In a shoe bottom heel portion, an upper midsole of a heel portion includes a central bulge and peripherally arranged pillars, a lower midsole includes a central mound opposing the bulge and peripherally arranged sockets receiving said pillars, and a thin, stiff shank extending rearward from the arch portion of the shoe bottom is bonded to the central bulge and to the central mound. Cavities are formed surrounding the central mound and openings are formed between the contacts. Through bending as well as compression, the upper and lower midsole and the shank cooperate to absorb impact. Optionally, the contacts are simplified and flattened. Optionally, the shank is omitted. Optionally, either of the mound and the bulge is omitted or substituted for the other.
SHOE BOTTOM HEEL PORTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to footwear, more particularly to shoe bottoms for active and sport footwear, and especially to shock-absorbing heel portions.

2. Description of the Related Art

The modern consumer of sport footwear expects support, comfort and impact absorption in a tastefully ornamented product. Footwear designers have responded with products combining new materials, conspicuously displayed performance engineering features, and a profusion of new ornamental shapes, colors and textures. The Shox® brand footwear offered by the Nike Corporation and the Wave Creation® brand footwear offered by the Mizuno Corporation exemplify this response to consumer demand. As the public grows more sophisticated in its perception of footwear design features, designers will be driven toward greater refinement in how they blend mechanical and ornamental functions in every structural element of a product.

The present invention recognizes and addresses a particular need for such refinement by providing a visually appealing laminated heel shoe bottom heel portion which absorbs impact comfortably over the lifetime of the product.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a shoe bottom heel portion with cushioning and improved durability.

In accordance with this object and with others which will be described and which will become apparent, a preferred exemplary embodiment of a shoe bottom heel portion in accordance with the present invention includes an upper midsole forming a central bulge; a lower midsole forming a central mound; a shank bonded to the central bulge and to the central mound; and a plurality of contacts of the upper midsole with the lower midsole. The contacts are arranged peripherally. Each contact includes a projection, either of the upper midsole or of the lower midsole, and also includes an indentation, in the lower or upper midsole, respectively. Each indentation receives a corresponding projection. This cooperation of the projections and indentations gives each contact a large surface area for adhesion and also reduces the likelihood of lateral displacement of the upper midsole relative to the lower midsole.

The upper midsole may have a first edge, the lower midsole may have a second edge, with the second edge at least partially surrounding and embracing the first edge to increase adhesion area between the two and to resist lateral displacement.

The contacts may be substantially permanent and may be bonded by an adhesive.

At least one of the upper midsole and the lower midsole includes an injection or compression molded portion, which may be, for example, formed of ethylene vinyl acetate (EVA) or thermoplastic urethane (TPU). In a preferred embodiment, the upper midsole is formed of EVA of approximately 65 shore C durometer hardness and the lower midsole is formed of TPU.

At least one of the contacts may include a load transferring area surrounding the indentation and the projection thereof.

The upper midsole and the lower midsole may have opposing concave forms intermediate the contacts, thereby forming peripheral openings intermediate the contacts. The openings enable the upper midsole and the lower midsole to bend and move closer together in order to cushion a wearer’s footsteps.

The upper midsole and the lower midsole may have opposing concave forms proximate the central bulge and the central mound, thereby forming cavities between the upper midsole and the lower midsole. The cavities enable the upper midsole and the lower midsole to bend and move closer together in order to cushion a wearer’s heel strike. The cavities may communicate with the peripheral openings at the first edge and second edge, between the contacts.

The upper midsole and the shank may extend forward beyond the lower midsole. A pair of the contacts may be located forward of the central mound, one laterally, the other medially, with the lower midsole including a front edge indented rearward from the pair of contacts to the central mound.

The shank may contact the central mound over a first surface area and contact the central bulge over a second surface area, the second surface area being at least twice, four times, or eight times the first surface area.

The central bulge may be formed of a material having a first stiffness, the central mound of a material having a second stiffness substantially greater than the first stiffness, and the shank formed of a material having a third stiffness substantially greater than the second stiffness, whereby bending is utilized to absorb impact. The central bulge may formed of 65 shore C durometer hardness EVA, the central mound of TPU, and the shank of a hard urethane resin.

Also in accordance with the invention, a first alternative embodiment of a shoe bottom heel portion includes an upper midsole forming a central bulge; a lower midsole forming a central mound; and a shank bonded to the central bulge and to the central mound. However, this first alternative embodiment does not include the pillars and sockets that were described for the preferred exemplary embodiment.

The upper midsole may have a first edge, the lower midsole may have a second edge, and the second edge may at least partially surround and embrace the first edge.

At least one of the upper midsole and the lower midsole may include an injection or compression molded portion such as a piece formed of EVA or TPU, particularly an upper midsole formed of EVA of approximately 65 shore C durometer hardness and a lower midsole formed of TPU.

The upper midsole and the lower midsole may have opposing concave forms proximate the central bulge and the central mound, the shank conforming to the upper midsole, forming at least one cavity between the upper midsole and the lower midsole. The cavity may open at the first edge and second edge.

The upper midsole and the shank may extend forward beyond the lower midsole.
The upper midsole may extend forward beyond the lower midsole medially and laterally, and the lower midsole may include a front edge indented rearward centrally to the central mound.

The Shank may contact the central mound over a first surface area and contact the central bulge over a second surface area, the second surface area being at least twice, four times, or eight times the first surface area.

The central bulge may be formed of a material having a first stiffness, the central mound of a material having a second stiffness substantially greater than the first stiffness, and the Shank formed of a material having a third stiffness hardness equivalent to or greater than the second stiffness, whereby bending is utilized to absorb impact.

The central bulge formed of 65 Shore C durometer hardness EVA, the central mound of TPU, and the Shank of a hard urethane resin.

Also in accordance with the invention, a second alternative embodiment of a shoe bottom heel portion includes an upper midsole and a lower midsole, the upper midsole having a plurality of contacts with the lower midsole, the contacts being arranged peripherally, the contacts including projections of one of the upper midsole and the lower midsole and indentations of the other of the upper midsole and the lower midsole, the indentations receive respective ones of the projections. However, this second alternative embodiment does not include the Shank inset and the Shank as described for the preferred exemplary embodiment, although it may optionally include the central mound and central bulge as described for that embodiment.

The upper midsole may have a first edge, the lower midsole may have a second edge, and the second edge may at least partially surround and embrace the first edge. The contacts may be substantially permanent and may be adhesive.

At least one of the upper midsole and the lower midsole may include an injection or compression molded portion, such as a piece formed of EVA or TPU, and particularly an upper midsole formed of EVA of approximately 65 Shore C durometer hardness and a lower midsole formed of TPU.

At least one of the contacts may include a load transferring area surrounding the indentation and the projection thereof.

The upper midsole and the lower midsole may have opposing concave forms intermediate the contacts, thereby forming peripheral openings intermediate the contacts.

The upper midsole and the lower midsole may have opposing concave forms, one of the upper midsole and the lower midsole having a central bulge, the other thereof having a central mound opposing and proximate the central bulge, forming at least one cavity between the upper midsole and the lower midsole. The at least one cavity may open at the first edge and second edge.

The upper midsole may extend forward beyond the lower midsole. A pair of the contacts may be located forward of the central mound, one laterally, the other medially, with lower midsole including a front edge indented rearward from the pair of contacts to the central mound.

It is an advantage of the present invention that a midsole constructed of 65 Shore C durometer hardness EVA, which is more durable than 55-durometer EVA but which might be uncomfortably hard in a solid shoe bottom, utilizes bending deformation to supplement compression deformation to provide resistance which gently increases with an increasing applied load. As a result, the shoe bottom is both impact-absorbing and durable.

For a further understanding of the objects and advantages of the present invention, reference should be had to the following detailed description, taken in conjunction with the accompanying drawings, in which like parts are given like reference numbers and wherein:

FIG. 1 is a right side elevational view of the shoe bottom heel portion in accordance with the present invention;

FIG. 2 is a bottom plan view thereof;

FIG. 3 is an unfolded perspective view of the upper and lower midsole portions and the Shank portion thereof, the upper midsole portion and the Shank portion being inverted, the Shank portion and lower midsole portion being separated from the upper midsole portion, the lower midsole portion being rotated;

FIG. 4 is a partially unfolded perspective view of the upper midsole portion and Shank portion thereof (together, inverted) and the lower midsole portion thereof (separated and rotated);

FIGS. 5-7 are rear sectional views thereof taken along the lines 5-6, 6-7, and 7-7 respectively in FIG. 1;

FIG. 8 is a right side cross sectional view thereof taken along the line 5-5 in FIG. 2;

FIG. 9 is an unfolded perspective view of a first alternative embodiment of a shoe bottom heel portion in accordance with the present invention, the upper and lower midsole portions and the Shank portion thereof, the upper midsole portion and the Shank portion being inverted, the Shank portion and lower midsole portion being separated from the upper midsole portion, the lower midsole portion being rotated;

FIG. 10 is a partially unfolded perspective view of the upper midsole portion and Shank portion of the first alternative embodiment, (together, inverted) and the lower midsole portion thereof (separated and rotated); and

FIG. 11 is an unfolded perspective view of the upper and lower midsole portions of a second alternative embodiment of the shoe bottom heel portion in accordance with the present invention, the upper midsole portion portion being inverted, the lower midsole portion being separated from the upper midsole portion, the lower midsole portion being rotated.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will now be described with reference to FIG. 1, which illustrates in side view a preferred embodiment of a shoe bottom heel portion in accordance with the present invention, shown generally by the reference number
in a shoe 32 having a shoe upper 34 and a shoe bottom 36 including a forefoot portion 38, an arch portion 40 and a heel portion 42. The heel portion 42 is assembled from discretely formed components including an outsole 44, a lower midsole 46 (also referred to as the “Truss Cradle”), and an upper midsole 48. The arch portion 40 of the shoe bottom 36 includes a Shank 50 which extends forward into the forefoot portion 38 and rearward into the heel portion 42, being inserted between the lower midsole 46 and the upper midsole 48. In the heel portion 42. In the finished shoe bottom 36, the upper midsole 48, the Shank 50, the lower midsole 46, and the outsole 44 are permanently bonded together. The upper midsole 48 and the lower midsole 46 absorb impact. The Shank 50 supports the arch portion 40 and stiffens the shoe bottom 36. The outsole 44 provides traction and resists abrasion. Lenticular openings 94 are formed between the upper midsole 48 and the lower midsole 46.

FIG. 2 shows a bottom plan view of the shoe bottom heel portion 36 in accordance with the present invention in a shoe bottom 36 having a forefoot portion 38, an arch portion 40, and a heel portion 42 including the Shank 50, the upper midsole 48, and the lower midsole 46. The lower midsole 46 has two downward-projecting ridges 80. The outsole 44 is permanently attached to the lower midsole 46 between the ridges 80.

FIG. 3 shows an unfolded perspective view of the upper midsole 48 and the lower midsole 46 of the shoe bottom 36 (the upper midsole 48 being inverted, the lower midsole 46 being uplifted and rotated). The Shank 50 is also shown, separated from the upper midsole 48. The heel portion 42 of the upper midsole 48 includes left and right forward pillars 52, left and right middle pillars 54 and a rear pillar 56, these being arranged peripherally about a central Shank-adhering inset 58 including a smoothly convex central bulge 60. The Shank-adhering inset 58 extends forward, between the left and right forward pillars 52, onto the arch portion 40, and then spreads laterally onto the forefoot portion 38. A forward adhesion area 62 partially surrounds each forward pillar 52. A middle adhesion area 64 joins each middle pillar 54. A rear adhesion area 66 adjoins the rear pillar 56.

With continued reference to FIG. 3, the upper midsole 48 is compression molded of ethylene vinyl acetate (EVA) and has a 65 shore C durometer hardness, which is a higher value than the 55 durometer hardness that is commonly used in cushioning elements of footwear. At a hardness of 65, the upper midsole 48 in this exemplary embodiment of the present invention is stiffer and harder, i.e., more resistant to compression, than it would be at a hardness of 55. It is also more capable of retaining its originally molded shape and dimensions for the lifetime of the product. In particular, at a durometer hardness of 65, the forward pillars 52, middle pillars 54, rear pillar 56 and central bulge 60 have greater structural definition and durability than they would have at a hardness of 55.

With continued reference to FIG. 3, the lower midsole 46 includes left and right forward sockets 68, left and right middle sockets 70 and a rear socket 72, these being arranged peripherally, and a truncated central mound 74 forming a shallow Shank-adhering cup 76. Between the forward sockets 68, the front edge 78 of the lower midsole 46 is indented rearward to the cup 76. The lower midsole 46 is injection molded of thermoplastic urethane (TPU) and is considerably harder and stiffer than the upper midsole 46.

With continued reference to FIG. 3, the Shank 50 is shaped to conform to the Shank-adhering inset 58 of the upper midsole 48 and to the Shank-adhering cup 76 of the lower midsole 46. The Shank 50 is relatively thin, but is molded of a polymeric material hardness equivalent to or greater than that of the lower midsole 46. The Shank 50 includes upturned side portions 82 which stiffen the upper midsole 48 in the arch portion 40. Additionally, the Shank 50 has high tensile strength. Thus, when bonded to the upper midsole 48 and the lower midsole 46, the Shank 50 cooperates with those structures to provide increased stiffness.

With reference to FIG. 4 and also with reference to the rear sectional views of FIGS. 5-7 and the side sectional view (inverted) of FIG. 8, the upper midsole 48, the Shank 50, the lower midsole 46, and the outsole 44 are permanently bonded together. The rear socket 72 of the lower midsole 46 receives and is bonded to the rear pillar 56 of the upper midsole 48. The rear adhesion area 66 abuts and is bonded to the lower midsole 46 adjacent the rear socket 72. Each middle pillar 70 receives and is bonded to the corresponding midsole pillar 54 of the upper midsole 48. Each middle adhesion area 64 abuts and is bonded to the lower midsole 46 adjacent the corresponding midsole socket 70. Each forward socket 68 receives and is bonded to the corresponding forward pillar 52 of the upper midsole 48. Each forward adhesion area 62 abuts and is bonded to the lower midsole 46 adjacent the corresponding forward socket 68.

With continued reference to FIGS. 3 and 8, the rear pillar 56 and the rear adhesion area 66 cooperate with the rear socket 72 with the lower midsole 46 adjacent the rear socket 72 to form a rear contact 88, represented as a region circumscribed by a dotted oval in FIG. 8. In the rear contact 88, the rear adhesion area 66 and the rear pillar 56 provide substantial surface area for bonding to the lower midsole 46, thereby resisting separation. Because the rear pillar 56 projects into the rear socket 72, the rear contact 88 also resists lateral displacement of the upper midsole 48 relative to the lower midsole 46. Additionally, when a load is applied to the heel portion 42 of the shoe bottom 36, the rear contact 88 transfers a portion of that load to the lower midsole 46.

With continued reference to FIGS. 3 and 8 and also with reference to FIG. 6, in similar manner, each middle pillar 54 and each middle adhesion area 64 cooperate with the corresponding midsole socket 70 and with the lower midsole 46 adjacent the middle socket 70 to form a middle contact 90; and each forward pillar 52 and each forward adhesion area 62 cooperate with the corresponding forward socket 68 and with the lower midsole 46 adjacent the forward socket 68 to form a forward contact 92. Also in similar manner, separation and lateral displacement are resisted and loads are transferred from the upper midsole 48 to the lower midsole 46. With continued reference to FIG. 3 and to the inverted side sectional view of FIG. 8, between each forward contact 92 and the corresponding middle contact 90, and also between each middle contact 90 and the rear contact 88, the opposed upper midsole 48 and lower midsole 46 form lenticular openings 94. Loads passing from the upper midsole 48 to the lower midsole 46 via the forward contacts 92,
middle contacts 90 and rear contact 88 must bypass these openings 94. As the loads increase, they not only compress the upper midsole 48 and, to a far lesser extent, the lower midsole 46, but also bend both the upper midsole 48 and the lower midsole 46, forcing the gently concave, opposed upper midsole 48 and lower midsole 46 into closer proximity and flattening the openings 94. By bending under the load, the relatively hard 65 shore C durometer hardness EVA upper midsole 48 cooperates with the even harder TPU lower midsole 46 to provide a heel portion 42 which yields under impact as if it contained a softer, 55-durometer upper midsole 48. With a 65-durometer upper midsole 48 instead of 55-durometer, the shoe bottom 36 will more likely retain its shape and bulk characteristics over its lifetime. Thus, the shoe bottom 36 will cushion a wearer’s footsteps as well as the wearer might expect from a shoe bottom 36 incorporating larger amounts of a softer material.

With reference to FIGS. 4-7, in the assembled shoe bottom 36, the Shank 50 forms a shallow bowl 96 which is centered on and bonded to the Shank-adhering cup 76 of the lower midsole 46 and which extends peripherally beneath and is bonded to the upper midsole 48. Rearward and laterally of the Shank-adhering cup 76, the opposed upper midsole 48 and lower midsole 46 are gently concave and form a cavity 98. When a load is applied to the heel portion 42 of the shoe bottom 36, a major portion of that load passes through the central bulge 60 of the upper midsole 48 into the bowl 96 of the Shank 50. The lower midsole 46 directly supports the bowl 96 of the Shank 50 only through the Shank-adhering cup 76, which is smaller than the bowl 96. Therefore, the central bulge 60 and the bowl 96 cooperate to concentrate a portion of the load from the upper midsole 48 into the central mound 74 of the lower midsole 46. In the process, as a greater load is applied to the heel portion 42, the bowl 96 of the Shank 50 is bent so that it assumes a shallower shape, the opposed upper midsole 48 and lower midsole 46 move into closer proximity, and the volume of the cavity 98 decreases. By bending under the load, the relatively hard 65 shore C durometer hardness EVA central bulge 60 of the upper midsole 48 cooperates with the even harder lower midsole 46 and with the thin, stiff bowl 96 of the Shank 50 to allow the heel portion 42 to yield under impact as if it contained a softer, 55-durometer upper midsole 48. Thus, these structures cushion a wearer’s footsteps as well as the wearer might expect from a shoe bottom 36 incorporating larger amounts of a softer material. With a 65-durometer upper midsole 48 instead of 55-durometer, the shoe bottom 36 will more likely retain its shape and bulk characteristics over its lifetime.

With reference to FIGS. 1 and 3, it is noted that the front edge 78 of the lower midsole 46 is indented rearward, between the forward sockets 68, to the cup 76. The Shank 50 extends forward beyond the front edge 78 of the lower midsole 46, being bonded to the upper midsole 48 in the arch portion 40. Consequently, as loads are applied to the upper midsole 48 in the arch portion 40, the Shank 50 directs a portion of these loads rearward into the central mound 74 and laterally into the forward contacts 92. Thus, the Shank 50, the upper midsole 48 and the lower midsole 46 cooperate to resist deformation by supporting the arch portion 40, while at the same time absorbing impact by yielding gradually with increasing load on the arch portion 40.

With reference to FIGS. 9 and 10, show a first alternative embodiment of the shoe bottom heel portion in accordance with the present invention, which includes the central mound 74, cup 76, Shank 50 and central bulge 60 functioning as described for the preferred exemplary embodiment, and which may have the same exterior appearance, including lenticular openings 94 and a cavity 98. However, in this first alternative embodiment, the contacts 88, 90 and 92 are simplified and flattened and do not include the pillars 52, 54 and 56 and sockets 68, 70 and 72 described for the preferred exemplary embodiment.

FIG. 9 shows an unfolded perspective view of the upper midsole 48 and the lower midsole 46 of the shoe bottom 36 (the upper midsole 48 being uplifted and rotated). The Shank 50 is also shown, separated from the upper midsole 48. The heel portion 42 of the upper midsole 48 includes a central Shank-adhering inset 58 including a smoothly convex central bulge 60. The Shank-adhering inset 58 extends forward onto the arch portion 40, and then spreads laterally onto the forefoot portion 38.

With continued reference to FIG. 9, the upper midsole 48 is compression molded of ethylene vinyl acetate (EVA) and has a 65 shore C durometer hardness, which is a higher value than the 55 durometer hardness that is commonly used in cushioning elements of footwear. At a hardness of 65, the upper midsole 48 in this exemplary embodiment of the present invention is stiffer and harder, i.e., more resistant to compression, than it would be at a hardness of 55. It is also more capable of retaining its originally molded shape and dimensions for the lifetime of the product. In particular, at a durometer hardness of 65, the central bulge 60 has greater structural definition and durability than it would have at a hardness of 55.

With continued reference to FIG. 9, the lower midsole 46 includes a truncated central mound 74 forming a shallow Shank-adhering cup 76. The front edge 78 of the lower midsole 46 is indented centrally rearward to the cup 76. The lower midsole 46 is injection molded of thermoplastic urethane (TPU) and is considerably harder and stiffer than the upper midsole 48.

With continued reference to FIG. 9, the Shank 50 is shaped to conform to the Shank-adhering inset 58 of the upper midsole 48 and to the Shank-adhering cup 76 of the lower midsole 46. The Shank 50 is relatively thin, but is molded of a polymeric material with a hardness equivalent to or greater than that of the lower midsole 46. The Shank 50 includes upturned side portions 82 which stiffen the upper midsole 48 in the arch portion 40. Additionally, the Shank 50 has high tensile strength. Thus, when bonded to the upper midsole 48 and the lower midsole 46, the Shank 50 cooperates with those structures to provide increased stiffness.

With reference to FIG. 10, the upper midsole 48, the Shank 50, the lower midsole 46, and the outsole 44 are permanently bonded together.

With reference to FIGS. 9 and 10, in the assembled shoe bottom 36, the Shank 50 forms a shallow bowl 96 which is centered on and bonded to the Shank-adhering cup 76 of the lower midsole 46 and which extends peripherally beneath and is bonded to the upper midsole 48. Rearward and laterally of the Shank-adhering cup 76, the opposed
upper midsole 48 and lower midsole 46 are gently concave and form a cavity 98. When a load is applied to the heel portion 42 of the shoe bottom 36, a major portion of that load passes through the central bulge 60 of the upper midsole 48 into the bowl 96 of the shank 50. The lower midsole 46 directly supports the bowl 96 of the shank 50 only through the shank-adhering cup 76, which is smaller than the bowl 96. Therefore, the central bulge 60 and the bowl 96 cooperate to concentrate a portion of the load from the upper midsole 48 and into the central mound 74 of the lower midsole 46. In the process, as a greater load is applied to the heel portion 42, the bowl 96 of the shank 50 is bent so that assumes a shallower shape, the opposed upper midsole 48 and lower midsole 46 move into closer proximity, and the volume of the cavity 98 decreases. By bending under the load, the relatively hard 65 Shore C durometer hardness EVA central bulge 60 of the upper midsole 48 cooperates with the even harder lower midsole 46 and with the thin, stiff bowl 96 of the shank 50 to allow the heel portion 42 to yield under impact as if it contained a softer, 55-durometer upper midsole 48. Thus, these structures cushion a wearer’s foot steps as well as the wearer might expect from a shoe bottom 36 incorporating larger amounts of a softer material. With a 65 Shore C durometer hardness upper midsole 48 instead of 55-durometer, the shoe bottom 36 will more likely retain its shape and bulk characteristics over its lifetime.

[0063] With reference to FIGS. 9 and 10, it is noted that the front edge 78 of the lower midsole 46 is indented rearward to the cup 76. The shank 50 extends forward beyond the front edge 78 of the lower midsole 46, being bonded to the upper midsole 48 in the arch portion 40. Consequently, as loads are applied to the upper midsole 48 in the arch portion 40, the shank 50 directs a portion of these loads rearward into the central mound 74. Thus, the shank 50, the upper midsole 48 and the lower midsole 46 cooperate to resist deformation by supporting the arch portion 40, while at the same time absorbing impact by yielding gradually with increasing load on the arch portion 40.

[0064] FIG. 11 shows a second alternative embodiment of the shoe bottom heel portion in accordance with the present invention, which does not include the shank inset 58 and the shank 50 as described for the preferred exemplary embodiment. This second alternative embodiment may optionally include the central mound 74 and central bulge 60 as described for the preferred exemplary embodiment.

[0065] FIG. 11 shows an unfolded perspective view of the upper midsole 48 and the lower midsole 46 of the shoe bottom 36 (the upper midsole 48 being inverted, the lower midsole 46 being uplifted and rotated). The heel portion 42 of the upper midsole 48 includes left and right forward pillars 52, left and right middle pillars 54 and a rear pillar 56, these being arranged peripherally about a smoothly convex central bulge 60. A forward adhesion area 62 partially surrounds each forward pillar 52. A middle adhesion area 64 adjoins each middle pillar 54. A rear adhesion area 66 adjoins the rear pillar 56.

[0066] With continued reference to FIG. 11, the upper midsole 48 is compression molded of ethylene vinyl acetate (EVA) and has a 65 Shore C durometer hardness, which is a higher value than the 55 durometer hardness that is commonly used in cushioning elements of footwear. At a hardness of 65, the upper midsole 48 in this exemplary embodiment of the present invention is stiffer and harder, i.e., more resistant to compression, than it would be at a hardness of 55. It is also more capable of retaining its originally molded shape and dimensions for the lifetime of the product. In particular, at a durometer hardness of 65, the forward pillars 52, middle pillars 54, rear pillar 56 and central bulge 60 have greater structural definition and durability than they would have at a hardness of 55.

[0067] With continued reference to FIG. 11, the lower midsole 46 includes left and right forward sockets 68, left and right middle sockets 70 and a rear socket 72, these being arranged peripherally, and a truncated central mound 74. Between the forward sockets 68, the front edge 78 of the lower midsole 46 is indented rearward to the mound 74. The lower midsole 46 is injection molded of thermoplastic urethane (TPU) and is considerably harder and stiffer than the upper midsole 48.

[0068] With continued reference to FIG. 11, the upper midsole 48, the lower midsole 46, and the outsole 44 are permanently bonded together. The rear socket 72 of the lower midsole 46 receives and is bonded to the rear pillar 56 of the upper midsole 48. The rear adhesion area 66 abuts and is bonded to the lower midsole 46 adjacent the rear socket 72. Each middle socket 70 receives and is bonded to the corresponding middle pillar 54 of the upper midsole 48. Each middle adhesion area 64 abuts and is bonded to the lower midsole 46 adjacent the corresponding middle socket 70. Each forward socket 68 receives and is bonded to the lower midsole 46 adjacent the corresponding forward socket 52 of the upper midsole 48. Each forward adhesion area 62 abuts and is bonded to the lower midsole 46 adjacent the corresponding forward socket 68.

[0069] With continued reference to FIG. 11, the rear pillar 56 and the rear adhesion area 66 cooperate with the rear socket 72 with the lower midsole 46 adjacent the rear socket 72 to form a rear contact 88, represented as a region circumscribed by a dotted oval in FIG. 8. In the rear contact 88, the rear adhesion area 66 and the rear pillar 56 provide substantial surface area for bonding to the lower midsole 46, thereby resisting separation. Because the rear pillar 56 projects into the rear socket 72, the rear contact 88 also resists lateral displacement of the upper midsole 48 relative to the lower midsole 46. Additionally, when a load is applied to the heel portion 42 of the shoe bottom 36, the rear contact 88 transfers a portion of that load to the lower midsole 46.

[0070] With continued reference to FIG. 11, in similar manner, each middle pillar 54 and each middle adhesion area 64 cooperate with the corresponding middle socket 70 and with the lower midsole 46 adjacent the middle socket 70 to form a middle contact 90; and each forward pillar 52 and each forward adhesion area 62 cooperate with the corresponding forward socket 68 and with the lower midsole 46 adjacent the forward socket 68 to form a forward contact 92. Also in similar manner, separation and lateral displacement are resisted and loads are transferred from the upper midsole 48 to the lower midsole 46.

[0071] With continued reference to FIG. 11 and also with reference to FIG. 1, between each forward contact 92 and the corresponding middle contact 90, and also between each middle contact 90 and the rear contact 88, the opposed upper midsole 48 and lower midsole 46 form lenticular openings 94. Loads passing from the upper midsole 48 to the lower
midsole 46 via the forward contacts 92, middle contacts 90 and rear contact 88 must bypass these openings 94. As the loads increase, they not only compress the upper midsole 48 and, to a far lesser extent, the lower midsole 46, but also bend both the upper midsole 48 and the lower midsole 46, forcing the gently concave, opposed upper midsole 48 and lower midsole 46 into closer proximity and flattening the openings 94. By bending under the load, the relatively hard 65 shore C durometer hardness EVA upper midsole 48 cooperates with the even harder TPU lower midsole 46 to provide a heel portion 42 which yields under impact as if it contained a softer, 55-durometer upper midsole 48. With a 65-durometer upper midsole 48 instead of 55-durometer, the shoe bottom 36 will more likely retain its shape and bulk characteristics over its lifetime. Thus, the shoe bottom 36 will cushion a wearer’s footsteps as well as the wearer might expect from a shoe bottom 36 incorporating larger amounts of a softer material.

[0072] With continued reference to FIGS. 1 and 11, in the assembled shoe bottom 36, the central bulge 60 of the upper midsole 48 is centered on and bonded to the central mound 74 of the lower midsole 46. Rearward and laterally of the central mound 74, the opposed upper midsole 48 and lower midsole 46 are gently concave and form a cavity 98. When a load is applied to the heel portion 42 of the shoe bottom 36, a major portion of that load passes through the central bulge 60 of the upper midsole 48 into the central mound 74 of the lower midsole 46. As a greater load is applied to the heel portion 42, the opposed upper midsole 48 and lower midsole 46 move into closer proximity, and the volume of the cavity 98 decreases. At the same time, with increasing load, the central mound 74 gradually intrudes into the central bulge 60, deforming the central bulge 60 and allowing the heel portion 42 to yield under impact as if it contained a softer, 55-durometer upper midsole 48. Thus, these structures cushion a wearer’s footsteps somewhat as a wearer might expect from a shoe bottom 36 incorporating larger amounts of a softer material. With a 65-durometer upper midsole 48 instead of 55-durometer, the shoe bottom 36 will more likely retain its shape and bulk characteristics over its lifetime.

[0073] With continued reference to FIG. 11, it is noted that the front edge 78 of the lower midsole 46 is indented rearward, between the forward sockets 68, to the mound 74. As loads are applied to the upper midsole 48 in the arch portion 40, the a portion of these loads is directed rearward through the upper midsole 48 into the central mound 74 and laterally into the forward contacts 92. Thus, the upper midsole 48 and the lower midsole 46 cooperate to resist deformation by supporting the arch portion 40, while at the same time absorbing impact by yielding gradually with increasing load on the arch portion 40.

[0074] In this second alternative embodiment, the locations of the central bulge 60 and the central mound 74 may be exchanged, one or the other of them may be exaggerated or reduced, and either may be replaced by the other to provide opposing bulges or opposing mounds.

[0075] While the foregoing detailed description sets forth exemplary embodiments of a shoe bottom heel portion in accordance with the present invention, it is to be understood that the above description is illustrative only and not limiting of the disclosed invention. Indeed, it will be appreciated that the embodiments discussed above and the virtually infinite embodiments that are not mentioned could easily be within the scope and spirit of the present invention. Thus, the present invention is to be limited only by the claims as set forth below.

- [0076] shoe bottom heel portion 30
- [0077] shoe 32
- [0078] shoe upper 34
- [0079] shoe bottom 36
- [0080] forefoot portion 38
- [0081] arch portion 40
- [0082] heel portion 42
- [0083] outsole 44
- [0084] lower midsole 46
- [0085] upper midsole 48
- [0086] shank 50
- [0087] forward pillar 52
- [0088] middle pillar 54
- [0089] rear pillar 56
- [0090] inset 58
- [0091] central bulge 60
- [0092] forward adhesion area 62
- [0093] middle adhesion area 64
- [0094] rear adhesion area 66
- [0095] forward socket 68
- [0096] middle sockets 70
- [0097] rear socket 72
- [0098] central mound 74
- [0099] shank-adhering cup 76
- [0100] front edge 78
- [0101] ridges 80
- [0102] side portions 82
- [0103] rear contact 88
- [0104] middle contact 90
- [0105] forward contact 92
- [0106] lenticular openings 94
- [0107] bowl 96
- [0108] cavity 98

What is claimed is:

1. A shoe bottom heel portion, comprising of:
   - an upper midsole forming a central bulge;
   - a lower midsole forming a central mound;
   - a shank bonded to said central bulge and to said central mound;
and a plurality of contacts of said upper midsole with said lower midsole, said contacts being arranged peripherally, said contacts including projections of one of said upper midsole and said lower midsole and indentations of the other of said upper midsole and said lower midsole, whereby said indentations receive respective ones of said projections.

2. A shoe bottom heel portion as set forth in claim 1, wherein said upper midsole has a first edge, said lower midsole has a second edge, and said second edge at least partially surrounds and embraces said first edge.

3. A shoe bottom heel portion as set forth in claim 1, wherein said contacts are substantially permanent.

4. A shoe bottom heel portion as set forth in claim 1, wherein said contacts are adhesive.

5. A shoe bottom heel portion as set forth in claim 1, wherein said upper midsole and said lower midsole each includes an injection or compression molded portion.

6. A shoe bottom heel portion as set forth in claim 1, wherein said upper midsole and said lower midsole each includes a piece formed of EVA or TPU.

7. A shoe bottom heel portion as set forth in claim 1, wherein said upper midsole is formed of EVA of approximately 65 shore C durometer hardness, and said lower midsole is formed of TPU.

8. A shoe bottom heel portion as set forth in claim 1, wherein at least one of said contacts includes a load transferring area surrounding said indentation and said projection thereof.

9. A shoe bottom heel portion as set forth in claim 1, said upper midsole and said lower midsole having opposing concave forms intermediate said contacts, thereby forming peripheral openings intermediate said contacts.

10. A shoe bottom heel portion as set forth in claim 1, said upper midsole and said lower midsole having opposing concave forms proximate said central bulge and said central mound, said shank conforming to said upper midsole, thereby forming at least one cavity between said upper midsole and said lower midsole.

11. A shoe bottom heel portion as set forth in claim 10, wherein said at least one cavity opens at said first edge and second edge.

12. A shoe bottom heel portion as set forth in claim 10, wherein said upper midsole and said shank extend forward beyond said lower midsole.

13. A shoe bottom heel portion as set forth in claim 12, wherein a pair of said contacts is located forward of said central mound, one laterally, the other medially, and wherein said lower midsole includes a front edge indented rearward from said pair of contacts to said central mound.

14. A shoe bottom heel portion as set forth in claim 1, wherein said shank contacts said central mound over a first surface area, said shank contacts said central bulge over a second surface area, and said second surface area is at least twice said first surface area.

15. A shoe bottom heel portion as set forth in claim 1, wherein said shank contacts said central mound over a first surface area, said shank contacts said central bulge over a second surface area, and said second surface area is at least four times said first surface area.

16. A shoe bottom heel portion as set forth in claim 1, wherein said shank contacts said central mound over a first surface area, said shank contacts said central bulge over a second surface area, and said second surface area is at least eight times said first surface area.

17. A shoe bottom heel portion as set forth in claim 16, wherein said central bulge is formed of a material having a first stiffness, said central mound is formed of a material having a second stiffness substantially greater than said first stiffness, and said shank is formed of a material having a third stiffness substantially greater than said second stiffness.

18. A shoe bottom heel portion as set forth in claim 17, wherein said central bulge is formed of 65 shore C durometer hardness EVA, said central mound is formed of TPU, and said shank is formed of a hard urethane resin.

19. A shoe bottom heel portion, comprising of:

an upper midsole forming a central bulge;
a lower midsole forming a central mound; and
a shank bonded to said central bulge and to said central mound.

20. A shoe bottom heel portion as set forth in claim 19, wherein said upper midsole has a first edge, said lower midsole has a second edge, and said second edge at least partially surrounds and embraces said first edge.

21. A shoe bottom heel portion as set forth in claim 19, wherein said upper midsole and said lower midsole each includes an injection or compression molded portion.

22. A shoe bottom heel portion as set forth in claim 19, wherein said upper midsole and said lower midsole each includes a piece formed of EVA or TPU.

23. A shoe bottom heel portion as set forth in claim 19, wherein said upper midsole is formed of EVA of approximately 65 shore C durometer hardness, and said lower midsole is formed of TPU.

24. A shoe bottom heel portion as set forth in claim 19, said upper midsole and said lower midsole having opposing concave forms proximate said central bulge and said central mound, said shank conforming to said upper midsole, thereby forming at least one cavity between said upper midsole and said lower midsole.

25. A shoe bottom heel portion as set forth in claim 23, wherein said at least one cavity opens at said first edge and second edge.

26. A shoe bottom heel portion as set forth in claim 19, wherein said upper midsole and said shank extend forward beyond said lower midsole.

27. A shoe bottom heel portion as set forth in claim 19, said upper midsole extends forward beyond said lower midsole medially and laterally, and wherein said lower midsole includes a front edge indented rearward centrally to said central mound.

28. A shoe bottom heel portion as set forth in claim 19, wherein said shank contacts said central mound over a first surface area, said shank contacts said central bulge over a second surface area, and said second surface area is at least twice said first surface area.

29. A shoe bottom heel portion as set forth in claim 19, wherein said shank contacts said central mound over a first surface area, said shank contacts said central bulge over a second surface area, and said second surface area is at least four times said first surface area.

30. A shoe bottom heel portion as set forth in claim 19, wherein said shank contacts said central mound over a first surface area, said shank contacts said central bulge over a second surface area, and said second surface area is at least eight times said first surface area.

31. A shoe bottom heel portion as set forth in claim 29, wherein said central bulge is formed of a material having a first stiffness, said central mound is formed of a material having a second stiffness substantially greater than said first stiffness.
stiffness, and said shank is formed of a material having a third stiffness substantially greater than said second stiffness.

32. A shoe bottom heel portion as set forth in claim 30, wherein said central bulge is formed of 65 shore C durometer hardness EVA, said central mound is formed of TPU, and said shank is formed of a hard urethane resin.

33. A shoe bottom heel portion, comprising:
   an upper midsole;
   a lower midsole; and
   a plurality of contacts of said upper midsole with said lower midsole.

34. A shoe bottom heel portion as set forth in claim 33, wherein said plurality of contacts are arranged peripherally.

35. A shoe bottom heel portion as set forth in claim 33, wherein said plurality of contacts include projections of one of said upper midsole and said lower midsole and indentations of the other of said upper midsole and said lower midsole.

36. A shoe bottom heel portion as set forth in claim 35, wherein said indentations receive respective ones of said projections.

37. A shoe bottom heel portion as set forth in claim 33, wherein said upper midsole has a first edge, said lower midsole has a second edge, and said second edge at least partially surrounds and embraces said first edge.

38. A shoe bottom heel portion as set forth in claim 33, wherein said contacts are substantially permanent.

39. A shoe bottom heel portion as set forth in claim 33, wherein said contacts are adhesive.

40. A shoe bottom heel portion as set forth in claim 33, wherein said upper midsole and said lower midsole each includes an injection or compression molded portion.

41. A shoe bottom heel portion as set forth in claim 33, wherein said upper midsole and said lower midsole each includes a piece formed of EVA or TPU.

42. A shoe bottom heel portion as set forth in claim 33, wherein said upper midsole is formed of EVA of approximately 65 shore C durometer hardness, and said lower midsole is formed of TPU.

43. A shoe bottom heel portion as set forth in claim 33, wherein at least one of said contacts includes a load transferring area surrounding said indentation and said projection thereof.

44. A shoe bottom heel portion as set forth in claim 33, said upper midsole and said lower midsole having opposing concave forms intermediate said contacts, thereby forming peripheral openings intermediate said contacts.

45. A shoe bottom heel portion as set forth in claim 42, said upper midsole and said lower midsole having opposing concave forms, one of said upper midsole and said lower midsole having a central bulge, the other thereof having a central mound opposing and proximate said central bulge, thereby forming at least one cavity between said upper midsole and said lower midsole.

46. A shoe bottom heel portion as set forth in claim 44, wherein said at least one cavity opens at said first edge and second edge.

47. A shoe bottom heel portion as set forth in claim 42, wherein said upper midsole extends forward beyond said lower midsole.

48. A shoe bottom heel portion as set forth in claim 46, wherein a pair of said contacts is located forward of said central mound, one laterally, the other medially, and wherein said lower midsole includes a front edge indented rearward from said pair of contacts to said central mound.

49. A shoe bottom heel portion, comprising:
   an upper midsole;
   a lower midsole; and
   a plurality of contacts of said upper midsole with said lower midsole, said contacts being arranged peripherally,
   said contacts including projections of one of said upper midsole and said lower midsole and indentations of the other of said upper midsole and said lower midsole, and said indentations receive respective ones of said projections.

50. A shoe bottom heel portion as set forth in claim 49, wherein said upper midsole has a first edge, said lower midsole has a second edge, and said second edge at least partially surrounds and embraces said first edge.

51. A shoe bottom heel portion as set forth in claim 49, wherein said contacts are substantially permanent.

52. A shoe bottom heel portion as set forth in claim 49, wherein said contacts are adhesive.

53. A shoe bottom heel portion as set forth in claim 49, wherein said upper midsole and said lower midsole each includes an injection or compression molded portion.

54. A shoe bottom heel portion as set forth in claim 49, wherein said upper midsole and said lower midsole each includes a piece formed of EVA or TPU.

55. A shoe bottom heel portion as set forth in claim 49, wherein said upper midsole is formed of EVA of approximately 65 shore C durometer hardness, and said lower midsole is formed of TPU.

56. A shoe bottom heel portion as set forth in claim 49, wherein at least one of said contacts includes a load transferring area surrounding said indentation and said projection thereof.

57. A shoe bottom heel portion as set forth in claim 49, said upper midsole and said lower midsole having opposing concave forms intermediate said contacts, thereby forming peripheral openings intermediate said contacts.

58. A shoe bottom heel portion as set forth in claim 55, said upper midsole and said lower midsole having opposing concave forms, one of said upper midsole and said lower midsole having a central bulge, the other thereof having a central mound opposing and proximate said central bulge, thereby forming at least one cavity between said upper midsole and said lower midsole.

59. A shoe bottom heel portion as set forth in claim 57, wherein said at least one cavity opens at said first edge and second edge.

60. A shoe bottom heel portion as set forth in claim 55, wherein said upper midsole extends forward beyond said lower midsole.

61. A shoe bottom heel portion as set forth in claim 59, wherein a pair of said contacts is located forward of said central mound, one laterally, the other medially, and wherein said lower midsole includes a front edge indented rearward from said pair of contacts to said central mound.