US 20200085142A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0085142 A1**

**GREEN** (43) **Pub. Date: Mar. 19, 2020**

(54) **REUSABLE CUSTOM INSOLES**

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(21) Appl. No.: **16/470,310**

(22) PCT Filed: **Dec. 15, 2016**

(86) PCT No.: **PCT/IL2016/051345**

§ 371 (c)(1),
(2) Date: **Jun. 17, 2019**

**Publication Classification**

(51) **Int. Cl.**

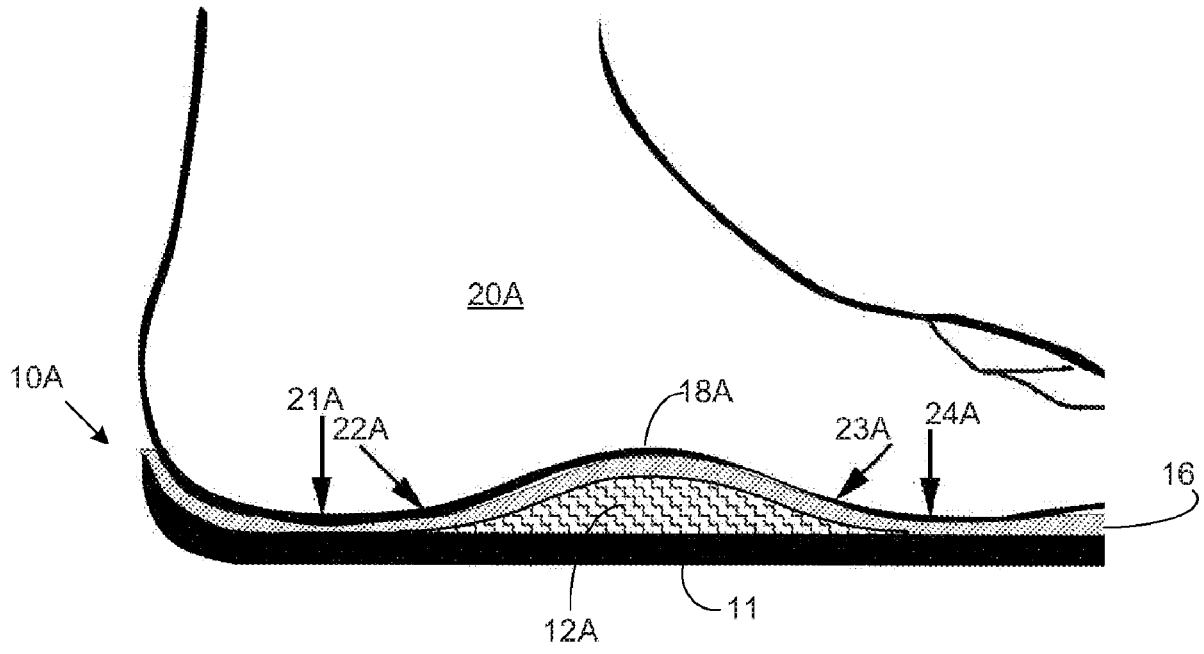
| | |
|---|---|
| ***A43B 17/18*** | (2006.01) |
| ***A43B 7/14*** | (2006.01) |
| ***A43B 17/14*** | (2006.01) |

(52) **U.S. Cl.**

CPC ..... ***A43B 17/18*** (2013.01); *A43B 7/223* (2013.01); ***A43B 17/14*** (2013.01); ***A43B 7/142*** (2013.01)

(57) **ABSTRACT**

A reusable, customizable shoe-insole having malleable support material configured to assume a first arch-support structure and a first metatarsal-support structure responsively to application of foot pressure of a first user and maintain the first arch-support structure and the first metatarsal-support structure during the absence of foot pressure and assume a new arch-support structure and a new metatarsal-support structure responsively to each new application of foot pressure of additional users.



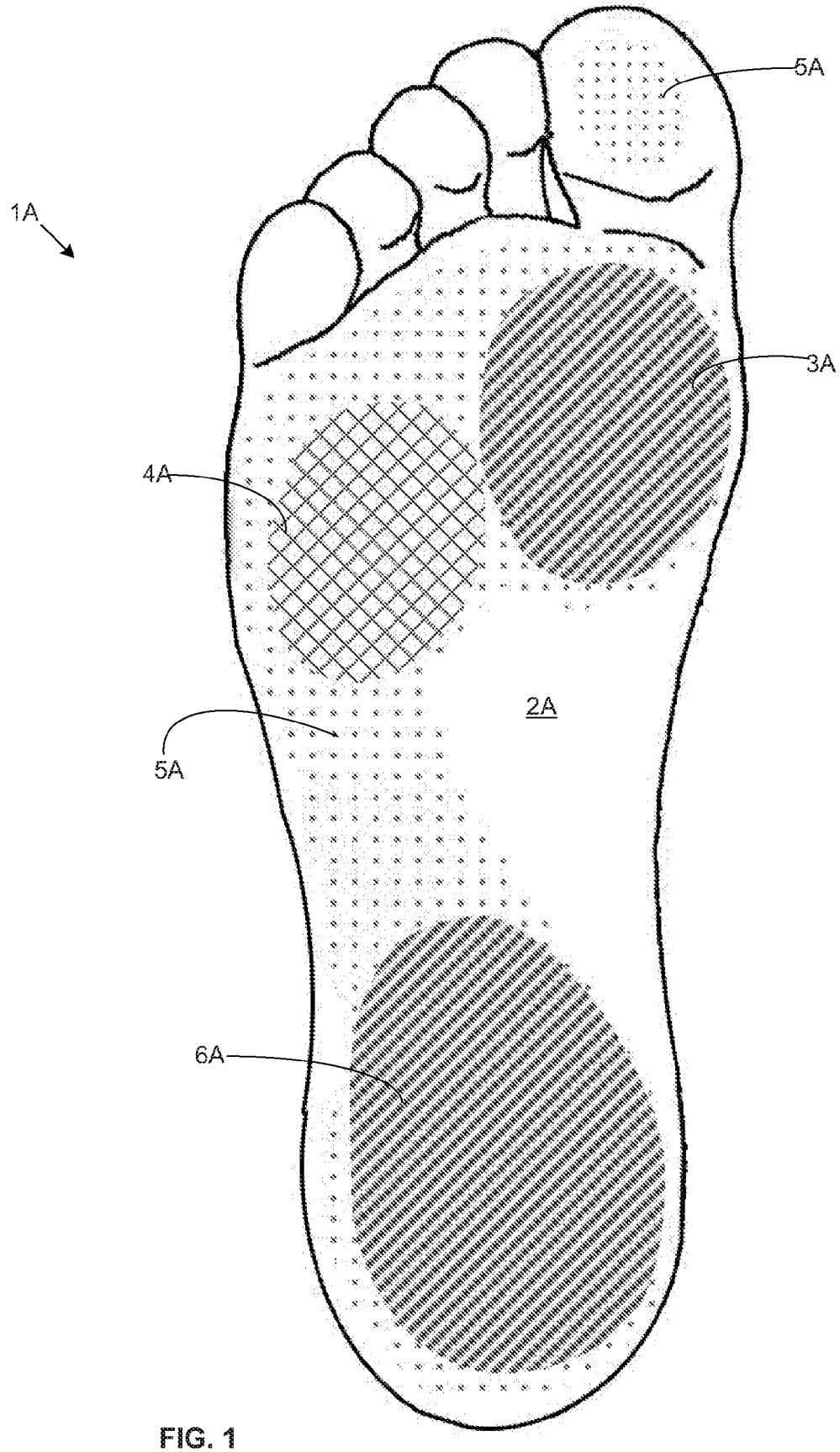



FIG. 1

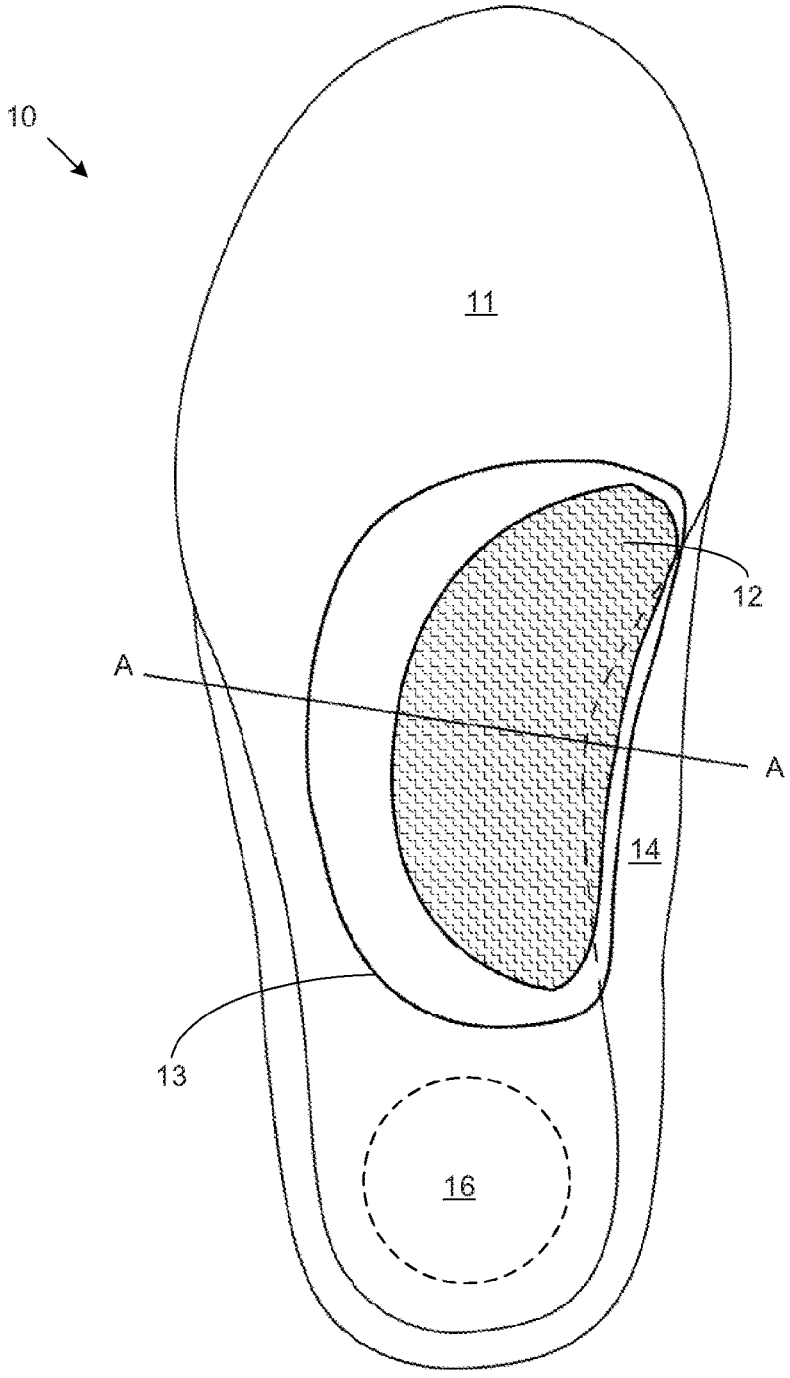



FIG. 2

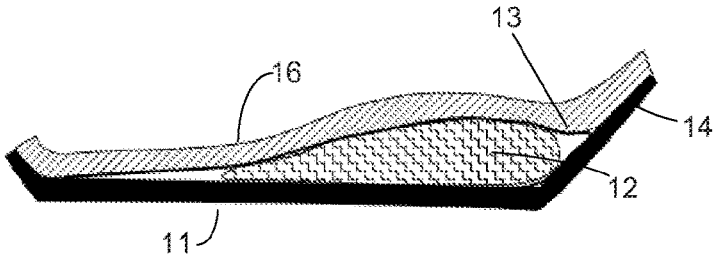



FIG. 3

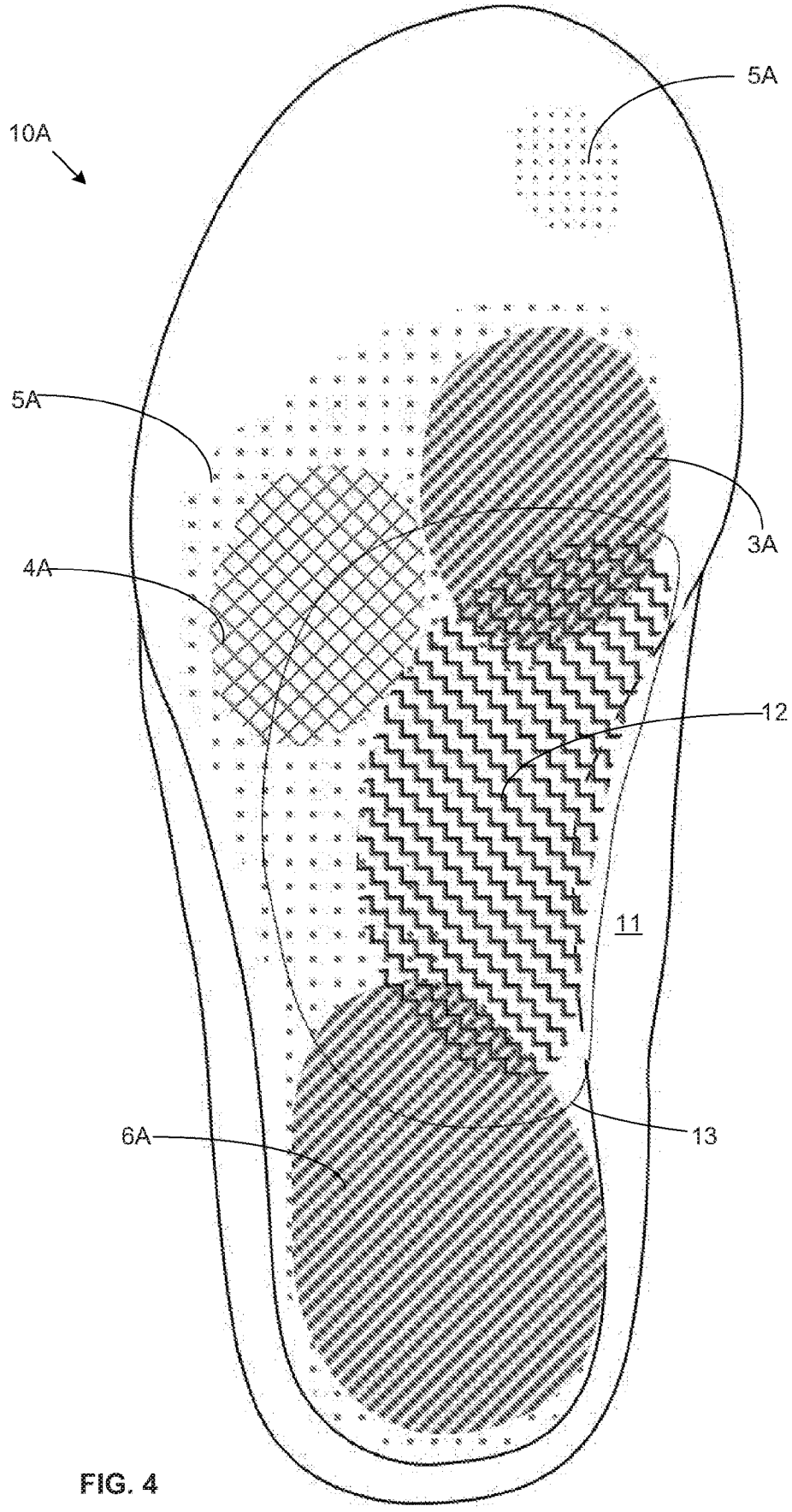



FIG. 4

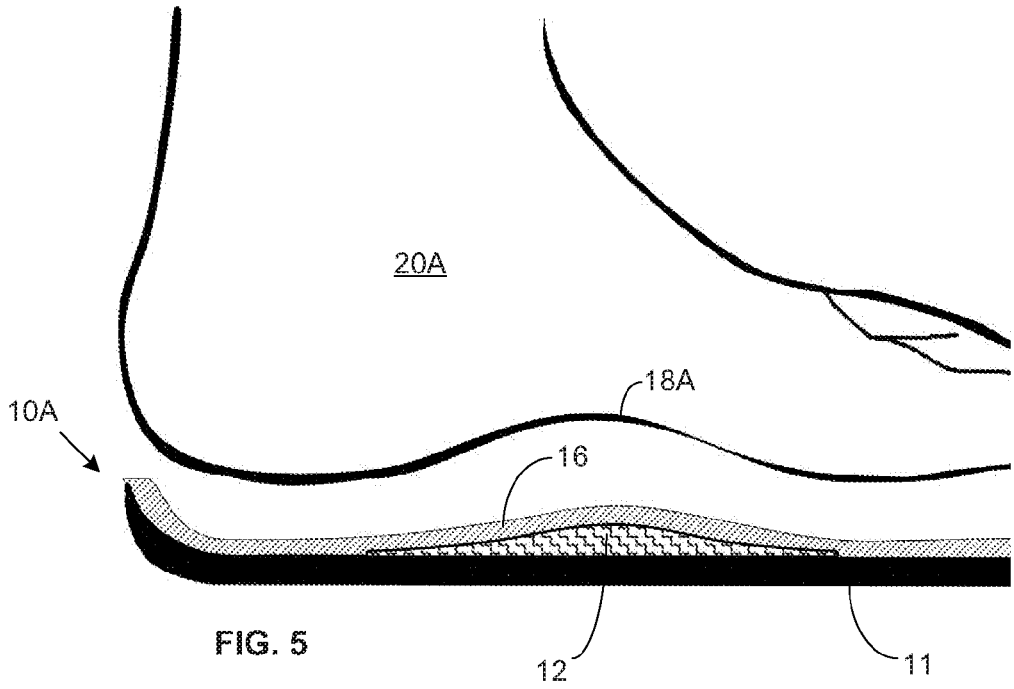



FIG. 5

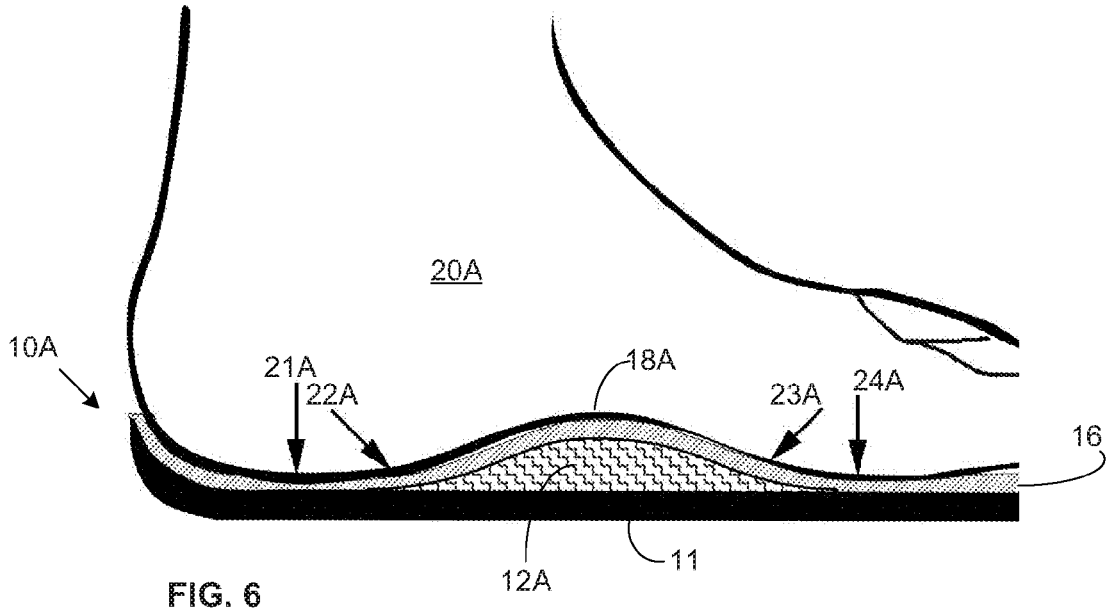



FIG. 6

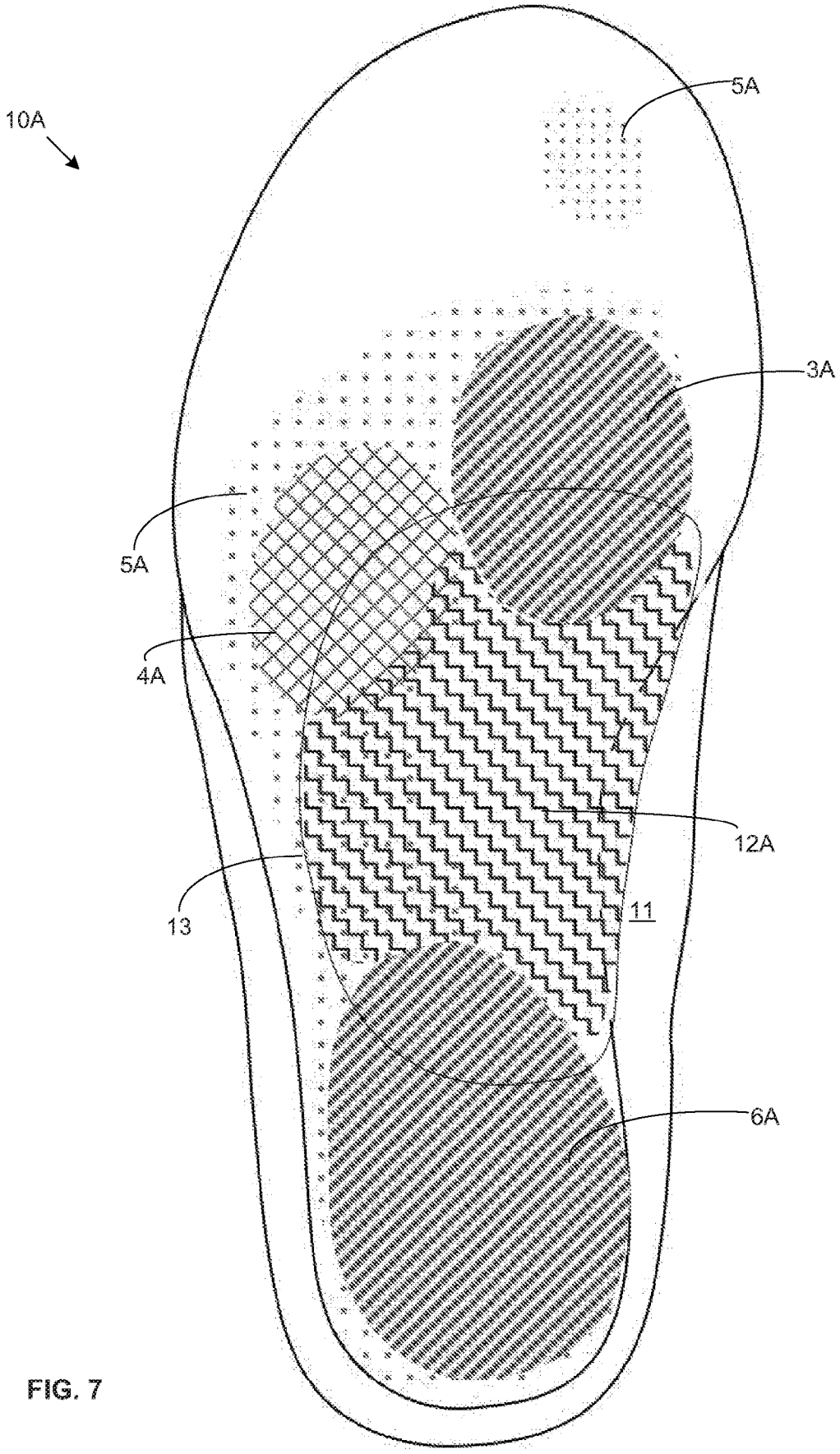



FIG. 7

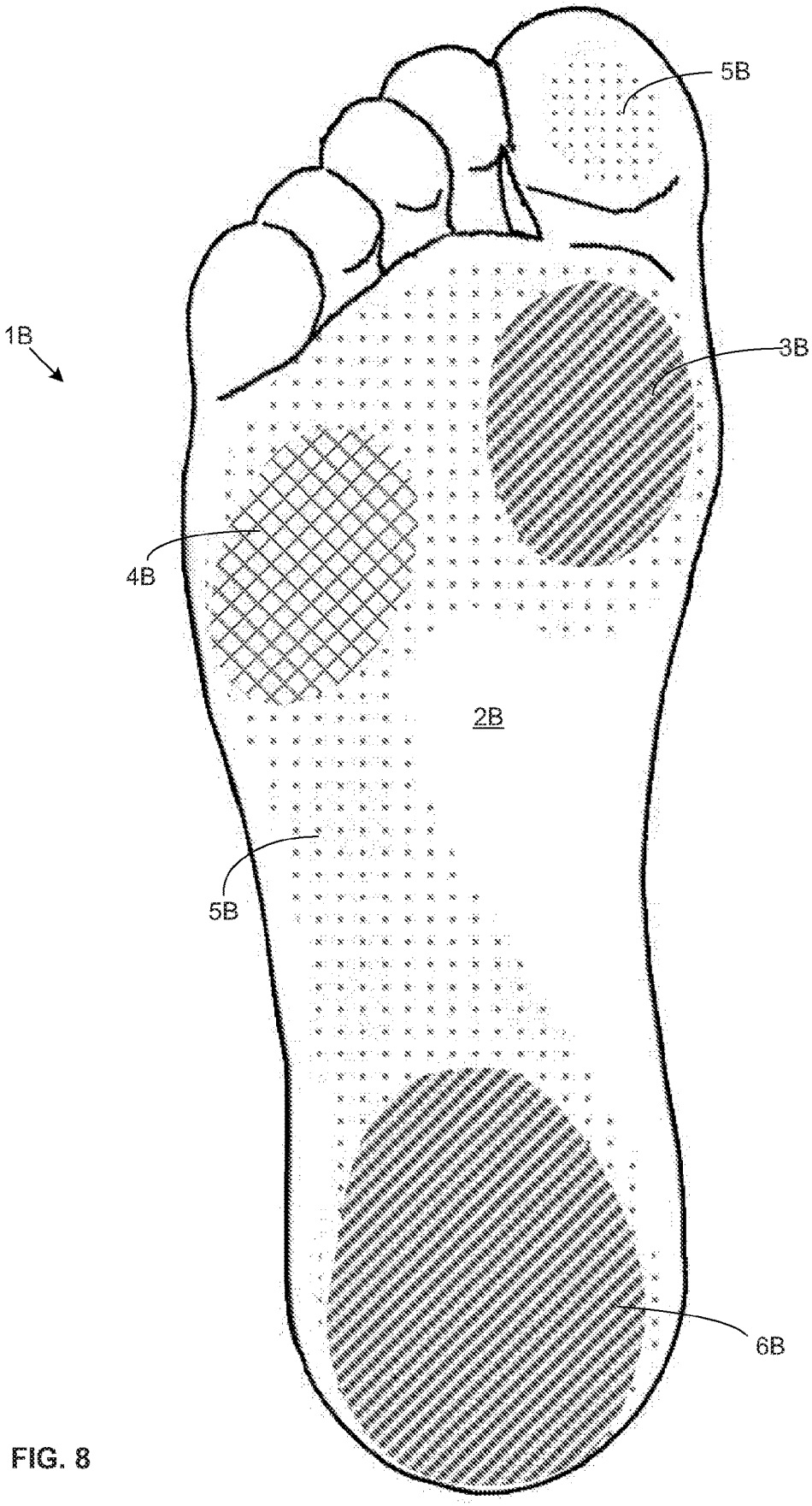



FIG. 8

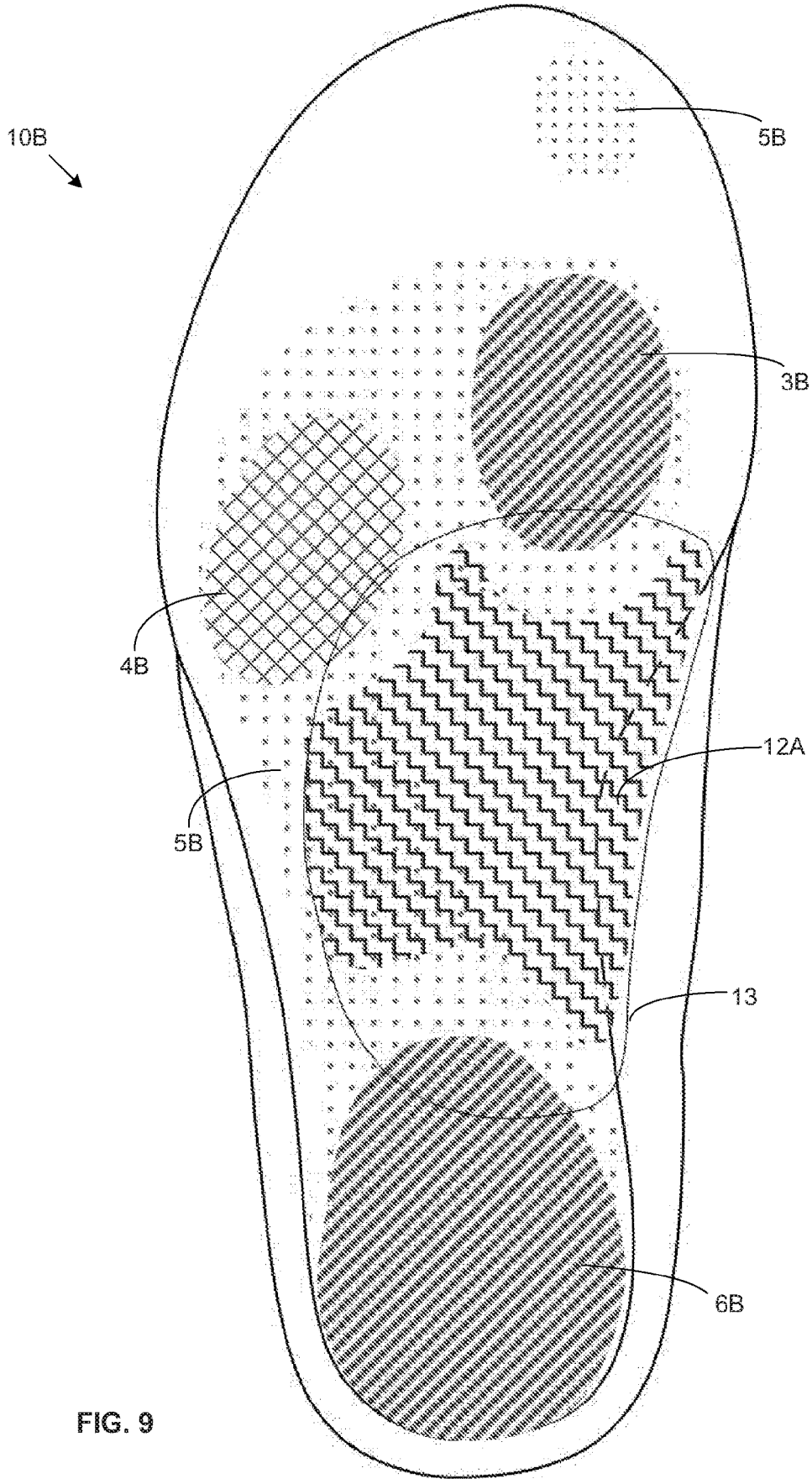



FIG. 9

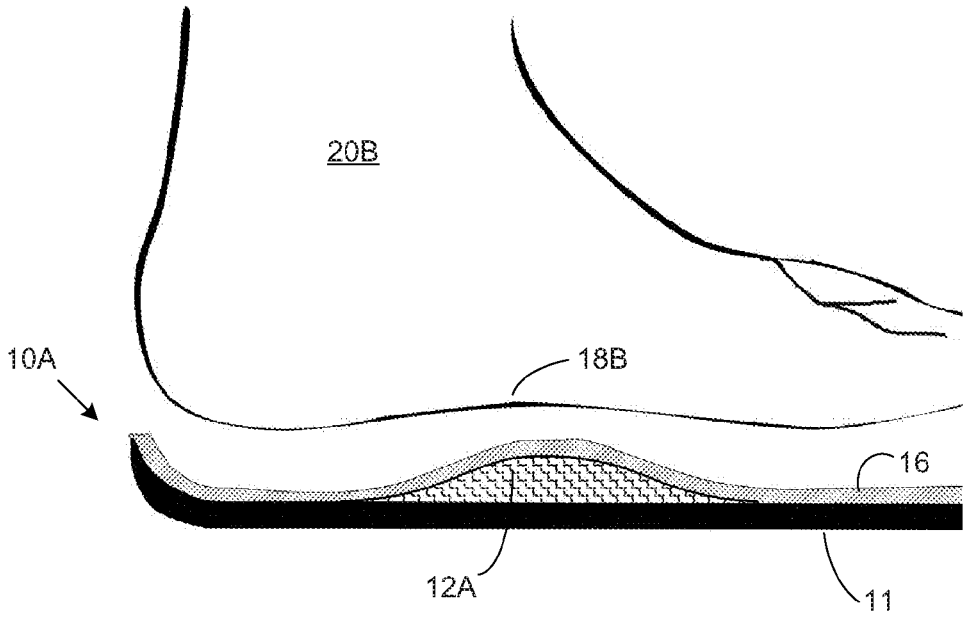



FIG. 10

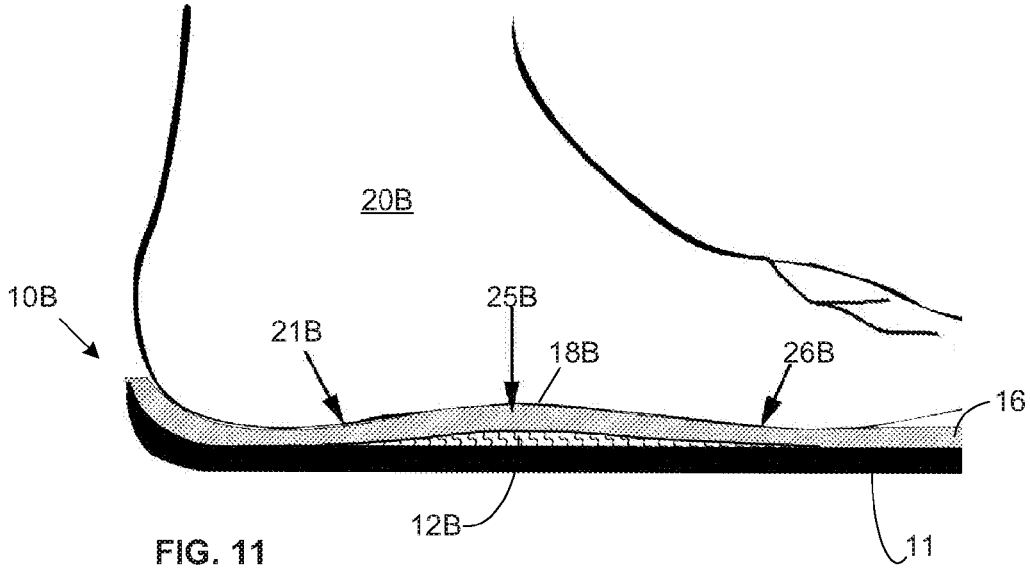



FIG. 11

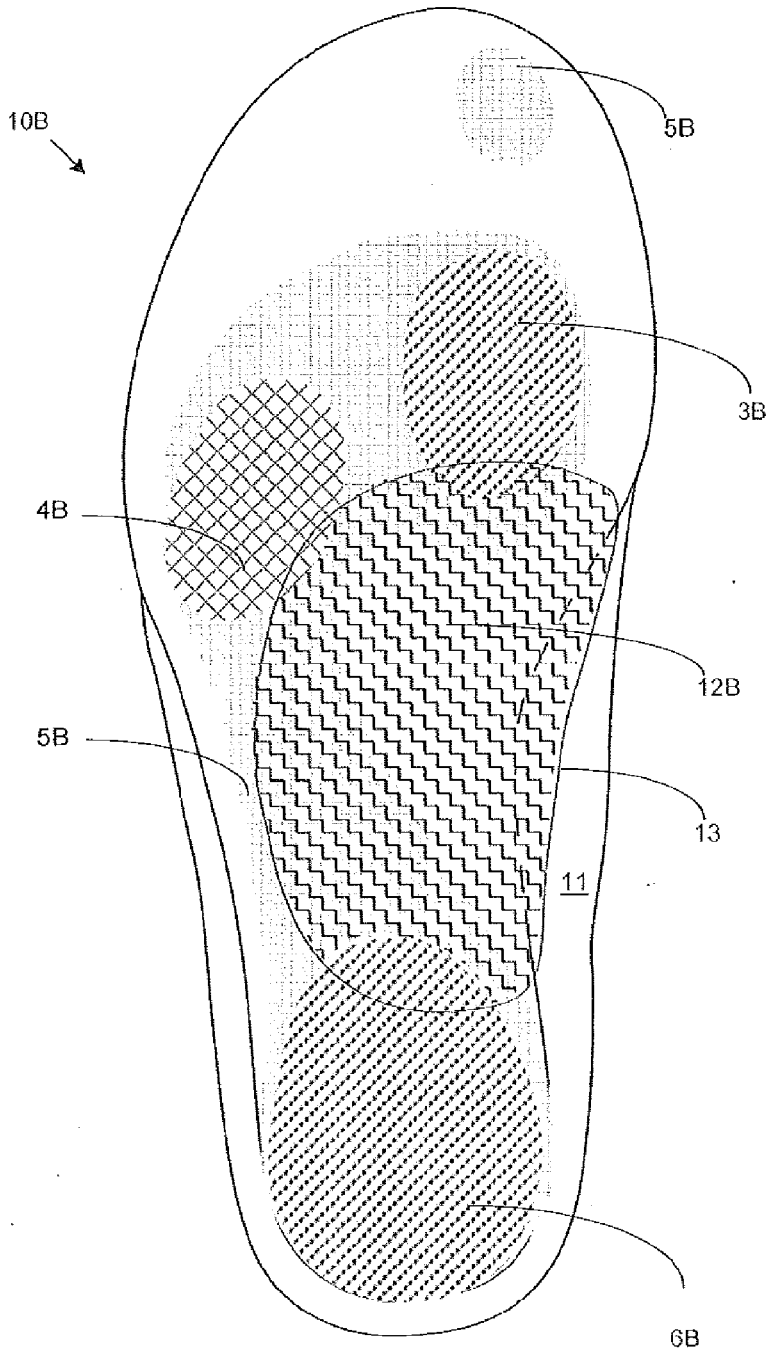



FIG. 12

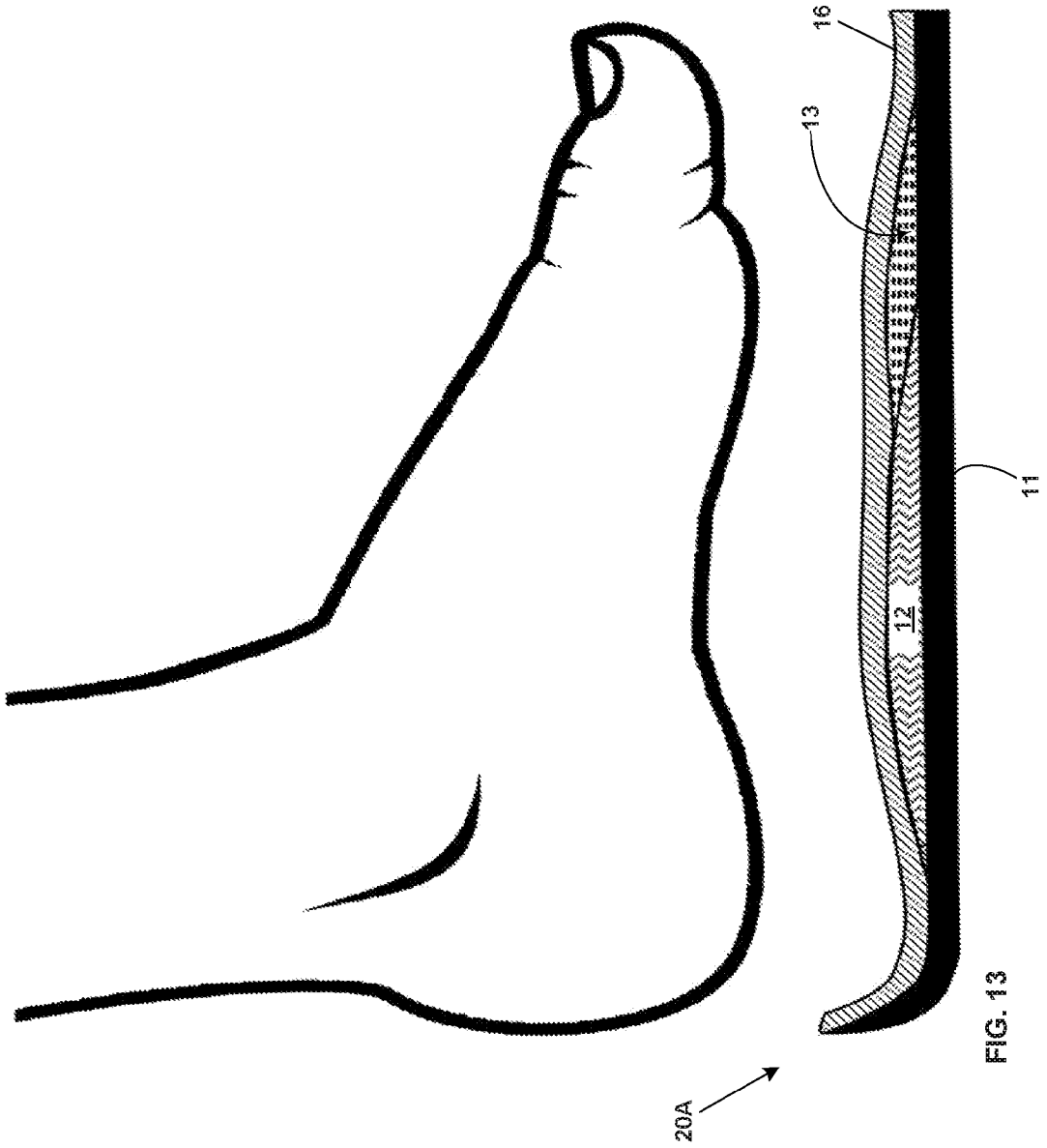



FIG. 13


FIG. 14


FIG. 15

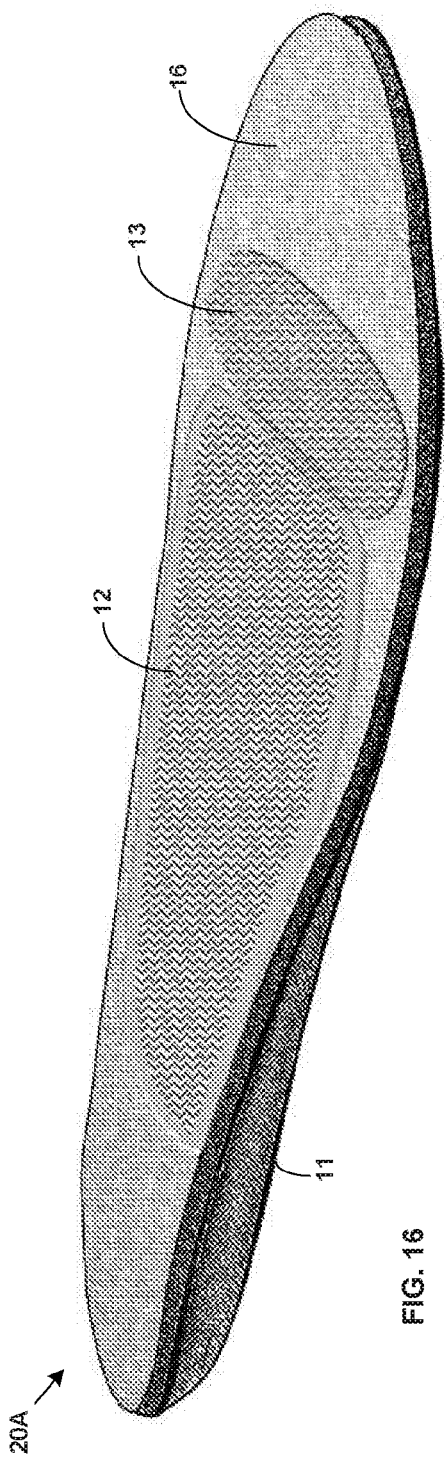



FIG. 16

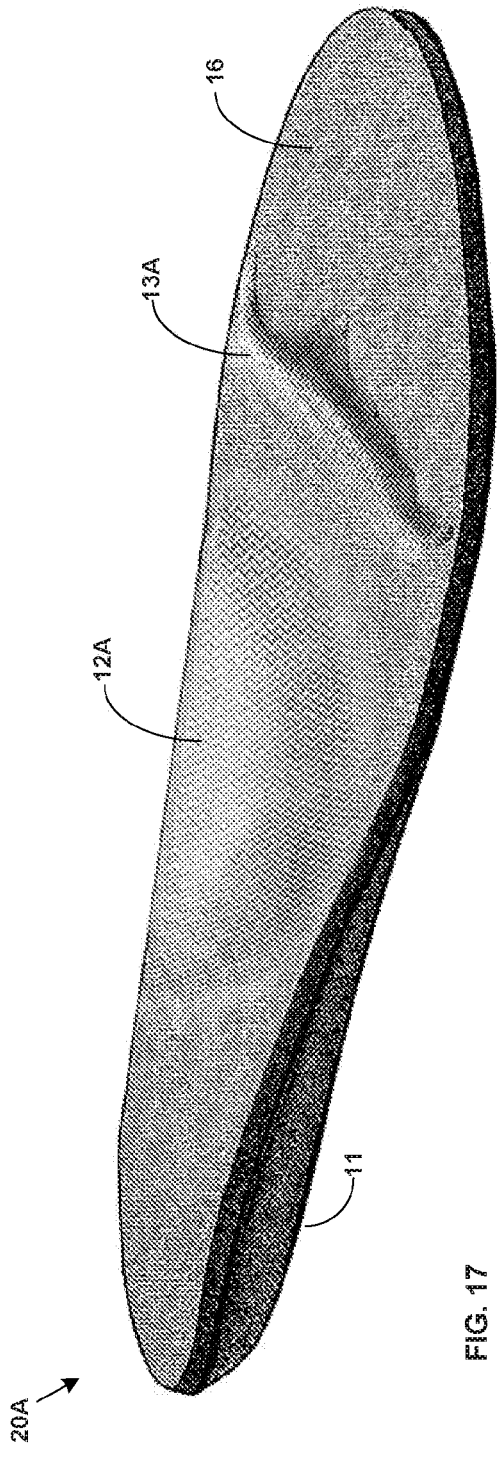



FIG. 17

# REUSABLE CUSTOM INSOLES

## BACKGROUND OF THE INVENTION

**[0001]** The present invention relates to shoe insoles, and particularly, relates to custom insoles providing customized arch and metatarsal support adaptable to a plurality of users; each having different support needs.

**[0002]** As is known, there are various insole designs providing various levels and types of arch support; some provide universal arch support, while other also provide customized support tailored to each user. Customized insoles typically employ a stiff, single-use material shaped with the aid of heat treatment, computer rendering, foam molding, or a combination of them to match the foot anatomy of each user.

**[0003]** In contrast, some insoles employ a relatively low-viscosity material like a gel or a liquid lacking sufficient stiffness to maintain a customized support geometry without a load being applied.

## SUMMARY OF THE INVENTION

**[0004]** According to the teachings of the present invention there is provided an insole base; and a malleable, arch-support material supported by the insole base, the arch-support material configured to assume a first arch-support structure responsively to application of foot pressure of a first user on the arch-support material and to maintain the first support-structure until foot pressure of a second user is applied to the first arch-support structure, wherein the arch support-structure corresponds to arch geometry between a heel bone and at least one metatarsal head of each of the first and second users.

**[0005]** According to a further feature of the present invention, the arch-support material is disclosed inside an airtight polymeric encasement.

**[0006]** According to a further feature of the present invention, the arch-support material includes malleable clay.

**[0007]** According to a further feature of the present invention, the arch-support material includes polydimethylsiloxane.

**[0008]** According to a further feature of the present invention, the polymeric encasement is constructed from a polymer selected from the group consisting of polyvinyl chloride, polypropylene, and polyethylene.

**[0009]** There is also provided according to the teachings of the present invention, a malleable, metatarsal-support material supported by the insole base, the metatarsal-support material configured to assume a first metatarsal-support structure responsively to application of the foot pressure of the first user on the metatarsal-support and to maintain the first metatarsal-support structure until foot pressure of the second user is applied to the first metatarsal-support structure.

**[0010]** There is also provided according to the teachings of the present invention, providing an insole base; and causing a malleable arch-support material to be supported by the insole base so as to enable the arch-support material to assume a first customized arch-support structure responsively to application of foot pressure of a first user on the arch-support material and to maintain the first customized arch-support structure until foot pressure of a second user is applied to the first arch-support structure, wherein the first customized arch-support structure is bound in part by a heel bone and at least one metatarsal head.

**[0011]** According to a further feature of the present invention, the arch-support material is disclosed inside an airtight polymeric encasement.

**[0012]** According to a further feature of the present invention, the arch-support material has a mass of about **30** to **40** grams.

**[0013]** According to a further feature of the present invention, the arch-support material includes malleable putty.

**[0014]** According to a further feature of the present invention, the arch-support material includes polydimethylsiloxane.

**[0015]** According to a further feature of the present invention, the polymeric encasement is constructed from a polymer selected from the group consisting of polyvinyl chloride, polypropylene, and polyethylene.

**[0016]** According to a further feature of the present invention, there is also provided a causing a malleable metatarsal-support material to be supported by the insole base so as to enable the metatarsal-support material to assume a first customized metatarsal-support structure responsively to application of the foot pressure of a first user on the metatarsal-support material and to maintain the first customized metatarsal-support structure until foot pressure of the second user is applied to the first metatarsal-support structure.

**[0017]** According to a further feature of the present invention, there is also provided further a padding layer covering the encasement.

**[0018]** According to a further feature of the present invention, the wherein the padding layer includes slow rebound foam.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0019]** The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The features, their interaction, operation, and advantages may best be understood with reference to the following detailed description in view of the accompanying drawings in which:

**[0020]** FIG. **1** is schematic view of pressure zones of a sole of a first user;

**[0021]** FIG. **2** is schematic top view of reusable custom insole having malleable support material disposed in an encasement, according to an embodiment;

**[0022]** FIG. **3** is schematic cross-sectional view of along section line A-A of the insole depicted in FIG. **2**, according to an embodiment;

**[0023]** FIG. **4** is schematic top view of reusable custom insole of FIG. **3** with superimposed pressure zones of FIG. **1**, according to an embodiment;

**[0024]** FIG. **5** is schematic side view of user stepping onto the insole of FIG. **4**, according to an embodiment;

**[0025]** FIG. **6** is schematic side view of the insole of FIG. **5** after user customization of the insole putty of FIG. **5**, according to an embodiment;

**[0026]** FIG. **7** is schematic top view of the insole of FIG. **6** after user compression of the malleable support material of FIG. **5** depicting support material borders defined by the high pressure areas applied to the support material by foot pressure, according to an embodiment;

**[0027]** FIG. **8** is schematic view of a sole of a second user depicting weight distribution zones; according to an embodiment;

**[0028]** FIG. **9** is schematic top view of superimposed pressure zones of the second user superimposed on the insole having a support material distribution defined by the pressure zones of the first user, according to an embodiment;

**[0029]** FIG. **10** is schematic side view of a second user stepping onto the customized insole of FIG. **9**, according to an embodiment;

**[0030]** FIG. **11** is schematic side view of the insole of FIG. **9** after customization of the insole putty by the second of FIG. **10**, according to an embodiment; and

**[0031]** FIG. **12** is schematic top view of the insole after compression of the insole putty by the second user of FIG. **11** in which new support material borders are defined by the high pressure areas of the second user, according to an embodiment.

**[0032]** FIG. **13** is schematic, side view of a variant embodiment of a customizable insole having both reusable arch and metatarsal support structures prior to the application of foot pressure; according to an embodiment;

**[0033]** FIG. **14** is schematic, side view of the insole of FIG. **13** in a customized state after application of foot pressure to the insole of FIG. **13** by a user, according to an embodiment;

**[0034]** FIG. **15** is schematic, side view of the variant embodiment of the customizable insole in a customized state securing a metatarsal area of a foot disposed in a high heel shoe; according to an embodiment; and

**[0035]** FIGS. **16** and **17** are schematic, perspective views of the customizable insole of FIGS. **13** and **14** in non-customized and customized states, respectively; according to an embodiment.

**[0036]** It will be appreciated that for clarity of illustration, elements shown in the figures have not necessarily been drawn to scale and reference numerals may be repeated in multiple figures to indicate corresponding or analogous elements and well-known methods, procedures, and components are omitted for the sake of clarity.

## DETAILED DESCRIPTION OF THE PRESENT INVENTION

**[0037]** The present invention relates to custom insole adaptable to multiple users each having his unique anatomical requirements.

**[0038]** The following terminology will be used throughout the document.

**[0039]** "Workable support material", "support material", "putty" all refer to a high-viscosity, non-elastic support material capable of preserving a shape into which it is formed upon the application of pressure without recoiling when the pressure is removed. The workable support material doesn't harden or undergo a reduction of malleability, thereby advantageously enabling additional shaping upon application of a different pressure distribution associated with a second user's foot. Malleable clay based or polydimethylsiloxane-based compounds or other workable support materials having similar malleability, non-elasticity and viscosity are included in the scope of the present invention.

**[0040]** In a certain embodiment, the workable support material is implemented as polyacrylamide, polyethylene glycol (PEG), or in a certain other embodiment, a combination of such suitable materials are employed.

**[0041]** Following are several non-limiting examples of support material viscosities as a function of shoe size.

**[0042]** On the men's scale, a US size 10 shoe (43 in European size) the support material has a viscosity of about 100,000,000 centipoise (cP) with a margin of error of about 20%, for example.

**[0043]** On the woman's scale the support material has a viscosity of about 75,000,000 cP with a margin of error of about 20%, for example.

**[0044]** On the children's scale, a US size 8 (25 in European size) the support material has a viscosity around 30,000,000 cP with a margin of error of about 10%, for example. Another example of a child's shoe having a US size 2 (34 in European size) has a viscosity of about 50,000,000 cP with a margin of error of about 20%, for example.

**[0045]** It should be appreciated that other viscosities providing such functionality are included within the scope of the invention.

**[0046]** As noted, the viscosity of the support material is sufficiently low to enable formation to the relevant sole geometries responsively to the application of foot pressure of subsequent users and sufficiently high to preserve each respective customized support structure when the foot pressure is removed from the insole.

**[0047]** It should be appreciated that putty exhibits elasticity during short periods of load application and is not pronounced during the relatively long period of time shape forming pressure is applied and is also not pronounced upon removal of the load.

**[0048]** Furthermore, workable support material exhibits non-stick properties with Polyvinyl Chloride (PVC) or Thermoplastic Polyurethane (TPU) or other employed in sack or encasements materials containing the workable support material so that shape formation will not be inhibited by sticking to the encasement upon application of a load. In a certain embodiments stick between the working support material and the encasement by application of a lubricants on the inner wall of the encasement.

**[0049]** "Heel area", "heel", or "heel bone" all refer to the pressure zone created by the calcaneus.

**[0050]** "Inner ball area or medial ball area" refers to the pressure zone created by the first and second metatarsal heads or just the first metatarsal head.

**[0051]** "Outer ball area or lateral ball area" refers to the pressure zone created by the combination of the fourth and fifth metatarsal heads or the fifth metatarsal head.

**[0052]** "Arch" refers to the foot's natural instep area between the heel bone and the first metatarsal head; alternatively, it is referred to as the medial longitudinal arch.

**[0053]** "The lateral longitudinal arch" is the area or zone spanning the heel bone and the fifth metatarsal head.

**[0054]** Without diminishing in scope, the working support material will be discussed in terms of putty.

**[0055]** FIG. **1** is schematic view of various zones of a foot sole of a first user **1**A depicted in terms of pressure exerted on a support surface when standing. As shown, heel area or heel bone **6**A exerts the greatest pressure, followed by inner ball area **3**A, outer ball area **4**A, lateral longitudinal arch area SA and medial longitudinal arch or instep **2**A. Areas designated SA located in areas other than longitudinal arch area exert about the same degree of pressure on a support surface like the longitudinal arch area.

**[0056]** FIGS. **2** and **3** are schematic top and transverse, cross-sectional views, respectively, of standard reusable custom insole **10** prior to customization. As shown, insole **10** has insole base **11** molded from ethyl vinyl acetate (E.V.A), according to an embodiment. In a certain embodiment, base **11** is shaped in accordance with heel geometry **16** and lacks arch support to ensure that maximum foot pressure is applied to the putty during shaping. It should be appreciated that insole base **11** is constructed from polyurethane, thermo-plastic rubber, nitrol polyvinyl chloride, latex rubber, or a combination of them are included within the scope of the present invention.

**[0057]** As further shown, insole **10** includes putty **12** housed in a polymeric encasement or sealed bag **13** disposed on base insole **11** underneath the arch area (**2**A of FIG. **1**) and follows the contour of inner sloping wall **14** of insole base **11**. Polymeric encasement **13** has sufficient volume to receive putty **12** as it spreads into a custom shape upon application of user weight. Encasement volume is also sized so that putty **12** slightly overlaps high pressure zones **6**A and **3**A prior to a first compression to prevent putty **12** from spreading away from the arch and forming uncomfortable bumps near the edge of encasement **13**. Furthermore, encasement **13** prevents putty from spreading into areas in which a second user would be unable to return it to the arch when stepping on insole **10**. It should be appreciated that there always exists an option of pushing putty **12** into desired with one's hand.

**[0058]** Polymeric encasement **13** may be implemented with a variety of flexible yet strong polymeric materials like polyvinyl chloride, polypropylene, polyethylene, or various other materials providing such functionality. Furthermore, putty encasements achieved through insole base and top padding materials are also included within the scope of the present invention.

**[0059]** Putty **12** is sufficiently malleable to spread responsively to the application of relatively high pressure from heel area **6**A and medial ball area **3**A; but, sufficiently viscous to hold the new shape even when the pressure is removed.

**[0060]** In a certain embodiment putty composition includes either a volume or a weight composition of chloroprene 7%, mineral oil 13%, cold factice 8%, and calcium powder 71.5% and in another embodiment Plasticine® is employed.

**[0061]** In a certain examples, putty **12** has a quantity ranging between about 30-40 grams for a man's US size 10 shoe to enable an arch support structure having a height of 14 mm and spanning an insole area of about 7.0×4.5 cm. In a certain other embodiment, 15-25 grams of putty **12** is employed to form arch support structure **12**A. Metatarsal support structure **13**A is formed from a quantity of putty ranging between 4-10 grams, in a certain non-limiting embodiment.

**[0062]** It should be appreciated that the quantity of support material, its distribution, and the size of the associated support material encasements are a function of ergonomic parameters and are selected to ensure proper formation of arch and/or metatarsal support structures responsively to the application of each subsequent, user-specific foot pressure to insole **20**A.

**[0063]** FIG. **3** is schematic cross-sectional view of along section line A-A of insole **10** depicted in FIG. **2**, according to an embodiment. As depicted, encased putty **12** is covered with a padding layer **16** constructed from slow rebound foam having a rebound time of over a minute to fully rebound from compression, according to an embodiment. Typical examples of rebound foam are, inter alia, viscoelastic polyurethane foam or EVA modified. It should be appreciated that in certain embodiments, a combination of quick slow rebound foam are employed in padding layer **16**.

**[0064]** Padding layer **16** implemented with rebound foam advantageously provides additional customization to the toes and other low pressure zones without crowding the foot.

**[0065]** Furthermore, slow rebound foam advantageously provides additional foot ventilation and use of a thicker, more comfortable padding layer **16**. A flexible top fabric (not shown) covering padding layer **16** also conforms to foot geometry. Typical examples of top fabric include cotton, polyester, and polypropylene

**[0066]** FIG. **4** is schematic top view of reusable custom insole **10**A depicting the pressure zones associated with a first user relative to insole elements.

**[0067]** As shown, heel area **6**A, inner ball area **3**A, putty **12** overlap such that when downward pressure is applied to putty **12** by a user a portion of the putty **12** shifts from these high pressure areas to the lower pressure areas; outer ball area **4**A, lateral longitudinal arch area SA. Remaining putty **12** forms an arch support structure in accordance with sole geometry defined in part by heel area **6**A, medial ball area **3**A and inner sole wall **14**.

**[0068]** FIGS. **5** and **6** are schematic side views of putty compression prior to and after the application of user weight achieved by stepping onto insole **10**A. As shown, putty **12** is disposed in its pre-compression position on base **12** underneath padding layer **16** in alignment with medial longitudinal arch **18**A associated with first user **20**A.

**[0069]** In FIG. **6** putty **12**A is shifted into a new positon conforming to the geometry of arch **18**A of first user. Putty **12**A is bound in part by the high pressure applied by heel area as depicted by vector arrows **21**A and **22**A and high pressure applied by the inner ball area as depicted by vector arrows **23**A and **24**A, according to an embodiment. The encased putty together with the absence of hard plastic advantageously provides customized arch support without sacrificing comfort.

**[0070]** FIG. **7** is schematic top view of the customized putty shape after user compression. As shown, putty borders are defined by heel area **6**A and inner ball area **3**A whereas putty **12**A has spread beyond the inner lower pressure boundaries of outer ball area **4**A lateral longitudinal arch area **5**A.

**[0071]** FIG. **8** is schematic view of a sole **1**B of a second user depicting analogues weight distribution zones; heel area **6**B, inner ball area **3**B, outer ball area **4**B, lateral longitudinal arch area **5**B and medial longitudinal arch or instep **2**B. As shown, the weigh distribution zones of sole **1**B of a second user have different geometries than the corresponding zones of the first user.

**[0072]** FIG. **9** is schematic top view of pressure zones of second user superimposed on a previously customized insole having a putty distribution defined by the pressure zones of first user. As shown, putty **12**A is no longer bound by heel area **6**B and medial ball area **3**B.

**[0073]** FIGS. **10** and **11** are schematic side views of re-customization of insole **10**A to match the sole anatomy of second user.

**[0074]** As shown in FIG. **10**, putty **12**A is accumulated in accordance with the arch geometry of a first user as shown

in FIG. **6**. Foot **20**B of second user has a less arcuate arch **18**B thereby rendering first insole **10**A unusable for him in the absence of modification.

**[0075]** As shown in FIG. **11** putty **12**B is shifted into a new positon conforming to the geometry of arch **18**B of foot **20**A of second user. Putty **12**B is bound in part by the high pressure applied by heel area as depicted by vector arrows **21**B and high pressure applied by the inner ball area as depicted by vector arrows **26**B as the flatter arch of second user's foot **20**B applies a downward force **25**B to form a re-customized arch support structure from putty **12**B.

**[0076]** This multi-user adaptability has many applications. For example, an unsatisfied customer is able return customized insoles to a store without the store suffering a loss because the store has the ability to re-customizes the insoles to the next buyer.

**[0077]** It should be appreciated that customization from a user having a low arch to one having a high arch requires pushing the putty by into the midsole area opposite the arch so that a new user can then step on the putty to distribute it in accordance with his sole geometry as previously described.

**[0078]** FIG. **12** is schematic top view of the customized putty shape after compression of a second user. As shown, putty borders are defined by variant heel area **6**B and inner ball area **3**B of the second user whereas putty **12**B has spread beyond the inner lower pressure boundaries of outer ball area **4**B lateral longitudinal arch area **5**B.

**[0079]** FIG. **13** is schematic, side view of a variant embodiment of a customizable insole **20**A having both reusable arch and metatarsal support provisions **12** and **13**, respectively, disposed in between sole **11** and padding layer **16**; according to an embodiment. As shown, both putties **12** and **13** are in a pre-customized state in their respective encasements (not shown) disposed underneath the arch and the metatarsal area, respectively.

**[0080]** FIG. **14** is schematic, side view of insole **20**A in a customized state after application of foot pressure to insole **20**A. Analogous to the above described process, applied foot pressure spreads malleable arch support material and metatarsal support **12**A and **13**A, respectively, to a point of either containment by the high pressure areas of the foot sole and the polymeric encasements (not shown) or to a threshold spread capacity for the particular applied foot pressure as indicated by label **13**A.

**[0081]** As shown, metatarsal support material **12**, is implemented with about 30-40 grams of arch support material spanning the mid-heel to the mid-metatarsal to advantageously enable contouring to a wide variety of arch geometries. Foot engagement becomes increasingly significant in high heeled shoes in which gravity pulls the foot forward and downward in the shoe as a function of heel height as shown in FIG. **15**.

**[0082]** FIGS. **16** and **17** are schematic, perspective views of the customizable insole of FIGS. **13** and **14** in non-customized and customized states, respectively; according to an embodiment.

**[0083]** As shown in FIG. **16**, encased metatarsal support material **13** is with a volume having a surface area spanning the full width of the metatarsal area to advantageously provide a wide variety of contouring options in accordance with metatarsal geometry.

**[0084]** Encased metatarsal support material **13** is disposed on top of encased arch support material **12**; however, it should be appreciated that in a certain embodiment, the order is reversed and arch support material **12** is disposed on top of encased metatarsal support material **13**. It should be appreciated that in a certain embodiment there is a viscosity differential between arch support material **12** and the metatarsal support material **13**. In a certain embodiment the viscosity differential is implemented with arch support material **12** having a great viscosity whereas in another embodiment the metatarsal support material **13** is implemented with a greater viscosity.

**[0085]** It should also be appreciated that arch and metatarsal support materials **12** and **13** are disposed in separate polymeric encasements in the depicted embodiment; however, in another embodiment the polymeric encasement is implemented as a single unit with separate pouches

**[0086]** As shown in FIG. **17**, customized, metatarsal-support material **12**A constitutes medial and lateral, longitudinal arches of the foot to provide optimal support. Analogously, customized, metatarsal-support material **12**A, metatarsal-support material **12**A constitutes a contoured ridge engaging the foot on insole **20**A. Such customization enables the foot to function from heel strike through propulsion at toe off without the impedance of conventional arch support insoles.

**[0087]** It should be appreciated that various combinations of features and methods not explicitly set forth in one particular embodiment are also within the scope of the present invention.

What is claimed is:

**1**. A custom, reusable shoe insole comprising:

an insole base; and

a malleable, arch-support material supported by the insole base, the arch-support material configured to assume a first arch-support structure responsively to application of foot pressure of a first user on the arch-support material and to maintain the first support-structure until foot pressure of a second user is applied to the first arch-support structure,

wherein the arch support-structure corresponds to arch geometry between a heel bone and at least one metatarsal head of each of the first and second users.

**2**. The custom reusable shoe insole of claim **1**, wherein the arch-support material is disclosed inside an airtight polymeric encasement.

**3**. The custom reusable shoe insole of claim **2**, wherein the arch-support material has a mass of about 15 to 25 grams

**4**. The custom reusable shoe insole of claim **2**, wherein the arch-support material includes malleable clay.

**5**. The custom reusable shoe insole of claim **4**, wherein the arch-support material includes polydimethylsiloxane.

**6**. The custom reusable shoe insole of claim **2**, wherein the polymeric encasement is constructed from a polymer selected from the group consisting of polyvinyl chloride, polypropylene, and polyethylene.

**7**. The custom reusable shoe insole of claim **2**, further comprising a padding layer covering the encasement.

**8**. A custom, reusable shoe insole further comprising:

a malleable, metatarsal-support material supported by the insole base, the metatarsal-support material configured to assume a first metatarsal-support structure responsively to application of the foot pressure of the first user on the metatarsal-support and to maintain the first

metatarsal-support structure until foot pressure of the second user is applied to the first metatarsal-support structure.

**9**. A method of constructing a custom, reusable shoe insole, the method comprising:

providing an insole base; and

causing a malleable arch-support material to be supported by the insole base so as to enable the arch-support material to assume a first customized arch-support structure responsively to application of foot pressure of a first user on the arch-support material and to maintain the first customized arch-support structure until foot pressure of a second user is applied to the first arch-support structure,

wherein the first customized arch-support structure is bound in part by a heel bone and at least one metatarsal head.

**10**. The method of claim **9**, wherein the arch-support material is disclosed inside an airtight polymeric encasement.

**11**. The method of claim **9**, wherein the arch-support material has a mass of about 30 to 40 grams.

**12**. The method of claim **11**, wherein the arch-support material includes malleable putty.

**13**. The method of claim **12**, wherein the arch-support material includes polydimethylsiloxane.

**14**. The method of claim **11**, wherein the polymeric encasement is constructed from a polymer selected from the group consisting of polyvinyl chloride, polypropylene, and polyethylene.

**15**. The method of claim **11**, further comprising:

causing a malleable metatarsal-support material to be supported by the insole base so as to enable the metatarsal-support material to assume a first customized metatarsal-support structure responsively to application of the foot pressure of a first user on the metatarsal-support material and to maintain the first customized metatarsal-support structure until foot pressure of the second user is applied to the first metatarsal-support structure.

**16**. The custom reusable shoe insole of claim **15**, further comprising a padding layer covering the encasement.

**17**. The custom reusable shoe insole of claim **16**, wherein the padding layer includes slow rebound foam.

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