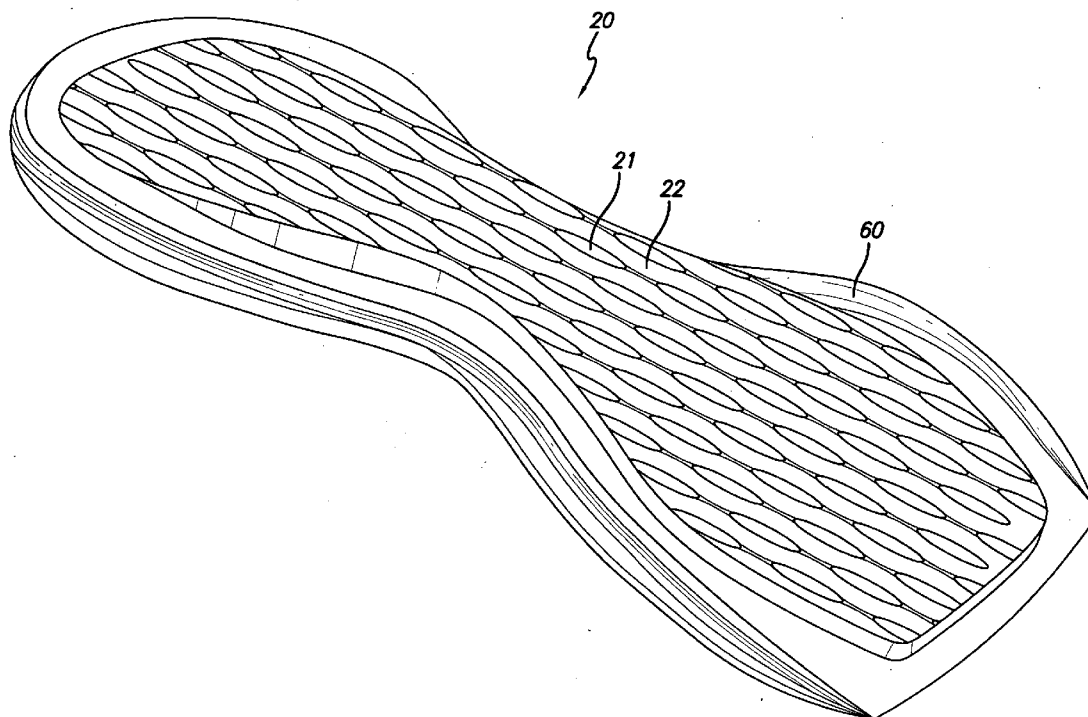




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(19) **United States**(12) **Patent Application Publication**
Alvear et al.(10) **Pub. No.: US 2012/0005920 A1**(43) **Pub. Date: Jan. 12, 2012**(54) **SHOE SOLE STRUCTURE AND ASSEMBLY****Publication Classification**(75) Inventors: **Isaac Alvear**, Laguna Niguel, CA
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Beach, CA (US)(51) **Int. Cl.**
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(52) **U.S. Cl.** **36/28; 36/30 R**(73) Assignee: **AMERICAN SPORTING
GOODS CORPORATION**,
ALISO VIEJO, CA (US)(57) **ABSTRACT**(21) Appl. No.: **12/803,782**

The present invention is a shoe sole comprising an array of elliptical cells, wherein each cell has a wall, and wherein each cell wall is conjoined to or contiguous with at least one other cell wall. The cell wall may be conjoined to another cell wall by a conjoining element. At least some of the cell walls buckle when compressive or shear force is applied during use. The sole is made from any material with elastic properties for this application. The shoe sole can further comprise a substrate, also made of elastomeric material, integrated with the cell walls at their upper level, lower level, or their periphery, forming a unitary piece. Variations can be made as to the dimensions and arrangement of these cell walls. This sole can be incorporated into a shoe sole assembly as a shoe midsole.

(22) Filed: **Jul. 6, 2010**

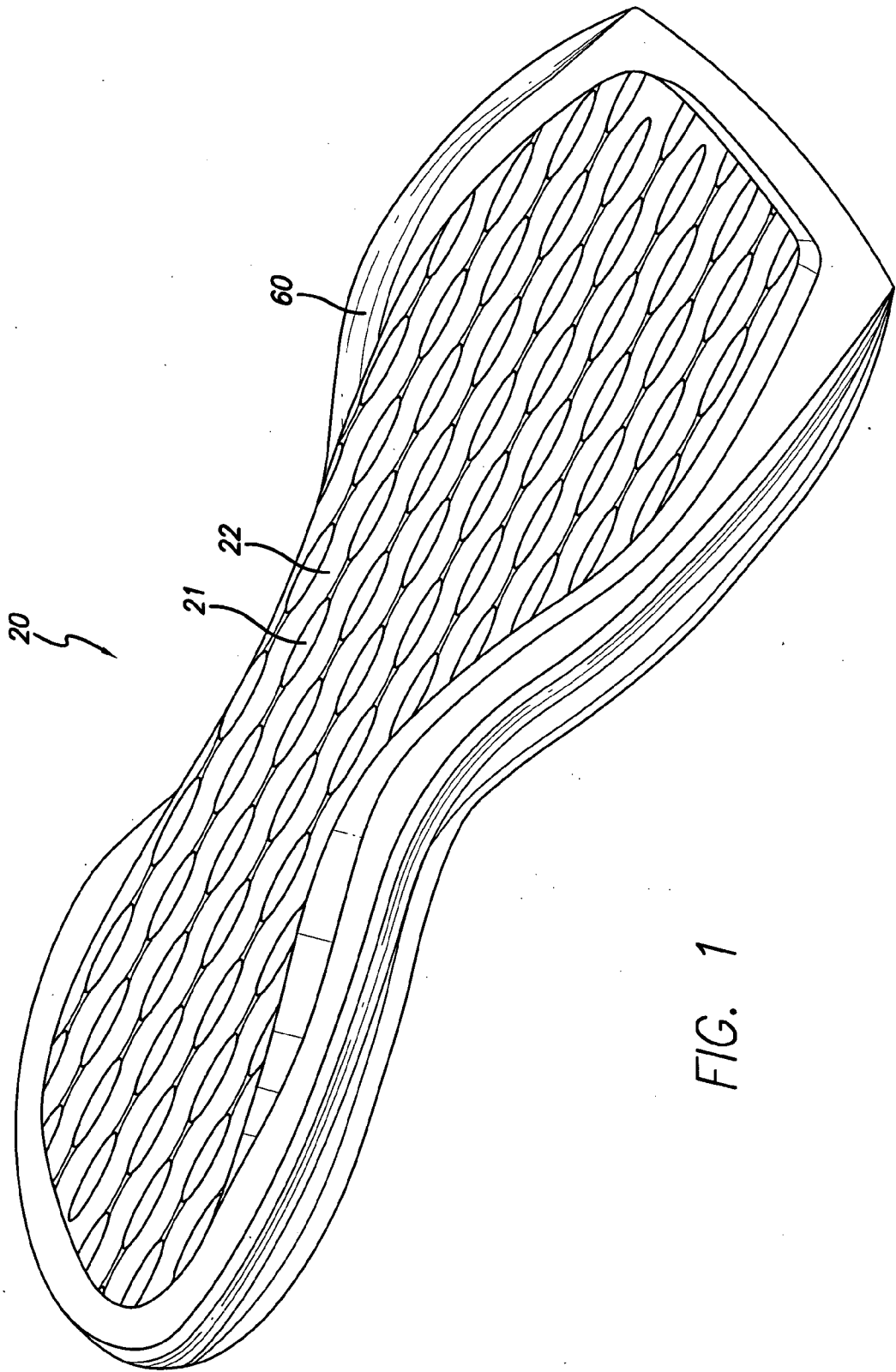


FIG. 1

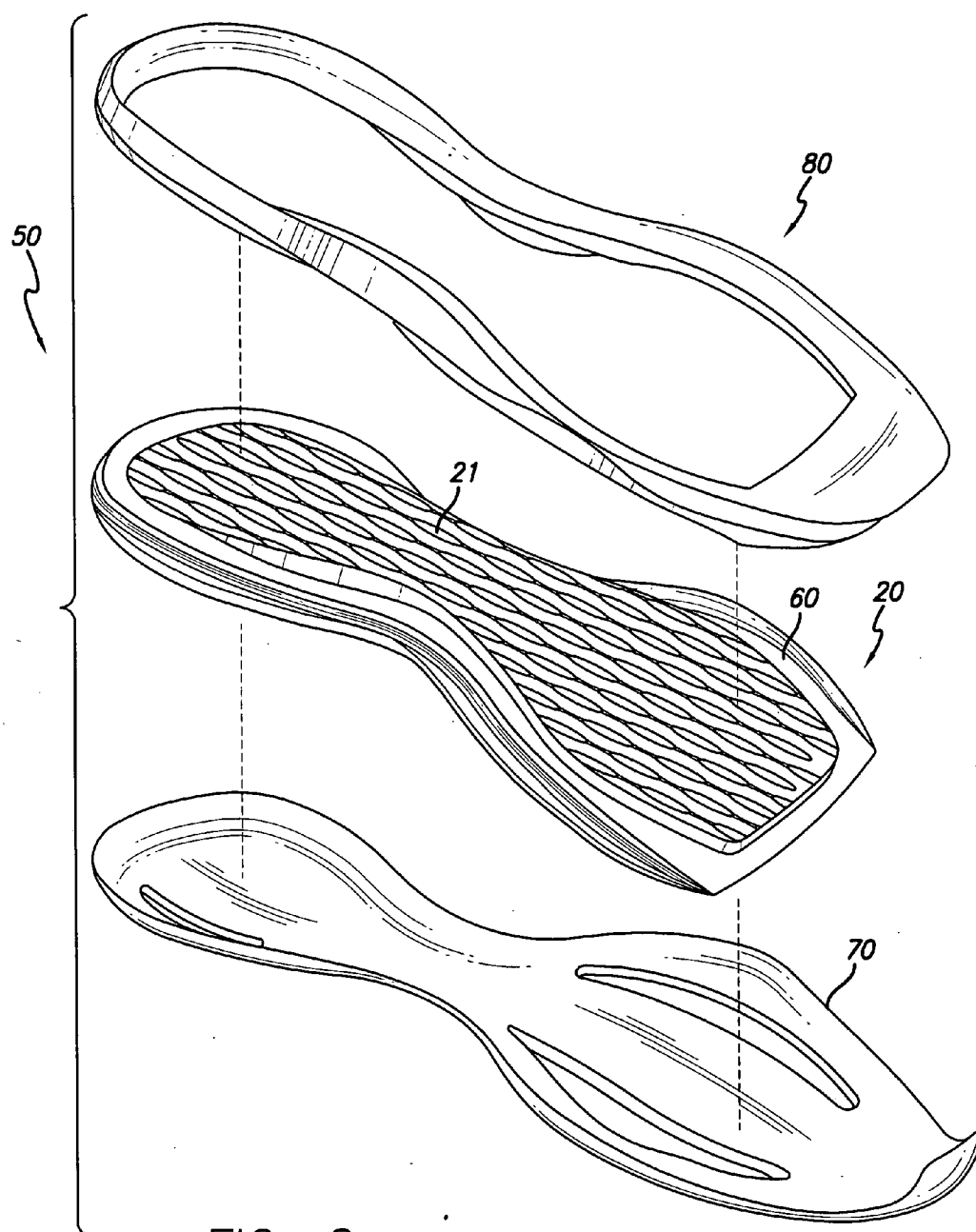


FIG. 2

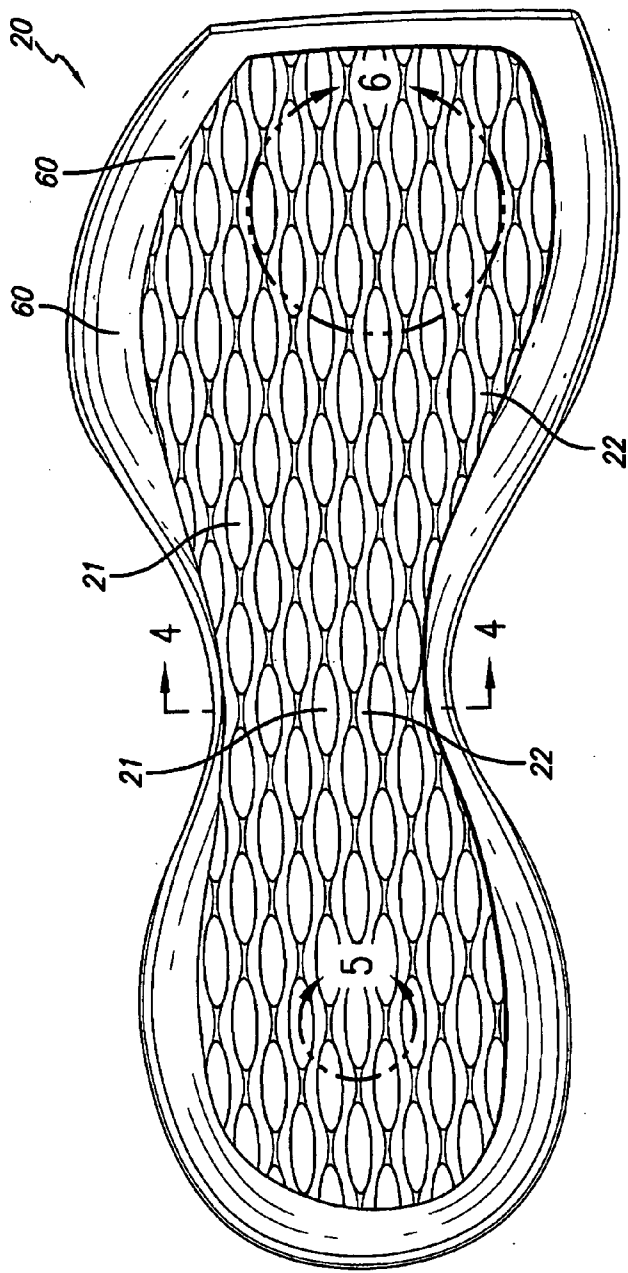


FIG. 3

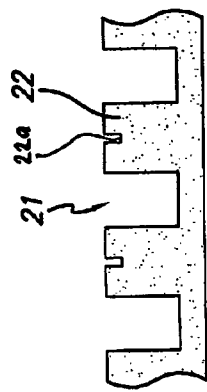


FIG. 4

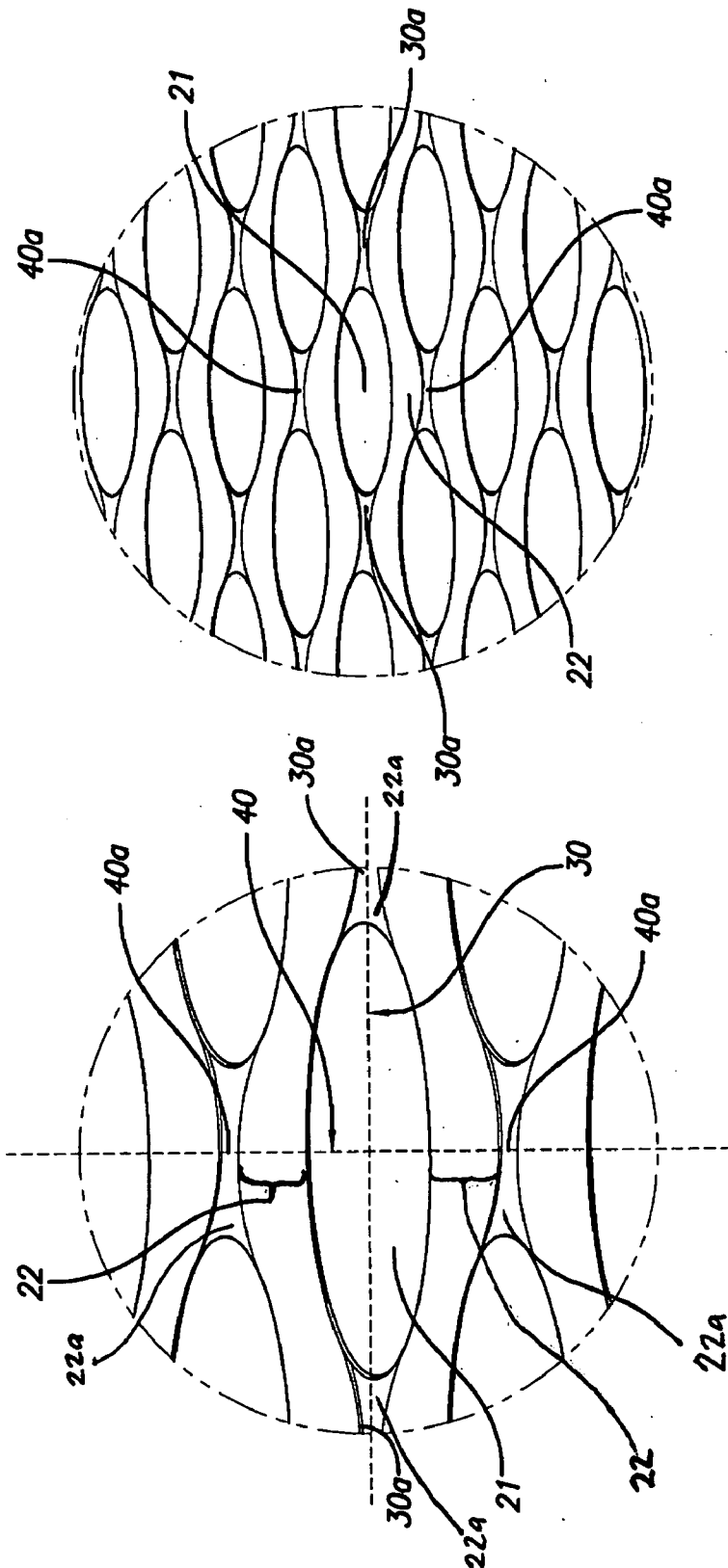


FIG. 6

FIG. 5

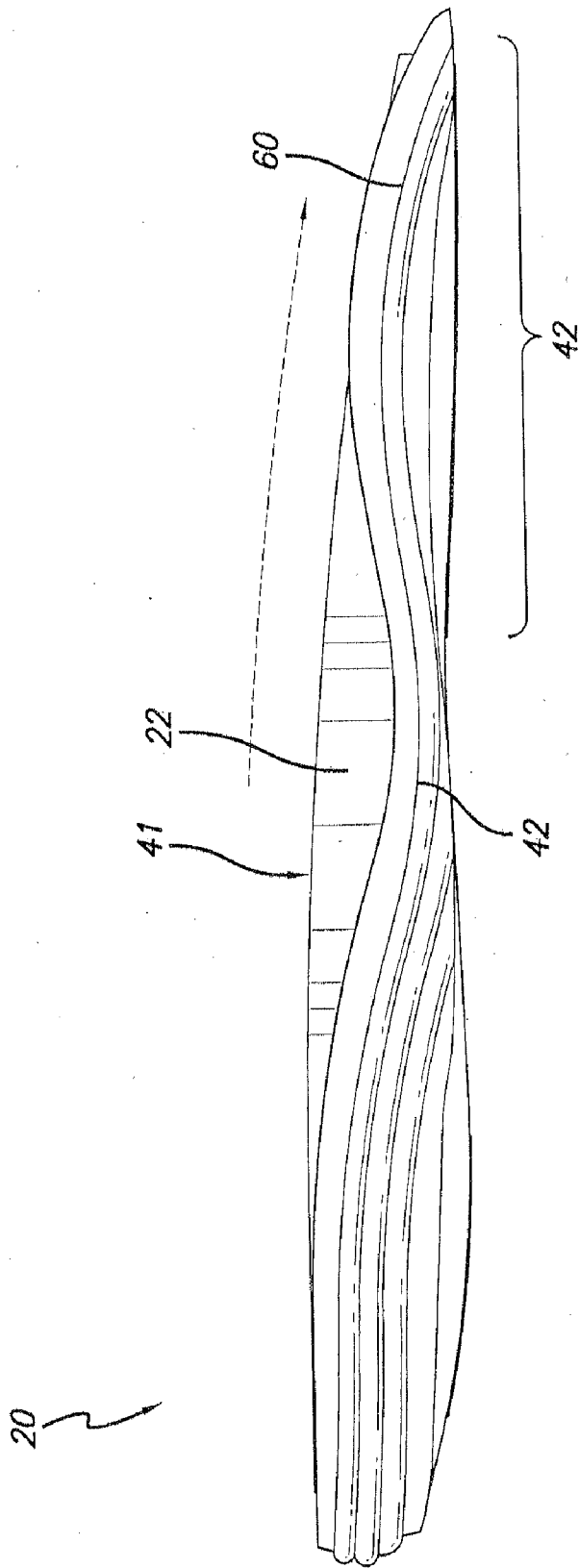


FIG. 7

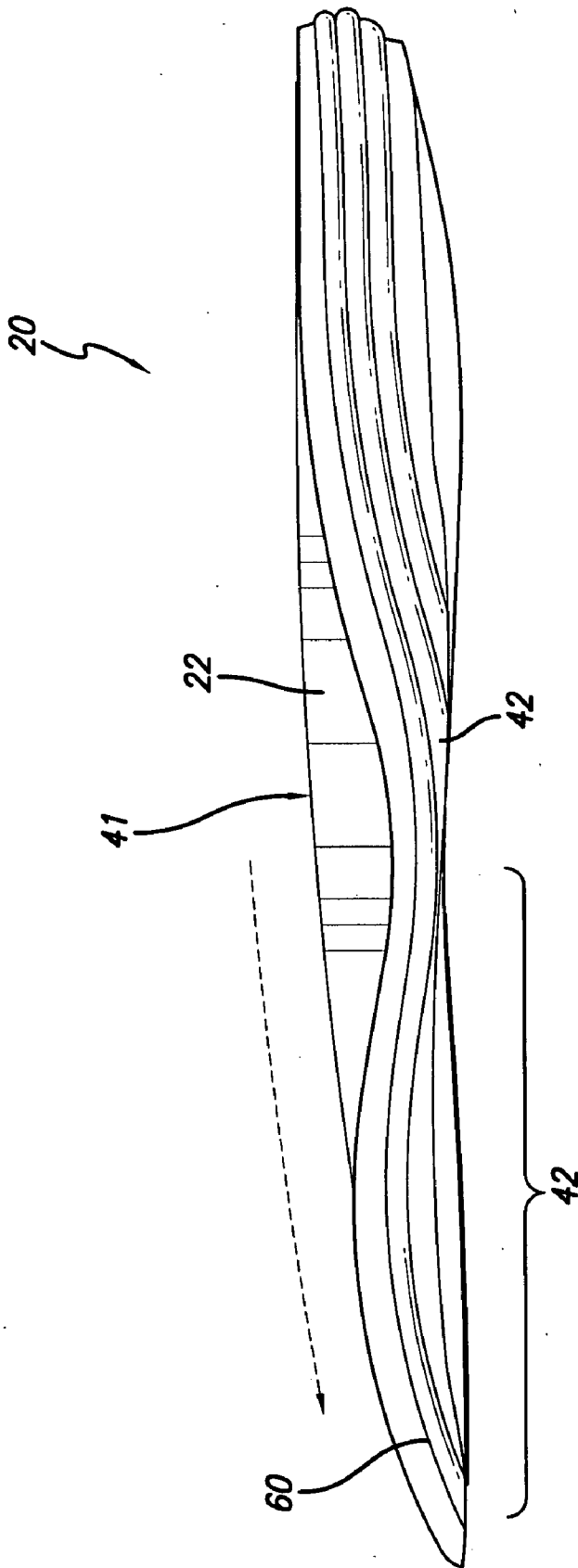


FIG. 8

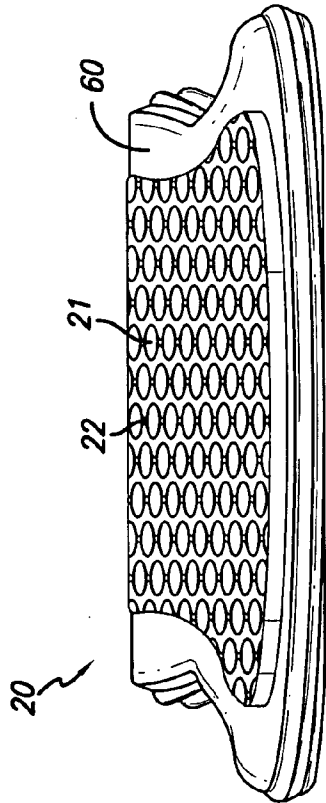


FIG. 9

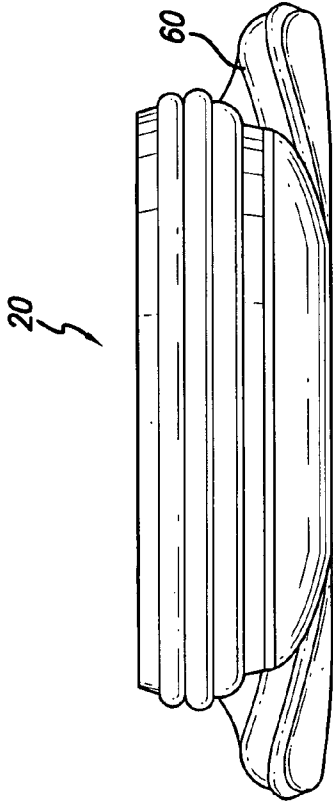


FIG. 10

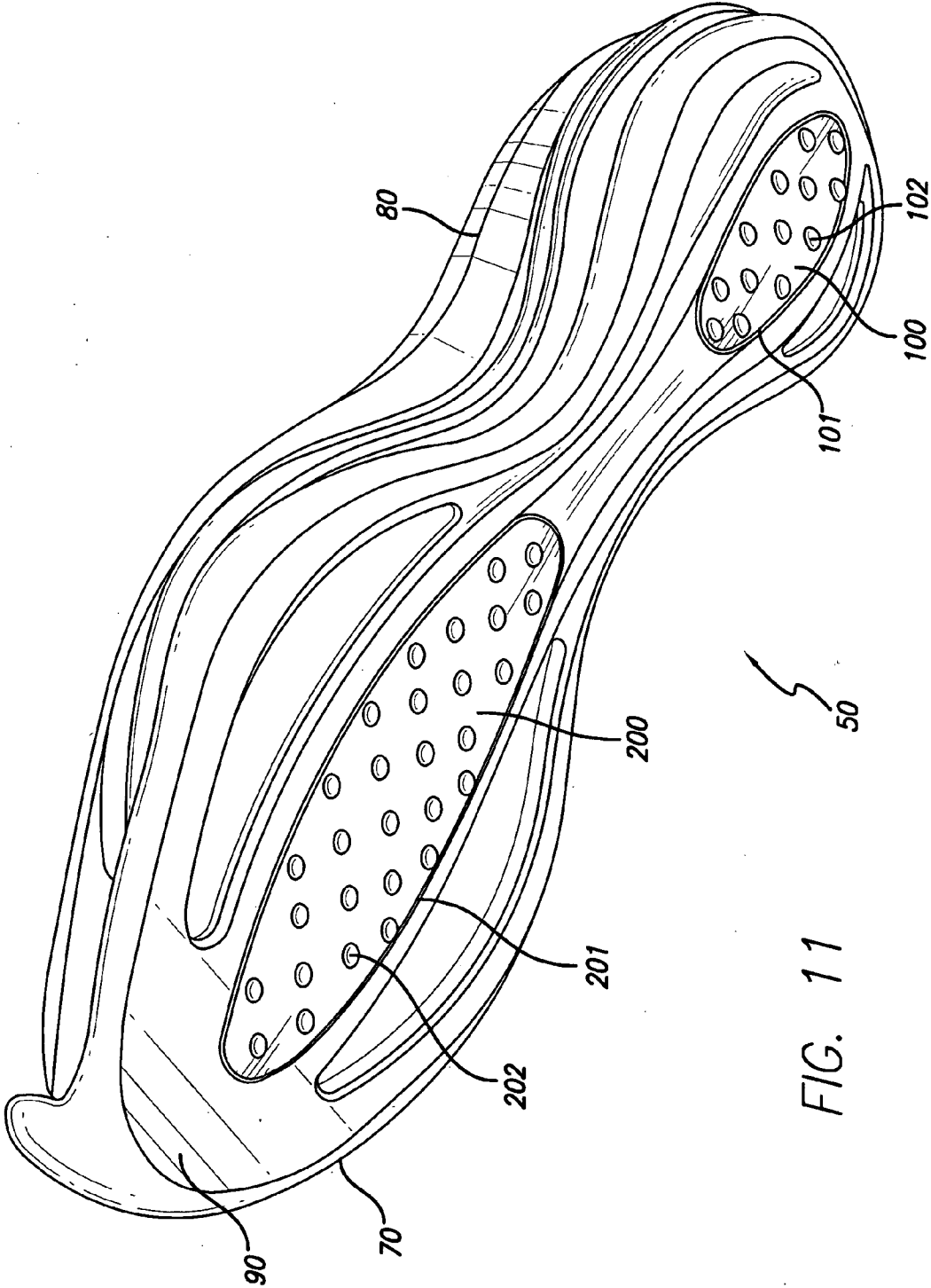


FIG. 11

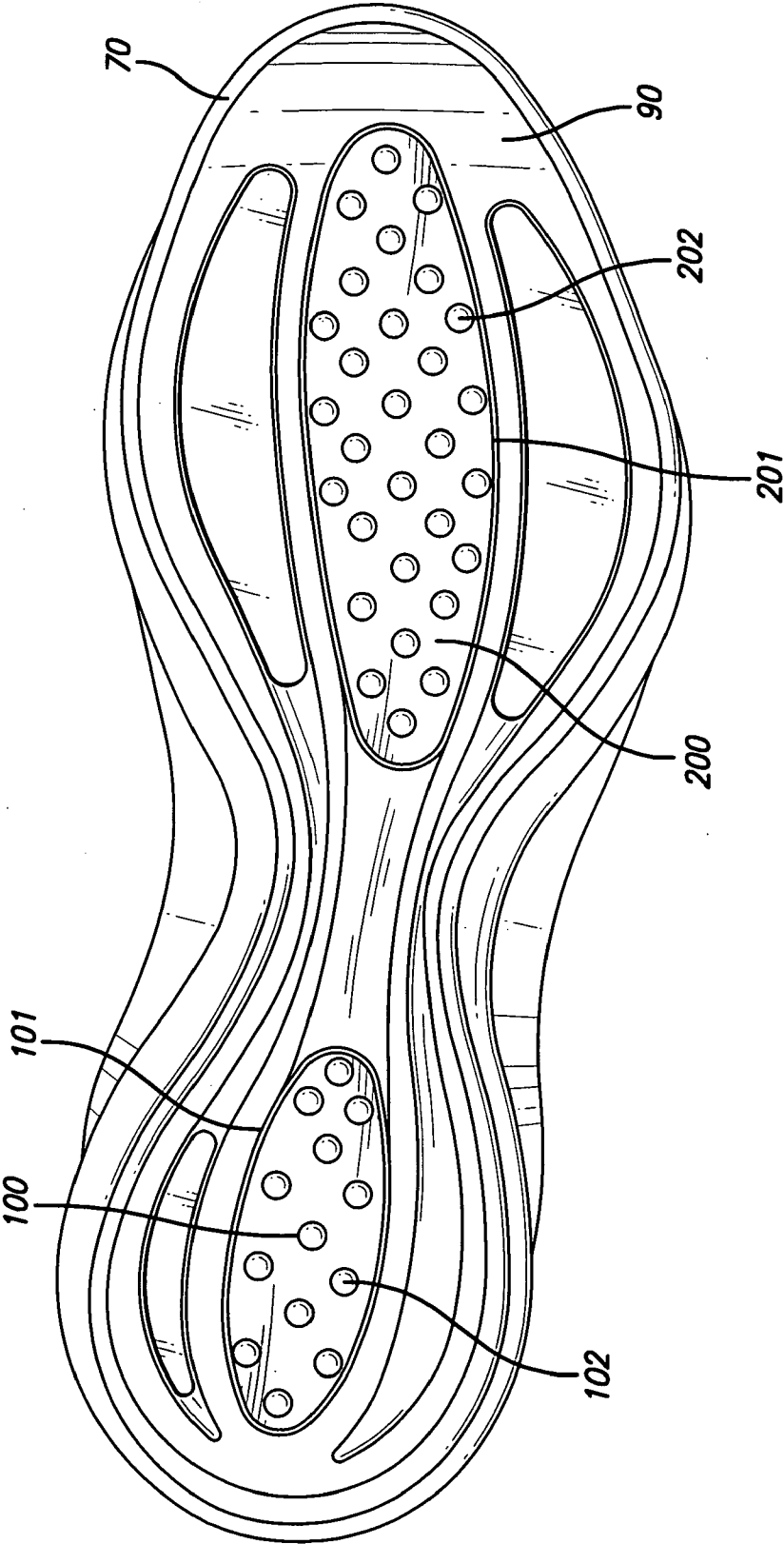
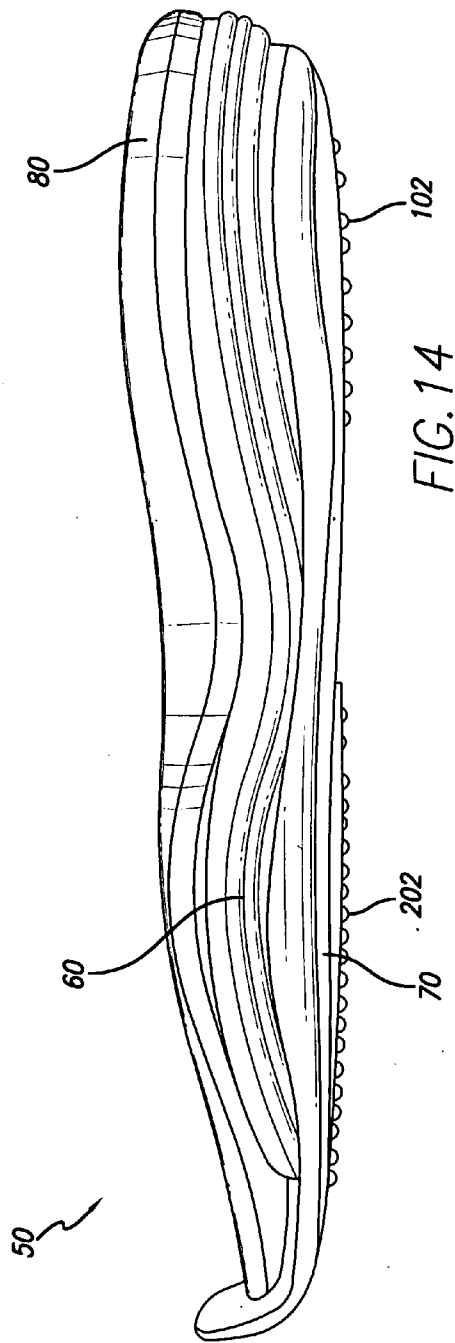
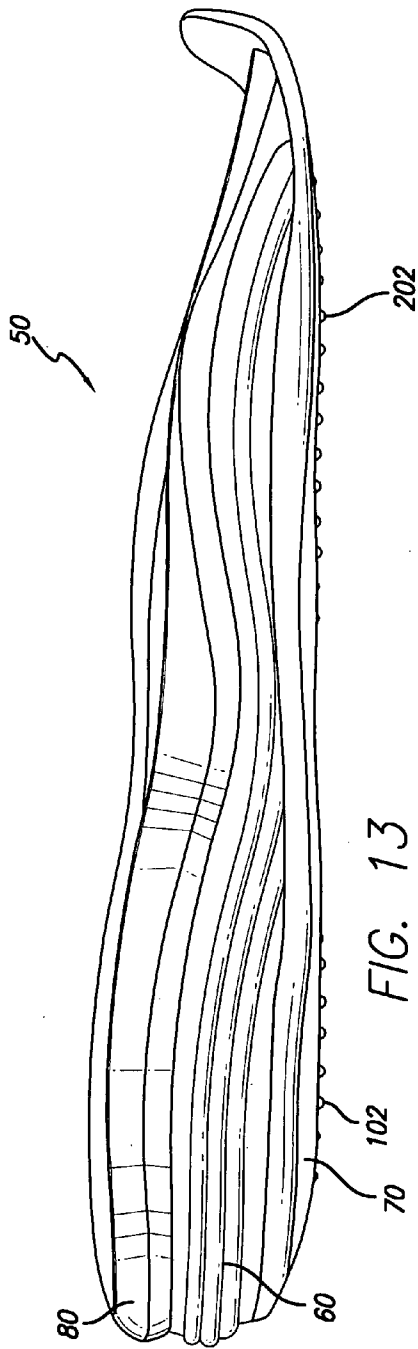
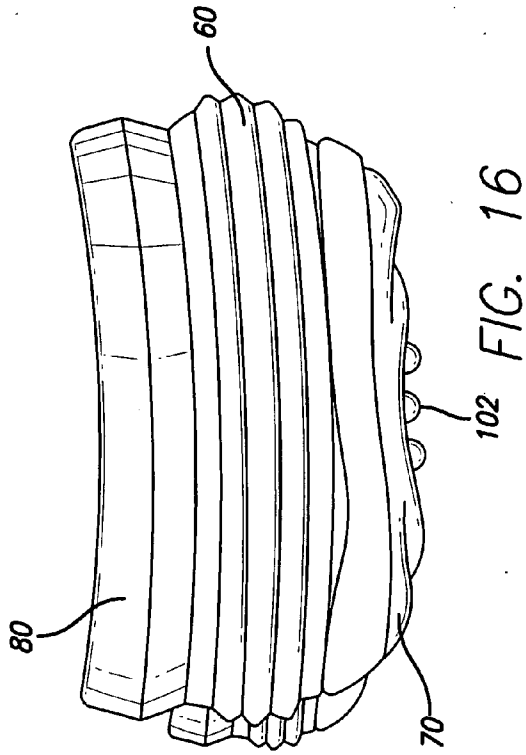
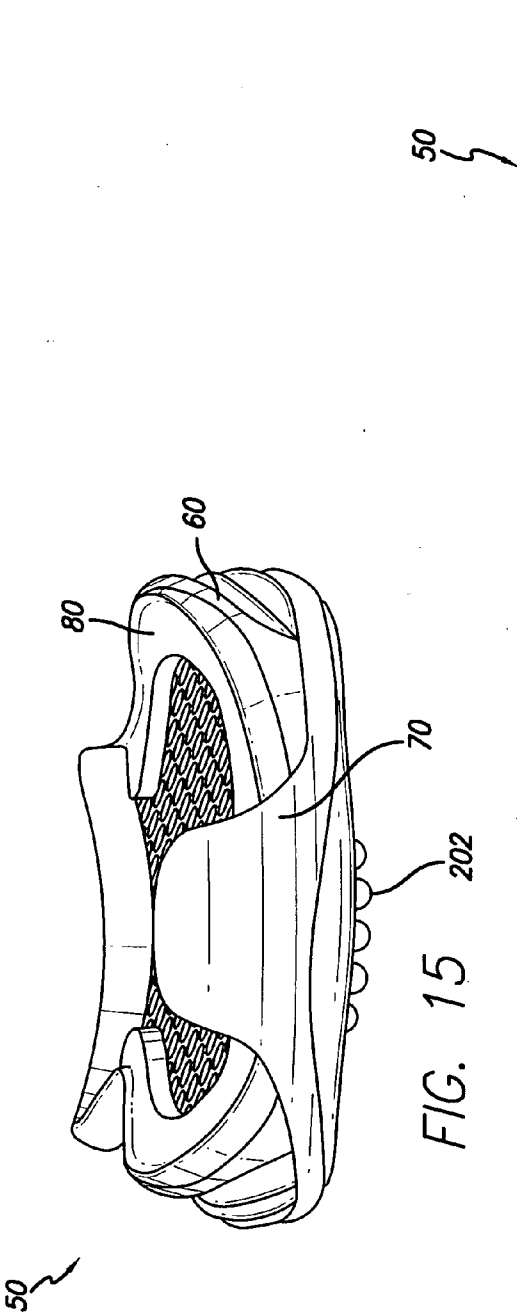


FIG. 12





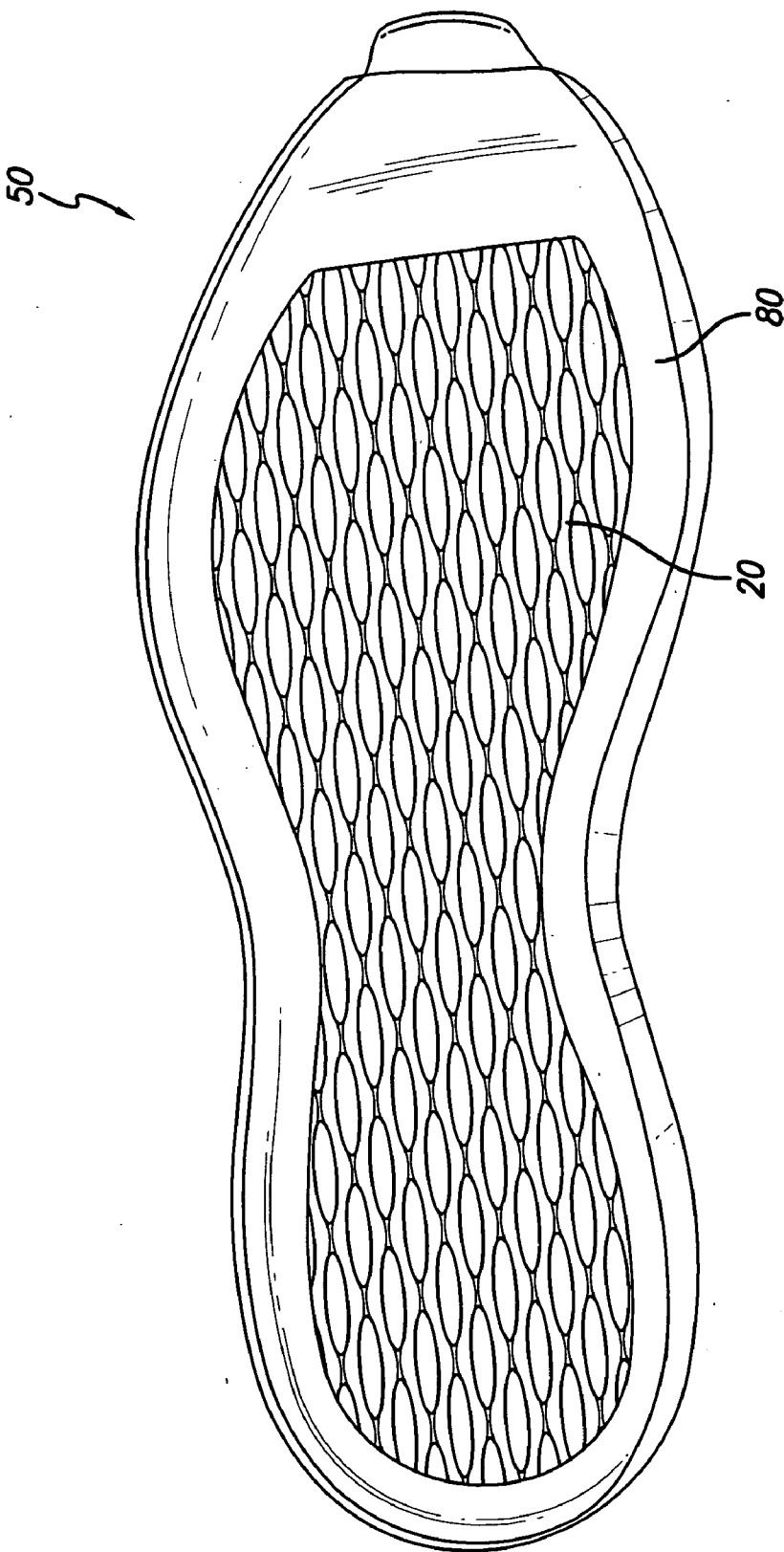


FIG. 17

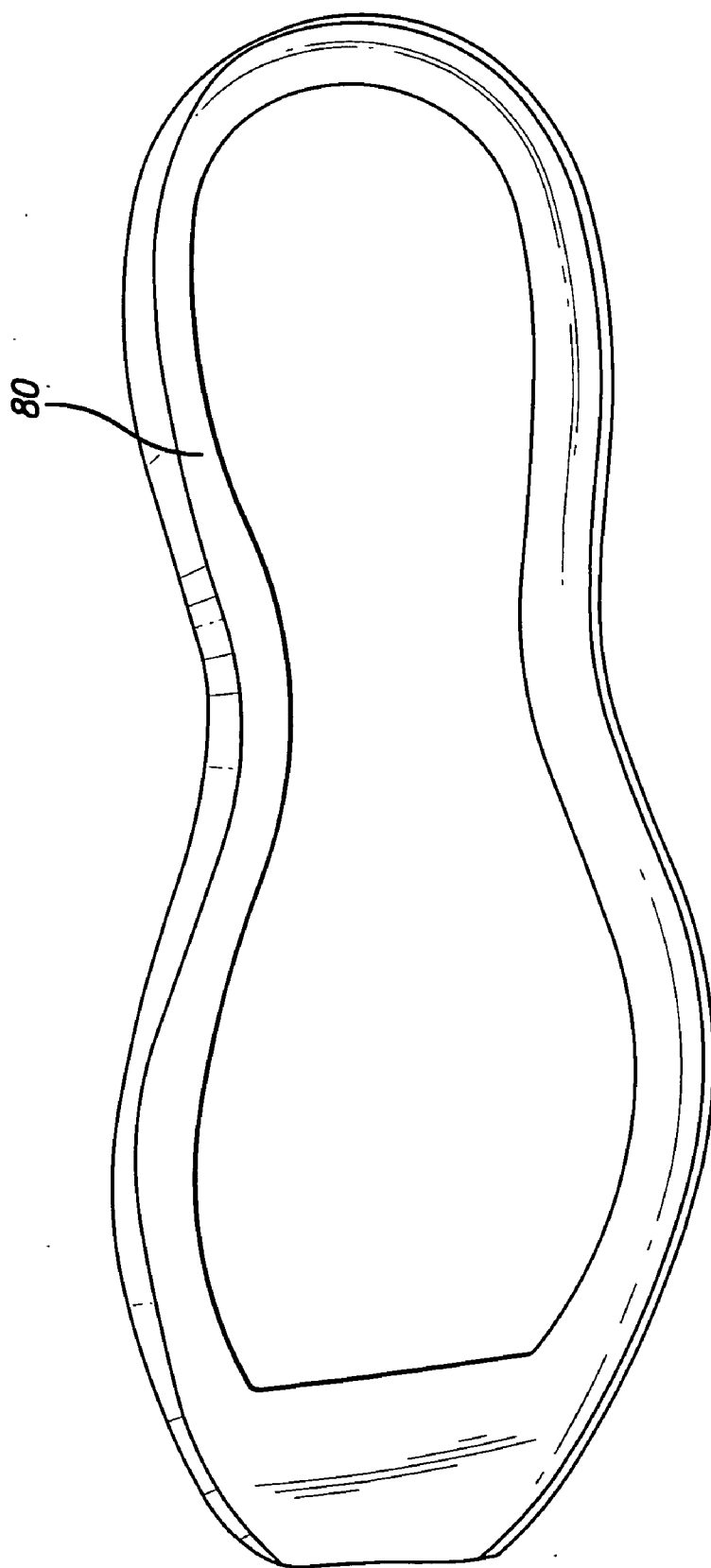


FIG. 18

SHOE SOLE STRUCTURE AND ASSEMBLY

BACKGROUND

[0001] The present invention is related to shoes and more particularly is directed towards an improved shoe sole having an array of intersecting cells and a shoe sole assembly incorporating this shoe sole as part of the midsole.

[0002] A shoe generally consists of two basic parts: an upper and a sole. The upper is generally designed to enclose the foot. The upper is attached to a sole.

[0003] The sole typically has two components: the outsole and the midsole. The outsole is the ground-contacting portion of the shoe and which provides the traction during use of the shoe. The various elements comprising the midsole provide protection, cushioning and stability to the foot during use.

[0004] Cushioning and stability are factors in the design and construction of shoes. Compressive and shear forces are generated during usage of the shoe, such as when the user is running, walking, or standing.

[0005] It is well known in the art that shoe design is one manner in which to reduce stress on the body during running, walking, or standing.

SUMMARY OF THE INVENTION

[0006] The present invention is a shoe sole comprising an array of elliptical cells, wherein each cell has a wall, and wherein each cell wall is conjoined to or contiguous with at least one other cell wall. The cell wall may be conjoined to another cell wall by a conjoining element. At least some of the cell walls buckle when compressive or shear force is applied during use. The sole is made from any material with elastic properties for this application.

[0007] The shoe sole may further comprise an array of elliptical cells wherein each cell has a major axis and a minor axis, the major axis having opposing vertices and the minor axis having opposing co-vertices. The vertices are located at an intersection of the major axis and the cell wall, and the co-vertices are located at an intersection of the minor axis and the cell wall. The cell wall is conjoined to or contiguous with another cell at the vertices or co-vertices.

[0008] The shoe sole may further comprise a substrate affixed to an upper level, lower level, or periphery of the array of cells. This substrate may also be made of elastomeric material. The substrate and array of cells can form a unitary piece. Variations can also be made to the height, dimensions and arrangement of the cells.

[0009] The present invention also comprises a shoe sole assembly incorporating the above shoe sole as a midsole. This shoe sole assembly comprises an outsole, a midsole seated above the outsole, and a support structure seated about the periphery of the midsole.

[0010] The above elements, their combination and their various embodiments, are described below in more detail.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is a perspective view of the shoe sole of the present invention;

[0012] FIG. 2 is an exploded view of a shoe sole assembly incorporating the shoe sole of FIG. 1;

[0013] FIG. 3 is a top plan view of the shoe sole shown in FIG. 1;

[0014] FIG. 4 is a cross-sectional view taken along line 4-4 of FIG. 3;

[0015] FIG. 5 is an enlarged view of several elliptical cells of the shoe sole shown in FIG. 3 taken within the circular segment "5" in FIG. 3;

[0016] FIG. 6 is a close-up view of a portion of the shoe sole shown within circular segment "6" in FIG. 3;

[0017] FIG. 7 is a right side elevational view of the shoe sole shown in FIG. 1;

[0018] FIG. 8 is a left side elevational view of the shoe sole shown in FIG. 1;

[0019] FIG. 9 is a front elevational view of the shoe sole shown in FIG. 1;

[0020] FIG. 10 is a rear elevational view of the shoe sole shown in FIG. 1;

[0021] FIG. 11 is a bottom perspective view of the shoe sole assembly shown in FIG. 2;

[0022] FIG. 12 is a bottom plan view of the shoe sole assembly shown in FIG. 2;

[0023] FIG. 13 is a right side elevational view of the shoe sole assembly shown in FIG. 2;

[0024] FIG. 14 is a left side elevational view of the shoe sole assembly shown in FIG. 2;

[0025] FIG. 15 is a front elevational view of the shoe sole assembly shown in FIG. 2;

[0026] FIG. 16 is a rear elevational view of the shoe sole assembly shown in FIG. 2;

[0027] FIG. 17 is a top plan view of the shoe sole assembly as shown in FIG. 2;

[0028] FIG. 18 is a top plan view of the support structure of the shoe sole assembly as shown in FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

[0029] Referring to the drawings, like reference numerals represent identical or corresponding parts throughout the several views of FIGS. 1 through 18.

[0030] While the present invention will be described in terms of the preferred embodiment, it will be understood that it is not intended to limit the invention to that specific embodiment. The present invention is intended to cover alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined by the claims herein.

[0031] Referring to FIG. 1, the shoe sole 20 comprises an array of elliptical cells 21. Each cell has a wall 22 which is conjoined to or contiguous with at least one other cell wall 22. This shoe sole 20 can be incorporated into a shoe sole assembly 50, as part of the shoe's midsole, as shown in FIG. 2.

[0032] At least some of the cell walls buckle when compressive or shear force is applied during use. The array of cells is made with any material with elastic properties for this application, which includes materials presently known in the art such as thermoplastic elastomers, thermoplastic polyurethanes, including gelatinous elastomers and materials such as Thermal Plastic Resin (TPR).

[0033] Referring to FIGS. 3, 4, 5 and 6, in a preferred embodiment, the elliptical cell 21 is formed by a combination of two opposing cell walls 22 and opposing related conjoining elements 22a. An inner boundary of the cell wall 22 creates the elliptical cell 21.

[0034] As can be seen in FIG. 5, each elliptical cell 21 has a geometry of an ellipse, which has a major axis 30 and a minor axis 40. The major axis 30 is the longer segment that runs through the center of the elliptical cell 21 and has opposing endpoints on the cell wall 22. These endpoints are called vertices 30a. The minor axis 40, which is the shorter segment,

also runs through the center of the elliptical cell **21** perpendicular to the major axis **30**, and has its opposing endpoints on the cell wall **22**. These endpoints are called co-vertices **40a**.

[0035] Referring to FIGS. **4**, **5**, and **6**, the cell walls intersect adjacent cell walls by fusion of the elastomeric material in the region of the vertices **30a** and co-vertices **40a**. This fusion is accomplished by a conjoining element **22a**. Thus, intersection in this preferred embodiment is accomplished by conjoining a cell wall **22** to another cell wall **22** by a conjoining element **22a**. However, other means of intersection can be used, such as by contiguous or adjacent placement of cells without the presence of a conjoining element **22a**, where the cells walls are directly contiguous to one another.

[0036] The upper layer **41** of the elliptical cell walls **22** are of uniform height along a horizontal plane. The elliptical cell walls **22** can also be of varying height. For example, as shown in FIGS. **7** and **8**, the height of the cell walls may proceed to slightly decrease towards the frontal region **42** of the element, where the toes sit. The height of the cell walls **22** could also be greater in areas of the foot which are frequently exposed to relatively high levels of ground reaction forces, such as the heel or the ball of the foot. Alternatively, for arch support, the height of the cell walls **22** could be greater in the area substantially corresponding to the arch of the wearer's foot.

[0037] The geometry of the cells can be varied by changing the ratio of the major axis **30** to the minor axis **40** of any or all of the cells to create a longer or shorter, wider or narrower cell.

[0038] Referring to FIGS. **7** and **8**, the elastomeric cell walls **22** extend vertically from the lower level of the wall to its upper level **41**. The cell wall height can range from 0.3 inches to approximately 1.2 inches. However, such height may be configured taking into account several factors such as thickness, shape, and circumference of the cell wall, array pattern, and material used in fabricating the cell walls.

[0039] The cell walls **22** may also be configured in any number of shapes and geometries other than an ellipse, such as circles, squares, S-shaped, diamond-shaped, parallelogram, or triangular, any combination of such, or any irregular shape, as long as the cell walls are fused, joined or integrated with adjacent cell walls.

[0040] In the present embodiment, the cells **21** are arranged in a staggered fashion such as in FIGS. **1** through **6**. In this staggered arrangement, the cells are arranged in an alternating fashion, whereby the minor axis **40** of a cell in one row directly corresponds with the minor axis **40** of another cell in alternate rows. In other embodiments, the cells are lined up side-by-side, from one row to the next, along their major axes **30** and minor axes **40** in a uniform fashion.

[0041] These intersecting elliptical cells may also be arranged longitudinally, with the major axis **30** of each cell running parallel to the longitudinal axis of the wearer's foot, as shown in FIGS. **3**, **5**, and **6**. In other embodiments, these intersecting elliptical cells may be arranged latitudinally, along the latitudinal axis of the wearer's foot, perpendicular to its longitudinal axis.

[0042] Referring to FIGS. **3**, **7**, **8**, **9**, and **10**, the shoe sole **20** can further comprise a substrate **60**. The substrate **60** can be affixed to, fused, joined, or integrated with the upper **41** or lower level **42** of the array of elliptical cell walls. In the preferred embodiment, this substrate **60** and array of intersecting elliptical cells form a unitary piece, with the substrate at the periphery and lower level of the cell walls. Additional

shoe components, such as an outsole **70**, can be affixed to the substrate **60**, as depicted in FIGS. **2**, **13**, **14**, **15** and **16**.

[0043] The substrate **60** and its periphery can vary in thickness, from 0.2 to 1.5 inches, and can also vary in width along the longitudinal axis of the wearer's foot. The height of the substrate **60** can also be greater in areas of the foot which are frequently exposed to relatively high levels of ground reaction forces, such as the heel or the ball of the foot. Alternatively, for arch support, the height could be greater in the area substantially corresponding to the arch of the wearer's foot.

[0044] In embodiments where the substrate **60** is integrated with or affixed to the upper level **41** of the array of cell walls, this substrate **60** forms the part of where the wearer's foot rests, such as the insole, which can be covered with any suitable material such as fabric, leather, vinyl foam, polyurethane or the like. Alternatively, this substrate **60** can also form the outsole of the shoe, with an outer sole surface which is the ground-contacting surface.

[0045] The substrate **60** can be made from the same material as the elastomeric cell walls **22**, or from any material with elastic properties which include those presently known in the art such as by way of example, various elastomers which include thermoplastic elastomers, thermoplastic polyurethanes, gelatinous elastomers, and TPR. Alternatively, it could also be made from rubber if this substrate **60** is also the shoe outsole comprising the ground-contacting surface of the shoe.

[0046] The shoe sole **20** may be manufactured using any appropriate technique and methodology known in the field, such as, by way of example, compression molding, thermofforming, or extrusion molding. The preferred method, however, is injection molding.

[0047] Referring now to FIGS. **2**, **11**, **12**, and **13**, the present invention also relates to a shoe sole assembly **50** which incorporates this shoe sole **20** as part of the midsole. The shoe sole assembly **50** comprises an outsole **70**, a shoe sole **20** seated above the outsole **70**, and a support structure **80** seated about the periphery of the midsole. The shoe sole **20** which is incorporated as a midsole of this shoe assembly can be in any of the embodiments of the shoe sole described above.

[0048] Referring to FIGS. **11** and **12**, the outsole **70** has an outer sole surface **90**, the outer sole surface comprising a heel portion **100** at a location substantially corresponding to the calcaneus region of the intended wearer's foot and a forefoot portion **200** at a location substantially corresponding to the forefoot region of the intended wearer's foot. The calcaneus is the heel bone of a human foot. The forefoot is composed of the five toes (called phalanges) and their connecting long bones (called metatarsals). The outsole **70** and its outer sole surface **90**, which is the ground-contacting surface, are typically made of rubber.

[0049] The heel portion **100** has an elliptical heel region **101** with a plurality of projections **102**. Similarly, the forefoot portion **200** has an elliptical heel region **201** with a plurality of projections **202**. These projections aid in traction and gripping the ground surface during use of the shoe. In various embodiments, these projections may be in the form of cleats, which include metal, plastic or hard rubber pieces. These projections may also be configured in any number of shapes such as, by way of example, rounded, arcuate, triangular, square, rectangular, oval, or diamond-shaped.

[0050] As shown in FIGS. **2**, and **13** through **17**, a support structure **80**, also forms a part of this sole assembly **50**. As can be seen in FIG. **17**, this support structure is attached to the

periphery of the midsole **20** and accommodates the fixation of additional shoe components. These additional shoe components can be the shoe upper, insole, or another midsole layer. **[0051]** The support structure **80** is typically made of blown plastic foam such as, by way of example, polyurethane foam or EVA. Higher-density foam materials are preferred for added support.

[0052] The above-described integrated array of cells facilitates the attenuation of ground reaction forces by distribution of shear or compressive forces through enhanced instability. This instability is achieved through buckling of the cell walls **22**, as described below.

[0053] Specifically, in the operation of the shoe sole assembly **50** of the present invention, the wearer of the shoe places weight on the shoe by standing, walking, running, or jumping. Various forces, such as compressive and shear forces, are created by such usage. These forces are transmitted from ground contact, upon heel strike to forefoot stance, to the shoe sole components. When shear or compressive forces are transmitted from the outer sole surface **90**, to the outsole **70**, then to the midsole **20** comprising an array of intersecting elliptical cells made of elastomeric material, the elliptical cell walls **22** buckle. This buckling of the cell walls **22** upon ground contact by the user disperses the shear and/or compressive forces to adjoining cell walls, which dispersal is facilitated by the presence of intersecting cell walls. This is believed to result in distribution of shear and compressive forces by the enhanced instability of the midsole provided by this array of intersecting cell walls.

[0054] The present invention can be used in any use or application of footwear.

[0055] Moreover, this disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size and arrangement of parts, within the principle of the invention, to the full extent indicated by the broad general meaning of the terms in which the claims herein are expressed.

What is claimed is:

1. A shoe sole comprising:
an array of elliptical cells,
wherein each cell has a wall;
wherein each cell wall is conjoined to or contiguous with at least one other cell wall; and
wherein at least some of the cell walls buckle when compressive or shear force is applied during use.
2. The sole of claim **1**, wherein the cell wall further comprises:

a major axis and a minor axis, the major axis having opposing vertices and the minor axis having opposing co-vertices;

wherein the co-vertices are located at an intersection of the minor axis and the elliptical cell wall;

wherein the vertices are located at an intersection of the major axis and the elliptical cell wall; and

wherein the cell wall is conjoined to or contiguous with another cell wall at the vertices or co-vertices.

3. The sole of claim **1** wherein a cell wall is conjoined to another cell wall by a conjoining element.

4. The sole of claim **1** wherein the sole is made of elastomeric material.

5. The sole of claim **1** further comprising a substrate affixed to an upper level, lower level, or periphery of the array.

6. The sole of claim **5** wherein the substrate is made of elastomeric material.

7. The sole of claim **5** wherein the substrate and the array form a unitary piece.

8. The sole of claim **1** wherein the cell walls are of varying dimensions.

9. The sole of claim **1** wherein the cells are staggered.

10. A shoe sole assembly comprising:

an outsole, a midsole seated above the outsole, and a support structure seated about the periphery of the midsole;

wherein the outsole has an outer sole surface, the outer sole surface comprising a heel portion at a location substantially corresponding to the calcaneus region of the intended wearer's foot and a forefoot portion at a location substantially corresponding to the forefoot region of the intended wearer's foot;

the heel portion having an elliptical heel region with a plurality of projections;

the forefoot portion having an elliptical forefoot region with a plurality of projections;

wherein the midsole comprises:

an array of elliptical cells,

wherein each cell has a wall;

wherein each cell wall is conjoined to or contiguous with at least one other cell wall;

wherein at least some of the cell walls buckle when compressive or shear force is applied during use; and

wherein the support structure further accommodates the fixation of additional shoe components.

* * * * *