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(54) **MIDSOLE STRUCTURE OF ATHLETIC SHOE**

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(57) **ABSTRACT**

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A midsole structure for an athletic shoe includes a midsole (3) formed of a soft elastic material and extending from a shoe heel region through a midfoot region to a forefoot region and a plastic shank member (10) or shankpiece and provided at regions that cover a midfoot portion (B) of the midsole (3) and having an oblong cross sectional shape where a dimension (W) in a shoe elongated direction is greater than a dimension (h) in the vertical direction. Thus, flexural rigidity of the midfoot portion (B) of the midsole (3) increases. When a bending moment is applied to the midsole (3), the shankmember (10) effectively exercises a so-called "shank effect" and thus, bending deformation can be prevented from occurring at the midfoot portion (B) of the midsole (3). As a result, flexibility or bendability of the forefoot portion (C) of the midsole (3) can be relatively advanced.

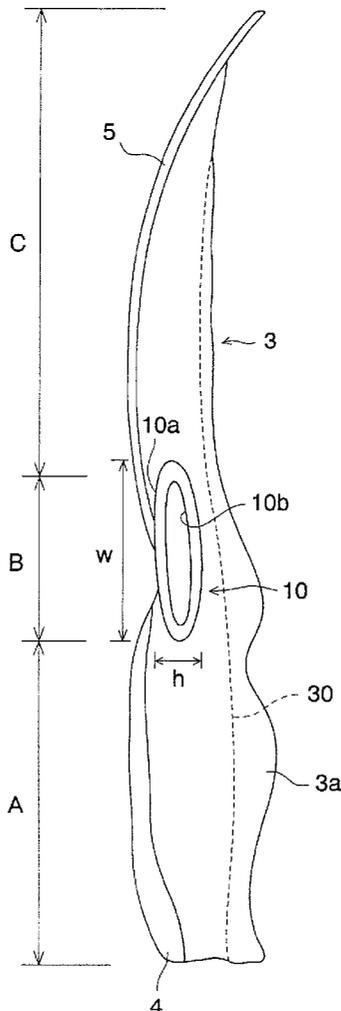


FIG. 1

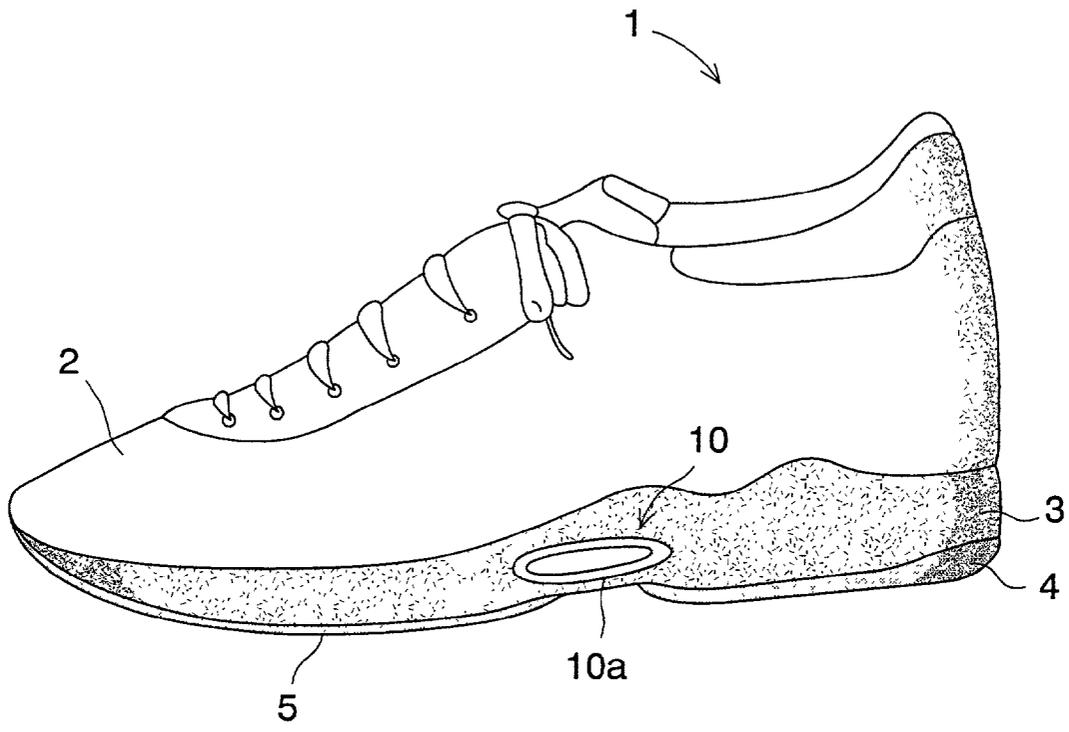


FIG. 2

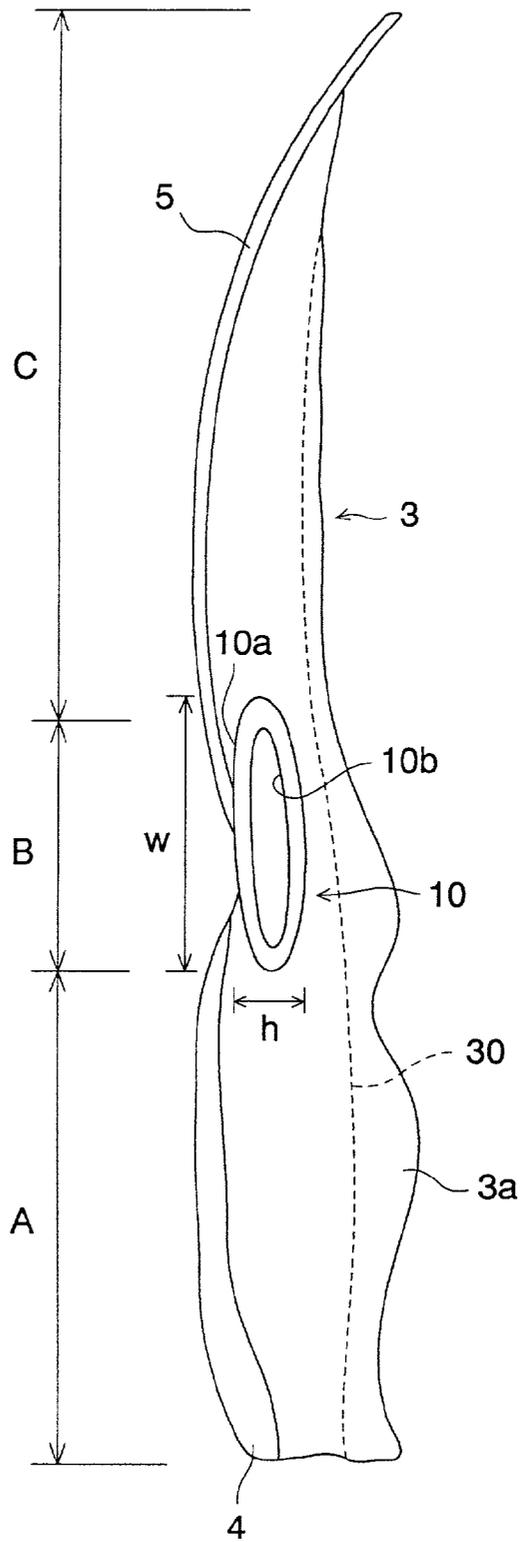


FIG. 3

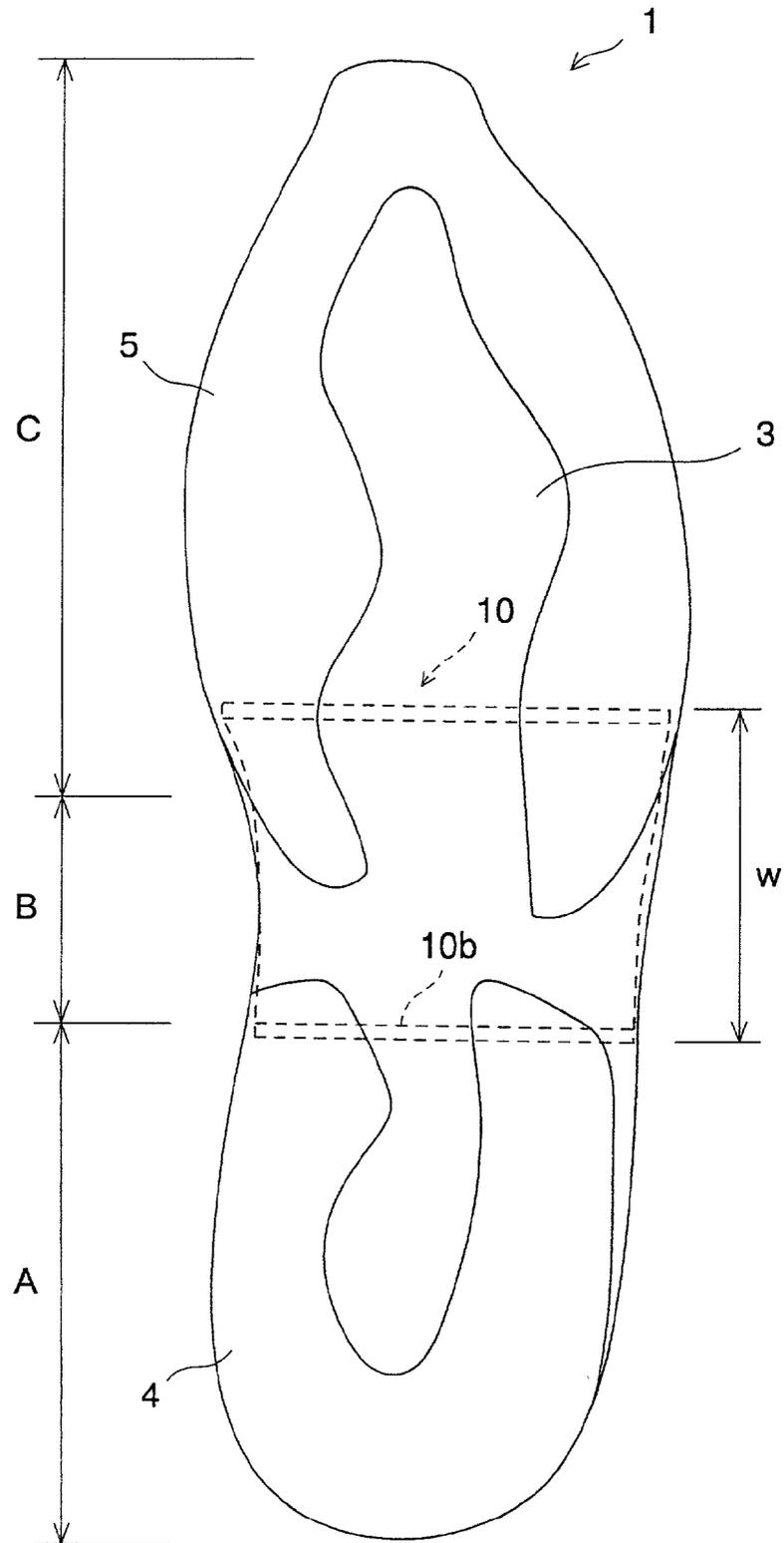


FIG. 4

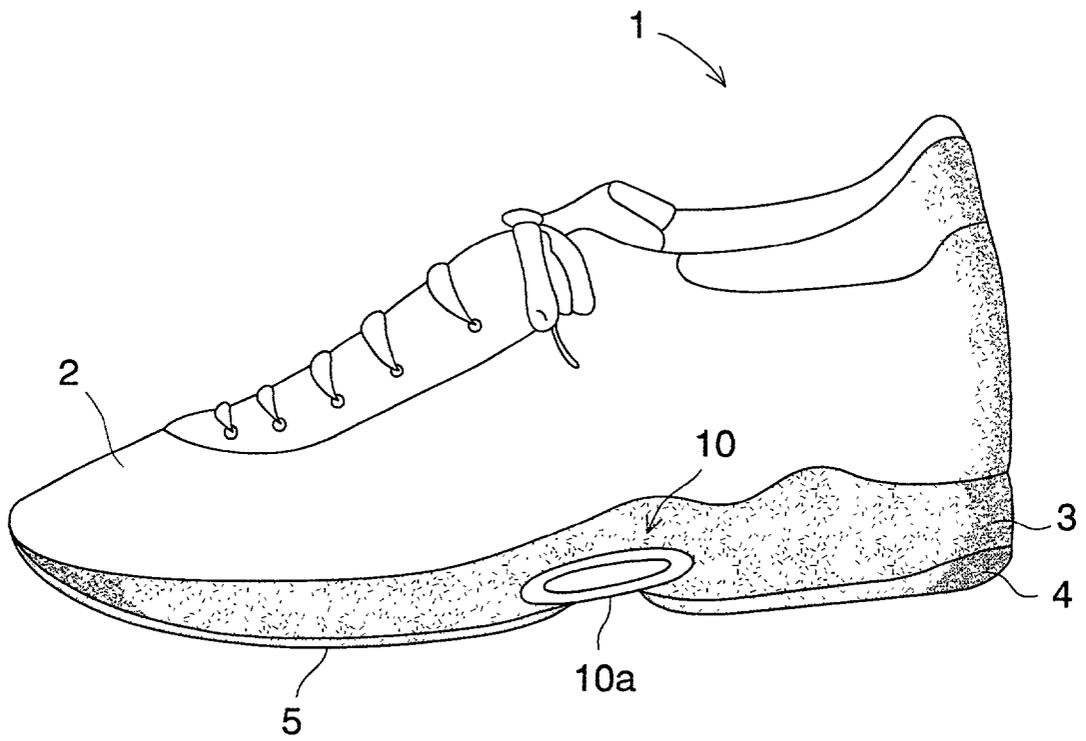


FIG. 5

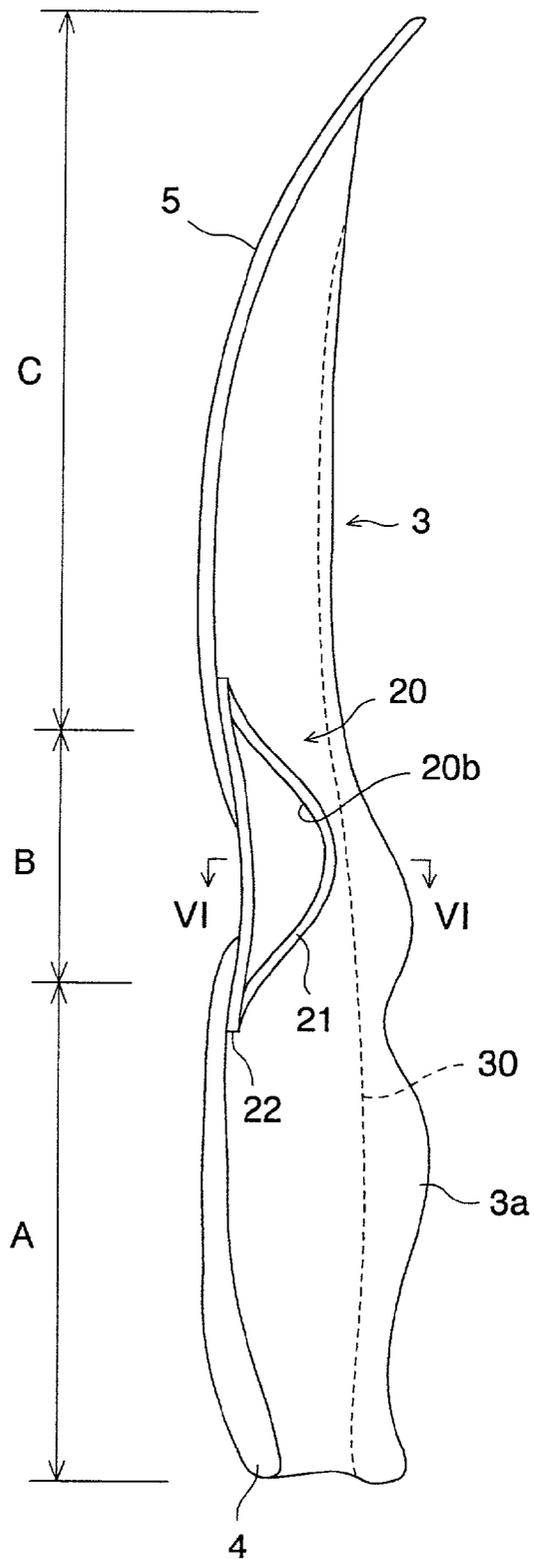


FIG. 6

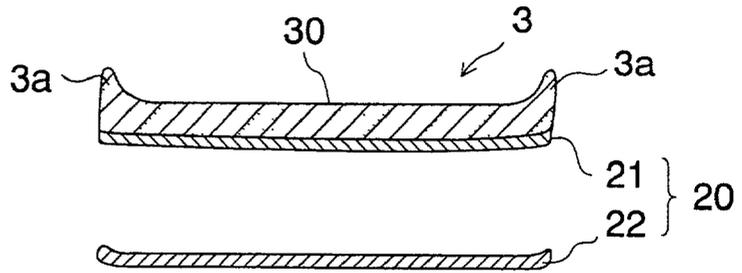


FIG. 7

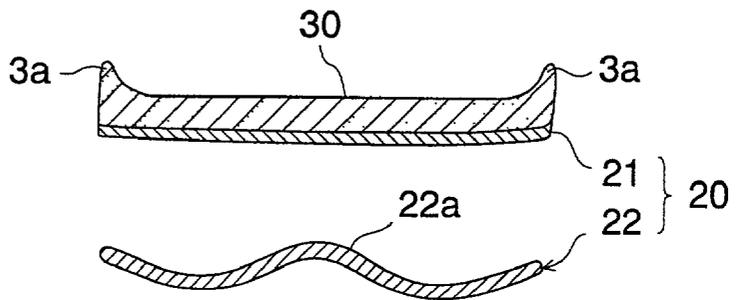


FIG. 9

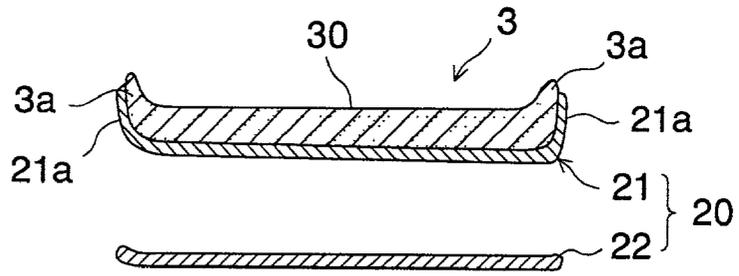


FIG. 11

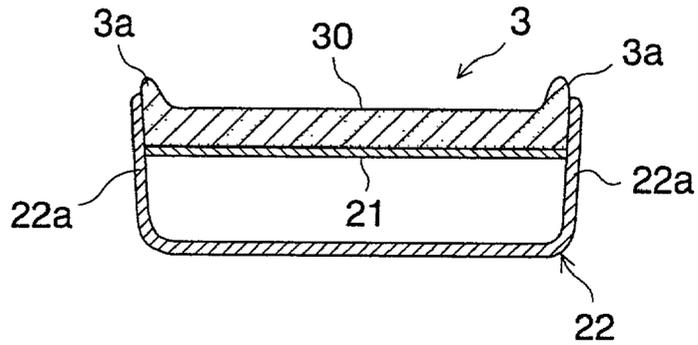


FIG. 8

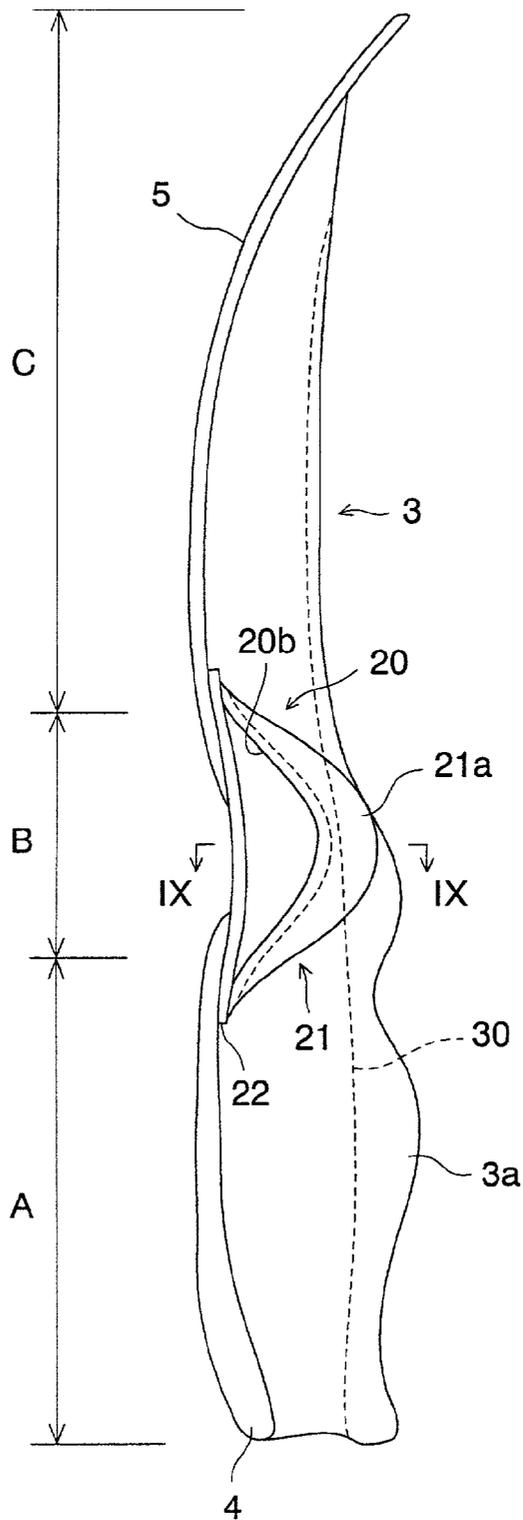


FIG. 10

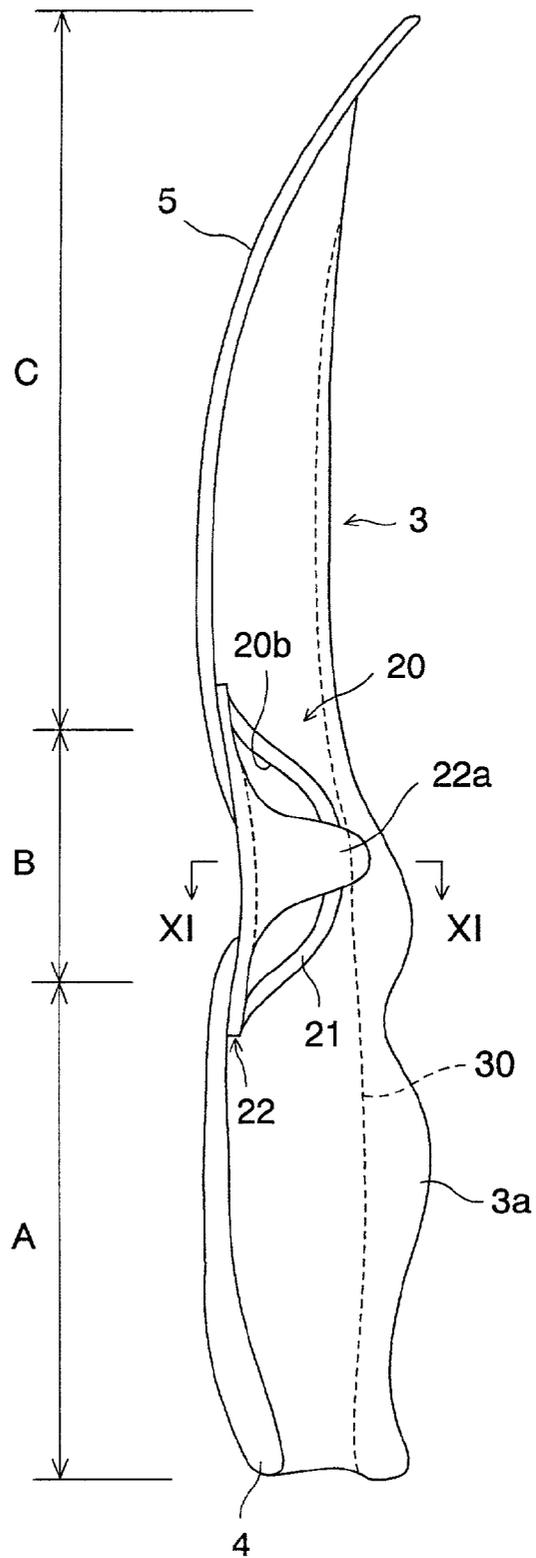


FIG. 12

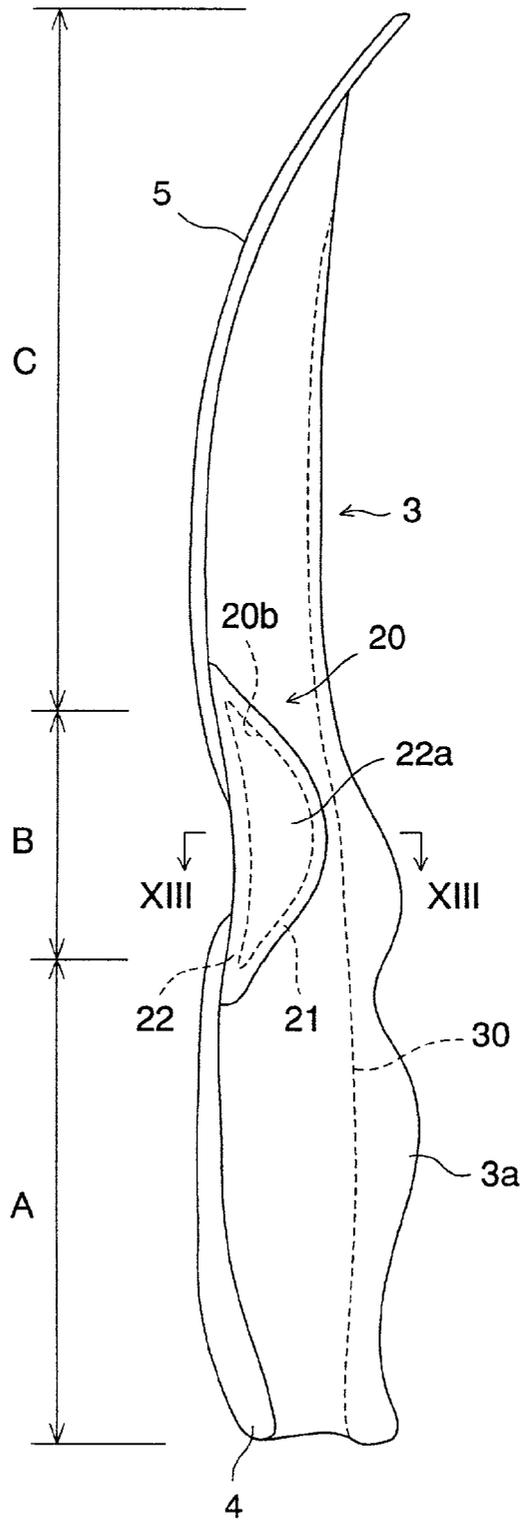


FIG. 13

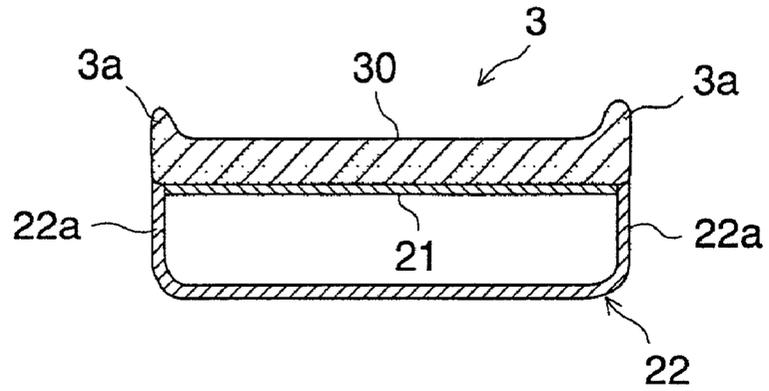
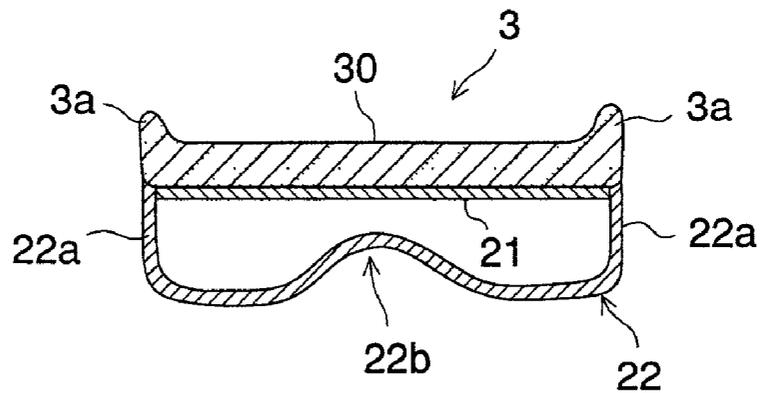


FIG. 14



MIDSOLE STRUCTURE OF ATHLETIC SHOE

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a midsole structure of an athletic shoe, and more particularly, a midsole assembly having a decreased flexibility or bendability at a midfoot portion and an improved flexibility or bendability at a forefoot portion.

[0002] A sole for an athletic shoe used in various sports includes a midsole formed of a soft elastic material to secure cushioning properties and an outsole fitted to the bottom surface of the midsole and directly contacting the ground.

[0003] As an athletic shoe, not only cushioning properties at a heel portion but also flexibility or bendability at a forefoot portion is required. Therefore, by decreasing a thickness of a forefoot portion of a midsole or forming a laterally extending groove on a forefoot portion, improvement in flexibility of a shoe forefoot portion has been generally introduced. Also, as shown in Japanese patent application laying-open publication No. 11-203, improvement in flexibility of a shoe forefoot portion was introduced by increasing flexural rigidity of a midfoot portion of a midsole to decrease flexibility of the midfoot portion.

[0004] In a midsole structure shown in the above-mentioned publication, a corrugated sheet is inserted into a midsole and a plurality of projections extending in a general shoe elongated direction are formed at a midfoot portion of the corrugated sheet. Thus, flexural rigidity of the midfoot portion of the corrugated sheet is increased and flexibility of the forefoot portion of the midsole decreases, thereby relatively improving flexibility of the forefoot portion of the midsole.

[0005] In this case, by utilizing a corrugated sheet inside the midsole and changing a cross sectional shape of the midfoot portion of the corrugated sheet, improvement in flexibility of the midsole forefoot portion is introduced. However, there is a need to increase flexibility of a forefoot portion of a shoe without a corrugated sheet. Furthermore, there is also a need to make a shoe midfoot portion less deformed.

[0006] An object of the present invention is to provide a midsole structure of an athletic shoe that can decrease flexibility or bendability of the midfoot portion and that can increase flexibility or bendability of the forefoot portion with a simple mechanism.

SUMMARY OF THE INVENTION

[0007] A midsole structure of a first embodiment of the present invention includes a midsole formed of a soft elastic material and having a heel portion, a midfoot portion and a forefoot portion and extending from a shoe heel region through a midfoot region to a forefoot region and a plastic shank member, or shankpiece provided at regions covering the midfoot portion of the midsole and having an oblong cross sectional shape where a dimension in a shoe elongated direction is greater than that in a vertical direction.

[0008] In this case, a shank member is provided at regions that cover the midfoot portion of the midsole, and the shank member has an elongated sectional shape. Thus, the midfoot portion of the midsole has an increased flexural rigidity. As

a result, at the time of bending deformation of the midsole, the shank member effectively exercises a so-called "shank effect" and the midsole can be prevented from being bent at the midfoot portion, thereby relatively improving cushioning properties of the shoe forefoot portion. Also, since the shank member itself has a simple structure with an elongated cross sectional shape, the whole midsole structure with a shank member does not become complicated.

[0009] Furthermore, in this case, by providing a shank member in the midfoot portion of the midsole, torsional rigidity of the shoe midfoot portion can also be made at a higher value, thereby restraining torsion of the shoe midfoot portion during activities.

[0010] Preferably, a front end edge of the shank member is disposed at a rear end portion of the midsole forefoot portion, and a rear end edge of the shank member is disposed at a front end portion of the midsole heel portion. In this case, since the shank member covers the front end portion of the midsole heel portion to the rear end portion of the midsole forefoot portion, the shank member can more effectively exercise a shank effect, and thus, flexibility of the shoe forefoot portion can further be improved.

[0011] The shank member may be a tubelike member having a hole that extends in a shoe width direction. In this case, since the hole functions as a cushion hole, cushioning properties of the shoe midfoot portion can be improved at the time of landing onto the ground.

[0012] The tubelike shank member may have a flat annular cross section, a generally D-shaped cross section or semi-circular cross section.

[0013] The shank member may be formed of an upper and lower portion. The upper portion is convexly curved upwardly and has a central curved face extending in a shoe width direction. The lower portion is convexly curved upwardly and has a central curved face extending in a shoe elongated direction. A front and rear end edge of the upper portion is connected to a front and rear end edge of the lower portion, respectively.

[0014] In this case, especially, a central curved face of the lower portion functions as a rib, and thus, the midsole is securely restrained from being bent at the midfoot portion, thereby securely improving flexibility of the shoe forefoot portion. In addition, the lower portion may be a flat extending member. In this case as well, since the upper portion is curved in a direction opposite a bending direction of the shoe midsole portion, bending deformation of the midsole midfoot portion can be restrained.

[0015] The upper portion of the shank member may have a pair of upwardly extending flanges at opposite end edges thereof. In this case, since the upper portion of the shank member has an increased flexural rigidity, flexural rigidity of the whole shank member is set at a higher value and thus, bending deformation of the midsole midfoot portion can be more firmly restrained. Also, the flanges sandwich both ends of at least the midsole midfoot portion, which prevents the midsole midfoot portion from being deformed laterally or transversely.

[0016] The lower portion of the shank member may have a pair of upwardly extending flanges at opposite end edges thereof. These flanges are connected to the upper portion and

close a portion of an opening of the hole in the shank member. In this case, flexural rigidity of the whole shank member is set at a further higher value and thus, bending deformation of the midsole midfoot portion can be further more firmly restrained.

[0017] The flanges of the lower portion of the shank member may close the whole portion of an opening of the hole in the shank member. In this case, flexural rigidity of the whole shank member is set at a still further higher value and thus, bending deformation of the midsole midfoot portion can be still further more firmly restrained.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] For a more complete understanding of the invention, reference should be made to the embodiments illustrated in greater detail in the accompanying drawings and described below by way of examples of the invention. In the drawings, which are not to scale:

[0019] FIG. 1 is a lateral side view of a left athletic shoe incorporating a midsole structure of a first embodiment of the present invention.

[0020] FIG. 2 is a lateral side enlarged view of the midsole structure of FIG. 1.

[0021] FIG. 3 is a bottom view of the midsole structure of FIG. 1.

[0022] FIG. 4 is a lateral side view of a left athletic shoe, illustrating a variant of FIG. 1.

[0023] FIG. 5 is a lateral side enlarged view of the midsole structure of a second embodiment of the present invention.

[0024] FIG. 6 is a cross sectional view of FIG. 5 taken along line VI-VI.

[0025] FIG. 7 illustrates a variant of FIG. 6.

[0026] FIG. 8 is a lateral side enlarged view of the midsole structure of a third embodiment of the present invention.

[0027] FIG. 9 is a cross sectional view of FIG. 8 taken along line IX-IX.

[0028] FIG. 10 is a lateral side enlarged view of the midsole structure of a fourth embodiment of the present invention.

[0029] FIG. 11 is a cross sectional view of FIG. 10 taken along line XI-XI.

[0030] FIG. 12 is a lateral side enlarged view of the midsole structure of a fifth embodiment of the present invention.

[0031] FIG. 13 is a cross sectional view of FIG. 12 taken along line XIII-XIII.

[0032] FIG. 14 illustrates a variant of FIG. 13.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0033] A first embodiment of the present invention is shown in FIGS. 1 to 3. As shown in FIG. 1, a sole for an athletic shoe 1 includes a midsole 3 extending from a shoe heel region through a midfoot or plantar arch region to a forefoot region and fitted to a bottom of an upper 2 and outsoles 4, 5 fitted on a bottom surface of the midsole 3 and

directly contacting the ground. A tubelike shank member 10 extending in a shoe width direction is provided inside the midfoot portion of the midsole 3.

[0034] The midsole 3 is provided in order to relieve a shock applied to the bottom of the shoe at the time of striking onto the ground. As shown in FIG. 2, the midsole 3 has a heel portion A, a midfoot portion B and a forefoot portion C, which respectively correspond to the shoe heel region, midfoot region and forefoot region. The midsole 3 is generally formed of a soft elastic material having good cushioning properties. Specifically, thermoplastic synthetic resin foam such as ethylene-vinyl acetate copolymer (EVA), thermosetting resin foam such as polyurethane (PU), or rubber material foam such as butadiene or chloroprene rubber are used. Also, the midsole 3 includes a base surface 30 to which the bottom of the upper 2 is attached and a pair of upraised portions 3a extending upwardly on opposite ends of the base surface 30.

[0035] The outsole 4 is disposed on the bottom surface of the heel portion A of the midsole 3 and the outsole 5 is disposed on the bottom surface of the forefoot portion C of the midsole 3.

[0036] As shown in FIGS. 2 and 3, the shank members 10 is disposed at regions that cover the midfoot portion B of the midsole 3. Preferably, a front end edge portion of the shank member 10 is disposed at a rear end portion of the forefoot portion C of the midsole 3 and a rear end edge portion of the shank member 10 is disposed at a front end portion of the heel portion A of the midsole 3. Also, the shank member 10 may be formed of thermoplastic resin such as thermoplastic polyurethane (TPU), polyamide elastomer (PAE), ABS resin or the like, or thermosetting resin such as epoxy resin, unsaturated polyester resin or the like.

[0037] As is clearly seen in FIG. 2, the shank member 10 has a hole 10b and a flat annular shape in cross section. A dimension w in a shoe elongated direction of the shank member 10 is greater than a dimension h in a vertical direction.

[0038] An example of the manufacturing method of inserting the shank member 10 into the inside of the midsole 3 is as follows: First, a shank member is formed by injection molding process or the like. Then, the shank member is inserted into a mold and foam materials such as polyurethane are injected into the mold and then, foaming process is performed. Thereafter, a midsole structure having a shank member 10 inserted thereto will be formed.

[0039] In FIG. 1, the shank member 10 is entirely buried inside the midfoot portion B of the midsole 3. As shown in FIG. 4, the shank member 10 may be provided in the midsole 3 in such a way that a lower surface 10a is exposed on a shoe bottom side.

[0040] As mentioned above, according to this embodiment, the shank member 10 is provided at regions that cover the midfoot portion B of the midsole 3, and the shank member 10 has an oblong sectional shape extending in a shoe elongated direction. Thereby, the midfoot portion B of the midsole 3 has an increased flexural rigidity. When the bending moment is applied to the midsole 3, the shank member 10 effectively exercises a so-called shank effect, and thus, the midsole 3 can be restrained from being bent at the midfoot portion B. As a result, the midsole 3 is easy to

be bent at the forefoot portion C and thus, flexibility or bendability of the shoe forefoot portion can be relatively improved.

[0041] Also, in this case, since the shank member has a simple structure, providing the shank member 10 in the midsole does not make the whole midsole structure complicated.

[0042] Furthermore, the shank member 10 increases torsional rigidity of the shoe midfoot portion and thus, torsion of the shoe midfoot portion can be restrained during activities.

[0043] Moreover, since the hole 10b formed inside the shank member 10 functions as a cushion hole, cushioning properties of the shoe midfoot portion can be improved at the time of striking onto the ground.

[0044] The shank member may have a generally D-shaped or semicircular cross sectional shape, as described herein-after.

[0045] A second embodiment of the present invention is shown in FIGS. 5 and 6. In this embodiment, a shank member 20 is formed of an upper portion 21 and a lower portion 22 disposed opposite the upper portion 21. The upper portion 21 is convexly curved upwardly and has a central curved face extending in a shoe width direction, or in a direction perpendicular to the page of FIG. 5. The lower portion 22 is slightly curved upwardly. A front and rear end edge of the upper portion 21 is connected to a front and rear end edge of the lower portion 22. The upper and lower portions 21 and 22 of the shank member 20 may be formed of the same materials or different materials.

[0046] In this case, the lower portion 22 as well as the upper portion 21 is curved in a direction opposite a bending direction of the shoe midfoot portion. Thus, at the time of bending of the midsole 3, the shank member 20 more effectively exercises a shank effect, thereby restraining the midsole 3 from being bent at the midfoot portion B. As a result, bendability or flexibility of the shoe forefoot portion can be further improved.

[0047] The lower portion 22 of the shank member 20, as shown in FIG. 7, may have a central curved face 22a, which is convexly curved upwardly and extends along a shoe elongated direction, or a direction perpendicular to the page of FIG. 7. In this case, since the curved face 22a of the lower portion 22 functions as a rib, the midsole 3 can be firmly restrained from being bent at the midfoot portion B, thereby improving flexibility of the shoe forefoot portion more firmly.

[0048] A third embodiment of the present invention is shown in FIGS. 8 and 9. In this embodiment, the upper portion 21 of the shank member 20 has a pair of flange portions 21a upwardly extending at both end edges. The upper portion 21 and thus, the whole shank member 20 has an increased flexural rigidity. Thereby, the midsole 3 can be more securely restrained from being bent at the midfoot portion B. Also, since the flange portions 21a sandwich both side faces of at least the midfoot portion B of the midsole 3, the midfoot portion B of the midsole 3 can be prevented from being deformed in the lateral direction.

[0049] A fourth embodiment of the present invention is shown in FIGS. 10 and 11. In this embodiment, the lower

portion 22 of the shank member 20 has a pair of flange portions 22a upwardly extending at both end edges. A top portion each of the flange portions 22a is connected to the upper portion 21 and thus, a portion of an opening of the hole 20b inside the shank member 20 is closed by the flange portions 22a. In this case, flexural rigidity of the lower portion 22 and thus, the whole shank member 20 can be set at a further higher value. Thus, bending deformation of the midsole 3 at the midfoot portion B can be more firmly restrained.

[0050] A fifth embodiment of the present invention is shown in FIGS. 12 to 14. In this embodiment, the whole opening of the hole 20b inside a shank member 20 is closed by the flange portions 22a of the lower portion 22. In this case, flexural rigidity of the whole shank member can be set at a much higher value. Thus, bending deformation of the midsole 3 at the midfoot portion B can be further securely restrained.

[0051] As shown in FIG. 14, the lower portion 22 of the shank member 20 may have a central curved face 22b, which can act as a rib. The curved face 22b is convexly curved upwardly and extends in a shoe elongated direction.

[0052] Those skilled in the art to which the invention pertains may make modifications and other embodiments employing the principles of this invention without departing from its spirit or essential characteristics particularly upon considering the forgoing teachings. The described embodiments and examples are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. Consequently, while the invention has been described with reference to particular embodiments and examples, modifications of structure, sequence, materials and the like would be apparent to those skilled in the art, yet fall within the scope of the invention.

What is claimed is:

1. A midsole structure of an athletic shoe comprising:

a midsole formed of a soft elastic material and having a heel portion, a midfoot portion and a forefoot portion and extending from heel region of said shoe to a forefoot region through a midfoot region; and

a shank member formed of plastics and provided at regions that cover said midfoot portion of said midsole and having an oblong cross sectional shape where a dimension in a shoe elongated direction is greater than that in a vertical direction.

2. The midsole structure of claim 1, wherein a front end edge of said shank member is disposed at a rear end portion of said forefoot portion of said midsole and a rear end edge of said shank member is disposed at a front end portion of said heel portion of said midsole.

3. The midsole structure of claim 2, wherein said shank member is a tubelike member that has a hole extending in a shoe width direction.

4. The midsole structure of claim 3, wherein said shank member has a flat annular shape in cross section.

5. The midsole structure of claim 3, wherein said shank member is generally D-shaped or semicircular in cross section.

6. The midsole structure of claim 5, wherein said shank member is formed of an upper portion and a lower portion,

said upper portion being convexly curved upwardly and having a central curved face that extends in a shoe width direction, said lower portion being convexly curved upwardly and having a central curved face that extends in a shoe elongated direction, or said lower portion extending in a flat shape, a front and rear end of said upper portion being connected to a front and rear end of said lower portion.

7. The midsole structure of claim 6, wherein said upper portion of said shank member has a pair of flanges that extend upwardly at opposite end edges thereof and that sandwich opposite side faces of said midfoot portion of said midsole.

8. The midsole structure of claim 6, wherein said lower portion of said shank member has a pair of flanges extending

upwardly at opposite end edges thereof, a top portion of each of said flanges being connected to said upper portion, said flanges closing a portion of an opening of said hole in said shank member.

9. The midsole structure of claim 6, wherein said lower portion of said shank member has a pair of flanges extending upwardly at opposite end edges thereof, a top portion of each of said flanges being connected to said upper portion, said flanges closing the whole portion of an opening of said hole in said shank member.

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