SHOE SOLES HAVING INCLINED GROOVES

A shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, wherein: the midsole is exposed in a central section of a rear foot section and an arch section; in the central section and a lateral side section of the rear foot section of the shoe sole, a diagonal groove is formed extending in a diagonal front-rear direction in the rear foot section to an outer edge of a lateral side of the rear foot section; an angle $\beta$, formed between a virtual center line of the diagonal groove and a longitudinal axis connecting between a center of a heel and a middle point between a big-toe ball and a little-toe ball, is set in a range of 12° to 35°; and a virtual intersection point between the longitudinal axis and the center line is set within a range of 21% to 43% of a full length of the longitudinal axis of the shoe sole from a posterior end of the shoe sole, the diagonal groove extending to a point anterior and medial to the intersection point.
The present invention relates to a shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, the shoe sole supporting a foot in a front foot section, an arch section, and a rear foot section, wherein:

the outsole is divided into pieces arranged in the front foot section and in the rear foot section, thereby leaving uncovered the arch section, and is formed in the rear foot section in a U-shape, with a central section cut out between a medial side and a lateral side of the foot; the midsole is exposed in the arch section and the central section of the rear foot section; a diagonal groove is formed in the midsole in the central section of the rear foot section and in the outsole in a lateral side section of the foot; in the rear foot section, the diagonal groove extending in a diagonal front-rear direction in the rear foot section to an outer edge of the lateral side of the foot; an angle formed by a virtual center line of the diagonal groove and a longitudinal axis is set in a range of 12° to 35°; and a virtual intersection point between the longitudinal axis and a virtual center line is arranged within a region from a rear half section to a front half section of the rear foot section.

As is well known in the art, a shoe sole is required to be light in weight, be capable of suppressing eversion of the heel area, and serve to absorb the impact on the heel area. However, these functions cannot be realized sufficiently only by forming a diagonal groove in a shoe sole. It is therefore an object of the present invention to form an appropriate diagonal groove so as to realize these functions.

The present invention in another aspect is a shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, wherein:

in a central section and a lateral side section of a rear foot section of the shoe sole, a diagonal groove is formed extending in a diagonal front-rear direction in the rear foot section to an outer edge of a lateral side of the rear foot section, an angle formed by a virtual center line of the diagonal groove and a longitudinal axis of the arch section is diagonally inclined from the shape of the sole.

The present invention in another aspect is a shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, wherein:

the outsole is divided into pieces arranged in the front foot section and in the rear foot section, thereby leaving uncovered the arch section, and is formed in the rear foot section in a U-shape, with a central section cut out between a medial side and a lateral side of the foot; the midsole is exposed in the arch section and the central section of the rear foot section; a diagonal groove is formed in the midsole in the central section of the rear foot section and in the outsole in a lateral side section of the foot; in the rear foot section, the diagonal groove extending in a diagonal front-rear direction in the rear foot section to an outer edge of the lateral side of the foot; an angle formed by a virtual center line of the diagonal groove and a longitudinal axis is set in a range of 12° to 35°; and a virtual intersection point between the longitudinal axis and a virtual center line is arranged within a region from a rear half section to a front half section of the rear foot section.

[0008] The present invention in another aspect is a shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, the shoe sole supporting a foot in a front foot section, an arch section, and a rear foot section, wherein:

the outsole is divided into pieces arranged in the front foot section and in the rear foot section, thereby leaving uncovered the arch section, and is formed in the rear foot section in a U-shape, with a central section cut out between a medial side and a lateral side of the foot; the midsole is exposed in the arch section and the central section of the rear foot section; a diagonal groove is formed in the midsole in the central section of the rear foot section and in the outsole in a lateral side section of the foot; in the rear foot section, the diagonal groove extending in a diagonal front-rear direction in the rear foot section to an outer edge of the lateral side of the foot; an angle formed by a virtual center line of the diagonal groove and a longitudinal axis is set in a range of 12° to 35°; and a virtual intersection point between the longitudinal axis and a virtual center line is arranged within a region from a rear half section to a front half section of the rear foot section.

As is well known in the art, a shoe sole is required to be light in weight, be capable of suppressing eversion of the heel area, and serve to absorb the impact on the heel area. However, these functions cannot be realized sufficiently only by forming a diagonal groove in a shoe sole. It is therefore an object of the present invention to form an appropriate diagonal groove so as to realize these functions.

The present invention in another aspect is a shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, wherein:

in a central section and a lateral side section of a rear foot section of the shoe sole, a diagonal groove is formed extending in a diagonal front-rear direction in the rear foot section to an outer edge of a lateral side of the rear foot section, an angle formed by a virtual center line of the diagonal groove and a longitudinal axis of the arch section is diagonally inclined from the shape of the sole.

The present invention in another aspect is a shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, wherein:

the outsole is divided into pieces arranged in the front foot section and in the rear foot section, thereby leaving uncovered the arch section, and is formed in the rear foot section in a U-shape, with a central section cut out between a medial side and a lateral side of the foot; the midsole is exposed in the arch section and the central section of the rear foot section; a diagonal groove is formed in the midsole in the central section of the rear foot section and in the outsole in a lateral side section of the foot; in the rear foot section, the diagonal groove extending in a diagonal front-rear direction in the rear foot section to an outer edge of the lateral side of the foot; an angle formed by a virtual center line of the diagonal groove and a longitudinal axis is set in a range of 12° to 35°; and a virtual intersection point between the longitudinal axis and a virtual center line is arranged within a region from a rear half section to a front half section of the rear foot section.

As is well known in the art, a shoe sole is required to be light in weight, be capable of suppressing eversion of the heel area, and serve to absorb the impact on the heel area. However, these functions cannot be realized sufficiently only by forming a diagonal groove in a shoe sole. It is therefore an object of the present invention to form an appropriate diagonal groove so as to realize these functions.

The present invention in another aspect is a shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, wherein:

in a central section and a lateral side section of a rear foot section of the shoe sole, a diagonal groove is formed extending in a diagonal front-rear direction in the rear foot section to an outer edge of a lateral side of the rear foot section, an angle formed by a virtual center line of the diagonal groove and a longitudinal axis of the arch section is diagonally inclined from the shape of the sole.

The present invention in another aspect is a shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, wherein:

the outsole is divided into pieces arranged in the front foot section and in the rear foot section, thereby leaving uncovered the arch section, and is formed in the rear foot section in a U-shape, with a central section cut out between a medial side and a lateral side of the foot; the midsole is exposed in the arch section and the central section of the rear foot section; a diagonal groove is formed in the midsole in the central section of the rear foot section and in the outsole in a lateral side section of the foot; in the rear foot section, the diagonal groove extending in a diagonal front-rear direction in the rear foot section to an outer edge of the lateral side of the foot; an angle formed by a virtual center line of the diagonal groove and a longitudinal axis is set in a range of 12° to 35°; and a virtual intersection point between the longitudinal axis and a virtual center line is arranged within a region from a rear half section to a front half section of the rear foot section.

As is well known in the art, a shoe sole is required to be light in weight, be capable of suppressing eversion of the heel area, and serve to absorb the impact on the heel area. However, these functions cannot be realized sufficiently only by forming a diagonal groove in a shoe sole. It is therefore an object of the present invention to form an appropriate diagonal groove so as to realize these functions.

The present invention in another aspect is a shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, wherein:

in a central section and a lateral side section of a rear foot section of the shoe sole, a diagonal groove is formed extending in a diagonal front-rear direction in the rear foot section to an outer edge of a lateral side of the rear foot section, an angle formed by a virtual center line of the diagonal groove and a longitudinal axis of the arch section is diagonally inclined from the shape of the sole.

The present invention in another aspect is a shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, wherein:

the outsole is divided into pieces arranged in the front foot section and in the rear foot section, thereby leaving uncovered the arch section, and is formed in the rear foot section in a U-shape, with a central section cut out between a medial side and a lateral side of the foot; the midsole is exposed in the arch section and the central section of the rear foot section; a diagonal groove is formed in the midsole in the central section of the rear foot section and in the outsole in a lateral side section of the foot; in the rear foot section, the diagonal groove extending in a diagonal front-rear direction in the rear foot section to an outer edge of the lateral side of the foot; an angle formed by a virtual center line of the diagonal groove and a longitudinal axis is set in a range of 12° to 35°; and a virtual intersection point between the longitudinal axis and a virtual center line is arranged within a region from a rear half section to a front half section of the rear foot section.

As is well known in the art, a shoe sole is required to be light in weight, be capable of suppressing eversion of the heel area, and serve to absorb the impact on the heel area. However, these functions cannot be realized sufficiently only by forming a diagonal groove in a shoe sole. It is therefore an object of the present invention to form an appropriate diagonal groove so as to realize these functions.

The present invention in another aspect is a shoe sole including: an outsole having a tread surface to be in contact with a road surface; and a midsole arranged on the outsole, wherein:

in a central section and a lateral side section of a rear foot section of the shoe sole, a diagonal groove is formed extending in a diagonal front-rear direction in the rear foot section to an outer edge of a lateral side of the rear foot section, an angle formed by a virtual center line of the diagonal groove and a longitudinal axis of the arch section is diagonally inclined from the shape of the sole.
position of the intersection point \( O \) is defined by the position in the arch section \( M \) and the rear foot section \( R \) of the shoe sole.

[0013] In the present specification, the arch section \( M \) refers to a middle foot area where the outsole \( 1 \) is absent, and the rear foot section \( R \) refers to an area posterior to the arch section \( M \).

[0014] In the present invention, the diagonal groove \( 4 \) reaches the outer periphery of the sole on the lateral posterior side. Therefore, it is believed that the compressive rigidity of the sole on the lateral posterior side lowers. While the heel contacts the ground from the lateral posterior side, it is expected that the lateral posterior side largely deforms in compressive deformation, thereby inclining the sole upper surface immediately after the heel contacts the ground, as compared with a case where the diagonal groove \( 4 \) is absent. This inclination is an inclination opposite to eversion, and therefore the angle of eversion of the heel area will be smaller as compared with a case where the diagonal groove \( 4 \) is absent.

[0015] The substantial deformation of the lateral posterior side also improves the impact-absorbing property.

[0016] The weight of the sole is reduced through the provision of the diagonal groove \( 4 \) extending along the subtalar joint axis \( A_1 \), in addition to the outsole \( 1 \) being cut out in the central section \( R_c \) and absent in the arch section \( M \).

[0017] Therefore, it is possible to suppress eversion of the heel area and improve the impact absorption for the heel area, while realizing a light weight.

[0018] Now, with the claimed arrangement of the diagonal groove \( 4 \), the diagonal groove \( 4 \) extends diagonally across the lateral side of the rear foot section of the outsole \( 1 \) having a U shape (horseshoe shape) at an angle \( \beta \) of 12° to 35°. Therefore, the length of the diagonal groove \( 4 \) is large on the lateral side of the outsole \( 1 \), which has a U shape and has a small area. That is, a long diagonal groove \( 4 \) is formed in the outsole \( 1 \), which has a U shape and has a small area. Therefore, it has a light weight, and provides the highly advantageous effect of suppressing eversion and absorbing impact.

[0019] The angle \( \beta \) should in principle be set to 23°, but with 23°, the anterior end of the diagonal groove \( 4 \) would extend toward the vicinity of the big-toe ball \( O_1 \), thereby forming the diagonal groove \( 4 \) on the medial side of the front foot section \( F \). In order to avoid this, the angle \( \beta \) may be preferably about 20° to 35°. Note that the angle \( \beta \) is defined to be less than or equal to 35°, which is 1° greater than 23°+11°=34°, taking measurement errors into consideration.

[0020] Since the outsole \( 1 \) has a U shape in which the central section \( R_c \) of the rear foot section \( R \) is cut out, the weight is reduced also because of the cutting out of the central section \( R_c \). Now, the diagonal groove \( 4 \) is formed in the midsole \( 2 \) in the central section \( R_c \). This also reduces the weight of the midsole \( 2 \) while the midsole \( 2 \) still contributes to the torsional rigidity.

BRIEF DESCRIPTION OF DRAWINGS

[0021] FIG. 1 is a perspective view showing a shoe according to an embodiment of the present invention as seen from the bottom rear side.

FIG. 2 is a perspective view showing the shoe as seen from the bottom lateral side.

FIG. 3 is a bottom view showing the shoe sole.

FIG. 4 is a bottom view showing the shoe sole.

FIG. 5 is an enlarged bottom view showing an arch section and a rear foot section of the shoe sole.

FIG. 6 is a plan view showing the foot bone structure.

FIG. 7A is a cross-sectional view taken along line VIIA-VIIA of FIG. 3, and FIG. 7B is a cross-sectional view taken along line VIIIB-VIIIB of FIG. 3.

FIGS. 8A to 8C show another embodiment, wherein FIG. 8A is a cross-sectional view showing a shoe sole in the arch section, FIG. 8B is a cross-sectional view of the shoe sole in the front half section of the rear foot section, and FIG. 8C is a cross-sectional view of the shoe sole at the posterior end of the rear foot section.

FIG. 9 is a bottom view of a shoe sole illustrating a still another embodiment.

DESCRIPTION OF EMBODIMENTS

[0022] Preferably, the diagonal groove \( 4 \) includes a front section \( 4_F \) located anterior to the intersection point \( O \), and a rear section \( 4_B \) located posterior to the intersection point \( O \); and a volume of the diagonal groove \( 4 \) in the rear section \( 4_B \) is larger than a volume of the diagonal groove \( 4 \) in the front section \( 4_F \).

[0023] Then, in the rear section \( 4_B \) where the volume of the diagonal groove \( 4 \) is large, deformation is relatively substantial, and the upper surface of the midsole \( 2 \) easily sinks, thereby making it possible to easily absorb the impact of the first strike upon landing. On the other hand, in the front section \( 4_F \) where the volume of the diagonal groove \( 4 \) is small, the upper surface of the midsole \( 2 \) less easily sinks, and the center of gravity is unlikely to remain stagnant on the medial side of the arch of the foot.

[0024] Preferably, the diagonal groove \( 4 \) does not extend to a medial edge of the shoe sole.

[0025] Then, the upper surface of the midsole \( 2 \) less easily sinks in the arch section \( M \) or the middle foot section.

[0026] Preferably, the diagonal groove \( 4 \) of the outsole \( 1 \) flares toward a diagonally posterior direction (widens in its width as it extends in a diagonally posterior direction).

[0027] Then, it is possible to easily absorb the impact of the first strike as described above, and the center of gravity is unlikely to remain stagnant on the medial side of the arch of the foot.
Preferably, the shoe sole further includes a transversal groove 5 extending in a direction perpendicular to the diagonal groove 4.

Such a transversal groove 5 will divide the outsole 1 into pieces on the lateral side of the foot, and will facilitate the deformation of the outsole 1 and the midsole 2 on the lateral side of the foot.

Preferably, the outsole 1 is divided into pieces arranged in a front foot section F and in the rear foot section R, thereby leaving uncovered an arch section M between the front foot section F and the rear foot section R; a reinforcement member 3 formed by a non-foamed body of a resin is attached on a lower surface of the midsole 2 in the arch section M; and the reinforcement member 3 has a diagonal section 31 extending generally parallel to the diagonal groove 4, and the diagonal section 31 is arranged in a vicinity of the diagonal groove 4 anterior to the diagonal groove 4.

In this case, the lowering of the arch section M due to the diagonal groove 4 in the arch section M or in the vicinity of the arch section M will be prevented by the diagonal section 31 of the reinforcement member M.

Preferably, a position of the virtual intersection point O is arranged anterior to a centroid G of the central section Rc.

With such an arrangement, the diagonal groove 4 is arranged over, or in the vicinity of, the subtalar joint axis A1.

Preferably, the diagonal groove 4 formed in the midsole 2 in the central section Rc of the rear foot section R is defined by one pair of first and second edge lines L1 and L2 which face each other; the diagonal groove 4 formed in the outsole 1 is defined by one pair of third and fourth edge lines L3 and L4 which face each other; and the third and fourth edge lines L3 and L4 are generally parallel to the first and second edge lines L1 and L2, respectively, or flare (gradually widen therebetween) to form an angle therebetween larger than an angle formed by the first and second edge lines L1 and L2.

In this case, the diagonal groove 4 of the midsole 2 and that of the outsole 1 cooperate with each other, thereby enhancing the advantageous effect of the present invention.

Preferably, the diagonal groove 4 extends to a medial side section 20 of the midsole 2 in the arch section M; and an average value of a cross-sectional area perpendicular to the center line Lc of the diagonal groove 4 in the arch section M is smaller than an average value of a cross-sectional area perpendicular to the center line Lc of the diagonal groove 4 in the central section Rc of the rear foot section R in the midsole 2.

Preferably, the diagonal groove 4 does not extend to an edge of the medial side section 20 of the midsole 2 in the arch section M; and a tip of the diagonal groove 4 is arranged posterior to an anterior end of the arch section M.

In these cases, the cross-sectional area of the diagonal groove 4 is small on the medial side of the arch section M, or the diagonal groove 4 does not extend to the medial edge of the arch section M, so that the sinking of the upper surface of the midsole is small on the medial side of the arch section M. Therefore, it is possible to suppress pronation of the foot, and to prevent the center of gravity from remaining stagnant on the medial side of the arch section M.

Preferably, the diagonal groove 4 of the outsole 1 flares toward a posterior direction (widens in its width as it extends in a posterior direction).

Preferably, the shoe sole further includes a transversal groove perpendicular to the diagonal groove 4.

Preferably, a reinforcement member 3 formed by a non-foamed body of a resin is attached to a lower surface of the midsole 2 in the arch section M; and the reinforcement member 3 has a diagonal section 31 extending generally parallel to the diagonal groove 4, and the diagonal section 31 is arranged in a vicinity of the diagonal groove 4 and anterior to the diagonal groove 4.

In this case, the lowering of the arch section M due to the diagonal groove 4 in the arch section M or in the vicinity of the arch section M will be prevented by the diagonal section 31 of the reinforcement member M.

Preferably, the diagonal section 31 extends to the front foot section F.

In this case, excessive bending of the sole is prevented, thereby enabling efficient running.

Preferably, the reinforcement member 3 further includes a lateral side section 32 extending along a lateral edge of the midsole 2 in the arch section M; and the lower surface of the midsole 2 is exposed between the lateral side section 32 and the diagonal section 31.

In this case, it is possible to reduce the weight of the reinforcement member M.

The present invention in one aspect is a shoe sole including: an outsole 1 having a tread surface to be in contact with a road surface; and a midsole 2 arranged on the outsole 1, the shoe sole supporting a foot in a front foot section F, an arch section M, and a rear foot section R, wherein:

the outsole 1 is divided into pieces arranged in the front foot section F and in the rear foot section R, thereby leaving uncovered the arch section M; a diagonal groove 4 is formed in the midsole 2 and the outsole 1, the diagonal groove 4 extending in a diagonal front-rear direction in the rear foot section R to an outer edge of a lateral side of the rear foot section R; an angle β, formed by a virtual center line Lc of the diagonal groove 4 and a longitudinal axis A2 connecting between a center of a heel and a middle point 03 between a big-toe ball 01 and a little-toe ball 05, is set in a range of 12° to 35°; a virtual intersection point O between the longitudinal
In this aspect, the lowering of the arch section M due to the diagonal groove 4 in the arch section M or in the vicinity of the arch section M will be prevented by the diagonal section 31 of the reinforcement member 3.

Preferably, the diagonal section 31 extends to the front foot section F.

In this case, excessive bending of the sole is prevented, thereby enabling efficient running.

Preferably, the reinforcement member 3 further includes a lateral side section 32 extending along a lateral side of the midsole 2 in the arch section M; and the lower surface of the midsole 2 is exposed between the lateral side section 32 and the diagonal section 31.

In this case, it is possible to reduce the weight of the reinforcement member 3.

Embodiment

The present invention will be understood more clearly from the following description of preferred embodiments taken in conjunction with the accompanying drawings. Note however that the embodiments and the drawings are merely illustrative, and should not be relied upon in defining the scope of the present invention. The scope of the present invention shall be defined only by the appended claims. In the accompanying drawings, like reference numerals denote like components throughout the plurality of figures.

One embodiment of the present invention will now be described with reference to the appended claims. In the accompanying drawings, like reference numerals denote like components throughout the plurality of figures.

As shown in FIGS. 1 and 2, the shoe sole includes the outsole 1 and the midsole 2. Note that FIGS. 1 to 5 do not show small grooves (so called "design") formed in the tread surface of the outsole 1.

As indicated by the regular dots in FIG. 3, the outsole 1 is arranged over the front foot section F and the rear foot section R. The outsole 1 is formed by a foamed body or a non-foamed body of a rubber, for example, and has a tread surface 1s (FIG. 7A) to be in contact with the road surface. Note that in FIG. 3, the outsole 1 is shaded with regular large dots.

The midsole 2 is formed by a foamed body of a resin such as EVA, for example, and is arranged on the outsole 1, as shown in FIG. 2, for absorbing the impact upon landing. Therefore, the midsole 2 is formed to be thicker than the outsole 1.

As shown in FIGS. 1 to 3, a lower surface 2u (FIG. 7A) of the midsole 2 is provided with the diagonal groove 4 and the transversal groove 5 to be described later, and with the outsole 1 divided into a plurality of parts. As shown in these figures, the midsole 2 may be exposed in the central section Rc of the rear foot section R and/or the arch section M.

As clearly shown in FIG. 3, the outsole 1 is divided into pieces arranged in the front foot section F and in the rear foot section R, thereby leaving uncovered the arch section M, and is formed in the rear foot section R in a U shape in which the central section Rc is cut out. That is, in the central section Rc of the rear foot section R, the outsole 1 is not provided on the surface of the midsole 2.

Here, "a U shape in which the central section Rc of the outsole 1 is cut out" includes arrangements where the outsole 1 is divided into a plurality of parts in the rear foot section R by a plurality of diagonal and transversal grooves 4 and 5, and further means that the outsole 1 is absent in the central section Rc and that the outsole 1 at the anterior end of the rear foot section R is divided into medial and lateral pieces by the diagonal groove 4.

Note that in the elliptical area of the central section Rc, the midsole 2 may be slightly dented.

In FIGS. 1 to 3, the bottom surfaces of the diagonal groove 4 and the transversal groove 5 are shaded with irregular, fine dots.

In the medial side section 20 of the arch section M of the midsole 2, the central section Rc of the rear foot section R of the midsole 2, and the lateral side section 11 of the outsole 1, the diagonal groove 4 extends in a diagonal front-rear direction from the medial edge on the medial side IN of the arch section M to the lateral edge on the lateral side OUT of the rear foot section R.

The depth of the deepest portion of the diagonal groove 4 in the central section Rc is preferably about 5 mm to about 10 mm, for example, and the depth of the deepest portion of the diagonal groove 4 in the lateral side section 11 is preferably about 5 mm to about 15 mm, for example. This is because the advantageous effects such as the light weight cannot be obtained sufficiently if the depth is too small, whereas the stable foot support cannot be obtained if the depth is too large.

The width of the diagonal groove 4 in the central section Rc is preferably about 5 mm to about 15 mm, for example, except for the area of the transversal groove 5. The torsional rigidity lowers significantly if the width of the groove is too large, whereas the advantageous effects such as the light weight cannot be obtained if the width of the groove is small.

As shown in FIG. 9, the diagonal groove 4 does not need to extend to the medial edge on the medial side IN in the arch section M. Where the diagonal groove 4 does not extend to the medial side section 20 of the midsole 2 in the arch section M, the anterior end of the diagonal groove 4 may be arranged posterior to the arch
section M or the anterior end of the rear foot section R.

[0067] Referring to FIG. 6, the angle α formed between the subtalar joint axis A1 and the longitudinal axis A2 is said to be 23° ± 11°. Now, the longitudinal axis A2 is represented by a straight line connecting between the center 04 of the heel and the middle point 03 between the center of the big-toe ball 01 and the center of the little-toe ball 05.

[0068] On the other hand, the subtalar joint axis A1 is represented by a straight line connecting between the head 06 of the talus and the calcaneus lateral tubercle 07.

[0069] The diagonal groove 4 is formed along the subtalar joint axis A1. That is, in FIG. 5, the angle β formed by the longitudinal axis A2 and the virtual center line Lc of the diagonal groove 4 is set in the range of 12° to 35°, and is set to about 30° in the present embodiment, for example.

[0070] The virtual intersection point O between the center line Lc and the longitudinal axis A2 is set in a region from the rear half section of the arch section M to the front half section RF of the rear foot section R. Represented by a dimensioned proportion, the virtual intersection point O of FIG. 5 is set in a range of 21% to 43% of the full length of the longitudinal axis A2 of the shoe sole from the posterior end. The diagonal groove 4 extends anterior and medial to the intersection point O and extends posterior and lateral to the intersection point O.

[0071] In the present embodiment, the position of the virtual intersection point O is provided in the central section RC of the rear foot section R, and is arranged anterior to the centroid G of the central section RC. With such an arrangement, the diagonal groove 4 is arranged over the subtalar joint axis A1 (FIG. 6). Note that the centroid G refers to the center of the planar shape of the central section RC.

[0072] The diagonal groove 4 includes the front section 4F anterior to the intersection point O, and the rear section 4B posterior to the intersection point O. The volume Vb of the diagonal groove 4 in the rear section 4B is greater than the volume Vf of the diagonal groove 4 in the front section 4F.

[0073] Now, the volume Vb, Vf of the diagonal groove 4 is the cross-sectional area of the diagonal groove 4 multiplied by the length of the diagonal groove 4 across the corresponding section. Therefore, the diagonal groove 4 in the arch section M is shallow, for example, and the average value of the cross-sectional area perpendicular to the center line Lc is as shown in FIGS. 8A to 8C, where the average value of the cross-sectional area of the diagonal groove 4 in the arch section M is smaller than the average value of the cross-sectional area of the diagonal groove 4 in the central section RC of the rear foot section R of the midsole 2.

[0074] In the present embodiment, the depth of the diagonal groove 4 in the arch section M of FIG. 2 gradually decreases as the groove 4 extends in the diagonally anterior direction. The cross-sectional area of the diagonal groove 4 may be largest in the central section RC of the rear foot section R of FIG. 7A, and the cross-sectional area of the diagonal groove 4 may be slightly smaller in a rear portion of the rear foot section R of FIG. 7B.

[0075] In FIG. 5, the diagonal groove 4 formed in the central section RC of the rear foot section R of the midsole 2 is defined by one pair of first and second edge lines L1 and L2 which are parallel to and facing each other. On the other hand, the diagonal groove 4 formed in the outsole 1 is defined by one pair of third and fourth edge lines L3 and L4 which are parallel to and facing each other.

[0076] While the third and fourth edge lines L3 and L4 are generally parallel to the first and second edge lines L1 and L2, respectively, in the present embodiment, the third and fourth edge lines L3 and L4 may be formed to flare (gradually widen in width therebetween) with an angle greater than the angle formed by the first and second edge lines L1 and L2 as shown in FIG. 9. That is, the diagonal groove 4 in the lateral side section 11 of the outsole 1 may be formed to flare toward the diagonally posterior direction.

[0077] While the transversal groove 5 of FIG. 5 extends in a direction perpendicular to the diagonal groove 4, and the transversal groove 5 is arranged so as to be perpendicular to the diagonal groove 4 in the present embodiment, the angle formed between the transversal groove 5 and the diagonal groove 4 may be set to about 70° to 90°.

[0078] The transversal groove 5 divides the outsole 1 into pieces in the medial side section 10 and in the lateral side section 11 of the U-shaped outsole 1. Note that as shown in FIG. 9, the transversal groove 5 may be formed to flare (gradually widen) in the direction from the medial side IN toward the lateral side OUT.

[0079] As indicated by the dots in FIG. 4, the reinforcement member 3 formed by a non-foamed body of a resin is attached on the lower surface of the midsole 2 in the arch section M. The reinforcement member 3 has the diagonal section 31 extending generally parallel to the diagonal groove 4, and the diagonal section 31 is arranged in the vicinity of the diagonal groove 4 and anterior to the diagonal groove 4. The diagonal section 31 may be extending from the arch section M to at least the posterior end of the front foot section F.

[0080] The reinforcement member 3 further includes the lateral side section 32 extending along the lateral side of the midsole 2 in the arch section M. An exposed section 22, which is the lower surface of the midsole 2, is exposed between the lateral side section 32 and the diagonal section 31.

[0081] A connecting section 33 is provided to bridge between the diagonal section 31 and the lateral side section 32 so as to connect between these sections 31 and 32. That is, the exposed section 22 of the midsole 2 is exposed in the area surrounded by the diagonal section 31, the lateral side section 32 and the connecting section 33.

[0082] The diagonal section 31 only needs to be arranged along the diagonal groove 4 above the diagonal groove 4, and therefore even a reinforcement member 3
A shoe sole comprising: an outsole 1 having a tread surface to be in contact with a road surface; and a midsole 2 arranged on the outsole 1, wherein:

in a central section and a lateral side section of a rear foot section R of the shoe sole, a diagonal groove 4 is formed extending in a diagonal front-rear direction in the rear foot section R to an outer edge of a lateral side of the rear foot section R;
an angle β, formed by a virtual center line Lc of the diagonal groove 4 and a longitudinal axis A2 connecting between a center O4 of a heel and a middle point O3 between a big-toe ball O1 and a little-toe ball O5, is set in a range of 12° to 35°; and

2. The shoe sole according to claim 1, wherein:

the diagonal groove 4 includes a front section 4F located anterior to the intersection point O, and a rear section 4B located posterior to the intersection point O; and

3. The shoe sole according to claim 1 or 2, wherein the diagonal groove 4 is unextended to a medial edge of the shoe sole.

4. The shoe sole according to claim 1, 2, or 3, wherein the diagonal groove 4 of the outsole 1 flares toward a diagonally posterior direction.

5. The shoe sole according to any one of claims 1 to 4, further comprising a transversal groove 5 extending in a direction perpendicular to the diagonal groove 4.

6. The shoe sole according to any one of claims 1 to 5, wherein:

the outsole 1 is divided into pieces arranged in a front foot section F and in the rear foot section R, thereby leaving uncovered an arch section M between the front foot section F and the rear foot section R; and

an reinforcement member 3 formed by a non-foamed body of a resin is attached on a lower surface of the midsole 2 in the arch section M; and

a reinforcement member 3 having a diagonal section 31 extending generally parallel to the diagonal groove 4, and the diagonal section 31 is arranged in a vicinity of the diagonal groove 4 and anterior to the diagonal groove 4.
midsole 2 arranged on the outsole 1, the shoe sole supporting a foot in a front foot section F, an arch section M, and a rear foot section R, wherein:

the outsole 1 is divided into pieces arranged in the front foot section F and in the rear foot section R, thereby leaving uncovered the arch section M, and is formed in the rear foot section R in a U shape, with a central section Rc cut out between a medial side IN and a lateral side OUT of the foot;
the midsole 2 is exposed in the arch section M and the central section Rc of the rear foot section R;
a diagonal groove 4 is formed in the midsole 2 in the central section Rc of the rear foot section R and in the outsole 1 in a lateral side section 11 of the rear foot section R, the diagonal groove 4 extending in a diagonal front-rear direction in the rear foot section R to an outer edge of the lateral side OUT of the rear foot section R;
an angle β, formed by a virtual center line Lc of the diagonal groove 4 and a longitudinal axis A2 connecting between a center 05 of a heel and a middle point 03 between a big-toe ball O1 and a little-toe ball O2, is set in a range of 12° to 35°;

9. The shoe according to claim 8, wherein:
the diagonal groove 4 formed in the midsole 2 in the central section Rc of the rear foot section R is defined by one pair of first and second edge lines L1 and L2 which face each other;
the diagonal groove 4 formed in the outsole 1 is defined by one pair of third and fourth edge lines L3 and L4 which face each other; and
the third and fourth edge lines L3 and L4 are generally parallel to the first and second edge lines L1 and L2, respectively, or flare to form an angle therebetween larger than an angle formed by the first and second edge lines L1 and L2.

10. The shoe sole according to any one of claims 7 to 9, wherein:
the diagonal groove 4 extends to a medial side section 20 of the midsole 2 in the arch section M; and

an average value of a cross-sectional area perpendicular to the center line Lc of the diagonal groove 4 in the arch section M is smaller than an average value of a cross-sectional area perpendicular to the center line Lc of the diagonal groove 4 in the central section Rc of the rear foot section R in the midsole 2.

11. The shoe sole according to any one of claims 7 to 9, wherein:
the diagonal groove 4 is unextended to an edge of the medial side section 20 of the midsole 2 in the arch section M; and
a tip of the diagonal groove 4 is arranged posterior to an anterior end of the arch section M.

12. The shoe sole according to any one of claims 7 to 11, wherein the diagonal groove 4 of the outsole 1 flares toward a diagonally posterior direction.

13. The shoe sole according to any one of claims 7 to 12, further comprising a transversal groove perpendicular to the diagonal groove 4.

14. The shoe sole according to any one of claims 7 to 13, wherein:
a reinforcement member 3 formed by a non-foamed body of a resin is attached to a lower surface of the midsole 2 in the arch section M; and
the reinforcement member 3 has a diagonal section 31 extending generally parallel to the diagonal groove 4, and the diagonal section 31 is arranged in a vicinity of the diagonal groove 4 and anterior to the diagonal groove 4.

15. The shoe sole according to claim 14, wherein: the diagonal section 31 extends to the front foot section F.

16. The shoe sole according to claim 15, wherein:
the reinforcement member 3 further includes a lateral side section 32 extending along a lateral edge of the midsole 2 in the arch section M; and
the lower surface of the midsole 2 is exposed between the lateral side section 32 and the diagonal section 31.

17. A shoe sole comprising: an outsole 1 having a tread surface to be in contact with a road surface; and a midsole 2 arranged on the outsole 1, the shoe sole supporting a foot in a front foot section F, an arch section M, and a rear foot section R, wherein:
the outsole 1 is divided into pieces arranged in
the front foot section \( \text{F} \) and in the rear foot sec-
tion \( \text{R} \), thereby leaving uncovered the arch sec-
tion \( \text{M} \);
a diagonal groove \( \text{4} \) is formed in the midsole \( \text{2} \)
and the outsole \( \text{1} \), the diagonal groove \( \text{4} \) extend-
ing in a diagonal front-rear direction in the rear
foot section \( \text{R} \) to an outer edge of a lateral side
of the rear foot section \( \text{R} \);
an angle \( \beta \), formed by a virtual center line \( \text{Lc} \) of
the diagonal groove \( \text{4} \) and a longitudinal axis \( \text{A2} \)
connecting between a center of a heel and a
middle point \( \text{03} \) between a big-toe ball \( \text{O1} \) and
a little-toe ball \( \text{05} \), is set in a range of 12° to 35°;
a virtual intersection point \( \text{O} \) between the longi-
tudinal axis \( \text{A2} \) and the center line \( \text{Lc} \) is arranged
within a region from a rear half section \( \text{Mb} \) of the
arch section \( \text{M} \) to a front half section \( \text{Rf} \) of the
rear foot section \( \text{R} \);
a reinforcement member \( \text{3} \) formed by a non-
foamed body of a resin is attached on a lower
surface of the midsole \( \text{2} \) in the arch section \( \text{M} \);
and
the reinforcement member \( \text{3} \) has a diagonal sec-
tion \( \text{31} \) extending generally parallel to the diag-
onal groove \( \text{4} \), and the diagonal section \( \text{31} \) is
arranged in a vicinity of the diagonal groove \( \text{4} \)
and anterior to the diagonal groove \( \text{4} \).

18. According to claim 17, wherein the diagonal section
\( \text{31} \) extends to the front foot section \( \text{F} \).

19. According to claim 18, wherein:

the reinforcement member \( \text{3} \) further includes a
lateral side section \( \text{32} \) extending along a lateral
side of the midsole \( \text{2} \) in the arch section \( \text{M} \); and
the lower surface of the midsole \( \text{2} \) is exposed
between the lateral side section \( \text{32} \) and the di-
agonal section \( \text{31} \).
INTERNATIONAL SEARCH REPORT

A43B13/14 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A43B13/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996
Kokai Jitsuyo Shinan Koho 1971-2012
Toroku Jitsuyo Shinan Koho 1994-2012

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>JP 2002-262903 A (DynaGait Co., Ltd.), 17 September 2002 (17.09.2002), paragraphs [0012], [0016] to [0018]; fig. 1 to 3 (Family: none)</td>
<td>1-19</td>
</tr>
</tbody>
</table>

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
  "I." document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  "O" document relating to an oral disclosure, use, exhibition or other means of disclosure published prior to the international filing date but later than the priority date claimed
  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "&" document member of the same patent family

50 Date of the actual completion of the international search
28 May, 2012 (28.05.12)

55 Name and mailing address of the ISA/Authorized officer
Japanese Patent Office

Fax: 224-85-210 (second sheet) (July 2009)
REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description