



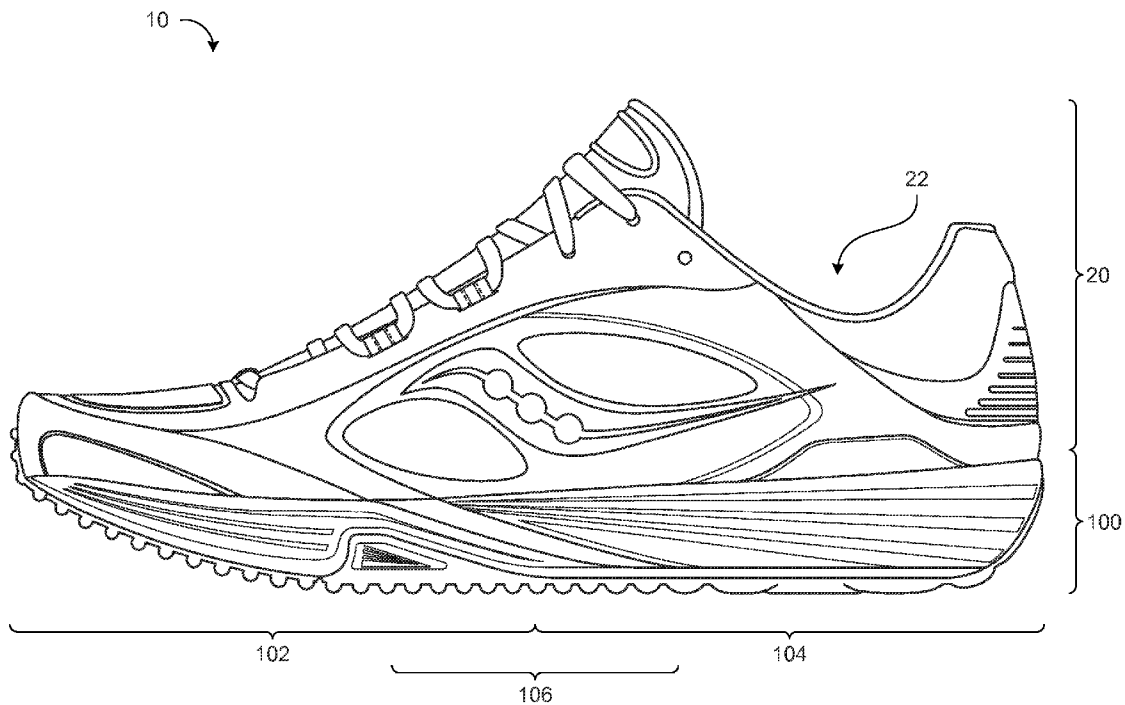
US 20110225852A1

(19) **United States**(12) **Patent Application Publication**  
**Mahoney**(10) **Pub. No.: US 2011/0225852 A1**(43) **Pub. Date: Sep. 22, 2011**(54) **ARTICLES OF FOOTWEAR****Publication Classification**(75) Inventor: **Christopher J. Mahoney**, Concord,  
MA (US)(51) **Int. Cl.**  
**A43B 13/12** (2006.01)(52) **U.S. Cl.** ..... **36/30 R**(73) Assignee: **Saucony, Inc.**, Lexington, MA (US)(57) **ABSTRACT**(21) Appl. No.: **13/042,208**

A sole assembly for an article of footwear including an outsole and a midsole disposed on the outsole. The midsole has forward and rearward portions, where the rearward midsole portion has a softer durometer than the forward midsole portion. The midsole also has a foot receiving surface. In an unloaded state, the foot receiving surface in a heel portion of the sole assembly is at least level with or elevated above the foot receiving surface in a forefoot portion of the sole assembly with respect to level ground. The foot receiving surface in the heel portion of the sole assembly drops below the foot receiving surface in the forefoot portion of the sole assembly while in a loaded state on level ground.

(22) Filed: **Mar. 7, 2011****Related U.S. Application Data**

(60) Provisional application No. 61/314,275, filed on Mar. 16, 2010.



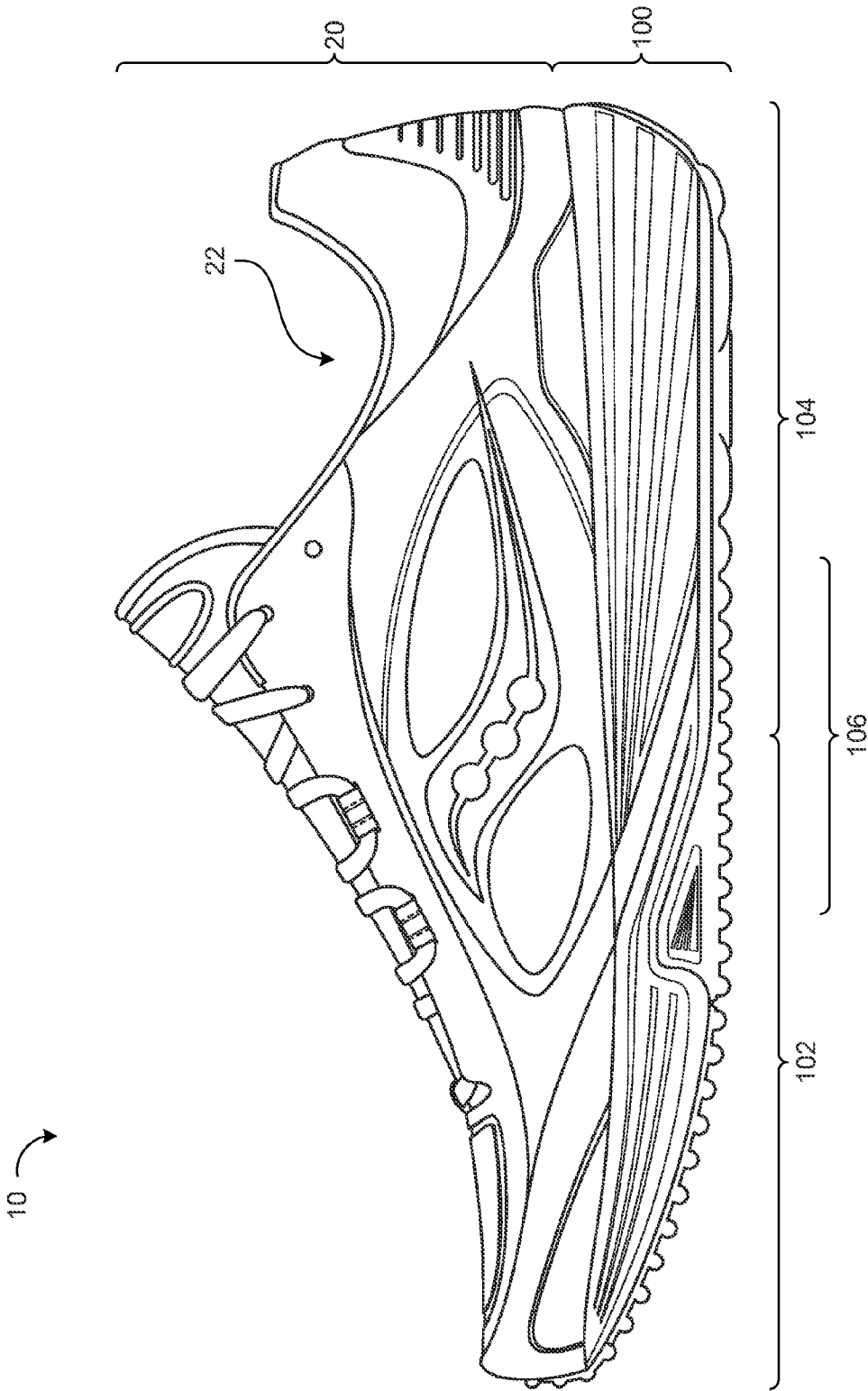


FIG. 1

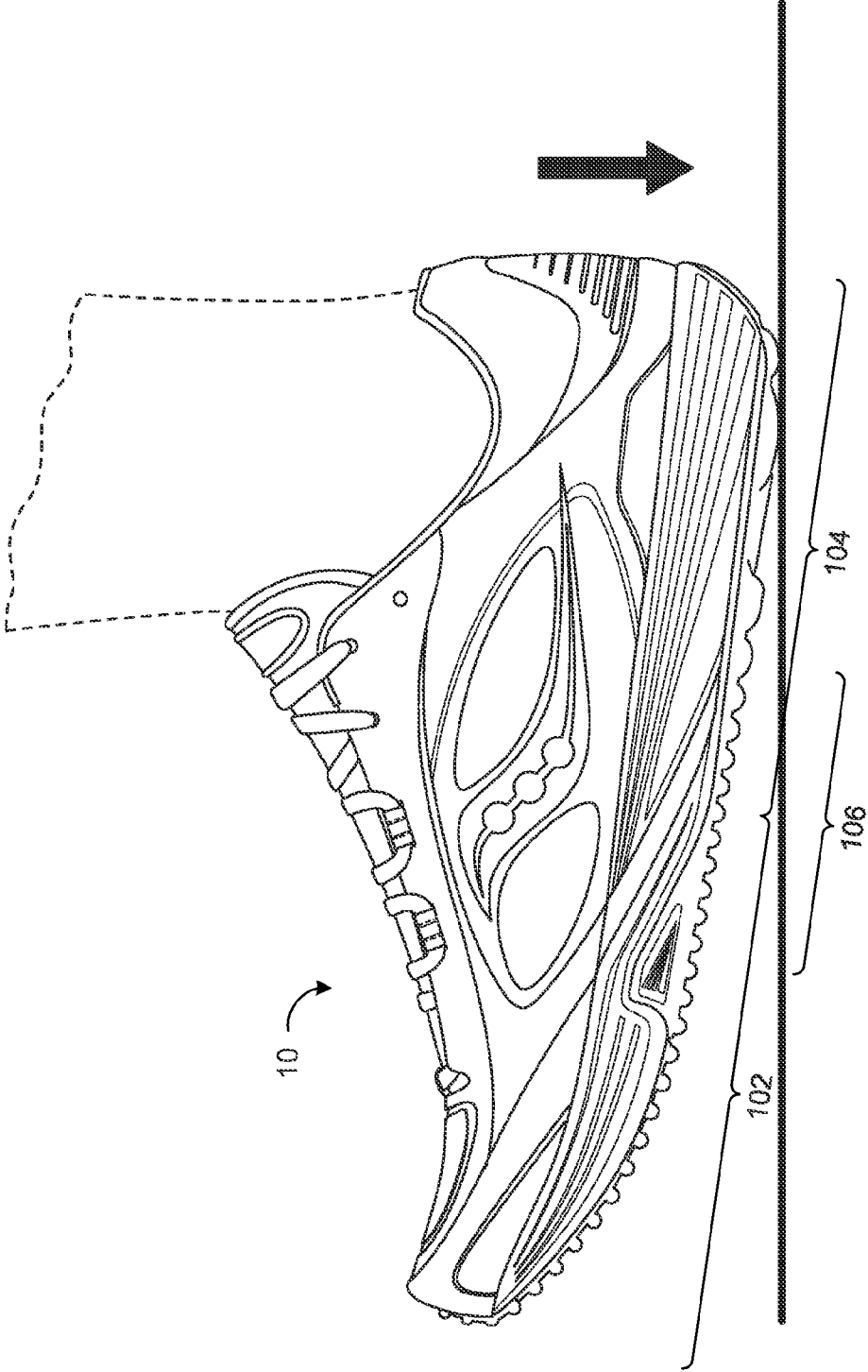


FIG. 2

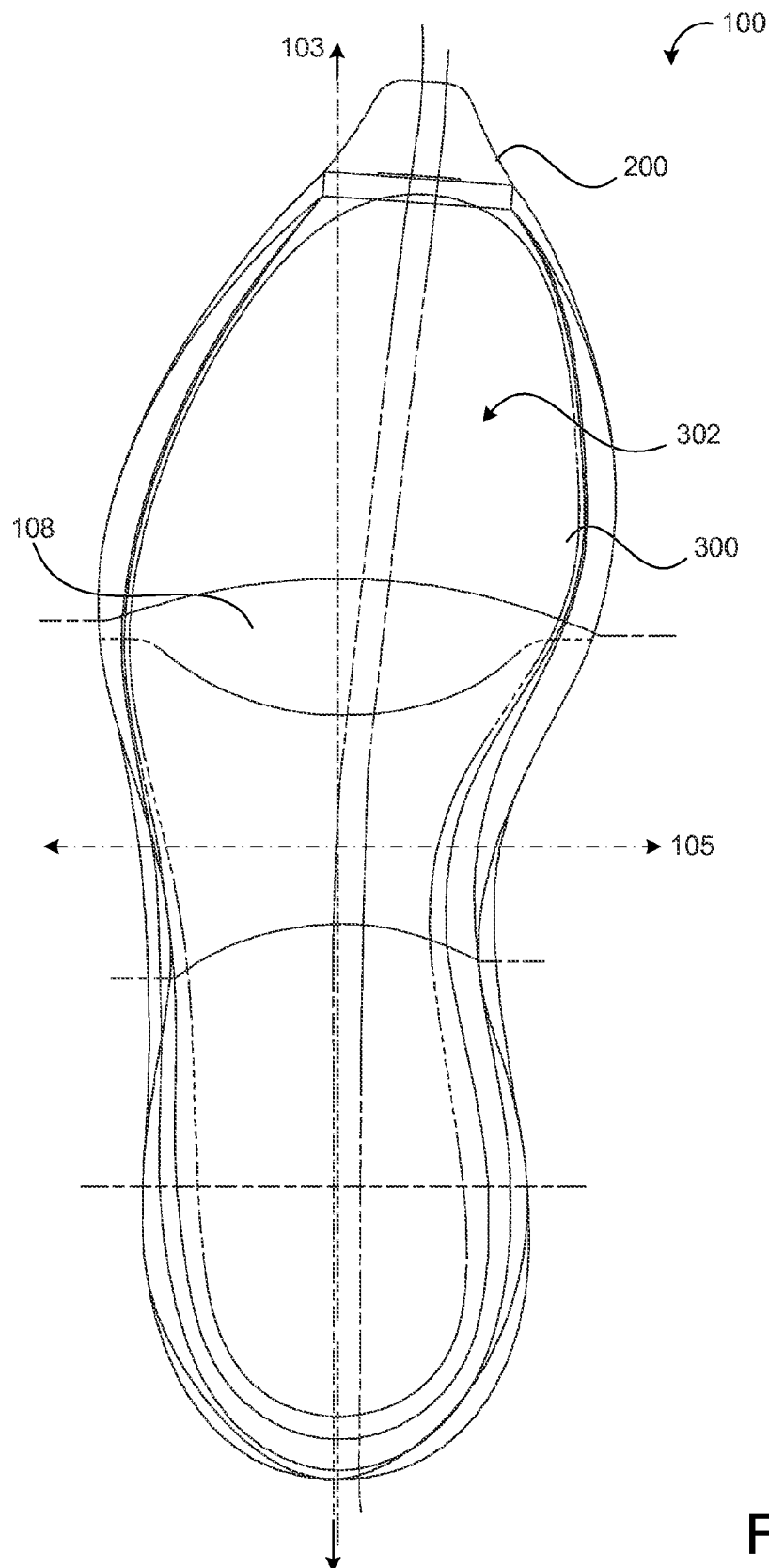


FIG. 3

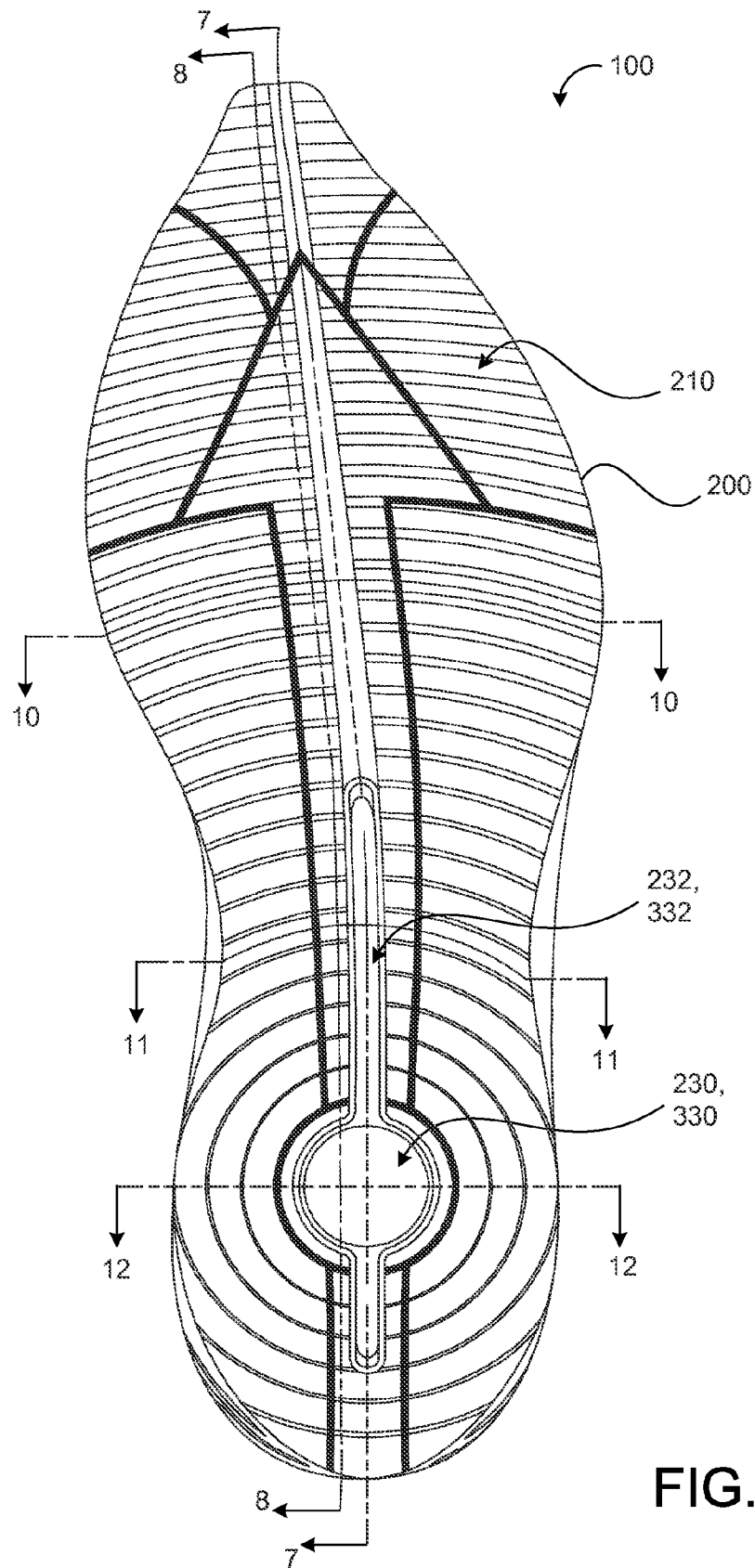


FIG. 4

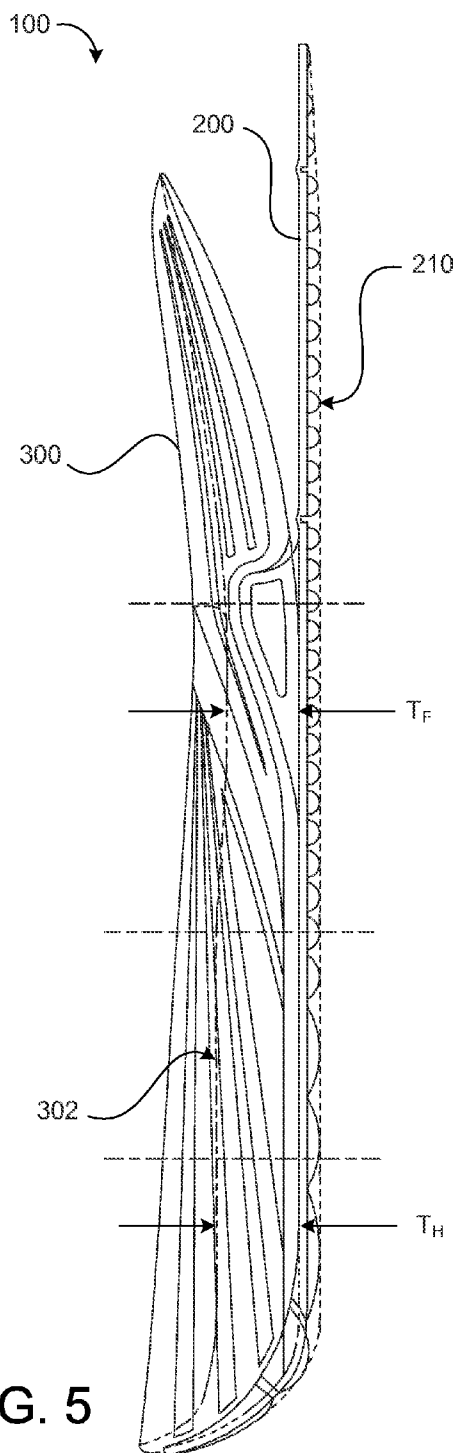


FIG. 5

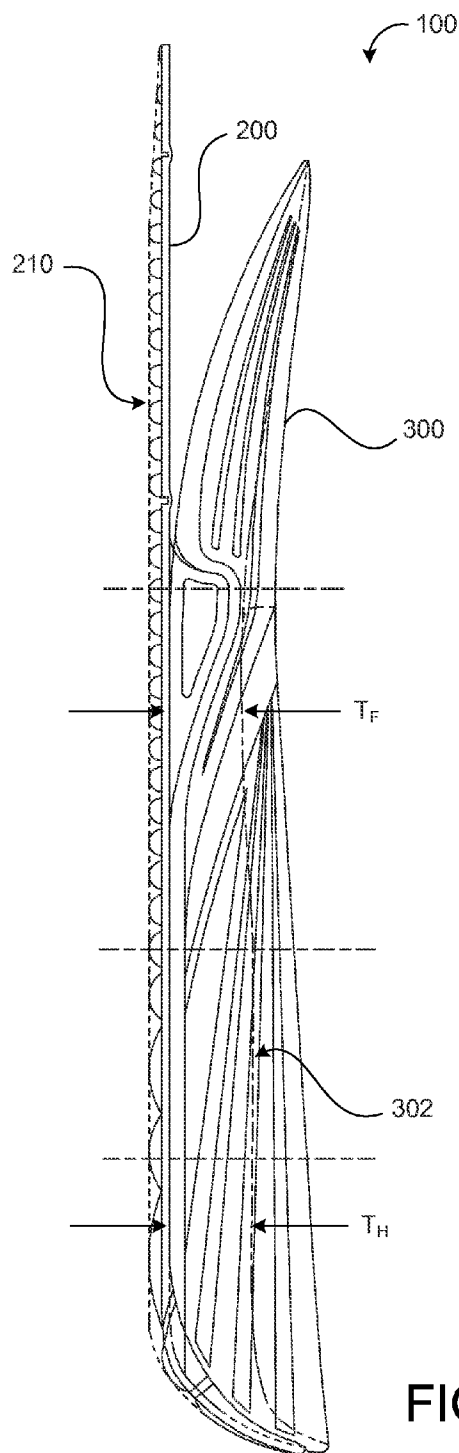


FIG. 6

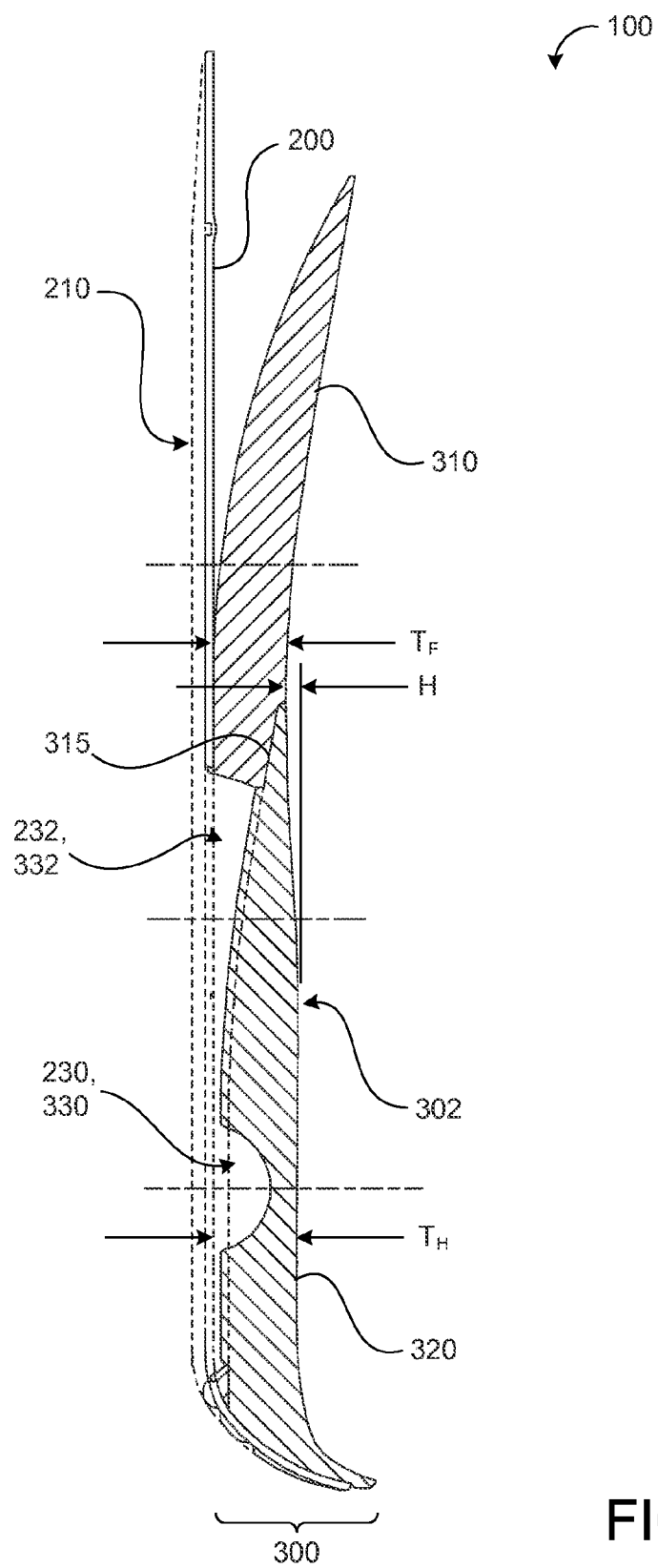


FIG. 7

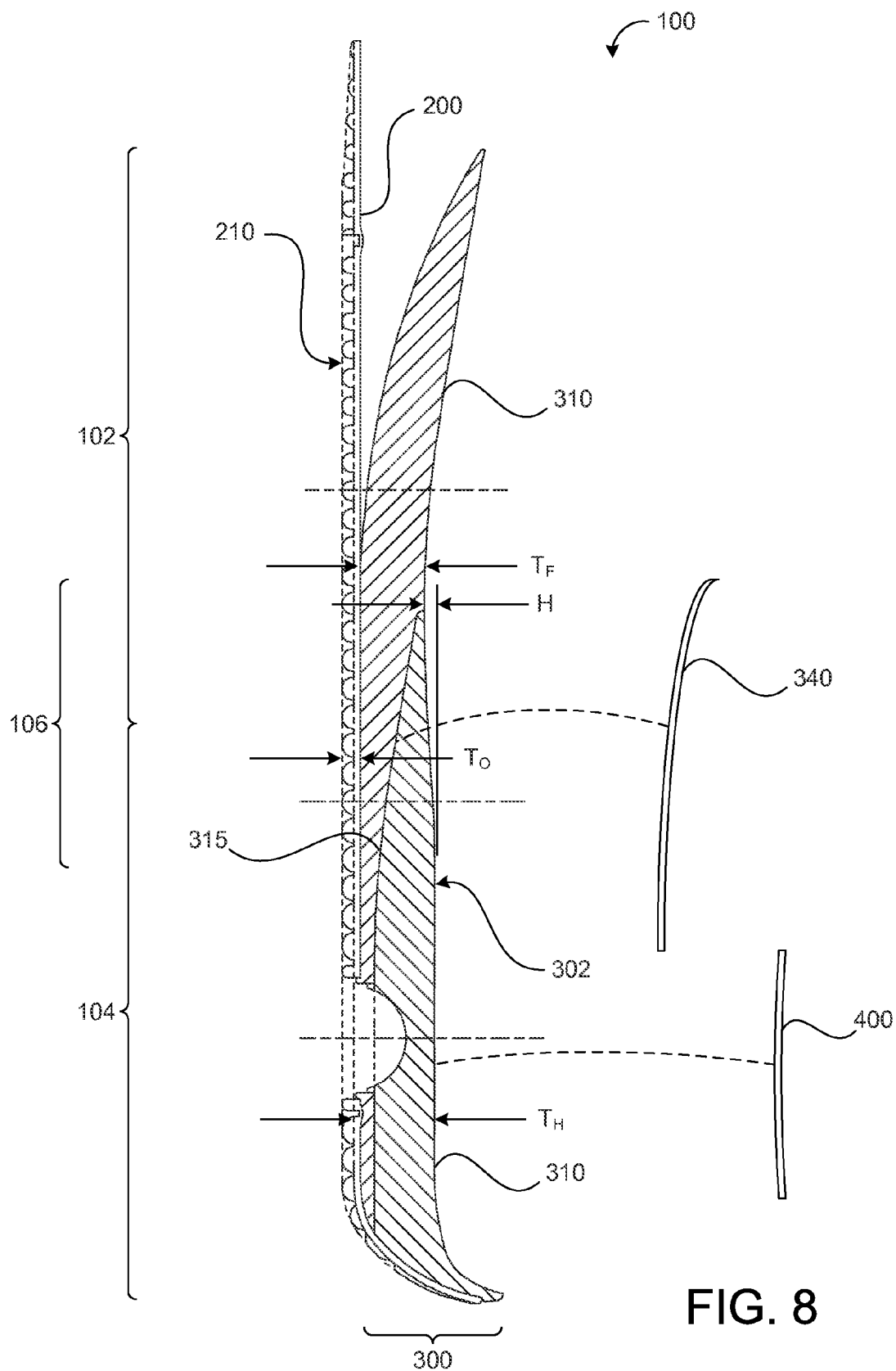


FIG. 8

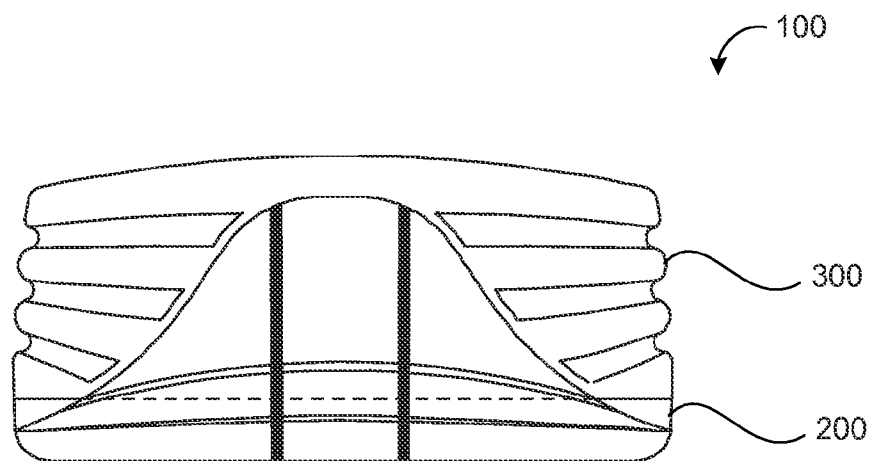


FIG. 9

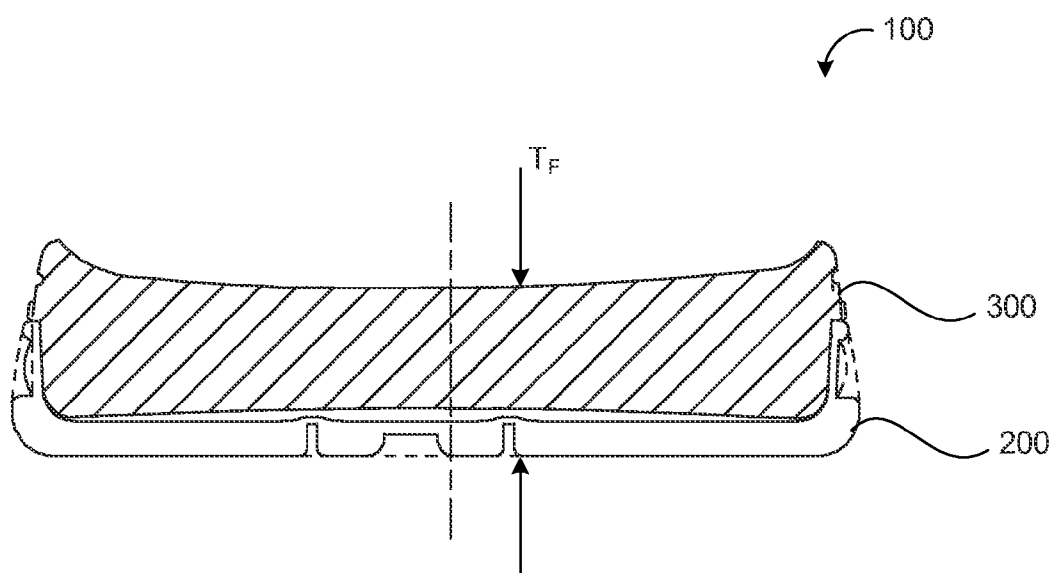


FIG. 10

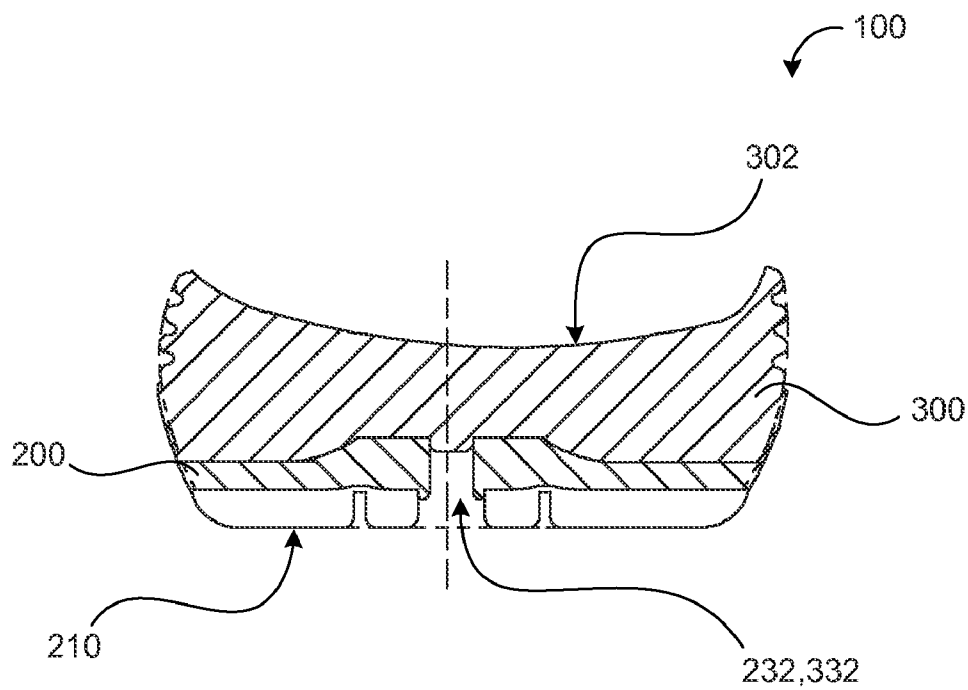


FIG. 11

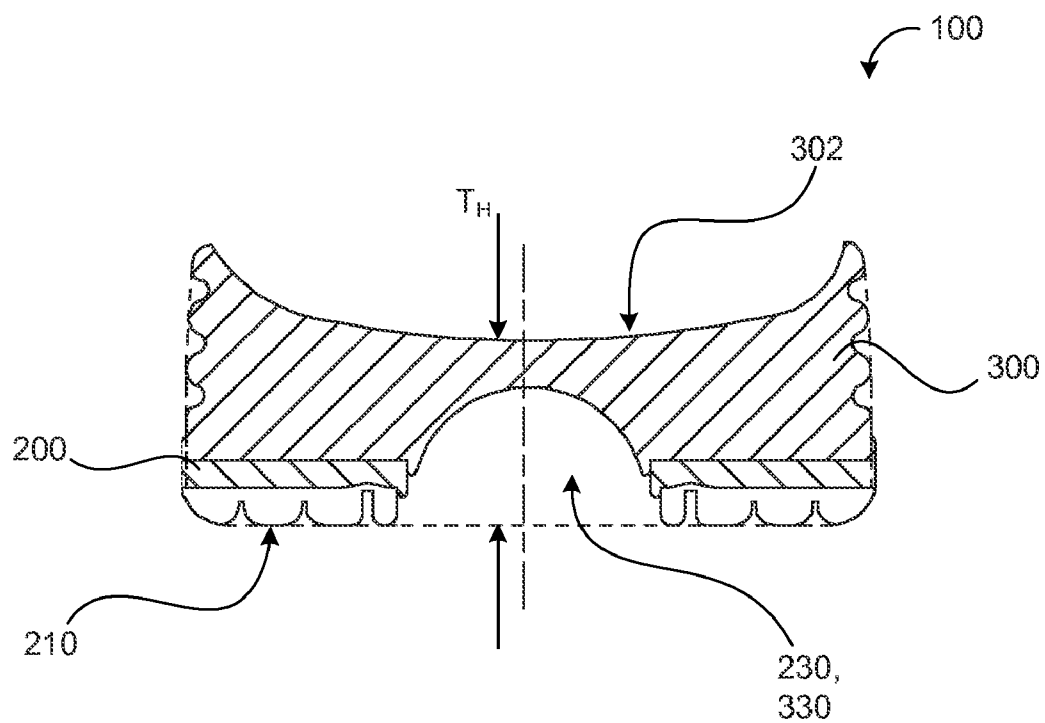


FIG. 12

## ARTICLES OF FOOTWEAR

### CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This U.S. patent application claims priority under 35 U.S.C. §119(e) to U.S. Provisional Application 61/314, 275, filed on Mar. 16, 2010, which is hereby incorporated by reference in its entirety.

### TECHNICAL FIELD

[0002] This disclosure relates to articles of footwear.

### BACKGROUND

[0003] In general, shoes, a type of articles of footwear, include an upper secured to a sole. The upper and the sole together define a void that is configured to hold a human foot. Often, the upper and/or the sole are/is formed from multiple layers that can be stitched or adhesively bonded together. For example, the upper portion can be made of a combination of leather and fabric, or foam and fabric, and the sole can be formed from at least one layer of natural rubber. Often materials are chosen for functional reasons, e.g., water-resistance, durability, abrasion-resistance, and breathability, while shape, texture, and color are used to promote the aesthetic qualities of the shoe.

### SUMMARY

[0004] One aspect of the disclosure provides a sole assembly for an article of footwear. The sole assembly includes an outsole and a midsole disposed on the outsole. The midsole has forward and rearward portions, where the rearward midsole portion has a softer durometer than the forward midsole portion. The midsole also has a foot receiving surface. In an unloaded state, the foot receiving surface in a heel portion of the sole assembly is at least level with or elevated above the foot receiving surface in a forefoot portion of the sole assembly with respect to level ground. The foot receiving surface in the heel portion of the sole assembly drops below the foot receiving surface in the forefoot portion of the sole assembly while in a loaded state on level ground.

[0005] Implementations of the disclosure may include one or more of the following features. In some implementations, the foot receiving surface in the heel portion of the sole assembly is elevated at least 2 mm above the foot receiving surface in the forefoot portion of the sole assembly while in the unloaded state. The foot receiving surface in the heel portion of the sole assembly may drop at least 2 mm below the foot receiving surface in the forefoot portion of the sole assembly while in the loaded state. In some examples, the rearward midsole portion is arranged rearward of a metatarsal head region of the sole assembly. The forward midsole portion may extend substantially the length of the outsole.

[0006] In some implementations, the forward and rearward midsole portions meet along a transition region extending from the heel portion of the sole assembly to the forefoot portion of the sole assembly. The thickness of the forward midsole portion increases as the thickness of the rearward midsole portion decreases proportionally along the transition region from the heel portion of the sole assembly to the forefoot portion of the sole assembly. In some examples, the transition region has a substantially linear side profile, while in other examples the transition region has a curved side profile. The transition region can be disposed rearward of a

metatarsal head region of the sole assembly, for example, to avoid a user feeling a change or transition in softness under his/her metatarsal head. In some implementations, the forward midsole portion comprises ethylene vinyl acetate and the rearward midsole portion comprises spongy injected molded ethylene vinyl acetate. The forward midsole portion can have a durometer of between about 50 Asker C and about 80 Asker C (e.g., about 52+/-3 Asker C), and the rearward midsole portion can have a durometer of between about 20 Asker C and about 50 Asker C (e.g., about 25 Asker C).

[0007] The outsole, in some examples, defines an aperture in the heel portion of the sole assembly and the midsole defines a recess substantially centered with the aperture. Together the outsole aperture and the midsole recess aid heel drop and cause a heel of a user to become substantially centered thereabove in the loaded state. The outsole may also define grooves substantially concentric around the outsole aperture. The grooves may be used to aid flexion or bending of the sole assembly in the walking direction.

[0008] Another aspect of the disclosure provides a sole assembly for an article of footwear that includes an outsole and a midsole disposed on the outsole and having a foot receiving surface. The midsole has forward and rearward portions meeting along a transition region extending from a heel portion of the sole assembly to the forefoot portion of the sole assembly. The thickness of the forward midsole portion increases as the thickness of the rearward midsole portion decreases proportionally along the transition region from the heel portion of the sole assembly to the forefoot portion of the sole assembly. The forward midsole portion has a durometer of between about 50 Asker C and about 80 Asker C, and the rearward midsole portion has a durometer of between about 20 Asker C and about 50 Asker C.

[0009] Implementations of the disclosure may include one or more of the following features. In some implementations, the forward midsole portion has a durometer of about 52 Asker C and the rearward midsole portion has a durometer of about 25 Asker C. The forward midsole portion may comprise ethylene vinyl acetate and the rearward midsole portion may comprise at least one of polyurethane and spongy injected molded ethylene vinyl acetate.

[0010] In some implementations, the foot receiving surface in the heel portion of the sole assembly may be at least level with or higher than the foot receiving surface in the forefoot portion of the sole assembly while in an unloaded state. The foot receiving surface in the heel portion of the sole assembly drops below the foot receiving surface in the forefoot portion of the sole assembly while in a loaded state on level ground. In some examples, the foot receiving surface in the heel portion of the sole assembly drops at least 2 mm below the foot receiving surface in the forefoot portion of the sole assembly while in the loaded state. The rearward midsole portion can be arranged rearward of a metatarsal head region of the sole assembly. The forward midsole portion may extend substantially the length of the outsole. In some examples, the transition region has a substantially linear side profile, while in other examples, the transition region has a curved side profile. As noted earlier, the transition region may be disposed rearward of a metatarsal head region of the sole assembly, so as to avoid a user experiencing or feeling the transition region under his/her metatarsal head.

[0011] The outsole, in some examples, defines an aperture in the heel portion of the sole assembly and the midsole defines a recess substantially centered with the aperture.

Together the outsole aperture and the midsole recess aid heel drop and cause a heel of a user to become substantially centered thereabove in the loaded state. The outsole may also define grooves substantially concentric around the outsole aperture. The grooves may be used to aid flexion or bending of the sole assembly in the walking direction.

**[0012]** In yet another aspect of the disclosure, a sole assembly for an article of footwear includes an outsole and a midsole disposed on the outsole and having forward and rearward portions. The forward and rearward midsole portions meet along a transition region extending from a heel portion of the sole assembly to a forefoot portion of the sole assembly. The thickness of the forward midsole portion increases as the thickness of the rearward midsole portion decreases proportionally along the transition region from the heel portion of the sole assembly to the forefoot portion of the sole assembly. The rearward midsole portion has a softer durometer than the forward midsole portion. The midsole has a foot receiving surface, and in an unloaded state, the foot receiving surface in the heel portion of the sole assembly is at least level with or elevated above the foot receiving surface in the forefoot portion of the sole assembly with respect to level ground. The foot receiving surface in the heel portion of the sole assembly drops below the foot receiving surface in the forefoot portion of the sole assembly while in a loaded state on level ground. The outsole defines an aperture in the heel portion of the sole assembly and the midsole defines a recess substantially centered with the aperture. Together the outsole aperture and the midsole recess aid heel drop and cause a heel of a user to become substantially centered thereabove in the loaded state.

**[0013]** Implementations of the disclosure may include one or more of the following features. In some implementations, the foot receiving surface in the heel portion of the sole assembly is elevated at least 2 mm above the foot receiving surface in the forefoot portion of the sole assembly while in the unloaded state. The foot receiving surface in the heel portion of the sole assembly may drop at least 2 mm below the foot receiving surface in the forefoot portion of the sole assembly while in the loaded state. In some examples, the rearward midsole portion is arranged rearward of a metatarsal head region of the sole assembly. Moreover, the forward midsole portion may extend substantially the length of the outsole. In some implementations, the transition region has a substantially linear side profile, while in other implementations, the transition region has a curved side profile. The transition region can be disposed rearward of a metatarsal head region of the sole assembly.

**[0014]** In some implementations, the forward midsole portion comprises ethylene vinyl acetate and the rearward midsole portion comprises at least one of polyurethane and spongy injected molded ethylene vinyl acetate. The forward midsole portion may have a durometer of between about 50 Asker C and about 80 Asker C, and the rearward midsole portion may have a durometer of between about 20 Asker C and about 50 Asker C. In some examples, the forward midsole portion has a durometer of about 52 Asker C and the rearward midsole portion has a durometer of about 25 Asker C.

**[0015]** The details of one or more implementations of the disclosure are set forth in the accompanying drawings and the description below. Other aspects, features, and advantages will be apparent from the description and drawings, and from the claims.

#### DESCRIPTION OF DRAWINGS

**[0016]** FIG. 1 is a side view of a shoe as an example of an article of footwear having a sole assembly that provides a user with a lowered heel experience.

**[0017]** FIG. 2 is a side view of a user wearing the shoe of FIG. 1 while exercising.

**[0018]** FIG. 3 is a top view of a sole assembly for an article of footwear.

**[0019]** FIG. 4 is a bottom view of the sole assembly of FIG. 3.

**[0020]** FIGS. 5 and 6 are side views of the sole assembly of FIG. 3.

**[0021]** FIG. 7 is a section view of the sole assembly of FIG. 4 along line 7-7.

**[0022]** FIG. 8 is a section view of the sole assembly of FIG. 4 along line 8-8.

**[0023]** FIG. 9 is a rear view of the sole assembly of FIG. 3.

**[0024]** FIG. 10 is a section view of the sole assembly of FIG. 4 along line 10-10.

**[0025]** FIG. 11 is a section view of the sole assembly of FIG. 4 along line 11-11.

**[0026]** FIG. 12 is a section view of the sole assembly of FIG. 4 along line 12-12.

**[0027]** Like reference symbols in the various drawings indicate like elements. By way of example only, all of the drawings are directed to an article of footwear and sole assembly suitable to be worn on a left foot. The invention includes also the mirror images of the drawings, i.e. an articles of footwear and sole assemblies suitable to be worn on a right foot.

#### DETAILED DESCRIPTION

**[0028]** The present disclosure includes articles of footwear (e.g., shoe, boot, sandal, etc.) that provide a user with a sensation of walking up hill while walking along a substantially level surface. In general, while wearing the footwear, the user experiences a lowered or negative heel arrangement that is typically experienced while walking or progressing uphill. While loaded under the user's weight, a rearward portion of a sole assembly of the article of footwear allows the user's heel to fall below a metatarsal head of the user's foot, providing the experience of standing on an incline facing uphill. As the user progresses forward, the user must lift his/her heel to drive forward over his/her metatarsal head or ball of foot. During this action, the user must move his/her heel through a greater angle of rotation or arc path relative to the metatarsal head to take steps forward. Consequently, the footwear causes the user to exert relatively more energy to lift his/her heel while walking, as compared to conventional footwear.

**[0029]** Referring to FIGS. 1 and 2, an article of footwear 10 includes a sole assembly 100 and an upper 20 attached to the sole assembly 100. Together, the sole assembly and the upper define a void 22 configured to securely and comfortably hold a human foot. The sole assembly 100 has a forefoot portion 102 and a heel portion 104. In some examples, a mid portion 106 lies between or overlaps portions of the forefoot and heel portions 102, 104. Although the example shown illustrates a shoe, the sole assembly 100 may be used for other types of articles of footwear, including, but not limited to boots, sandals, flip-flops, etc.

**[0030]** Referring to FIGS. 3 and 4, the sole assembly 100 includes an outsole 200 having a ground striking surface 210 and a midsole 300 disposed on the outsole 200. The ground striking surface 210 of the outsole 200 defines grooves 220 for traction as well as to aid flexion of the sole assembly 100 along a walking direction (e.g., bending about a transverse axis 105 defined by the sole assembly). The outsole 200 can

be formed of a thermoset elastomeric material (e.g., natural rubber), a rubber compound including isobutylene rubber, butadiene rubber, styrene butadiene rubber and/or natural rubber, which exhibits a balance of traction and shock absorbing characteristics. The outsole 210 can have a durometer of between about 40 Shore A and about 70 Shore A (e.g., 50 Shore A).

[0031] In some implementations, the outsole 200 defines an aperture 230 centered or concentric with a recess 330 defined by the midsole 300 in the heel portion 104 of the sole assembly 100 (see also FIGS. 7 and 12). In the example shown, the outsole aperture 230 and the midsole recess 330 are substantially circular from a bottom view; however, other shapes are possible as well, such as an elliptical, square or rectangular with rounded corners, etc. Together or individually, the outsole aperture 230 and the midsole recess 330 allow relatively greater downward localized compression of the sole assembly 100 while loaded by a user to center the user's heel in the heel portion 104 of the sole assembly 100. The outsole 200 defines the grooves 220 substantially concentric with the outsole aperture 230 and the midsole recess 330. In some examples, the outsole aperture 230 and the midsole recess 330 include longitudinal recess portions 232, 332 extending in the heel portion 104 of the sole assembly 100 substantially along a longitudinal axis 103 defined by the sole assembly 100 (see also FIGS. 7 and 11). The longitudinal recess portions 232, 332 further aid centering of a user's heel in the heel portion 104 of the sole assembly 100 by localized deflection or elastic deformation of the sole assembly 100 about the longitudinal recess portions 232, 332.

[0032] The midsole 300 has a foot receiving surface 302 for receiving and supporting a user's foot. The midsole 300 is configured to provide a user with a negative heel experience while wearing and loading the sole assembly 100. The negative heel experience causes a user to exert more energy relative to a non-negative heel shoe, and/or to provide the sensation of walking uphill while walking in the articles of footwear 10.

[0033] Referring to FIGS. 5-8, in an unloaded state, the foot receiving surface 302 of the midsole 300 is inclined forward such that the foot receiving surface 302 in a heel portion 104 of the sole assembly 100 is elevated above the foot receiving surface 302 in a forefoot portion 102 of the sole assembly 100. In some implementation, the foot receiving surface 302 of the midsole 300 in the heel portion 104 of the sole assembly 100 has a height  $H$  at least 2 mm above the foot receiving surface 302 in a forefoot portion 102 of the sole assembly 100. The height difference of the foot receiving surface 302 between the forefoot and heel portions 102, 104 of the sole assembly 100 may be achieved by different thickness of the outsole 200 and/or the midsole 300 in the respective forefoot and heel portions 102, 104 of the sole assembly 100. For example, the midsole 300 in the heel portion 104 of the sole assembly 100 can have a thickness  $T_H$  (FIG. 12) that is at least 2 mm greater than a thickness  $T_F$  (FIG. 10) of the midsole 300 in the forefoot portion 102 of the sole assembly 100. Alternatively or additionally, the outsole 200 may have a thickness  $T_O$  that is greater in the heel portion 104 than the forefoot portion 102 of the sole assembly 100. In the forefoot portion 102 of the sole assembly 100, the midsole 300 may have a thickness of about 14 mm, while the midsole 300 may have a thickness of about 16 mm in the heel portion 104 of the sole assembly 100. The outsole 200 may have a substantially constant thickness  $T_O$  of about 4.5 mm.

[0034] In some implementations, in the unloaded state, the foot receiving surface 302 in the heel portion 104 of the sole assembly 100 is elevated at a height difference  $H$  of between about 2 mm and about 5 mm above the foot receiving surface 302 in the forefoot portion 102 of the sole assembly 100. For example, the midsole 300 in the heel portion 104 assembly 100 may have a thickness  $T_H$  that is between about 2 mm and about 5 mm greater than a thickness  $T_F$  of the midsole 300 in the forefoot portion 102 of the sole assembly 100. Alternatively or additionally, the outsole 200 may have a thickness  $T_O$  that is about 2 mm and about 5 mm greater in the heel portion 104 than the forefoot portion 102 of the sole assembly 100.

[0035] In other implementations, in the unloaded state, the foot receiving surface 302 in the heel portion 104 of the sole assembly 100 has the same elevation (i.e.,  $H$  equals zero) as the foot receiving surface 302 in the forefoot portion 102 of the sole assembly 100 (e.g., the heel portion 104 assembly 100 has a thickness  $T_H$  that is substantially equal to a thickness  $T_F$  of the forefoot portion 102 of the sole assembly 100).

[0036] In a loaded state (e.g., bearing the weight of a user wearing the article of footwear 10), the sole assembly 100 causes the user's heel to sit lower than the user's ball of foot or metatarsal head relative to a level supporting surface, thus providing the sensation of facing uphill on an inclined supporting surface. In some implementation, in the loaded state, the foot receiving surface 302 of the midsole 300 in the heel portion 104 of the sole assembly 100 has a height difference  $H$  of at least 2 mm below the foot receiving surface 302 in a forefoot portion 102 of the sole assembly 100. For example, the midsole 300 in the heel portion 104 assembly 100 may have a loaded thickness  $T_H$  that is at least 2 mm less than a loaded thickness  $T_F$  of the midsole 300 in the forefoot portion 102 of the sole assembly 100. In some implementations, in the loaded state, the foot receiving surface 302 of the midsole 300 in the heel portion 104 of the sole assembly 100 has a height difference  $H$  of between about 2 mm and about 10 mm below the foot receiving surface 302 in a forefoot portion 102 of the sole assembly 100 (e.g., the midsole 300 in the heel portion 104 assembly 100 can have a loaded thickness  $T_H$  that is between about 2 mm and about 10 mm less than a loaded thickness  $T_F$  of the forefoot portion 102 of the sole assembly 100).

[0037] Referring to FIGS. 7 and 8, the midsole 300 includes a forward portion 310 and a rearward portion 320. The change in inclination of the foot receiving surface 302 between the unloaded and loaded states can be implemented and controlled by material selection and placement of the forward and rearward portions 310, 320 of the midsole 300 on the outsole 200. In some implementations, the forward portion 310 of the midsole 300 has relatively harder durometer than the rearward portion 320 of the midsole 300. For example, the forward midsole portion 310 may have a durometer of between about 50 Asker C and about 80 Asker C (e.g., about 52+/-3 Asker C), and the rearward portion 320 of the midsole 300 may have a durometer of between about 20 Asker C and about 50 Asker C (e.g., about 25 Asker C). The midsole 300 can be formed of a shock absorbing polyurethane. In some examples, the forward and rearward portions 310, 320 of the midsole 300 may include Thermo Plastic Rubber (TPR), rubber, a synthetic rubber, rubber compounds, and/or ethylene vinyl acetate (EVA). In some implementations, the forward portion 310 of the midsole 300 comprises EVA, while the rearward portion 320 of the midsole 300 comprises polyure-

thane (PU) and/or spongy injected molded EVA. By including a softer durometer material in the rearward midsole portion 320 relative to the forward midsole portion 310, the rearward midsole portion 320 compresses or elastically deforms greater under loading by the user, thus causing the user's heel to sit lower relative to the user's metatarsal head while standing in the article of footwear 10.

[0038] The forward and rearward portions 310, 320 of the midsole 300 meet along a transition region 315. The transition region 315 may extend along the length of the sole assembly 100 or remain localized within a portion of the sole assembly 100 (e.g., within the mid-portion 106 between the forefoot and heel portions 102, 104 of the sole assembly 100). In the examples shown, the transition region 315 extends along the longitudinal axis 105 of the sole assembly 100 from the forward midsole portion 310, rearward of or abutting a metatarsal head region 108 of the sole assembly 100 (FIG. 4), through the rearward midsole portion 320. The rearward midsole portion 320 may be arranged to meet the forward midsole portion 320 toward or heelward of the metatarsal head region 108 of the sole assembly 100 (e.g., outside of the metatarsal head region 108) to avoid a discontinuous feel in cushion, as a result of different durometers of the forward and rearward midsole portions 310, 320. In some examples, the rearward midsole portion 320 is arranged to meet the forward midsole portion 320 in the mid portion 106 of the sole assembly 100 (e.g., predominantly below an arch region of the user's foot). In other examples, the rearward midsole portion 320 may be arranged to meet the forward midsole portion 320 just toward of the metatarsal head region 108 of the sole assembly 100.

[0039] In the examples shown, the transition region 315 extends along a slightly arcuate path in side view (see FIGS. 7 and 8) from the rearward midsole portion 320 to the forward midsole portion 310. The gradual transition allows for a material arrangement of the rearward midsole portion 320 predominantly in the heel portion 104 of the sole assembly 100 and the forward midsole portion 320 predominantly in the forefoot portion 102 of the sole assembly 100, with substantially equal proportions of materials of the forward and rearward midsole portions 310, 320 in the mid portion 106 of the sole assembly 100. This arrangement allows the user to experience a gradual transition from a relative softer heel portion 104 of the sole assembly 100 to a relatively stiffer forefoot portion 102 of the sole assembly 100. In some examples, the transition region 315 extends in side view with a parabolic path, a linear path, a step function path, or any other profile conducive for providing the transition. The path profile of the transition region 315 may be chosen to provide a desired level of noticeable transition between the forefoot and heel portions 102, 104 of the sole assembly 100 when rocking forward and backward on the article of footwear 10. For example, for an abrupt transition, so as to provide a noticeable difference in feeling between the forefoot and heel portions 102, 104 of the sole assembly 100, a step profile may be used for the path of the transition region 315. With a step profile path, the user experiences an abrupt change in cushion, causing substantially any portion of the user's foot on the rearward midsole portion 320 to fall below the remaining portions of the user's foot on the forward midsole portion 310. Conversely, a linear or slightly curved path of the transition region 315 may be used for relatively gentler transition. With a linear or slightly curved path, the user experiences substantially a rearward inclined supporting surface, as if standing on an upwardly

sloped surface, even though actually on level ground. The transition path may vary in three-dimensions as well.

[0040] In some implementations, a substantially rigid transition guide 340 is disposed between the forward and rearward midsole portions 310, 320 in the transition region 315. The transition guide 340 may be used to force a particular transition geometry under loading conditions. The transition guide 340 can be formed to provide a desired transition path in two or three dimensions (2D or 3D). For example, in 2D, the transition guide 240 may be flat to provide a linear, curved, serpentine, stepped, etc. to provide a corresponding transition path. In 3D, the transition guide 240 may be concave, convex, serpentine with concavity and/or convexity to provide a corresponding transition path. The transition guide 340 can be made of a thermoplastic, e.g., polyolefin material, thermoplastic urethane (TPU), or nylon.

[0041] A combination of material selection, arrangement, and transitioning between the forward and rearward midsole portions 310, 320 can be implemented to provide a desired level of negative heel experience while loading the sole assembly 100. The effect can be further enhanced by apertures 230, 232 or recesses 330 332 defined by the outsole 200 and/or the midsole 300. In some implementations, the sole assembly 100 includes an outsole 200 having a substantially constant thickness  $T_o$  along the length of the outsole 200 and a midsole 300 disposed on the outsole 200 and having forward and rearward portions 310, 320 constructed of the same or different materials, but having different durometers. The forward midsole portion 310 has a softer durometer than the rearward midsole portion 320. For example, the forward midsole portion 310 has a durometer of between about 50 Asker C and about 80 Asker C (e.g., about 52+/-3 Asker C), and the rearward midsole portion 320 has a durometer of between about 20 Asker C and about 50 Asker C (e.g., about 25 Asker C). The transition region 315 between the forward and rearward midsole portions 310, 320 is linear or slightly curved upward in side view, and the heel portion 104 of the sole assembly 100 defines an outsole aperture 230 concentric with a midsole recess 330 to center the user's heel in the heel portion 104 of the sole assembly 100 and to allow further lowering the user's heel under loading (e.g., via elastic deflection or deformation of the midsole recess 330). This exemplary combination of material selection, arrangement, and transitioning between the forward and rearward midsole portions 310, 320 provides the user with a negative heel experience while loading the sole assembly 100, even though the sole assembly 100 has an elevated heel in an unloaded state.

[0042] While standing, walking, and/or running in the article of footwear 10, the user experiences a drop in his/her heel while pushing off the article of footwear 10, thus causing the user to exert more energy to overcome the heel drop and yet still push off of the article of footwear 10. Any one or combination of material selection, arrangement, and transitioning between the forward and rearward midsole portions 310, 320 can be chosen to provide a desired level of heel drop under loading. The softer the rearward midsole portion 320, the greater the heel drop (e.g., distance of heel drop relative to an unloaded state) and the quicker the heel drop upon loading. A material for the rearward midsole portion 320 may be chosen to provide a desired function between the loading of the sole assembly 100 and the distance of heel drop, such as a linear function, parabolic function, exponential function, etc.

[0043] Referring again to FIG. 8, in some implementations, a foam insert 400 is disposed on the rearward midsole portion

**320.** The foam insert **400** may comprise ethylene-vinyl acetate foam, a polyurethane foam, or any other suitable foam and can have a durometer of between about 30 Asker C and about 60 Asker C (e.g., 43+/-3 Asker C). The foam insert **400** may have a thickness of between about 2 mm and about 10 mm (e.g., 4 mm). The foam insert **400** may be used to enhance user comfort, while also providing soft elastically deformable material in the heel portion **104** of the sole assembly **100** for allowing heel drop upon loading the article of footwear **10**.  
**[0044]** A number of implementations have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the disclosure. Accordingly, other implementations are within the scope of the following claims.

What is claimed is:

**1.** A sole assembly for an article of footwear, the sole assembly comprising:

an outsole; and

a midsole disposed on the outsole and having forward and rearward portions, the rearward midsole portion have a softer durometer than the forward midsole portion;

wherein the midsole has a foot receiving surface, and in an unloaded state, the foot receiving surface in a heel portion of the sole assembly is at least level with or elevated above the foot receiving surface in a forefoot portion of the sole assembly with respect to level ground; and

wherein the foot receiving surface in the heel portion of the sole assembly drops below the foot receiving surface in the forefoot portion of the sole assembly while in a loaded state on level ground.

**2.** The sole assembly of claim **1**, the foot receiving surface in the heel portion of the sole assembly is elevated at least 2 mm above the foot receiving surface in the forefoot portion of the sole assembly while in the unloaded state.

**3.** The sole assembly of claim **1**, wherein the foot receiving surface in the heel portion of the sole assembly drops at least 2 mm below the foot receiving surface in the forefoot portion of the sole assembly while in the loaded state.

**4.** The sole assembly of claim **1**, wherein the rearward midsole portion is arranged rearward of a metatarsal head region of the sole assembly.

**5.** The sole assembly of claim **1**, wherein the forward midsole portion extends substantially the length of the outsole.

**6.** The sole assembly of claim **1**, wherein the forward and rearward midsole portions meet along a transition region extending from the heel portion of the sole assembly to the forefoot portion of the sole assembly.

**7.** The sole assembly of claim **6**, wherein the thickness of the forward midsole portion increases as the thickness of the rearward midsole portion decreases proportionally along the transition region from the heel portion of the sole assembly to the forefoot portion of the sole assembly.

**8.** The sole assembly of claim **6**, wherein the transition region has a substantially linear side profile.

**9.** The sole assembly of claim **6**, wherein the transition region has a curved side profile.

**10.** The sole assembly of claim **6**, wherein the transition region is disposed rearward of a metatarsal head region of the sole assembly.

**11.** The sole assembly of claim **1**, wherein the forward midsole portion comprises ethylene vinyl acetate and the rearward midsole portion comprises at least one of polyurethane and spongy injected molded ethylene vinyl acetate.

**12.** The sole assembly of claim **1**, wherein the forward midsole portion has a durometer of between about 50 Asker C and about 80 Asker C, and the rearward midsole portion has a durometer of between about 20 Asker C and about 50 Asker C.

**13.** The sole assembly of claim **12**, wherein the forward midsole portion has a durometer of about 52 Asker C and the rearward midsole portion has a durometer of about 25 Asker C.

**14.** The sole assembly of claim **1**, wherein the outsole defines an aperture in the heel portion of the sole assembly and the midsole defines a recess substantially centered with the aperture, together the outsole aperture and the midsole recess aiding heel drop and causing a heel of a user to become substantially centered thereabove in the loaded state.

**15.** The sole assembly of claim **14**, wherein the outsole defines groves substantially concentric around the outsole aperture.

**16.** A sole assembly for an article of footwear, the sole assembly comprising:

an outsole; and

a midsole disposed on the outsole and having a foot receiving surface, the midsole having forward and rearward portions meeting along a transition region extending from a heel portion of the sole assembly to a forefoot portion of the sole assembly, wherein the thickness of the forward midsole portion increases as the thickness of the rearward midsole portion decreases proportionally along the transition region from the heel portion of the sole assembly to the forefoot portion of the sole assembly;

wherein the forward midsole portion has a durometer of between about 50 Asker C and about 80 Asker C, and the rearward midsole portion has a durometer of between about 20 Asker C and about 50 Asker C.

**17.** The sole assembly of claim **16**, wherein the forward midsole portion has a durometer of about 52 Asker C and the rearward midsole portion has a durometer of about 25 Asker C.

**18.** The sole assembly of claim **16**, wherein the forward midsole portion comprises ethylene vinyl acetate and the rearward midsole portion comprises at least one of polyurethane and spongy injected molded ethylene vinyl acetate.

**19.** The sole assembly of claim **16**, wherein the foot receiving surface in the heel portion of the sole assembly is at least level with or higher than the foot receiving surface in the forefoot portion of the sole assembly while in an unloaded state; and

wherein the foot receiving surface in the heel portion of the sole assembly drops below the foot receiving surface in the forefoot portion of the sole assembly while in a loaded state on level ground.

**20.** The sole assembly of claim **19**, wherein the foot receiving surface in the heel portion of the sole assembly drops at least 2 mm below the foot receiving surface in the forefoot portion of the sole assembly while in the loaded state.

**21.** The sole assembly of claim **16**, wherein the rearward midsole portion is arranged rearward of a metatarsal head region of the sole assembly.

**22.** The sole assembly of claim **16**, wherein the forward midsole portion extends substantially the length of the outsole.

**23.** The sole assembly of claim **16**, wherein the transition region has a substantially linear side profile.

24. The sole assembly of claim 16, wherein the transition region has a curved side profile.

25. The sole assembly of claim 16, wherein the transition region is disposed rearward of a metatarsal head region of the sole assembly.

26. The sole assembly of claim 16, wherein the outsole defines an aperture in the heel portion of the sole assembly and the midsole defines a recess substantially centered with the aperture, together the outsole aperture and the midsole recess aiding heel drop and causing a heel of a user to become substantially centered thereabove in the loaded state.

27. The sole assembly of claim 26, wherein the outsole defines groves substantially concentric around the outsole aperture.

28. A sole assembly for an article of footwear, the sole assembly comprising:

an outsole; and

a midsole disposed on the outsole and having forward and rearward portions, the forward and rearward midsole portions meeting along a transition region extending from a heel portion of the sole assembly to a forefoot portion of the sole assembly, wherein the thickness of the forward midsole portion increases as the thickness of the rearward midsole portion decreases proportionally along the transition region from the heel portion of the sole assembly to the forefoot portion of the sole assembly, the rearward midsole portion have a softer durometer than the forward midsole portion;

wherein the midsole has a foot receiving surface, and in an unloaded state, the foot receiving surface in the heel portion of the sole assembly is at least level with or elevated above the foot receiving surface in the forefoot portion of the sole assembly with respect to level ground

wherein the foot receiving surface in the heel portion of the sole assembly drops below the foot receiving surface in the forefoot portion of the sole assembly while in a loaded state on level ground; and

wherein the outsole defines an aperture in the heel portion of the sole assembly and the midsole defines a recess

substantially centered with the aperture, together the outsole aperture and the midsole recess aiding heel drop and causing a heel of a user to become substantially centered thereabove in the loaded state.

29. The sole assembly of claim 28, the foot receiving surface in the heel portion of the sole assembly is elevated at least 2 mm above the foot receiving surface in the forefoot portion of the sole assembly while in the unloaded state.

30. The sole assembly of claim 28, wherein the foot receiving surface in the heel portion of the sole assembly drops at least 2 mm below the foot receiving surface in the forefoot portion of the sole assembly while in the loaded state.

31. The sole assembly of claim 28, wherein the rearward midsole portion is arranged rearward of a metatarsal head region of the sole assembly.

32. The sole assembly of claim 28, wherein the forward midsole portion extends substantially the length of the outsole.

33. The sole assembly of claim 28, wherein the transition region has a substantially linear side profile.

34. The sole assembly of claim 28, wherein the transition region has a curved side profile.

35. The sole assembly of claim 28, wherein the transition region is disposed rearward of a metatarsal head region of the sole assembly.

36. The sole assembly of claim 28, wherein the forward midsole portion comprises ethylene vinyl acetate and the rearward midsole portion comprises spongy injected molded ethylene vinyl acetate.

37. The sole assembly of claim 28, wherein the forward midsole portion has a durometer of between about 50 Asker C and about 80 Asker C, and the rearward midsole portion has a durometer of between about 20 Asker C and about 50 Asker C.

38. The sole assembly of claim 37, wherein the forward midsole portion has a durometer of about 52 Asker C and the rearward midsole portion has a durometer of about 25 Asker C.

\* \* \* \* \*