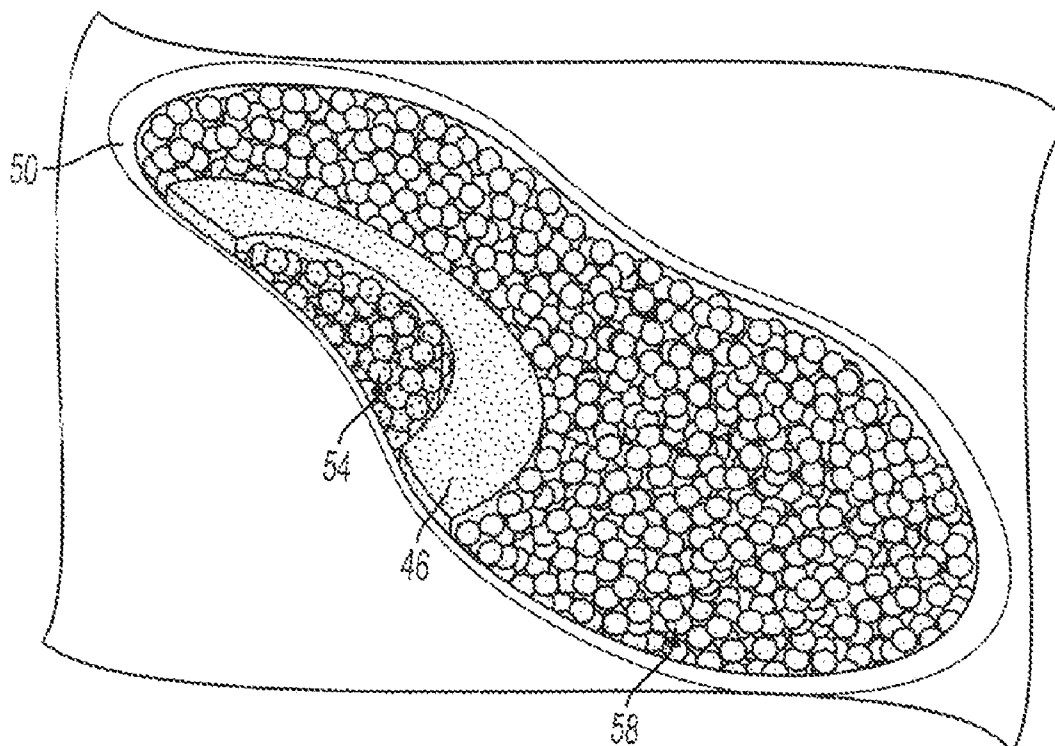




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(19) **United States**(12) **Patent Application Publication**
Portzline et al.(10) **Pub. No.: US 2011/0283560 A1**(43) **Pub. Date: Nov. 24, 2011**(54) **MULTIPLE RESPONSE PROPERTY
FOOTWEAR****Publication Classification**(75) Inventors: **William Scott Portzline**, Portland,
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A43D 8/00 (2006.01)(52) **U.S. Cl.** **36/31; 12/146 B**(73) Assignee: **MONTRAIL CORPORATION**,
Portland, OR (US)(21) Appl. No.: **13/110,876**(22) Filed: **May 18, 2011****Related U.S. Application Data**(60) Provisional application No. 61/345,978, filed on May
18, 2010.(57) **ABSTRACT**

Embodiments herein relate generally to the field of footwear, and more particularly to components of performance footwear, such as midsoles, as well as methods of making midsoles. In various embodiments, multiple response property midsoles and/or portions of footwear are provided that may include strategically arranged multiple response property areas having blended transition zones disposed there between. Such blended transition zones may help facilitate a more fluid foot movement, improve manufacturing and production techniques, and prevent injury to the foot, ankle, and/or legs during exercise, such as running, hiking, walking, and other impact-generating activities.



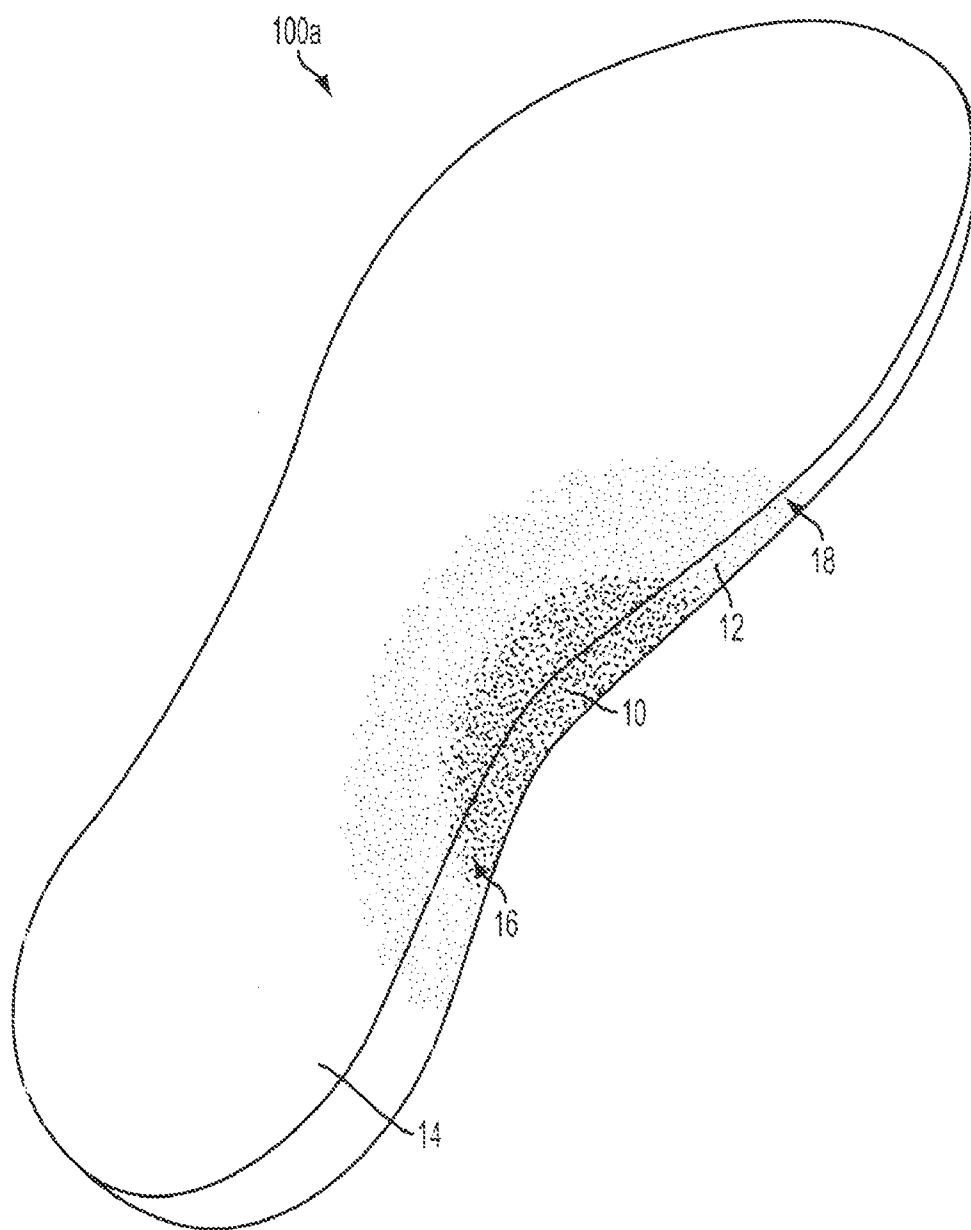


FIG. 1A

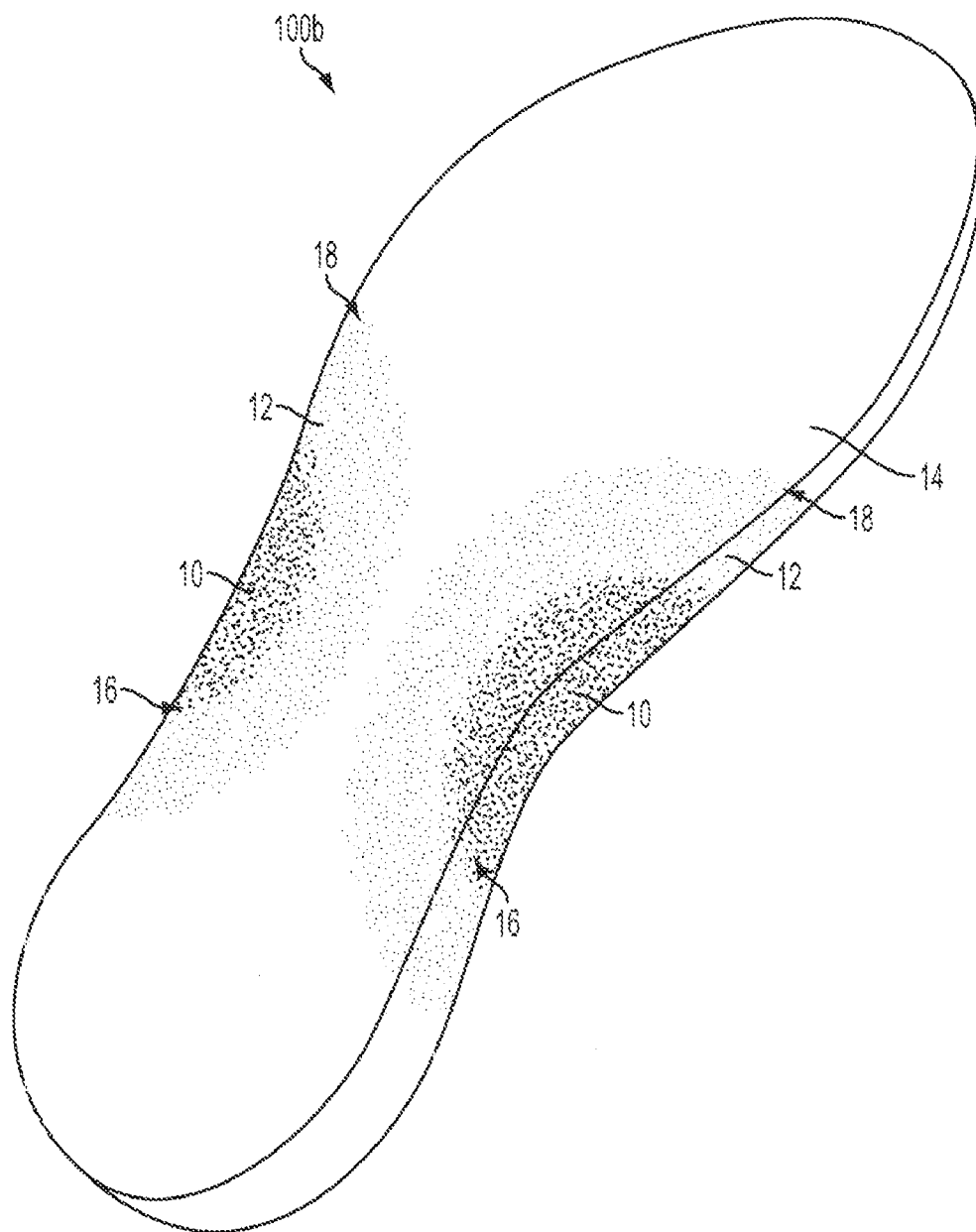


FIG. 1B

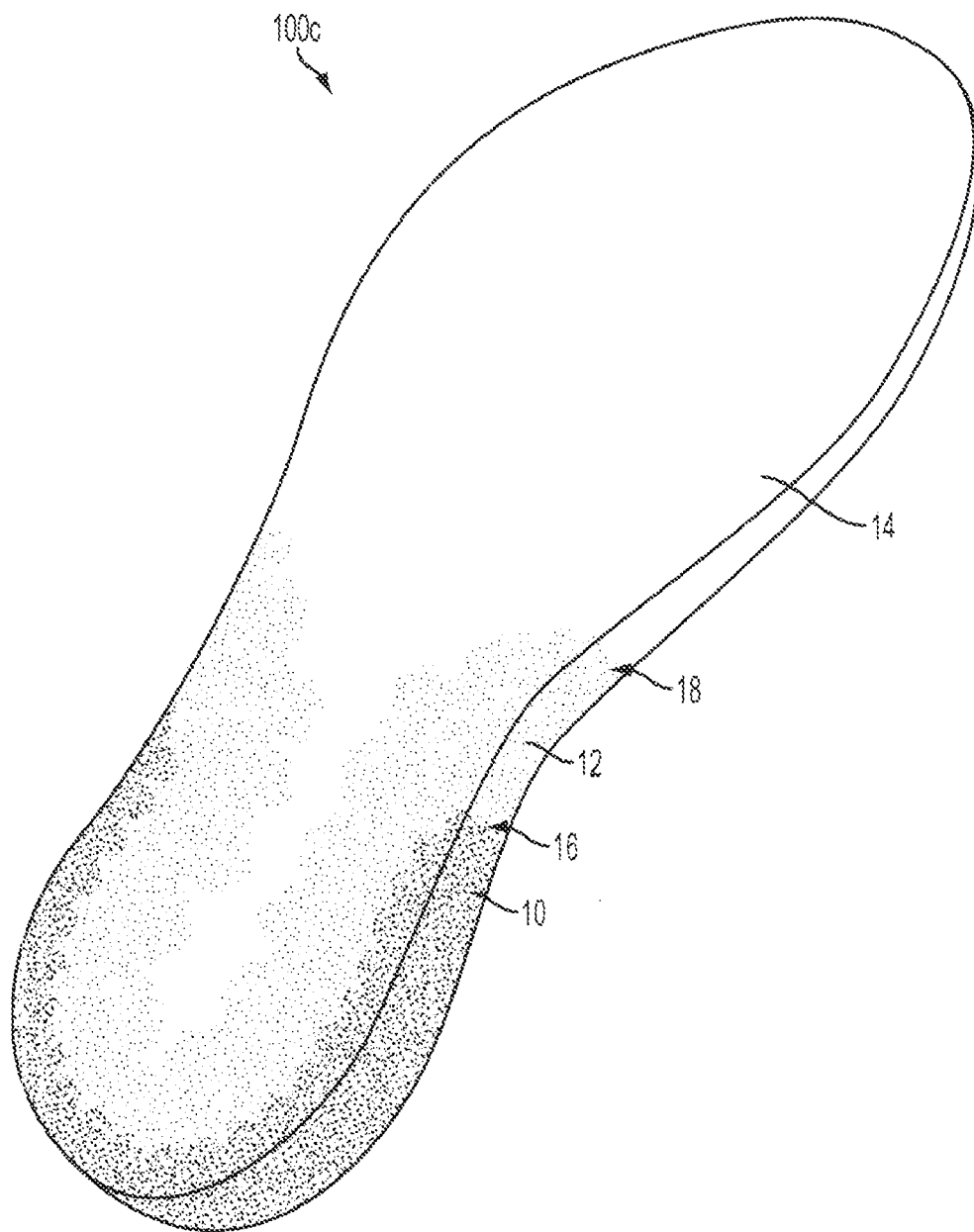


FIG. 1C

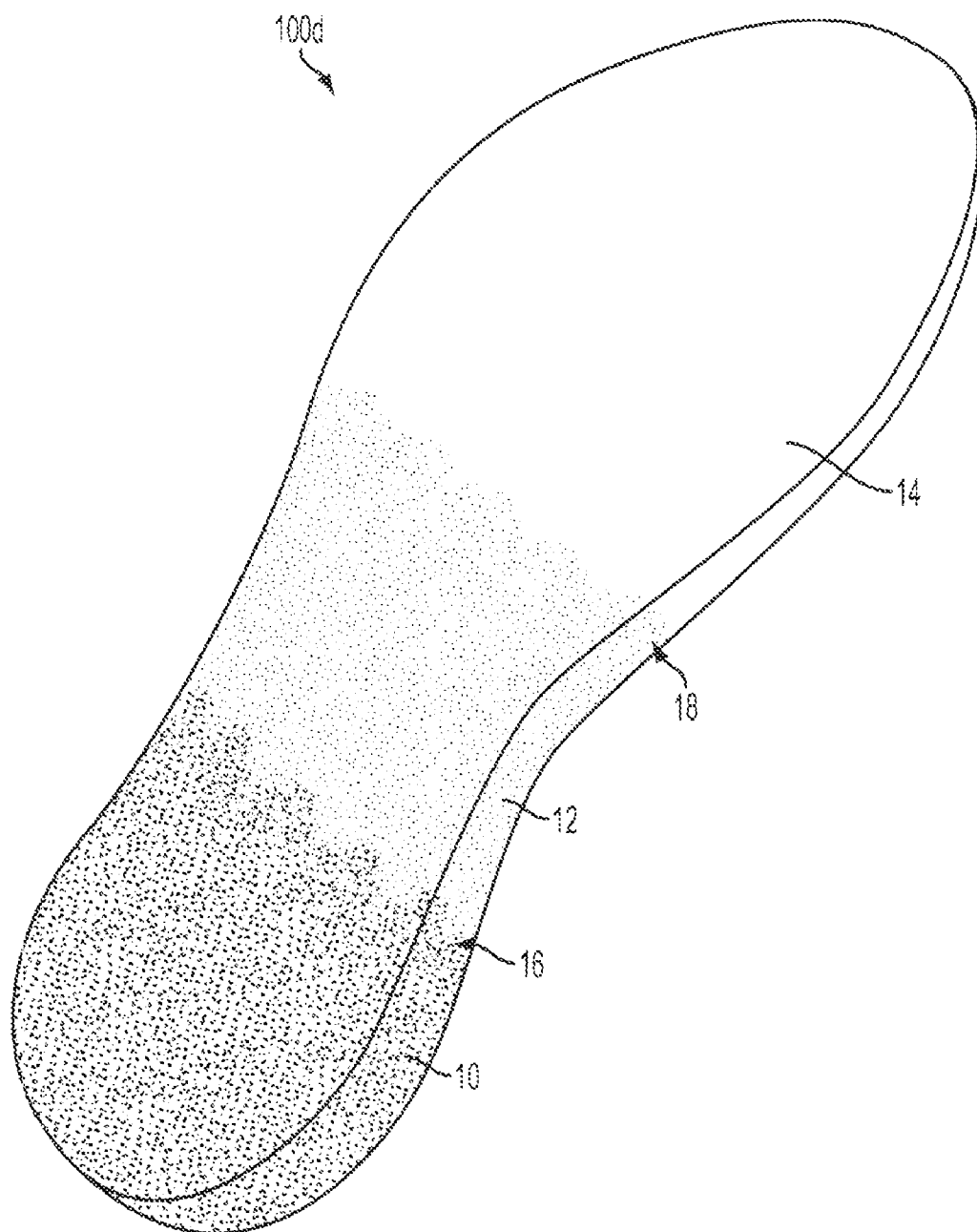
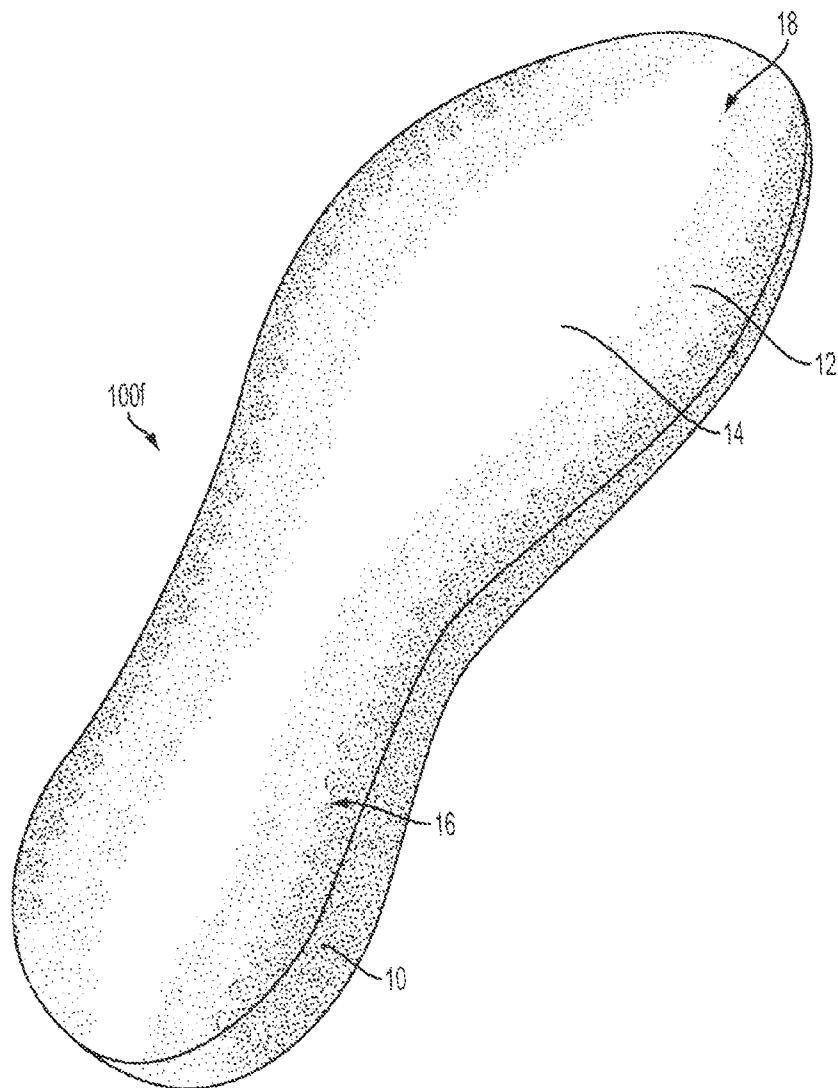
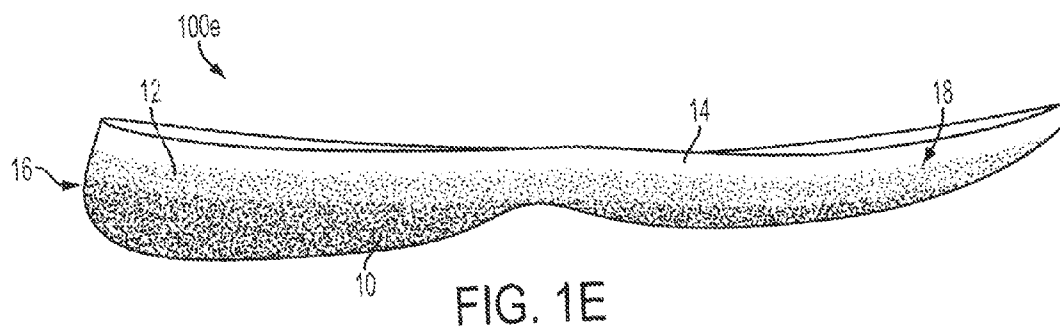


FIG. 1D



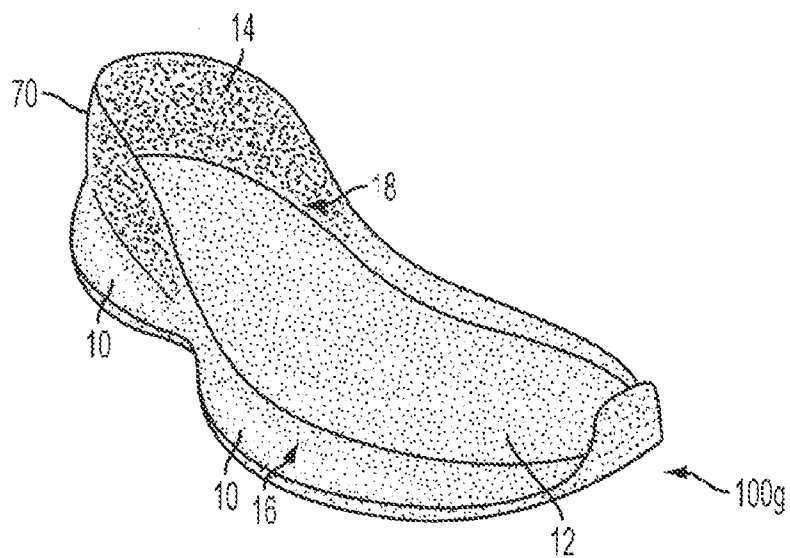


FIG. 1G

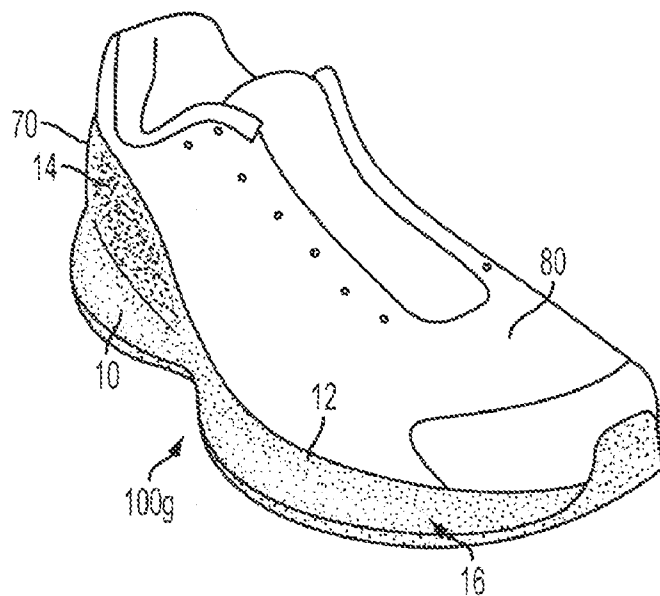


FIG. 1H

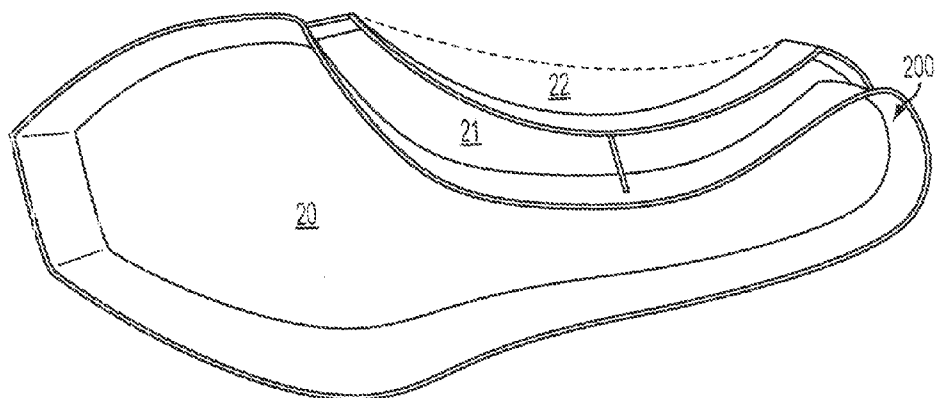


FIG. 2A

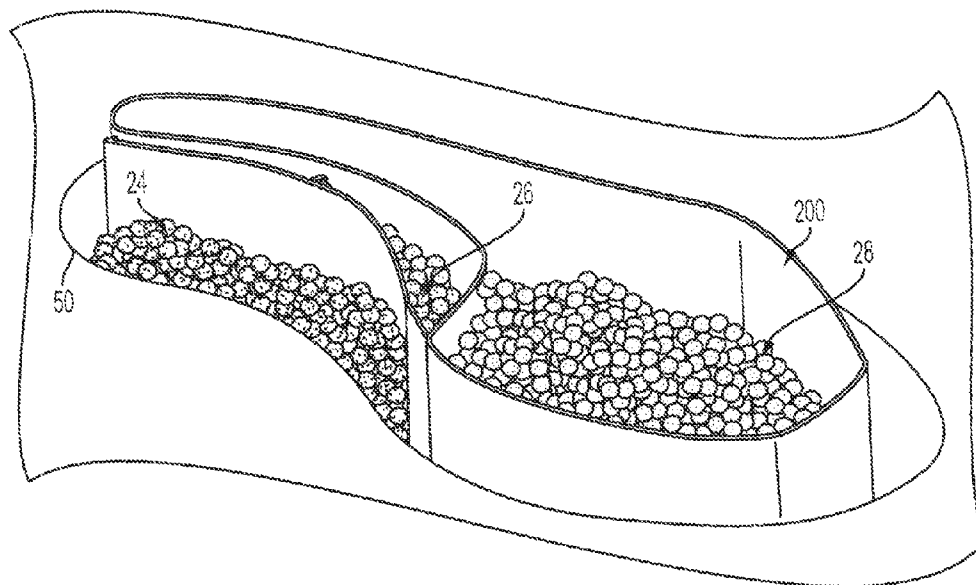


FIG. 2B

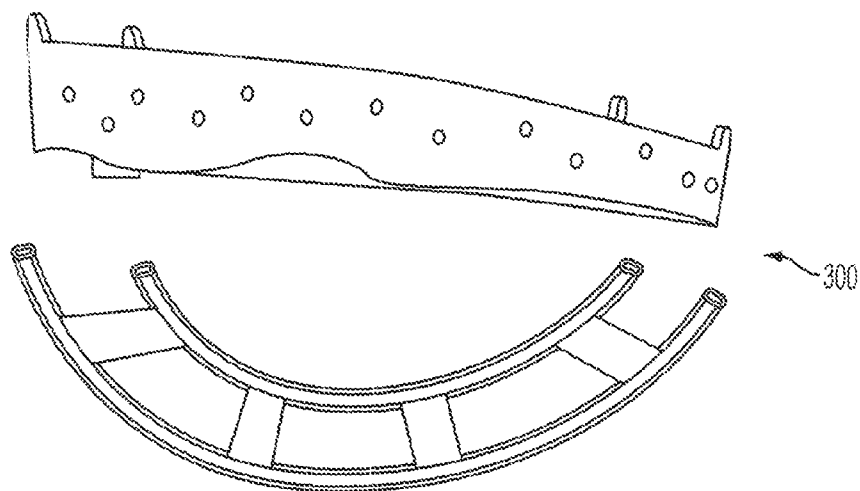


FIG. 3A

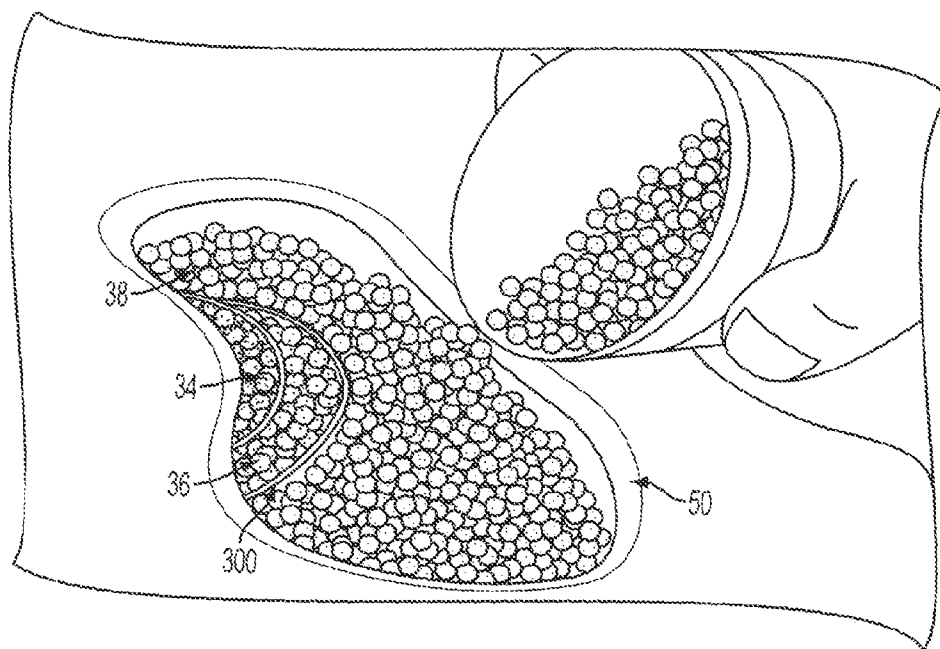


FIG. 3B

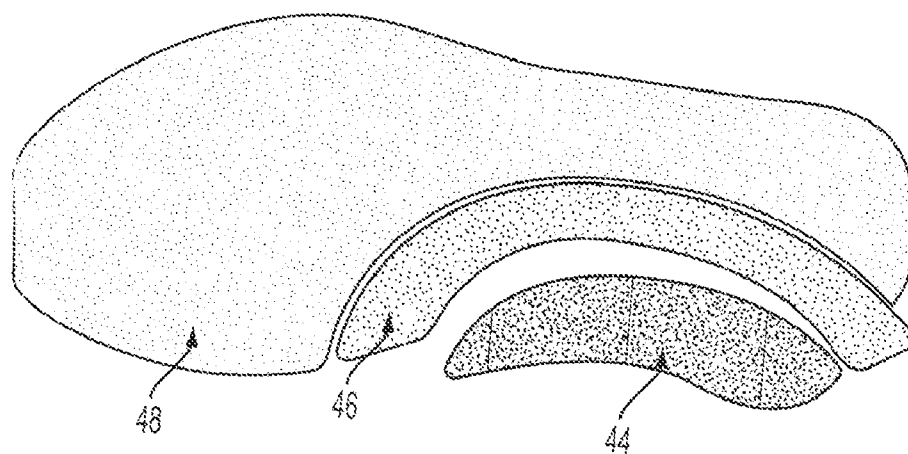


FIG. 4

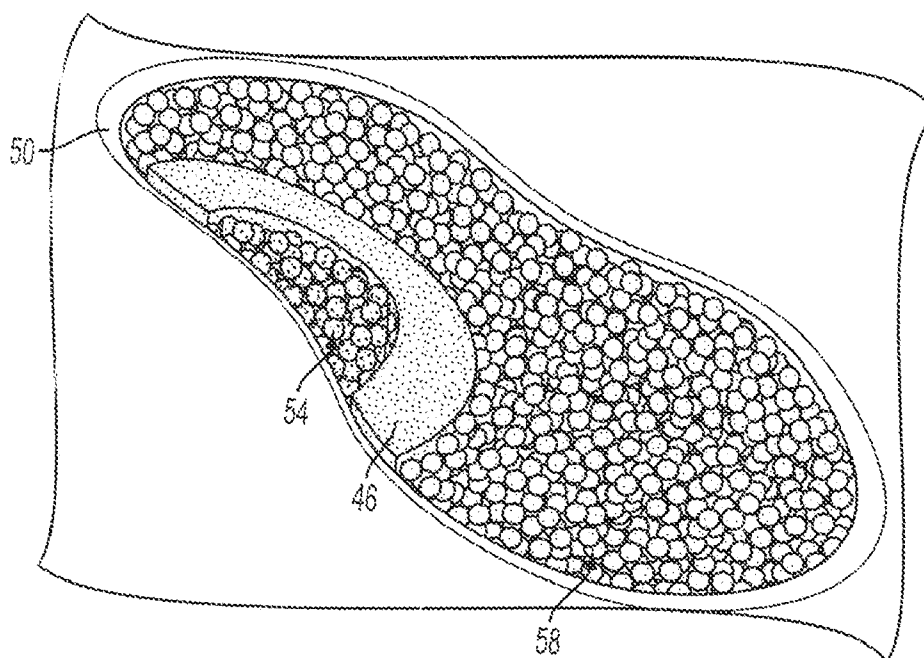


FIG. 5

MULTIPLE RESPONSE PROPERTY FOOTWEAR

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to U.S. Provisional Patent Application No. 61/345,978, filed May 18, 2010, entitled "MULTIPLE RESPONSE PROPERTY FOOTWEAR," the disclosure of which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] Embodiments herein relate generally to the field of footwear, and more particularly to components of performance footwear, such as midsoles, as well as methods of making midsoles.

BACKGROUND

[0003] The sole assembly of athletic footwear generally has a layered configuration that includes a comfort-enhancing insole, a resilient midsole formed from a polymer foam material, and a ground-contacting outsole that provides both abrasion-resistance and traction. The midsole imparts cushioning and helps control foot motion.

[0004] The midsole may be formed from a single-layer polymer foam that extends throughout the length and width of the footwear. With the exception of a difference in thickness between the heel and forefoot areas of the footwear, such a unitary midsole has substantially uniform properties. In order to vary the properties of midsole, some conventional midsoles incorporate dual- or multi-density or multi-durometer polymer foams. For instance, the lateral side of the midsole may be formed from one foam material, and the medial side of the midsole may be formed from a second, less-compressible, denser foam material.

[0005] Generally, the layers of foam are cut, placed, and glued together using a vertical or angled seam. This results in an undesirable lever effect during a footstrike as the weight of the foot travels over the abrupt transition point between foam densities or durometers. The sudden transition from firmer foam to softer foam (or visa versa) can result in instabilities in the footstrike, such as over-rapid pronation of the foot. Additionally, this method of construction can require the use of glues that may contain volatile organic compounds (VOCs), which may have undesirable environmental and health impacts, both for the manufacturer of the footwear and the wearer. Furthermore, the use of a glued seam creates a potential site of physical failure, and the midsole layers may separate with use.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Embodiments will be readily understood by the following detailed description in conjunction with the accompanying drawings. Embodiments are illustrated by way of example and not by way of limitation in the figures of the accompanying drawings.

[0007] FIGS. 1A, 1B, 1C, 1D, 1E, and 1F illustrate examples of multiple response property midsoles in accordance with various embodiments;

[0008] FIGS. 2A and 2B illustrate a method of making a multiple response property midsole, in accordance with various embodiments;

[0009] FIGS. 3A and 3B illustrate another method of making a multiple response property midsole, in accordance with various embodiments;

[0010] FIG. 4 illustrates another method of making a multiple response property midsole, in accordance with various embodiments; and

[0011] FIG. 5 illustrates another method of making a multiple response property midsole, in accordance with various embodiments.

DETAILED DESCRIPTION OF EMBODIMENTS

[0012] In the following detailed description, reference is made to the accompanying drawings which form a part hereof, and in which are shown by way of illustration embodiments that may be practiced. It is to be understood that other embodiments may be utilized and structural or logical changes may be made without departing from the scope. Therefore, the following detailed description is not to be taken in a limiting sense, and the scope of embodiments is defined by the appended claims and their equivalents.

[0013] Various operations may be described as multiple discrete operations in turn, in a manner that may be helpful in understanding embodiments; however, the order of description should not be construed to imply that these operations are order dependent.

[0014] The description may use perspective-based descriptions such as up/down, back/front, and top/bottom. Such descriptions are merely used to facilitate the discussion and are not intended to restrict the application of disclosed embodiments.

[0015] The terms "coupled" and "connected," along with their derivatives, may be used. It should be understood that these terms are not intended as synonyms for each other. Rather, in particular embodiments, "connected" may be used to indicate that two or more elements are in direct physical or electrical contact with each other. "Coupled" may mean that two or more elements are in direct physical contact. However, "coupled" may also mean that two or more elements are not in direct contact with each other, but yet still cooperate or interact with each other.

[0016] For the purposes of the description, a phrase in the form "A/B" or in the form "A and/or B" means (A), (B), or (A and B). For the purposes of the description, a phrase in the form "at least one of A, B, and C" means (A), (B), (C), (A and B), (A and C), (B and C), or (A, B and C). For the purposes of the description, a phrase in the form "(A)B" means (B) or (AB) that is, A is an optional element.

[0017] The description may use the terms "embodiment" or "embodiments," which may each refer to one or more of the same or different embodiments. Furthermore, the terms "comprising," "including," "having," and the like, as used with respect to embodiments, are synonymous.

[0018] Embodiments of the present disclosure are directed to performance footwear having portions that may help facilitate a more fluid foot movement, improve manufacturing and production techniques, and prevent injury to the foot, ankle, and/or legs during exercise, such as running, hiking, walking, and other impact-generating activities. In various embodiments, multiple response property midsoles and/or portions of footwear are provided that may include strategically arranged multiple response property areas having blended transition zones disposed there between.

[0019] In various embodiments, the multiple response property areas (and the differences between them) may be

characterized as having various properties, such as density, durometer, specific gravity, and other footwear design characteristics. In various embodiments, the blended transition zones between adjacent response property areas may allow for a variety of biomechanical improvements, including, but not limited to, improved impact cushioning, support, and stability, as well as a more fluid footstrike motion. As used herein, the term blended transition zone and any variation thereof may generally refer to the interlocking, intermingling, and/or intermixing of materials (e.g., foams) having different response properties (e.g., densities or durometers), such that there is not a definite, clearly defined linear or planar path between the materials with different response properties, but rather a gradual transition from one defined material/property to another.

[0020] In some embodiments, blending the transition zones in the midsole may help avoid the lever effect that is common when materials having different response properties are glued together, for instance with a vertical or angled seam. For example, when a denser or a higher durometer material is positioned directly against a less dense or lower durometer foam without a blended transition region, the foot may undergo an undesirably rapid and sudden pronation when it travels over the abrupt transition between densities. By contrast, the blended transitions in the multiple response property midsoles disclosed herein may provide a gradual transition between the portions with different material response properties, which in-turn may help to ensure a more fluid footstrike motion. In addition, the lack of traditional glued seams enhances the strength and integrity of the midsole, while also permitting the different response property material areas to be arranged in any desired configuration. Further, embodiments of the midsole may use a glueless construction method that effectively eliminates the VOCs present in the glues typically used to couple the different materials in a traditional midsole.

[0021] FIG. 1A illustrates an example of a midsole with blended transitions between areas of differing (e.g., multiple) material response properties (e.g., density or durometer) in accordance with various embodiments. In the illustrated embodiment, materials of different response properties have been strategically positioned in a posted configuration that may be useful in, for example, athletic shoes, to help control the rate of pronation. Midsole 100a may include different response property areas arranged from medial to lateral, with, for example, a higher density or durometer material disposed in the medial arch region, and transitioning to a less dense or softer material toward the lateral side of the midsole. In one embodiment, a first response property material 10 may be located in the immediate arch area, with a second response property material 12 disposed immediately adjacent to (e.g., on the lateral side of) the first response property material 10. A blended transition 16 may be disposed between the first and second response property materials. In some embodiments, a third response property material 14 may be positioned adjacent to the second response property material 12, and may generally comprise the rest of the midsole 100a. A blended transition area 18 may be disposed between the second and third response property materials.

[0022] In various embodiments, in transition zones 16 and 18, the different materials having different response properties may intermingle and blend over a certain distance, instead of having a traditional glued seam. In various embodiments, these blended transition zones 16 and 18 may help avoid the lever effect, which is common with an abrupt tran-

sition between materials such as is found with glued seams, and may help enhance fluid connection and movement between the different response property materials. In one embodiment, first response property material 10 may have a higher density or durometer, with second response property material 12 having a density or durometer that is less than that of first response property material 10, but greater than that of third response property material 14. Such a configuration may provide support and stability for a user who over-pronates during a stride, for example. As illustrated, the strategic alignment of the different material response properties and resulting blended transition zones may provide a midsole that may be useful in providing a combination of impact absorption, flexibility, and stability, for instance, for walking, jogging, comfort, cross-training, such as in running shoes, hiking boots, or trail shoes.

[0023] FIG. 1B illustrates another example of a multiple response property midsole with blended transitions in accordance with various embodiments. In the illustrated example, a first response property material 10 may be located at the sides of the midfoot region of the midsole 100b, for instance generally in the medial arch region and opposite the arch region near the lateral edge of the foot. In various embodiments, second response property material 12 may generally surround first response property material 10, with the remainder of the midsole comprising third response property material 14. In the illustrated embodiment, blended transition zones 16 and 18 may be disposed between the different response property materials, 10, 12, and 14, and may contribute to the fluid motion, strength, and mechanics of midsole 100b. For example, as described above, first response property material 10 may have a higher density or durometer than second response property material 12, which in turn may have a higher density or durometer than third response property material 14. In some embodiments, this configuration may provide lateral stability, which may be useful, for instance, on rocky or uneven terrain, or for a user who is prone to either over-pronation or over-supination. In various embodiments, this configuration also may provide enhanced flexibility, cushioning, and comfort in the heel and forefoot portions of the midsole. As illustrated, the strategic alignment of the different material response properties and resulting blended transition zones may provide a midsole that may be useful in providing a combination of impact absorption, flexibility, and stability, for instance, for jogging or running shoes, hiking boots, or trail shoes.

[0024] FIG. 1C illustrates another example of a multiple response property midsole with blended transitions in accordance with various embodiments. In this example, first response property material 10 may be located at the lateral and medial sides of the midfoot and the heel of midsole 100c, for instance generally in a horseshoe-like pattern. In various embodiments, second response property material 12 may generally surround first response property material 10, and third response property material 14 may comprise the rest of the midsole. In various embodiments, blended transition zones 16 and 18 may be disposed between the different response property materials, and may contribute to the fluid motion, strength, and mechanics of the midsole. For example, first response property material 10 may be of a higher density or durometer than second response property material 12 and third response property material 14, which may provide stability in the side and rear areas of the foot. This may be useful, for instance, on rocky or uneven terrain, while providing

enhanced pronation/supination prevention, enhanced flexibility, and cushioning and comfort in the central and forefoot regions of the midsole. As illustrated, the strategic alignment of the different response property materials and resulting blended transition zones may provide a midsole that may be useful in providing stability, for instance, for hiking boots or trail shoes.

[0025] FIG. 1D illustrates yet another multiple response property midsole **100d** with blended transitions in accordance with various embodiments. As illustrated, the strategic placement of the different response property material areas may include arranging a first response property material **10** in the heel region, a second response property material **12** in the mid-foot region, and a third response property material **14** in the toe region, with blended transition zones **16** and **18** formed between the different response property material areas. Such an embodiment may be useful, for instance, in sandals where a higher density or durometer material may be used as the first response property material **10**, for instance to improve impact absorbance of the heel region, support, and durability. The second response property material **12** may have a density or durometer less than that of the first response property, and may be positioned to provide additional support and cushioning for the midfoot area. Finally, the third response property material **14** may be the least dense of the three response property materials, and may be placed to provide enhanced comfort and flexibility in the forefoot region.

[0026] FIG. 1E illustrates still another multiple response property midsole with blended transitions in accordance with various embodiments. As illustrated, different response property material areas may be arranged or layered vertically within the midsole **100e**, from bottom to top. In some embodiments, a layer of second response property material **12** may be sandwiched between first response property material **10** and third response property material **14**. In some embodiments, first blended transition **16** may be disposed between first response property layer **10** and second response property layer **12**, and second blended transition zone **18** may be disposed between second response property layer **12** and third response property layer **14**. In one embodiment, the response properties may be selected such that a less dense or lower durometer (e.g., softer) third response property material **14** may be used as the upper layer to provide comfort, whereas second **12** and first **10** response property materials may have higher densities or durometers, for instance to provide durability, support and resilience. Such an embodiment may be particularly useful in comfort shoes, work shoes, etc.

[0027] FIG. 1F illustrates another example of a multiple response property midsole with blended transitions in accordance with various embodiments. As shown in the illustrated embodiment, midsole **100f** may have multiple response property materials arranged to enhance lateral stability. In the illustrated example, lateral stability bars of first response property material **10** may be disposed at the medial and lateral edges of the midsole. In various embodiments, the center portion of the midsole may include a third response property material **14**, and second response property material **12** may be disposed there between. In various embodiments, blended transition **16** may be disposed between first response property material **10** and second response property material **12**, and second blended transition **18** may be disposed between second response property material **12** and third response property material **14**. In various embodiments, such an arrange-

ment may provide a balance of cushioning (e.g., where third response property material **14** is a lower density or durometer foam) and stability (e.g., where first response property material **10** is a higher density or durometer foam).

[0028] In the foregoing embodiments, one of skill in the art will appreciate that, although three different response property materials/areas are illustrated in each example, any number of response property areas may be used, for instance 2, 3, 4, 5, 6, or even more response property areas. Such different response property areas may be arranged in a number of strategic configurations. For example, a low density or durometer material may be used wherever extra softness or cushioning is needed, such as in the forefoot area, heel layer, or upper layer of the midsole, or for use when the user has an injury or otherwise requires more cushioning. In another example, a higher density or durometer material may be included in any area requiring firm support, extra stability, or extra durability, such as in the arch region, the midfoot region, the heel region, or the lower portions of the midsole. In some embodiments, the specific configuration of the midsole may be customized to suit the needs, footstrike pattern, or running style of an individual user. In other embodiments, the blended transitions of the midsole may allow the shoe to respond to the individual needs of a particular user or the particular terrain conditions.

[0029] Although the response property areas are referred to herein as low, medium, and high (e.g., as it relates to a material response property that is density or durometer), one of skill in the art will appreciate that these terms are relative. In one embodiment where the material response property is durometer, for instance, the low, medium, and high identifiers may correspond to 55, 60, and 65 Asker C; or 55, 65, and 75 Asker C. In other embodiments, greater or lower response property materials also may be used to suit the desired application.

[0030] In embodiments, changing the material hardness of the midsole may change the activity in various lower extremity muscles, such as rectus femoris, biceps femoris, medial gastrocnemius, and tibialis anterior. For instance, when running on a dense midsole, the tibialis anterior muscle may exert significantly more force before the heel strike and less force following the heel strike than when running on a medium midsole. Additionally, using shoes with a denser midsole may reduce the energy dissipated at the metatarsophalangeal joints and aid in improving jumping performances and economy of foot movement. Thus, in various embodiments, the response may be varied in particular regions of the midsole and/or other portions of the footwear for a variety of reasons.

[0031] FIGS. 1G and 1H illustrate a multiple response property article of footwear in accordance with various embodiments, where the multiple response property materials comprise not only the midsole, but also portions of, for example, the heel cup **70** and/or upper **80**. For example, midsole **100g** may also extend upward around the heel cup region **70**, which may provide greater heel stability and/or protection. As illustrated, the strategic placement of the different response property material areas may include arranging a first response property material **10** in the heel region of the midsole, a second response property material **12** in the foot bed region of the midsole, and a third response property material **14** in heel cup region, with blended transition zones **16** and **18** formed between the different response property material areas. In some embodiments, the multiple response

property materials may extend to encompass all or a portion of the vamp or upper **80**, such as the toe box, the instep, the tongue, or the ankle collar, or all or part of the insole or, outsole (not shown).

[0032] In other embodiments, the midsole material may extend around and/or over the instep, for instance to provide greater protection and stability through the midfoot region. In still other embodiments, the midsole material may extend around and/or over the forefoot region, for instance to provide protection to the toes. In some embodiments, the midsole material may extend around the entire foot and may form a part of or all of the footwear upper, for instance in boots or shoes that provide extra ankle support or foot protection. In some embodiments, the portion of the midsole material that extends past the midsole may include a less dense material, such as an extra soft response property material.

[0033] In other embodiments, methods of making a multiple response property midsoles and other footwear portions are provided. Conventional multiple response property midsoles are typically constructed by stock-fitting or gluing together individual material components prior to final molding or after final molding. This leaves a distinct line and a generally solid border between the different response property materials, which border is often delineated by a glue seam. By contrast, the disclosed methods may allow the different response property material areas to have blended transition zones, which again may produce a more fluid, gradual change in the midsole response property as detected by the foot.

[0034] In various embodiments, the different response properties may be achieved by a variety of materials suitable for midsole construction. In some embodiments, polymer foam pellets may be arranged such that compression molding of the pellets may result in blending of the different response properties in the transition zones, as illustrated in the examples shown in FIGS. 1A-1H. In some embodiments, the polymer foam pellets may be ethylene vinyl acetate (EVA) pellets. EVA is a polymer that may approach elastomeric materials in softness and flexibility, yet may be processed like other thermoplastics. The material has good clarity and gloss, barrier properties, low-temperature toughness, stress-crack resistance, hot-melt adhesive waterproof properties, and resistance to UV radiation. In other embodiments, the midsole may include one or more other types of material, such as rubberized EVA, polyurethane, and/or any other midsole/footwear construction material known to those of skill in the art.

[0035] Although the foregoing examples illustrate embodiments having three distinct response property materials, one of skill in the art will appreciate that some embodiments, of the midsole may include only two different response property materials, whereas other embodiments may include four, five, six, or even more response property materials. In addition, these materials may be distributed about the midsole wherever a particular response property is desired. For instance, more or less of the midsole may comprise higher density or durometer foams than in the illustrated examples. Additionally, in some embodiments, lower or higher density or durometer materials may be incorporated under the metatarsals, for instance, to form crash pads.

[0036] In various embodiments, multiple response property midsoles with blended transition areas may be formed in a number of ways, for example using known midsole forming techniques, such as pre-form and compression molding,

injection molding, pellet pour, and the like. In one embodiment, as illustrated in FIGS. 2A and 2B, the midsole may be formed by arranging foam pellets of different response properties in a specifically designed jig. As illustrated, a jig **200** having one or more compartments may be positioned within a midsole mold **50**. EVA or other midsole forming pellets may be poured into the compartments **20**, **21** of jig **200**, as well as into a space **22** created between jig **200** and mold **50**. As illustrated, a jig with two different compartments may allow for the midsole to be formed using pellets **24**, **26**, **28** of three different response properties, although other jig configurations are contemplated that have more or fewer compartments.

[0037] In various embodiments, the different response properties of pellets **24**, **26**, **28** may be color-coded for visual determination and placement in the proper compartments **20**, **21**, **22** of the jig **200**. In some embodiments, once the pellets **24**, **26**, **28** are positioned correctly, the jig **200** may then be removed by lifting in a vertical direction, thereby allowing the pellets **24**, **26**, **28** to intermingle, or at least providing the potential to intermingle during the midsole formation process. The strategically positioned pellets **24**, **26**, **28** in the mold may then be subjected to a pre-form process, which includes addition of heat and temperature to activate the blowing agent in, for example, the EVA to induce the intended properties. During the pre-form process, blended transition zones are formed by virtue of contiguity between the different pellets, which allows for some flow or migration of the differing response property materials between strategic response property zones. The blocker or pre-form may then be compression molded, giving the midsole its final dimensions.

[0038] In various embodiments, blended transition zones formed during the pre-form and molding process may result in a mechanical coupling of the different response property areas without using an adhesive. Further, in some embodiments, the absence of harsh, inflexible lines/seams between traditional multi-density midsoles may provide a more fluid and gradual tactile feel as the foot naturally pronates during the running or walking motion. In some embodiments, different colors may be chosen for the different response property pellets **24**, **26**, **28**, which may allow for the blended transition zones to be visually distinguishable, and which may also give the final midsole a unique look.

[0039] FIGS. 3A and 3B illustrate side and top views of an example of another method for forming midsoles in accordance with various embodiments. In various embodiments, a cage **300** may be inserted into mold **50**, and may be configured to separate different response property pellets. In various embodiments, cage **300** may surround second response property pellets **36**, and may separate them from first response property pellets **34** and third response property pellets **38**. In some embodiments, cage **300** may be generally shaped like jig **200** in the previous embodiment, forming one or more compartments for the different response property pellets. In some embodiments, the cage may be configured to melt during the pre-form formation stage, thereby allowing the cage material to integrate with and become part of the midsole. In various embodiments, the melting of cage **300** may allow different response property pellets **34**, **36**, **38** to intermingle at the cage borders and form blended transition zones between differing response property material areas. As in the previous embodiment, the blocker or pre-form may then be compression molded, giving the midsole its final dimensions.

[0040] FIG. 4 illustrates an example of another method for forming midsoles in accordance with various embodiments. A quantity of pellets of each desired response property may be lightly molded prior to the pre-form stage, thereby forming one or more pre-molds 44, 46, 48, of a material that will achieve a desired response property. One or more different pre-molds 44, 46, 48 may then be placed within the mold 50 in the desired configuration. In some embodiments, given that the pre-mold does not significantly change the pellet characteristics, but only temporarily holds like response property pellets in a desired configuration for placement in the mold, during the pre-form process the pellets/materials may still flow into adjacent response property materials, and thereby form the blended transition zones.

[0041] In various embodiments, the pre-molds 44, 46, 48 may be formed in a variety of ways. In one example, the pre-mold may include gently and briefly heating certain response property foam pellets in an individual mold such that the pellets adhere to one another to form the desired pre-form shape. In particular embodiments, the pellets may be heated to approximately 130° C. for about 4 minutes, and then cooled prior to placement in the pre-form mold. In some embodiments, slight pressure may be added to ensure that a one-piece formation of the pre-form is achieved. In some embodiments, a binder may be used to hold the response property material pellets together for strategic placement in the mold. The binder may be selected such that it may mix with the multiple response property materials during the pre-form process, similar to the aforementioned cage embodiments where the cage material is selected to melt and integrate with the pre-form.

[0042] In one embodiment, the pre-molds 44, 46, 48 may be placed in the pre-form mold, for instance, with a higher response property pre-mold 44 in the medial arch position, and with a medium response property pre-mold 46 sandwiched between the higher response property pre-mold 44 and the low response property pre-mold 48, which may be placed in the lateral position. The pre-molds 44, 46, 48 may then undergo the pre-form treatment and allow the different response property materials to intermingle and form the blended transition zones. As in the previous embodiments, the blocker or pre-form may then be compression molded, giving the midsole its final dimensions.

[0043] FIG. 5 illustrates yet another example method for forming midsoles in accordance with various embodiments. Similar to the embodiment described with respect to FIG. 4, a single pre-mold 46 may be positioned within the pre-form mold in order to control placement of other loose pellets 54 and 58 having different response properties. For example, the pre-mold 46 may be made from a second or a medium-response property pellet, and may be positioned within the pre-form mold such that it creates one or more partitions within the pre-form mold. Pellets 54 and 58 of different response properties may be disposed in the areas adjacent to the pre-mold. In the pre-form process, the different response property materials may intermingle to thereby form a blended transition zone. As in the previous embodiments, the blocker or pre-form may then be compression molded, giving the midsole its final dimensions.

[0044] In various embodiments, different response property separation techniques may be used in order to strategically place the different response properties in/on the midsole to accomplish the desired effect of manufacturing a multiple response property midsole having blended transitions

between the materials of different response properties. Further, the various examples illustrated and described herein may be used together as needed (e.g., use of a jig with different pre-molds, etc.). Finally, though certain formed midsoles with strategically positioned response property areas have been illustrated, a variety of different response property placements are possible depending on the particular need.

[0045] Although the foregoing examples illustrate methods of making midsoles having three distinct response property materials, one of skill in the art will appreciate that some embodiments, the methods may be adapted for making midsoles that may include only two different response property materials, or midsoles that may include four, five, six, or even more response property materials.

[0046] Although certain embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a wide variety of alternate and/or equivalent embodiments or implementations calculated to achieve the same purposes may be substituted for the embodiments shown and described without departing from the scope. Those with skill in the art will readily appreciate that embodiments may be implemented in a very wide variety of ways. This application is intended to cover any adaptations or variations of the embodiments discussed herein. Therefore, it is manifestly intended that embodiments be limited only by the claims and the equivalents thereof.

We claim:

1. A multiple response property midsole comprising:
 - a first foam material having a first material response property;
 - a second foam material having a second material response property, wherein the second foam material is coupled to the first foam material at a first junction zone; wherein the first junction zone comprises a blended transition between the first foam material and the second foam material.
2. The multiple response property midsole of claim 1, further comprising a third foam material having a third material response property, wherein the third foam material is coupled to the second foam material at a second junction zone, wherein the second junction zone comprises a blended transition between the third foam material and the second foam material.
3. The multiple response property midsole of claim 2, further comprising a fourth foam material having a fourth material response property, wherein the fourth foam material is coupled to the third foam material at a third junction zone, wherein the third junction zone comprises a blended transition between the fourth foam material and the third foam material.
4. The multiple response property midsole of claim 1, wherein the first and second material response properties are density or durometer.
5. The multiple response property midsole of claim 1, wherein the midsole lacks a linear or planar seam between the first foam material and the second foam material.
6. The multiple response property midsole of claim 1, where the first foam material is positioned in an arch region of the midsole, and wherein the first foam material comprises a higher density or durometer foam than the second foam material.
7. The multiple response property midsole of claim 6, further comprising a third foam material, wherein the second foam material comprises a higher density or durometer foam

than the third foam material, and wherein the second foam material is positioned between the first and the third foam materials.

8. The multiple response property midsole of claim 7, wherein the third foam material is coupled to the second foam material at a second junction zone; and wherein the second junction zone comprises a blended transition between the second foam material and the third foam material.

9. The multiple response property midsole of claim 1, where the first foam material is positioned in both a medial midfoot region and a lateral midfoot region of the midsole, and wherein the first foam material comprises a higher density or durometer foam than the second foam material.

10. The multiple response property midsole of claim 8, further comprising a third foam material, wherein the second foam material comprises a higher density or durometer foam than the third foam material, and wherein the second foam material is positioned between the first and the third foam materials in both the medial and lateral midfoot regions.

11. The multiple response property midsole of claim 10, wherein the third foam material is coupled to the second foam material at a second junction zone; and wherein the second junction zone comprises a blended transition between the second foam material and the third foam material.

12. The multiple response property midsole of claim 1, where the first foam material is positioned in a heel region, a medial midfoot region, and a lateral midfoot region of the midsole, and wherein the first foam material comprises a higher density or durometer foam than the second foam material.

13. The multiple response property midsole of claim 12, further comprising a third foam material, wherein the second foam material comprises a higher density or durometer foam than the third foam material, and wherein the second foam material is positioned between the first and the third foam materials in the heel region, in the medial midfoot region, and in the lateral midfoot region.

14. The multiple response property midsole of claim 13, wherein the third foam material is coupled to the second foam material at a second junction zone; and wherein the second junction zone comprises a blended transition between the second foam material and the third foam material.

15. The multiple response property midsole of claim 1, wherein at least one of the first and second foam material comprise ethylene vinyl acetate foam.

16. The multiple response property midsole of claim 1, wherein the midsole does not comprise any glue.

17. The multiple response property midsole of claim 1, where the midsole is free of volatile organic compounds.

18. A method of making a multiple response property midsole, comprising:

- positioning a first foam material having a first density or durometer in a midsole mold;
- positioning a second foam material having a second density or durometer adjacent the first foam material in the

midsole mold, wherein the first foam material forms a first interface with the second foam material; and heating the first and second foam materials sufficiently to cause blending of the first and second foam materials at the first interface.

19. The method of claim 18, wherein the method further comprises positioning a third foam material having a third density or durometer adjacent the first or second foam material, wherein the third foam material forms a second interface with the first and/or second foam material, and wherein heating the first, second, and third foam materials causes blending of the first, second, and/or third foam materials at the first and second interfaces.

20. The method of claim 19, wherein the method further comprises positioning a fourth foam material having a fourth density or durometer adjacent the first, second, and/or third foam material, wherein the fourth foam material forms a third interface with the first, second, and/or third foam material, and wherein heating the first, second, third, and fourth foam materials causes blending of the first, second, third, and/or fourth foam materials at the first, second, and third interfaces.

21. The method of claim 18, wherein the method further comprises:

forming a first pre-molded portion of a midsole from first foam pellets to form the first foam material.

22. The method of claim 21, wherein the method further comprises:

forming a second pre-molded portion of a midsole from second foam pellets to form the second foam material.

23. The method of claim 21, wherein forming a first pre-molded portion of the midsole comprises:

positioning the first foam pellets in a pre-mold; heating the first foam pellets to a temperature of about 130° C.; and

cooling the first pre-molded portion before positioning the first pre-molded portion in the midsole mold.

24. The method of claim 18, wherein the first density or durometer is greater than the second density or durometer.

25. The method of claim 18, wherein the method further comprises:

pre-cutting the first foam material in a first desired shape.

26. The method of claim 25, wherein the method further comprises:

pre-cutting the second foam material in a second desired shape.

27. The method of claim 18, further comprising positioning the first and/or second foam material in the midsole mold using a jig or cage.

28. The method of claim 27, wherein the cage is configured to melt or dissolve when heated to a temperature of about 130° C.

29. The method of claim 18, wherein at least one of the first and second foam materials comprise ethylene vinyl acetate.

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