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(54) Title: FOOTWEAR INSOLE

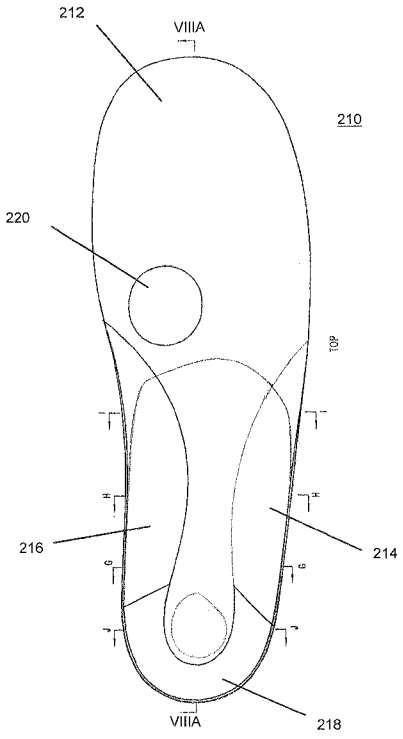

FIG. 7A

(57) Abstract: A human shoe sole or insole, sockliner or orthotic for insertion into a human shoe having a foot supporting upper surface including a first region for supporting at least the first, metatarsal head of the foot, and a second region surrounding the first region. The first region provides less resistance to downward motion than the second region, and includes a hollow or depressed area, sized and located to promote eversion of the first metatarsal head as the wearer moves from midstance through propulsive phase. Also provided human insole or orthotic for insertion into a human shoe having a bottom surface with a hard shell covering at least a heel portion of the bottom surface, which reduces the deformation of the footbed under load. The insole or orthotic may also include a series of grooves located to increase flexibility where necessary.

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FOOTWEAR INSOLE

This invention relates generally to footwear and, more particularly to insoles for footwear having features that improve the comfort for the wearer during standing, walking and running.

Footwear has undergone significant evolutionary advances in technology, particularly since the development of the electrodynogram which has permitted researchers to measure dynamic forces and to better understand biomechanical action of a human foot within a shoe while the wearer is walking or running. Using this tool, many researchers have made technological advances directed towards the mid-sole of a shoe. Since the mid-sole functions primarily as a suspension system of the sole of the foot, and often provides both protective cushioning and a stable platform for the wearer's foot, many conventional technologies have focused on cushioning the impact associated with foot strike by varying the spring coefficients in the mid-sole to dispense shock.

In my earlier U.S. Patent 4,597,195 I describe a discovery of a then previously misunderstood phenomena, functional hallux limitus, that is believed to affect a majority of the population. To treat functional hallux limitus I created an improved shoe sole design which permits the first metatarsal to better achieve plantarflex relative to the great toe and remaining metatarsal heads. As explained in my aforesaid '195 patent, plantarflex allows for the extension of the human great toe during human gate cycle in an efficient fashion. More particularly in accordance with my prior '195 patent, I created a human shoe sole having an area of reduced support underlying substantially only the location of the first metatarsal head of the wearer's foot. As described in my '195 patent, providing an area of reduced support substantially only under the head of the first metatarsal encourages eversion and plantarflexion of the first metatarsal head as weight shifts from the heel to the first ray. Thus the normal functioning of the foot for plantarflexion and supination is encouraged with beneficial results for improved walking comfort and shock absorption on subsequent heel contact. Following my discovery millions of pairs of shoes have been manufactured with foot beds having an area of reduced support underlying substantially only the location of the first metatarsal head of the wearer's foot, to encourage plantarflexion of the first metatarsal head.

In one aspect, the present invention provides an improved insole which incorporates an area of reduced support which includes an asymmetrically shaped depression under the first metatarsal head, fashioned with its lowest point skewed to the medial side of center. This unique shape further encourages the first metatarsal head into eversion as the wearer moves from midstance to propulsive phase.

As used herein the term "sole" and "inner sole" are used interchangeably. Moreover, a "sole" or "insole" may be an element built into or forming an integral element of a footwear product such as an insole board, or as a separate element, including, e.g. a sock liner or removable insole, an after-market insole device, or a custom or prefabricated foot orthotic, which may be inserted into a footwear product post-manufacture. The element also may be cut into or formed in the foot supporting surface of a shoe.

In another aspect, the present invention provides an insole or orthotic for insertion into a human shoe having a foot supporting upper surface having regions of varying hardness that approximately match the regions of varying hardness of the underside of the wearer's foot, and a bottom surface comprising a hard shell covering at least a heel portion of the bottom surface. The hard shell may include side walls that partially surround the heel portion of the insole. The insole or orthotic may also include an asymmetric heel pad which corresponds to the shape of the calcaneus. The hard shell includes a depression corresponding to the asymmetric heel pad, so that the upper surface is apparently undisturbed. The bottom surface preferably also includes a plurality of grooves that are located under the second, third, fourth and fifth metatarsal heads of the foot which grooves serve to increase flexibility of the insole.

Yet another aspect of the present invention provides an insole or orthotic for insertion into a human shoe having a foot supporting upper surface including a first region for supporting at least the first metatarsal head of the foot, and a second region surrounding the first region for supporting the remainder of the foot, at least in part, wherein the first region provides less resistance to downward motion than the second region, wherein the depression has its lowest point skewed to the medial side of center, whereby to promote eversion of the first metatarsal head as the wearer moves from midstance through propulsive phase. The depression is formed in a location

that is approximately 72.5% of the length of the length of the insert, measured from the heel, minus 10 mm.

Still yet another aspect of the present invention provides an insole for insertion into a human shoe having a foot supporting upper surface, and a bottom surface comprising a hard shell covering at least a heel portion of the bottom surface. The bottom surface includes a plurality of grooves that are located in the insole or orthotic beneath the second, third, fourth and fifth metatarsal heads of the foot, forward of the first metatarsal head, which grooves serve to increase flexibility of the insole or othotic. The invention also includes a plurality of vent holes connecting the grooves to the upper surface for passing moisture away from the upper surface.

Finally, the present invention provides further improvements in insoles for footwear which can be used alone or in combination with a depression under the metatarsal as described in my earlier '195 patent and as described above.

Further features and advantages of the present invention will be seen from the following detailed description, taking in conjunction with the accompanying drawings, wherein:

FIG. 1 is a top plan view of a sole incorporating an insert according to a first embodiment of my present invention for the right foot;

FIG. 1A is a top plan view showing details of an insert element, with contour lines taken at 0.3 cm superimposed thereon, according to the first embodiment;

FIGs. 2A-2C are cross-sectional views taken along lines IIA-IIC of FIG. 1;

FIG. 2D is a cross-sectional view taken along lines IID of Fig. 1;

FIG. 3 is a top plan view, and FIG. 4 a transparent perspective view, with contour lines taken at 0.3 cm superimposed thereon, showing details of portions of a second embodiment of the insert element of my invention;

FIG. 5 is a cross-sectional view showing a third embodiment of my invention;

FIG. 6 is a perspective view of a sole according to a fourth embodiment of my invention;

FIGs. 7A and 7B are top and bottom, respectively, of an insert element constructed in accordance with a fifth embodiment of my invention;

FIGs. 8A and 8B are cross-sectional views taken along lines VIIIA and VIIIB of FIGs. 7A and 7B;

FIGs. 9A and 9B are top and side views of a shell in accordance with the embodiment shown in FIGs. 7A and 7B; and

FIGs. 10A and 10B are cross-sectional views taken along lines XA and XB of FIGs. 9A and 9B.

Referring to FIGs. 1, 1A and 2A-D of the drawings, footwear made in accordance with the present invention includes foot supporting surfaces, i.e., a sole, designated reference numeral 10, having a heel section 12, an arch section 14, a forefoot section 16 and a toe section 18, corresponding to parts of a wearer's foot. In use, the heel section 12 underlies the heel of the wearer's foot and includes medial and lateral regions designated 20, 22, respectively corresponding to the inner and outer sides of the foot. Likewise, the arch section 14 which is forward the heel section 12, underlies the arch of the wearer's foot and also includes medial and lateral regions 24, 26, respectively. The forefoot section 16 is forward the arch section 14 and includes the so-called ball of the foot which includes the first, second, third, fourth and fifth metatarsals indicated in phantom at M1-M5. The ball of the foot also includes first, second, third, fourth and fifth metatarsal heads (N1-N5) associated with the respective first, second, third, fourth and fifth metatarsal heads, and first, second, third, fourth and fifth proximal phalanges (PP1-PP5) forward of the respective first, second, third, fourth and fifth metatarsal heads, and associated metatarsal first, second, third, fourth and fifth metatarsal phalangeal joints (not labeled) between the associated metatarsal heads and proximal phalageals. The forefoot section 16 is divided into first and second regions designated 28 and 30, respectively. The first region 28 is adapted to underlie the first, second, third, and fourth metatarsal heads and optionally the fifth metatarsal head, in part, while the second region 30 is adapted to underlie the proximal phalanges (PP1-PP5), at least in part. The toe section 18 of the sole is spaced forward of the forefoot section 16 and underlies at least the middle phalanges MP2-MP5 and distal phalanges DP1-DP5 of the toe of the wearer's foot.

The sole 10 is formed so that an area of reduced support or reduced resistance to downward loading or movement is located in the first region 28 of the forefoot section 16. The first region 28 is formed of a resiliently deformable material that offers less resistance to downward movement than the region surrounding the first region, i.e. the second region 30, and also the toe section region 18. Region 28 may

be formed of a material having a lower durometer than the surrounding regions 30 and 18. Preferably, region 28 will have a Shore A hardness in the range of 30-35, which closely matches the hardness of the fat pad of a typical human foot. Alternatively, region 28 may be made thinner so as to at least in part fall below the surface of the second region 30 and toe section 18. Region 28 may be formed as a separate element, e.g. a plug or insert 40 cut or built into the sole 10, or as a recess formed in the top or bottom surface of the sole, e.g. by molding or by machining. Region 28 may be covered by a flexible liner (not shown).

Also, a region within region 28, underlying substantially only the first metatarsal head of the wearer includes a hollow or depression 42, relative to the remainder of region 28, of asymmetric shape, with the lowest point of the hollow or depression skewed to the medial side of center. That is to say, as seen particularly in Fig. 1A, the hollow or depression 42 has a shallower slope on its lateral side.

In practice, depression 42 is round or nearly round in plan, and the corresponding medial and lateral walls 44 and 46 are also somewhat rounded or curved. Accordingly, as used herein, "slope" is an imaginary line or cord running between the top edge of the side wall and a point where the side wall morphs into the bottom of the depression. This is best seen by phantom line 43 (Fig. 4) which is an imaginary cross-sectional line through the midpoint of insert 40. This unique geometry has the effect of rotating the first metatarsal head of the wearer into eversion as the wearer moves from midstance to propulsive phase.

In dimensions, the hollow depression 42 should be large enough in plan to accommodate the first metatarsal head, at least in part. In a typical embodiment, depression 42 is substantially circular in plan, preferably having a diameter of about 2.54 cm. to about 3.81 cm., depending on foot size. The depression also may be oval, egg-shaped, or elongated in plan, and should have a nominal depth preferably in the range of about 2-3 mm measured from the top edge of the side walls to the lowest point of the depression. Despite this relatively small amount, this has a profound effect of rotating the first metatarsal head into eversion as the wearer moves from midstance to propulsive phase. In an alternative embodiment, the depression 42A is somewhat elongated and slightly wider at its toward end, e.g. as shown in FIG. 3-4.

The soles described above may be used with street and sport footwear including sandals. As noted above, the soles may be incorporated into an insole board at the time of manufacture, formed as a sock liner or as an aftermarket insole device or a custom or prefabricated (over-the-counter) orthotic for placing into a shoe by the wearer.

FIG. 6 is an illustration of a shoe sole 110, in accordance with one embodiment of the present disclosure. The shoe sole 110 includes a composite insole having a footbed 112, a lateral arch region 114, a medial arch region 116, and a heel region 118. The footbed 112 and the lateral arch region 114 have a first hardness value. The medial arch region 116 has a second hardness value that is softer than the first hardness value. The heel region 118 has a third hardness value that is harder than the first hardness value.

In use, the heel region 118 underlies the heel of the wearer's foot. Likewise, the lateral arch region 114 and the medial arch region 116 underlie the arch of the wearer's foot. The footbed 112 extends from the central space between the lateral arch region 114 and the medial arch region 116 to the fore of the shoe sole 110, beneath the ball of the wearer's foot, including the first, second, third, fourth, and fifth metatarsals. Varying durometers of the shoe sole 110 are selected to approximately match the regions of varying hardness of the underside of the wearer's foot. While foot shapes and size vary from person to person, anthropometric studies show that the hardness of the "fat pad" of the bottom of the average human foot does not vary significantly. Accordingly, we have determined that footwear may be made significantly more comfortable to the average user, and bio-mechanical efficiency improved by varying the hardness of the insole to approximately match the regions of varying hardness of the underside of the wearer's foot. In essence, in the context of the present invention, applicants mechanically impedance match the insole to the underside of the foot so that the amount the insole moves for given force is essentially the same as the movement of the padding of the underside of the foot. In this way, the insole is a natural extension of the padding of the underside of the foot. For example, the first hardness value may be approximately 20 to 60 Shore C, preferably about 40 Shore C, the second hardness value may be approximately 15 to 55 Shore C, preferably about 35 Shore C, and the third hardness value may be approximately 30 to

70 Shore C, preferably about 50 Shore C, where Shore C is a durometer scale recognized by the American Society for Testing and Materials. Under Shore A, another durometer scale recognized by the American Society for Testing and Materials, those preferred values are approximately 20 Shore A, 15 Shore A, and 30 Shore A, respectively.

While the footbed 112 and the lateral arch region 114 are described as having the first hardness value, these two regions may have slightly different hardness values without departing from the scope of the present disclosure. Rather these regions are described together based upon having approximately similar hardness values relative to the heel region 118 and the medial arch region 116.

In another embodiment of the invention, the footbed 112 may also have a depression or hollow 120 located approximately beneath the location of the first metatarsal head of a user's foot, i.e. in accordance with the teachings of my aforesaid U.S. Patent 4,597,195 or my aforesaid co-pending U.S. Application Serial No. 12/534,741, and as described above with reference to Figs. 1-5. As described in my aforesaid '741 application, and above, the hollow or depression 120 promotes eversion of the first metatarsal head as the wearer moves from midstance through propulsive phase. This hollow or depression 120 should have the same approximate hardness as footbed 112 and the lateral arch region 114, though differences may be expected depending on the method of production.

FIGs. 7A-10B depict a further embodiment of the invention which combines some of the features discussed above with additional improvements. This embodiment features an insert 210 having a depression 220 that is located and sized to accommodate most users. By using a formula to predict the proper location of the depression, the inserts can be produced to predictably accommodate approximately 95% of users. The optimal location for the depression, as measured from the back of the heel portion 218, is 72.5% of the length of the foot (or the length of a typical foot for a particular shoe size, as the case may be), minus 10 mm based on anthropometry studies conducted by the United States Army Natick Research, Development and Engineering Center, Technical Report Natick/TR-92/028, entitled "Anthropometry of the Foot and Lower Leg of U.S. Army Soldiers: Fort Jackson, SC-1985", by Kenneth R. Parham, Claire C. Gordon, and Carolyn K. Bensel, Final Report, dated September

1992. The depression itself is appropriately sized according to any of the methods described above or in the aforementioned, commonly owned, patent applications.

As with the examples described above, the insert may be constructed with a multidurometer top surface intended to match the hardness of various regions of the typical adult foot. In this example, lateral arch region 214 and the footbed region 212 are constructed with a Shore C hardness of 40, the medial arch region 216 is constructed with a Shore C hardness of 35, and the heel region 218 is constructed with a Shore C hardness of 50. These hardness levels are typical, but may vary, for example, by ± 5 on the Shore C hardness scale.

Another advantageous feature of this embodiment is shell 230, which is included to provide structural support and to reduce the deformation of the geometry of the footbed under load. The shell 230 typically is formed of a material, such as a hard plastic, that meets this criteria without significantly increasing the cost of manufacturing the insert. In the example depicted by the figures, the shell is located on the bottom of the insert, and covers roughly half of the bottom of the insert, including the heel. Shell 230 can be seen as a separate component in FIGs. 9A-10B. Alternatively, the insert may be constructed with a shell that covers as much as the entire bottom of the insert. In any event, the shell should always be configured to cover the area of the heel. The hard shell may also comprise sidewalls 232, which surround the heel portion of the insert to aid the alignment of the insert with the heel and to provide some lateral support.

FIGs. 7B and 8B show an additional feature of the present embodiment, wherein the insert includes an asymmetric portion 236 in the insert beneath the heel. This feature more appropriately matches the irregular surface of the bottom of the calcaneus, thus improving comfort. The shell includes a corresponding depression, heel depression 234, which further provides some plantar relief without disturbing the top surface geometry. Depression 234 can also be seen independent of the asymmetric heel pad in FIGs. 9A, 10A and 10B. Upward projecting solutions, in contrast, do not provide significant relief to the irregular geometry of the calcaneus.

Further, the example shown includes a frictional surface 238, which can be located surrounding the asymmetric portion 236 of the insert, which is shown protruding through the heel depression in the shell 230. The frictional surface

provides a non-slip surface so that the insert stays securely in place. Frictional surface 238 may be in the form of a ridge 244, as shown in FIG. 8B. Alternatively, the surface may be a deformable material with a high coefficient of friction.

This embodiment also includes a series of grooves 240 on the bottom of the insert. These grooves are sized and located to increase the flexibility of the insert where appropriate. The grooves may provide access to a plurality of vent holes 244, which are arranged to allow moisture to pass through the insert, thereby avoiding further discomfort. However, the grooves should end forward of the first metatarsal head, leaving flat portion 242, thereby advantageously reducing the flexibility of the insole under the big toe.

The various regions of the device, according to any of the embodiments described above, may be manufactured unitarily, may be co-extruded, bonded together, adhesively joined, chemically joined, mechanically joined, or unified in any manner known to those having ordinary skill in the art. The shoe sole device may be used with men's, women's and children's street and sport footwear, including sandals. The shoe sole may be incorporated into an insole board at the time of manufacture, formed as a sock liner, or as an aftermarket insole device or a custom or prefabricated over-the-counter orthotic for placing into a shoe by the wearer. If formed within a sock liner, insole board, or other similar encompassing product, the various regions of the shoe sole 10 may not be joined to each other, but may simply be held in place by the encompassing product.

Various changes can be made in the above construction without departing from the scope of the invention. For example, an asymmetrically shaped hollow having tapered side walls skewed to the medial side of center may be formed extending downwardly from the bottom of an insole board or sock liner of a shoe, and underlying substantially only the first metatarsal head. It is intended therefore that matter contained in the above description or shown in the accompanying drawings shall be interpreted as an illustrative and not in a limiting sense.

What is claimed is:

1. An insole, orthotic or sockliner for insertion into a human shoe having a foot supporting upper surface having regions of varying hardness that approximately match the regions of varying hardness of the underside of the wearer's foot, and a bottom surface comprising a hard shell covering at least a heel portion of the bottom surface.

2. The insole, orthotic or sockliner of claim 1, characterized by one or more of the following features:

(a) wherein the hard shell includes side walls that partially surround the heel portion of the insole;

(b) further comprising an asymmetric heel pad, and optionally further comprising a depression in the hard shell corresponding to the asymmetric heel pad;

(c) wherein the hard shell further comprises a frictional surface for preventing slipping;

(d) wherein the bottom surface includes a plurality of grooves that are located beneath the second, third, fourth and fifth metatarsal heads of the foot, and forward of the first metatarsal head of the foot;

(e) including a footbed, a lateral arch region, a medial arch region and a heel region, wherein the footbed and the lateral arch region have a first hardness value, the medial arch region has a second hardness value that is softer than the first hardness value, and the heel region has a third hardness value that is harder than the first and second hardness values;

(f) wherein the footbed includes a forward region which includes a hollow or depression underlying the first metatarsal head of the wearer; and

(g) wherein the medial arch region has a second hardness value that is at least 5 Shore C points softer than the first hardness value, but not more than 10 Shore C points softer, and the heel region has a third hardness value that is at least 10 Shore C points harder than the first hardness values, but not more than 20 Shore C points harder.

3. An insole, orthotic or sockliner for insertion into a human shoe having a foot supporting upper surface including a first region for supporting at least the first metatarsal head of the foot, and a second region surrounding the first region for

supporting the remainder of the foot, at least in part, wherein the first region provides less resistance to downward motion than the second region, wherein the first region includes a hollow or depressed area relative to the remainder of the first region having a medial border portion and a lateral border portion, wherein the depression has its lowest point skewed to the medial side of center, whereby to promote eversion of the first metatarsal head as the wearer moves from midstance through propulsive phase, wherein the depression is formed in a location that is approximately 72.5% of the length of the length of the insert, measured from the heel, minus 10 mm.

4. The insole, orthotic or sockliner of claim 3, characterized by one or more of the following claims:

(a) wherein the first region has a lower durometer than the second region, and wherein the first region preferably has a Shore A hardness of 30-35;

(b) wherein the first region is formed of a plug of material surrounded by the second region;

(c) wherein the depressed area comprises an opening formed and extending from the upper foot supporting surface;

(d) wherein the depression comprises a hollow formed below the foot supporting upper surface; and

(e) having a bottom surface that includes a hard shell covering at least a heel portion of the bottom surface.

5. An insole or orthotic for insertion into a human shoe having a foot supporting upper surface, and a bottom surface comprising a hard shell covering at least a heel portion of the bottom surface, wherein the bottom surface includes a plurality of grooves located beneath the second, third, fourth and fifth metatarsal heads of the foot, and forward of the first metatarsal of the foot, and an asymmetric heel pad having a depression located beneath the heel.

6. The insole or orthotic of claim 5, characterized by one or more of the following features:

(a) futher including a plurality of vent holes connecting the grooves to the upper surface for passing moisture away from the upper surface;

(b) wherein the hard shell includes side walls that partially surround the heel portion of the wearer's foot;

(c) wherein the depression in the hard shell is tear shaped; and

(d) wherein the depression comprises a hole formed in the hard shell.

7. A human shoe having a foot supporting upper surface having regions of varying hardness that approximately match the regions of varying hardness of the underside of the wearer's foot, and a bottom surface comprising a hard shell covering at least a heel portion of the bottom surface.

8. The human shoe sole of claim 7, characterized by one or more of the following features:

(a) wherein the hard shell includes side walls that partially surround the heel portion of the insole;

(b) further comprising an asymmetric heel pad;

(c) further comprising a depression in the hard shell corresponding to the asymmetric heel pad;

(d) wherein the hard shell further comprises a frictional surface for preventing slipping;

(e) wherein the bottom surface includes a plurality of grooves that are located beneath the second, third, fourth and fifth metatarsal heads of the foot, and and forward of the first metatarsal head of the foot;

(f) including a footbed, a lateral arch region, a medial arch region and a heel region, wherein the footbed and the lateral arch region have a first hardness value, the medial arch region has a second hardness value that is softer than the first hardness value, and the heel region has a third hardness value that is harder than the first and second hardness values, wherein the footbed preferably includes a forward region which includes a hollow or depression underlying the first metatarsal head of the wearer; and

(g) wherein the medial arch region has a second hardness value that is at least 5 Shore C points softer than the first hardness value, but not more than 10 Shore C points softer, and the heel region has a third hardness value that is at least 10 Shore C points harder than the first hardness values, but not more than 20 Shore C points harder.

9. A human shoe having a foot supporting upper surface including a first region for supporting at least the first metatarsal head of the foot, and a second region

surrounding the first region for supporting the remainder of the foot, at least in part, wherein the first region provides less resistance to downward motion than the second region, wherein the first region includes a hollow or depressed area relative to the remainder of the first region having a medial border portion and a lateral border portion, wherein the depression has its lowest point skewed to the medial side of center, whereby to promote eversion of the first metatarsal head as the wearer moves from midstance through propulsive phase, wherein the depression is formed in a location that is approximately 72.5% of the length of the length of the insert, measured from the heel, minus 10 mm.

10. The human shoe sole of claim 9, characterized by one or more of the following features:

(a) wherein the first region has a lower durometer than the second region, wherein the first region preferably has a Shore A hardness of 30-35;

(b) wherein the first region is formed of a plug of material surrounded by the second region;

(c) wherein the depressed area comprises an opening formed in and extending from the foot supporting upper surface;

(d) wherein the depression comprises a hollow formed below the foot supporting upper surface; and

(e) having a bottom surface that includes a hard shell covering at least a heel portion of the bottom surface.

11. A human shoe having a foot supporting upper surface, and a bottom surface, the bottom surface includes a plurality of grooves located beneath the second, third, fourth and fifth metatarsal heads of the foot, and forward of the first metatarsal of the foot, and an asymmetric heel pad having a depression located beneath the heel.

12. The human shoe sole of claim 11, characterized by one or more of the following features:

(a) further including a plurality of vent holes connecting the grooves to the upper surface for passing moisture away from the upper surface;

(b) wherein the foot supporting upper surface includes side walls that partially surround the heel portion of the wearer's foot; and

(c) wherein the depression beneath the heel is tear shaped.

13. An insole, or orthotic or sockliner for insertion into a human shoe having a foot supporting upper surface having regions of varying hardness that approximately match the regions of varying hardness of the underside of the wearer's foot.

14. The insole, or orthotic or sockliner of claim 13, wherein the foot supporting upper surface includes a footbed, a lateral arch region, a medial arch region and a heel region, wherein the footbed and the lateral arch region have a first hardness value, the medial arch region has a second hardness value that is softer than the first hardness value, and the heel region has a third hardness value that is harder than the first and second hardness values.

15. The insole, or orthotic or sockliner of claim 12, characterized by one or more of the following features:

(a) wherein the lateral arch region has a Shore C hardness value of 20 to 60;

(b) wherein the lateral arch region has a Shore C hardness of about 40;

(c) wherein the medial arch region has a Shore C hardness of about 15 to 55;

(d) wherein the medial arch region has a Shore C hardness of about 35;

(e) wherein the heel region has a Shore C hardness of about 30 to 70;

(f) wherein the heel region has a Shore C hardness of about 50;

(g) wherein the footbed includes a forward region which includes a hollow or depression underlying the first metatarsal head of the wearer; and

(h) wherein the medial arch region has a second hardness value that is at least 5 Shore C points softer than the first hardness value, but not more than 10 Shore C points softer, and the heel region has a third hardness value that is at least 10 Shore C points harder than the first hardness values, but not more than 20 Shore C points harder.

16. A human shoe having a foot supporting upper surface having regions of varying hardness that approximately match the regions of varying hardness of the underside of the wearer's foot.

17. The human shoe of claim 16, wherein the foot supporting upper surface includes a footbed, a lateral arch region, a medial arch region and a heel region, wherein the footbed and the lateral arch region have a first hardness value, the medial

arch region has a second hardness value that is softer than the first hardness value, and the heel region has a third hardness value that is harder than the first and second hardness values.

18. The human shoe of claim 16, characterized by one or more of the following features:

(a) wherein the lateral arch region has a Shore C hardness value of 20 to 60;

(b) wherein the lateral arch region has a Shore C hardness of about 40;

(c) wherein the medial arch region has a Shore C hardness of about 15 to 55;

(d) wherein the medial arch region has a Shore C hardness of about 35;

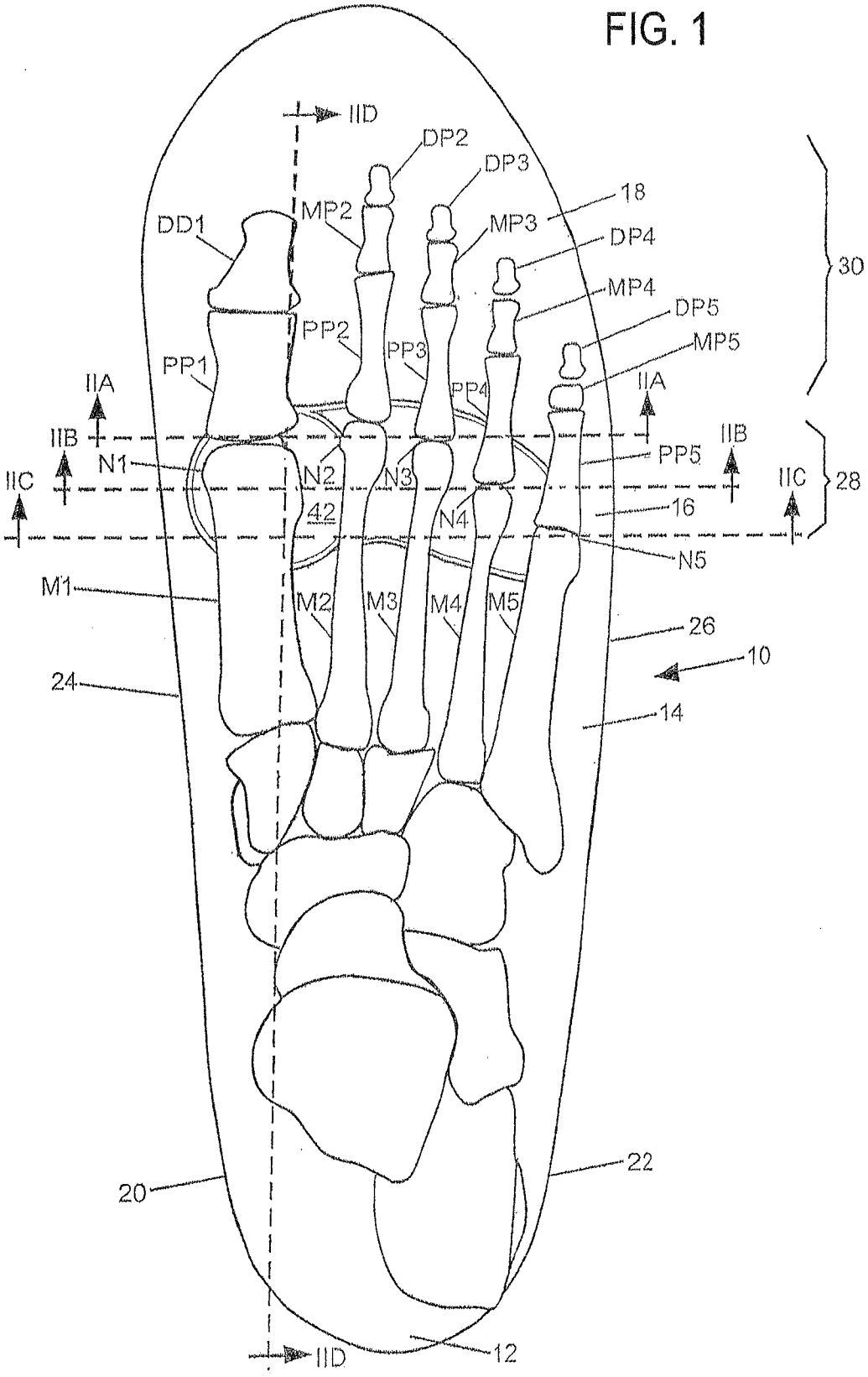
(e) wherein the heel region has a Shore C hardness of about 30 to 70;

(f) wherein the heel region has a Shore C hardness of about 50;

(g) wherein the upper surface includes a forward region which includes a hollow or depression underlying the first metatarsal head of the wearer; and

(h) wherein the medial arch region has a second hardness value that is at least 5 Shore C points softer than the first hardness value, but not more than 10 Shore C points softer, and the heel region has a third hardness value that is at least 10 Shore C points harder than the first hardness values, but not more than 20 Shore C points harder.

FIG. 1


IID
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DP3
18
DD1
MP2
MP3
DP4
MP4
DP5
MP5
30
PP2
PP3
PP1
PP4
IIA
IIA
IIB
IIB
PP5
N1
N2
N3
IIC
IIC
28
42
N4
16
N5
M1
M2
M3
M4
M5
26
10
24
14
22
20
IID
12

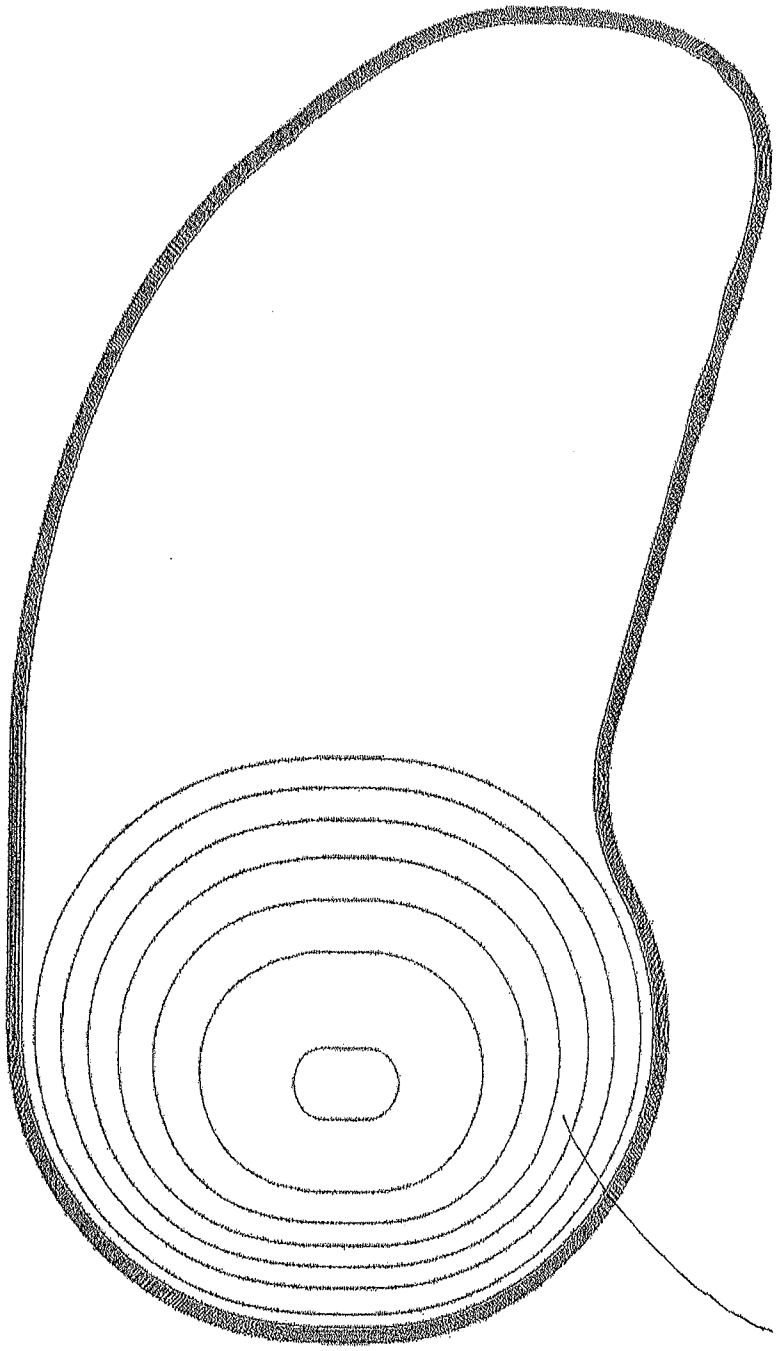


FIG. 1A

FIG. 2A

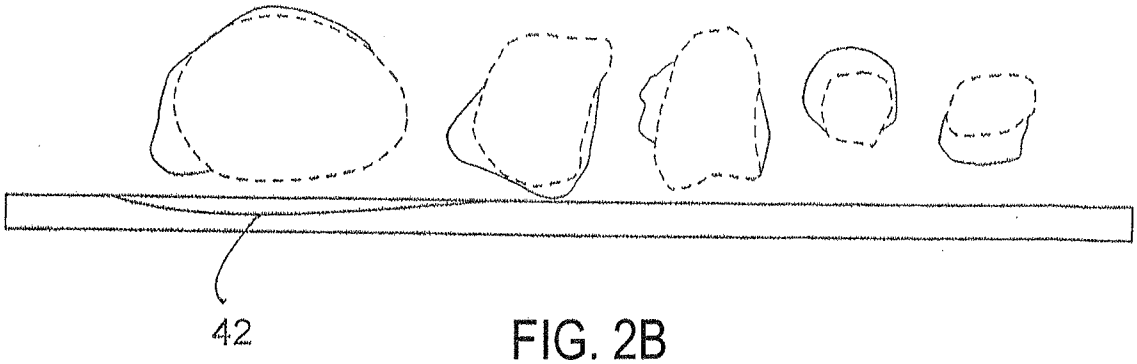


FIG. 2B

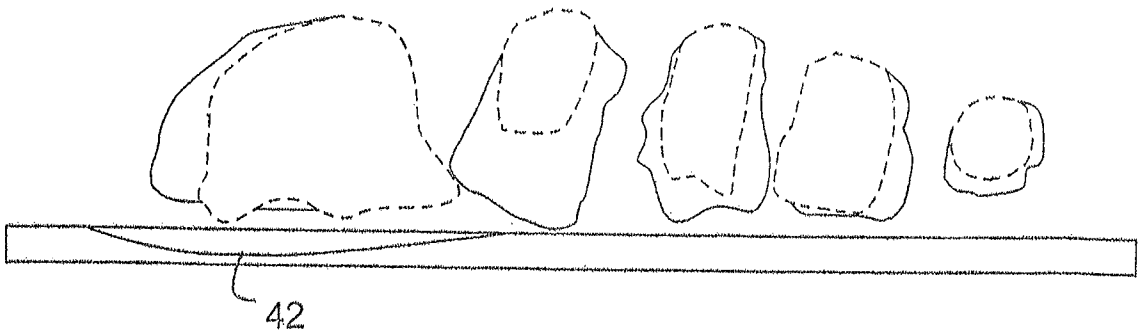
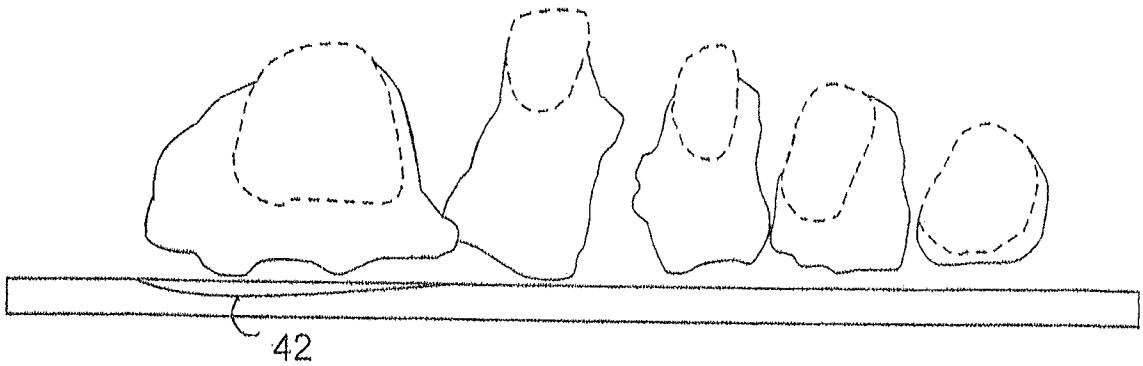


FIG. 2C



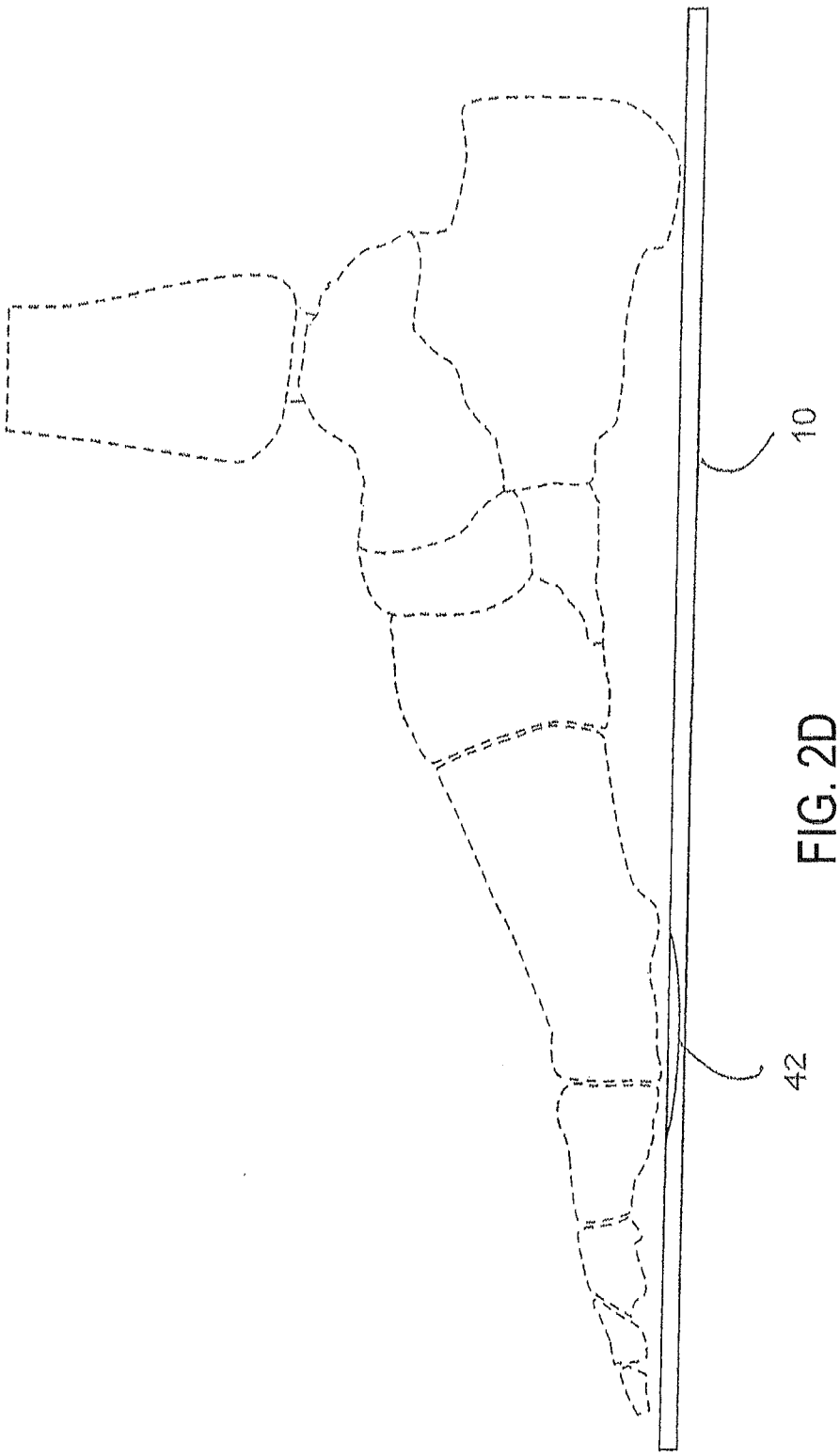


FIG. 2D

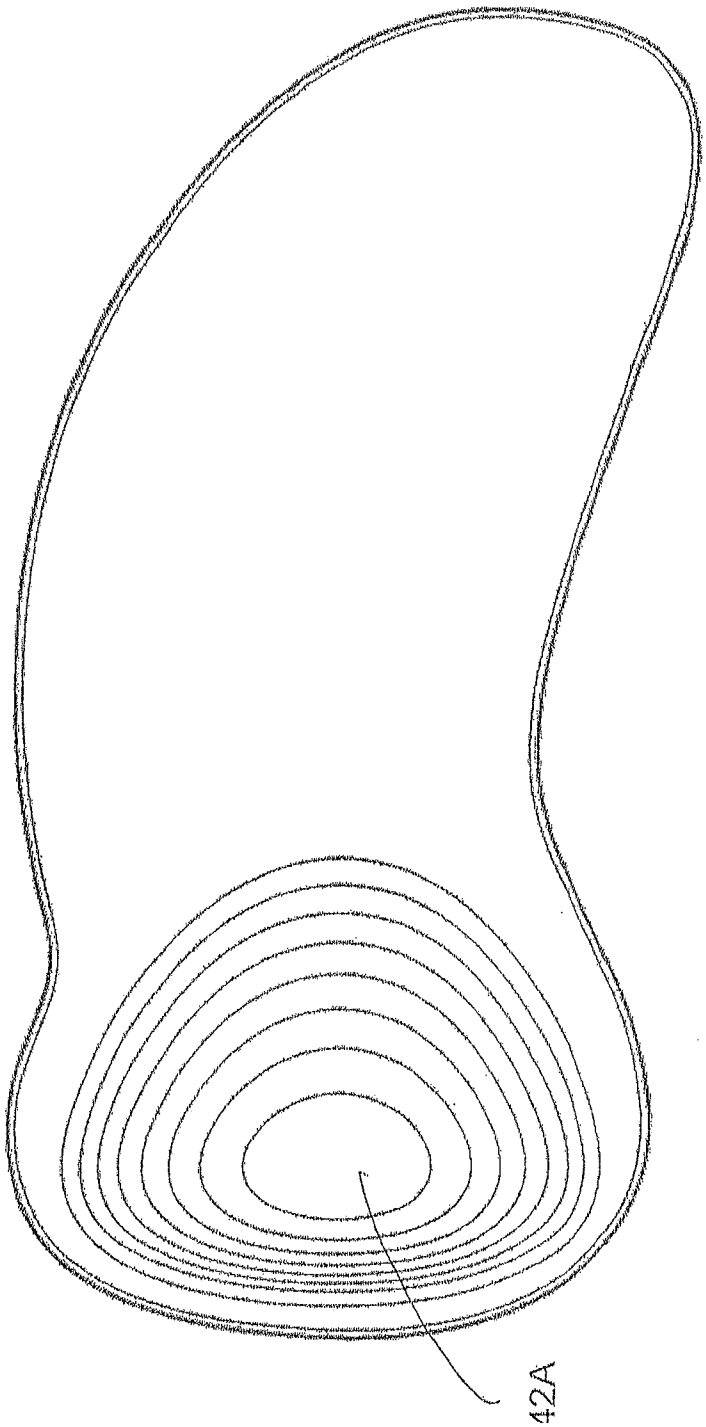


FIG. 3

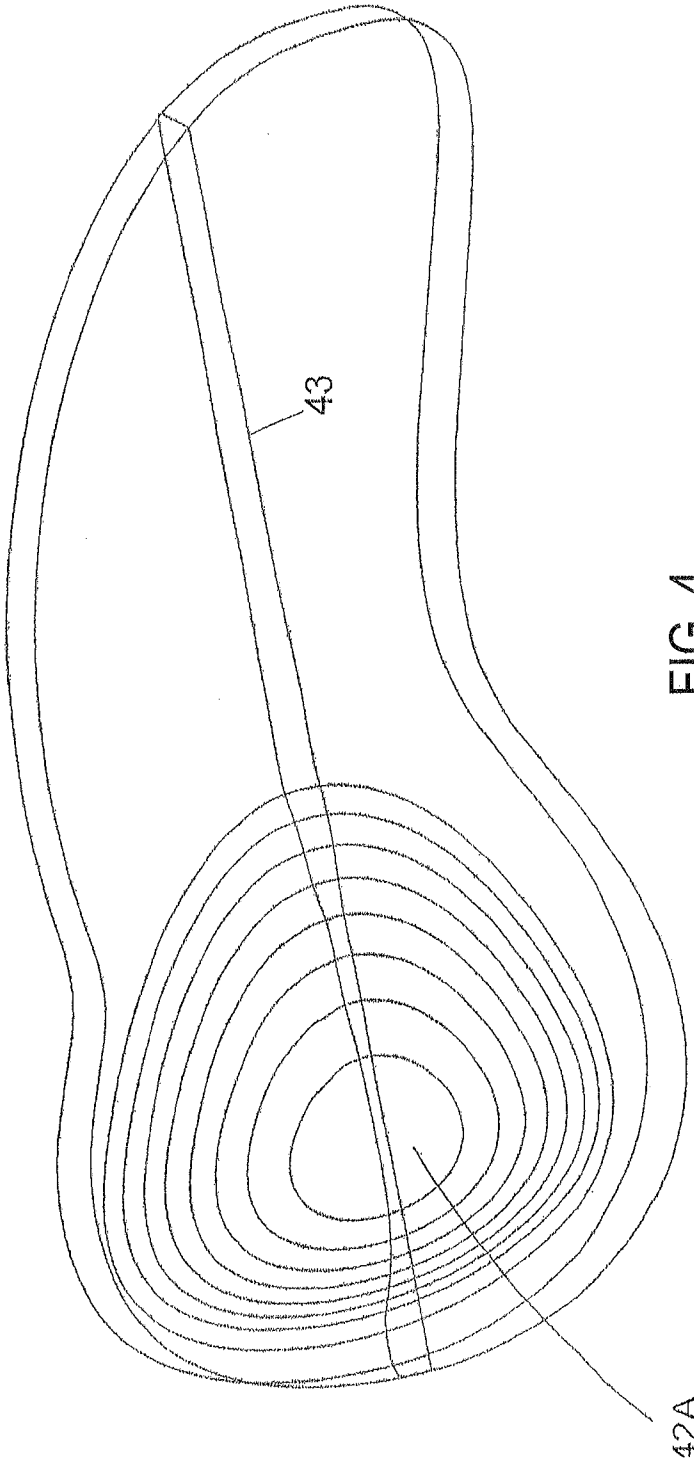


FIG. 4

FIG. 5

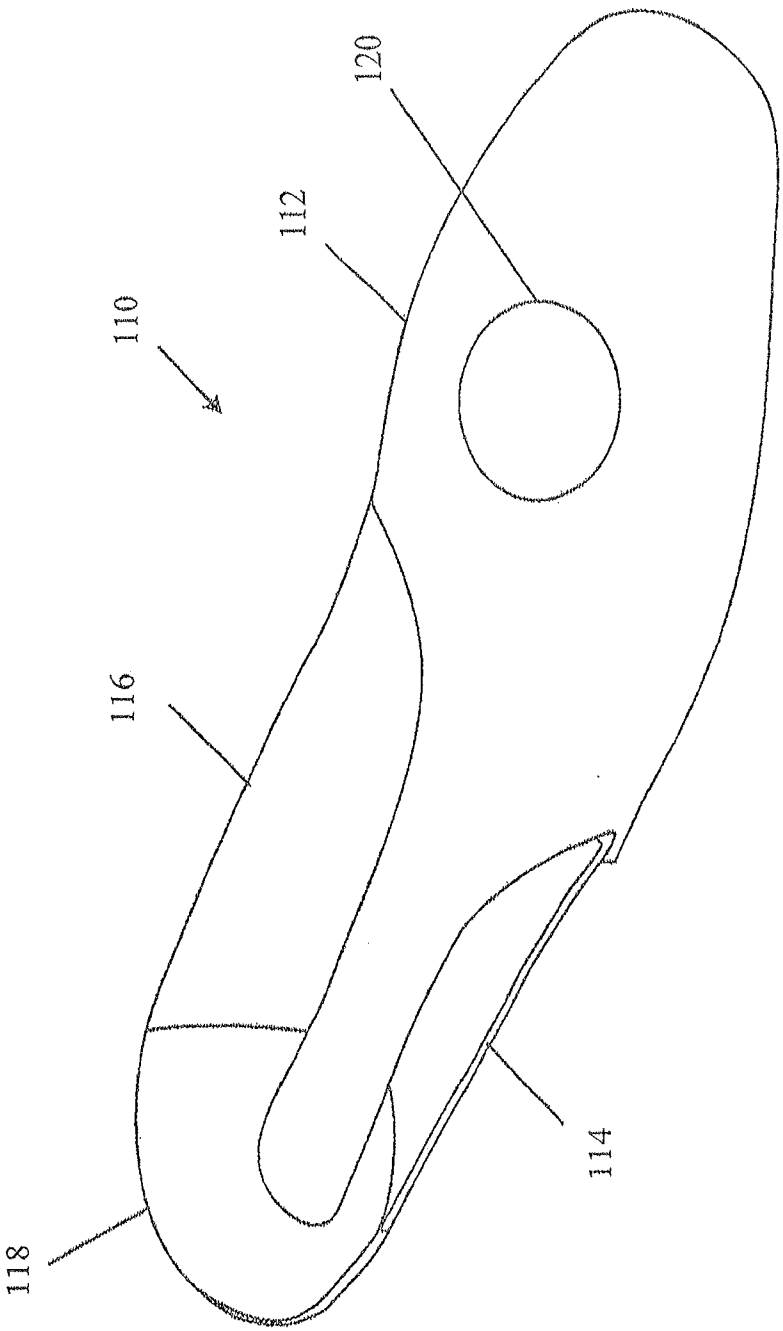


FIG. 6

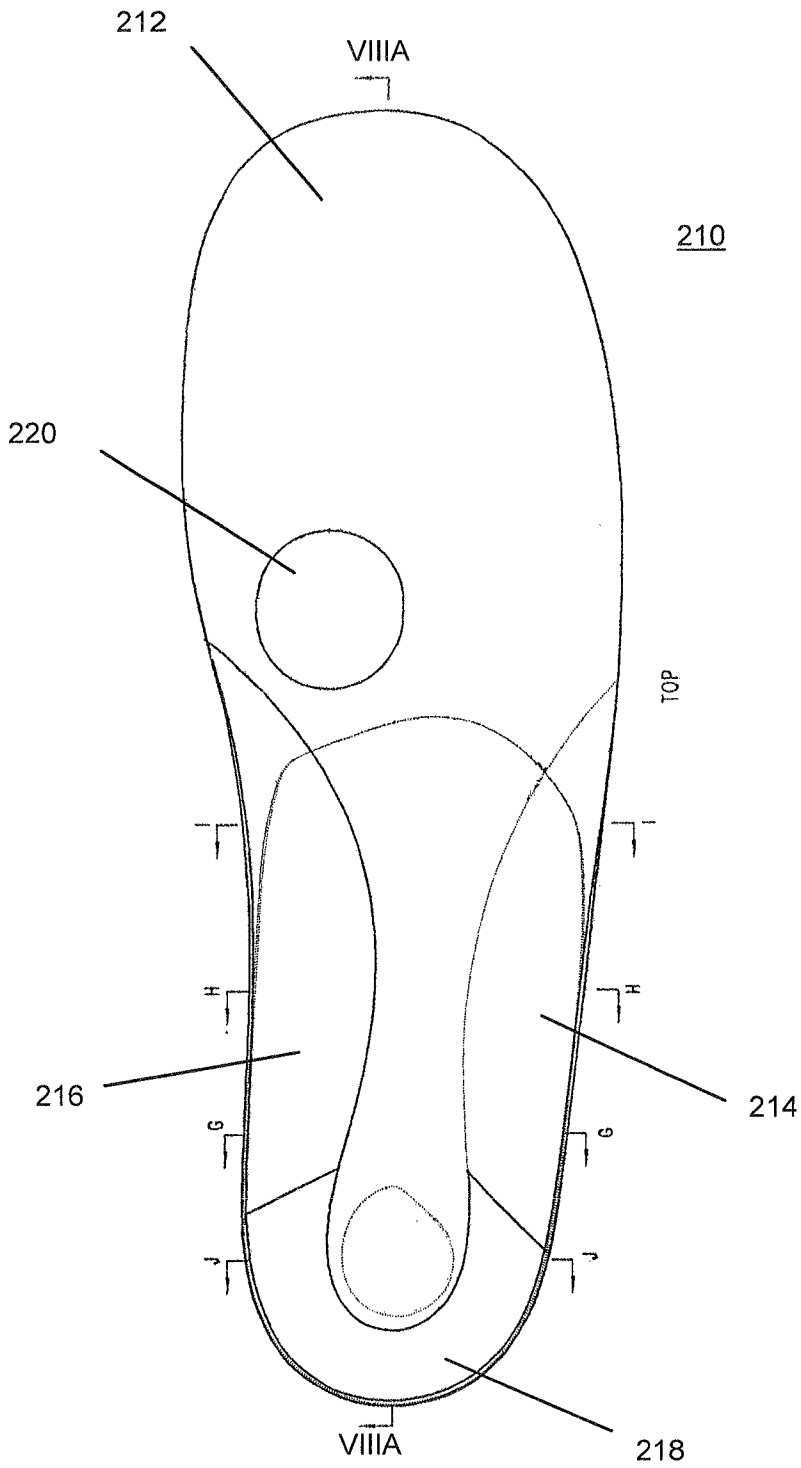


FIG. 7A

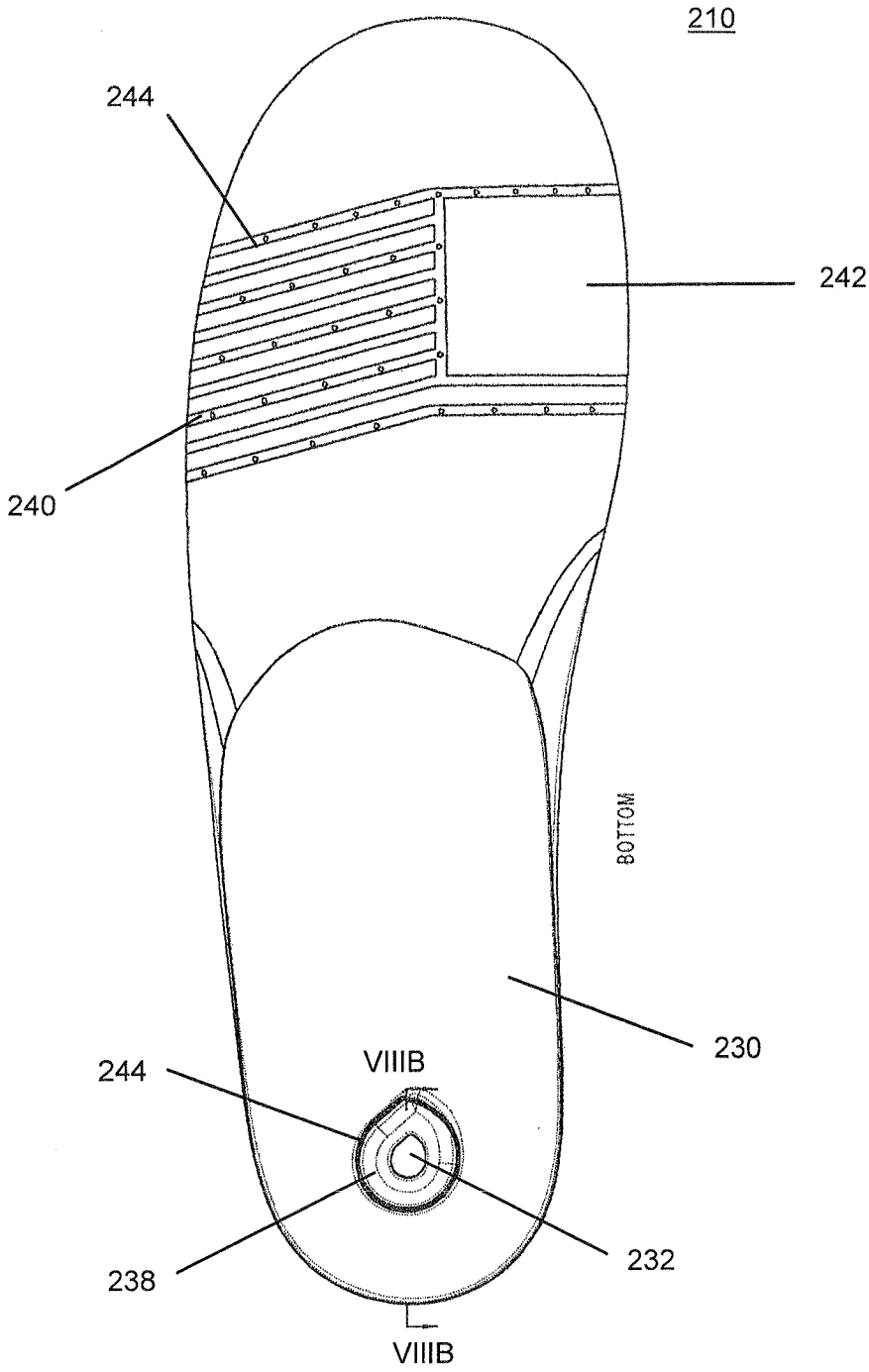
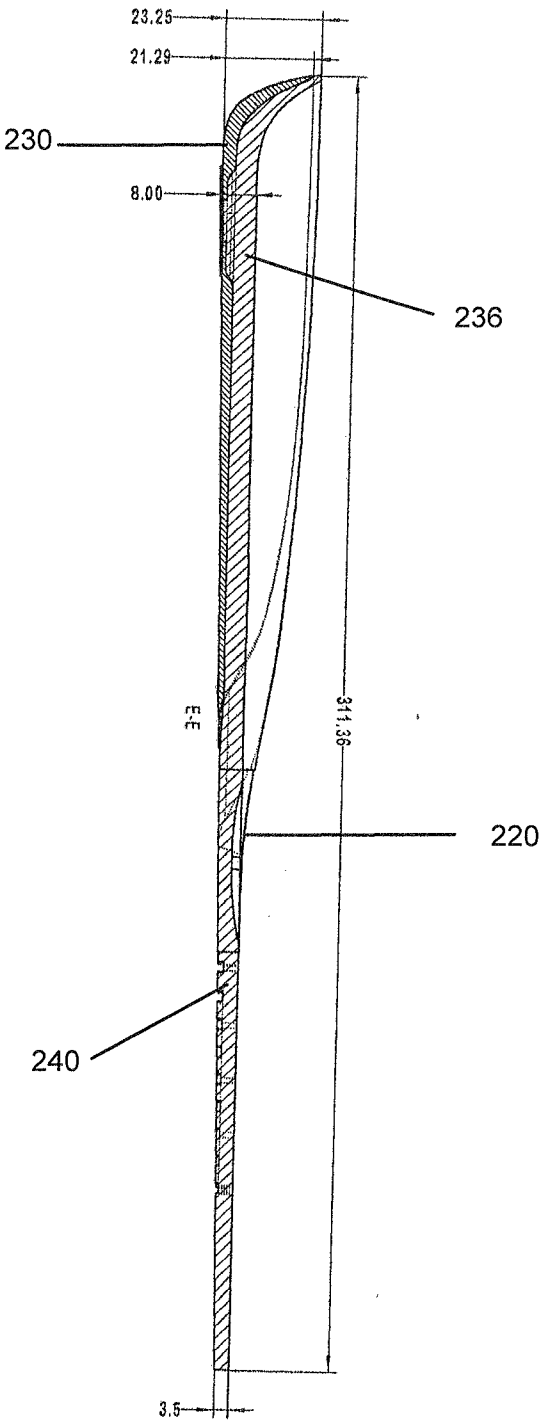


FIG. 7B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8.00
236
E-E
311.36
220
240
3.5

FIG. 8A

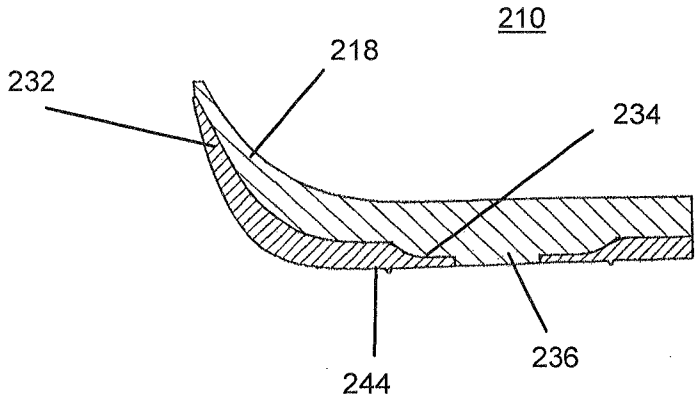

210
218
232
234
236
244

FIG. 8B

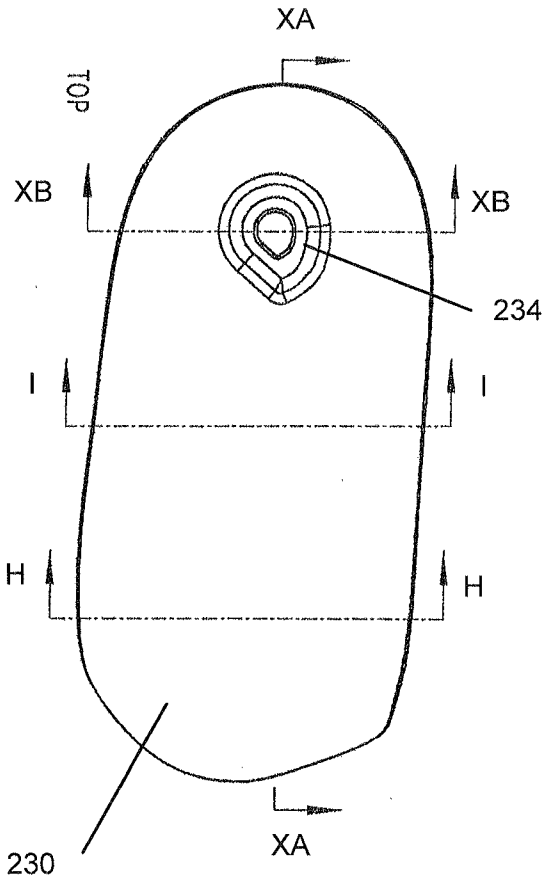


FIG. 9A

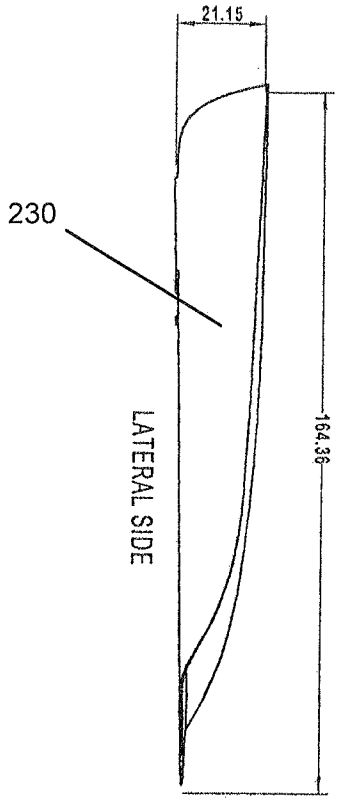
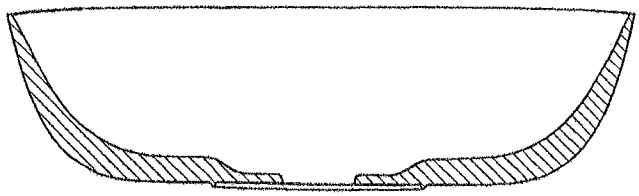


FIG. 9B



XB-XB Scale 2:1

FIG. 10B

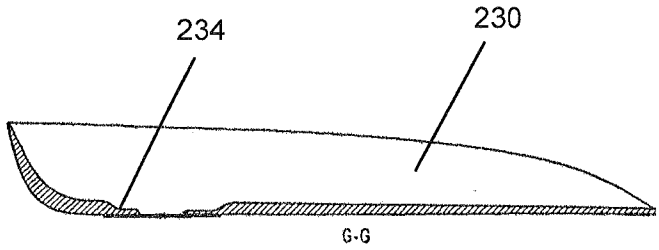


FIG. 10A