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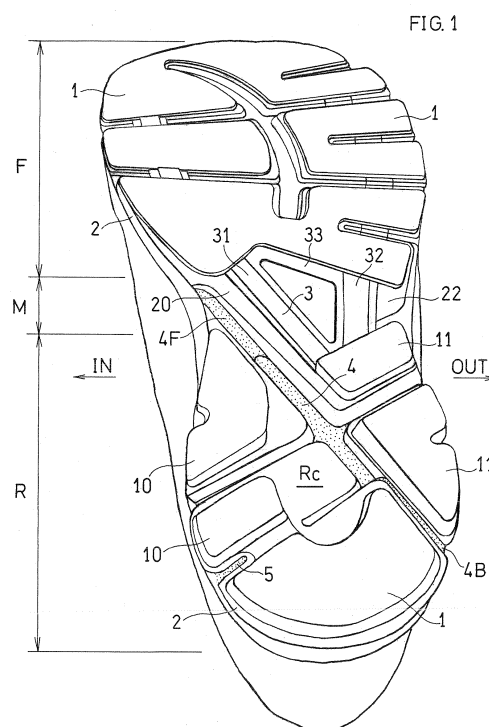
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(54) **SHOE SOLES HAVING INCLINED GROOVES**

(57) 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 β , 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.



Description

TECHNICAL FIELD

[0001] The present invention relates to a shoe sole having a diagonal groove. 5

BACKGROUND ART

[0002] Shoe soles having a diagonal groove are known in the art. (the first patent document) 10

CITATION LIST

PATENT LITERATURE 15

[0003]

First Patent Document: JP 2008-620 A (FIG. 4, FIG. 10(b)) 20

Second Patent Document: JP H07-236503 A

SUMMARY OF INVENTION

[0004] 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. 25

[0005] However, these functions cannot be realized sufficiently only by forming a diagonal groove in a shoe sole. 30

[0006] It is therefore an object of the present invention to form an appropriate diagonal groove so as to realize these functions.

[0007] 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, wherein: 35

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 04 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°; and a virtual intersection point **O** between the longitudinal axis **A2** and the center line **Lc** is set within a range of 21% to 43% of a full length of the longitudinal axis **A2** of the shoe sole from a posterior end of the shoe sole, the diagonal groove 4 extending to a point anterior and medial to the intersection point **O**. 40 45 50 55

[0008] The present invention in another 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**, 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 01 and a little-toe ball 02, is set in a range of 12° to 35°; and a virtual intersection point **O** between the longitudinal axis **A2** and the center line **Lc** is arranged within a region from a rear half section **Mb** of the arch section **M** to a front half section **Rf** of the rear foot section **R**. 30 35 40 45 50 55

[0009] Eversion of the heel area occurs as the foot is rotated (twisted) about the subtalar joint axis **A1**. The subtalar joint axis **A1** is diagonally inclined, in the horizontal plane, with respect to the anatomical longitudinal axis **A2** of the foot section. According to V.T Inman (1969), the inclination angle is 23° on average, and varies over a range of about $\pm 11^\circ$ due to individual differences. Therefore, for suppressing eversion of the heel area, it is important to keep the torsional rigidity of the sole so as to reduce the rotation about the subtalar joint axis **A1**, which is inclined by $23^\circ \pm 11^\circ$.

[0010] Typically, even if a groove is present along the torsional axis, it does not substantially change the torsional rigidity about the axis from that when such a groove is absent. Thus, in the present invention, the presence of the diagonal groove 4 does not substantially lower the rigidity about the subtalar joint axis **A1**, and maintains stability against twisting.

[0011] However, it is very difficult to identify the position of the subtalar joint axis **A1** from the shape of the sole. Therefore, according to the present invention, the invention is not defined by the subtalar joint axis **A1**, but is defined by the position of the diagonal groove 4 with respect to the sole, i.e., the position of the intersection point **O**.

[0012] That is, in one aspect, the position of the intersection point **O** is defined by the dimension from the posterior end of the shoe sole, and in another aspect, the

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 **A1**, in addition to the outsole **1** being cut out in the central section **Rc** 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 β 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 β 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 **O1**, thereby forming the diagonal groove **4** on the medial side of the front foot section **F**. In order to avoid this, the angle β may be preferably about 20° to 35° . Note that the angle β is defined to be less than or equal to 35° , which is 1° greater than $23^\circ + 11^\circ = 34^\circ$, taking measurement errors into consideration.

[0020] Since the outsole **1** has a U shape in which the central section **Rc** of the rear foot section **R** is cut out, the weight is reduced also because of the cutting out of the central section **Rc**. Now, the diagonal groove **4** is formed in the midsole **2** in the central section **Rc**. 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 one 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 a 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 VIIB-VIIB 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 still another embodiment.

DESCRIPTION OF EMBODIMENTS

[0022] Preferably, 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

a volume of the diagonal groove **4** in the rear section **4B** is larger than a volume of the diagonal groove **4** in the front section **4F**.

[0023] Then, in the rear section **4B** 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 **4F** 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.

[0028] Preferably, the shoe sole further includes a transversal groove **5** extending in a direction perpendicular to the diagonal groove **4**.

[0029] 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.

[0030] 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** and anterior to the diagonal groove **4**.

[0031] 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 **3**.

[0032] Preferably, a position of the virtual intersection point **O** is arranged anterior to a centroid **G** of the central section **Rc**.

[0033] With such an arrangement, the diagonal groove **4** is arranged over, or in the vicinity of, the subtalar joint axis **A1**.

[0034] 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**.

[0035] 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.

[0036] 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**.

[0037] 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**.

[0038] 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**.

[0039] 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).

[0040] Preferably, the shoe sole further includes a transversal groove perpendicular to the diagonal groove **4**.

[0041] 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**.

[0042] 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 **3**.

[0043] Preferably, the diagonal section **31** extends to the front foot section **F**.

[0044] In this case, excessive bending of the sole is prevented, thereby enabling efficient running.

[0045] 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**.

[0046] In this case, it is possible to reduce the weight of the reinforcement member **3**.

[0047] 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

axis **A2** and the center line **Lc** is arranged within a region from a rear half section **Mb** of the arch section **M** to a front half section **Rf** of 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** and anterior to the diagonal groove **4**.

[0048] 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**.

[0049] Preferably, the diagonal section **31** extends to the front foot section **F**.

[0050] In this case, excessive bending of the sole is prevented, thereby enabling efficient running.

[0051] 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**.

[0052] In this case, it is possible to reduce the weight of the reinforcement member **3**.

Embodiment

[0053] 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.

[0054] One embodiment of the present invention will now be described with reference to the drawings.

[0055] 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**.

[0056] 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.

[0057] 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**.

[0058] 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**.

[0059] 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**.

[0060] 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**.

[0061] Note that in the elliptical area of the central section **Rc**, the midsole **2** may be slightly dented.

[0062] In FIGS. 1 to 3, the bottom surfaces of the diagonal groove **4** and the transversal groove **5** are shaded with irregular, fine dots.

[0063] 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**.

[0064] 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.

[0065] 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.

[0066] 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 $23^\circ \pm 11^\circ$. 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 dimensional 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 about 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**

that covers generally the entire area of the arch section **M**, as shown in FIG. 9, has a diagonal section **31**.

[0083] While preferred embodiments have been described above with reference to the drawings, various obvious changes and modifications will readily occur to those skilled in the art upon reading the present specification.

[0084] For example, the outsole **1** may be provided generally over the entire length from the front foot section **F** to the rear foot section **R** and across the entire area thereof. Moreover, in the arch section **M** or the rear foot section **R**, the midsole **2** may not be exposed. The reinforcement member **3** and the transversal groove **5** may be absent.

[0085] Thus, such changes and modifications are deemed to fall within the scope of the present invention, which is defined by the appended claims.

INDUSTRIAL APPLICABILITY

[0086] The present invention is applicable to various athletic shoes such as for running.

REFERENCE SIGNS LIST

[0087]

1: Outsole 1s: Tread surface 10: Medial side section
11: Lateral side section
2: Midsole 2u: Lower surface 20: Medial side section
22: Exposed section
3: Reinforcement member 31: Diagonal section 32:
Lateral side section 33: Connecting section
4: Diagonal groove 4F: Front section 4B: Rear section
5: Transversal groove
A1: Subtalar joint axis **A2**: Longitudinal axis
Lc: Center line **L1** to **L4**: First to fourth lines
F: Front foot section
R: Rear foot section **Rc**: Central section Rf: Front
half section
M: Arch section Mb: Rear half section
O: Intersection point
O1: Big-toe ball **O2**: little-toe ball
IN: Medial side OUT: Lateral side
 α , β : Angle

Claims

1. 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

a virtual intersection point **O** between the longitudinal axis **A2** and the center line **Lc** is set within a range of 21% to 43% of a full length of the longitudinal axis **A2** of the shoe sole from a posterior end of the shoe sole, extending to a point anterior and medial to the intersection point **O**.

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

a volume of the diagonal groove **4** in the rear section **4B** is larger than a volume of the diagonal groove **4** in the front section **4F**.

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**;

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** and anterior to the diagonal groove **4**.

7. 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 **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 **01** and a little-toe ball **02**, is set in a range of 12° to 35° ; and
- a virtual intersection point **O** between the longitudinal axis **A2** and the center line **Lc** is arranged within a region from a rear half section **Mb** of the arch section **M** to a front half section **Rf** of the rear foot section **R**.
8. The shoe according to claim 7, wherein a position of the virtual intersection point **O** is arranged anterior to a centroid **G** of the central section **Rc**.
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 **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 axis **A2** and the center line **Lc** is arranged within a region from a rear half section **Mb** of the arch section **M** to a front half section **Rf** of 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

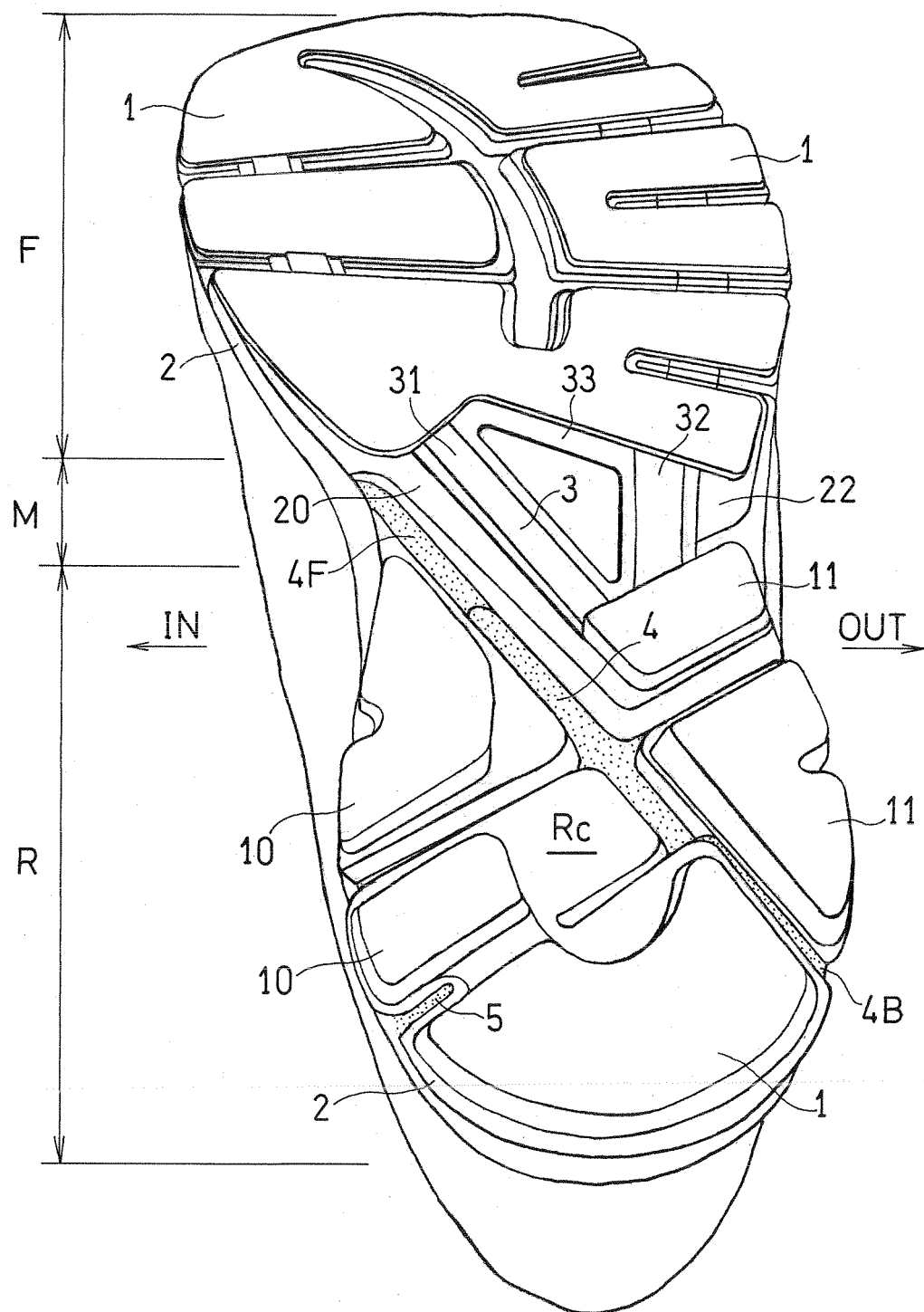
the reinforcement member **3** has a diagonal section **31** extending generally parallel to the diagonal groove **4**, and the diagonal section **31** is arranged in a vicinity of the diagonal groove **4** and anterior to the diagonal groove **4**.

18. According to claim 17, wherein the diagonal section **31** extends to the front foot section **F**.

19. According to claim 18, wherein:

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**.

FIG. 1



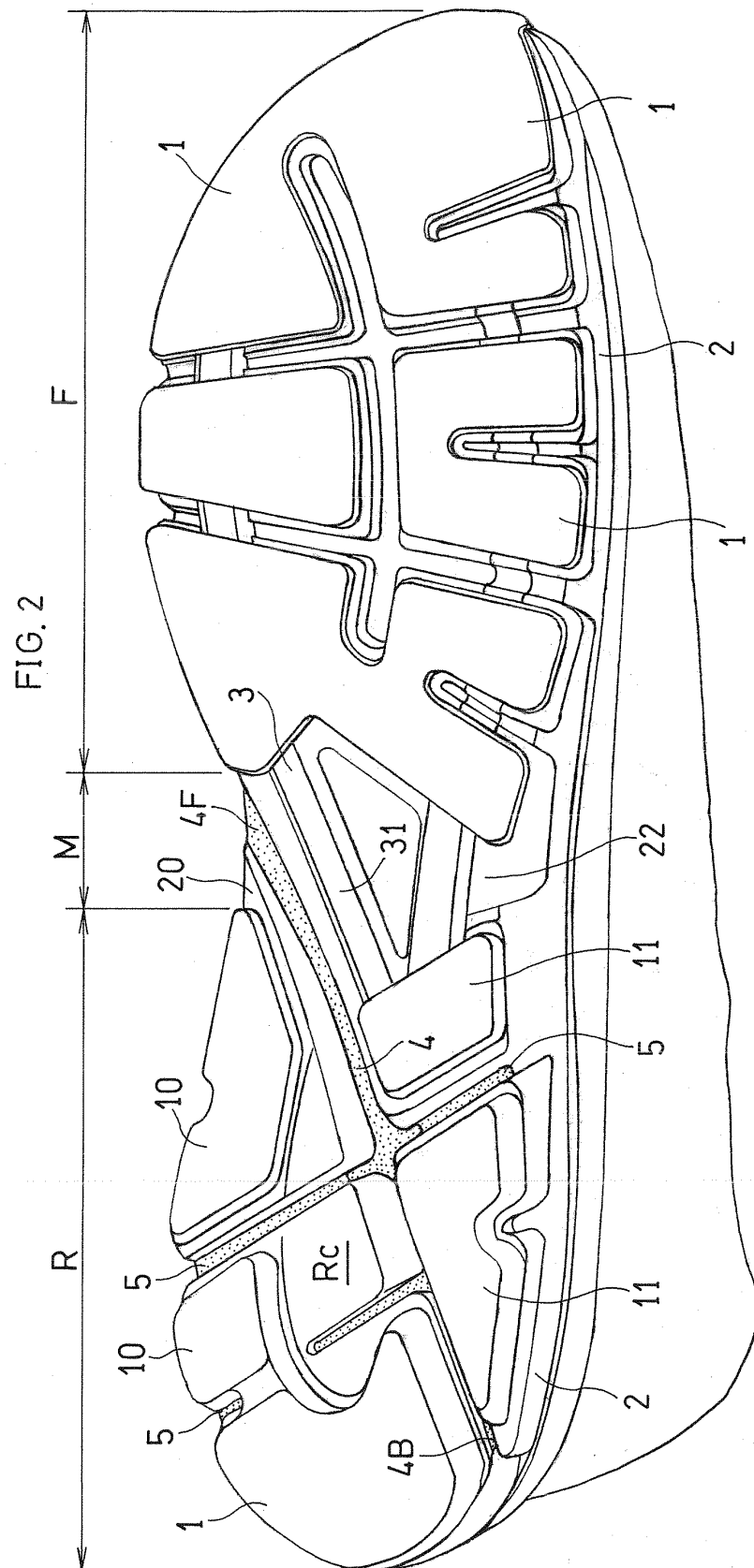


FIG. 3

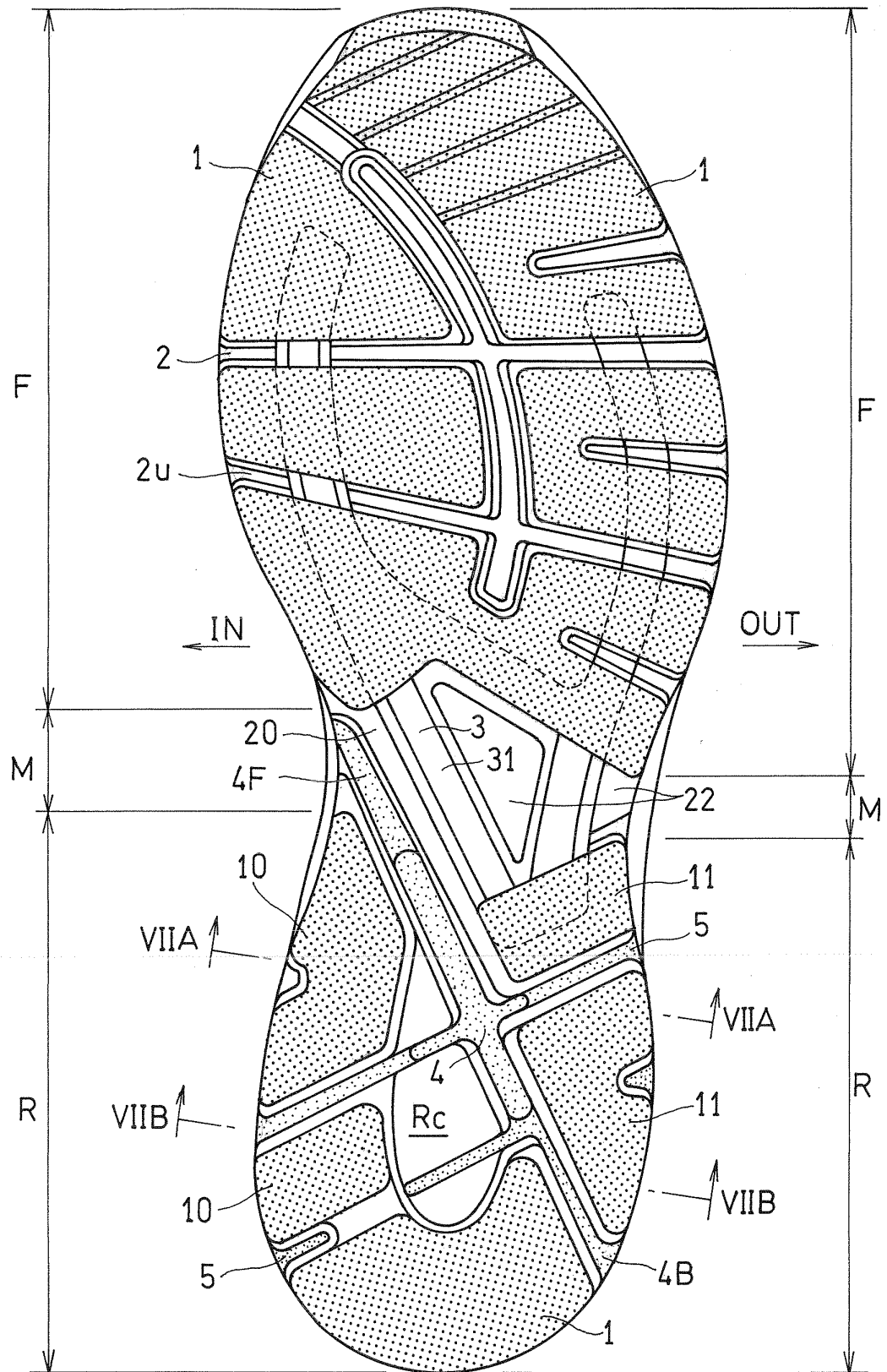


FIG. 4

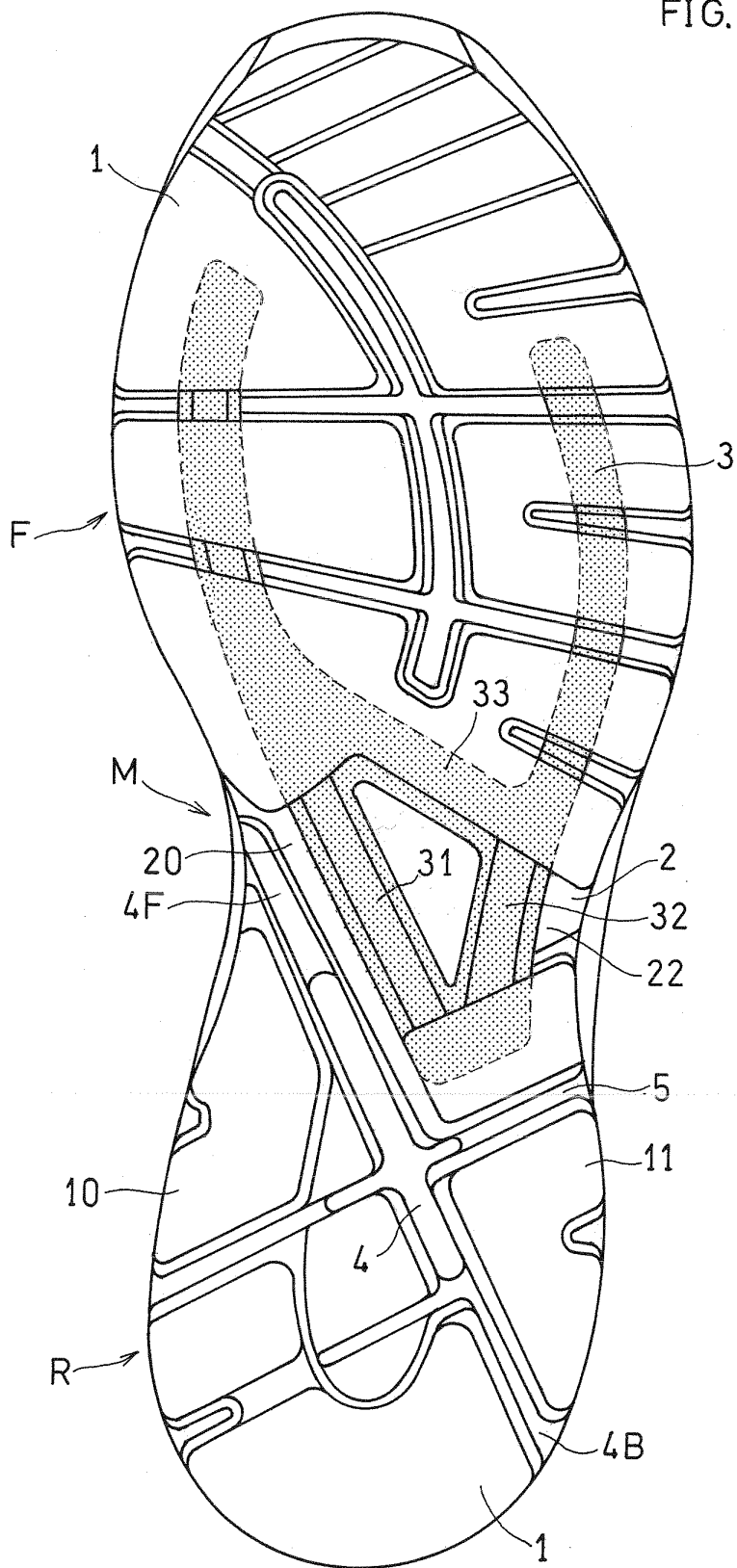


FIG. 5

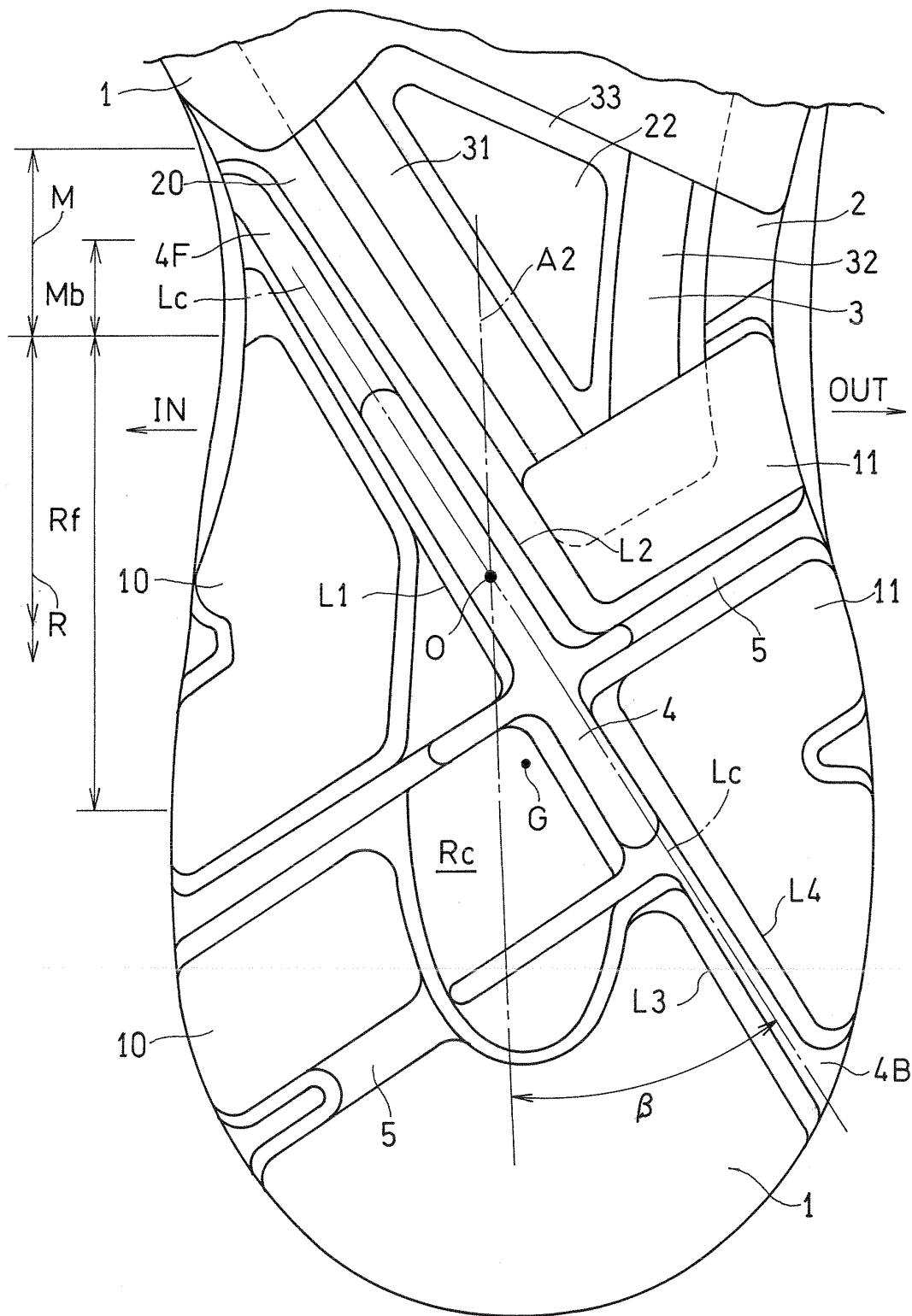


FIG. 6

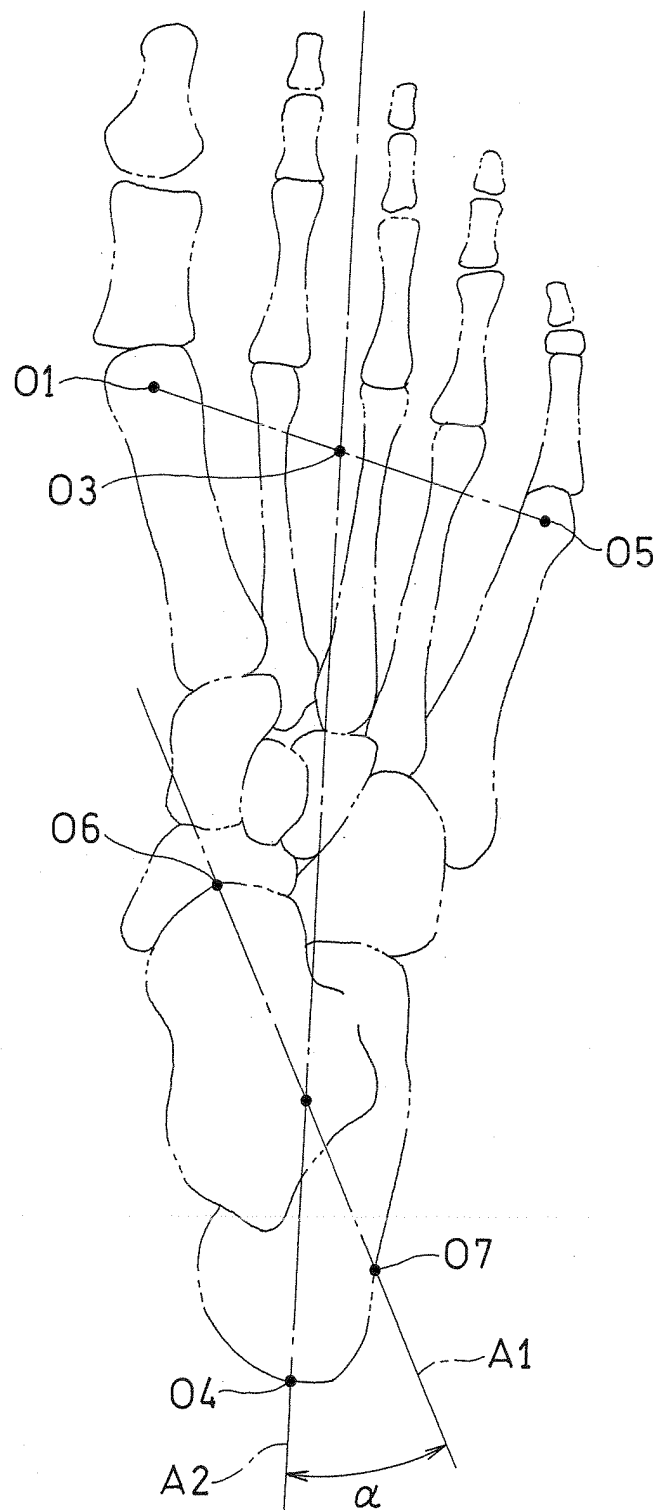


FIG.7A

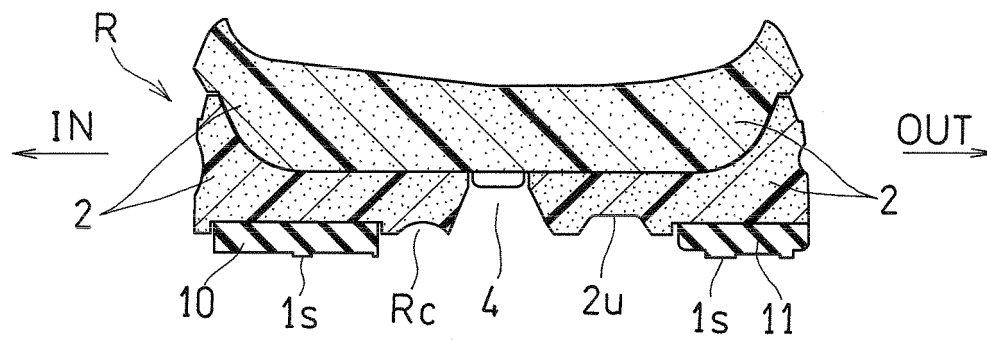


FIG.7B

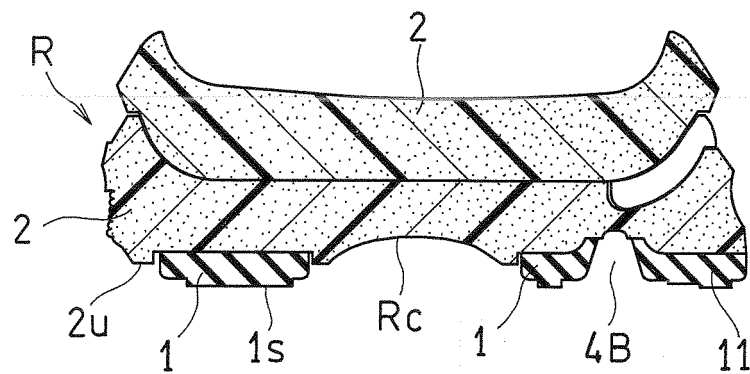


FIG.8A

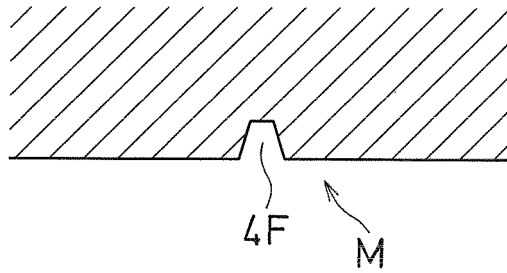


FIG.8B

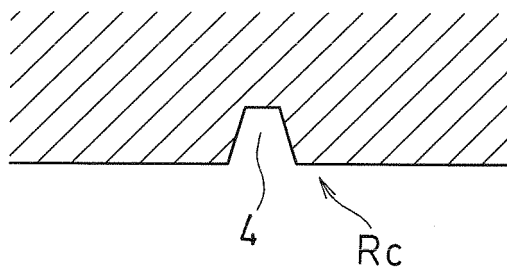


FIG.8C

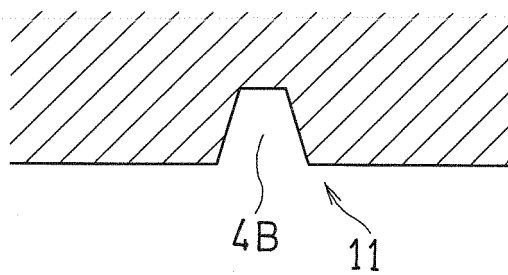
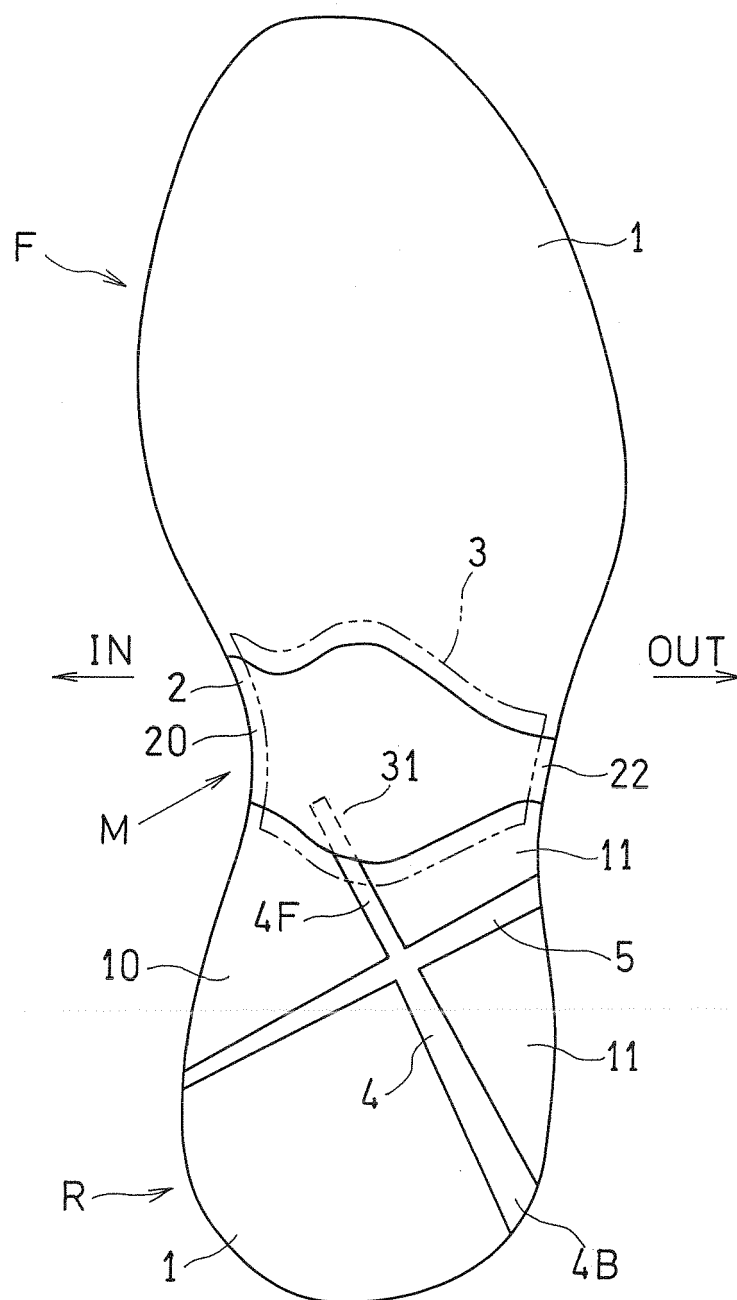


FIG.9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/062010

A. CLASSIFICATION OF SUBJECT MATTER
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 Jitsuyo Shinan Toroku Koho 1996-2012
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

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2002-262903 A (DynaGait Co., Ltd.), 17 September 2002 (17.09.2002), paragraphs [0012], [0016] to [0018]; fig. 1 to 3 (Family: none)	1-19
A	JP 2005-095388 A (MIZUNO INC.), 14 April 2005 (14.04.2005), paragraph [0085] (Family: none)	1-19

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

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

Date of mailing of the international search report
12 June, 2012 (12.06.12)

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Patent documents cited in the description

- JP 2008000620 A [0003]
- JP H07236503 A [0003]