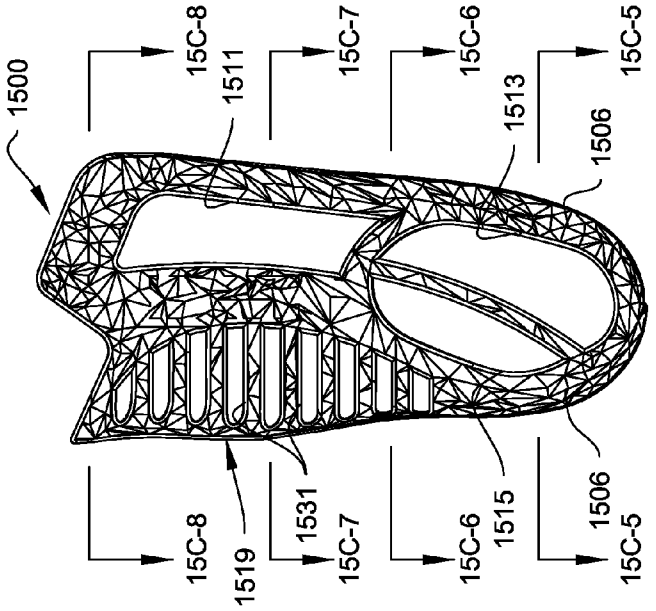

FIG. 15C-2

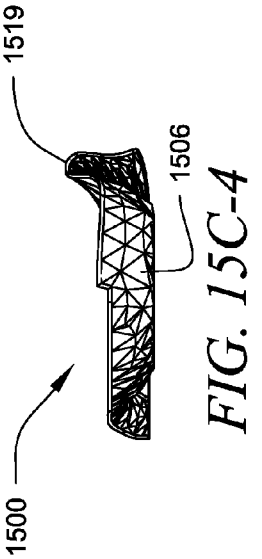

FIG. 15C-4

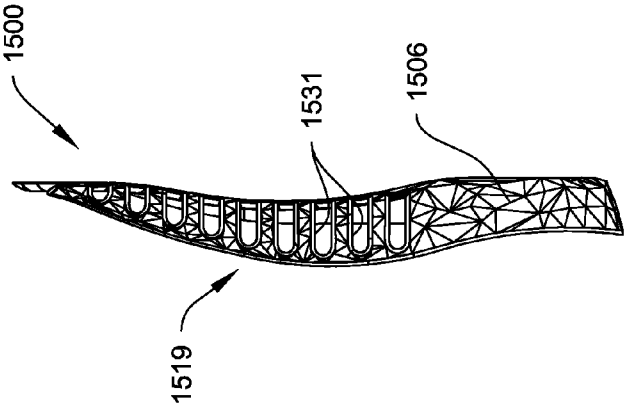

FIG. 15C-1

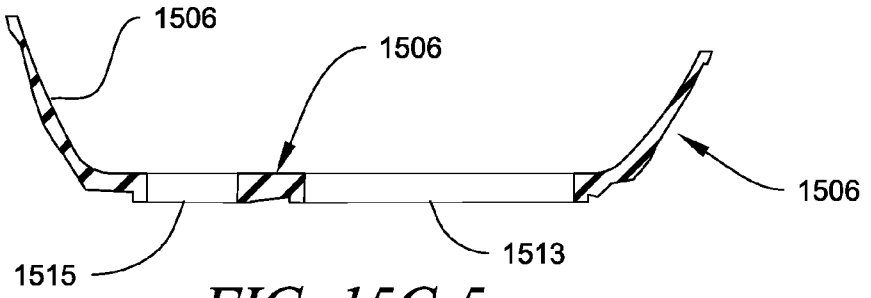

FIG. 15C-5

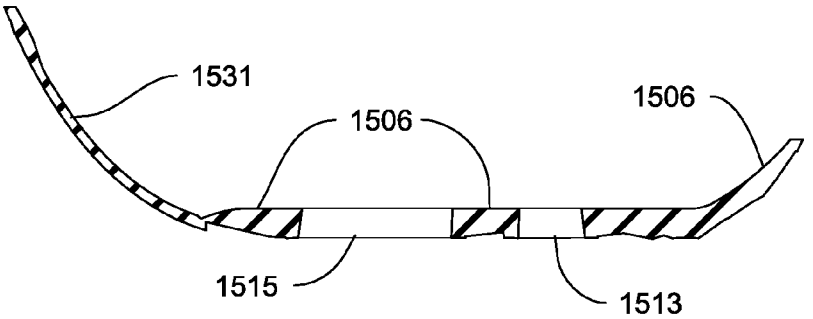

FIG. 15C-6

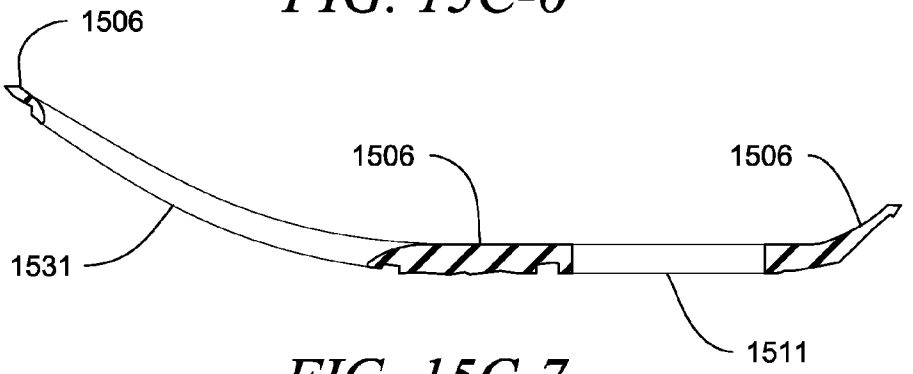

FIG. 15C-7

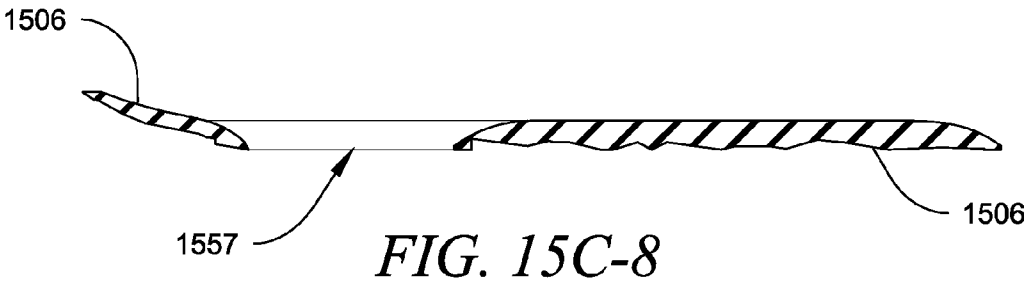

FIG. 15C-8

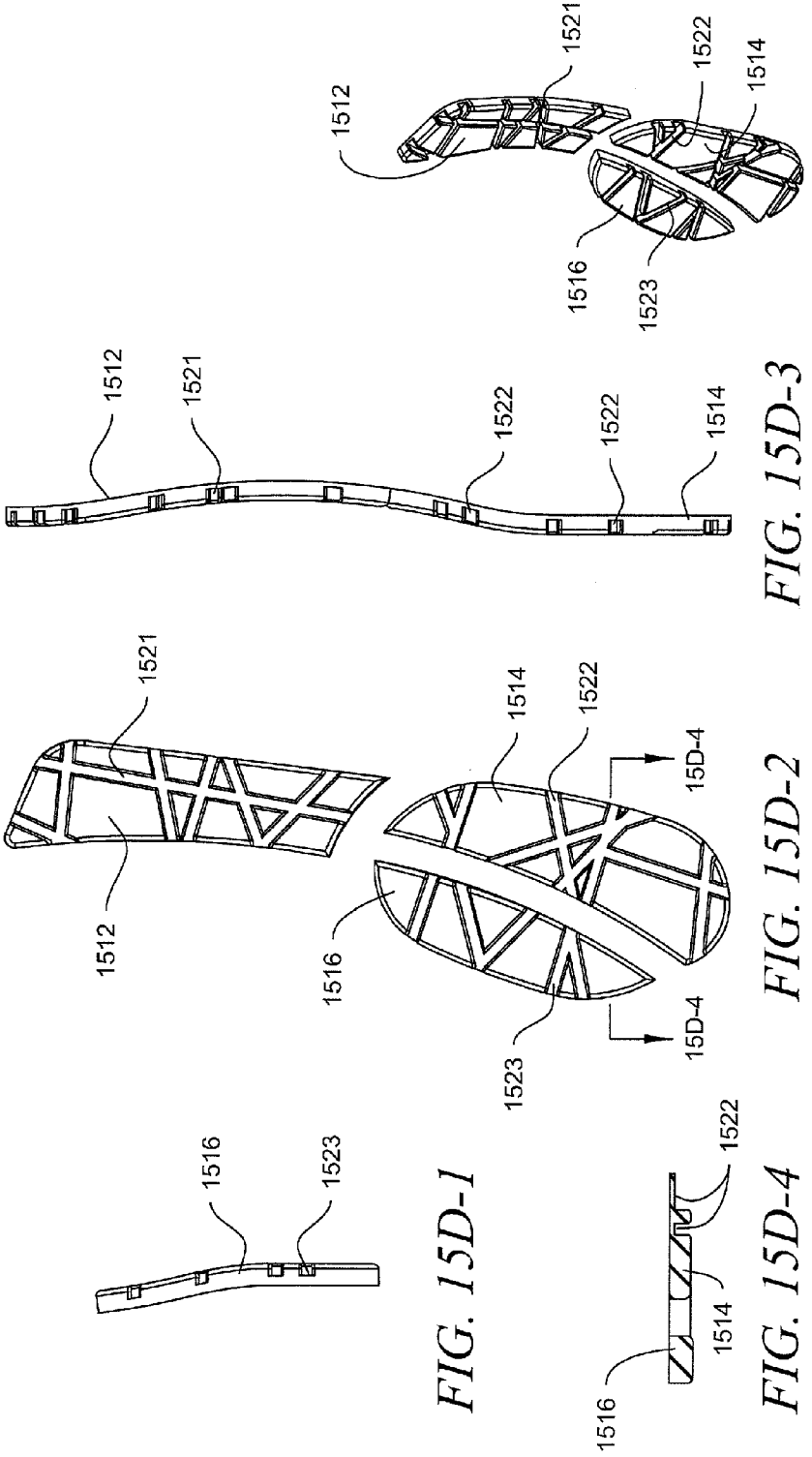

FIG. 15D-1

FIG. 15D-2

FIG. 15D-3

FIG. 15D-4

FIG. 15D-5

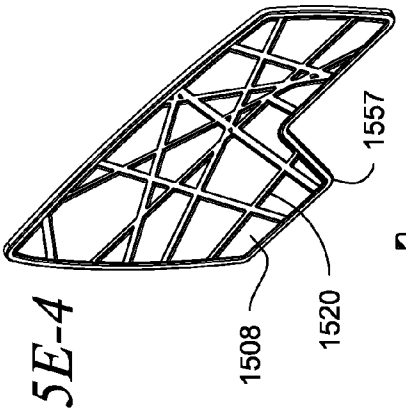

FIG. 15E-4

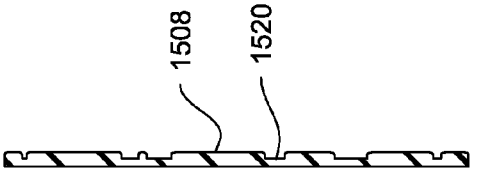

FIG. 15E-3

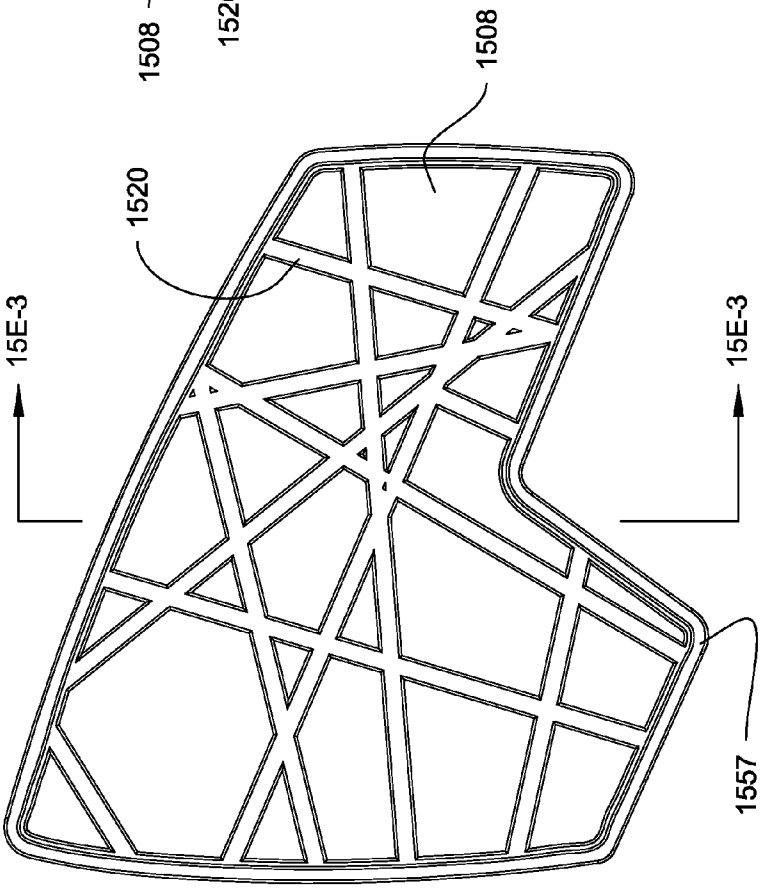

FIG. 15E-2

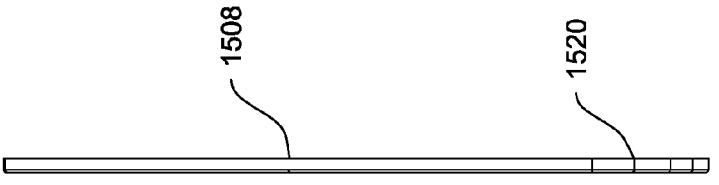

FIG. 15E-1

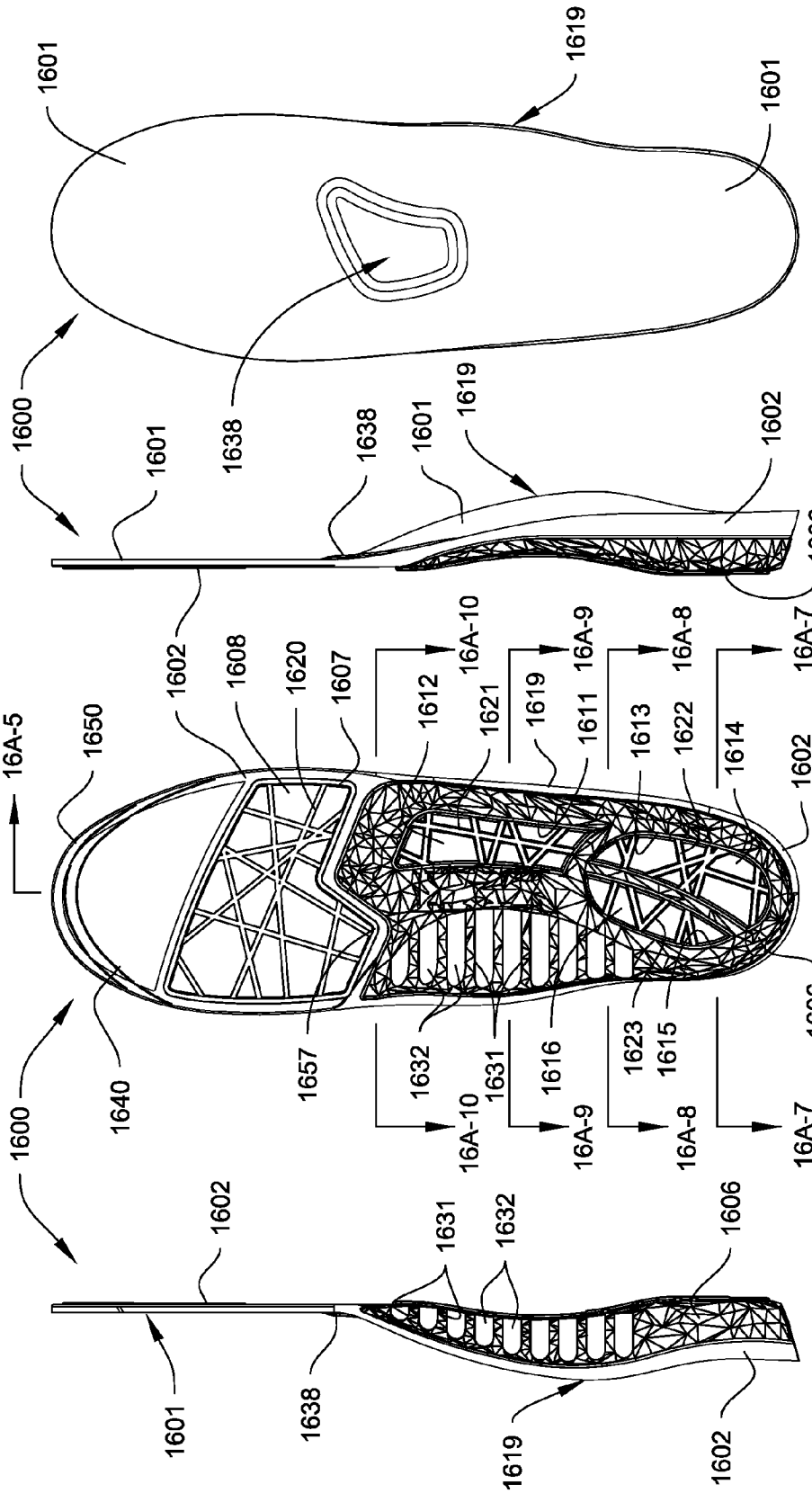

FIG. 16A-1 FIG. 16A-2 FIG. 16A-3 FIG. 16A-4

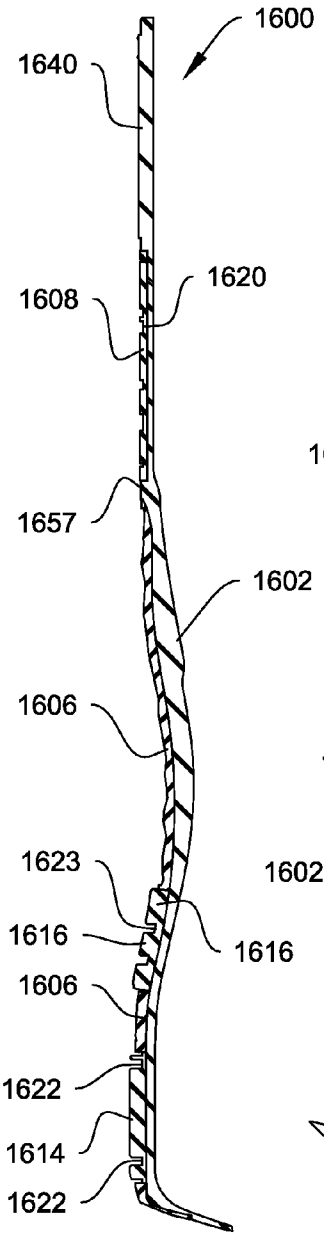

FIG. 16A-5

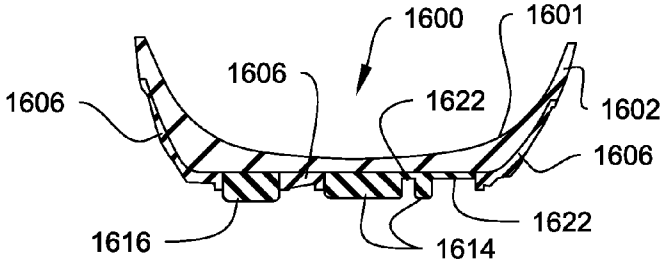

FIG. 16A-7

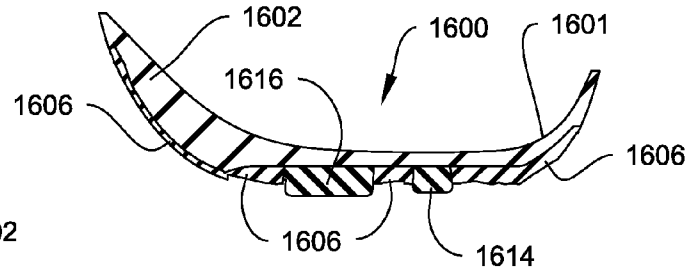

FIG. 16A-8

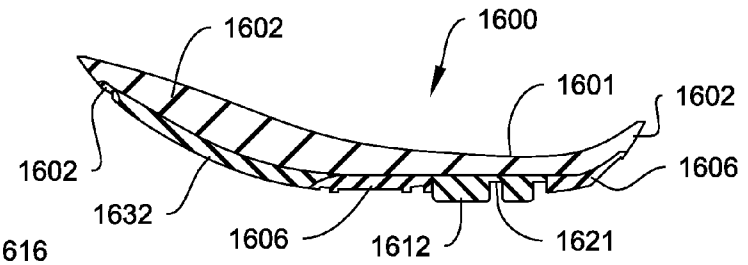

FIG. 16A-9

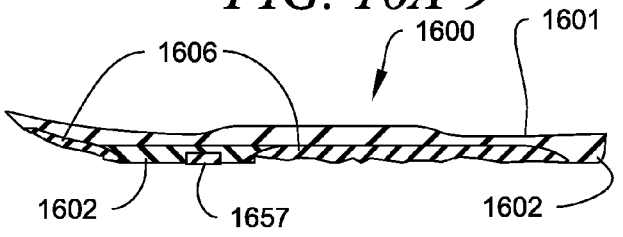

FIG. 16A-10

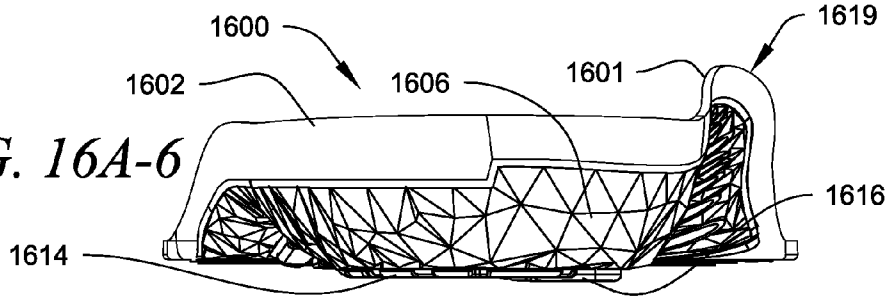

FIG. 16A-6

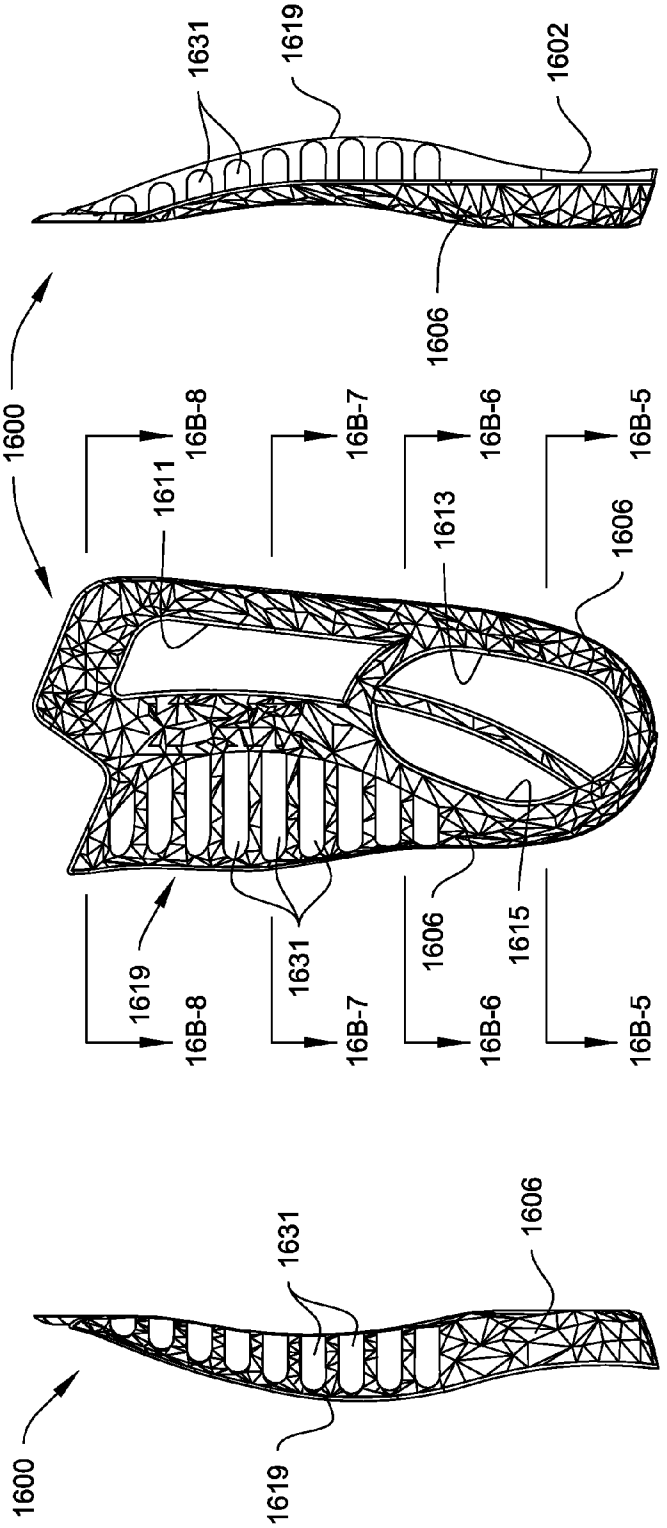

FIG. 16B-1

FIG. 16B-2

FIG. 16B-3

FIG. 16B-4

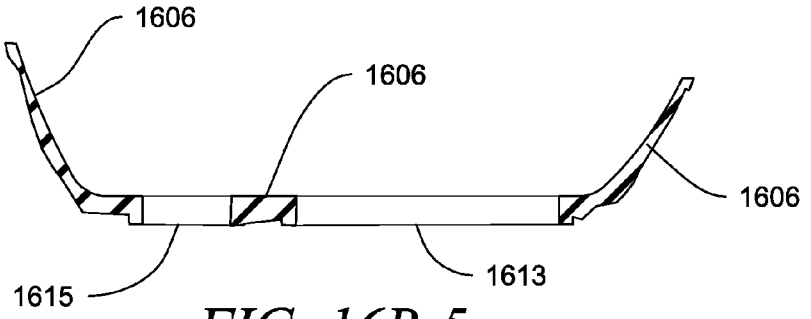

FIG. 16B-5

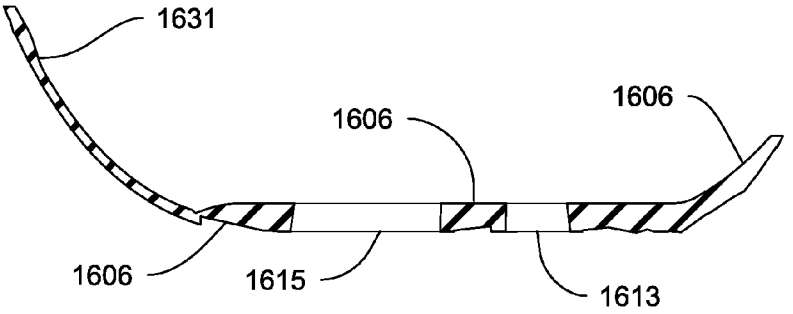

FIG. 16B-6

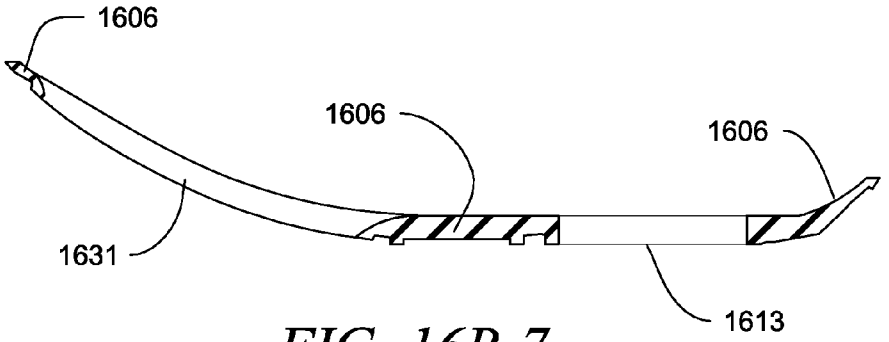

FIG. 16B-7

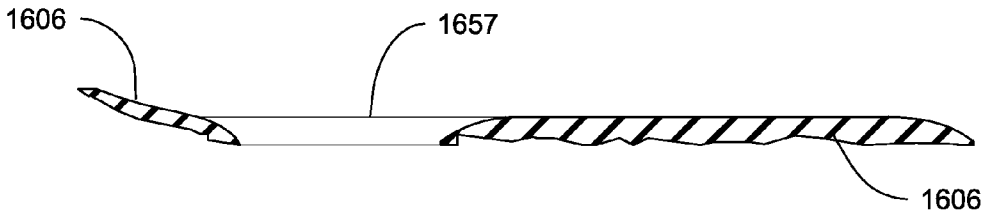

FIG. 16B-8

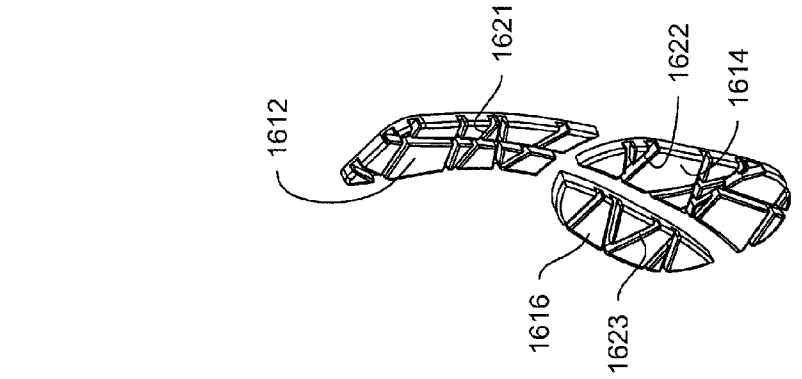

FIG. 16C-5

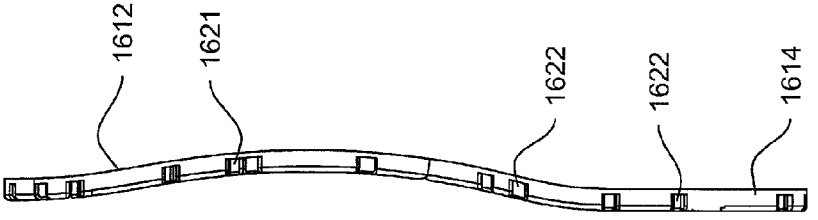

FIG. 16C-3

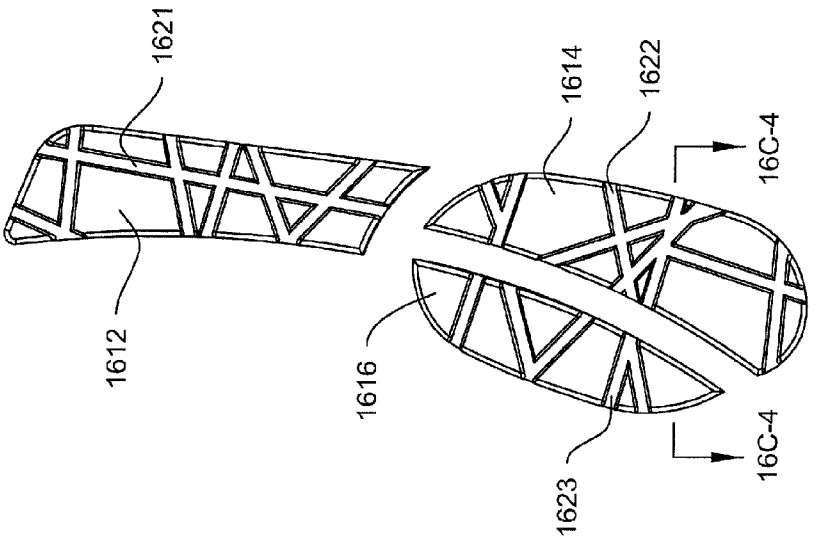

FIG. 16C-2

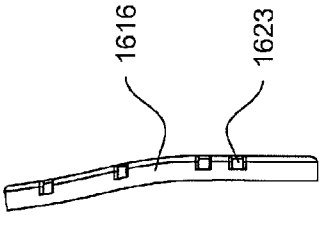

FIG. 16C-1

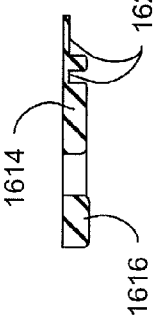

FIG. 16C-4

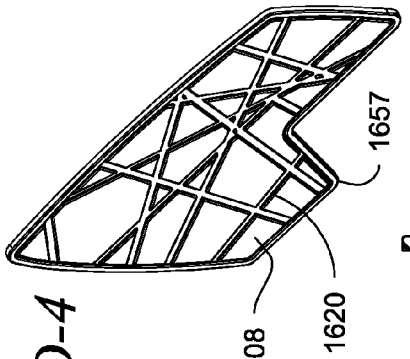

FIG. 16D-4

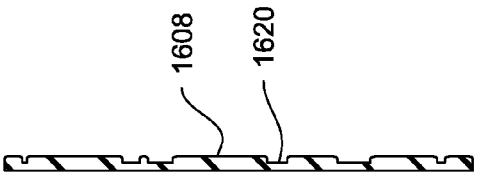

FIG. 16D-3

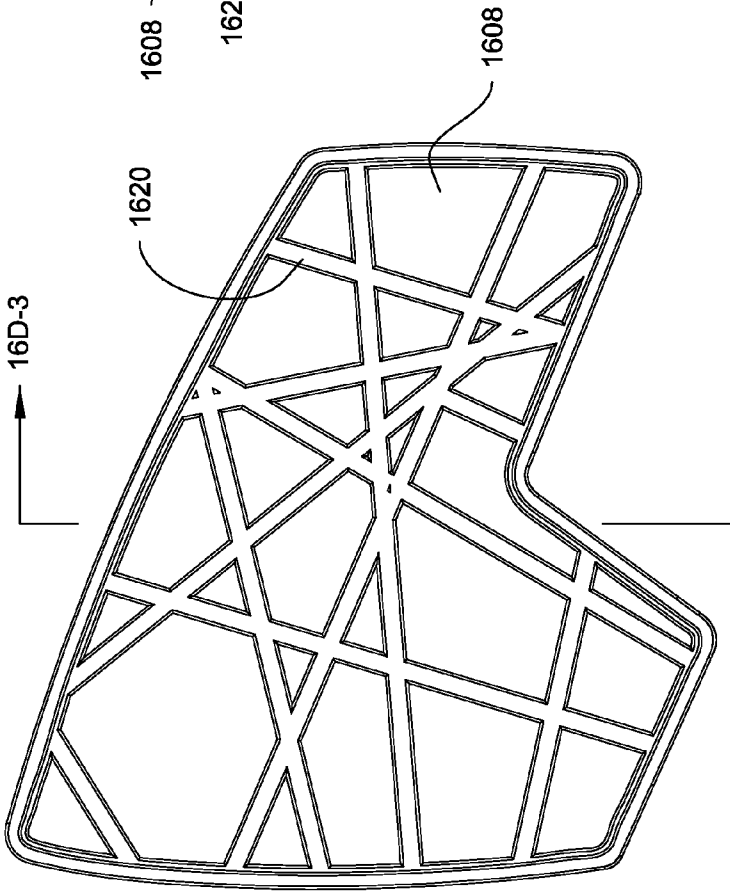

FIG. 16D-2

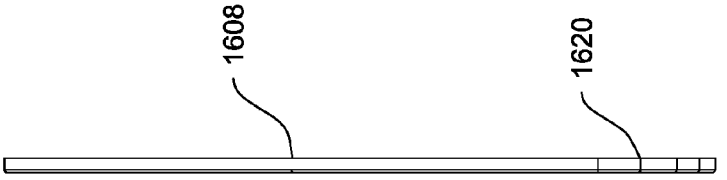

FIG. 16D-1

TRIATHLON INSOLE

RELATED APPLICATION DATA

[0001] Not applicable.

TECHNICAL FIELD

[0002] The present invention relates to a shoe insole with improved cushioning and support to the foot of a wearer engaging in cross training and triathlon sporting activities.

BACKGROUND OF THE INVENTION

[0003] 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.

[0004] 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.

[0005] 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.

[0006] 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.

[0007] 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.

[0008] The Applicant has received patents for insoles having a stability cradle and multiple pods located thereon. These patents include U.S. Pat. Nos. 7,484,319, 7,665,169, 7,908,768 and 8,250,784. These patents, however, do not address the possible movement of the insole during shoe operation or provide more enhanced cushioning characteristics to address constant run training, for example for a triathlon.

[0009] There is a present need for a shoe insole that accomplishes the goals to: (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 running and cross-training shoes, (4) be extremely light, (5) provide enhanced cushioning capabilities and (6) have essentially zero movement or sliding during shoe operation and change-overs.

SUMMARY OF THE INVENTION

[0010] It is also an object of the present invention to provide an insole that provides both cushioning 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 both motion control and cushioning. The insole includes a system of interacting components that cooperate to achieve a desired combination of foot cushioning and motion control. The components include a foam core, a semi-rigid or rigid stability cradle, and a number of elastomeric pods and pads. The characteristics of the components, their size and shape, and their position are selected to provide a desired blend of cushioning and control, and more specifically to achieve a desired biomechanical function.

[0011] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0012] 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 insole designs can be made to address a broad range of different activities. In one embodiment of the invention, an insole comprises a kit including a number of interchangeable pods having different characteristics. Using such a kit, an end user can selectively change the pods to customize the insole to accommodate a specific activity.

[0013] The current invention is an insole that incorporates, but is not limited to: (1) a faceted stability cradle with transverse stability ribs, (2) plurality of pods, (3) a forefoot pad (4) criss-cross groove patterns on the bottom surface of the pods and forefoot pad, and (5) a jadeite cooling top cloth. 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 insole movement or sliding during shoe operation and change-overs, and (4) provide enhanced cushioning features to the heel, midfoot, arch and forefoot for running and cross-training exercises.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** is a exploded bottom perspective view of an illustrative embodiment of an insole in accordance with the principles of the present invention;

[0015] FIG. **2** is a bottom perspective view showing the base of the insole;

[0016] FIG. **3**A is a bottom view of the stability cradle;

[0017] FIG. **3**B is a bottom perspective view of the stability cradle;

[0018] FIG. **4** is a top (dorsal) view of the insole;

[0019] FIG. **5** bottom (plantar) view of the insole;

[0020] FIG. **6** is a lateral (outer side) view of the insole;

[0021] FIG. **7** is a medial (inner side) view of the insole;

[0022] FIG. **8** is a rear (proximal) view of the insole;

[0023] FIG. **9** is a longitudinal cross sectional view of the insole along **9-9**;

[0024] FIG. **10** is a transverse cross sectional view behind the metatarsal area of the insole along **10-10**;

[0025] FIG. **11** is a transverse cross sectional view through the arch area of the insole along **11-11**;

[0026] FIG. **12** is a transverse cross sectional view through the heel area of the insole along **12-12**;

[0027] FIG. **13** is a view of the bones of the foot superimposed on a bottom (plantar) view of the insole;

[0028] FIG. **14** is a bottom view illustrating the various areas of the insole;

[0029] FIGS. **15**A-**15**E illustrate the preferred embodiment or an insole for triathlon racing; and,

[0030] FIGS. **16**A-**16**D illustrate a second preferred embodiment or an insole for triathlon training.

DETAILED DESCRIPTION

[0031] All insoles with a heelcup and a degree of medial longitudinal arch support are likely to provide a modicum (a couple of degrees) of pronation "control." A degree of medical longitudinal and support is just a couple of degrees based on research evidence. By pronation "control," we mean the increase in supination moments acting around the joints of the rearfoot and decrease the magnitude of pronation moments).

[0032] The current invention is an insole that incorporates, but is not limited to: (1) a faceted stability cradle with a plurality of stability ribs, (2) plurality of pods, (3) a forefoot pad (4) criss-cross groove patterns on the bottom surface of the pods and forefoot pads, and (5) a jadeite cooling top cloth. In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe. 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 insole movement or sliding during shoe operation and change-overs, and (4) provide enhanced cushioning features to the heel, midfoot, arch and forefoot during running and cross-training exercises.

[0033] In reference to FIGS. **1** through **16**, an insole constructed in accordance with the principles of the present invention is disclosed. It should be understood that insoles are generally adapted to be inserted inside a user's shoe. A user's right shoe and left shoe are mirror images of one another as are the insoles adapted to be inserted in a right shoe and a left shoe respectively. Only the left insole is illustrated in the Figures. It will be understood by those of skill in the art that the right insole has a mirror image construction of the left insole.

[0034] The insole of the invention is shaped essentially like the bottom interior of an athletic shoe (and therefore adapted to receive a user's foot which has a generally similar shape when at rest). The insole 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 thereof, connecting said toe end to said heel end on the other side of the insole. The insole also has a forefoot area (area that correlates with the metatarsal and phalanges of the foot), an arch area (along the medial side), a heel area (just forward of the heel end), and a midfoot area (between the heel area and forefoot area).

[0035] As shown in the exploded view of FIG. **1**, insole **100** preferably comprises a top sheet **101** and a base **102** having a top surface secured to said top sheet and an opposite bottom surface. Base **102** also defines a longitudinal 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.

[0036] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support that lies under the metatarsal head area of the foot (best shown in FIGS. **4** and **10**). The upward extension of transverse arch support pushes up a portion of the top sheet **101** that corresponds to the area of the transverse arch support.

[0037] The bottom surface of base **102** defines a forefoot pad recession area **107** in the forefoot area and a stability cradle recession area **105** along the midfoot and heel areas. The bottom surface of base **102** also defines one or more ribs or protrusions **132** that extend outwardly along the arch area. The ribs **132** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. An alternate embodiment has the ribs or protrusions defined by the stability cradle **106** and extending outwardly from the stability cradle **106** in the arch area.

[0038] Base **102** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. As best seen in FIGS. **10-12**, the height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0039] The forefoot pad recession area **107** begins partially proximal form the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area **107** extends rearward to about the 3^{rd} through 5^{th} metatarsal heads on a lateral portion and approximately halfway along the 1^{st} and 2^{nd} metatarsals on a medial portion. Preferably the forefoot pad recession area **107** has a rear apex **157** that lies between the 1^{st} and 2^{nd} metatarsals.

[0040] Forefoot pad **108** is shaped essentially the same as forefoot pad recession area **107** and is secured therein. Forefoot pad **108** has a medial edge, a lateral edge, a proximal

(back) edge and a distal (front) edge. The medial edge of forefoot pad **108** 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 **157**, laterally and distally towards the 3rd metatarsal head, then laterally and proximally to the lateral edge approximately along the 3rd through 5th metatarsal heads. The lateral edge connects said proximal edge to said top edge of said forefoot pad. In use, forefoot pad recession area **107** and forefoot pad **108** underlie 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. FIG. **11** shows the placement of foot bones on the insole.

[0041] An adhesive is be used to secure the components. The forefoot pad **108** 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.

[0042] It is estimated that using tougher materials increases the durability of the insole by 35% to 65% over insoles that use softer materials for this portion of the foot insole.

[0043] The stability cradle recession area **105** is located in the midfoot and heel areas of the bottom surface of base **102**. The stability cradle recession area **105** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **107** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **106** is shaped essentially the same as stability cradle recession area **105** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **105**.

[0044] Stability cradle **106** has walls that wrap up the sides and rear of base **102** to provide support for the foot. Preferably, stability cradle **106** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **106** are preferably higher on the medial side of the foot because of the higher loading. Preferably, stability cradle **106** is made of a nylon material with a hardness of approximately Shore A 95. In a preferred embodiment, the stability cradle is semi-rigid. In an alternate embodiment, the stability cradle is rigid.

[0045] Preferably, the shoe facing surface of stability cradle **106** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping and "change-over" of shoes and running gear to other footwear, or vice versa is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0046] The stability cradle **106** preferably defines one or more rib-shaped openings **131**. In a preferred embodiment, the rib-shaped openings **131** allow said ribs **132** of base **102** to extend therethrough. Preferably, base **102** is molded so that the ribs **132** project into rib-shaped openings **131** so that the ribs **132** are approximately flush with the outer surface of stability cradle **106** and mechanically lock stability cradle **106** and base **102** together. Advantageously, the ribs **132** are also able to bulge through rib-shaped openings **131** when base **102** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **132** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **131** allow the stability cradle **106** to be more flexible in the arch area compared to the rest of the stability cradle **106**.

[0047] In an alternate embodiment, stability cradle **106** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0048] Stability cradle **106** defines a lateral midfoot pod opening **111** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening **111** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod **112** is shaped essentially the same as lateral midfoot pod opening **111** and is secured to the bottom surface of base **102** within the stability cradle recession area **105** in a location that correlates to the lateral midfoot pod opening **111** and allows lateral midfoot pod **112** to extend out through said lateral midfoot pod opening **111**.

[0049] Lateral midfoot pod **112** is preferably made from TPR or PU of a hardness of about 45-50 ASKER C. If TPR is used, a fabric is in turn secured to the base **102** in the lateral midfoot pod opening **111** of said base **102**. The fabric component allows the TPR to properly adhere to the base **102**.

[0050] Stability cradle **106** also defines a lateral heel pod opening **113** that extends through the lateral side of the heel area of stability cradle **106** from approximately rearward of the lateral midfoot pod opening **111** toward the heel end. Lateral heel pod **114** is shaped essentially the same as lateral heel pod opening **113** and is secured to the bottom surface of base **102** within the stability cradle recession area **105** in a location that correlates to the lateral heel pod opening **113** and allows lateral heel pod **114** to extend out through said lateral heel pod opening **113**. Lateral heel pod **114** has a lateral edge which extends along the lateral border of insole **100** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **114** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0051] The configuration, material and position of the lateral heel pod **114** provides cushioning and works in association with the medial heel pod **115** to stabilize the ankle. The hardness of the lateral heel pod is preferably essentially the same as the lateral midfoot pod, which work in concert to help reduce the incidence of lateral ankle roll-overs. It is preferably made of TPR or PU of a hardness of about Shore C 45-50. If TPR is used, a fabric is in turn secured to the base **102** in the lateral heel pod opening **113** of said base **102**. The fabric component allows the TPR to properly adhere to the base **102**.

[0052] Stability cradle **106** defines a medial heel pod opening **115** that extends through the heel area along the medial

side of heel area on the bottom surface of base **102** just short of the heel end. Medial heel pod **116** is shaped essentially the same as medial heel pod opening **115** and is secured to the bottom surface of base **102** within the stability cradle recession area **105** in a location that correlates to the medial heel pod opening **115** and allows medial heel pod **116** to extend out through said medial heel pod opening **115**. The medial heel pod **116** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0053] Medial heel pod **116** is preferably made from TPR or PU of a hardness of about 60 ASKER C±3. If TPR is used, a fabric is in turn secured to the base **102** in the medial heel pod opening **115** of said base **102**. The fabric component allows the TPR to properly adhere to the base **102**.

[0054] 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. To cushion the impact, lateral heel pod **114** is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle **106**. Preferably, lateral heel pod **114** is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0055] 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.

[0056] Stability cradle **106** provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod **116** helps to control the rate of pronation by forming medial heel pod **116** out of a material having different characteristics than lateral heel pod **114**. For example, to reduce a pronation rate, medial heel pod **116** is made from a firmer material than lateral heel pod **114**. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod **116** made from a firmer material would compress less than a lateral heel pod **114** made of a softer material. As a result, medial heel pod **116** tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod **116** from a softer material than lateral heel pod **114** would tend to increase the amount and rate of pronation.

[0057] Preferably, the firmness of the material used in medial heel pod **116** is selected based on the firmness of lateral heel pod **114** and on the type of intended activity. For example, the firmness of lateral heel pod **114** and medial heel pod **116** differs by about 20-30% for an insole to be used during light to moderate activities.

[0058] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel pod **116** is made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0059] Lateral midfoot pod **112** provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod **112** is formed of a material having the same properties, e.g., firmness, as lateral heel pod **114**. However, a material having different characteristics may also be used.

[0060] The use of dual density heel pods is employed to cause a kinetic change in foot function to promote ankle stability. It is also not out of the scope of the invention to have the medial heel pod softer than the lateral heel pod and/or lateral midfoot pod or any combination thereof to address different joint moments or ankle rolls.

[0061] 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 **108** is located under this part of the foot. Preferably, forefoot pad **108** is formed of a relatively resilient material so that energy put into compressing forefoot pad **108** is returned to help propel the foot at toe-off.

[0062] 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 medial portion of forefoot pad **108** extends rearward into a corresponding concave edge portion of the distal edge of stability cradle **106**. The shape of the stability cradle **106** and forefoot pad **108** permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

[0063] Base **102** is preferably made of foam or other material having suitable cushioning properties. Preferably, base **102** comprises an Ethylene vinyl acetate ("EVA") foam, which is a copolymer of ethylene and vinyl acetate, or a Thermoplastic Rubber ("TPR")/EVA mix. A preferred EVA or TPR/EVA mix has a durometer (hardness) of about Asker C 45-50.

[0064] Forefoot pad **108** is preferably made from a Thermoplastic Rubber ("TPR") or Polyurethane ("PU"). The hardness of the TPR or PU used in the forefoot pad is preferably about 30 Asker C±3.

[0065] The forefoot pad **120**, lateral midfoot pod **121**, lateral heel pod **122**, and medial heel pod **123** are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties of each pod and pad. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern **120** is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns **121** and **122** are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern **123** is approximately 1.00 to 2.50 mm deep. Preferably the TPR pods have the deeper criss-cross groove pattern and the PU pods have the shallower criss-cross groove pattern due to the compression characteristics of the materials. The criss-cross groove patterns assists with securing the insole in the shoe cavity and keeping the insole in place such that it will not move or slide around The criss-cross groove pattern also allows for air circulation and/or provides different cushioning and spring properties.

[0066] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0067] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the criss-cross groove pattern designs will help provide a lighter insole.

[0068] In a preferred embodiment, base **102** is covered with top sheet **101** from toe to heel areas of the insole, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **101** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0069] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base **102** in the recession areas defined by base **102** on the bottom surface are permanently affixed to base **102** using an appropriate means such as an adhesive. The components are also secured during the molding process using techniques known in the art of molding insoles.

[0070] The recession areas can also be lined with a cloth having a base surface and a pad/pod surface, secured to said base along said base surface and said pad/pod along said pad/pod surface. Alternatively, a cloth is secured to pad/pod and then the composite structure secured to the recession area.

[0071] Some shoes may slightly differ in size on the inner part of the shoe. Some shoes may also provide extra padding along the inner sides, front or back of the shoe that alter the actual space provided for the foot and/or an insole on the inner part of the shoe. Base **102** may have sizing guides **150** that allow a user to shorten the length of the insole for proper fit within the shoe, sizing guides **150** provide various cutting guide lines that the user would cut along, preferably with scissors.

[0072] The current invention is an insole that incorporates, but is not limited to: (1) a faceted stability cradle with a plurality of stability ribs, (2) plurality of pods, (3) a forefoot pad (4) criss-cross groove patterns on the bottom surface of the pods and forefoot pads, and (5) a jadeite cooling top cloth. In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe. 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 insole movement or sliding during shoe operation and change-overs, and (4) provide enhanced cushioning features to the heel, midfoot, arch and forefoot during running and cross-training exercises.

[0073] FIG. **2** illustrates a perspective view of the bottom of base **202** without any pads, pods, or attachments. Base **202** has a top surface and an opposite bottom surface. Base **202** also defines a longitudinal arch support **219** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0074] The bottom surface of base **202** defines a forefoot pad recession area **207** in the forefoot area and a stability cradle recession area **205** along the midfoot and heel areas. The bottom surface of base **202** defines one or more ribs or protrusions **232** that extend outwardly along the arch area. The ribs **232** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. An alternate embodiment has the ribs or protrusions defined by a stability cradle and extending outwardly from the stability cradle in the arch area.

[0075] Base **202** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. As best seen in FIGS. **10-12**, the height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0076] The forefoot pad recession area **207** begins partially proximal form the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area **207** extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area **207** has a rear apex **257** that lies between the 1st and 2nd metatarsals.

[0077] The stability cradle recession area **205** is located in the midfoot and heel areas of the bottom surface of base **202**. The stability cradle recession area **205** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **207** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off.

[0078] Base **202** is preferably made of foam or other material having suitable cushioning properties. Preferably, base **202** comprises an Ethylene vinyl acetate ("EVA") foam, which is a copolymer of ethylene and vinyl acetate, or a Thermoplastic Rubber ("TPR")/EVA mix. A preferred EVA or TPR/EVA mix has a durometer (hardness) of about Asker C 45-50.

[0079] FIGS. **3**A and **3**B are bottom and perspective views of a stability cradle **306**. A stability cradle recession area is located in the midfoot and heel areas of the bottom surface of a base. The stability cradle recession area extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of a forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **306** is shaped essentially the same as the stability cradle recession area and has a base facing surface and a shoe

facing surface. The base facing surface is secured to said stability cradle recession area.

[0080] Stability cradle **306** has walls that wrap up the sides and rear of the base to provide support for the foot. Preferably, stability cradle **306** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **306** are preferably higher on the medial side of the foot because of the higher loading. Preferably, stability cradle **306** is made of a nylon material with a hardness of approximately Shore A 95. In a preferred embodiment, the stability cradle is semi-rigid. In an alternate embodiment, the stability cradle is rigid.

[0081] Preferably, the shoe facing surface of stability cradle **306** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear to other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0082] The stability cradle **306** preferably defines one or more rib-shaped openings **331**. In a preferred embodiment, the rib-shaped openings **331** allow ribs on the base to extend therethrough. Advantageously, the ribs are also able to bulge through rib-shaped openings **331** when base is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. The rib-shaped openings **331** allow the stability cradle **306** to be more flexible in the arch area compared to the rest of the stability cradle **306**.

[0083] Stability cradle **306** defines a lateral midfoot pod opening **311** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening **311** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. The lateral midfoot pod opening **311** is designed to allow a lateral midfoot pod to extend there through.

[0084] Stability cradle **306** also defines a lateral heel pod opening **313** that extends through the lateral side of the heel area of stability cradle **306** from approximately rearward of the lateral midfoot pod opening **311** toward the heel end. Lateral heel pod opening **313** has a lateral edge which extends along the lateral border of insole from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod opening **311**. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod opening **313** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines. Lateral heel pod opening **313** is designed to allow a lateral heel pod to extend there through.

[0085] Medial heel pod opening **315** extends through the heel area along the medial side of heel area on the bottom surface of base **302** just short of the heel end. The medial heel pod opening **315** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod opening. Medial heel pod opening **315** is designed to allow a medial heel pod to extend there through.

[0086] Stability cradle **306** provides firm support along the medial portion of the foot to help control the amount of pronation.

[0087] FIG. **4** is a top view of the insole illustrating the top sheet **401** and transverse arch support **438**. Insole **400** comprises a top sheet **401** secured across the entire top surface of the base from toe area to heel area. Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **438** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **438** pushes up a portion of the top sheet **401** that corresponds to the area of the transverse arch support **438**.

[0088] Traverse arch support **438** preferably lies under the second to fourth metatarsal heads. Traverse arch support **438** provides additional stability and cushioning to the forefoot and middle of the foot.

[0089] In a preferred embodiment, top sheet **401** is a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **401** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi. A series of air holes extend through top sheet **401** and the base to permit air circulation above and below insole **400**.

[0090] FIG. **5** illustrates the bottom view of the insole. Insole **500** preferably comprises a top sheet **501** and a base **502** having a top surface secured to said top sheet and an opposite bottom surface. Base **502** also defines a longitudinal arch support **519** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0091] The bottom surface of base **502** defines a forefoot pad recession area **507** in the forefoot area and a stability cradle recession area **505** along the midfoot and heel areas. The bottom surface of base **502** also defines one or more ribs or protrusions **532** that extend outwardly along the arch area. The ribs **532** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape.

[0092] Base **502** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. As best seen in FIGS. **10-12**, the height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0093] The forefoot pad recession area **507** begins partially proximal form the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area **507** extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area **507** has a rear apex **557** that lies between the 1st and 2nd metatarsals.

[0094] Forefoot pad **508** is shaped essentially the same as forefoot pad recession area **507** and is secured therein. Forefoot pad **508** has a medial edge, a lateral edge, a proximal (back) edge and a distal (front) edge. The medial edge of

forefoot pad **508** 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 **557**, laterally and distally towards the 3rd metatarsal head, then laterally and proximally to the lateral edge approximately along the 3rd through 5th metatarsal heads. The lateral edge connects said proximal edge to said top edge of said forefoot pad. In use, forefoot pad recession area **507** and forefoot pad **508** underlie 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. FIG. **11** shows the placement of foot bones on the insole.

[0095] An adhesive is used to secure the components. The forefoot pad **508** 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.

[0096] It is estimated that using tougher materials increase the durability of the insole by 35% to 65% over insoles that use softer materials for this portion of the foot insole.

[0097] The stability cradle recession area **505** is located in the midfoot and heel areas of the bottom surface of base **502**. The stability cradle recession area **505** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **507** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **506** is shaped essentially the same as stability cradle recession area **505** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **505**.

[0098] Stability cradle **506** has walls that wrap up the sides and rear of base **502** to provide support for the foot. Preferably, stability cradle **506** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **506** are preferably higher on the medial side of the foot because of the higher loading. Preferably, stability cradle **506** is made of a nylon material with a hardness of approximately Shore A 95. In a preferred embodiment, the stability cradle is semi-rigid. In an alternate embodiment, the stability cradle is rigid.

[0099] Preferably, the shoe facing surface of stability cradle **506** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear to other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0100] The stability cradle **506** preferably defines one or more rib-shaped openings **531**. In a preferred embodiment, the rib-shaped openings **531** allow said ribs **532** of base **502** to extend therethrough. Preferably, base **502** is molded so that the ribs **532** project into rib-shaped openings **531** so that the ribs **532** are approximately flush with the outer surface of stability cradle **506** and mechanically lock stability cradle **506** and base **502** together. Advantageously, the ribs **532** are also able to bulge through rib-shaped openings **531** when base **502** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **532** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **531** allow the stability cradle **506** to be more flexible in the arch area compared to the rest of the stability cradle **506**.

[0101] In an alternate embodiment, stability cradle **506** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0102] Stability cradle **506** defines a lateral midfoot pod opening **511** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening **511** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod **512** is shaped essentially the same as lateral midfoot pod opening **511** and is secured to the bottom surface of base **502** within the stability cradle recession area **505** in a location that correlates to the lateral midfoot pod opening **511** and allows lateral midfoot pod **512** to extend out through said lateral midfoot pod opening **511**.

[0103] Lateral midfoot pod **512** is preferably made from TPR or PU of a hardness of about 45-50 ASKER C. If TPR is used, a fabric is in turn secured to the base **502** in the lateral midfoot pod opening **511** of said base **502**. The fabric component allows the TPR to properly adhere to the base **502**.

[0104] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0105] Stability cradle **506** also defines a lateral heel pod opening **513** that extends through the lateral side of the heel area of stability cradle **506** from approximately rearward of the lateral midfoot pod opening **511** toward the heel end. Lateral heel pod **514** is shaped essentially the same as lateral heel pod opening **513** and is secured to the bottom surface of base **502** within the stability cradle recession area **505** in a location that correlates to the lateral heel pod opening **513** and allows lateral heel pod **514** to extend out through said lateral heel pod opening **513**. Lateral heel pod **514** has a lateral edge which extends along the lateral border of insole **500** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **514** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0106] The configuration, material and position of the lateral heel pod **514** provides cushioning and works in association with the medial heel pod **515** to stabilize the ankle. The hardness of the lateral heel pod is preferably essentially the same as the lateral midfoot pod, which work in concert to help reduce the incidence of lateral ankle roll-overs. It is preferably made of TPR or PU of a hardness of about Shore C 45-50. If TPR is used, a fabric is in turn secured to the base **502** in the lateral heel pod opening **511** of said base **502**. The fabric component allows the TPR to properly adhere to the base **502**.

[0107] Stability cradle **506** defines a medial heel pod opening **515** that extends through the heel area along the medial side of heel area on the bottom surface of base **502** just short of the heel end. Medial heel pod **516** is shaped essentially the same as medial heel pod opening **515** and is secured to the bottom surface of base **502** within the stability cradle recession area **505** in a location that correlates to the medial heel pod opening **515** and allows medial heel pod **516** to extend out through said medial heel pod opening **515**. The medial heel pod **516** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0108] Medial heel pod **516** is preferably made from TPR or PU of a hardness of about 60 ASKER C±3. If TPR is used, a fabric is in turn secured to the base **502** in the medial heel pod opening **515** of said base **502**. The fabric component allows the TPR to properly adhere to the base **502**.

[0109] 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. To cushion the impact, lateral heel pod **514** is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle **506**. Preferably, lateral heel pod **514** is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0110] 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 results in injury.

[0111] Stability cradle **506** provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod **516** helps to control the rate of pronation by forming medial heel pod **516** out of a material having different characteristics than lateral heel pod **514**. For example, to reduce a pronation rate, medial heel pod **516** can be made from a firmer material than lateral heel pod **514**. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod **516** made from a firmer material would compress less than a lateral heel pod **514** made of a softer material. As a result, medial heel pod **516** tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod **516** from a softer material than lateral heel pod **514** would tend to increase the amount and rate of pronation.

[0112] Preferably, the firmness of the material used in medial heel pod **516** is selected based on the firmness of lateral heel pod **514** and on the type of intended activity. For example, the firmness of lateral heel pod **514** and medial heel pod **516** differs by about 20-30% for an insole to be used during light to moderate activities.

[0113] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel pod **516** can be made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0114] Lateral midfoot pod **512** provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod **512** is formed of a material having the same properties, e.g., firmness, as lateral heel pod **514**. However, a material having different characteristics can also be used.

[0115] The use of dual density heel pods is employed to cause a kinetic change in foot function to promote ankle stability. It is also not out of the scope of the invention to have the medial heel pod softer than the lateral heel pod and/or lateral midfoot pod or any combination thereof to address different joint moments or ankle rolls.

[0116] 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 **508** is located under this part of the foot. Preferably, forefoot pad **508** is formed of a relatively resilient material so that energy put into compressing forefoot pad **508** is returned to help propel the foot at toe-off.

[0117] 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 medial portion of forefoot pad **508** extends rearward into a corresponding concave edge portion of the distal edge of stability cradle **506**. The shape of the stability cradle **506** and forefoot pad **508** permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

[0118] Base **502** is preferably made of foam or other material having suitable cushioning properties. Preferably, base **502** comprises an Ethylene vinyl acetate ("EVA") foam, which is a copolymer of ethylene and vinyl acetate, or a Thermoplastic Rubber ("TPR")/EVA mix. A preferred EVA or TPR/EVA mix has a durometer (hardness) of about Asker C 45-50.

[0119] Forefoot pad **508** is preferably made from a Thermoplastic Rubber ("TPR") or Polyurethane ("PU"). The hardness of the TPR or PU used in the forefoot pad is preferably about 30 Asker C±3.

[0120] The forefoot pad **520**, lateral midfoot pod **521**, lateral heel pod **522**, and medial heel pod **523** are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern **520** is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns **521** and **522** are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern **523** is approximately 1.00 to

2.50 mm deep. Preferably the TPR pods have the deeper criss-cross groove pattern and the PU pods have the shallower criss-cross groove pattern due to the compression characteristics of the materials. The criss-cross groove patterns also assists with keeping the insole in place and not move or slide around within the shoe.

[0121] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0122] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the open-cell designs will provide for a lighter insole.

[0123] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base **502** in the recession areas defined by base **502** on the bottom surface are permanently affixed to base **502** 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.

[0124] The recession areas also is lined with a cloth having a base surface and a pad/pod surface, secured to said base along said base surface and said pad/pod along said pad/pod surface. Alternatively, a cloth is secured to pad/pod and then the composite structure secured to the recession area.

[0125] Some shoes may slightly differ in size on the inner part of the shoe. Some shoes may also provide extra padding along the inner sides, front or back of the shoe that alter the actual space provided for the foot and/or an insole on the inner part of the shoe. Base **502** may have sizing guides **550** that allow a user to shorten the length of the insole for proper fit within the shoe, sizing guides **550** provide various cutting guide lines that the user would cut along, preferably with scissors.

[0126] FIG. **6** illustrates a lateral side view of the insole. Insole **600** preferably comprises a top sheet **601** and a base **602** having a top surface secured to said top sheet **601** and an opposite bottom surface. Base **602** also defines a longitudinal arch support **619** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0127] The bottom surface of base **602** defines a forefoot pad recession area in the forefoot area and a stability cradle recession area **605** along the midfoot and heel areas.

[0128] Base **602** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. The height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0129] The forefoot pad recession area begins partially proximal from the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area has a rear apex that lies between the 1st and 2nd metatarsals. A forefoot pad is shaped essentially the same as forefoot pad recession area and is secured therein.

[0130] The stability cradle recession area **605** is located in the midfoot and heel areas of the bottom surface of base **602**. The stability cradle recession area **605** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **607** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **606** is shaped essentially the same as stability cradle recession area **605** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **605**.

[0131] Stability cradle **606** has walls that wrap up the sides and rear of base **602** to provide support for the foot. Preferably, stability cradle **606** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **606** are preferably higher on the medial side of the foot because of the higher loading.

[0132] Preferably, the shoe facing surface of stability cradle **606** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear to other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0133] Stability cradle **606** defines a lateral midfoot pod opening that extends from the behind the 3^{rd} though 5^{th} metatarsal heads proximally to the back of the cuboid. A lateral midfoot pod **612** is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **602** within the stability cradle recession area **605** in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod **612** to extend out through said lateral midfoot pod opening.

[0134] Stability cradle **606** also defines a lateral heel pod opening that extends through the lateral side of the heel area of stability cradle **606** from approximately rearward of the lateral midfoot pod opening toward the heel end. Lateral heel pod **614** is shaped essentially the same as lateral heel pod opening and is secured to the bottom surface of base **602** within the stability cradle recession area **605** in a location that correlates to the lateral heel pod opening and allows lateral heel pod **614** to extend out through said lateral heel pod opening.

[0135] Stability cradle **606** defines a medial heel pod opening that extends through the heel area along the medial side of heel area on the bottom surface of base **602** just short of the heel end. Medial heel pod is shaped essentially the same as medial heel pod opening and is secured to the bottom surface of base **602** within the stability cradle recession area **605** in a

location that correlates to the medial heel pod opening and allows medial heel pod to extend out through said medial heel pod opening.

[0136] In a preferred embodiment, base **602** is covered with top sheet **601**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **601** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0137] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **638** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **638** pushes up a portion of the top sheet **601** that corresponds to the area of the transverse arch support **638**.

[0138] Traverse arch support **638** preferably lies under the second to fourth metatarsal heads. Traverse arch support **638** provides additional stability and cushioning to the forefoot and middle of the foot.

[0139] FIG. **7** illustrates a medial side view of the insole. Insole **700** preferably comprises a top sheet **701** and a base **702** having a top surface secured to said top sheet and an opposite bottom surface. Base **702** also defines a longitudinal arch support **719** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0140] The bottom surface of base **702** defines a forefoot pad recession area in the forefoot area and a stability cradle recession area **705** along the midfoot and heel areas. The bottom surface of base **702** also defines one or more ribs or protrusions **732** that extend outwardly along the arch area. The ribs **732** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape.

[0141] Base **702** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. The height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0142] The forefoot pad recession area begins partially proximal from the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area has a rear apex that lies between the 1st and 2nd metatarsals. A forefoot pad is shaped essentially the same as forefoot pad recession area and is secured therein.

[0143] The stability cradle recession area **705** is located in the midfoot and heel areas of the bottom surface of base **702**. The stability cradle recession area **705** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **706** is shaped essentially the same as stability cradle recession area **705** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **705**.

[0144] Stability cradle **706** has walls that wrap up the sides and rear of base **702** to provide support for the foot. Preferably, stability cradle **706** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **706** are preferably higher on the medial side of the foot because of the higher loading.

[0145] Preferably, the shoe facing surface of stability cradle **706** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear with other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0146] The stability cradle **706** preferably defines one or more rib-shaped openings **731**. In a preferred embodiment, the rib-shaped openings **731** allow said ribs **732** of base **702** to extend therethrough. Preferably, base **702** is molded so that the ribs **732** project into rib-shaped openings **731** so that the ribs **732** are approximately flush with the outer surface of stability cradle **706** and mechanically lock stability cradle **706** and base **702** together. Advantageously, the ribs **732** are also able to bulge through rib-shaped openings **731** when base **702** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **732** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **731** allow the stability cradle **706** to be more flexible in the arch area compared to the rest of the stability cradle **706**.

[0147] In an alternate embodiment, stability cradle **706** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0148] Stability cradle **706** defines a lateral midfoot pod opening that extends from the behind the 3^{rd} though 5^{th} metatarsal heads proximally to the back of the cuboid. A lateral midfoot pod is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **702** within the stability cradle recession area **705** in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod to extend out through said lateral midfoot pod opening.

[0149] Stability cradle **706** also defines a lateral heel pod opening that extends through the lateral side of the heel area of stability cradle **706** from approximately rearward of the lateral midfoot pod opening toward the heel end. Lateral heel pod is shaped essentially the same as lateral heel pod opening and is secured to the bottom surface of base **702** within the stability cradle recession area **705** in a location that correlates

to the lateral heel pod opening and allows lateral heel pod to extend out through said lateral heel pod opening.

[0150] Stability cradle **706** defines a medial heel pod opening that extends through the heel area along the medial side of heel area on the bottom surface of base **702** just short of the heel end. Medial heel pod **716** is shaped essentially the same as medial heel pod opening and is secured to the bottom surface of base **702** within the stability cradle recession area **705** in a location that correlates to the medial heel pod opening and allows medial heel pod **716** to extend out through said medial heel pod opening.

[0151] In a preferred embodiment, base **702** is covered with top sheet **701**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **701** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0152] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **738** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **738** pushes up a portion of the top sheet **701** that corresponds to the area of the transverse arch support **738**.

[0153] Traverse arch support **738** preferably lies under the second to fourth metatarsal heads. Traverse arch support **738** provides additional stability and cushioning to the forefoot and middle of the foot.

[0154] FIG. **8** illustrates a rear view of the insole. Insole **800** preferably comprises a top sheet **801** and a base **802** having a top surface secured to said top sheet and an opposite bottom surface. Base **802** also defines a longitudinal arch support **819** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0155] The bottom surface of base **802** defines a forefoot pad recession area in the forefoot area and a stability cradle recession area **805** along the midfoot and heel areas. The bottom surface of base **802** also define one or more ribs or protrusions **832** that extend outwardly along the arch area. The ribs **832** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. An alternate embodiment has the ribs or protrusions defined by the stability cradle **806** and extending outwardly from the stability cradle **806** in the arch area.

[0156] Base **802** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. The height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0157] The forefoot pad recession area begins partially proximal from the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area has a rear apex that lies between the 1st and 2nd metatarsals. A forefoot pad is shaped essentially the same as forefoot pad recession area and is secured therein.

[0158] The stability cradle recession area **805** is located in the midfoot and heel areas of the bottom surface of base **802**. The stability cradle recession area **805** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **806** is shaped essentially the same as stability cradle recession area **805** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **805**.

[0159] Stability cradle **806** has walls that wrap up the sides and rear of base **802** to provide support for the foot. Preferably, stability cradle **806** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **806** are preferably higher on the medial side of the foot because of the higher loading.

[0160] Preferably, the shoe facing surface of stability cradle **806** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear with other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0161] The stability cradle **806** preferably defines one or more rib-shaped openings **831**. In a preferred embodiment, the rib-shaped openings **831** allow said ribs **832** of base **802** to extend therethrough. Preferably, base **802** is molded so that the ribs **832** project into rib-shaped openings **831** so that the ribs **832** are approximately flush with the outer surface of stability cradle **806** and mechanically lock stability cradle **806** and base **802** together. Advantageously, the ribs **832** are also able to bulge through rib-shaped openings **831** when base **802** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **832** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **831** allow the stability cradle **806** to be more flexible in the arch area compared to the rest of the stability cradle **806**.

[0162] In an alternate embodiment, stability cradle **806** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0163] Stability cradle **806** defines a lateral midfoot pod opening that extends from the behind the 3^{rd} though 5^{th} metatarsal heads proximally to the back of the cuboid. A lateral midfoot pod is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **802** within the stability cradle recession area **805** in a location that

correlates to the lateral midfoot pod opening and allows lateral midfoot pod to extend out through said lateral midfoot pod opening.

[0164] Stability cradle **806** also defines a lateral heel pod opening that extends through the lateral side of the heel area of stability cradle **806** from approximately rearward of the lateral midfoot pod opening toward the heel end. Lateral heel pod **814** is shaped essentially the same as lateral heel pod opening and is secured to the bottom surface of base **802** within the stability cradle recession area **805** in a location that correlates to the lateral heel pod opening and allows lateral heel pod **814** to extend out through said lateral heel pod opening.

[0165] Stability cradle **806** defines a medial heel pod opening that extends through the heel area along the medial side of heel area on the bottom surface of base **802** just short of the heel end. Medial heel pod **816** is shaped essentially the same as medial heel pod opening and is secured to the bottom surface of base **802** within the stability cradle recession area **805** in a location that correlates to the medial heel pod opening and allows medial heel pod **816** to extend out through said medial heel pod opening.

[0166] In a preferred embodiment, base **802** is covered with top sheet **801**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **801** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0167] FIG. **9** is a section view **9-9** along the middle of the insole as identified in FIGS. **4** and **5**. Insole **900** preferably comprises a top sheet **901** and a base **902** having a top surface secured to said top sheet **901** and an opposite bottom surface. The bottom surface of base **902** defines a forefoot pad recession area **907** in the forefoot area and a stability cradle recession area **905** along the midfoot and heel areas.

[0168] Base **902** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. As best seen in FIGS. **10-12**, the height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0169] Preferably, the top surface of the base **902** defines an upwardly-extending portion or transverse arch support **938** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **938** pushes up a portion of the top sheet **901** that corresponds to the area of the transverse arch support **938**. Traverse arch support **938** preferably lies under the second to fourth metatarsal heads. Traverse arch support **938** provides additional stability and cushioning to the forefoot and middle of the foot.

[0170] The forefoot pad recession area **907** begins partially proximal form the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area **907** extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area **907** has a rear apex that lies between the 1st and 2nd metatarsals.

[0171] Forefoot pad **908** is shaped essentially the same as forefoot pad recession area **907** and is secured therein. Forefoot pad **908** has a medial edge, a lateral edge, a proximal (back) edge and a distal (front) edge. The medial edge of forefoot pad **908** 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 **957**, laterally and distally towards the 3rd metatarsal head, then laterally and proximally to the lateral edge approximately along the 3rd through 5th metatarsal heads. The lateral edge connects said proximal edge to said top edge of said forefoot pad. In use, forefoot pad recession area **907** and forefoot pad **908** underlie 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. FIG. **11** shows the placement of foot bones on the insole.

[0172] An adhesive is be used to secure the components. The forefoot pad **908** 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.

[0173] It is estimated that using tougher materials increases the durability of the insole by 35% to 65% over insoles that use softer materials for this portion of the foot insole.

[0174] The stability cradle recession area **905** is located in the midfoot and heel areas of the bottom surface of base **902**. The stability cradle recession area **905** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **907** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **906** is shaped essentially the same as stability cradle recession area **905** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **905**.

[0175] Stability cradle **906** has walls that wrap up the sides and rear of base **902** to provide support for the foot.

[0176] Preferably, the shoe facing surface of stability cradle **906** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear with other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0177] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in

the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0178] Stability cradle **906** defines a lateral midfoot pod opening that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **902** within the stability cradle recession area **905** in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod to extend out through said lateral midfoot pod opening.

[0179] Stability cradle **906** also defines a lateral heel pod opening **913** that extends through the lateral side of the heel area of stability cradle **906** from approximately rearward of the lateral midfoot pod opening **911** toward the heel end. Lateral heel pod **914** is shaped essentially the same as lateral heel pod opening **913** and is secured to the bottom surface of base **902** within the stability cradle recession area **905** in a location that correlates to the lateral heel pod opening **913** and allows lateral heel pod **914** to extend out through said lateral heel pod opening **913**. Lateral heel pod **914** has a lateral edge which extends along the lateral border of insole **900** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **914** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0180] The configuration, material and position of the lateral heel pod **914** provides cushioning and works in association with the medial heel pod **915** to stabilize the ankle.

[0181] Stability cradle **906** defines a medial heel pod opening **915** that extends through the heel area along the medial side of heel area on the bottom surface of base **902** just short of the heel end. Medial heel pod **916** is shaped essentially the same as medial heel pod opening **915** and is secured to the bottom surface of base **902** within the stability cradle recession area **905** in a location that correlates to the medial heel pod opening **915** and allows medial heel pod **916** to extend out through said medial heel pod opening **915**. The medial heel pod **916** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0182] 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. To cushion the impact, lateral heel pod **914** is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle **906**. Preferably, lateral heel pod **914** is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0183] 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 results in injury.

[0184] Stability cradle **906** provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod **916** helps to control the rate of pronation by forming medial heel pod **916** out of a material having different characteristics than lateral heel pod **914**. For example, to reduce a pronation rate, medial heel pod **916** is made from a firmer material than lateral heel pod **914**. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod **916** made from a firmer material would compress less than a lateral heel pod **914** made of a softer material. As a result, medial heel pod **916** tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod **916** from a softer material than lateral heel pod **914** would tend to increase the amount and rate of pronation.

[0185] Preferably, the firmness of the material used in medial heel pod **916** is selected based on the firmness of lateral heel pod **914** and on the type of intended activity. For example, the firmness of lateral heel pod **914** and medial heel pod **916** differs by about 20-30% for an insole to be used during light to moderate activities.

[0186] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel pod **916** is made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0187] Lateral midfoot pod **912** provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod is formed of a material having the same properties, e.g., firmness, as lateral heel pod **914**. However, a material having different characteristics may also be used.

[0188] The use of dual density heel pods is employed to cause a kinetic change in foot function to promote ankle stability. It is also not out of the scope of the invention to have the medial heel pod softer than the lateral heel pod and/or lateral midfoot pod or any combination thereof to address different joint moments or ankle rolls.

[0189] 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 **908** is located under this part of the foot. Preferably, forefoot pad **908** is formed of a relatively resilient material so that energy put into compressing forefoot pad **908** is returned to help propel the foot at toe-off.

[0190] 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 medial portion of forefoot pad **908** extends rearward into a corresponding concave edge portion of the distal edge of stability cradle **906**. The shape of the stability cradle **906** and forefoot pad **908** permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

[0191] The forefoot pad **920**, lateral midfoot pod **921**, lateral heel pod **922**, and medial heel pod **923** are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties. It also allows for use of less material and therefore

a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern **920** is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern **923** is approximately 1.00 to 2.50 mm deep.

[0192] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0193] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the criss-cross groove pattern designs will help provide a lighter insole.

[0194] In a preferred embodiment, base **902** is covered with top sheet **901**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **901** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0195] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base **902** in the recession areas defined by base **902** on the bottom surface are permanently affixed to base **902** using an appropriate means such as an adhesive. The components also be secured during the molding process using techniques known in the art of molding insoles.

[0196] The recession areas are also be lined with a cloth having a base surface and a pad/pod surface, secured to said base along said base surface and said pad/pod along said pad/pod surface. Alternatively, a cloth is secured to pad/pod and then the composite structure secured to the recession area.

[0197] FIG. **10** illustrates a cross section **10-10** as identified in FIGS. **4** and **5**. Insole **1000** preferably comprises a top sheet **1001** and a base **1002** having a top surface secured to said top sheet **1001** and an opposite bottom surface. The bottom surface of base **1002** defines a forefoot pad recession area and a stability cradle recession area.

[0198] The stability cradle recession area **1005** is located in the midfoot and heel areas of the bottom surface of base **1002**. The stability cradle recession area **1005** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **106** is shaped essentially the same as stability cradle recession area **1005** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1005**.

[0199] Preferably, the shoe facing surface of stability cradle **1006** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use.

[0200] In a preferred embodiment, base **1002** is covered with top sheet **1001**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1001** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0201] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **1038** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1038** pushes up a portion of the top sheet **1001** that corresponds to the area of the transverse arch support **1038**.

[0202] Traverse arch support **1038** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1038** provides additional stability to the forefoot and middle of the foot.

[0203] FIG. **11** illustrates a cross section **11-11** as identified in FIGS. **4** and **5**. Insole **1100** preferably comprises a top sheet **1101** and a base **1102** having a top surface secured to said top sheet **1101** and an opposite bottom surface. The bottom surface of base **1102** defines a forefoot pad recession area and a stability cradle recession area.

[0204] The stability cradle recession area **1105** is located in the midfoot and heel areas of the bottom surface of base **1102**. The stability cradle recession area **1105** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **116** is shaped essentially the same as stability cradle recession area **1105** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1105**. Stability cradle **1106** has walls that wrap up the sides and rear of base **102** to provide support for the foot.

[0205] Preferably, the shoe facing surface of stability cradle **1106** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use.

[0206] The stability cradle **1106** preferably defines one or more rib-shaped openings **1131**. In a preferred embodiment, the rib-shaped openings **1131** allow said ribs **1132** of base **1102** to extend therethrough. Preferably, base **1102** is molded so that the ribs **1132** project into rib-shaped openings **1131** so that the ribs **1132** are approximately flush with the outer surface of stability cradle **1106** and mechanically lock stability cradle **106** and base **1102** together. Advantageously, the ribs **1132** are also able to bulge through rib-shaped openings **1131** when base **1102** is compressed (e.g., while walking or running) to provide additional cushioning and support to the

arch of the foot. Preferably said ribs **1132** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **1131** allow the stability cradle **1106** to be more flexible in the arch area compared to the rest of the stability cradle **1106**.

[0207] In an alternate embodiment, stability cradle **1106** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0208] Stability cradle **106** defines a lateral midfoot pod opening **1111** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening **1111** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod **1112** is shaped essentially the same as lateral midfoot pod opening **1111** and is secured to the bottom surface of base **1102** within the stability cradle recession area in a location that correlates to the lateral midfoot pod opening **1111** and allows lateral midfoot pod **1112** to extend out through said lateral midfoot pod opening **1111**.

[0209] In a preferred embodiment, base **1102** is covered with top sheet **1101**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1101** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0210] FIG. **12** illustrates a cross section **12-12** as identified in FIGS. **4** and **5**. Insole **1200** preferably comprises a top sheet **1201** and a base **1202** having a top surface secured to said top sheet **1201** and an opposite bottom surface. The bottom surface of base **1202** defines a forefoot pad recession area and a stability cradle recession area.

[0211] The stability cradle recession area **1205** is located in the midfoot and heel areas of the bottom surface of base **1202**. The stability cradle recession area **1205** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **1206** is shaped essentially the same as stability cradle recession area **1205** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1205**. Stability cradle **1206** has walls that wrap up the sides and rear of base **102** to provide support for the foot.

[0212] Preferably, the shoe facing surface of stability cradle **1206** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use.

[0213] Stability cradle **1206** also defines a lateral heel pod opening **1213** that extends through the lateral side of the heel area of stability cradle **1206** from approximately rearward of the lateral midfoot pod opening **1211** toward the heel end. Lateral heel pod **1214** is shaped essentially the same as lateral heel pod opening **1213** and is secured to the bottom surface of base **1202** within the stability cradle recession area **1205** in a location that correlates to the lateral heel pod opening **1213** and allows lateral heel pod **1214** to extend out through said lateral heel pod opening **1213**. Lateral heel pod **1214** has a lateral edge which extends along the lateral border of insole **1200** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **1214** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0214] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0215] Stability cradle **1206** defines a medial heel pod opening **1215** that extends through the heel area along the medial side of heel area on the bottom surface of base **1202** just short of the heel end. Medial heel pod **1216** is shaped essentially the same as medial heel pod opening **1215** and is secured to the bottom surface of base **1202** within the stability cradle recession area **1205** in a location that correlates to the medial heel pod opening **1215** and allows medial heel pod **1216** to extend out through said medial heel pod opening **1215**. The medial heel pod **1216** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0216] In a preferred embodiment, base **1202** is covered with top sheet **1201**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1201** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0217] FIG. **13** illustrates the bones of the foot superimposed over a bottom view of the insole of the present invention. At the heel of the foot is the calcaneus **1370** and forward of the calcaneus **1370** is the talus **1372**. Forward of the talus **1372** on the medial side is the navicular **1374** and on the lateral side is the cuboid **1376**. Forward of the cuboid **1376** and the navicular **1374** are cuneiforms **1378**. Forward of the cuneiforms **1378** and cuboid **1376** are the metatarsals **1380**A-**1380**E. The first metatarsal **1380**A is located on the medial side of the foot and the fifth metatarsal **1380**E is located on the lateral side of the foot. Forward of the metatarsals **1380**A-**1380**E are the proximal phalanges **1382**. Forward of the

proximal phalanges **1382** are the middle phalanges **1384**, and at the end of each toe are the distal phalanges **1386**.

[0218] FIG. **14** shows the bottom view of the insole (similar to FIG. **5**) and illustrates the various areas of the insole: distal medial arch area **1465**, lateral midfoot area **1466**, proximal medial arch area **1467**, medial heel area **1468**, lateral heel area **1469**, forefoot area **1493**, toe area **1491**, metatarsal head area **1492**, midfoot area **1494**, and heel area **1495**.

[0219] Forefoot area **1493** comprises toe area **1491** and metatarsal head area **1492**, encompassing the entire width of the insole from the toe end to behind the metatarsal heads or "balls" of the feet. Toe area **1491** has a length extending from the toe end to a diagonal edge that runs generally behind the 1^{st} distal phalange and 2^{nd} and 3^{rd} middle phalanges and 4^{th} and 5^{th} distal phalanges and forward of the metatarsal heads. Toe area **1491** has a width extending from the medial border to the lateral border. Metatarsal head area **1492**, comprising first metatarsal head area **1403** and lesser metatarsal head area **1404**, has a length extending from a front diagonal edge, adjacent the diagonal edge of toe area **1491**, to a back diagonal edge that generally runs behind the metatarsal heads. Metatarsal head area **1492** has a width extending from the medial border to the lateral border.

[0220] Midfoot area **1494** comprises distal medial arch area **1465** and lateral midfoot area **1466**. Midfoot area **1494** has a front edge adjacent forefoot area **1493** or metatarsal head area **1492** and a back edge that runs diagonally from between the talus and navicular on the medial side to just behind the cuboid on the lateral side. Midfoot area **1494** has a width extending from the medial border to the lateral border.

[0221] Distal medial arch area **1465** extends from a front edge just behind the first metatarsal head and adjacent the back diagonal edge of metatarsal head area **1492** to a back edge between the talus and navicular. The width of distal medial arch area **1465** extends from the medial border to near the middle of the foot. Lateral midfoot area **1466** extends from the back diagonal edge of metatarsal head area **1492** to a back edge just behind the cuboid. The width of lateral midfoot area extends from near the middle of the foot to the lateral border.

[0222] Heel area **1495** comprises proximal medial arch area **1467**, medial heel area **1468**, and lateral heel area **1469**. Heel area **1495** has a front edge adjacent the back edge of midfoot area **1494** and extends proximally to the heel end. Heel area **1495** has a width extending from the medial border to the lateral border.

[0223] Proximal medial arch area **1467** extends from a front edge between the talus and navicular or adjacent the front edge of heel area **1495** to a back point along the medial border about midway between the heel end and the talus. The width of proximal medial arch area **1467** extends from the medial border to diagonal lateral edge where the diagonal lateral edge extends from about a third of the insole width laterally from the medial border along the front edge of the heel area **1495** to the back point of proximal medial arch area **1467**.

[0224] Lateral heel area **1469** extends from a front edge just behind the cuboid or adjacent the front edge of heel area **1495** to the heel end. The width of lateral heel area extends from a diagonal medial edge to the lateral border where diagonal medial edge extends from about a third of the insole width medially from the lateral border along the front edge of the heel area **1495** to a point just medial of the heel end.

[0225] Medial heel area **1468** extends from the front edge of the heel area **1495** to the medial border just medial of the heel end. The width of medial heel area **1468** extends from the lateral diagonal edge of proximal medial arch area **1467** to the medial diagonal edge of lateral heel area **1469**.

[0226] Forefoot pad recession area **1467** preferably extends the entire length of the metatarsal head area **1492** on the medial half and from the front diagonal edge of metatarsal head area **1492** to 3^{rd} through 5^{th} metatarsal heads on the lateral half. Forefoot pad **1468** is secured to the forefoot pad recession area **1467**.

[0227] Stability cradle **1406** is located in the entire midfoot area **1494** and heel area **1495**. A portion of stability cradle **1406** on the lateral half extends forward into metatarsal head area **1492** to just behind the 3^{rd} through 5^{th} metatarsal heads.

[0228] In a preferred embodiment, ribs **1432** of base **1402** extend through rib openings **1431** and are located in the majority of the distal medial arch area **1465** and proximal medial arch area **1467**. In an alternate embodiment, the ribs or protrusions are defined by the stability cradle **1406** and extending outwardly from the stability cradle **1406** and are located in the majority of the distal medial arch area **1465** and proximal medial arch area **1467**.

[0229] Lateral midfoot pod opening is located approximately in the middle third of the lateral midfoot area **1466**. Lateral midfoot pod opening extends essentially the entire length of lateral midfoot area **1466**. Lateral midfoot pod **1412** is secured to lateral midfoot pod opening.

[0230] Medial heel pod opening is located in the majority of the medial heel area **1468**. Medial heel pod **1416** is secured to medial heel pod opening. Lateral heel pod opening is located in the majority of the lateral heel area **1469**. Lateral heel pod **1414** is secured to lateral heel pod opening.

[0231] FIGS. **15**A-**15**E illustrate the preferred embodiment or an insole for triathlon racing. FIGS. **15**A-**1** and **15**A-**2** shows the top and bottom perspective views. The current invention is an insole that incorporates, but is not limited to: (1) a faceted stability cradle with a plurality of stability ribs, (2) plurality of pods, (3) a forefoot pad (4) criss-cross groove patterns on the bottom surface of the pods and forefoot pads, and (5) a jadeite cooling top cloth. In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe. 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 insole movement or sliding during shoe operation and change-overs, and (4) provide enhanced cushioning features to the heel, midfoot, arch and forefoot during running and cross-training exercises.

[0232] FIG. **15**A-**1** is a top view of the insole **1500** illustrating the top sheet **1501** and transverse arch support **1538**. Insole **1500** comprises a top sheet **1501** secured across the entire top surface of the base from toe area to heel area.

Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **1538** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1538** pushes up a portion of the top sheet **401** that corresponds to the area of the transverse arch support **1538**.

[0233] Traverse arch support **1538** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1538** provides additional stability and cushioning to the forefoot and middle of the foot.

[0234] In a preferred embodiment, top sheet **1501** is a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1501** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi. A series of air holes extend through top sheet **1501** and the base to permit air circulation above and below insole **1500**.

[0235] FIG. **15**A-**2** illustrates the bottom view of the insole. Insole **1500** preferably comprises a top sheet **1501** and a base **1502** having a top surface secured to said top sheet and an opposite bottom surface. Base **1502** also defines a longitudinal arch support **1519** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0236] The bottom surface of base **1502** defines a forefoot pad recession area **1507** in the forefoot area and a stability cradle recession area **1505** along the midfoot and heel areas. The bottom surface of base **1502** also defines one or more ribs or protrusions **1532** that extend outwardly along the arch area. The ribs **1532** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape.

[0237] Base **1502** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. As best seen in FIGS. **15**B-**7** to **15**B-**10**, the height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0238] The forefoot pad recession area **1507** begins partially proximal form the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area **1507** extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area **1507** has a rear apex **1557** that lies between the 1st and 2nd metatarsals.

[0239] Forefoot pad **1508** is shaped essentially the same as forefoot pad recession area **1507** and is secured therein. Forefoot pad **1508** has a medial edge, a lateral edge, a proximal (back) edge and a distal (front) edge. The medial edge of forefoot pad **1508** 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 **1557**, laterally and distally towards the 3rd metatarsal head, then laterally and proximally to the lateral edge approximately along the 3rd through 5th metatarsal heads. The lateral edge connects said proximal edge to said top edge of said forefoot pad. In use, forefoot pad recession area **1507** and forefoot pad **1508** underlie 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. FIG. **13** shows the placement of foot bones on the insole.

[0240] An adhesive is used to secure the components. The forefoot pad **1508** 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.

[0241] It is estimated that using tougher materials increase the durability of the insole by 35% to 65% over insoles that use softer materials for this portion of the foot insole.

[0242] The stability cradle recession area **1505** is located in the midfoot and heel areas of the bottom surface of base **1502**. The stability cradle recession area **1505** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **1507** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **1506** is shaped essentially the same as stability cradle recession area **1505** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1505**.

[0243] Stability cradle **1506** has walls that wrap up the sides and rear of base **1502** to provide support for the foot. Preferably, stability cradle **1506** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1506** are preferably higher on the medial side of the foot because of the higher loading. Preferably, stability cradle **1506** is made of a nylon material with a hardness of approximately Shore A 95. In a preferred embodiment, the stability cradle is semi-rigid. In an alternate embodiment, the stability cradle is rigid.

[0244] Preferably, the shoe facing surface of stability cradle **1506** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear to other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0245] The stability cradle **1506** preferably defines one or more rib-shaped openings **1531**. In a preferred embodiment, the rib-shaped openings **1531** allow said ribs **1532** of base **1502** to extend therethrough. Preferably, base **1502** is molded so that the ribs **1532** project into rib-shaped openings **1531** so that the ribs **1532** are approximately flush with the outer surface of stability cradle **1506** and mechanically lock stability cradle **1506** and base **1502** together. Advantageously, the ribs **1532** are also able to bulge through rib-shaped openings **1531** when base **1502** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **1532** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **1531** allow

the stability cradle **1506** to be more flexible in the arch area compared to the rest of the stability cradle **1506**.

[0246] In an alternate embodiment, stability cradle **1506** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0247] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0248] Stability cradle **1506** defines a lateral midfoot pod opening **1511** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening **1511** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod **1512** is shaped essentially the same as lateral midfoot pod opening **1511** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral midfoot pod opening **1511** and allows lateral midfoot pod **1512** to extend out through said lateral midfoot pod opening **1511**.

[0249] Lateral midfoot pod **1512** is preferably made from TPR or PU of a hardness of about 45-50 ASKER C. If TPR is used, a fabric is in turn secured to the base **1502** in the lateral midfoot pod opening **1511** of said base **1502**. The fabric component allows the TPR to properly adhere to the base **1502**.

[0250] Stability cradle **1506** also defines a lateral heel pod opening **1513** that extends through the lateral side of the heel area of stability cradle **1506** from approximately rearward of the lateral midfoot pod opening **1511** toward the heel end. Lateral heel pod **1514** is shaped essentially the same as lateral heel pod opening **1513** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral heel pod opening **1513** and allows lateral heel pod **1514** to extend out through said lateral heel pod opening **1513**. Lateral heel pod **1514** has a lateral edge which extends along the lateral border of insole **1500** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **1514** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0251] The configuration, material and position of the lateral heel pod **1514** provides cushioning and works in association with the medial heel pod **515** to stabilize the ankle. The hardness of the lateral heel pod is preferably essentially the same as the lateral midfoot pod, which work in concert to help reduce the incidence of lateral ankle roll-overs. It is preferably made of TPR or PU of a hardness of about Shore C 45-50. If TPR is used, a fabric is in turn secured to the base **1502** in the lateral heel pod opening **1511** of said base **1502**. The fabric component allows the TPR to properly adhere to the base **1502**.

[0252] Stability cradle **1506** defines a medial heel pod opening **1515** that extends through the heel area along the medial side of heel area on the bottom surface of base **1502** just short of the heel end. Medial heel pod **1516** is shaped essentially the same as medial heel pod opening **1515** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the medial heel pod opening **1515** and allows medial heel pod **1516** to extend out through said medial heel pod opening **1515**. The medial heel pod **1516** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0253] Medial heel pod **1516** is preferably made from TPR or PU of a hardness of about 60 ASKER C±3. If TPR is used, a fabric is in turn secured to the base **1502** in the medial heel pod opening **1515** of said base **1502**. The fabric component allows the TPR to properly adhere to the base **1502**.

[0254] 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. To cushion the impact, lateral heel pod **1514** is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle **1506**. Preferably, lateral heel pod **1514** is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0255] 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 results in injury.

[0256] Stability cradle **1506** provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod **1516** helps to control the rate of pronation by forming medial heel pod **1516** out of a material having different characteristics than lateral heel pod **1514**. For example, to reduce a pronation rate, medial heel pod **1516** can be made from a firmer material than lateral heel pod **1514**. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod **1516** made from a firmer material would compress less than a lateral heel pod **1514** made of a softer material. As a result, medial heel pod **1516** tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod **1516** from a softer material than lateral heel pod **1514** would tend to increase the amount and rate of pronation.

[0257] Preferably, the firmness of the material used in medial heel pod **1516** is selected based on the firmness of lateral heel pod **1514** and on the type of intended activity. For example, the firmness of lateral heel pod **1514** and medial heel pod **1516** differs by about 20-30% for an insole to be used during light to moderate activities.

[0258] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel pod **1516** can be made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0259] Lateral midfoot pod **1512** provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod **1512** is formed of a material having the same properties, e.g., firmness, as lateral heel pod **1514**. However, a material having different characteristics can also be used.

[0260] The use of dual density heel pods is employed to cause a kinetic change in foot function to promote ankle stability. It is also not out of the scope of the invention to have the medial heel pod softer than the lateral heel pod and/or lateral midfoot pod or any combination thereof to address different joint moments or ankle rolls.

[0261] 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 **1508** is located under this part of the foot. Preferably, forefoot pad **1508** is formed of a relatively resilient material so that energy put into compressing forefoot pad **1508** is returned to help propel the foot at toe-off.

[0262] 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 medial portion of forefoot pad **1508** extends rearward into a corresponding concave edge portion of the distal edge of stability cradle **1506**. The shape of the stability cradle **1506** and forefoot pad **1508** permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

[0263] Base **1502** is preferably made of foam or other material having suitable cushioning properties. Preferably, base **1502** comprises an Ethylene vinyl acetate ("EVA") foam, which is a copolymer of ethylene and vinyl acetate, or a Thermoplastic Rubber ("TPR")/EVA mix. A preferred EVA or TPRIEVA mix has a durometer (hardness) of about Asker C 45-50.

[0264] Forefoot pad **1508** is preferably made from a Thermoplastic Rubber ("TPR") or Polyurethane ("PU"). The hardness of the TPR or PU used in the forefoot pad is preferably about 30 Asker C±3.

[0265] The forefoot pad **1520**, lateral midfoot pod **1521**, lateral heel pod **1522**, and medial heel pod **1523** are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern **1520** is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns **1521** and **1522** are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern **1523** is approximately 1.00 to 2.50 mm deep. Preferably the TPR pods have the deeper criss-cross groove pattern and the PU pods have the shallower criss-cross groove pattern due to the compression characteristics of the materials. The criss-cross groove patterns also assists with keeping the insole in place and not move or slide around within the shoe.

[0266] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0267] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the open-cell designs will provide for a lighter insole.

[0268] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base **1502** in the recession areas defined by base **1502** on the bottom surface are permanently affixed to base **1502** 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.

[0269] The recession areas also is lined with a cloth having a base surface and a pad/pod surface, secured to said base along said base surface and said pad/pod along said pad/pod surface. Alternatively, a cloth is secured to pad/pod and then the composite structure secured to the recession area.

[0270] Some shoes may slightly differ in size on the inner part of the shoe. Some shoes may also provide extra padding along the inner sides, front or back of the shoe that alter the actual space provided for the foot and/or an insole on the inner part of the shoe. Base **1502** may have sizing guides **1550** that allow a user to shorten the length of the insole for proper fit within the shoe, sizing guides **1550** provide various cutting guide lines that the user would cut along, preferably with scissors.

[0271] FIG. **15B-1** to **15B-10** shows the top, bottom, medial side, lateral side, back, and five cross-section views of the insole.

[0272] FIG. **15B-1** illustrates a medial side view of the insole. Insole **1500** preferably comprises a top sheet **1501** and a base **1502** having a top surface secured to said top sheet and an opposite bottom surface. Base **1502** also defines a longitudinal arch support **1519** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0273] The bottom surface of base **1502** defines a forefoot pad recession area in the forefoot area and a stability cradle recession area **1505** along the midfoot and heel areas. The bottom surface of base **1502** also defines one or more ribs or protrusions **1532** that extend outwardly along the arch area. The ribs **1532** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape.

[0274] Base **1502** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. The height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0275] The forefoot pad recession area begins partially proximal from the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area extends rearward to about the 3rd through 5th meta-

tarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area has a rear apex that lies between the 1st and 2nd metatarsals. A forefoot pad is shaped essentially the same as forefoot pad recession area and is secured therein.

[0276] The stability cradle recession area **1505** is located in the midfoot and heel areas of the bottom surface of base **1502**. The stability cradle recession area **1505** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **1506** is shaped essentially the same as stability cradle recession area **1505** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1505**.

[0277] Stability cradle **1506** has walls that wrap up the sides and rear of base **1502** to provide support for the foot. Preferably, stability cradle **1506** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1506** are preferably higher on the medial side of the foot because of the higher loading.

[0278] Preferably, the shoe facing surface of stability cradle **1506** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear with other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0279] The stability cradle **1506** preferably defines one or more rib-shaped openings **1531**. In a preferred embodiment, the rib-shaped openings **1531** allow said ribs **1532** of base **1502** to extend therethrough. Preferably, base **1502** is molded so that the ribs **1532** project into rib-shaped openings **1531** so that the ribs **1532** are approximately flush with the outer surface of stability cradle **1506** and mechanically lock stability cradle **1506** and base **1502** together. Advantageously, the ribs **1532** are also able to bulge through rib-shaped openings **1531** when base **1502** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **1532** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **1531** allow the stability cradle **1506** to be more flexible in the arch area compared to the rest of the stability cradle **1506**.

[0280] In an alternate embodiment, stability cradle **1506** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0281] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0282] Stability cradle **1506** defines a lateral midfoot pod opening that extends from the behind the 3^{rd} though 5^{th} metatarsal heads proximally to the back of the cuboid. A lateral midfoot pod is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod to extend out through said lateral midfoot pod opening.

[0283] Stability cradle **1506** also defines a lateral heel pod opening that extends through the lateral side of the heel area of stability cradle **1506** from approximately rearward of the lateral midfoot pod opening toward the heel end. Lateral heel pod is shaped essentially the same as lateral heel pod opening and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral heel pod opening and allows lateral heel pod to extend out through said lateral heel pod opening.

[0284] Stability cradle **1506** defines a medial heel pod opening that extends through the heel area along the medial side of heel area on the bottom surface of base **1502** just short of the heel end. Medial heel pod **1516** is shaped essentially the same as medial heel pod opening and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the medial heel pod opening and allows medial heel pod **1516** to extend out through said medial heel pod opening.

[0285] In a preferred embodiment, base **1502** is covered with top sheet **1501**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1501** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0286] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **1538** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1538** pushes up a portion of the top sheet **1501** that corresponds to the area of the transverse arch support **1538**.

[0287] Traverse arch support **1538** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1538** provides additional stability and cushioning to the forefoot and middle of the foot.

[0288] FIG. **15A-2** illustrates the bottom view of the insole. Insole **1500** preferably comprises a top sheet **1501** and a base **1502** having a top surface secured to said top sheet and an opposite bottom surface. Base **1502** also defines a longitudi-

nal arch support **1519** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0289] The bottom surface of base **1502** defines a forefoot pad recession area **1507** in the forefoot area and a stability cradle recession area **1505** along the midfoot and heel areas. The bottom surface of base **1502** also defines one or more ribs or protrusions **1532** that extend outwardly along the arch area. The ribs **1532** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape.

[0290] Base **1502** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. As best seen in FIGS. **15**B-**7** to **15**B-**10**, the height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0291] The forefoot pad recession area **1507** begins partially proximal form the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area **1507** extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area **1507** has a rear apex **1557** that lies between the 1st and 2nd metatarsals.

[0292] Forefoot pad **1508** is shaped essentially the same as forefoot pad recession area **1507** and is secured therein. Forefoot pad **1508** has a medial edge, a lateral edge, a proximal (back) edge and a distal (front) edge. The medial edge of forefoot pad **1508** 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 **1557**, laterally and distally towards the 3rd metatarsal head, then laterally and proximally to the lateral edge approximately along the 3rd through 5th metatarsal heads. The lateral edge connects said proximal edge to said top edge of said forefoot pad. In use, forefoot pad recession area **1507** and forefoot pad **1508** underlie 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. FIG. **11** shows the placement of foot bones on the insole.

[0293] An adhesive is used to secure the components. The forefoot pad **1508** 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.

[0294] It is estimated that using tougher materials increase the durability of the insole by 35% to 65% over insoles that use softer materials for this portion of the foot insole.

[0295] The stability cradle recession area **1505** is located in the midfoot and heel areas of the bottom surface of base **1502**. The stability cradle recession area **1505** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **1507** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **1506** is shaped essentially the same as stability cradle recession area **1505** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1505**.

[0296] Stability cradle **1506** has walls that wrap up the sides and rear of base **1502** to provide support for the foot. Preferably, stability cradle **1506** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1506** are preferably higher on the medial side of the foot because of the higher loading. Preferably, stability cradle **1506** is made of a nylon material with a hardness of approximately Shore A 95. In a preferred embodiment, the stability cradle is semi-rigid. In an alternate embodiment, the stability cradle is rigid.

[0297] Preferably, the shoe facing surface of stability cradle **1506** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear to other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0298] The stability cradle **1506** preferably defines one or more rib-shaped openings **1531**. In a preferred embodiment, the rib-shaped openings **1531** allow said ribs **1532** of base **1502** to extend therethrough. Preferably, base **1502** is molded so that the ribs **1532** project into rib-shaped openings **1531** so that the ribs **1532** are approximately flush with the outer surface of stability cradle **1506** and mechanically lock stability cradle **1506** and base **1502** together. Advantageously, the ribs **1532** are also able to bulge through rib-shaped openings **1531** when base **1502** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **1532** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **1531** allow the stability cradle **1506** to be more flexible in the arch area compared to the rest of the stability cradle **1506**.

[0299] In an alternate embodiment, stability cradle **1506** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0300] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0301] Stability cradle **1506** defines a lateral midfoot pod opening **1511** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The

length of the lateral midfoot pod opening **1511** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod **1512** is shaped essentially the same as lateral midfoot pod opening **1511** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral midfoot pod opening **1511** and allows lateral midfoot pod **1512** to extend out through said lateral midfoot pod opening **1511**.

[0302] Lateral midfoot pod **1512** is preferably made from TPR or PU of a hardness of about 45-50 ASKER C. If TPR is used, a fabric is in turn secured to the base **1502** in the lateral midfoot pod opening **1511** of said base **1502**. The fabric component allows the TPR to properly adhere to the base **1502**.

[0303] Stability cradle **1506** also defines a lateral heel pod opening **1513** that extends through the lateral side of the heel area of stability cradle **1506** from approximately rearward of the lateral midfoot pod opening **1511** toward the heel end. Lateral heel pod **1514** is shaped essentially the same as lateral heel pod opening **1513** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral heel pod opening **1513** and allows lateral heel pod **1514** to extend out through said lateral heel pod opening **1513**. Lateral heel pod **1514** has a lateral edge which extends along the lateral border of insole **1500** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **1514** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0304] The configuration, material and position of the lateral heel pod **1514** provides cushioning and works in association with the medial heel pod **1515** to stabilize the ankle. The hardness of the lateral heel pod is preferably essentially the same as the lateral midfoot pod, which work in concert to help reduce the incidence of lateral ankle roll-overs. It is preferably made of TPR or PU of a hardness of about Shore C 45-50. If TPR is used, a fabric is in turn secured to the base **1502** in the lateral heel pod opening **1511** of said base **1502**. The fabric component allows the TPR to properly adhere to the base **1502**.

[0305] Stability cradle **1506** defines a medial heel pod opening **1515** that extends through the heel area along the medial side of heel area on the bottom surface of base **1502** just short of the heel end. Medial heel pod **1516** is shaped essentially the same as medial heel pod opening **1515** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the medial heel pod opening **1515** and allows medial heel pod **1516** to extend out through said medial heel pod opening **1515**. The medial heel pod **1516** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0306] Medial heel pod **1516** is preferably made from TPR or PU of a hardness of about 60 ASKER C±3. If TPR is used, a fabric is in turn secured to the base **1502** in the medial heel pod opening **1515** of said base **1502**. The fabric component allows the TPR to properly adhere to the base **1502**.

[0307] 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. To cushion the impact, lateral heel pod **1514** is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle **1506**. Preferably, lateral heel pod **1514** is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0308] 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 results in injury.

[0309] Stability cradle **1506** provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod **1516** helps to control the rate of pronation by forming medial heel pod **1516** out of a material having different characteristics than lateral heel pod **1514**. For example, to reduce a pronation rate, medial heel pod **1516** can be made from a firmer material than lateral heel pod **1514**. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod **1516** made from a firmer material would compress less than a lateral heel pod **1514** made of a softer material. As a result, medial heel pod **1516** tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod **1516** from a softer material than lateral heel pod **1514** would tend to increase the amount and rate of pronation.

[0310] Preferably, the firmness of the material used in medial heel pod **1516** is selected based on the firmness of lateral heel pod **1514** and on the type of intended activity. For example, the firmness of lateral heel pod **1514** and medial heel pod **1516** differs by about 20-30% for an insole to be used during light to moderate activities.

[0311] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel pod **1516** can be made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0312] Lateral midfoot pod **1512** provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod **1512** is formed of a material having the same properties, e.g., firmness, as lateral heel pod **1514**. However, a material having different characteristics can also be used.

[0313] The use of dual density heel pods is employed to cause a kinetic change in foot function to promote ankle stability. It is also not out of the scope of the invention to have the medial heel pod softer than the lateral heel pod and/or lateral midfoot pod or any combination thereof to address different joint moments or ankle rolls.

[0314] 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 **1508** is located under this part of the foot. Preferably, forefoot pad **1508** is

formed of a relatively resilient material so that energy put into compressing forefoot pad **1508** is returned to help propel the foot at toe-off.

[0315] 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 medial portion of forefoot pad **1508** extends rearward into a corresponding concave edge portion of the distal edge of stability cradle **1506**. The shape of the stability cradle **1506** and forefoot pad **1508** permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

[0316] Base **1502** is preferably made of foam or other material having suitable cushioning properties. Preferably, base **1502** comprises an Ethylene vinyl acetate ("EVA") foam, which is a copolymer of ethylene and vinyl acetate, or a Thermoplastic Rubber ("TPR")/EVA mix. A preferred EVA or TPR/EVA mix has a durometer (hardness) of about Asker C 45-50.

[0317] Forefoot pad **1508** is preferably made from a Thermoplastic Rubber ("TPR") or Polyurethane ("PU"). The hardness of the TPR or PU used in the forefoot pad is preferably about 30 Asker C±3.

[0318] The forefoot pad **1520**, lateral midfoot pod **1521**, lateral heel pod **1522**, and medial heel pod **1523** are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern **1520** is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns **1521** and **1522** are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern **1523** is approximately 1.00 to 2.50 mm deep. Preferably the TPR pods have the deeper criss-cross groove pattern and the PU pods have the shallower criss-cross groove pattern due to the compression characteristics of the materials. The criss-cross groove patterns also assists with keeping the insole in place and not move or slide around within the shoe.

[0319] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0320] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the open-cell designs will provide for a lighter insole.

[0321] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base **1502** in the recession areas defined by base **1502** on the bottom surface are permanently affixed to base **1502** 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.

[0322] The recession areas also is lined with a cloth having a base surface and a pad/pod surface, secured to said base along said base surface and said pad/pod along said pad/pod surface. Alternatively, a cloth is secured to pad/pod and then the composite structure secured to the recession area.

[0323] Some shoes may slightly differ in size on the inner part of the shoe. Some shoes may also provide extra padding along the inner sides, front or back of the shoe that alter the actual space provided for the foot and/or an insole on the inner part of the shoe. Base **1502** may have sizing guides **1550** that allow a user to shorten the length of the insole for proper fit within the shoe, sizing guides **1550** provide various cutting guide lines that the user would cut along, preferably with scissors.

[0324] FIG. **15**B-**3** illustrates a lateral side view of the insole. Insole **1500** preferably comprises a top sheet **1501** and a base **1502** having a top surface secured to said top sheet **1501** and an opposite bottom surface. Base **1502** also defines a longitudinal arch support **1519** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0325] The bottom surface of base **1502** defines a forefoot pad recession area in the forefoot area and a stability cradle recession area **1505** along the midfoot and heel areas.

[0326] Base **1502** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. The height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0327] The forefoot pad recession area begins partially proximal from the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area has a rear apex that lies between the 1st and 2nd metatarsals. A forefoot pad is shaped essentially the same as forefoot pad recession area and is secured therein.

[0328] The stability cradle recession area **1505** is located in the midfoot and heel areas of the bottom surface of base **1502**. The stability cradle recession area **1505** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **1507** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **1506** is shaped essentially the same as stability cradle recession area **1505** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1505**.

[0329] Stability cradle **1506** has walls that wrap up the sides and rear of base **1502** to provide support for the foot. Preferably, stability cradle **1506** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1506** are preferably higher on the medial side of the foot because of the higher loading.

[0330] Preferably, the shoe facing surface of stability cradle **1506** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe.

Swapping shoes and running gear to other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0331] Stability cradle **1506** defines a lateral midfoot pod opening that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. A lateral midfoot pod **1512** is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod **1512** to extend out through said lateral midfoot pod opening.

[0332] Stability cradle **1506** also defines a lateral heel pod opening that extends through the lateral side of the heel area of stability cradle **1506** from approximately rearward of the lateral midfoot pod opening toward the heel end. Lateral heel pod **1514** is shaped essentially the same as lateral heel pod opening and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral heel pod opening and allows lateral heel pod **1514** to extend out through said lateral heel pod opening.

[0333] Stability cradle **1506** defines a medial heel pod opening that extends through the heel area along the medial side of heel area on the bottom surface of base **1502** just short of the heel end. Medial heel pod is shaped essentially the same as medial heel pod opening and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the medial heel pod opening and allows medial heel pod to extend out through said medial heel pod opening.

[0334] In a preferred embodiment, base **1502** is covered with top sheet **1501**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1501** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0335] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **1538** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1538** pushes up a portion of the top sheet **1501** that corresponds to the area of the transverse arch support **1538**.

[0336] Traverse arch support **1538** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1538** provides additional stability and cushioning to the forefoot and middle of the foot.

[0337] FIG. **15A-1** is a top view of the insole illustrating the top sheet **1501** and transverse arch support **1538**. Insole **1500** comprises a top sheet **1501** secured across the entire top surface of the base from toe area to heel area. Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **1538** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1538** pushes up a portion of the top sheet **1501** that corresponds to the area of the transverse arch support **1538**.

[0338] Traverse arch support **1538** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1538** provides additional stability and cushioning to the forefoot and middle of the foot.

[0339] In a preferred embodiment, top sheet **1501** is a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1501** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi. A series of air holes extend through top sheet **1501** and the base to permit air circulation above and below insole **1500**.

[0340] FIG. **15B-5** is a section view **15B-5** along the middle of the insole as identified in FIGS. **15B-2**. Insole **1500** preferably comprises a top sheet **1501** and a base **1502** having a top surface secured to said top sheet **1501** and an opposite bottom surface. The bottom surface of base **1502** defines a forefoot pad recession area **1507** in the forefoot area and a stability cradle recession area **1505** along the midfoot and heel areas.

[0341] Base **1502** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. As best seen in FIGS. **15B-6** to **15B-10**, the height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0342] Preferably, the top surface of the base **1502** defines an upwardly-extending portion or transverse arch support **1538** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1538** pushes up a portion of the top sheet **1501** that corresponds to the area of the transverse arch support **1538**. Traverse arch support **1538** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1538** provides additional stability and cushioning to the forefoot and middle of the foot.

[0343] The forefoot pad recession area **1507** begins partially proximal form the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area **1507** extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area **1507** has a rear apex that lies between the 1st and 2nd metatarsals.

[0344] Forefoot pad **1508** is shaped essentially the same as forefoot pad recession area **1507** and is secured therein. Forefoot pad **1508** has a medial edge, a lateral edge, a proximal (back) edge and a distal (front) edge. The medial edge of forefoot pad **1508** 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 **1557**, laterally and distally towards the 3rd metatarsal head, then laterally and proximally to the lateral edge approximately along the 3rd through 5th metatarsal heads. The lateral edge connects said proximal edge to said top edge of said forefoot pad. In use, forefoot pad recession area **1507** and forefoot pad **1508** underlie 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. FIG. **11** shows the placement of foot bones on the insole.

[0345] An adhesive is be used to secure the components. The forefoot pad **1508** 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.

[0346] It is estimated that using tougher materials increases the durability of the insole by 35% to 65% over insoles that use softer materials for this portion of the foot insole.

[0347] The stability cradle recession area **1505** is located in the midfoot and heel areas of the bottom surface of base **1502**. The stability cradle recession area **1505** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **1507** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **1506** is shaped essentially the same as stability cradle recession area **1505** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1505**.

[0348] Stability cradle **1506** has walls that wrap up the sides and rear of base **1502** to provide support for the foot.

[0349] Preferably, the shoe facing surface of stability cradle **1506** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear with other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0350] Stability cradle **1506** defines a lateral midfoot pod opening that extends from the behind the 3rd through 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod to extend out through said lateral midfoot pod opening.

[0351] Stability cradle **1506** also defines a lateral heel pod opening **1513** that extends through the lateral side of the heel area of stability cradle **1506** from approximately rearward of the lateral midfoot pod opening **1511** toward the heel end. Lateral heel pod **1514** is shaped essentially the same as lateral heel pod opening **1513** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral heel pod opening **1513** and allows lateral heel pod **1514** to extend out through said lateral heel pod opening **1513**. Lateral heel pod **1514** has a lateral edge which extends along the lateral border of insole **1500** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **1514** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0352] The configuration, material and position of the lateral heel pod **1514** provides cushioning and works in association with the medial heel pod **1515** to stabilize the ankle.

[0353] Stability cradle **1506** defines a medial heel pod opening **1515** that extends through the heel area along the medial side of heel area on the bottom surface of base **1502** just short of the heel end. Medial heel pod **1516** is shaped essentially the same as medial heel pod opening **1515** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the medial heel pod opening **1515** and allows medial heel pod **1516** to extend out through said medial heel pod opening **1515**. The medial heel pod **1516** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0354] 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. To cushion the impact, lateral heel pod **1514** is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle **1506**. Preferably, lateral heel pod **1514** is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0355] 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 results in injury.

[0356] Stability cradle **1506** provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod **1516** helps to control the rate of pronation by forming medial heel pod **1516** out of a material having different characteristics than lateral heel pod **1514**. For example, to reduce a pronation rate, medial heel pod **1516** is made from a firmer material than lateral heel pod **1514**. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod **1516** made from a firmer material would compress less than a lateral heel pod **1514** made of a softer material. As a result, medial heel pod **1516** tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod **1516** from a softer material than lateral heel pod **1514** would tend to increase the amount and rate of pronation.

[0357] Preferably, the firmness of the material used in medial heel pod **1516** is selected based on the firmness of lateral heel pod **1514** and on the type of intended activity. For example, the firmness of lateral heel pod **1514** and medial heel pod **1516** differs by about 20-30% for an insole to be used during light to moderate activities.

[0358] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation

during and following heel strike. Accordingly, medial heel pod **1516** is made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0359] Lateral midfoot pod **1512** provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod is formed of a material having the same properties, e.g., firmness, as lateral heel pod **1514**. However, a material having different characteristics may also be used.

[0360] The use of dual density heel pods is employed to cause a kinetic change in foot function to promote ankle stability. It is also not out of the scope of the invention to have the medial heel pod softer than the lateral heel pod and/or lateral midfoot pod or any combination thereof to address different joint moments or ankle rolls.

[0361] 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 **1508** is located under this part of the foot. Preferably, forefoot pad **1508** is formed of a relatively resilient material so that energy put into compressing forefoot pad **1508** is returned to help propel the foot at toe-off.

[0362] 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 medial portion of forefoot pad **1508** extends rearward into a corresponding concave edge portion of the distal edge of stability cradle **1506**. The shape of the stability cradle **1506** and forefoot pad **1508** permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

[0363] The forefoot pad **120**, lateral midfoot pod **121**, lateral heel pod **122**, and medial heel pod **123** are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern **1520** is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern **1523** is approximately 1.00 to 2.50 mm deep.

[0364] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0365] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the criss-cross groove pattern designs will help provide a lighter insole.

[0366] In a preferred embodiment, base **1502** is covered with top sheet **1501**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1501** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0367] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base **1502** in the recession areas defined by base **1502** on the bottom surface are permanently affixed to base **1502** using an appropriate means such as an adhesive. The components also be secured during the molding process using techniques known in the art of molding insoles.

[0368] The recession areas are also be lined with a cloth having a base surface and a pad/pod surface, secured to said base along said base surface and said pad/pod along said pad/pod surface. Alternatively, a cloth is secured to pad/pod and then the composite structure secured to the recession area.

[0369] FIG. **15**B-**6** illustrates a rear view of the insole. Insole **1500** preferably comprises a top sheet **1501** and a base **1502** having a top surface secured to said top sheet and an opposite bottom surface. Base **1502** also defines a longitudinal arch support **1519** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0370] The bottom surface of base **1502** defines a forefoot pad recession area in the forefoot area and a stability cradle recession area **1505** along the midfoot and heel areas. The bottom surface of base **1502** also define one or more ribs or protrusions **1532** that extend outwardly along the arch area. The ribs **1532** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. An alternate embodiment has the ribs or protrusions defined by the stability cradle **1506** and extending outwardly from the stability cradle **1506** in the arch area.

[0371] Base **1502** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. The height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0372] The forefoot pad recession area begins partially proximal from the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area has a rear apex that lies between the 1st and 2nd metatarsals. A forefoot pad is shaped essentially the same as forefoot pad recession area and is secured therein.

[0373] The stability cradle recession area **1505** is located in the midfoot and heel areas of the bottom surface of base **1502**. The stability cradle recession area **1505** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **1506** is shaped essentially the same as stability cradle recession area **1505** and has a base facing surface and a shoe

facing surface. The base facing surface is secured to said stability cradle recession area **1505**.

[0374] Stability cradle **1506** has walls that wrap up the sides and rear of base **1502** to provide support for the foot. Preferably, stability cradle **1506** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1506** are preferably higher on the medial side of the foot because of the higher loading.

[0375] Preferably, the shoe facing surface of stability cradle **1506** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear with other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0376] The stability cradle **1506** preferably defines one or more rib-shaped openings **1531**. In a preferred embodiment, the rib-shaped openings **1531** allow said ribs **1532** of base **1502** to extend therethrough. Preferably, base **1502** is molded so that the ribs **1532** project into rib-shaped openings **1531** so that the ribs **1532** are approximately flush with the outer surface of stability cradle **1506** and mechanically lock stability cradle **1506** and base **1502** together. Advantageously, the ribs **1532** are also able to bulge through rib-shaped openings **1531** when base **1502** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **1532** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **1531** allow the stability cradle **1506** to be more flexible in the arch area compared to the rest of the stability cradle **1506**.

[0377] In an alternate embodiment, stability cradle **1506** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0378] Stability cradle **1506** defines a lateral midfoot pod opening that extends from the behind the 3^{rd} though 5^{th} metatarsal heads proximally to the back of the cuboid. A lateral midfoot pod is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod to extend out through said lateral midfoot pod opening.

[0379] Stability cradle **1506** also defines a lateral heel pod opening that extends through the lateral side of the heel area of stability cradle **1506** from approximately rearward of the lateral midfoot pod opening toward the heel end. Lateral heel pod **1514** is shaped essentially the same as lateral heel pod opening and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral heel pod opening and allows lateral heel pod **1514** to extend out through said lateral heel pod opening.

[0380] Stability cradle **1506** defines a medial heel pod opening that extends through the heel area along the medial side of heel area on the bottom surface of base **1502** just short of the heel end. Medial heel pod **1516** is shaped essentially the same as medial heel pod opening and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the medial heel pod opening and allows medial heel pod **1516** to extend out through said medial heel pod opening.

[0381] In a preferred embodiment, base **1502** is covered with top sheet **1501**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1501** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi. Preferably the forefoot pad recession area **1507** has a rear apex that lies between the 1st and 2nd metatarsals.

[0382] FIG. **15**B-**7** illustrates a cross section **15**B-**7** as identified in FIGS. **15**B-**2**. Insole **1500** preferably comprises a top sheet **1501** and a base **1502** having a top surface secured to said top sheet **1501** and an opposite bottom surface. The bottom surface of base **1502** defines a forefoot pad recession area and a stability cradle recession area.

[0383] The stability cradle recession area **1505** is located in the midfoot and heel areas of the bottom surface of base **1502**. The stability cradle recession area **1505** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **1526** is shaped essentially the same as stability cradle recession area **1505** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1505**. Stability cradle **1506** has walls that wrap up the sides and rear of base **1502** to provide support for the foot.

[0384] Preferably, the shoe facing surface of stability cradle **1506** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use.

[0385] Stability cradle **1506** also defines a lateral heel pod opening **1513** that extends through the lateral side of the heel area of stability cradle **1506** from approximately rearward of the lateral midfoot pod opening **1511** toward the heel end. Lateral heel pod **1514** is shaped essentially the same as lateral heel pod opening **1513** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral heel pod opening **1513** and allows lateral heel pod **1514** to extend out through said lateral heel pod opening **1513**. Lateral heel pod **1514** has a lateral edge which extends along the lateral border of insole **1500** from said heel end to a lateral heel edge spaced apart

from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **1514** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0386] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0387] Stability cradle **1506** defines a medial heel pod opening **1515** that extends through the heel area along the medial side of heel area on the bottom surface of base **1502** just short of the heel end. Medial heel pod **1516** is shaped essentially the same as medial heel pod opening **1515** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the medial heel pod opening **1515** and allows medial heel pod **1516** to extend out through said medial heel pod opening **1515**. The medial heel pod **1516** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0388] In a preferred embodiment, base **1502** is covered with top sheet **1501**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1501** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0389] FIGS. **15**B-**9** and **15**B-**8** illustrates a cross section **15**B-**9** and **15**B-**8**, respectively, as identified in FIGS. **15**B-**2**. Insole **1500** preferably comprises a top sheet **1501** and a base **1502** having a top surface secured to said top sheet **1501** and an opposite bottom surface. The bottom surface of base **1502** defines a forefoot pad recession area and a stability cradle recession area.

[0390] The stability cradle recession area **1505** is located in the midfoot and heel areas of the bottom surface of base **1502**. The stability cradle recession area **1505** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **1516** is shaped essentially the same as stability cradle recession area **1505** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1505**. Stability cradle **1506** has walls that wrap up the sides and rear of base **1502** to provide support for the foot.

[0391] Preferably, the shoe facing surface of stability cradle **1506** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use.

[0392] The stability cradle **1506** preferably defines one or more rib-shaped openings **1531**. In a preferred embodiment, the rib-shaped openings **1531** allow said ribs **1532** of base **1502** to extend therethrough. Preferably, base **1502** is molded so that the ribs **1532** project into rib-shaped openings **1531** so that the ribs **1532** are approximately flush with the outer surface of stability cradle **1506** and mechanically lock stability cradle **1506** and base **1502** together. Advantageously, the ribs **1532** are also able to bulge through rib-shaped openings **1531** when base **1502** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **1532** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **1531** allow the stability cradle **1506** to be more flexible in the arch area compared to the rest of the stability cradle **1506**.

[0393] In an alternate embodiment, stability cradle **1506** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0394] Stability cradle **1506** defines a lateral midfoot pod opening **1511** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening **1511** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod **1512** is shaped essentially the same as lateral midfoot pod opening **1511** and is secured to the bottom surface of base **1502** within the stability cradle recession area in a location that correlates to the lateral midfoot pod opening **1511** and allows lateral midfoot pod **1512** to extend out through said lateral midfoot pod opening **1511**.

[0395] In a preferred embodiment, base **1502** is covered with top sheet **1501**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1501** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0396] FIG. **15**B-**10** illustrates a cross section **15**B-**10** as identified in FIGS. **15**B-**2**. Insole **1500** preferably comprises a top sheet **1501** and a base **1502** having a top surface secured to said top sheet **1501** and an opposite bottom surface. The bottom surface of base **1502** defines a forefoot pad recession area and a stability cradle recession area.

[0397] The stability cradle recession area **1505** is located in the midfoot and heel areas of the bottom surface of base **1502**. The stability cradle recession area **1505** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial

portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **1506** is shaped essentially the same as stability cradle recession area **1505** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1505**.

[0398] Preferably, the shoe facing surface of stability cradle **1506** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use.

[0399] In a preferred embodiment, base **1502** is covered with top sheet **1501**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1501** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0400] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **1538** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1538** pushes up a portion of the top sheet **1501** that corresponds to the area of the transverse arch support **1538**.

[0401] Traverse arch support **1538** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1538** provides additional stability to the forefoot and middle of the foot.

[0402] FIG. **15**C-**1** to **15**C-**8** shows a medial side, bottom, lateral side, back, and four cross-section views of the stability cradle.

[0403] FIGS. **15**C-**1** to **15**C-**8** medial side, bottom, lateral side, back and four cross section views of a stability cradle **1506**. A stability cradle recession area is located in the midfoot and heel areas of the bottom surface of a base. The stability cradle recession area extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of a forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **1506** is shaped essentially the same as the stability cradle recession area and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area.

[0404] Stability cradle **1506** has walls that wrap up the sides and rear of the base to provide support for the foot. Preferably, stability cradle **1506** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1506** are preferably higher on the medial side of the foot because of the higher loading. Preferably, stability cradle **1506** is made of a nylon material with a hardness of approximately Shore A 95. In a preferred embodiment, the stability cradle is semi-rigid. In an alternate embodiment, the stability cradle is rigid.

[0405] Preferably, the shoe facing surface of stability cradle **1506** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear to other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0406] The stability cradle **1506** preferably defines one or more rib-shaped openings **1531**. In a preferred embodiment, the rib-shaped openings **1531** allow ribs on the base to extend therethrough. Advantageously, the ribs are also able to bulge through rib-shaped openings **1531** when base is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. The rib-shaped openings **1531** allow the stability cradle **1506** to be more flexible in the arch area compared to the rest of the stability cradle **1506**.

[0407] Stability cradle **1506** defines a lateral midfoot pod opening **1511** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening **1511** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. The lateral midfoot pod opening **1511** is designed to allow a lateral midfoot pod to extend there through.

[0408] Stability cradle **1506** also defines a lateral heel pod opening **1513** that extends through the lateral side of the heel area of stability cradle **1506** from approximately rearward of the lateral midfoot pod opening **1511** toward the heel end. Lateral heel pod opening **1513** has a lateral edge which extends along the lateral border of insole from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod opening **1511**. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod opening **1513** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines. Lateral heel pod opening **1513** is designed to allow a lateral heel pod to extend there through.

[0409] Medial heel pod opening **1515** extends through the heel area along the medial side of heel area on the bottom surface of base **1502** just short of the heel end. The medial heel pod opening **1515** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod opening. Medial heel pod opening **1515** is designed to allow a medial heel pod to extend there through.

[0410] Stability cradle **1506** provides firm support along the medial portion of the foot to help control the amount of pronation.

[0411] FIG. **15**D-**1** to **15**D-**5** shows a medial side, bottom, lateral side, prospective and a cross-section of the insole pads **1512**, **1514** and **1516**.

[0412] FIG. **15**D-**1** to **15**D-**5** show a medial side, bottom, lateral side, prospective and one cross-section view of the insole pads **1512**, **1514** and **1516**. Stability cradle **1506** also defines a lateral heel pod opening **1513** that extends through the lateral side of the heel area of stability cradle **1506** from approximately rearward of the lateral midfoot pod opening

1511 toward the heel end. Lateral heel pod **1514** is shaped essentially the same as lateral heel pod opening **1513** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the lateral heel pod opening **1513** and allows lateral heel pod **1514** to extend out through said lateral heel pod opening **1513**. Lateral heel pod **1514** has a lateral edge which extends along the lateral border of insole **1500** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **1514** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0413] The configuration, material and position of the lateral heel pod **1514** provides cushioning and works in association with the medial heel pod **1515** to stabilize the ankle. The hardness of the lateral heel pod is preferably essentially the same as the lateral midfoot pod, which work in concert to help reduce the incidence of lateral ankle roll-overs. It is preferably made of TPR or PU of a hardness of about Shore C 45-50. If TPR is used, a fabric is in turn secured to the base **102** in the lateral heel pod opening **1513** of said base **1502**. The fabric component allows the TPR to properly adhere to the base **1502**.

[0414] Stability cradle **1506** defines a medial heel pod opening **1515** that extends through the heel area along the medial side of heel area on the bottom surface of base **1502** just short of the heel end. Medial heel pod **1516** is shaped essentially the same as medial heel pod opening **1515** and is secured to the bottom surface of base **1502** within the stability cradle recession area **1505** in a location that correlates to the medial heel pod opening **1515** and allows medial heel pod **1516** to extend out through said medial heel pod opening **1515**. The medial heel pod **1516** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0415] Medial heel pod **1516** is preferably made from TPR or PU of a hardness of about 60 ASKER C±3. If TPR is used, a fabric is in turn secured to the base **1502** in the medial heel pod opening **1515** of said base **1502**. The fabric component allows the TPR to properly adhere to the base **1502**.

[0416] 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. To cushion the impact, lateral heel pod **1514** is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle **1506**. Preferably, lateral heel pod **1514** is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0417] 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.

[0418] Stability cradle **1506** provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod **1516** helps to control the rate of pronation by forming medial heel pod **1516** out of a material having different characteristics than lateral heel pod **1514**. For example, to reduce a pronation rate, medial heel pod **1516** is made from a firmer material than lateral heel pod **1514**. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod **1516** made from a firmer material would compress less than a lateral heel pod **1514** made of a softer material. As a result, medial heel pod **1516** tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod **1516** from a softer material than lateral heel pod **1514** would tend to increase the amount and rate of pronation.

[0419] Preferably, the firmness of the material used in medial heel pod **1516** is selected based on the firmness of lateral heel pod **1514** and on the type of intended activity. For example, the firmness of lateral heel pod **1514** and medial heel pod **1516** differs by about 20-30% for an insole to be used during light to moderate activities.

[0420] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel pod **1516** is made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0421] Lateral midfoot pod **1512** provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod **1512** is formed of a material having the same properties, e.g., firmness, as lateral heel pod **1514**. However, a material having different characteristics may also be used.

[0422] FIG. **15**E-**1** to **15**E-**4** shows a medial side, bottom, cross section prospective view of the forefoot pad.

[0423] FIGS. **15**E-**1** to **15**E-**4** show a medial side, bottom, cross-section and prospective view of the forefoot pad **1508**. Forefoot pad **108** is preferably made from a Thermoplastic Rubber ("TPR") or Polyurethane ("PU"). The hardness of the TPR or PU used in the forefoot pad is preferably about 30 Asker C±3. The forefoot pad **1520**, lateral midfoot pod **1521**, lateral heel pod **1522**, and medial heel pod **1523** are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties of each pod and pad. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern **1520** is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns **1521** and **1522** are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern **1523** is approximately 1.00 to 2.50 mm deep. Preferably the TPR pods have the deeper criss-cross groove pattern and the PU pods have the shallower criss-cross groove pattern due to the compression characteristics of the materials. The criss-cross groove patterns assists with securing the insole in the shoe cavity and keeping the insole in place such that it will not move or slide around. The criss-cross groove pattern also allows for air circulation and/or provides different cushioning and spring properties.

[0424] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0425] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the criss-cross groove pattern designs will help provide a lighter insole.

[0426] In a preferred embodiment, base **1502** is covered with top sheet **1501** from toe to heel areas of the insole, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1501** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0427] Insole preferably comprises a top sheet and a base having a top surface secured to said top sheet and an opposite bottom surface. Base also defines a longitudinal arch support that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0428] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support that lies under the metatarsal head area of the foot. The upward extension of transverse arch support pushes up a portion of the top sheet that corresponds to the area of the transverse arch support.

[0429] The bottom surface of base defines a forefoot pad recession area in the forefoot area and a stability cradle recession area along the midfoot and heel areas. The bottom surface of base also defines one or more ribs or protrusions that extend outwardly along the arch area. The ribs are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. An alternate embodiment has the ribs or protrusions defined by the stability cradle and extending outwardly from the stability cradle in the arch area.

[0430] Base has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. The height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0431] The forefoot pad recession area begins partially proximal from the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area has a rear apex that lies between the 1st and 2nd metatarsals.

[0432] Forefoot pad is shaped essentially the same as forefoot pad recession area and is secured therein. Forefoot pad has a medial edge, a lateral edge, a proximal (back) edge and a distal (front) edge. The medial edge of forefoot pad 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. The lateral edge connects said proximal edge to said top edge of said forefoot pad. In use, forefoot pad recession area and forefoot pad underlie 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.

[0433] An adhesive is be used to secure the components. The forefoot pad 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.

[0434] The stability cradle recession area is located in the midfoot and heel areas of the bottom surface of base. The stability cradle recession area extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle is shaped essentially the same as stability cradle recession area and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area.

[0435] Stability cradle has walls that wrap up the sides and rear of base to provide support for the foot. Preferably, stability cradle ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle are preferably higher on the medial side of the foot because of the higher loading. Preferably, stability cradle is made of a nylon material with a hardness of approximately Shore A 95. In a preferred embodiment, the stability cradle is semi-rigid. In an alternate embodiment, the stability cradle is rigid.

[0436] Preferably, the shoe facing surface of stability cradle has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping and "change-over" of shoes and running gear to other footwear, or vice versa is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0437] The stability cradle preferably defines one or more rib-shaped openings. In a preferred embodiment, the rib-shaped openings allow said ribs of base to extend therethrough. Preferably, base is molded so that the ribs project into rib-shaped openings so that the ribs are approximately flush with the outer surface of stability cradle and mechanically lock stability cradle and base together. Advantageously, the ribs are also able to bulge through rib-shaped openings when base is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm.

The rib-shaped openings allow the stability cradle to be more flexible in the arch area compared to the rest of the stability cradle.

[0438] In an alternate embodiment, stability cradle defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0439] Stability cradle **1506** defines a lateral midfoot pod opening that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base within the stability cradle recession area in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod to extend out through said lateral midfoot pod opening.

[0440] Lateral midfoot pod is preferably made from TPR or PU of a hardness of about 45-50 ASKER C. If TPR is used, a fabric is in turn secured to the base in the lateral midfoot pod opening of said base. The fabric component allows the TPR to properly adhere to the base.

[0441] Stability cradle also defines a lateral heel pod opening that extends through the lateral side of the heel area of stability cradle from approximately rearward of the lateral midfoot pod opening toward the heel end. Lateral heel pod is shaped essentially the same as lateral heel pod opening and is secured to the bottom surface of base within the stability cradle recession area in a location that correlates to the lateral heel pod opening and allows lateral heel pod to extend out through said lateral heel pod opening. Lateral heel pod has a lateral edge which extends along the lateral border of insole from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0442] The configuration, material and position of the lateral heel pod provides cushioning and works in association with the medial heel pod to stabilize the ankle. The hardness of the lateral heel pod is preferably essentially the same as the lateral midfoot pod, which work in concert to help reduce the incidence of lateral ankle roll-overs. It is preferably made of TPR or PU of a hardness of about Shore C 45-50. If TPR is used, a fabric is in turn secured to the base in the lateral heel pod opening of said base. The fabric component allows the TPR to properly adhere to the base.

[0443] Stability cradle defines a medial heel pod opening that extends through the heel area along the medial side of heel area on the bottom surface of base just short of the heel end. Medial heel pod is shaped essentially the same as medial heel pod opening and is secured to the bottom surface of base **102** within the stability cradle recession area in a location that correlates to the medial heel pod opening and allows medial heel pod to extend out through said medial heel pod opening. The medial heel pod has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0444] Medial heel pod is preferably made from TPR or PU of a hardness of about 60 ASKER C±3. If TPR is used, a fabric is in turn secured to the base in the medial heel pod opening of said base. The fabric component allows the TPR to properly adhere to the base.

[0445] 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. To cushion the impact, lateral heel pod is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle. Preferably, lateral heel pod is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0446] 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.

[0447] Stability cradle provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod helps to control the rate of pronation by forming medial heel pod out of a material having different characteristics than lateral heel pod. For example, to reduce a pronation rate, medial heel pod is made from a firmer material than lateral heel pod. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod made from a firmer material would compress less than a lateral heel pod made of a softer material. As a result, medial heel pod tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod from a softer material than lateral heel pod would tend to increase the amount and rate of pronation.

[0448] Preferably, the firmness of the material used in medial heel pod is selected based on the firmness of lateral heel pod and on the type of intended activity. For example, the firmness of lateral heel pod and medial heel pod differs by about 20-30% for an insole to be used during light to moderate activities.

[0449] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel pod is made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0450] Lateral midfoot pod provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod is formed of a material having the same properties, e.g., firmness, as lateral heel pod. However, a material having different characteristics may also be used.

[0451] The use of dual density heel pods is employed to cause a kinetic change in foot function to promote ankle stability. It is also not out of the scope of the invention to have the medial heel pod softer than the lateral heel pod and/or lateral midfoot pod or any combination thereof to address different joint moments or ankle rolls.

[0452] 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 is located under this part of the foot. Preferably, forefoot pad is formed of a relatively resilient material so that energy put into compressing forefoot pad is returned to help propel the foot at toe-off.

[0453] 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 medial portion of forefoot pad extends rearward into a corresponding concave edge portion of the distal edge of stability cradle. The shape of the stability cradle and forefoot pad permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

[0454] Base is preferably made of foam or other material having suitable cushioning properties. Preferably, base comprises an Ethylene vinyl acetate ("EVA") foam, which is a copolymer of ethylene and vinyl acetate, or a Thermoplastic Rubber ("TPR")/EVA mix. A preferred EVA or TPR/EVA mix has a durometer (hardness) of about Asker C 45-50.

[0455] Forefoot pad is preferably made from a Thermoplastic Rubber ("TPR") or Polyurethane ("PU"). The hardness of the TPR or PU used in the forefoot pad is preferably about 30 Asker C±3.

[0456] The forefoot pad, lateral midfoot pod, lateral heel pod, and medial heel pod are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces a friction fit and air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties of each pod and pad. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns and are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern is approximately 1.00 to 2.50 mm deep. Preferably the TPR pods have the deeper criss-cross groove pattern and the PU pods have the shallower criss-cross groove pattern due to the compression characteristics of the materials. The criss-cross groove patterns assists with securing the insole in the shoe cavity and keeping the insole in place such that it will not move or slide around The criss-cross groove pattern also allows for air circulation and/or provides different cushioning and spring properties.

[0457] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0458] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the criss-cross groove pattern designs will help provide a lighter insole.

[0459] In a preferred embodiment, base is covered with top sheet from toe to heel areas of the insole, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0460] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base in the recession areas defined by base on the bottom surface are permanently affixed to base using an appropriate means such as an adhesive. The components are also secured during the molding process using techniques known in the art of molding insoles.

[0461] The recession areas can also be lined with a cloth having a base surface and a pad/pod surface, secured to said base along said base surface and said pad/pod along said pad/pod surface. Alternatively, a cloth is secured to pad/pod and then the composite structure secured to the recession area.

[0462] Some shoes may slightly differ in size on the inner part of the shoe or provide extra padding along the inner walls that alter the space provided on the inner part of the shoe. Base may have sizing guides that allow a user to shorten the length of the insole for proper fit within the shoe, sizing guides provide various cutting guide lines that the user would cut along, preferably with scissors.

[0463] The dimensions and measurements shown in FIGS. **15**A-**15**E are dimensions and measurements of a preferred embodiment which are incorporated herein.

[0464] FIGS. **16**A-**16**D illustrate the preferred embodiment or an insole for triathlon training. FIG. **16**A-**1** to **16**A-**10** shows the top, bottom, medial side, lateral side, back, and five cross-section views of the insole. The current invention is an insole that incorporates, but is not limited to: (1) a faceted stability cradle with a plurality of stability ribs, (2) plurality of pods, (3) a forefoot pad (4) criss-cross groove patterns on the bottom surface of the pods and forefoot pads, and (5) a jadeite cooling top cloth. In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe. 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 insole movement or sliding during shoe operation and change-overs, and (4) provide enhanced cushioning features to the heel, midfoot, arch and forefoot during running and cross-training exercises.

[0465] FIG. **16**A-**1** is a top view of the insole **1600** illustrating the top sheet **1601** and transverse arch support **1638**. Insole **1600** comprises a top sheet **1601** secured across the entire top surface of the base from toe area to heel area. Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **1638** that lies under the metatarsal head area of the foot. The upward exten-

sion of transverse arch support **1638** pushes up a portion of the top sheet **401** that corresponds to the area of the transverse arch support **1638**.

[0466] Traverse arch support **1638** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1638** provides additional stability and cushioning to the forefoot and middle of the foot.

[0467] In a preferred embodiment, top sheet **1601** is a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **401** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi. A series of air holes extend through top sheet **1601** and the base to permit air circulation above and below insole **1600**.

[0468] FIG. **16**A-**2** illustrates the bottom view of the insole. Insole **1600** preferably comprises a top sheet **1601** and a base **1602** having a top surface secured to said top sheet and an opposite bottom surface. Base **1602** also defines a longitudinal arch support **1619** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0469] The bottom surface of base **1602** defines a forefoot pad recession area **1607** in the forefoot area and a stability cradle recession area **1605** along the midfoot and heel areas. The bottom surface of base **1602** also defines one or more ribs or protrusions **1632** that extend outwardly along the arch area. The ribs **1632** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape.

[0470] Base **1602** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. As best seen in FIGS. **16**B-**7** to **16**B-**10**, the height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0471] The forefoot pad recession area **1607** begins partially proximal form the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area **1607** extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area **1607** has a rear apex **1657** that lies between the 1st and 2nd metatarsals.

[0472] Forefoot pad **1608** is shaped essentially the same as forefoot pad recession area **1607** and is secured therein. Forefoot pad **1608** has a medial edge, a lateral edge, a proximal (back) edge and a distal (front) edge. The medial edge of forefoot pad **1608** 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 **1657**, laterally and distally towards the 3rd metatarsal head, then laterally and proximally to the lateral edge approximately along the 3rd through 5th metatarsal heads. The lateral edge connects said proximal edge to said top edge of said forefoot pad. In use, forefoot pad recession area **1607** and forefoot pad **1608** underlie 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. FIG. **11** shows the placement of foot bones on the insole.

[0473] An adhesive is used to secure the components. The forefoot pad **1608** 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.

[0474] It is estimated that using tougher materials increase the durability of the insole by 35% to 65% over insoles that use softer materials for this portion of the foot insole.

[0475] The stability cradle recession area **1605** is located in the midfoot and heel areas of the bottom surface of base **1602**. The stability cradle recession area **1605** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **1607** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **1606** is shaped essentially the same as stability cradle recession area **1605** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1605**.

[0476] Stability cradle **1606** has walls that wrap up the sides and rear of base **1602** to provide support for the foot. Preferably, stability cradle **1606** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1606** are preferably higher on the medial side of the foot because of the higher loading. Preferably, stability cradle **1606** is made of a nylon material with a hardness of approximately Shore A 95. In a preferred embodiment, the stability cradle is semi-rigid. In an alternate embodiment, the stability cradle is rigid.

[0477] Preferably, the shoe facing surface of stability cradle **1606** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear to other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0478] The stability cradle **1606** preferably defines one or more rib-shaped openings **1631**. In a preferred embodiment, the rib-shaped openings **1631** allow said ribs **1632** of base **1602** to extend therethrough. Preferably, base **1602** is molded so that the ribs **1632** project into rib-shaped openings **1631** so that the ribs **1632** are approximately flush with the outer surface of stability cradle **1606** and mechanically lock stability cradle **1606** and base **1602** together. Advantageously, the ribs **1632** are also able to bulge through rib-shaped openings **1631** when base **1602** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **1632** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **1631** allow the stability cradle **1606** to be more flexible in the arch area compared to the rest of the stability cradle **1606**.

[0479] In an alternate embodiment, stability cradle **1606** defines one or more protruding ribs instead of openings. The

protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0480] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0481] Stability cradle **1606** defines a lateral midfoot pod opening **1611** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening **1611** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod **1612** is shaped essentially the same as lateral midfoot pod opening **1611** and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral midfoot pod opening **1611** and allows lateral midfoot pod **1612** to extend out through said lateral midfoot pod opening **1611**.

[0482] Lateral midfoot pod **1612** is preferably made from TPR or PU of a hardness of about 45-50 ASKER C. If TPR is used, a fabric is in turn secured to the base **1602** in the lateral midfoot pod opening **1611** of said base **1602**. The fabric component allows the TPR to properly adhere to the base **1602**.

[0483] Stability cradle **1606** also defines a lateral heel pod opening **1613** that extends through the lateral side of the heel area of stability cradle **1606** from approximately rearward of the lateral midfoot pod opening **1611** toward the heel end. Lateral heel pod **1614** is shaped essentially the same as lateral heel pod opening **1613** and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral heel pod opening **1613** and allows lateral heel pod **1614** to extend out through said lateral heel pod opening **1613**. Lateral heel pod **1614** has a lateral edge which extends along the lateral border of insole **1600** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **1614** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0484] The configuration, material and position of the lateral heel pod **1614** provides cushioning and works in association with the medial heel pod **1616** to stabilize the ankle. The hardness of the lateral heel pod is preferably essentially the same as the lateral midfoot pod, which work in concert to help reduce the incidence of lateral ankle roll-overs. It is preferably made of TPR or PU of a hardness of about Shore C 45-50. If TPR is used, a fabric is in turn secured to the base **1602** in the lateral heel pod opening **1611** of said base **1602**. The fabric component allows the TPR to properly adhere to the base **1602**.

[0485] Stability cradle **1606** defines a medial heel pod opening **1615** that extends through the heel area along the medial side of heel area on the bottom surface of base **1602** just short of the heel end. Medial heel pod **1616** is shaped essentially the same as medial heel pod opening **1615** and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the medial heel pod opening **1615** and allows medial heel pod **1616** to extend out through said medial heel pod opening **1615**. The medial heel pod **1616** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0486] Medial heel pod **1616** is preferably made from TPR or PU of a hardness of about 60 ASKER C±3. If TPR is used, a fabric is in turn secured to the base **1602** in the medial heel pod opening **1615** of said base **1602**. The fabric component allows the TPR to properly adhere to the base **1602**.

[0487] 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. To cushion the impact, lateral heel pod **1614** is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle **1606**. Preferably, lateral heel pod **1614** is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0488] 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 results in injury.

[0489] Stability cradle **1606** provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod **1616** helps to control the rate of pronation by forming medial heel pod **1616** out of a material having different characteristics than lateral heel pod **1614**. For example, to reduce a pronation rate, medial heel pod **1616** can be made from a firmer material than lateral heel pod **1614**. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod **1616** made from a firmer material would compress less than a lateral heel pod **1614** made of a softer material. As a result, medial heel pod **1616** tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod **1616** from a softer material than lateral heel pod **1614** would tend to increase the amount and rate of pronation.

[0490] Preferably, the firmness of the material used in medial heel pod **1616** is selected based on the firmness of lateral heel pod **1614** and on the type of intended activity. For example, the firmness of lateral heel pod **1614** and medial heel pod **1616** differs by about 20-30% for an insole to be used during light to moderate activities.

[0491] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel

pod **1616** can be made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0492] Lateral midfoot pod **1612** provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod **1612** is formed of a material having the same properties, e.g., firmness, as lateral heel pod **1614**. However, a material having different characteristics can also be used.

[0493] The use of dual density heel pods is employed to cause a kinetic change in foot function to promote ankle stability. It is also not out of the scope of the invention to have the medial heel pod softer than the lateral heel pod and/or lateral midfoot pod or any combination thereof to address different joint moments or ankle rolls.

[0494] 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 **1608** is located under this part of the foot. Preferably, forefoot pad **1608** is formed of a relatively resilient material so that energy put into compressing forefoot pad **1608** is returned to help propel the foot at toe-off.

[0495] 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 medial portion of forefoot pad **1608** extends rearward into a corresponding concave edge portion of the distal edge of stability cradle **1606**. The shape of the stability cradle **1606** and forefoot pad **1608** permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

[0496] Base **1602** is preferably made of foam or other material having suitable cushioning properties. Preferably, base **1602** comprises an Ethylene vinyl acetate ("EVA") foam, which is a copolymer of ethylene and vinyl acetate, or a Thermoplastic Rubber ("TPR")/EVA mix. A preferred EVA or TPR/EVA mix has a durometer (hardness) of about Asker C 45-50.

[0497] Forefoot pad **1608** is preferably made from a Thermoplastic Rubber ("TPR") or Polyurethane ("PU"). The hardness of the TPR or PU used in the forefoot pad is preferably about 30 Asker C±3.

[0498] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0499] The forefoot pad **1620**, lateral midfoot pod **1621**, lateral heel pod **1622**, and medial heel pod **1623** are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern **1620** is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns **1621** and **1622** are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern **1623** is approximately 1.00 to 2.50 mm deep. Preferably the TPR pods have the deeper criss-cross groove pattern and the PU pods have the shallower criss-cross groove pattern due to the compression characteristics of the materials. The criss-cross groove patterns also assists with keeping the insole in place and not move or slide around within the shoe.

[0500] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0501] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the open-cell designs will provide for a lighter insole.

[0502] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base **1602** in the recession areas defined by base **1602** on the bottom surface are permanently affixed to base **1602** 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.

[0503] The recession areas also is lined with a cloth having a base surface and a pad/pod surface, secured to said base along said base surface and said pad/pod along said pad/pod surface. Alternatively, a cloth is secured to pad/pod and then the composite structure secured to the recession area.

[0504] Some shoes may slightly differ in size on the inner part of the shoe. Some shoes may also provide extra padding along the inner sides, front or back of the shoe that alter the actual space provided for the foot and/or an insole on the inner part of the shoe. Base **1602** may have sizing guides **1650** that allow a user to shorten the length of the insole for proper fit within the shoe, sizing guides **1650** provide various cutting guide lines that the user would cut along, preferably with scissors.

[0505] FIG. **16**B-**1** to **16**B-**8** shows a bottom, medial side, lateral side, back, and four cross-section views of the stability cradle.

[0506] FIG. **16**B-**1** illustrates a medial side view of the insole. Insole **1600** preferably comprises a top sheet **1601** and a base **1602** having a top surface secured to said top sheet and an opposite bottom surface. Base **1602** also defines a longitudinal arch support **1619** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0507] The bottom surface of base **1602** defines a forefoot pad recession area in the forefoot area and a stability cradle recession area **1605** along the midfoot and heel areas. The bottom surface of base **1602** also defines one or more ribs or protrusions **1632** that extend outwardly along the arch area. The ribs **1632** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape.

[0508] Base **1602** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. The height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0509] The forefoot pad recession area begins partially proximal from the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area has a rear apex that lies between the 1st and 2nd metatarsals. A forefoot pad is shaped essentially the same as forefoot pad recession area and is secured therein.

[0510] The stability cradle recession area **1605** is located in the midfoot and heel areas of the bottom surface of base **1602**. The stability cradle recession area **1605** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **1606** is shaped essentially the same as stability cradle recession area **1605** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1605**.

[0511] Stability cradle **1606** has walls that wrap up the sides and rear of base **1602** to provide support for the foot. Preferably, stability cradle **1606** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1606** are preferably higher on the medial side of the foot because of the higher loading.

[0512] Preferably, the shoe facing surface of stability cradle **1606** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear with other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0513] The stability cradle **1606** preferably defines one or more rib-shaped openings **1631**. In a preferred embodiment, the rib-shaped openings **1631** allow said ribs **1632** of base **1602** to extend therethrough. Preferably, base **1602** is molded so that the ribs **1632** project into rib-shaped openings **1631** so that the ribs **1632** are approximately flush with the outer surface of stability cradle **1606** and mechanically lock stability cradle **1606** and base **1602** together. Advantageously, the ribs **1632** are also able to bulge through rib-shaped openings **1631** when base **1602** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **1632** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **1631** allow the stability cradle **1606** to be more flexible in the arch area compared to the rest of the stability cradle **1606**.

[0514] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0515] In an alternate embodiment, stability cradle **1606** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0516] Stability cradle **1606** defines a lateral midfoot pod opening that extends from the behind the 3^{rd} though 5^{th} metatarsal heads proximally to the back of the cuboid. A lateral midfoot pod is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod to extend out through said lateral midfoot pod opening.

[0517] Stability cradle **1606** also defines a lateral heel pod opening that extends through the lateral side of the heel area of stability cradle **1606** from approximately rearward of the lateral midfoot pod opening toward the heel end. Lateral heel pod is shaped essentially the same as lateral heel pod opening and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral heel pod opening and allows lateral heel pod to extend out through said lateral heel pod opening.

[0518] Stability cradle **1606** defines a medial heel pod opening that extends through the heel area along the medial side of heel area on the bottom surface of base **1602** just short of the heel end. Medial heel pod **1616** is shaped essentially the same as medial heel pod opening and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the medial heel pod opening and allows medial heel pod **1616** to extend out through said medial heel pod opening.

[0519] In a preferred embodiment, base **1602** is covered with top sheet **1601**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1601** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0520] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **1638** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1638** pushes up

a portion of the top sheet **1601** that corresponds to the area of the transverse arch support **1638**.

[0521] Traverse arch support **1638** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1638** provides additional stability and cushioning to the forefoot and middle of the foot.

[0522] FIG. **16**A-**2** illustrates the bottom view of the insole. Insole **1600** preferably comprises a top sheet **1601** and a base **1602** having a top surface secured to said top sheet and an opposite bottom surface. Base **1602** also defines a longitudinal arch support **1619** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0523] The bottom surface of base **1602** defines a forefoot pad recession area **1607** in the forefoot area and a stability cradle recession area **1605** along the midfoot and heel areas. The bottom surface of base **1602** also defines one or more ribs or protrusions **1632** that extend outwardly along the arch area. The ribs **1632** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape.

[0524] Base **1602** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. As best seen in FIGS. **16**B-**7** to **16**B-**10**, the height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0525] The forefoot pad recession area **1607** begins partially proximal form the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area **1607** extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area **1607** has a rear apex **1657** that lies between the 1st and 2nd metatarsals.

[0526] Forefoot pad **1608** is shaped essentially the same as forefoot pad recession area **1607** and is secured therein. Forefoot pad **1608** has a medial edge, a lateral edge, a proximal (back) edge and a distal (front) edge. The medial edge of forefoot pad **1608** 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 **1657**, laterally and distally towards the 3rd metatarsal head, then laterally and proximally to the lateral edge approximately along the 3rd through 5th metatarsal heads. The lateral edge connects said proximal edge to said top edge of said forefoot pad. In use, forefoot pad recession area **1607** and forefoot pad **1608** underlie 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. FIG. **11** shows the placement of foot bones on the insole.

[0527] An adhesive is used to secure the components. The forefoot pad **1608** 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.

[0528] It is estimated that using tougher materials increase the durability of the insole by 35% to 65% over insoles that use softer materials for this portion of the foot insole.

[0529] The stability cradle recession area **1605** is located in the midfoot and heel areas of the bottom surface of base **1602**. The stability cradle recession area **1605** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **1607** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **1606** is shaped essentially the same as stability cradle recession area **1605** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1605**.

[0530] Stability cradle **1606** has walls that wrap up the sides and rear of base **1602** to provide support for the foot. Preferably, stability cradle **1606** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1606** are preferably higher on the medial side of the foot because of the higher loading. Preferably, stability cradle **1606** is made of a nylon material with a hardness of approximately Shore A 95. In a preferred embodiment, the stability cradle is semi-rigid. In an alternate embodiment, the stability cradle is rigid.

[0531] Preferably, the shoe facing surface of stability cradle **1606** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear to other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0532] The stability cradle **1606** preferably defines one or more rib-shaped openings **1631**. In a preferred embodiment, the rib-shaped openings **1631** allow said ribs **1632** of base **1602** to extend therethrough. Preferably, base **1602** is molded so that the ribs **1632** project into rib-shaped openings **1631** so that the ribs **1632** are approximately flush with the outer surface of stability cradle **1606** and mechanically lock stability cradle **1606** and base **1602** together. Advantageously, the ribs **1632** are also able to bulge through rib-shaped openings **1631** when base **1602** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **1632** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **1631** allow the stability cradle **1606** to be more flexible in the arch area compared to the rest of the stability cradle **1606**.

[0533] In an alternate embodiment, stability cradle **1606** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0534] Stability cradle **1606** defines a lateral midfoot pod opening **1611** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening **1611** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod **1612** is shaped essentially the same as lateral midfoot pod opening **1611** and is secured to

the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral midfoot pod opening **1611** and allows lateral midfoot pod **1612** to extend out through said lateral midfoot pod opening **1611**.

[0535] Lateral midfoot pod **1612** is preferably made from TPR or PU of a hardness of about 45-50 ASKER C. If TPR is used, a fabric is in turn secured to the base **1602** in the lateral midfoot pod opening **1611** of said base **1602**. The fabric component allows the TPR to properly adhere to the base **1602**.

[0536] Stability cradle **1606** also defines a lateral heel pod opening **1613** that extends through the lateral side of the heel area of stability cradle **1606** from approximately rearward of the lateral midfoot pod opening **1611** toward the heel end. Lateral heel pod **1614** is shaped essentially the same as lateral heel pod opening **1613** and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral heel pod opening **1613** and allows lateral heel pod **1614** to extend out through said lateral heel pod opening **1613**. Lateral heel pod **1614** has a lateral edge which extends along the lateral border of insole **1600** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **1614** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0537] The configuration, material and position of the lateral heel pod **1614** provides cushioning and works in association with the medial heel pod **516** to stabilize the ankle. The hardness of the lateral heel pod is preferably essentially the same as the lateral midfoot pod, which work in concert to help reduce the incidence of lateral ankle roll-overs. It is preferably made of TPR or PU of a hardness of about Shore C 45-50. If TPR is used, a fabric is in turn secured to the base **1602** in the lateral heel pod opening **1611** of said base **1602**. The fabric component allows the TPR to properly adhere to the base **1602**.

[0538] Stability cradle **1606** defines a medial heel pod opening **1615** that extends through the heel area along the medial side of heel area on the bottom surface of base **1602** just short of the heel end. Medial heel pod **1616** is shaped essentially the same as medial heel pod opening **1615** and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the medial heel pod opening **1615** and allows medial heel pod **1616** to extend out through said medial heel pod opening **1615**. The medial heel pod **1616** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0539] Medial heel pod **1616** is preferably made from TPR or PU of a hardness of about 60 ASKER C±3. If TPR is used, a fabric is in turn secured to the base **1602** in the medial heel pod opening **1615** of said base **1602**. The fabric component allows the TPR to properly adhere to the base **1602**.

[0540] 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. To cushion the impact, lateral heel pod **1614** is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle **1606**. Preferably, lateral heel pod **1614** is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0541] 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 results in injury.

[0542] Stability cradle **1606** provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod **1616** helps to control the rate of pronation by forming medial heel pod **1616** out of a material having different characteristics than lateral heel pod **1614**. For example, to reduce a pronation rate, medial heel pod **1616** can be made from a firmer material than lateral heel pod **1614**. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod **1616** made from a firmer material would compress less than a lateral heel pod **1614** made of a softer material. As a result, medial heel pod **1616** tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod **1616** from a softer material than lateral heel pod **1614** would tend to increase the amount and rate of pronation.

[0543] Preferably, the firmness of the material used in medial heel pod **1616** is selected based on the firmness of lateral heel pod **1614** and on the type of intended activity. For example, the firmness of lateral heel pod **1614** and medial heel pod **1616** differs by about 20-30% for an insole to be used during light to moderate activities.

[0544] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel pod **1616** can be made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0545] Lateral midfoot pod **1612** provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod **1612** is formed of a material having the same properties, e.g., firmness, as lateral heel pod **1614**. However, a material having different characteristics can also be used.

[0546] The use of dual density heel pods is employed to cause a kinetic change in foot function to promote ankle stability. It is also not out of the scope of the invention to have the medial heel pod softer than the lateral heel pod and/or lateral midfoot pod or any combination thereof to address different joint moments or ankle rolls.

[0547] 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 **1608** is located under this part of the foot. Preferably, forefoot pad **1608** is formed of a relatively resilient material so that energy put into compressing forefoot pad **1608** is returned to help propel the foot at toe-off.

[0548] 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 medial portion of forefoot pad **1608** extends rearward into a corresponding concave edge portion of the distal edge of stability cradle **1606**. The shape of the stability cradle **1606** and forefoot pad **1608** permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

[0549] Base **1602** is preferably made of foam or other material having suitable cushioning properties. Preferably, base **1602** comprises an Ethylene vinyl acetate ("EVA") foam, which is a copolymer of ethylene and vinyl acetate, or a Thermoplastic Rubber ("TPR")/EVA mix. A preferred EVA or TPR/EVA mix has a durometer (hardness) of about Asker C 45-50.

[0550] Forefoot pad **1608** is preferably made from a Thermoplastic Rubber ("TPR") or Polyurethane ("PU"). The hardness of the TPR or PU used in the forefoot pad is preferably about 30 Asker C±3.

[0551] The forefoot pad **1620**, lateral midfoot pod **1621**, lateral heel pod **1622**, and medial heel pod **1623** are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern **1620** is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns **1621** and **1622** are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern **1623** is approximately 1.00 to 2.50 mm deep. Preferably the TPR pods have the deeper criss-cross groove pattern and the PU pods have the shallower criss-cross groove pattern due to the compression characteristics of the materials. The criss-cross groove patterns also assists with keeping the insole in place and not move or slide around within the shoe.

[0552] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0553] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the open-cell designs will provide for a lighter insole.

[0554] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base **1602** in the recession areas defined by base **1602** on the bottom surface are permanently affixed to base **1602** 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.

[0555] The recession areas also is lined with a cloth having a base surface and a pad/pod surface, secured to said base along said base surface and said pad/pod along said pad/pod surface. Alternatively, a cloth is secured to pad/pod and then the composite structure secured to the recession area.

[0556] Some shoes may slightly differ in size on the inner part of the shoe. Some shoes may also provide extra padding along the inner sides, front or back of the shoe that alter the actual space provided for the foot and/or an insole on the inner part of the shoe. Base **1602** may have sizing guides **1650** that allow a user to shorten the length of the insole for proper fit within the shoe, sizing guides **1650** provide various cutting guide lines that the user would cut along, preferably with scissors.

[0557] FIG. **16**B-**3** illustrates a lateral side view of the insole. Insole **1600** preferably comprises a top sheet **1601** and a base **1602** having a top surface secured to said top sheet **1601** and an opposite bottom surface. Base **1602** also defines a longitudinal arch support **1619** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0558] The bottom surface of base **1602** defines a forefoot pad recession area in the forefoot area and a stability cradle recession area **1605** along the midfoot and heel areas.

[0559] Base **1602** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. The height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0560] The forefoot pad recession area begins partially proximal from the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area has a rear apex that lies between the 1st and 2nd metatarsals. A forefoot pad is shaped essentially the same as forefoot pad recession area and is secured therein.

[0561] The stability cradle recession area **1605** is located in the midfoot and heel areas of the bottom surface of base **1602**. The stability cradle recession area **1605** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **1607** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **1606** is shaped essentially the same as stability cradle recession area **1605** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1605**.

[0562] Stability cradle **1606** has walls that wrap up the sides and rear of base **1602** to provide support for the foot. Preferably, stability cradle **1606** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1606** are preferably higher on the medial side of the foot because of the higher loading.

[0563] Preferably, the shoe facing surface of stability cradle **1606** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear to other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-

faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0564] Stability cradle **1606** defines a lateral midfoot pod opening that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. A lateral midfoot pod **1612** is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod **1612** to extend out through said lateral midfoot pod opening.

[0565] Stability cradle **1606** also defines a lateral heel pod opening that extends through the lateral side of the heel area of stability cradle **1606** from approximately rearward of the lateral midfoot pod opening toward the heel end. Lateral heel pod **1614** is shaped essentially the same as lateral heel pod opening and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral heel pod opening and allows lateral heel pod **1614** to extend out through said lateral heel pod opening.

[0566] Stability cradle **1606** defines a medial heel pod opening that extends through the heel area along the medial side of heel area on the bottom surface of base **1602** just short of the heel end. Medial heel pod is shaped essentially the same as medial heel pod opening and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the medial heel pod opening and allows medial heel pod to extend out through said medial heel pod opening.

[0567] In a preferred embodiment, base **1602** is covered with top sheet **1601**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1601** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0568] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **1638** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1638** pushes up a portion of the top sheet **1601** that corresponds to the area of the transverse arch support **1638**.

[0569] Traverse arch support **1638** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1638** provides additional stability and cushioning to the forefoot and middle of the foot.

[0570] FIG. **16**B-**4** is a top view of the insole illustrating the top sheet **1601** and transverse arch support **1638**. Insole **1600** comprises a top sheet **1601** secured across the entire top surface of the base from toe area to heel area. Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **1638** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1638** pushes up a portion of the top sheet **1601** that corresponds to the area of the transverse arch support **1638**.

[0571] Traverse arch support **1638** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1638** provides additional stability and cushioning to the forefoot and middle of the foot.

[0572] In a preferred embodiment, top sheet **1601** is a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1601** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi. A series of air holes extend through top sheet **1601** and the base to permit air circulation above and below insole **1600**.

[0573] FIG. **16**B-**5** is a section view line **16**B-**5** along the middle of the insole as identified in FIGS. **16**B-**2**. Insole **1600** preferably comprises a top sheet **1601** and a base **1602** having a top surface secured to said top sheet **1601** and an opposite bottom surface. The bottom surface of base **1602** defines a forefoot pad recession area **1607** in the forefoot area and a stability cradle recession area **1605** along the midfoot and heel areas.

[0574] Base **1602** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. As best seen in FIGS. **16**B-**6** to **16**B-**10**, the height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0575] Preferably, the top surface of the base **1602** defines an upwardly-extending portion or transverse arch support **1638** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1638** pushes up a portion of the top sheet **1601** that corresponds to the area of the transverse arch support **1638**. Traverse arch support **1638** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1638** provides additional stability and cushioning to the forefoot and middle of the foot.

[0576] The forefoot pad recession area **1607** begins partially proximal form the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area **1607** extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area **1607** has a rear apex that lies between the 1st and 2nd metatarsals.

[0577] Forefoot pad **1608** is shaped essentially the same as forefoot pad recession area **1607** and is secured therein. Forefoot pad **1608** has a medial edge, a lateral edge, a proximal (back) edge and a distal (front) edge. The medial edge of forefoot pad **1608** 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 **1657**, laterally and distally towards the 3rd metatarsal head, then laterally and proximally to the lateral edge approximately along the 3rd through 5th metatarsal heads. The lateral edge connects said proximal edge to said top edge of said forefoot pad. In use, forefoot pad recession area **1607** and forefoot pad **1608** underlie 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. FIG. **11** shows the placement of foot bones on the insole.

[0578] An adhesive is be used to secure the components. The forefoot pad **1608** 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.

[0579] It is estimated that using tougher materials increases the durability of the insole by 35% to 65% over insoles that use softer materials for this portion of the foot insole.

[0580] The stability cradle recession area **1605** is located in the midfoot and heel areas of the bottom surface of base **1602**. The stability cradle recession area **1605** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area **1607** to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off. Stability cradle **1606** is shaped essentially the same as stability cradle recession area **1605** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1605**.

[0581] Stability cradle **1606** has walls that wrap up the sides and rear of base **1602** to provide support for the foot.

[0582] Preferably, the shoe facing surface of stability cradle **1606** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear with other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0583] Stability cradle **1606** defines a lateral midfoot pod opening that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod to extend out through said lateral midfoot pod opening.

[0584] Stability cradle **1606** also defines a lateral heel pod opening **1613** that extends through the lateral side of the heel area of stability cradle **1606** from approximately rearward of the lateral midfoot pod opening **1611** toward the heel end. Lateral heel pod **1614** is shaped essentially the same as lateral heel pod opening **1613** and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral heel pod opening **1613** and allows lateral heel pod **1614** to extend out through said lateral heel pod opening **1613**. Lateral heel pod **1614** has a lateral edge which extends along the lateral border of insole **1600** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **1614** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0585] The configuration, material and position of the lateral heel pod **1614** provides cushioning and works in association with the medial heel pod **1615** to stabilize the ankle.

[0586] Stability cradle **1606** defines a medial heel pod opening **1615** that extends through the heel area along the medial side of heel area on the bottom surface of base **1602** just short of the heel end. Medial heel pod **1616** is shaped essentially the same as medial heel pod opening **1615** and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the medial heel pod opening **1615** and allows medial heel pod **1616** to extend out through said medial heel pod opening **1615**. The medial heel pod **1616** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0587] 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. To cushion the impact, lateral heel pod **1614** is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle **1606**. Preferably, lateral heel pod **1614** is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0588] 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 results in injury.

[0589] Stability cradle **1606** provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod **1616** helps to control the rate of pronation by forming medial heel pod **1616** out of a material having different characteristics than lateral heel pod **1614**. For example, to reduce a pronation rate, medial heel pod **1616** is made from a firmer material than lateral heel pod **1614**. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod **1616** made from a firmer material would compress less than a lateral heel pod **1614** made of a softer material. As a result, medial heel pod **1616** tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod **1616** from a softer material than lateral heel pod **1614** would tend to increase the amount and rate of pronation.

[0590] Preferably, the firmness of the material used in medial heel pod **1616** is selected based on the firmness of lateral heel pod **1614** and on the type of intended activity. For example, the firmness of lateral heel pod **1614** and medial heel pod **1616** differs by about 20-30% for an insole to be used during light to moderate activities.

[0591] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel pod **1616** is made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0592] Lateral midfoot pod **1612** provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod is formed of a material having the same properties, e.g., firmness, as lateral heel pod **1614**. However, a material having different characteristics may also be used.

[0593] The use of dual density heel pods is employed to cause a kinetic change in foot function to promote ankle stability. It is also not out of the scope of the invention to have the medial heel pod softer than the lateral heel pod and/or lateral midfoot pod or any combination thereof to address different joint moments or ankle rolls.

[0594] 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 **1608** is located under this part of the foot. Preferably, forefoot pad **1608** is formed of a relatively resilient material so that energy put into compressing forefoot pad **1608** is returned to help propel the foot at toe-off.

[0595] 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 medial portion of forefoot pad **1608** extends rearward into a corresponding concave edge portion of the distal edge of stability cradle **1606**. The shape of the stability cradle **1606** and forefoot pad **1608** permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

[0596] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0597] The forefoot pad **1620**, lateral midfoot pod **1621**, lateral heel pod **1622**, and medial heel pod **1623** are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern **1620** is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern **1623** is approximately 1.00 to 2.50 mm deep.

[0598] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0599] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the criss-cross groove pattern designs will help provide a lighter insole.

[0600] In a preferred embodiment, base **1602** is covered with top sheet **1601**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1601** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0601] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base **1602** in the recession areas defined by base **1602** on the bottom surface are permanently affixed to base **1602** using an appropriate means such as an adhesive. The components also be secured during the molding process using techniques known in the art of molding insoles.

[0602] The recession areas are also be lined with a cloth having a base surface and a pad/pod surface, secured to said base along said base surface and said pad/pod along said pad/pod surface. Alternatively, a cloth is secured to pad/pod and then the composite structure secured to the recession area.

[0603] FIG. **16**B-**6** illustrates a rear view of the insole. Insole **1600** preferably comprises a top sheet **1601** and a base **1602** having a top surface secured to said top sheet and an opposite bottom surface. Base **1602** also defines a longitudinal arch support **1619** that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0604] The bottom surface of base **1602** defines a forefoot pad recession area in the forefoot area and a stability cradle recession area **1605** along the midfoot and heel areas. The bottom surface of base **1602** also define one or more ribs or protrusions **1632** that extend outwardly along the arch area. The ribs **1632** are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. An alternate embodiment has the ribs or protrusions defined by the stability cradle **1606** and extending outwardly from the stability cradle **1606** in the arch area.

[0605] Base **1602** has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. The height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0606] The forefoot pad recession area begins partially proximal from the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area has a rear apex that lies between the 1st and 2nd metatarsals. A forefoot pad is shaped essentially the same as forefoot pad recession area and is secured therein.

[0607] The stability cradle recession area **1605** is located in the midfoot and heel areas of the bottom surface of base **1602**. The stability cradle recession area **1605** extends from a

medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **1606** is shaped essentially the same as stability cradle recession area **1605** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1605**.

[0608] Stability cradle **1606** has walls that wrap up the sides and rear of base **1602** to provide support for the foot. Preferably, stability cradle **1606** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1606** are preferably higher on the medial side of the foot because of the higher loading.

[0609] Preferably, the shoe facing surface of stability cradle **1606** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear with other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0610] The stability cradle **1606** preferably defines one or more rib-shaped openings **1631**. In a preferred embodiment, the rib-shaped openings **1631** allow said ribs **1632** of base **1602** to extend therethrough. Preferably, base **1602** is molded so that the ribs **1632** project into rib-shaped openings **1631** so that the ribs **1632** are approximately flush with the outer surface of stability cradle **1606** and mechanically lock stability cradle **1606** and base **1602** together. Advantageously, the ribs **1632** are also able to bulge through rib-shaped openings **1631** when base **1602** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **1632** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **1631** allow the stability cradle **1606** to be more flexible in the arch area compared to the rest of the stability cradle **1606**.

[0611] In an alternate embodiment, stability cradle **1606** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0612] Stability cradle **1606** defines a lateral midfoot pod opening that extends from the behind the 3^{rd} though 5^{th} metatarsal heads proximally to the back of the cuboid. A lateral midfoot pod is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod to extend out through said lateral midfoot pod opening.

[0613] Stability cradle **1606** also defines a lateral heel pod opening that extends through the lateral side of the heel area of stability cradle **1606** from approximately rearward of the lateral midfoot pod opening toward the heel end. Lateral heel pod **1614** is shaped essentially the same as lateral heel pod opening and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral heel pod opening and allows lateral heel pod **1614** to extend out through said lateral heel pod opening.

[0614] Stability cradle **1606** defines a medial heel pod opening that extends through the heel area along the medial side of heel area on the bottom surface of base **1602** just short of the heel end. Medial heel pod **1616** is shaped essentially the same as medial heel pod opening and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the medial heel pod opening and allows medial heel pod **1616** to extend out through said medial heel pod opening.

[0615] In a preferred embodiment, base **1602** is covered with top sheet **1601**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1601** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi. Preferably the forefoot pad recession area **1607** has a rear apex that lies between the 1st and 2nd metatarsals.

[0616] FIG. **16**B-**7** illustrates a cross section **16**B-**7** as identified in FIGS. **16**B-**2**. Insole **1600** preferably comprises a top sheet **1601** and a base **1602** having a top surface secured to said top sheet **1601** and an opposite bottom surface. The bottom surface of base **1602** defines a forefoot pad recession area and a stability cradle recession area.

[0617] The stability cradle recession area **1605** is located in the midfoot and heel areas of the bottom surface of base **1602**. The stability cradle recession area **1605** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **1626** is shaped essentially the same as stability cradle recession area **1605** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1605**. Stability cradle **1606** has walls that wrap up the sides and rear of base **1602** to provide support for the foot.

[0618] Preferably, the shoe facing surface of stability cradle **1606** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use.

[0619] Stability cradle **1606** also defines a lateral heel pod opening **1613** that extends through the lateral side of the heel area of stability cradle **1606** from approximately rearward of the lateral midfoot pod opening **1611** toward the heel end. Lateral heel pod **1614** is shaped essentially the same as lateral

heel pod opening **1613** and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral heel pod opening **1613** and allows lateral heel pod **1614** to extend out through said lateral heel pod opening **1613**. Lateral heel pod **1614** has a lateral edge which extends along the lateral border of insole **1600** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **1614** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0620] Stability cradle **1606** defines a medial heel pod opening **1615** that extends through the heel area along the medial side of heel area on the bottom surface of base **1602** just short of the heel end. Medial heel pod **1616** is shaped essentially the same as medial heel pod opening **1615** and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the medial heel pod opening **1615** and allows medial heel pod **1616** to extend out through said medial heel pod opening **1615**. The medial heel pod **1616** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0621] In a preferred embodiment, base **1602** is covered with top sheet **1601**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1601** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0622] FIGS. **16B-9** and **16B-8** illustrates a cross section **16B-9** and **16B-8**, respectively, as identified in FIGS. **16B-2**. Insole **1600** preferably comprises a top sheet **1601** and a base **1602** having a top surface secured to said top sheet **1601** and an opposite bottom surface. The bottom surface of base **1602** defines a forefoot pad recession area and a stability cradle recession area.

[0623] The stability cradle recession area **1605** is located in the midfoot and heel areas of the bottom surface of base **1602**. The stability cradle recession area **1605** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **1616** is shaped essentially the same as stability cradle recession area **1605** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1605**. Stability cradle **1606** has walls that wrap up the sides and rear of base **1602** to provide support for the foot.

[0624] Preferably, the shoe facing surface of stability cradle **1606** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use.

[0625] The stability cradle **1606** preferably defines one or more rib-shaped openings **1631**. In a preferred embodiment, the rib-shaped openings **1631** allow said ribs **1632** of base **1602** to extend therethrough. Preferably, base **1602** is molded so that the ribs **1632** project into rib-shaped openings **1631** so that the ribs **1632** are approximately flush with the outer surface of stability cradle **1606** and mechanically lock stability cradle **1606** and base **1602** together. Advantageously, the ribs **1632** are also able to bulge through rib-shaped openings **1631** when base **1602** is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. Preferably said ribs **1632** extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings **1631** allow the stability cradle **1606** to be more flexible in the arch area compared to the rest of the stability cradle **1606**.

[0626] In an alternate embodiment, stability cradle **1606** defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0627] Stability cradle **1606** defines a lateral midfoot pod opening **1611** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening **1611** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod **1612** is shaped essentially the same as lateral midfoot pod opening **1611** and is secured to the bottom surface of base **1602** within the stability cradle recession area in a location that correlates to the lateral midfoot pod opening **1611** and allows lateral midfoot pod **1612** to extend out through said lateral midfoot pod opening **1611**.

[0628] In a preferred embodiment, base **1602** is covered with top sheet **1601**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1601** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0629] FIG. **16B-10** illustrates a cross section **16B-10** as identified in FIGS. **16B-2**. Insole **1600** preferably comprises a top sheet **1601** and a base **1602** having a top surface secured to said top sheet **1601** and an opposite bottom surface. The bottom surface of base **1602** defines a forefoot pad recession area and a stability cradle recession area.

[0630] The stability cradle recession area **1605** is located in the midfoot and heel areas of the bottom surface of base **1602**. The stability cradle recession area **1605** extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **1606** is shaped essentially the same as stability cradle recession area **1605** and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area **1605**.

[0631] Preferably, the shoe facing surface of stability cradle **1606** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use.

[0632] In a preferred embodiment, base **1602** is covered with top sheet **1601**, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1601** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0633] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support **1638** that lies under the metatarsal head area of the foot. The upward extension of transverse arch support **1638** pushes up a portion of the top sheet **1601** that corresponds to the area of the transverse arch support **1638**.

[0634] Traverse arch support **1638** preferably lies under the second to fourth metatarsal heads. Traverse arch support **1638** provides additional stability to the forefoot and middle of the foot.

[0635] FIGS. **16**C-**1** to **16**C-**8** medial side, bottom, lateral side, back and four cross section views of a stability cradle **1606**. A stability cradle recession area is located in the midfoot and heel areas of the bottom surface of a base. The stability cradle recession area extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of a forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle **1606** is shaped essentially the same as the stability cradle recession area and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area.

[0636] Stability cradle **1606** has walls that wrap up the sides and rear of the base to provide support for the foot. Preferably, stability cradle **1606** ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle **1606** are preferably higher on the medial side of the foot because of the higher loading. Preferably, stability cradle **1606** is made of a nylon material with a hardness of approximately Shore A 95. In a preferred embodiment, the stability cradle is semi-rigid. In an alternate embodiment, the stability cradle is rigid.

[0637] Preferably, the shoe facing surface of stability cradle **1606** has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping shoes and running gear to other footwear, or vice versa, is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improves the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0638] The stability cradle **1606** preferably defines one or more rib-shaped openings **1631**. In a preferred embodiment, the rib-shaped openings **1631** allow ribs on the base to extend therethrough. Advantageously, the ribs are also able to bulge through rib-shaped openings **1631** when base is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the foot. The rib-shaped openings **1631** allow the stability cradle **1606** to be more flexible in the arch area compared to the rest of the stability cradle **1606**.

[0639] Stability cradle **1606** defines a lateral midfoot pod opening **1611** that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening **1611** is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. The lateral midfoot pod opening **1611** is designed to allow a lateral midfoot pod to extend there through.

[0640] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0641] Stability cradle **1606** also defines a lateral heel pod opening **1613** that extends through the lateral side of the heel area of stability cradle **1606** from approximately rearward of the lateral midfoot pod opening **1611** toward the heel end. Lateral heel pod opening **1613** has a lateral edge which extends along the lateral border of insole from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod opening **1611**. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod opening **1613** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines. Lateral heel pod opening **1613** is designed to allow a lateral heel pod to extend there through.

[0642] Medial heel pod opening **1615** extends through the heel area along the medial side of heel area on the bottom surface of base **1602** just short of the heel end. The medial heel pod opening **1615** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod opening. Medial heel pod opening **1615** is designed to allow a medial heel pod to extend there through.

[0643] Stability cradle **1606** provides firm support along the medial portion of the foot to help control the amount of pronation.

[0644] FIG. **16**C-**1** to **16**C-**5** shows a bottom and side views of the lateral midfoot pod, medial heel pod, and lateral heel pod, and a section view of the medial heel pod and lateral heel pod.

[0645] FIG. **16**D-**1** to **16**D-**5** show a medial side, bottom, lateral side, prospective and one cross-section view of the insole pads **1612**, **1614** and **1616**. Stability cradle **1606** also defines a lateral heel pod opening **1613** that extends through the lateral side of the heel area of stability cradle **1606** from approximately rearward of the lateral midfoot pod opening **1611** toward the heel end. Lateral heel pod **1614** is shaped essentially the same as lateral heel pod opening **1613** and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the lateral heel pod opening **1613** and allows lateral heel pod **1614** to extend out through said lateral heel pod opening **1613**. Lateral heel pod **1614** has a lateral edge which extends along the lateral border of insole **1600** from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod **1614** also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0646] The configuration, material and position of the lateral heel pod **1614** provides cushioning and works in association with the medial heel pod **1615** to stabilize the ankle. The hardness of the lateral heel pod is preferably essentially the same as the lateral midfoot pod, which work in concert to help reduce the incidence of lateral ankle roll-overs. It is preferably made of TPR or PU of a hardness of about Shore C 45-50. If TPR is used, a fabric is in turn secured to the base **102** in the lateral heel pod opening **1613** of said base **1602**. The fabric component allows the TPR to properly adhere to the base **1602**.

[0647] Stability cradle **1606** defines a medial heel pod opening **1615** that extends through the heel area along the medial side of heel area on the bottom surface of base **1602** just short of the heel end. Medial heel pod **1616** is shaped essentially the same as medial heel pod opening **1615** and is secured to the bottom surface of base **1602** within the stability cradle recession area **1605** in a location that correlates to the medial heel pod opening **1615** and allows medial heel pod **1616** to extend out through said medial heel pod opening **1615**. The medial heel pod **1616** has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0648] Medial heel pod **1616** is preferably made from TPR or PU of a hardness of about 60 ASKER C±3. If TPR is used, a fabric is in turn secured to the base **102** in the medial heel pod opening **1615** of said base **1602**. The fabric component allows the TPR to properly adhere to the base **1602**.

[0649] 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. To cushion the impact, lateral heel pod **1614** is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle **1606**. Preferably, lateral heel pod **1614** is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0650] 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.

[0651] Stability cradle **1606** provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod **1616** helps to control the rate of pronation by forming medial heel pod **1616** out of a material having different characteristics than lateral heel pod **1614**. For example, to reduce a pronation rate, medial heel pod **1616** is made from a firmer material than lateral heel pod **1614**. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod **1616** made from a firmer material would compress less than a lateral heel pod **1614** made of a softer material. As a result, medial heel pod **1616** tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod **1616** from a softer material than lateral heel pod **1614** would tend to increase the amount and rate of pronation.

[0652] Preferably, the firmness of the material used in medial heel pod **1616** is selected based on the firmness of lateral heel pod **1614** and on the type of intended activity. For example, the firmness of lateral heel pod **1614** and medial heel pod **1616** differs by about 20-30% for an insole to be used during light to moderate activities.

[0653] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel pod **1616** is made significantly firmer in an insole designed for use while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0654] Lateral midfoot pod **1612** provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod **1612** is formed of a material having the same properties, e.g., firmness, as lateral heel pod **1614**. However, a material having different characteristics may also be used.

[0655] FIG. **16**D-**1** to **16**D-**4** shows a bottom, side, cross section and prospective view of the forefoot pad.

[0656] FIGS. **16**E-**1** to **16**E-**4** show a medial side, bottom, cross-section and prospective view of the forefoot pad **1608**. Forefoot pad **108** is preferably made from a Thermoplastic Rubber ("TPR") or Polyurethane ("PU"). The hardness of the TPR or PU used in the forefoot pad is preferably about 30 Asker C±3. The forefoot pad **1620**, lateral midfoot pod **1621**, lateral heel pod **1622**, and medial heel pod **1623** are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties of each pod and pad. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern **1620** is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns **1621** and **1622** are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern **1623** is approximately 1.00 to 2.50 mm deep. Preferably the TPR pods have the deeper criss-cross groove pattern and the PU pods have the shallower criss-cross groove pattern due to the compression characteristics of the materials. The criss-cross groove patterns assists with securing the insole in the shoe cavity and keeping the insole in place such

that it will not move or slide around. The criss-cross groove pattern also allows for air circulation and/or provides different cushioning and spring properties.

[0657] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0658] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the criss-cross groove pattern designs will help provide a lighter insole.

[0659] In a preferred embodiment, base **1602** is covered with top sheet **1601** from toe to heel areas of the insole, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet **1601** is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0660] Insole preferably comprises a top sheet and a base having a top surface secured to said top sheet and an opposite bottom surface. Base also defines a longitudinal arch support that extends upwardly along the medial side of the insole to provide extra cushion and support to the arch area of the foot.

[0661] Preferably, the top surface of the base defines an upwardly-extending portion or transverse arch support that lies under the metatarsal head area of the foot. The upward extension of transverse arch support pushes up a portion of the top sheet that corresponds to the area of the transverse arch support.

[0662] The bottom surface of base defines a forefoot pad recession area in the forefoot area and a stability cradle recession area along the midfoot and heel areas. The bottom surface of base also defines one or more ribs or protrusions that extend outwardly along the arch area. The ribs are preferably longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. An alternate embodiment has the ribs or protrusions defined by the stability cradle and extending outwardly from the stability cradle in the arch area.

[0663] Base has a raised edge that wraps around the heel and extends partially along the sides of the foot such that the insole has a heel cup, which conforms to the natural shape of the foot. The height of the raised edge is generally higher and thicker on the medial side of the insole and is lower and thinner on the lateral side of the insole.

[0664] The forefoot pad recession area begins partially proximal from the toe end of the insole near the distal ends of the proximal phalanges of the foot. The forefoot pad recession area extends rearward to about the 3rd through 5th metatarsal heads on a lateral portion and approximately halfway along the 1st and 2nd metatarsals on a medial portion. Preferably the forefoot pad recession area has a rear apex that lies between the 1st and 2nd metatarsals.

[0665] Forefoot pad is shaped essentially the same as forefoot pad recession area and is secured therein. Forefoot pad has a medial edge, a lateral edge, a proximal (back) edge and a distal (front) edge. The medial edge of forefoot pad 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. The lateral edge connects said proximal edge to said top edge of said forefoot pad. In use, forefoot pad recession area and forefoot pad underlie 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.

[0666] An adhesive is be used to secure the components. The forefoot pad 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.

[0667] The stability cradle recession area is located in the midfoot and heel areas of the bottom surface of base. The stability cradle recession area extends from a medial edge approximate the medial border to a lateral edge approximate the lateral border of the base and from a distal edge slightly proximal of the forefoot recession area to a proximal edge approximate the heel end of the base. A medial portion of the distal edge is shaped to accommodate downward motion of the 1st metatarsal during toe off Stability cradle is shaped essentially the same as stability cradle recession area and has a base facing surface and a shoe facing surface. The base facing surface is secured to said stability cradle recession area.

[0668] Stability cradle has walls that wrap up the sides and rear of base to provide support for the foot. Preferably, stability cradle ranges from approximately 0.5 mm to 3 mm thick and the walls taper from approximately 3 mm to about 0.5 mm. The sides of stability cradle are preferably higher on the medial side of the foot because of the higher loading. Preferably, stability cradle is made of a nylon material with a hardness of approximately Shore A 95. In a preferred embodiment, the stability cradle is semi-rigid. In an alternate embodiment, the stability cradle is rigid.

[0669] Preferably, the shoe facing surface of stability cradle has a "faceted" surface texture. This textured faceted surface increases the ability of the insole to "stay in place" when a user's foot is being placed into or out of the shoe. Swapping and "change-over" of shoes and running gear to other footwear, or vice versa is a very common practice during triathlon events and practice sessions. As such, these faceted textures significantly improve the use and performance of these insoles for this particular use by allowing the insole to resist movement out of the shoe during these change-over or swapping activities. The faceted design increases the internal function quotient of the insole significantly (by as much as 50% compared to non-faceted or smooth stability cradles) when located in the shoe cavity, thereby preventing the insole's movement or exit from the shoe cavity.

[0670] The stability cradle preferably defines one or more rib-shaped openings. In a preferred embodiment, the rib-shaped openings allow said ribs of base to extend therethrough. Preferably, base is molded so that the ribs project into rib-shaped openings so that the ribs are approximately flush with the outer surface of stability cradle and mechanically lock stability cradle and base together. Advantageously, the ribs are also able to bulge through rib-shaped openings when base is compressed (e.g., while walking or running) to provide additional cushioning and support to the arch of the

foot. Preferably said ribs extend outwardly approximately 0.50 mm to 1.5 mm and have a width of approximately 4 mm. The rib-shaped openings allow the stability cradle to be more flexible in the arch area compared to the rest of the stability cradle.

[0671] In an alternate embodiment, stability cradle defines one or more protruding ribs instead of openings. The protruding ribs extend outwardly along the arch area. The protruding ribs are longer around the cuneiforms and gradually shorter distally and proximally from the cuneiforms creating a parabolic-like overall shape. The protruding ribs extend outward approximately 0.50 mm.

[0672] Stability cradle **106** defines a lateral midfoot pod opening that extends from the behind the 3rd though 5th metatarsal heads proximally to the back of the cuboid. The length of the lateral midfoot pod opening is preferably sufficient to provide cushioning to the lateral aspect of the midfoot. Lateral midfoot pod is shaped essentially the same as lateral midfoot pod opening and is secured to the bottom surface of base within the stability cradle recession area in a location that correlates to the lateral midfoot pod opening and allows lateral midfoot pod to extend out through said lateral midfoot pod opening.

[0673] Lateral midfoot pod is preferably made from TPR or PU of a hardness of about 45-50 ASKER C. If TPR is used, a fabric is in turn secured to the base in the lateral midfoot pod opening of said base. The fabric component allows the TPR to properly adhere to the base.

[0674] Stability cradle also defines a lateral heel pod opening that extends through the lateral side of the heel area of stability cradle from approximately rearward of the lateral midfoot pod opening toward the heel end. Lateral heel pod is shaped essentially the same as lateral heel pod opening and is secured to the bottom surface of base within the stability cradle recession area in a location that correlates to the lateral heel pod opening and allows lateral heel pod to extend out through said lateral heel pod opening. Lateral heel pod has a lateral edge which extends along the lateral border of insole from said heel end to a lateral heel edge spaced apart from said lateral midfoot pod. The lateral edge curves in the area of the heel to follow the outline of the insole heel end. The lateral heel pod also has a medial curvilinear edge. The overall configuration is roughly a multi-sided geometric shape with curved edges as described rather than straight lines.

[0675] The configuration, material and position of the lateral heel pod provides cushioning and works in association with the medial heel pod to stabilize the ankle. The hardness of the lateral heel pod is preferably essentially the same as the lateral midfoot pod, which work in concert to help reduce the incidence of lateral ankle roll-overs. It is preferably made of TPR or PU of a hardness of about Shore C 45-50. If TPR is used, a fabric is in turn secured to the base in the lateral heel pod opening of said base. The fabric component allows the TPR to properly adhere to the base.

[0676] In accordance with principles of the present invention, a cushioning core or base is combined with a relatively stiff stability cradle and a number of elastomeric pods to form an insole that provides cushioning, stability, and control. Each pod can have a different firmness, and there are three pods that include a lateral midfoot pod, a medial heel pod, and a lateral heel pod. The pods 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 pods. The pods are separate in the heel pad area, and the midfoot and heel pads have grooved patterns on their bottom surface for better cushioning and traction grip in the shoe.

[0677] Stability cradle defines a medial heel pod opening that extends through the heel area along the medial side of heel area on the bottom surface of base just short of the heel end. Medial heel pod is shaped essentially the same as medial heel pod opening and is secured to the bottom surface of base **102** within the stability cradle recession area in a location that correlates to the medial heel pod opening and allows medial heel pod to extend out through said medial heel pod opening. The medial heel pod has essentially a pea-pod shape; it has a medial edge and a lateral edge which are connected to one another at a first distal apex and a second proximal apex. The edges widen out opposite one another to define said medial heel pod.

[0678] Medial heel pod is preferably made from TPR or PU of a hardness of about 60 ASKER C±3. If TPR is used, a fabric is in turn secured to the base in the medial heel pod opening of said base. The fabric component allows the TPR to properly adhere to the base.

[0679] 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. To cushion the impact, lateral heel pod is positioned along the rear and lateral side of the calcaneus (heel bone) and extends outwardly below stability cradle. Preferably, lateral heel pod is made of a material having suitable cushioning properties and are selected based on an intended type of activity.

[0680] 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.

[0681] Stability cradle provides firm support along the medial portion of the foot to help control the amount of pronation. Medial heel pod helps to control the rate of pronation by forming medial heel pod out of a material having different characteristics than lateral heel pod. For example, to reduce a pronation rate, medial heel pod is made from a firmer material than lateral heel pod. A firmer or stiffer material does not compress as much or as fast as a softer material under the same load. Thus, a medial heel pod made from a firmer material would compress less than a lateral heel pod made of a softer material. As a result, medial heel pod tends to resist or counteract pronation and thereby help to reduce the degree and rate of pronation. Conversely, making medial heel pod from a softer material than lateral heel pod would tend to increase the amount and rate of pronation.

[0682] Preferably, the firmness of the material used in medial heel pod is selected based on the firmness of lateral heel pod and on the type of intended activity. For example, the firmness of lateral heel pod and medial heel pod differs by about 20-30% for an insole to be used during light to moderate activities.

[0683] Carrying a heavy backpack or other articles significantly increases the load on the foot and the rate of pronation during and following heel strike. Accordingly, medial heel pod is made significantly firmer in an insole designed for use

while backpacking. As an example, a difference in firmness of about 20-40% is more appropriate for such activities.

[0684] Lateral midfoot pod provides cushioning and control to the lateral side of the foot during the midstance portion of a step. Typically, lateral midfoot pod is formed of a material having the same properties, e.g., firmness, as lateral heel pod. However, a material having different characteristics may also be used.

[0685] The use of dual density heel pods is employed to cause a kinetic change in foot function to promote ankle stability. It is also not out of the scope of the invention to have the medial heel pod softer than the lateral heel pod and/or lateral midfoot pod or any combination thereof to address different joint moments or ankle rolls.

[0686] 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 is located under this part of the foot. Preferably, forefoot pad is formed of a relatively resilient material so that energy put into compressing forefoot pad is returned to help propel the foot at toe-off.

[0687] 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 medial portion of forefoot pad extends rearward into a corresponding concave edge portion of the distal edge of stability cradle. The shape of the stability cradle and forefoot pad permit the first metatarsal to flex more naturally and thereby encourage loading of the great toe during toe off.

[0688] Base is preferably made of foam or other material having suitable cushioning properties. Preferably, base comprises an Ethylene vinyl acetate ("EVA") foam, which is a copolymer of ethylene and vinyl acetate, or a Thermoplastic Rubber ("TPR")/EVA mix. A preferred EVA or TPR/EVA mix has a durometer (hardness) of about Asker C 45-50.

[0689] Forefoot pad is preferably made from a Thermoplastic Rubber ("TPR") or Polyurethane ("PU"). The hardness of the TPR or PU used in the forefoot pad is preferably about 30 Asker C±3.

[0690] The forefoot pad, lateral midfoot pod, lateral heel pod, and medial heel pod are constructed with a criss-cross groove pattern on the bottom surface of the pod or pad. The criss-cross groove pattern introduces air gaps into the pod/pad surfaces. Such air gaps and criss-cross groove patterns positively influence the impact absorption properties of each pod and pad. It also allows for use of less material and therefore a lighter insole while still providing the desired cushioning function. Preferably, the forefoot criss-cross groove pattern is approximately 0.75 mm deep. Preferably the lateral midfoot and heel criss-cross groove patterns and are approximately 1.00 to 3.00 mm deep. Preferably, the medial heel criss-cross groove pattern is approximately 1.00 to 2.50 mm deep. Preferably the TPR pods have the deeper criss-cross groove pattern and the PU pods have the shallower criss-cross groove pattern due to the compression characteristics of the materials. The criss-cross groove patterns assists with securing the insole in the shoe cavity and keeping the insole in place such that it will not move or slide around The criss-cross groove pattern also allows for air circulation and/or provides different cushioning and spring properties.

[0691] For a men's size 11-12 insole, the width of the forefoot pad from the medial to lateral side is about 85 to 95 mm. The height is about 100 to 110 mm. The depth is about 0.95 to 1.50 mm.

[0692] It is desirable to minimize the total weight of the insoles by selection of materials working with the structural features of the insole. It is desirable that the total weight of the preferred embodiment of the insole (men's size 10/11) be about 4.0 ounces. It is desirable that the total weight of an alternate embodiment of the insole be about 5.0 to 6.0 ounces for a men's size 10/11 and about 6.5 to 7.5 ounces for a men's size 12/13. Other sizes will be proportional. Using the criss-cross groove pattern designs will help provide a lighter insole.

[0693] In a preferred embodiment, base is covered with top sheet from toe to heel areas of the insole, which is preferably a non-woven fabric layer with a low coefficient of friction so as to minimize the possibility of blisters. Preferably, top sheet is made of a cooling fabric which contains a special low temperature jade obtained from a natural source. The form of jade in the fabric is a jadeite. In a preferred embodiment, the fabric is treated with an antibacterial agent, which in combination with a moisture barrier reduces odor causing bacteria and fungi.

[0694] In a first preferred embodiment of the present invention, the various components of an insole which are secured to base in the recession areas defined by base on the bottom surface are permanently affixed to base using an appropriate means such as an adhesive. The components are also secured during the molding process using techniques known in the art of molding insoles.

[0695] The recession areas can also be lined with a cloth having a base surface and a pad/pod surface, secured to said base along said base surface and said pad/pod along said pad/pod surface. Alternatively, a cloth is secured to pad/pod and then the composite structure secured to the recession area.

[0696] Some shoes may slightly differ in size on the inner part of the shoe or provide extra padding along the inner walls that alter the space provided on the inner part of the shoe. Base may have sizing guides that allow a user to shorten the length of the insole for proper fit within the shoe, sizing guides provide various cutting guide lines that the user would cut along, preferably with scissors.

[0697] The dimensions and measurements shown in FIGS. **16**A-**16**D are dimensions and measurements of a second preferred embodiment which are incorporated herein.

[0698] While preferred embodiments of the invention have been shown and described, modifications thereof can be made by one skilled in the art without departing from the spirit and teachings of the invention. The embodiments described herein are exemplary only, and are not intended to be limiting. Many variations and modifications of the invention disclosed herein are possible and are within the scope of the invention.

Having described the invention, we claim:

1. An insole for use in a shoe having a top side for contacting a user's foot and a bottom side for contacting the inside of a user's shoe, comprising:

a. a base, said base having a base top surface and a base bottom surface, said base having a heel end, a toe end, a medial border and a lateral border, said medial and lateral borders extending from said heel end to said toe end along the medial and lateral sides of the insole, respectively, said base bottom side defining:

(i) a forefoot area extending from the toe end to a location behind a metatarsal head area of the feet,

(ii) a midfoot area that extends from said metatarsal head area to an edge that lies forward of the calcaneus of the foot,

(iii) a heel area that extends from said midfoot area to said heel end,

(iv) a forefoot pad recession area located in said forefoot area, and extending under the hallux of the foot from near the distal end of the base proximally to the front of the first metatarsal head, and

(v) a stability cradle recession area located essentially along the midfoot and heel areas of the foot,

b. an arch support located in said midfoot area, said arch support extends transverse upwardly along the medial border and under the arch of the foot;

c. a stability cradle made of semi-rigid material and secured to said stability cradle recession area of said base bottom side, said stability cradle having a plurality of pod openings that allow pod components to extend therethrough and said stability cradle having a faceted bottom surface;

d. a forefoot pad secured to said forefoot pad recession area, said forefoot pad extending laterally and proximally under the lesser metatarsal heads of the foot to beneath the greater metatarsals; and

e. a lateral heel pod extending through a lateral heel pod opening in said stability cradle and being located on the lateral side of said heel area, said lateral heel pod having a criss-cross groove pattern on its bottom surface, and

f. a medial heel pod being located on the medial side of the heel area and extending through a medial heel pod opening, said medial heel pod being separated from said lateral heel pod component by a groove gap and said medical heel pod having a criss-cross groove pattern on its bottom surface.

2. The insole of claim **1** wherein the pod disposed under the medial side of the heel is made of a firmer material than the material of the lateral heel pod.

3. The insole of claim **2**, wherein the firmness of the lateral heel pod is in the range of Shore C 45-50 and the firmness of the medial heel pod is approximately Shore C 60.

4. The insole of claim **2**, wherein the firmness of the lateral heel pod is in the range of Shore C 50-55 and the firmness of the medial heel pod is in the range of about Shore C 65-70.

5. The insole of claim **2**, wherein the firmness of the pods is selected to control a rate of pronation.

6. The insole of claim **2**, wherein the firmness of the pods is selected based on a type of activity for which the insole is designed.

7. The insole of claim **1**, wherein the stability cradle is shaped to enable flexing of the first metatarsal during toe off.

8. The insole of claim **1** further comprising:

a lateral midfoot pod located in the midfoot area along the lateral side of the insole and extending through a lateral midfoot pod opening, said lateral midfoot pod having a criss-cross groove pattern on its bottom surface.

9. The insole of claim **8**, wherein the firmness of the pods is selected to control the rate of pronation.

10. The insole of claim **8**, wherein the firmness of the pods is selected based on the type of activity for which the insole is designed.

11. An insole for use in a shoe having a top side for contacting a user's foot and a bottom side for contacting the inside of a user's shoe, comprising:

a. a base, said base having a base top surface and a base bottom surface, said base having a heel end, a toe end, a medial border and a lateral border, said medial and lateral borders extending from said heel end to said toe end along the medial and lateral sides of the insole, respectively,

b. an arch support extending transverse upwardly along the medial border and under the arch of the foot;

c. a stability cradle made of semi-rigid material with stability ribs, said stability cradle having pod openings that allow pod components to extend therethrough and said stability cradle having a faceted bottom surface;

d. a lateral heel pod extending through a lateral heel pod opening in said stability cradle on the lateral side of said heel area, said lateral heel pod components having a criss-cross groove pattern on its bottom surface,

e. a medial heel pod extending through a medial heel pod opening on the medial side of the heel area, said medial heel pod separated from said lateral heel pod component by a gap and said medial heel pod having a criss-cross groove pattern on its bottom surface, and

f. a lateral midfoot pod being located in the midfoot area along the lateral side of the insole and extending through a lateral midfoot pod opening, said lateral midfoot pod having a criss-cross groove pattern on its bottom surface.

12. The insole of claim **11** wherein the pod disposed under the medial side of the heel is made of a firmer material than the material of the lateral heel pod.

13. The insole of claim **12**, wherein the firmness of the lateral heel pod is in the range of Shore C 45-50 and the firmness of the medial heel pod is approximately Shore C 60.

14. The insole of claim **12**, wherein the firmness of the lateral heel pod is in the range of Shore C 50-55 and the firmness of the medial heel pod is in the range of about Shore C 65-70.

15. The insole of claim **12**, wherein the firmness of the pods is selected to control the rate of pronation.

16. The insole of claim **12**, wherein the firmness of the pods is selected based on the type of activity for which the insole is designed.

17. The insole of claim **11**, wherein the stability cradle is shaped to enable flexing of the 1st metatarsal during toe off.

18. The insole of claim **11** wherein the lateral midfoot pod is made of softer material than material used in medial heel pod.

19. The insole of claim **18**, wherein the firmness of the lateral midfoot pod is in the range of Shore C 45-50 and the firmness of the medial heel pod is approximately Shore C 60.

20. The insole of claim **18**, wherein the firmness of the lateral midfoot pod is in the range of Shore C 50-55 and the firmness of the medial heel pod is in the range of about Shore C 65-70.

21. A method of making a cushion to control the motion of a foot in a shoe, the method comprising:

providing a base having a base top surface and a base bottom surface, said base having a heel end, a toe end, a medial border and a lateral border, said borders extending from said heel end to said toe end, said base bottom side defining:

(a) a forefoot area extending from the toe end to a location behind a metatarsal head area of the feet,

(b) a midfoot area that extends from said metatarsal head area to an edge that lies forward of the calcaneus of the foot, and

(c) a heel area that extends from said midfoot area to said heel end;

coupling a stability cradle to the base, said stability cradle being made of semi-rigid material and said stability cradle secured to a stability cradle recession area of said base bottom side, said stability cradle recession area located essentially along the midfoot and heel areas of the foot, said stability cradle having pod openings that allow pod components to extend therethrough and said stability cradle having a faceted surface;

coupling an arch support to the base, said arch support extends transverse upwardly along the medial border and under the arch of the foot;

coupling a forefoot pad to the base, said forefoot pad extending laterally and proximally under the lesser metatarsal heads of the foot to beneath the greater metatarsal; and,

extending interacting cooperative pod components through pod openings in said stability cradle, said pod components including a lateral heel pod located on the lateral side of said heel area, a medial heel pod separated from said lateral heel pod and located on the medial side of said heel area, and a lateral midfoot pod located on the lateral side of the midfoot area of the insole, said pod components having a criss-cross groove pattern on their bottom surface.

22. The method of claim **21** wherein the medial heel pod is made of a firmer material than the material of the lateral heel pod.

23. The method of claim **22**, wherein the firmness of the lateral heel pod is in the range of Shore C 45-50 and the firmness of the medial heel pod is approximately Shore C 60.

24. The method of claim **22**, wherein the firmness of the lateral heel pod is in the range of Shore C 50-55 and the firmness of the medial heel pod is in the range of about Shore C 65-70.

25. The method of claim **21** wherein the medial heel pod is made of a firmer material than the material of the lateral midfoot pod.

26. The method of claim **25**, wherein the firmness of the lateral midfoot pod is in the range of Shore C 45-50 and the firmness of the medial heel pod is approximately Shore C 60.

27. The method of claim **25**, wherein the firmness of the lateral midfoot pod is in the range of Shore C 50-55 and the firmness of the medial heel pod is in the range of about Shore C 65-70.

28. The method of claim **21**, wherein the firmness of the pods is selected to control the rate of pronation.

29. The method of claim **21**, wherein the firmness of the pods is selected based on the type of activity for which the insole is designed.

30. The method of claim **21**, wherein the stability cradle is shaped to enable flexing of the first metatarsal during toe off.

31. The method of claim **21** wherein the base comprises an EVA foam material.

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