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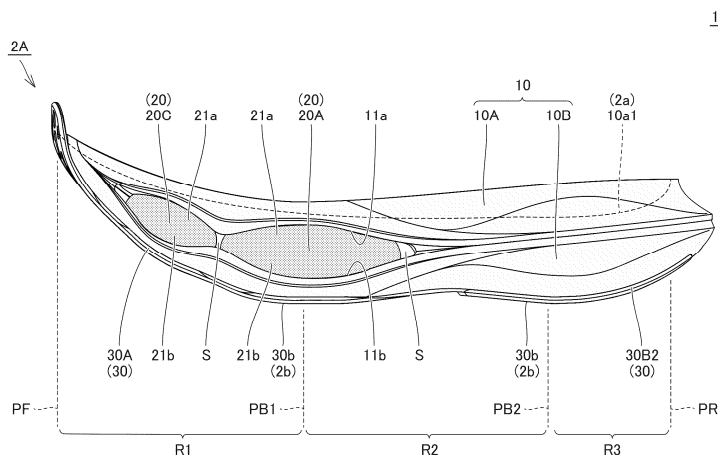
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(54) **SOLE AND SHOE PROVIDED WITH SAME**

(57) A sole (2A) has a ground contact surface (2b) and a supporting surface (2a) configured to support a bottom of a foot of a wearer, and includes a first base portion (10A) and a core portion (20). The first base portion (10A) is formed of a foam material and is formed of a layered portion having a thickness direction corresponding to an up-down direction. The core portion (20) is located on a side of the ground contact surface (2b) with respect to the first base portion (10A), and is formed of a foam material lower in hardness than the foam material

forming the first base portion (10A). Assuming that the up-down direction is defined as an axial direction, the core portion (20) has an enlarged portion having a cross-sectional area increasing in the axial direction from one to the other of a side of the supporting surface (2a) and the side of the ground contact surface (2b). At least a part of a peripheral surface of the enlarged portion is configured as an unrestrained surface that is opened without being covered by other members.

FIG.3



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Description

BACKGROUND

Technical field

[0001] The present disclosure relates to a sole and a shoe provided with the same.

Background Information

[0002] Regarding a sole provided in a shoe, in order to improve the shock absorbing performance, a sole including a foam material adjusted to have a low hardness has been conventionally widely used. A sole including a foam material adjusted to have a low hardness is disclosed, for example, in Japanese Patent Laying-Open No. 2021-105153.

SUMMARY

[0003] When a wearer's foot lands on the ground, the sole is sandwiched between the foot and the ground and thereby compressed. Then, when the foot lifts off the ground, the sole is released from the sandwiched state and thereby restored to its original shape. As compared with a foam material having a high hardness, the foam material having a low hardness undergoes a large amount of deformation when the foot lands on the ground, and also undergoes a large amount of restoration when the foot lifts off the ground. Thus, the sole including the foam material adjusted to have a low hardness not only has excellent shock absorbing performance but also has high resilience. This high resilience contributes to improvement in forward propulsive force during walking or running.

[0004] However, even the sole including a foam material adjusted to have a low hardness exhibits only a limited shock absorbing performance and resilience if this foam material is incorporated in the sole in a conventionally known manner. For example, in order to achieve high shock absorbing performance and high resilience, the thickness of the foam material adjusted to have a low hardness is increased so as to increase the amount of deformation occurring at the time of landing on the ground. Even in this case, only such a configuration achieves insufficient compression of the foam material when the foot lands on the ground, with the result that the shock absorbing performance and the resilience are not sufficiently improved.

[0005] Thus, an object of the present disclosure is to provide a sole improved in shock absorbing performance and resilience, and a shoe provided with the sole.

[0006] A sole according to one aspect of the present disclosure has a thickness direction corresponding to an up-down direction that is orthogonal to both: a front-rear direction corresponding to a foot length direction of a wearer; and a left-right direction corresponding to a foot

width direction of the wearer, and the sole has: a top surface configured as a supporting surface configured to support a bottom of a foot of the wearer; and a bottom surface configured as a ground contact surface. The sole includes a first base portion and a core portion. The first base portion has a layered shape, is formed of a foam material, and has a thickness direction corresponding to the up-down direction. The core portion is located on a side of the ground contact surface with respect to the first base portion, and is formed of a foam material lower in hardness than a foam material forming the first base portion. The up-down direction is defined as an axial direction. The core portion at least includes an enlarged portion having a cross-sectional area increasing in the axial direction from one to the other of a side of the supporting surface and a side of the ground contact surface. At least a part of a peripheral surface of the enlarged portion is configured as an unrestrained surface that is opened without being covered by other members.

[0007] A shoe according to one aspect of the present disclosure includes: the sole according to one aspect of the present disclosure; and an upper located above the sole.

[0008] The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent in view of the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a schematic perspective view of a shoe according to a first embodiment.

Fig. 2 is a schematic side view of a sole shown in Fig. 1 as viewed from a medial foot side.

Fig. 3 is a schematic side view of the sole shown in Fig. 1 as viewed from a lateral foot side.

Fig. 4 is a plan view of the sole shown in Fig. 1.

Fig. 5A is a schematic cross-sectional view taken along a line VA-VA shown in Fig. 4.

Fig. 5B is a schematic cross-sectional view taken along a line VB-VB shown in Fig. 4.

Fig. 6A is a schematic cross-sectional view taken along a line VIA-VIA shown in Fig. 4.

Fig. 6B is a schematic cross-sectional view taken along a line VIB-VIB shown in Fig. 4.

Fig. 7A is a schematic cross-sectional view taken along a line VIIA-VIIA shown in Fig. 4.

Fig. 7B is a schematic cross-sectional view taken along a line VIIB-VIIB shown in Fig. 4.

Fig. 8 is an exploded perspective view of the sole shown in Fig. 1 as viewed from one direction.

Fig. 9 is an exploded perspective view of the sole shown in Fig. 1 as viewed from another direction.

Fig. 10 is a schematic cross-sectional view showing a state of the shoe shown in Fig. 1 immediately after

the foot lands on the ground.

Fig. 11 is a schematic cross-sectional view showing a state of the shoe shown in Fig. 1 after a lapse of a prescribed time period from when the foot lands on the ground.

Fig. 12 is a schematic plan view showing a state in which a top-side midsole is imaginarily removed from the sole in the state shown in Fig. 11.

Fig. 13A is a schematic cross-sectional view showing a vicinity of a core portion of a sole according to a first modification.

Fig. 13B is a schematic cross-sectional view showing a vicinity of a core portion of a sole according to a second modification.

Fig. 14A is a schematic cross-sectional view showing a vicinity of a core portion of a sole according to a third modification.

Fig. 14B is a schematic cross-sectional view showing a vicinity of a core portion of a sole according to a fourth modification.

Fig. 15A is a schematic cross-sectional view showing a vicinity of a core portion of a sole according to a fifth modification.

Fig. 15B is a schematic cross-sectional view showing a vicinity of a core portion of a sole according to a sixth modification.

Fig. 16 is a schematic side view of a sole according to a second embodiment as viewed from a lateral foot side.

Fig. 17 is an exploded perspective view of the sole shown in Fig. 16.

Fig. 18A is a schematic cross-sectional view showing a vicinity of a core portion of a sole according to a seventh modification.

Fig. 18B is a schematic cross-sectional view showing a vicinity of a core portion of a sole according to an eighth modification.

Fig. 19 is a schematic side view of a sole according to a third embodiment as viewed from a lateral foot side.

Fig. 20 is a schematic plan view of the sole shown in Fig. 19.

Fig. 21A is a schematic cross-sectional view taken along a line XXIA-XXIA shown in Fig. 20.

Fig. 21B is a schematic cross-sectional view taken along a line XXIB-XXIB shown in Fig. 20.

Fig. 22 is an exploded perspective view of the sole shown in Fig. 19.

Fig. 23 is a schematic plan view showing a state in which a midsole is removed from the sole shown in Fig. 19.

Fig. 24 is a schematic side view of a sole according to a fourth embodiment as viewed from a lateral foot side.

Fig. 25 is a schematic plan view of the sole shown in Fig. 24.

Fig. 26A is a schematic cross-sectional view taken along a line XXVIA-XXVIA shown in Fig. 25.

Fig. 26B is a schematic cross-sectional view taken

along a line XXVIB-XXVIB shown in Fig. 25.

Fig. 27 is an exploded perspective view of the sole shown in Fig. 24.

Fig. 28 is a schematic plan view showing a state in which a top-side midsole and a top-side plate are removed from the sole shown in Fig. 24.

Fig. 29 is a schematic side view of a sole according to a fifth embodiment as viewed from a lateral foot side.

Fig. 30 is a schematic plan view of the sole shown in Fig. 29.

Fig. 31A is a schematic cross-sectional view taken along a line XXXIA-XXXIA shown in Fig. 30.

Fig. 31B is a schematic cross-sectional view taken along a line XXXIB-XXXIB shown in Fig. 30.

Fig. 32 is an exploded perspective view of the sole shown in Fig. 29.

Fig. 33 is a schematic plan view showing a state in which a top-side midsole is removed from the sole shown in Fig. 29.

Fig. 34 is a schematic side view of a sole according to a sixth embodiment as viewed from a medial foot side.

Fig. 35 is a schematic side view of the sole shown in Fig. 34 as viewed from a lateral foot side.

Fig. 36 is a schematic bottom view of the sole shown in Fig. 34.

Fig. 37 is a schematic side view of a sole according to a seventh embodiment as viewed from a lateral foot side.

Fig. 38 is a schematic perspective view showing a state in which an outsole is removed from the sole shown in Fig. 37.

Fig. 39 is a schematic cross-sectional view taken along a line XXXIX-XXXIX shown in Fig. 37.

Fig. 40 is a schematic side view of a sole according to an eighth embodiment as viewed from a lateral foot side.

Fig. 41 is a schematic perspective view of the sole shown in Fig. 40.

Fig. 42 is a schematic cross-sectional view taken along a line XLII-XLII shown in Fig. 40.

Fig. 43 is a schematic side view of a sole according to a ninth embodiment as viewed from a lateral foot side.

Fig. 44 is a schematic bottom view of the sole shown in Fig. 43.

DETAILED DESCRIPTION

[0010] Hereinafter, embodiments will be described in detail with reference to the accompanying drawings. In the embodiments described below, the same or common portions are denoted by the same reference characters in the drawings, and the description thereof will not be repeated.

<First Embodiment>

[0011] Fig. 1 is a schematic perspective view of a shoe according to the first embodiment, and Figs. 2 and 3 are schematic side views of the sole shown in Fig. 1 as viewed from the medial foot side and the lateral foot side, respectively. Fig. 4 is a plan view of the sole shown in Fig. 1, and Figs. 5A, 5B, 6A, 6B, 7A, and 7B are schematic cross-sectional views taken along lines VA-VA, VB-VB, VIA-VIA, VIB-VIB, VIIA-VIIA, and VIIB-VIIB, respectively, shown in Fig. 4. Fig. 8 is an exploded perspective view of the sole shown in Fig. 1 as viewed from one direction, and Fig. 9 is an exploded perspective view of the sole shown in Fig. 1 as viewed from another direction. First, referring to Figs. 1 to 9, the following describes configurations of a shoe 1A according to the present embodiment and a sole 2A provided in the shoe 1A.

[0012] As shown in Fig. 1, the shoe 1A includes the sole 2A and an upper 3. The sole 2A has a substantially flat shape having a thickness direction corresponding to an up-down direction, and includes: a top surface defining a supporting surface 2a (see Figs. 2 to 4 and the like) that supports a bottom of a foot of a wearer; and a bottom surface defining a ground contact surface 2b that lands on the ground during use such as walking and running. The sole 2A is a member that supports the bottom of the wearer's foot. The upper 3 is located above the sole 2A and shaped to cover the substantially entire portion extending from an ankle of the inserted wearer's foot to a distal end.

[0013] As shown in Figs. 2 to 4, the sole 2A is divided into a forefoot portion R1, a midfoot portion R2, and a rearfoot portion R3 in a front-rear direction (in a left-right direction in Figs. 2 and 3, and an up-down direction in Fig. 4) that corresponds to a foot length direction of the wearer's foot in a plan view. The forefoot portion R1 supports a toe portion and a ball portion of the wearer's foot, the midfoot portion R2 supports an arch portion of the wearer's foot, and the rearfoot portion R3 supports a heel portion of the wearer's foot.

[0014] In this case, with reference to a front-side end position PF of the supporting surface 2a of the sole 2A, a first boundary position PB1 is defined at a position located at 40% of the dimension of the supporting surface 2a of the sole 2A from the front-side end position PF in the front-rear direction, and a second boundary position PB2 is defined at a position located at 80% of the dimension of the supporting surface 2a of the sole 2A from the front-side end position PF in the front-rear direction. In this case, the forefoot portion R1 corresponds to a portion included between the front-side end position PF and the first boundary position PB1 in the front-rear direction, the midfoot portion R2 corresponds to a portion included between the first boundary position PB1 and the second boundary position PB2 in the front-rear direction, and the rearfoot portion R3 corresponds to a portion included between the second boundary position PB2 and the rear-side end position PR of the supporting surface 2a

of the sole 2A in the front-rear direction.

[0015] Further, as shown in Fig. 4, the sole 2A is divided into a medial foot-side portion (a portion on the S1 side shown in the figure) and a lateral foot-side portion (a portion on the S2 side shown in the figure) in the left-right direction corresponding to a foot width direction of the wearer's foot (in the left-right direction in the figure) when viewed in a plan view. In this case, the medial foot-side portion corresponds to the medial side of the foot in anatomical position (i.e., the side close to the midline) and the lateral foot-side portion is opposite to the medial side of the foot in anatomical position (i.e., the side away from the midline).

[0016] In this case, a boundary line that divides the sole 2A into the medial foot-side portion and the lateral foot-side portion is what is called a shoe center SC. The shoe center SC is an imaginary straight line obtained by projecting a straight line onto the sole 2A in the up-down direction in the state in which a standard wearer having a foot size suitable for the shoe 1A wears the shoe 1A, the straight line connecting a central portion of a calcaneus bone (what is called a heel center (the heel center is indicated by a reference character "HC" in Figs. 4 and the like)) to a portion between the first toe and the second toe of this standard wearer. The front-side end position PF and the rear-side end position PR of the supporting surface 2a of the sole 2A correspond to the end portions of the supporting surface 2a of the sole 2A that are located on the shoe center SC.

[0017] As shown in Fig. 1, the upper 3 includes an upper body 50, a shoe tongue 51, and a shoelace 52. Among them, the shoe tongue 51 and the shoelace 52 are each fixed or attached to the upper body 50.

[0018] The upper body 50 has a top portion provided with a top side opening through which the upper portion of an ankle of the wearer's foot and a part of the instep of the wearer's foot are exposed. Further, the upper body 50 has a bottom portion provided with, as one example, a bottom side opening covered by the sole 2A and, as another example, a bottom portion formed by stitching the bottom end of the upper body 50 with French seam or the like.

[0019] The shoe tongue 51 is fixed to the upper body 50 by sewing, welding, bonding, or a combination thereof so as to cover a portion of the top side opening provided in the upper body 50 through which a part of the instep of the wearer's foot is exposed. For the upper body 50 and the shoe tongue 51, for example, woven fabric, knitted fabric, nonwoven fabric, synthetic leather, resin, or the like may be used. For shoes particularly required to be air permeable and lightweight, a double raschel warp knitted fabric with a polyester yarn knitted therein may be used.

[0020] The shoelace 52 is formed of a member in the form of a string for pulling together, in the left-right direction, portions of a peripheral edge of the upper body 50 defining a portion of the top side opening that is covered by the shoe tongue 51. The shoelace 52 is passed through a plurality of holes provided along the peripheral

edge of the upper body 50. When the shoelace 52 is tightened in the state in which the wearer's foot is inserted into the upper body 50, the upper body 50 can be brought into close contact with the foot.

[0021] As shown in Figs. 1 to 9, the sole 2A includes a midsole 10, a core portion 20, and an outsole 30. The midsole 10 includes a top-side midsole 10A and a bottom-side midsole 10B, and the core portion 20 includes a first core portion 20A, a second core portion 20B, and a third core portion 20C. The outsole 30 includes a front-side outsole 30A and a pair of rear-side outsides 30B1 and 30B2.

[0022] Herein, in order to facilitate understanding, in Figs. 1 to 9 excluding Figs. 5A to 7B, the midsole 10 is shown in light color and the core portion 20 is shown in dark color (the same also applies to Fig. 12 described later).

[0023] The midsole 10 is a portion serving as a base of the sole 2A and is located to continuously extend from the forefoot portion R1 through the midfoot portion R2 to the rearfoot portion R3. The core portion 20 is disposed at a prescribed position inside the midsole 10, and the outsole 30 is disposed to extend substantially over the entire bottom surface of the midsole 10.

[0024] As shown in Figs. 1 to 9, the midsole 10 has a substantially flat plate shape and is configured to be relatively thicker than the outsole 30. The midsole 10 includes the top-side midsole 10A as a first base portion and the bottom-side midsole 10B as a second base portion. The top-side midsole 10A is located in a top-side portion of the sole 2A, and the bottom-side midsole 10B is located in a bottom-side portion of the sole 2A.

[0025] Referring particularly to Figs. 8 and 9, the top-side midsole 10A includes a top surface 10a1 and a bottom surface 10b1, and the bottom-side midsole 10B includes a top surface 10a2 and a bottom surface 10b2. The midsole 10 is formed by bonding the bottom surface 10b1 of the top-side midsole 10A at a prescribed position and the top surface 10a2 of the bottom-side midsole 10B at a prescribed position by adhesion or the like. Thereby, the top surface 10a1 of the top-side midsole 10A defines the above-mentioned supporting surface 2a of the sole 2A. The supporting surface 2a of the sole 2A is entirely or partially bonded to the upper body 50, for example, by adhesion or the like, so that the sole 2A is fixed to the upper 3 (see Fig. 1).

[0026] The top surface 10a1 of the top-side midsole 10A has a peripheral edge shaped to protrude more than the surrounding area. Thereby, the top surface 10a1 of the top-side midsole 10A is provided with a recessed portion in which the upper 3 is received. The portion of the top surface 10a1 of the top-side midsole 10A that excludes the above-mentioned peripheral edge, i.e., the bottom surface of this recessed portion, has a smooth curved surface so as to be fitted to the bottom of the wearer's foot.

[0027] In this case, as shown particularly in Figs. 2 and 3, a recessed portion 11a is provided in the bottom sur-

face 10b1 of the top-side midsole 10A, and a recessed portion 11b is provided in a portion of the top surface 10a2 of the bottom-side midsole 10B that corresponds to the portion in which the recessed portion 11a is provided. Thereby, at a prescribed position of the sole 2A, a gap is provided due to a configuration in which the top-side midsole 10A and the bottom-side midsole 10B are not bonded to each other but face each other at a prescribed distance therebetween. The core portion 20 is to be disposed in this gap, which will be described later in detail.

[0028] It is preferable that the midsole 10, i.e., the top-side midsole 10A and the bottom-side midsole 10B in the present embodiment, is excellent in shock absorbing performance and resilience while having appropriate strength. From this viewpoint, the midsole 10 is formed of a foam material of a polymer composition. The polymer composition contains a base polymer. Further, the polymer composition may further contain one or more selected from: a foaming agent, an inorganic filler, a cross-linking agent, and a crosslinking aid.

[0029] The base polymer is not particularly limited, and examples thereof applicable herein include resins, thermoplastic elastomers, and various types of rubbers.

[0030] The resins are not particularly limited, and examples thereof applicable herein include an ethylene-vinyl acetate copolymer (EVA), an ethylene- α -olefin block copolymer (OBC), an ethylene- α -olefin random copolymer (POE), and the like. These base polymers may be used alone or in combination of two or more types thereof.

[0031] The thermoplastic elastomers are not particularly limited, and examples thereof applicable herein include a styrene-based thermoplastic elastomer (TPS), a urethane-based thermoplastic elastomer (TPU), an olefin-based thermoplastic elastomer (TPO), and the like. These base polymers may be used alone or in combination of two or more types thereof.

[0032] The rubbers are not particularly limited, and examples thereof applicable herein include a natural rubber (NR), a nitrile rubber (NBR), an ethylene propylene diene rubber (EPDM), a urethane rubber (PU), a silicone rubber, and fluorine rubber, and the like. These base polymers may be used alone or in combination of two or more types thereof.

[0033] Examples of the foaming agent applicable herein include an organic thermal decomposition foaming agent, an inorganic thermal decomposition foaming agent, an organic foaming agent, an inorganic foaming agent, and the like.

[0034] Examples of the organic thermal decomposition foaming agent include: azo compounds such as azodicarbonamide (ADCA), 1,1'-azobis(1-acetoxy-1-phenylethane), dimethyl-2,2'-azobisbutyrate, dimethyl-2,2'-azobisisobutyrate, 2,2'-azobis(2,4,4-trimethylpentane), 1,1'-azobis(cyclohexane-1-carbonitrile), 2,2'-azobis[N-(2-carboxyethyl)-2-methyl-propionamidine]; nitroso compounds such as N,N'-dinitrosopentamethylenetetra-

mine (DPT); hydrazine derivatives such as 4,4'-oxy-bis(benzenesulfonylhydrazide) and diphenylsulfone-3,3'-disulfonylhydrazide; semicarbazide compounds such as p-toluenesulfonyl semicarbazide; trihydrazinotriazine; and the like.

[0035] Examples of the inorganic thermal decomposition foaming agent applicable herein include: bicarbonates such as sodium hydrogencarbonate and ammonium hydrogencarbonate; carbonates such as sodium carbonate and ammonium carbonate; nitrites such as ammonium nitrite; hydrogen compounds; and the like.

[0036] When the foaming agent is the thermal decomposition foaming agent as described above, the polymer composition may contain, for example, a foaming aid such as: a metal oxide-based foaming aid of zinc oxide or the like; a urea-based foaming aid; a salicylic acid-based foaming aid; and a benzoic acid-based foaming aid.

[0037] Examples of the organic foaming agent applicable herein include various aliphatic hydrocarbons such as methanol, ethanol, propane, butane, pentane, and hexane.

[0038] Examples of the inorganic foaming agent applicable herein include air, carbon dioxide, nitrogen, argon, water, and the like.

[0039] Examples of the inorganic filler applicable herein include silica particles, alumina particles, talc particles, clay particles, calcium carbonate particles, magnesium carbonate particles, aluminum hydroxide particles, magnesium hydroxide particles, and the like. These inorganic fillers may be used alone or in combination of two or more types thereof.

[0040] Examples of the crosslinking agent applicable herein include organic peroxides such as dicumyl peroxide, di-t-butyl peroxide, 2,5-dimethyl-2,5-di-(t-butylperoxy)hexane, 2,5-dimethyl-2,5-di-(t-butylperoxy)hexyne-3, 1,3-bis(t-butylperoxyisopropyl)benzene, 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane, n-butyl-4,4-bis(t-butylperoxy)valerate, benzoyl peroxide, p-chlorobenzoyl peroxide, 2,4-dichlorobenzoyl peroxide, t-butyl peroxybenzoate, t-butyl peroxyisopropyl carbonate, diacetyl peroxide, lauroyl peroxide, and t-butyl cumyl peroxide.

[0041] Examples of the crosslinking aid applicable herein include divinylbenzene, trimethylolpropane trimethacrylate, 1,6-hexanediol methacrylate, 1,9-nonanediol dimethacrylate, 1,10-decanediol dimethacrylate, trimellitic acid triallyl ester, triallyl cyanurate (TAC), triallyl isocyanurate (TAIC), neopentyl glycol dimethacrylate, 1,2,4-benzenetricarboxylic acid triallyl ester, tricyclodecane dimethacrylate, polyethylene glycol diacrylate, and the like.

[0042] When forming a foam mentioned above, the contents of the foaming agent, the crosslinking agent, and the like contained in the polymer composition should only be adjusted as appropriate according to the foaming ratio, the degree of crosslinking, and the like required for the foam material.

[0043] The polymer composition may further include a fiber reinforced material such as carbon fibers and glass fibers.

[0044] Thereby, the midsole 10 is substantially formed of a soft member having a low Young's modulus. Thus, when receiving a compressive load, the midsole 10 is elastically deformed relatively easily, so that the midsole 10 has excellent shock absorbing performance and resilience.

[0045] The top-side midsole 10A and the bottom-side midsole 10B constituting the midsole 10 may be formed of the same material or may be formed of different materials.

[0046] As shown in Figs. 1 to 3 and Figs. 5A to 9, the outsole 30 has a substantially flat plate shape and is configured to be relatively thinner than the midsole 10. The outsole 30 is attached to the bottom surface of the midsole 10 (more specifically, the bottom surface 10b2 of the bottom-side midsole 10B) and has a substantially flat plate shape. In the present embodiment, the outsole 30 includes the front-side outsole 30A and a pair of the rear-side outsides 30B 1 and 30B2. The rear-side outsole 30B 1 is disposed in the medial foot-side portion of the sole 2A, and the rear-side outsole 30B2 is disposed in the lateral foot-side portion of the sole 2A. Note that the outsole 30 does not need to be divided into a plurality of parts, but may be formed of a single member.

[0047] Referring particularly to Figs. 8 and 9, the outsole 30 includes a top surface 30a and a bottom surface 30b that defines the ground contact surface 2b of the sole 2A described above. In order to improve the grip performance, the bottom surface 30b of the outsole 30 may be provided with holes or irregularities so as to have a tread pattern. The top surface 30a of the outsole 30 is bonded to the bottom surface 10b2 of the bottom-side midsole 10B, for example, by adhesion or the like.

[0048] The outsole 30 is preferably excellent in wear resistance and grip performance. From this viewpoint, the outsole 30 is formed using a member, for example, made of a material containing: a rubber material as a main component; and a plasticizer, a reinforcing agent, and a cross-linking agent as subcomponents. As the rubber material, for example, butadiene rubber can be suitably used.

[0049] Thereby, the outsole 30 is substantially formed of a hard member having a high Young's modulus. In other words, the outsole 30 is formed of a member higher in hardness than the midsole 10 and the core portion 20. Thus, the outsole 30 is excellent in durability such as wear resistance.

[0050] As shown in Figs. 1 to 4, 5B, 6B, 8, and 9, the core portion 20 includes the first core portion 20A, the second core portion 20B, and the third core portion 20C, each of which is formed in a flat and substantially ball-like shape. The first core portion 20A, the second core portion 20B, and the third core portion 20C are held by the top-side midsole 10A and the bottom-side midsole 10B in the state in which these core portions are sandwiched be-

tween the top-side midsole 10A and the bottom-side midsole 10B.

[0051] More specifically, the bottom surface 10b1 of the top-side midsole 10A is provided with the recessed portion 11a extending from a portion of the forefoot portion R1 that is close to its front end to a substantially central portion of the midfoot portion R2 in the front-rear direction, and the top surface 10a2 of the bottom-side midsole 10B is provided with the recessed portion 11b extending from a portion of the forefoot portion R1 that is close to its front end to a substantially central portion of the midfoot portion R2 in the front-rear direction. Thereby, in the front-side portion of the midsole 10, a gap is provided due to a configuration in which the top-side midsole 10A and the bottom-side midsole 10B are not bonded to each other but are located at a prescribed distance therebetween. This gap is included in a portion of the sole 2A that supports the toe portion of the wearer's foot and a portion of the sole 2A that supports the MP joint of the wearer's foot.

[0052] As shown particularly in Fig. 4, the first core portion 20A is disposed in a portion of the sole 2A that supports the MP joint of the wearer's foot (Fig. 4 shows a one-dot chain line indicating a portion in which the MP joint is located when the wearer is wearing the shoe, and this portion is indicated as a reference character MP). More specifically, the first core portion 20A is located so as to extend from a medial foot-side edge portion to a lateral foot-side edge portion of the sole 2A in the left-right direction, and end portions of the first core portion 20A in the left-right direction protrude outward from the sole 2A. Further, the first core portion 20A is located so as to extend in the front-rear direction from a portion of the forefoot portion R1 that is close to its rear end to a portion of the midfoot portion R2 that is close to its front end. Thus, the first core portion 20A is disposed so as to encompass the portion of the sole 2A that supports the MP joint of the wearer's foot and the vicinity of this portion.

[0053] Further, the second core portion 20B and the third core portion 20C are disposed in a portion of the sole 2A that supports the toe portion of the wearer's foot. More specifically, the second core portion 20B is located in a portion of the forefoot portion R1 on the medial foot side in a substantially central portion in the front-rear direction, and a medial foot-side end portion of this portion protrudes outward from the sole 2A. The portion in which the second core portion 20B is disposed substantially corresponds to a portion of the sole 2A that supports the first toe of the wearer's foot. On the other hand, the third core portion 20C is located in a portion of the forefoot portion R1 on the lateral foot side in a substantially central portion in the front-rear direction, and a lateral foot-side end portion of this portion protrudes outward from the sole 2A. The portion in which the third core portion 20C is disposed substantially corresponds to a portion of the sole 2A that supports the second toe, the third toe, the fourth toe, and the fifth toe of the wearer's foot.

[0054] Thus, in a front-side portion of the sole 2A in an

area in which the top-side midsole 10A and the bottom-side midsole 10B face each other, a gap is provided between these midsoles. Then, the first core portion 20A, the second core portion 20B, and the third core portion 20C are disposed in the gap. Further, in an area in which the top-side midsole 10A and the bottom-side midsole 10B face each other and no gap is provided therebetween, the top-side midsole 10A and the bottom-side midsole 10B are bonded to each other. Thereby, the sole 2A having a cross-sectional shape as shown in Figs. 5A to 7C is formed.

[0055] In other words, the sole 2A has a configuration in which the top-side midsole 10A and the bottom-side midsole 10B are directly bonded to each other at the positions indicated by the lines VA-VA, VIIA-VIIA, and VIIB-VIIB in Fig. 4 and in the vicinities of the respective positions (i.e., in a portion of the forefoot portion R1 that is close to its front end, and a portion extending from a substantially central portion of the midfoot portion R2 in the front-rear direction to a portion of the rearfoot portion R3 that is close to its rear end). Further, the sole 2A has a configuration in which the second core portion 20B and the third core portion 20C are sandwiched and held between the top-side midsole 10A and the bottom-side midsole 10B at the position indicated by the line VB-VB in Fig. 4 and in the vicinity of this position (i.e., in the substantially central portion of the forefoot portion R1 in the front-rear direction).

[0056] Further, the sole 2A has a configuration in which the first core portion 20A is sandwiched and held between the top-side midsole 10A and the bottom-side midsole 10B at the position indicated by the line VIB-VIB in Fig. 4 and in the vicinity of this position (i.e., in an area extending from a portion of the forefoot portion R1 that is close to its rear end to a portion of the midfoot portion R2 that is close to its front end). Further, the sole 2A has a configuration in which a gap is provided between the top-side midsole 10A and the bottom-side midsole 10B at the position indicated by the line VIA-VIA in Fig. 4 and in the vicinity of this position (i.e., between a substantially central portion of the forefoot portion and a portion of the forefoot portion that is close to its rear end in the front-rear direction). Although not shown in the cross-sectional view, the sole 2A has a configuration in which a gap is provided between the top-side midsole 10A and the bottom-side midsole 10B also in a part of the portion of the sole 2A that is close to its front end, and has a configuration in which a gap is provided between the top-side midsole 10A and the bottom-side midsole 10B also between a portion of the midfoot portion R2 of the sole 2A that is close to its front end and a substantially central portion of the midfoot portion R2 in the front-rear direction.

[0057] In this case, each of the portion of the top-side midsole 10A in which the recessed portion 11a is provided and the portion of the bottom-side midsole 10B in which the recessed portion 11b is provided has a layered shape whose thickness direction corresponds to the up-down direction. Thus, the first core portion 20A, the

second core portion 20B, and the third core portion 20C are sandwiched between the layered portions of the top-side midsole 10A and the bottom-side midsole 10B.

[0058] On the other hand, as shown particularly in Figs. 8 and 9, each of the first core portion 20A, the second core portion 20B, and the third core portion 20C has a flat and substantially ball-like shape as described above. Thereby, as shown particularly in Figs. 3, 4, 5B, and 6B, assuming that the up-down direction of the sole 2A is defined as an axial direction, the first core portion 20A, the second core portion 20B, and the third core portion 20C each have a top-side portion including a first enlarged portion 21a whose cross-sectional area increases in the axial direction from the supporting surface 2a side to the ground contact surface 2b side, and each have a bottom-side portion including a second enlarged portion 21b whose cross-sectional area increases in the axial direction from the ground contact surface 2b side to the supporting surface 2a side.

[0059] In the present embodiment, each of the first core portion 20A, the second core portion 20B, and the third core portion 20C is configured to have a cross-sectional area continuously increasing toward the ground contact surface 2b or the supporting surface 2a in the axial direction, but this cross-sectional area does not necessarily need to continuously increase. For example, any one of the first core portion 20A, the second core portion 20B, and the third core portion 20C may have a surface with irregularities such that its cross-sectional area partially discontinuously increases. The same also applies to the following embodiments and modifications thereof.

[0060] Thus, the first enlarged portion 21a of each of the first core portion 20A, the second core portion 20B, and the third core portion 20C is located adjacent to the bottom surface 10b1 of the top-side midsole 10A, and the second enlarged portion 21b of each of the first core portion 20A, the second core portion 20B, and the third core portion 20C is located adjacent to the top surface 10a2 of the bottom-side midsole 10B.

[0061] Further, as shown particularly in Figs. 5B, 6B, and 9, a receiving portion 12a is provided in a portion of the top-side midsole 10A, the portion being provided with the recessed portion 11a and facing the first core portion 20A, the second core portion 20B, and the third core portion 20C. The receiving portion 12a has a shape corresponding to the shape of the apex and its vicinity of the first enlarged portion 21a included in each of the first core portion 20A, the second core portion 20B, and the third core portion 20C. Also, the apex and its vicinity of the first enlarged portion 21a included in each of the first core portion 20A, the second core portion 20B, and the third core portion 20C are fitted into the corresponding receiving portion 12a.

[0062] Further, as shown particularly in Figs. 5B, 6B, and 8, a receiving portion 12b is provided in a portion of the bottom-side midsole 10B, the portion being provided with the recessed portion 11b and facing the first core portion 20A, the second core portion 20B, and the third

core portion 20C. The receiving portion 12b has a shape corresponding to the shape of the apex and its vicinity of the second enlarged portion 21b included in each of the first core portion 20A, the second core portion 20B, and the third core portion 20C. Also, the apex and its vicinity of the second enlarged portion 21b included in each of the first core portion 20A, the second core portion 20B, and the third core portion 20C are fitted into the corresponding receiving portion 12b.

[0063] Thereby, each of the first core portion 20A, the second core portion 20B, and the third core portion 20C is accurately positioned and arranged with respect to the top-side midsole 10A and the bottom-side midsole 10B, and also is maintained in the state in which each of these core portions is sandwiched and held between the top-side midsole 10A and the bottom-side midsole 10B. Note that each of the first core portion 20A, the second core portion 20B, and the third core portion 20C is preferably bonded, for example, by adhesion or the like to the top-side midsole 10A and the bottom-side midsole 10B at portions of contact therebetween.

[0064] It is preferable that the core portion 20, i.e., the first core portion 20A, the second core portion 20B, and the third core portion 20C in the present embodiment, is excellent in shock absorbing performance and resilience while having appropriate strength. From this viewpoint, the core portion 20 is formed of a foam material of a polymer composition. The polymer composition contains a base polymer. Further, the polymer composition may further contain one or more selected from: a foaming agent, an inorganic filler, a crosslinking agent, and a crosslinking aid.

[0065] Herein, specific examples of the base polymer, the foaming agent, the inorganic filler, the crosslinking agent, and the crosslinking aid are the same as those of the midsole 10. In other words, the core portion 20 is made of the same materials as those of the midsole 10, and may be made of the materials that are completely the same as those of the midsole 10.

[0066] Thereby, the core portion 20 is to be substantially formed of a soft member having a low Young's modulus. Thus, when the core portion 20 receives a compressive load, it is elastically deformed relatively easily, so that the core portion 20 has excellent shock absorbing performance and resilience.

[0067] Note that the core portion 20 is formed of a foam material lower in hardness than the foam material forming the midsole 10. Herein, "low in hardness" means that one member is lower in Asker C hardness than another member. In other words, the core portion 20 is lower in Asker C hardness than the midsole 10.

[0068] "Asker C" is a measuring instrument for measuring hardness and is one of durometers (spring-type hardness meters) defined in the Society of Rubber Industry, Japan Standard (SRIS) 0101. In the present disclosure, "Asker C hardness" refers to hardness measured using an Asker C hardness meter as described above. As an Asker C hardness, an average value of

values measured at five points during the measurement is adopted.

[0069] The first core portion 20A, the second core portion 20B, and the third core portion 20C included in the core portion 20 may be formed of the same material or may be formed of different materials.

[0070] As shown in Figs. 2, 3, 5B to 6B, 8, and 9, the top-side midsole 10A and the bottom-side midsole 10B include parts holding the first core portion 20A, the second core portion 20B, and the third core portion 20C, and each of these parts has a layered shape as described above. Also, the first core portion 20A, the second core portion 20B, and the third core portion 20C each have a flat and substantially ball-like shape. Thus, a cavity S is located exclusively around each of the first core portion 20A, the second core portion 20B, and the third core portion 20C. Thereby, the peripheral surfaces of the first core portion 20A, the second core portion 20B, and the third core portion 20C are configured as unrestrained surfaces that are opened without being covered by other members.

[0071] In other words, as shown in Fig. 6B, the top surface of the first core portion 20A that is the surface in the vicinity of the apex of the first enlarged portion 21a included in the first core portion 20A is in contact with the receiving portion 12a provided in the top-side midsole 10A, and thereby, is configured as a restrained surface restrained by other members. Further, the bottom surface of the first core portion 20A that is the surface in the vicinity of the apex of the second enlarged portion 21b included in the first core portion 20A is in contact with the receiving portion 12b provided in the bottom-side midsole 10B, and thereby, is configured as a restrained surface restrained by other members.

[0072] On the other hand, the peripheral surface of the first core portion 20A excluding the top surface and the bottom surface thereof is opened without being in contact with the top-side midsole 10A and the bottom-side midsole 10B. In particular, parts of the peripheral surface of the first core portion 20A that protrude toward the outside of the sole 2A from the medial and lateral foot-side edge portions of the sole 2A in the left-right direction are opened toward the space outside the sole 2A, and the peripheral surface of the first core portion 20A excluding these parts faces the cavity S provided inside the sole 2A and thereby is opened. Thus, the entire peripheral surface of the first core portion 20A is configured as an unrestrained surface that is opened without being covered by other members.

[0073] As shown in Fig. 5B, the top surface of the second core portion 20B that is the surface in the vicinity of the apex of the first enlarged portion 21a included in the second core portion 20B is in contact with the receiving portion 12a provided in the top-side midsole 10A, and thereby, is configured as a restrained surface restrained by other members. Further, the bottom surface of the second core portion 20B that is the surface in the vicinity of the apex of the second enlarged portion 21b included in

the second core portion 20B is in contact with the receiving portion 12b provided in the bottom-side midsole 10B, and thereby, is configured as a restrained surface restrained by other members.

[0074] On the other hand, the peripheral surface of the second core portion 20B excluding the top surface and the bottom surface thereof is opened without being in contact with the top-side midsole 10A and the bottom-side midsole 10B. In particular, a part of the peripheral surface of the second core portion 20B that protrudes toward the outside of the sole 2A from the medial foot-side edge portion of the sole 2A in the left-right direction is opened toward the space outside the sole 2A, and the peripheral surface of the second core portion 20B excluding this part faces the cavity S provided inside the sole 2A and thereby is opened. Thus, the entire peripheral surface of the second core portion 20B is configured as an unrestrained surface that is opened without being covered by other members.

[0075] Further, as shown in Fig. 5B, the top surface of the third core portion 20C that is the surface in the vicinity of the apex of the first enlarged portion 21a included in the third core portion 20C is in contact with the receiving portion 12a provided in the top-side midsole 10A, and thereby, is configured as a restrained surface restrained by other members. Further, the bottom surface of the third core portion 20C that is the surface in the vicinity of the apex of the second enlarged portion 21b included in the third core portion 20C is in contact with the receiving portion 12b provided in the bottom-side midsole 10B, and thereby, is configured as a restrained surface restrained by other members.

[0076] On the other hand, the peripheral surface of the third core portion 20C excluding the top surface and the bottom surface thereof is opened without being in contact with the top-side midsole 10A and the bottom-side midsole 10B. In particular, a part of the peripheral surface of the third core portion 20C that protrudes toward the outside of the sole 2A from the lateral foot-side edge portion of the sole 2A in the left-right direction is opened toward the space outside the sole 2A, and the peripheral surface of the third core portion 20C excluding this part faces the cavity S provided inside the sole 2A and thereby is opened. Thus, the entire peripheral surface of the third core portion 20C is configured as an unrestrained surface that is opened without being covered by other members.

[0077] With such a configuration, the sole 2A according to the present embodiment and the shoe 1A provided with the same not only has high shock absorbing performance but also has high resilience, which will be hereinafter described in detail.

[0078] Fig. 10 is a schematic cross-sectional view showing the state of the shoe shown in Fig. 1 immediately after the foot lands on the ground. Further, Fig. 11 is a schematic cross-sectional view showing the state of the shoe shown in Fig. 1 after a lapse of a prescribed time period from when the foot lands on the ground, and Fig. 12 is a schematic plan view showing the state in which the

top-side midsole is imaginarily removed from the sole in the state shown in Fig. 11. Herein, the "state immediately after the foot lands on the ground" means the state immediately before the sole is compressed by the foot landing on the ground, and the "state after a lapse of a prescribed time period" from when the foot lands on the ground means the state in which the sole is compressed by the foot landing on the ground. Figs. 10 and 11 are schematic views including cross sections of the sole 2A at their different positions in the left-right direction.

[0079] As shown in Fig. 10, in the state immediately before the sole 2A is compressed by the foot landing on the ground, the sole 2A is sandwiched between a ground 100 and a foot 200 of the wearer. However, since no load has yet been applied to the sole 2A, the sole 2A does not significantly deform. After a lapse of a certain time period from this state, a load is applied to the sole 2A from the ground 100 and the foot 200 of the wearer, and thus, compressive deformation occurs in the sole 2A entirely in the up-down direction.

[0080] Fig. 11 shows outlined arrows schematically indicating the directions of displacement occurring due to the above-mentioned compressive deformation particularly in a front-side portion of the top surface 10a1 of the top-side midsole 10A (i.e., the supporting surface 2a of the sole 2A). Further, Figs. 11 and 12 each show solid arrows schematically indicating the directions of displacement occurring due to the above-mentioned compressive deformation in the first core portion 20A, the second core portion 20B, and the third core portion 20C.

[0081] As shown in Fig. 11, when a load from the foot 200 of the wearer is applied to the top surface 10a1 of the top-side midsole 10A, the front-side portion of the top surface 10a1 of the top-side midsole 10A is displaced toward the ground contact surface 2b as indicated by the outlined arrows in the figure. Further, a load is applied also to the bottom surface 10b2 of the bottom-side midsole 10B from the ground 100 through the outsole 30. However, since the ground 100 is stationary, no displacement substantially occurs in the bottom surface 10b2 of the bottom-side midsole 10B. Thereby, the front-side portion of the midsole 10 is compressed and deformed so as to be reduced in thickness in the up-down direction.

[0082] At this time, a load in the axial direction (i.e., the up-down direction) is applied also to the first core portion 20A, the second core portion 20B, and the third core portion 20C from both sides in the axial direction, so that the first core portion 20A, the second core portion 20B, and the third core portion 20C are also compressed and deformed so as to be reduced in thickness in the up-down direction. Accordingly, as indicated by solid arrows in the figure, the top surfaces of the first core portion 20A, the second core portion 20B, and the third core portion 20C are displaced toward the ground contact surface 2b, and the bottom surfaces of the first core portion 20A, the second core portion 20B, and the third core portion 20C are displaced toward the supporting surface 2a.

[0083] Since the peripheral surfaces of the first core

portion 20A, the second core portion 20B, and the third core portion 20C are configured as the unrestrained surfaces as described above, the peripheral surfaces of the first core portion 20A, the second core portion 20B, and the third core portion 20C are displaced outward at this time as shown in Figs. 11 and 12. Thus, the compressive deformations of the first core portion 20A, the second core portion 20B, and the third core portion 20C are promoted.

[0084] Further, the first enlarged portion 21a and the second enlarged portion 21b included in each of the first core portion 20A, the second core portion 20B, and the third core portion 20C are shaped to have cross-sectional areas increasing with distance from the top surface and the bottom surface, respectively, serving as the restrained surfaces of the first core portion 20A, the second core portion 20B, and the third core portion 20C. Thus, also in this respect, the first core portion 20A, the second core portion 20B, and the third core portion 20C are efficiently compressed and deformed, so that the compressive deformations thereof are promoted.

[0085] Herein, as described above, each of the first core portion 20A, the second core portion 20B, and the third core portion 20C included in the core portion 20 is formed of a member lower in hardness than the midsole 10 constituted of the top-side midsole 10A and the bottom-side midsole 10B. Thus, also in this respect, the compressive deformations of the first core portion 20A, the second core portion 20B, and the third core portion 20C are promoted.

[0086] Therefore, by adopting the above-described configuration, in the region where the core portion 20 is disposed and in the vicinity of this region, not only the shock absorbing performance is enhanced due to an increase in amount of deformation resulting from the compressive deformation of the sole 2A, but also the resilience is enhanced due to an increase in amount of restoration occurring during reduction of the load. In other words, adopting the above-described configuration allows improvement not only in terms of material but also in terms of structure, so that unprecedented shock absorbing performance and resilience can be achieved.

[0087] Specifically, even in the case where, in order to improve the shock absorbing performance and the resilience, the amount of deformation at the time of landing on the ground is to be increased by increasing the thickness of the foam material adjusted to have a low hardness, the compression of the foam material is insufficient simply only by increasing the thickness of the single-layered foam material. However, adopting the configuration as described in the present embodiment structurally promotes the compressive deformation, with the result that the shock absorbing performance and the resilience can be improved by increasing the thickness of the foam material.

[0088] As described above, by the sole 2A according to the present embodiment and the shoe 1A provided with the same, the shock absorbing performance and resili-

ence higher than those in the conventional art can be achieved.

[0089] Herein, as described above, in the present embodiment, the core portion 20 is disposed in a portion of the sole 2A that supports the MP joint of the wearer's foot and a portion of the sole 2A that supports the toe portion of the wearer's foot. With such a configuration, high resilient force generated in the sole 2A can be appropriately applied to the MP joint and the toe portion of the wearer's foot, each of which serves to strongly kick the ground when the foot pushes off the ground. Thus, the forward propulsive force can be improved to thereby allow efficient walking and running.

[0090] Further, in order to obtain high propulsive force when the foot pushes off the ground, it is preferable that the position of the supporting surface of the front-side portion of the sole is lower in height at the time of landing on the ground (i.e., shorter in distance from the ground contact surface) than the position of the supporting surface of the rear-side portion of the sole that serves to support the heel portion of the wearer's foot. On the other hand, in the sole 2A according to the present embodiment and the shoe 1A provided with the same, the core portion 20 is provided in the front-side portion of the sole 2A as shown in Fig. 10, so that the heights of the positions of the supporting surfaces of the front-side and rear-side portions of the sole are substantially equal to each other while no load is applied.

[0091] However, as shown in Fig. 11, when the sole 2A is compressed and deformed at the time of landing on the ground, particularly the front-side portion of the sole 2A is significantly compressed and deformed as described above. Thus, when the foot pushes off the ground, the position of the supporting surface of the front-side portion of the sole 2A naturally becomes lower than the position of the supporting surface of the rear-side portion of the sole 2A. Accordingly, also when the above-described configuration is adopted to increase the thickness of the front-side portion of the sole 2A, it is possible to achieve high propulsive force when the foot pushes off the ground, and also possible to more smoothly shift the body weight from when the foot lands on the ground to when the foot pushes off the ground.

[0092] In this regard, the portion provided with the core portion 20 can be formed such that the thickness of the core portion 20 with respect to the total thickness of the midsole 10 and the core portion 20 is, for example, 10% or more. Further, when the thickness of the core portion 20 with respect to the total thickness of the midsole 10 and the core portion 20 is 30% or more, excellent shock absorbing performance and resilience are achieved. Further, when the above-mentioned thickness is 50% or more, further excellent shock absorbing performance and resilience are achieved.

[0093] By forming the core portion 20 to have a flat and substantially ball-like shape as in the present embodiment, the core portion 20 deforms to expand at the time of landing on the ground in a plan view, with the result that

the stability at the time of landing on the ground can also be ensured.

<First to Sixth Modifications>

[0094] Figs. 13A, 13B, 14A, 14B, 15A, and 15B are each a schematic cross-sectional view showing the vicinity of a core portion of a sole according to a corresponding one of the first to sixth modifications. Hereinafter, soles 2A1 to 2A6 according to the first to sixth modifications based on the above-described first embodiment will be described with reference to Figs. 13A to 15B. Note that each of the soles 2A1 to 2A6 according to the first to sixth modifications is provided in the shoe 1A, instead of the sole 2A according to the above-described first embodiment.

[0095] In the above-described first embodiment, the sole 2A including the core portion 20 having a flat and substantially ball-like shape has been exemplified, but the core portion 20 may be configured to have any shape as long as it has an enlarged portion shaped to have a cross-sectional area increasing in the axial direction from one to the other of the supporting surface 2a side and the ground contact surface 2b side.

[0096] As shown in Figs. 13A and 13B, in the soles 2A1 and 2A2 according to the first and second modifications, the core portion 20 is configured to have a flat semi-ball-like shape.

[0097] As shown in Fig. 13A, in the sole 2A1 according to the first modification, the core portion 20 is disposed such that a curved surface portion of the core portion 20 faces the top-side midsole 10A and a flat surface portion of the core portion 20 faces the bottom-side midsole 10B. In such a configuration, the core portion 20 includes only the first enlarged portion 21a having a cross-sectional area increasing in the axial direction from the supporting surface 2a side to the ground contact surface 2b side.

[0098] As shown in Fig. 13B, in the sole 2A2 according to the second modification, the core portion 20 is disposed such that the flat surface portion of the core portion 20 faces the top-side midsole 10A and the curved surface portion of the core portion 20 faces the bottom-side midsole 10B. In such a configuration, the core portion 20 includes only the second enlarged portion 21b having a cross-sectional area increasing in the axial direction from the ground contact surface 2b side to the supporting surface 2a side.

[0099] As shown in Figs. 14A and 14B, in the soles 2A3 and 2A4 according to the third and fourth modifications, the core portion 20 is configured to have a truncated conical shape.

[0100] As shown in Fig. 14A, in the sole 2A3 according to the third modification, the core portion 20 is disposed such that, among a pair of flat surface portions of the core portion 20, the flat surface portion having a smaller area faces the top-side midsole 10A and the flat surface portion having a larger area faces the bottom-side midsole 10B. In such a configuration, the core portion 20 includes

only the first enlarged portion 21a having a cross-sectional area increasing in the axial direction from the supporting surface 2a side to the ground contact surface 2b side.

[0101] As shown in Fig. 14B, in the sole 2A4 according to the fourth modification, the core portion 20 is disposed such that, among the pair of flat surface portions of the core portion 20, the flat surface portion having a larger area faces the top-side midsole 10A and the flat surface portion having a smaller area faces the bottom-side midsole 10B. In such a configuration, the core portion 20 includes only the second enlarged portion 21b having a cross-sectional area increasing in the axial direction from the ground contact surface 2b side to the supporting surface 2a side.

[0102] As shown in Fig. 15A, in the sole 2A5 according to the fifth modification, the core portion 20 is configured to have a substantially circular columnar shape whose central portion in the axial direction is narrowed. In such a configuration, the core portion 20 includes: the first enlarged portion 21a having a cross-sectional area increasing in the axial direction from the supporting surface 2a side to the ground contact surface 2b side; and the second enlarged portion 21b having a cross-sectional area increasing in the axial direction from the ground contact surface 2b side to the supporting surface 2a side. The second enlarged portion 21b is disposed on the side close to the top-side midsole 10A and the first enlarged portion 21a is disposed on the side close to the bottom-side midsole 10B.

[0103] As shown in Fig. 15B, in the sole 2A6 according to the sixth modification, the core portion 20 is configured to have a substantially ball-like shape whose central portion in the axial direction is narrowed. In such a configuration, the core portion 20 includes, in an alternate manner: the first enlarged portion 21a having a cross-sectional area increasing in the axial direction from the supporting surface 2a side to the ground contact surface 2b side; and the second enlarged portion 21b having a cross-sectional area increasing in the axial direction from the ground contact surface 2b side to the supporting surface 2a side. More specifically, the first enlarged portion 21a, the second enlarged portion 21b, the first enlarged portion 21a, and the second enlarged portion 21b are arranged in this order from the side on which the top-side midsole 10A is located toward the side on which the bottom-side midsole 10B is located.

[0104] Even in the case of the core portion 20 having such a shape, the effects similar to those described in the first embodiment are achieved. In addition to the above, the core portion 20 can also be configured to have a spherical shape, a rugby ball-like shape, a truncated pyramid shape, or the like.

<Second Embodiment>

[0105] Fig. 16 is a schematic side view of a sole according to the second embodiment as viewed from the

lateral foot side, and Fig. 17 is an exploded perspective view of the sole shown in Fig. 16. In order to facilitate understanding, in Figs. 16 and 17, the midsole 10 is shown in light color and the core portion 20 is shown in dark color. Hereinafter, a shoe 1B according to the present embodiment and a sole 2B provided therein will be described with reference to Figs. 16 and 17. Note that an upper (not shown) included in the shoe 1B according to the present embodiment is the same as the upper 3 included in the shoe 1A according to the above-described first embodiment.

[0106] As shown in Figs. 16 and 17, the sole 2B according to the present embodiment is different in configuration from the sole 2A according to the above-described first embodiment mainly in that it further includes a top-side plate 40A.

[0107] Specifically, the top-side plate 40A as a first high hardness portion having a plate shape is embedded in the midsole 10 so as to extend in the sole 2B from the portion of the forefoot portion R1 that is close to its front end to the rear end of the midfoot portion R2. The top-side plate 40A has a part extending from a portion of the forefoot portion R1 that is close to its front end to a portion of the midfoot portion R2 that is close to its front end, and particularly this part of the top-side plate 40A is configured to be wide so as to substantially reach a medial foot-side edge portion and a lateral foot-side edge portion of the sole 2B. The top-side plate 40A serves to suppress dorsiflexion occurring in the sole particularly during running, to thereby increase the forward propulsive force at the time when the foot pushes off the ground.

[0108] Unlike the case in the above-described first embodiment, the bottom surface 10b1 of the top-side midsole 10A is not provided with the recessed portion 11a (see Figs. 2, 3, 9, and the like), but only the top surface 10a2 of the bottom-side midsole 10B is provided with the recessed portion 11b similar to that in the above-described first embodiment. By providing the recessed portion 11b in the top surface 10a2 of the bottom-side midsole 10B, a gap is provided in the front-side portion of the midsole 10 due to a configuration in which the top-side midsole 10A and the bottom-side midsole 10B are not bonded to each other but are located at a prescribed distance therebetween. Also, the first core portion 20A, the second core portion 20B, and the third core portion 20C each as the core portion 20 are disposed in the gap.

[0109] The top-side plate 40A is disposed between the top-side midsole 10A and the bottom-side midsole 10B. The top-side plate 40A is disposed along the bottom surface 10b1 of the top-side midsole 10A. Thus, in the portion in which the first core portion 20A, the second core portion 20B, and the third core portion 20C are disposed, the top-side plate 40A is located above the first core portion 20A, the second core portion 20B, and the third core portion 20C.

[0110] The top-side plate 40A disposed between the top-side midsole 10A and each of the first core portion 20A, the second core portion 20B, and the third core

portion 20C is bonded to the bottom surface 10b1 of the top-side midsole 10A, for example, by adhesion or the like. Top-side ends of the first core portion 20A, the second core portion 20B, and the third core portion 20C are bonded to the top-side plate 40A, for example, by adhesion or the like.

[0111] The top-side plate 40A should only be made of a material higher in hardness than the materials forming the midsole 10 and the core portion 20, but the material thereof is not particularly limited. Examples of the material of the top-side plate 40A include: a fiber-reinforced resin made using, as reinforcing fibers, carbon fibers, glass fibers, aramid fibers, Dyneema (R) fibers, Zylon (R) fibers, boron fibers, or the like and using, as base materials, an epoxy resin, a polyester resin, a phenol resin, a polyamide resin, a polypropylene resin, a polyethylene resin, a polyurethane resin, or the like; a non-fiber-reinforced resin made of a polymer resin such as a urethane-based thermoplastic elastomer (TPU), an amide-based thermoplastic elastomer (TPA), or an ethylene-vinyl acetate copolymer (EVA); and the like.

[0112] Also by the shoe 1B according to the present embodiment and the sole 2B provided therein as described above, the effects similar to those described in the above-described first embodiment are achieved, so that the shock absorbing performance and resilience higher than those in the conventional art can be achieved. In particular, adopting the configuration as in the present embodiment allows a still higher resilience to be achieved along with a combination of: the resilience obtained by providing the sole 2B with the core portion 20 formed of a foam material having a low hardness; and the resilience obtained by providing the sole 2B with the top-side plate 40A.

<Seventh and Eighth Modifications>

[0113] Figs. 18A and 18B are schematic cross-sectional views of the vicinities of core portions of soles according to the seventh and eighth modifications, respectively. Hereinafter, soles 2B1 and 2B2 according to the seventh and eighth modifications based on the above-described second embodiment will be described with reference to Figs. 18A and 18B. Each of the soles 2B1 and 2B2 according to the seventh and eighth modifications is included in the shoe 1B instead of the sole 2B according to the above-described second embodiment.

[0114] The above-described second embodiment has presented an example in which the plate made of a material higher in hardness than the materials forming the midsole 10 and the core portion 20 is disposed above the core portion 20, but the position where the plate is disposed is not particularly limited thereto.

[0115] As shown in Fig. 18A, in the sole 2B1 according to the seventh modification, a bottom-side plate 40B as a second high hardness portion having a plate shape is disposed along the top surface 10a2 of the bottom-side midsole 10B. Thus, in the portion in which the core portion

20 is disposed, the bottom-side plate 40B is located below each core portion 20.

[0116] The bottom-side plate 40B disposed between the bottom-side midsole 10B and the core portion 20 is bonded to the top surface 10a2 of the bottom-side midsole 10B, for example, by adhesion or the like. A bottom-side end of the core portion 20 is bonded to the bottom-side plate 40B, for example, by adhesion or the like.

[0117] Similarly to the top-side plate 40A described above, the bottom-side plate 40B should only be made of a material higher in hardness than the materials forming the midsole 10 and the core portion 20, and can be formed of the same material as that of the top-side plate 40 as described above.

[0118] As shown in Fig. 18B, the sole 2B2 according to the eighth modification includes the top-side plate 40A as the first high hardness portion having a plate shape and the bottom-side plate 40B as the second high hardness portion having a plate shape. In the sole 2B2, the top-side plate 40A is disposed on the bottom surface 10b1 of the top-side midsole 10A, and the bottom-side plate 40B is disposed on the top surface 10a2 of the bottom-side midsole 10B, so that the top-side end of the core portion 20 is fixed to the top-side plate 40A, and the bottom-side end of the core portion 20 is fixed to the bottom-side plate 40B.

[0119] Also when a plate made of a material higher in hardness than the materials forming the midsole 10 and the core portion 20 is disposed at such a position, the effects similar to those described in the second embodiment are achieved.

<Third Embodiment>

[0120] Fig. 19 is a schematic side view of a sole according to the third embodiment as viewed from the lateral foot side, and Fig. 20 is a schematic plan view of the sole shown in Fig. 19. Figs. 21A and 21B are schematic cross-sectional views taken along lines XXIA-XXIA and XXIB-XXIB, respectively, shown in Fig. 20. Fig. 22 is an exploded perspective view of the sole shown in Fig. 19, and Fig. 23 is a schematic plan view showing the state in which the midsole is removed from the sole shown in Fig. 19. Hereinafter, a shoe 1C according to the present embodiment and a sole 2C provided therein will be described with reference to Figs. 19 to 23. Note that an upper (not shown) included in the shoe 1C according to the present embodiment is the same as the upper 3 included in the shoe 1A according to the first embodiment described above.

[0121] As shown in Figs. 19 to 23, the sole 2C according to the present embodiment is different in configuration from the sole 2A according to the above-described first embodiment mainly in that the midsole 10 is not constituted of two members, i.e., the top-side midsole 10A and the bottom-side midsole 10B, but is constituted of a single member.

[0122] Specifically, the sole 2B includes: the midsole

10 serving as the first base portion; the first core portion 20A, the second core portion 20B, and the third core portion 20C each serving as the core portion 20; and the front-side outsole 30A and a rear-side outsole 30B each serving as the outsole 30.

[0123] Herein, in order to facilitate understanding, in Figs. 19 to 23 excluding Figs. 21A and 21B, the midsole 10 is shown in light color and the core portion 20 is shown in dark color.

[0124] Referring particularly to Fig. 22, the midsole 10 includes the top surface 10a and the bottom surface 10b, and the top surface 10a defines the supporting surface 2a of the sole 2C. Further, the bottom surface 10b of the midsole 10 is provided with the recessed portion 11a extending from a portion of the forefoot portion R1 that is close to its front end to a substantially central portion of the midfoot portion R2 in the front-rear direction.

[0125] As shown in Figs. 19 to 23, each of the first core portion 20A, the second core portion 20B, and the third core portion 20C is formed in a flat and substantially ball-like shape, and is disposed in the recessed portion 11a provided in the midsole 10. As shown particularly in Fig. 20, the first core portion 20A is disposed in a portion of the sole 2C that supports the MP joint of the wearer's foot, and the second core portion 20B and the third core portion 20C are disposed in a portion of the sole 2C that supports the toe portion of the wearer's foot.

[0126] As shown in Figs. 19 and 21A to 23, the outsole 30 is located to cover the bottom surface 10b of the midsole 10 and the bottom surfaces of the first core portion 20A, the second core portion 20B, and the third core portion 20C, so that the first core portion 20A, the second core portion 20B, and the third core portion 20C are sandwiched and thereby held between the midsole 10 and the outsole 30.

[0127] More specifically, the top surfaces of the first core portion 20A, the second core portion 20B, and the third core portion 20C are bonded to a portion of the bottom surface 10b of the midsole 10 that includes the recessed portion 11a, for example, by adhesion or the like, and the bottom surfaces of the first core portion 20A, the second core portion 20B, and the third core portion 20C are bonded to the top surface 30a of the outsole 30, for example, by adhesion or the like. Thereby, the first core portion 20A, the second core portion 20B, and the third core portion 20C are fixed to both the midsole 10 and the outsole 30 so as not to be movable.

[0128] In the present embodiment, the outsole 30 is formed of two members, i.e., the front-side outsole 30A and the rear-side outsole 30B, as described above. Among these outsoles, the front-side outsole 30A is disposed to cover the recessed portion 11 provided in the bottom surface 10b of the midsole 10. Thereby, the bottom surfaces of the first core portion 20A, the second core portion 20B, and the third core portion 20C are fixed to the front-side outsole 30A. The bottom surfaces 30b of the front-side outsole 30A and the rear-side outsole 30B define the ground contact surface 2b of the sole 2C.

[0129] As shown in Figs. 19, 21A, 21B, and 22, the midsole 10 includes parts holding the first core portion 20A, the second core portion 20B, and the third core portion 20C, and each of these parts has a layered shape. Also, the first core portion 20A, the second core portion 20B, and the third core portion 20C each have a flat and substantially ball-like shape. Thus, the cavity S is located around each of the first core portion 20A, the second core portion 20B, and the third core portion 20C.

[0130] Thereby, also in the sole 2C according to the present embodiment, the peripheral surfaces of the first core portion 20A, the second core portion 20B, and the third core portion 20C are configured as unrestrained surfaces that are opened without being covered by other members, similarly to the above-described first embodiment. Further, the peripheral surface of each of the first core portion 20A, the second core portion 20B, and the third core portion 20C, which is configured as an unrestrained surface, is a surface of the portion corresponding to the first enlarged portion 21a and the second enlarged portion 21b included in each of the first core portion 20A, the second core portion 20B, and the third core portion 20C.

[0131] Therefore, also by the shoe 1C according to the present embodiment and the sole 2C provided therein as described above, the effects similar to those described in the above-described first embodiment are achieved, so that the shock absorbing performance and resilience higher than those in the conventional art can be achieved.

<Fourth Embodiment>

[0132] Fig. 24 is a schematic side view of a sole according to the fourth embodiment as viewed from the lateral foot side, and Fig. 25 is a schematic plan view of the sole shown in Fig. 24. Figs. 26A and 26B are schematic cross-sectional views taken along lines XXVIA-XXVIA and XXVIB-XXVIB, respectively, shown in Fig. 25. Fig. 27 is an exploded perspective view of the sole shown in Fig. 24, and Fig. 28 is a schematic plan view showing the state in which a top-side midsole and a top-side plate are removed from the sole shown in Fig. 24. Hereinafter, a shoe 1D according to the present embodiment and a sole 2D provided therein will be described with reference to Figs. 24 to 28. Note that an upper (not shown) included in the shoe 1D according to the present embodiment is the same as the upper 3 included in the shoe 1A according to the above-described first embodiment.

[0133] As shown in Figs. 24 to 28, similarly to the sole 2B according to the above-described second embodiment, the sole 2D according to the present embodiment includes: the midsole 10 constituted of the top-side midsole 10A as the first base portion and the bottom-side midsole 10B as the second base portion; the first core portion 20A, the second core portion 20B, and the third core portion 20C each as the core portion 20; and the front-side outsole 30A and a pair of the rear-side outsoles

30B 1 and 30B2 each as the outsole 30; and the top-side plate 40A as the first high hardness portion having a plate shape.

[0134] Herein, in order to facilitate understanding, in Figs. 24 to 28 excluding Figs. 26A and 26B, the midsole 10 is shown in light color and the core portion 20 is shown in dark color.

[0135] In the sole 2D according to the present embodiment, similarly to the sole 2B according to the above-described second embodiment, the core portion 20 is configured to include the first core portion 20A, the second core portion 20B, and the third core portion 20C each having a flat and substantially ball-like shape, but is different in configuration from the sole 2B according to the above-described second embodiment in that the first core portion 20A, the second core portion 20B, and the third core portion 20C are connected to each other.

[0136] Specifically, as shown particularly in Figs. 25, 27 and 28, the first core portion 20A is disposed in a portion of the sole 2D that supports the MP joint of the wearer's foot, the second core portion 20B is disposed in a portion of the sole 2D that supports the first toe of the wearer's foot, and the third core portion 20C is disposed in a portion of the sole 2D that supports the second toe, the third toe, the fourth toe, and the fifth toe of the wearer's foot. Among them, the second core portion 20B has a part facing the first core portion 20A and connected to the first core portion 20A, and the third core portion 20C has a part facing the first core portion 20A and connected to the first core portion 20A.

[0137] With such a configuration, the core portion 20 is configured as a single member constituted of the first core portion 20A, the second core portion 20B, and the third core portion 20C that are connected to one another. Thus, the number of components is reduced to thereby improve the mountability during manufacturing of the sole 2D, and also, the structure is simplified to thereby improve the durability.

[0138] As shown particularly in Figs. 24 and 26A to 28, similarly to the above-described second embodiment, the sole 2D according to the present embodiment also has a configuration in which the front-side portion of the sole 2D in an area where the top-side midsole 10A and the bottom-side midsole 10B face each other is provided with a gap between these midsoles, the first core portion 20A, the second core portion 20B, and the third core portion 20C are disposed in this gap, and the cavities S are located around the first core portion 20A, the second core portion 20B, and the third core portion 20C, so that the peripheral surfaces of these core portions are configured as unrestrained surfaces that are opened without being covered by other members.

[0139] Further, the peripheral surface of each of the first core portion 20A, the second core portion 20B, and the third core portion 20C, which is configured as an unrestrained surface, is a surface of the portion corresponding to the first enlarged portion 21a and the second enlarged portion 21b included in each of the first core

portion 20A, the second core portion 20B, and the third core portion 20C.

[0140] Therefore, also by the shoe 1D according to the present embodiment and the sole 2D provided therein as described above, the effects similar to those described in the above-described second embodiment are achieved, so that the shock absorbing performance and resilience higher than those in the conventional art can be achieved.

[0141] As a manner of connection of the first core portion 20A, the second core portion 20B, and the third core portion 20C to each other, for example, a substantially columnar bridge portion or the like may be provided between adjacent ones of these core portions to connect them to each other, or, as in the present embodiment, the enlarged portions of the core portions adjacent to each other may be directly connected to each other without providing such a bridge portion or the like.

<Fifth Embodiment>

[0142] Fig. 29 is a schematic side view of a sole according to the fifth embodiment as viewed from the lateral foot side, and Fig. 30 is a schematic plan view of the sole shown in Fig. 29. Figs. 31A and 31B are schematic cross-sectional views taken along lines XXXIA-XXXIA and XXXIB-XXXIB, respectively, shown in Fig. 30. Fig. 32 is an exploded perspective view of the sole shown in Fig. 29, and Fig. 33 is a schematic plan view showing the state in which the top-side midsole is removed from the sole shown in Fig. 29. Hereinafter, a shoe 1E according to the present embodiment and a sole 2E provided therein will be described with reference to Figs. 29 to 33. Note that an upper (not shown) included in the shoe 1E according to the present embodiment is the same as the upper 3 included in the shoe 1A according to the above-described first embodiment.

[0143] As shown in Figs. 29 to 33, the sole 2E according to the present embodiment is different in configuration of the core portion 20 from the sole 2A according to the above-described first embodiment. More specifically, the sole 2E according to the present embodiment is different in configuration from the sole 2A according to the above-described first embodiment in that the core portion 20 is constituted of a medial foot-side first core portion 20A1, a lateral foot-side first core portion 20A2, the second core portion 20B, the third core portion 20C, and a fourth core portion 20D, and also in that the peripheral surfaces of these core portions are partially restrained by other members.

[0144] Herein, in order to facilitate understanding, in Figs. 29 to 33 excluding Figs. 31A and 31B, the midsole 10 is shown in light color and the core portion 20 is shown in dark color.

[0145] As shown particularly in Fig. 30, the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2 are disposed in a portion of the sole 2E that supports the MP joint of the wearer's foot. More specifically, the medial foot-side first core portion 20A1

is located in an area on the medial foot side extending from a portion of the forefoot portion R1 that is close to its rear end to a portion of the midfoot portion R2 that is close to its front end. Also, the lateral foot-side first core portion 20A2 is located in an area on the lateral foot side extending from a portion of the forefoot portion R1 that is close to its rear end to a portion of the midfoot portion R2 that is close to its front end. The portion in which the medial foot-side first core portion 20A1 is disposed corresponds to a portion of the sole 2E that supports the medial foot-side portion of the MP joint of the wearer's foot (i.e., the portion on the side of a ball of the wearer's foot), and the portion in which the lateral foot-side first core portion 20A2 is disposed corresponds to a portion of the sole 2E that supports the lateral foot-side portion of the MP joint of the wearer's foot (i.e., the portion on the side of a hypothenar of the wearer's foot).

[0146] Further, the second core portion 20B, the third core portion 20C, and the fourth core portion 20D are disposed in a portion of the sole 2E that supports the toe portion of the wearer's foot. More specifically, the second core portion 20B is located in a portion of the forefoot portion R1 on the medial foot side in a substantially central portion in the front-rear direction, and the third core portion 20C is located in a portion of the forefoot portion R1 on the lateral foot side in a substantially central portion in the front-rear direction. On the other hand, the fourth core portion 20D is located in a portion of the forefoot portion R1 in a substantially central portion in the front-rear direction and also in a substantially central portion in the left-right direction. The portion in which the second core portion 20B is disposed corresponds to a portion of the sole 2E that supports the first toe of the wearer's foot, and the portion in which the third core portion 20C is disposed substantially corresponds to a portion of the sole 2E that supports the fourth and fifth toes of the wearer's foot. On the other hand, the portion in which the fourth core portion 20D is disposed substantially corresponds to a portion of the sole 2E that supports the second and third toes of the wearer's foot.

[0147] As shown in Figs. 29 and 31A to 32, the top-side midsole 10A and the bottom-side midsole 10B include parts holding the medial foot-side first core portion 20A1, the lateral foot-side first core portion 20A2, the second core portion 20B, the third core portion 20C, and the fourth core portion 20D, and each of these parts has a substantially layered shape. Also, each of the medial foot-side first core portion 20A1, the lateral foot-side first core portion 20A2, the second core portion 20B, the third core portion 20C, and the fourth core portion 20D has a flat and substantially ball-like shape. Thus, the cavities S are located exclusively partially around the medial foot-side first core portion 20A1, the lateral foot-side first core portion 20A2, the second core portion 20B, the third core portion 20C, and the fourth core portion 20D. Thereby, most parts of the peripheral surfaces of the first core portion 20A, the second core portion 20B, and the third core portion 20C are configured as unrestrained surfaces

that are opened without being covered by other members.

[0148] More specifically, as shown particularly in Fig. 29, the peripheral surfaces of the medial foot-side first core portion 20A1, the lateral foot-side first core portion 20A2, the second core portion 20B, the third core portion 20C, and the fourth core portion 20D have parts located in the front-rear direction, and these parts are in contact with the top-side midsole 10A and the bottom-side midsole 10B and thereby configured as restrained surfaces restrained by other members. On the other hand, as shown particularly in Figs. 31A and 31B, the peripheral surfaces of the medial foot-side first core portion 20A1, the lateral foot-side first core portion 20A2, the second core portion 20B, the third core portion 20C, and the fourth core portion 20D have parts located in the left-right direction, and these parts are located to face the outside of the sole 2E or face the cavities S provided inside the sole 2E, and thereby are opened. Thus, most parts of the peripheral surfaces of the medial foot-side first core portion 20A1, the lateral foot-side first core portion 20A2, the second core portion 20B, the third core portion 20C, and the fourth core portion 20D are configured as unrestrained surfaces that are opened without being covered by other members.

[0149] Further, the peripheral surface of each of the medial foot-side first core portion 20A1, the lateral foot-side first core portion 20A2, the second core portion 20B, the third core portion 20C, and the fourth core portion 20D, which is configured as an unrestrained surface, is a surface of the portion corresponding to the first enlarged portion 21a and the second enlarged portion 21b included in each of the medial foot-side first core portion 20A1, the lateral foot-side first core portion 20A2, the second core portion 20B, the third core portion 20C, and the fourth core portion 20D.

[0150] Therefore, also by the shoe 1E according to the present embodiment and the sole 2E provided therein as described above, the effects similar to those described in the above-described first embodiment are achieved, so that the shock absorbing performance and resilience higher than those in the conventional art can be achieved.

[0151] As in the present embodiment, the peripheral surfaces of the medial foot-side first core portion 20A1, the lateral foot-side first core portion 20A2, the second core portion 20B, the third core portion 20C, and the fourth core portion 20D are partially configured as restrained surfaces, which makes it possible to ensure higher stability at the time of landing on the ground.

<Sixth Embodiment>

[0152] Fig. 34 is a schematic side view of a sole according to the sixth embodiment as viewed from the medial foot side, and Fig. 35 is a schematic side view of the sole shown in Fig. 34 as viewed from the lateral foot side. Fig. 36 is a schematic bottom view of the sole shown in Fig. 34. Hereinafter, a shoe 1F according to the present

embodiment and a sole 2F provided therein will be described with reference to Figs. 34 to 36. Note that an upper (not shown) included in the shoe 1F according to the present embodiment is the same as the upper 3 included in the shoe 1A according to the above-described first embodiment.

[0153] As shown in Figs. 34 to 36, the sole 2F according to the present embodiment is different from the sole 2A according to the above-described first embodiment in the configurations of the midsole 10 and the core portion 20, and also in that the outsole 30 (see Fig. 1 and the like) is not included. More specifically, in the sole 2F according to the present embodiment, the midsole 10 is formed of a single member, and the core portion 20 includes the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2.

[0154] Herein, in order to facilitate understanding, in Figs. 34 to 36, the midsole 10 is shown in light color and the core portion 20 is shown in dark color. In the present embodiment, an outsole is not provided in the sole 2F but may be separately provided.

[0155] The midsole 10 includes the top surface 10a and the bottom surface 10b. The top surface 10a defines the supporting surface 2a of the sole 2F, and the bottom surface 10b defines the ground contact surface 2b of the sole 2F. Further, the bottom surfaces of the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2 also define the ground contact surface 2b of the sole 2F.

[0156] Each of the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2 is formed in a flat and substantially ball-like shape, and is disposed in a portion of the sole 2F that supports the MP joint of the wearer's foot. More specifically, the medial foot-side first core portion 20A1 is located in an area on the medial foot side extending from a portion of the forefoot portion R1 that is close to its rear end to a portion of the midfoot portion R2 that is close to its front end, and the lateral foot-side first core portion 20A2 is located in an area on the lateral foot side extending from a portion of the forefoot portion R1 that is close to its rear end to a portion of the midfoot portion R2 that is close to its rear end. The portions of the bottom surface 10b of the midsole 10 that include the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2 are provided with the respective recessed portions 11a having shapes corresponding thereto. The medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2 are fitted into the respective recessed portions 11a.

[0157] The midsole 10 includes parts holding the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2, and each of these parts has a substantially layered shape. Also, as described above, each of the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2 has a flat and substantially ball-like shape. Thus, each of the medial foot-side first core portion 20A1 and the lateral foot-side

first core portion 20A2 has the first enlarged portion 21a and the second enlarged portion 21b. In particular, portions of the peripheral surfaces of the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2 that correspond to the bottom portion of the first enlarged portion 21a and the second enlarged portion 21b are configured as unrestrained surfaces that are opened without being covered by other members.

[0158] Therefore, also by the shoe 1F according to the present embodiment and the sole 2F provided therein as described above, the effects similar to those described in the above-described first embodiment are achieved, so that the shock absorbing performance and resilience higher than those in the conventional art can be achieved.

[0159] The part that normally first comes into contact with the ground at the time of landing on the ground is a part located on the lateral foot side, including the lateral foot-side first core portion 20A2, and extending from a portion of the forefoot portion R1 that is close to its rear end and a portion of the midfoot portion R2 that is close to its rear end. In this part, a relatively high load acts as a reaction force on the wearer's foot. Thus, extending the lateral foot-side first core portion 20A2 to this part makes it possible to improve, particularly, the shock absorbing performance.

<Seventh Embodiment>

[0160] Fig. 37 is a schematic side view of a sole according to the seventh embodiment as viewed from the lateral foot side, and Fig. 38 is a schematic perspective view showing the state in which an outsole is removed from the sole shown in Fig. 37. Fig. 39 is a schematic cross-sectional view taken along a line XXXIX-XXXIX shown in Fig. 37. Hereinafter, a shoe 1G according to the present embodiment and a sole 2G provided therein will be described with reference to Figs. 37 to 39. Note that an upper (not shown) included in the shoe 1G according to the present embodiment is the same as the upper 3 included in the shoe 1A according to the above-described first embodiment.

[0161] As shown in Figs. 37 to 39, the sole 2G according to the present embodiment is different from the sole 2A according to the above-described first embodiment in the configurations of the midsole 10 and the core portion 20, and also in the configuration of the outsole 30 accordingly.

[0162] Specifically, the sole 2G includes: the midsole 10 constituted of the top-side midsole 10A and a pair of bottom-side midsoles 10B1 and 10B2; the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2 each as the core portion 20; and front-side outsoles 30A1 to 30A3 and the rear-side outsole 30B each as the outsole 30.

[0163] Herein, in order to facilitate understanding, in Figs. 37 and 38, the midsole 10 is shown in light color and the core portion 20 is shown in dark color.

[0164] The top-side midsole 10A includes the top sur-

face 10a1 and the bottom surface 10b1, and the top surface 10a1 defines the supporting surface 2a of the sole 2G. As shown particularly in Fig. 37, the bottom surface 10b1 of the top-side midsole 10A is provided with the recessed portion 11a extending from a substantially central portion of the forefoot portion R1 in the front-rear direction to a substantially central portion of the midfoot portion R2 in the front-rear direction.

[0165] Each of the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2 is formed in a flat and substantially ball-like shape, and disposed in the recessed portion 11a provided in the top-side midsole 10A. The medial foot-side first core portion and the lateral foot-side first core portion 20A2 are disposed in a portion of the sole 2G that supports the MP joint of the wearer's foot. More specifically, the medial foot-side first core portion 20A1 is located in an area on the medial foot side extending from a substantially central portion of the forefoot portion R1 in the front-rear direction to a substantially central portion of the midfoot portion R2 in the front-rear direction, and the lateral foot-side first core portion 20A2 is located in an area on the lateral foot side extending from a substantially central portion of the forefoot portion R1 in the front-rear direction to a substantially central portion of the midfoot portion R2 in the front-rear direction.

[0166] As shown in Figs. 37 to 39, the pair of bottom-side midsoles 10B1 and 10B2 are disposed so as to cover the bottom surfaces of the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2, respectively. The pair of bottom-side midsoles 10B1 and 10B2 cover only the bottom surfaces of the medial foot-side first core portion and the lateral foot-side first core portion 20A2, respectively, and are not bonded to the top-side midsole 10A.

[0167] As shown in Figs. 37 and 39, the front-side outsole 30A1 is located so as to cover only a part of the bottom surface 10b1 that is forward of the recessed portion 11a in the top-side midsole 10A, and is bonded to this part of the top-side midsole 10A, for example, by adhesion or the like. The front-side outsoles 30A2 and 30A3 are located so as to cover only the bottom surfaces 10b2 of the pair of bottom-side midsoles 10B1 and 10B2, respectively, and bonded to these bottom surfaces of the pair of bottom-side midsoles 10B1, 10B2, for example, by adhesion or the like. The rear-side outsole 30B is located so as to cover only a part of the bottom surface 10b1 that is rearward of the recessed portion 11a in the top-side midsole 10A, and is bonded to this part of the top-side midsole 10A, for example, by adhesion or the like.

[0168] The top-side midsole 10A includes parts holding the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2, and each of these parts has a substantially layered shape. Also, as described above, each of the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2 has a flat and substantially ball-like shape. Thus, each of the medial foot-side first core portion 20A1 and

the lateral foot-side first core portion 20A2 has the first enlarged portion 21a and the second enlarged portion 21b, and the peripheral surfaces thereof are configured as unrestrained surfaces that are opened without being covered by other members.

[0169] Therefore, also by the shoe 1G according to the present embodiment and the sole 2G provided therein as described above, the effects similar to those described in the above-described first embodiment are achieved, so that the shock absorbing performance and resilience higher than those in the conventional art can be achieved.

[0170] In the present embodiment, as described above, the pair of bottom-side midsoles 10B1 and 10B2 are not bonded to the top-side midsole 10A so as to cover only the bottom surfaces of the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2, respectively. Such a configuration enhances the mobility of the pair of bottom-side midsoles 10B1 and 10B2 and thereby the medial foot-side first core portion 20A1 and the lateral foot-side first core portion 20A2 to which these bottom-side midsoles are respectively fixed. Therefore, adopting the configuration as in the present embodiment makes it possible to obtain a sole suitable for walking or running particularly on a rough ground or the like having severe irregularities, undulations, or the like; and a shoe provided with the sole.

<Eighth Embodiment>

[0171] Fig. 40 is a schematic side view of a sole according to the eighth embodiment as viewed from the lateral foot side, and Fig. 41 is a schematic perspective view of the sole shown in Fig. 40. Fig. 42 is a schematic cross-sectional view taken along a line XLII-XLII shown in Fig. 40. Hereinafter, a shoe 1H according to the present embodiment and a sole 2H provided therein will be described with reference to Figs. 40 to 42. Note that an upper (not shown) included in the shoe 1H according to the present embodiment is the same as the upper 3 included in the shoe 1A according to the above-described first embodiment.

[0172] As shown in Figs. 40 to 42, the sole 2H according to the present embodiment is different from the sole 2A according to the above-described first embodiment in the configurations of the midsole 10 and the core portion 20, and also in that the outsole 30 (see Fig. 1 and the like) is not provided. More specifically, in the sole 2H according to the present embodiment, the midsole 10 includes the top-side midsole 10A and the bottom-side midsole 10B, and the core portion 20 is formed of a single member sandwiched between the top-side midsole 10A and the bottom-side midsole 10B.

[0173] Herein, in order to facilitate understanding, in Figs. 40 and 41, the midsole 10 is shown in light color and the core portion 20 is shown in dark color. In the present embodiment, an outsole is not provided in the sole 2H, but may be separately provided.

[0174] The top-side midsole 10A includes the top sur-

face 10a1 and the bottom surface 10b1, and the top surface 10a1 defines the supporting surface 2a of the sole 2H. The bottom-side midsole 10B includes the top surface 10a2 and the bottom surface 10b2, and the bottom surface 10b2 defines the ground contact surface 2b of the sole 2H. A slit-like hole extending in the front-rear direction is provided in each of the medial foot-side portion and the lateral foot-side portion of the bottom-side midsole 10B.

[0175] The core portion 20 is formed in a flat and substantially ball-like shape, and is located to extend in the left-right direction substantially from a medial foot-side edge portion to a lateral foot-side edge portion of the sole 2H, and also located to extend in the front-rear direction from a portion of the forefoot portion R1 that is close to its front end to a portion of the rearfoot portion R3 that is close to its rear end. The bottom surface 10b1 of the top-side midsole 10A is provided with the recessed portion 11a having a shape corresponding to the top surface of the core portion 20. The top surface 10a2 of the bottom-side midsole 10B is provided with the recessed portion 11b having a shape corresponding to the bottom surface of the core portion 20. Thereby, the core portion 20 is sandwiched and held between the top-side midsole 10A and the bottom-side midsole 10B, and is located over substantially the entire region excluding the outer peripheral edge portion of the sole 2H in a plan view.

[0176] The top-side midsole 10A and the bottom-side midsole 10B include parts holding the core portion 20, and each of these parts has a substantially layered shape. Also, the core portion 20 has a flat and substantially ball-like shape as described above. Thus, the core portion 20 has the first enlarged portion 21a and the second enlarged portion 21b, and the peripheral surfaces thereof are configured as unrestrained surfaces that are opened without being covered by other members.

[0177] Therefore, also by the shoe 1H according to the present embodiment and the sole 2H provided therein as described above, the effects similar to those described in the above-described first embodiment are achieved, so that the shock absorbing performance and resilience higher than those in the conventional art can be achieved.

[0178] Further, in the present embodiment, the core portion 20 is disposed also in a portion of the sole 2H that is configured to support the heel portion of the wearer's foot. Accordingly, such a configuration improves the shock absorbing performance for the heel portion of the wearer's foot to which a relatively high load is applied as a reaction force at the time of landing on the ground. Thus, it is possible to obtain a sole further excellent in shock absorbing performance and a shoe provided with the same.

<Ninth Embodiment>

[0179] Fig. 43 is a schematic side view of a sole according to the ninth embodiment as viewed from the

lateral foot side, and Fig. 44 is a schematic bottom view of the sole shown in Fig. 43. Hereinafter, a shoe 1I according to the present embodiment and a sole 2I provided therein will be described with reference to Figs. 43 and 44. Note that an upper (not shown) included in the shoe 1I according to the present embodiment is the same as the upper 3 included in the shoe 1A according to the above-described first embodiment.

[0180] As shown in Figs. 43 and 44, the sole 2I according to the present embodiment is different from the sole 2A according to the above-described first embodiment in the configurations of the midsole 10 and the core portion 20 and also in that the outsole 30 (see Fig. 1 and the like) is not provided. More specifically, in the sole 2I according to the present embodiment, the midsole 10 includes the top-side midsole 10A and the pair of bottom-side midsoles 10B1 and 10B2, and the core portion 20 includes a group of medial foot-side core portions 20E1 to 20E4 and a group of lateral foot-side core portions 20F1 to 20F4.

[0181] Herein, in order to facilitate understanding, in Figs. 43 and 44, the midsole 10 is shown in light color and the core portion 20 is shown in dark color. In the present embodiment, an outsole is not provided in the sole 2I but may be separately provided.

[0182] The top-side midsole 10A includes the top surface 10a1 and the bottom surface 10b1, and the top surface 10a1 defines the supporting surface 2a of the sole 2I. Further, the bottom surface 10b1 of the top-side midsole 10A is provided with the recessed portion 11a extending from a portion of the forefoot portion R1 that is close to its front end to the rear end of the rearfoot portion R3.

[0183] The bottom-side midsole 10B1 is located in the medial foot-side portion of the sole 2I and extends in the front-rear direction. The bottom-side midsole 10B2 is located in the lateral foot-side portion of the sole 2I and extends in the front-rear direction. Each of the pair of bottom-side midsoles 10B1 and 10B2 includes the top surface 10a2 and the bottom surface 10b2, and the bottom surface 10b2 defines the supporting surface 2a of the sole 2I. Further, the top surface 10a2 of each of the pair of bottom-side midsoles 10B1 and 10B2 is provided with the recessed portion 11b extending from a portion of the forefoot portion R1 that is close to its front end to the rear end of the rearfoot portion R3.

[0184] Each medial foot-side core portion in the group of medial foot-side core portions 20E1 to 20E4 is formed in a flat and substantially ball-like shape, and is sandwiched and thereby held between the medial foot-side portion of the top-side midsole 10A and the bottom-side midsole 10B1 in the state in which each medial foot-side core portion is disposed in the above-described recessed portions 11a and 11b. More specifically, the group of medial foot-side core portions 20E1 to 20E4 are located in the medial foot-side portion of the sole 2I so as to be aligned in the front-rear direction, and the sizes and orientations thereof are adjusted as appropriate.

[0185] Each lateral foot-side core portion in the group

of lateral foot-side core portions 20F1 to 20F4 is formed in a flat and substantially ball-like shape, and is sandwiched and thereby held between the lateral foot-side portion of the top-side midsole 10A and the bottom-side midsole 10B2 in the state in which each lateral foot-side core portion is disposed in the above-described recessed portions 11a and 11b. More specifically, the group of lateral foot-side core portions 20F1 to 20F4 are located in the lateral foot-side portion of the sole 21 so as to be aligned in the front-rear direction, and the sizes and orientations thereof are adjusted as appropriate.

[0186] The top-side midsole 10A and the bottom-side midsoles 10B1 and 10B2 include parts holding the group of medial foot-side core portions 20E1 to 20E4 and the group of lateral foot-side core portions 20F1 to 20F4, and each of these parts has a substantially layered shape. Also, as described above, each core portion of the group of medial foot-side core portions 20E1 to 20E4 and the group of lateral foot-side core portions 20F1 to 20F4 has a flat and substantially ball-like shape. Thus, each core portion of the group of medial foot-side core portions 20E1 to 20E4 and the group of lateral foot-side core portions 20F1 to 20F4 has the first enlarged portion 21a and the second enlarged portion 21b, and the peripheral surfaces thereof are configured as unrestrained surfaces that are opened without being covered by other members.

[0187] Therefore, also by the shoe 11 according to the present embodiment and the sole 21 provided therein as described above, the effects similar to those described in the above-described first embodiment are achieved, so that the shock absorbing performance and resilience higher than those in the conventional art can be achieved.

<Summary of Disclosure in the First to Ninth Embodiments and Modifications thereof>

[0188] The following summarizes the characteristic configurations disclosed in the first to ninth embodiments and the modifications thereof as described above.

[Additional Aspect 1]

[0189] A sole having a thickness direction corresponding to an up-down direction that is orthogonal to both: a front-rear direction corresponding to a foot length direction of a wearer; and a left-right direction corresponding to a foot width direction of the wearer, the sole having

a top surface configured as a supporting surface configured to support a bottom of a foot of the wearer, and
a bottom surface configured as a ground contact surface,

the sole comprising:

a first base portion having a layered shape, formed of

a foam material, and having a thickness direction corresponding to the up-down direction; and
a core portion located on a side of the ground contact surface with respect to the first base portion, the core portion being formed of a foam material lower in hardness than a foam material forming the first base portion, wherein

the up-down direction is defined as an axial direction, the core portion at least includes an enlarged portion having a cross-sectional area increasing in the axial direction from one to the other of a side of the supporting surface and a side of the ground contact surface, and

at least a part of a peripheral surface of the enlarged portion is configured as an unrestrained surface that is opened without being covered by other members.

[0190] By adopting the configuration described in Additional Aspect 1, when the sole is compressed in the up-down direction, the core portion is easily deformed. Thus, the amount of deformation resulting from the compressive deformation of the sole and the amount of restoration occurring during reduction of the load increase in the region where the core portion is disposed and the vicinity of this region. Therefore, a sole having unprecedented shock absorbing performance and resilience can be obtained.

[Additional Aspect 2]

[0191] The sole according to Additional Aspect 1, wherein the core portion includes, as the enlarged portion,

a first enlarged portion having a cross-sectional area increasing in the axial direction from the side of the supporting surface to the side of the ground contact surface, and
a second enlarged portion having a cross-sectional area increasing in the axial direction from the side of the ground contact surface to the side of the supporting surface.

[0192] By adopting the configuration described in Additional Aspect 2, the deformation of the core portion described above can be easily promoted with a simple configuration.

[Additional Aspect 3]

[0193] The sole according to Additional Aspect 2, wherein the core portion has a ball-like shape having a top-side portion including the first enlarged portion and a bottom-side portion including the second enlarged portion.

[0194] By adopting the configuration described in Additional Aspect 3, the deformation of the core portion described above can be maximally promoted with a

simple configuration, so that a sole having high shock absorbing performance and resilience can be obtained.

[Additional Aspect 4]

[0195] The sole according to any one of Additional Aspects 1 to 3, wherein the unrestrained surface is located on each of both sides of the core portion in the left-right direction.

[0196] By adopting the configuration described in Additional Aspect 4, the deformation of the core portion described above can be easily promoted with a simple configuration.

[Additional Aspect 5]

[0197] The sole according to any one of Additional Aspects 1 to 3, wherein the unrestrained surface is located on each of both sides of the core portion in the front-rear direction.

[0198] By adopting the configuration described in Additional Aspect 5, the deformation of the core portion described above can be easily promoted with a simple configuration.

[Additional Aspect 6]

[0199] The sole according to any one of Additional Aspects 1 to 3, wherein the unrestrained surface is located along an entire periphery of the core portion.

[0200] By adopting the configuration described in Additional Aspect 6, the deformation of the core portion described above can be maximally promoted, so that a sole having high shock absorbing performance and resilience can be obtained.

[Additional Aspect 7]

[0201] The sole according to any one of Additional Aspects 1 to 6, wherein, by providing a cavity portion inside the sole so as to face the core portion, a part of a peripheral surface of the core portion that faces the cavity portion is configured as the unrestrained surface.

[0202] By adopting the configuration described in Additional Aspect 7, the deformation of the core portion described above can be maximally promoted, so that a sole having high shock absorbing performance and resilience can be obtained.

[Additional Aspect 8]

[0203] The sole according to any one of Additional Aspects 1 to 7, further comprising a first high hardness portion having a plate shape and formed of a member higher in hardness than a foam material forming the first base portion and the core portion, wherein

the first high hardness portion is disposed between

the first base portion and the core portion, and a top-side end of the core portion is fixed to the first high hardness portion.

5 **[0204]** By adopting the configuration described in Additional Aspect 8, in addition to the resilience obtained by providing the core portion, the resilience obtained by providing the high hardness portion having a plate shape can also be achieved, so that a sole having further excellent resilience can be obtained.

[Additional Aspect 9]

10 **[0205]** The sole according to any one of Additional Aspects 1 to 7, further comprising a second base portion having a layered shape and having a thickness direction corresponding to the up-down direction, the second base portion being located on the side of the ground contact surface with respect to the core portion, wherein
20 the second base portion is formed of a foam material higher in hardness than a foam material forming the core portion.

[0206] Also by adopting the configuration described in Additional Aspect 9, when the sole is compressed in the
25 up-down direction, the core portion is easily deformed. Thus, the amount of deformation resulting from the compressive deformation of the sole and the amount of restoration occurring during reduction of the load increase in the region where the core portion is disposed and the vicinity of this region. Therefore, a sole having unprecedented shock absorbing performance and resilience can be obtained.

[Additional Aspect 10]

35 **[0207]** The sole according to Additional Aspect 9, further comprising a first high hardness portion having a plate shape and formed of a member higher in hardness than a foam material forming the first base portion and the core portion, wherein
40

the first high hardness portion is disposed between the first base portion and the core portion, and a top-side end of the core portion is fixed to the first high hardness portion.

45 **[0208]** By adopting the configuration described in Additional Aspect 10, in addition to the resilience obtained by providing the core portion, the resilience obtained by providing the high hardness portion having a plate shape can also be achieved, so that a sole having further excellent resilience can be obtained.

[Additional Aspect 11]

55 **[0209]** The sole according to Additional Aspect 9, further comprising a second high hardness portion having a plate shape and formed of a member higher in

hardness than a foam material forming the core portion and the second base portion, wherein

the second high hardness portion is disposed between the core portion and the second base portion, and
a bottom-side end of the core portion is fixed to the second high hardness portion.

[0210] By adopting the configuration described in Additional Aspect 11, in addition to the resilience obtained by providing the core portion, the resilience obtained by providing the high hardness portion having a plate shape can also be achieved, so that a sole having further excellent resilience can be obtained.

[Additional Aspect 12]

[0211] The sole according to Additional Aspect 9, further comprising:

a first high hardness portion having a plate shape and formed of a member higher in hardness than a foam material forming the first base portion and the core portion; and
a second high hardness portion having a plate shape and formed of a member higher in hardness than a foam material forming the core portion and the second base portion, wherein
the first high hardness portion is disposed between the first base portion and the core portion,
the second high hardness portion is disposed between the core portion and the second base portion,
a top-side end of the core portion is fixed to the first high hardness portion, and
a bottom-side end of the core portion is fixed to the second high hardness portion.

[0212] By adopting the configuration described in Additional Aspect 12, in addition to the resilience obtained by providing the core portion, the resilience obtained by providing the high hardness portion having a plate shape can also be achieved, so that a sole having further excellent resilience can be obtained.

[Additional Aspect 13]

[0213] The sole according to any one of Additional Aspects 1 to 8, further comprising an outsole formed of a member higher in hardness than a foam material forming the core portion, the outsole constituting the ground contact surface, wherein
the outsole is fixed to the core portion so as to cover a bottom-side end of the core portion.

[0214] Also by adopting the configuration described in Additional Aspect 13, when the sole is compressed in the up-down direction, the core portion is easily deformed. Thus, the amount of deformation resulting from the com-

pressive deformation of the sole and the amount of restoration occurring during reduction of the load increase in the region where the core portion is disposed and the vicinity of this region. Therefore, a sole having unprecedented shock absorbing performance and resilience can be obtained.

[Additional Aspect 14]

[0215] The sole according to any one of Additional Aspects 1 to 13, wherein the core portion is disposed in a portion of the sole, the portion being configured to support an MP joint of the foot of the wearer.

[0216] By adopting the configuration described in Additional Aspect 14, high resilient force generated in the sole can be appropriately applied to the MP joint of the wearer's foot that serves to strongly kick the ground when the foot pushes off the ground. Thus, a sole improved in forward propulsive force can be obtained.

[Additional Aspect 15]

[0217] The sole according to any one of Additional Aspects 1 to 13, wherein the core portion is disposed in a portion of the sole, the portion being configured to support a toe portion of the foot of the wearer.

[0218] By adopting the configuration described in Additional Aspect 15, high resilient force generated in the sole can be appropriately applied to the toe portion of the wearer's foot that serves to strongly kick the ground when the foot pushes off the ground. Thus, a sole improved in forward propulsive force can be obtained.

[Additional Aspect 16]

[0219] The sole according to any one of Additional Aspects 1 to 13, wherein the core portion is disposed in a portion of the sole, the portion being configured to support a heel portion of the foot of the wearer.

[0220] Adopting the configuration described in Additional Aspect 16 improves the shock absorbing performance for the heel portion of the wearer's foot to which a relatively high load is applied as a reaction force at the time of landing on the ground, with the result that the sole entirely further excellent in shock absorbing performance can be obtained.

[Additional Aspect 17]

[0221] The sole according to any one of Additional Aspects 1 to 16, comprising a plurality of the core portions, wherein

the plurality of the core portions are arranged to be aligned in a direction intersecting the up-down direction.

[0222] Also by adopting the configuration described in Additional Aspect 17, when the sole is compressed in the up-down direction, the plurality of core portions are easily deformed. Thus, the amount of deformation resulting

from the compressive deformation of the sole and the amount of restoration occurring during reduction of the load increase in the region where the plurality of core portions are disposed and the vicinity of this region. Therefore, a sole having unprecedented shock absorbing performance and resilience can be obtained.

[Additional Aspect 18]

[0223] The sole according to Additional Aspect 17, wherein the plurality of the core portions include at least two core portions connected to each other.

[0224] By adopting the configuration described in Additional Aspect 18, the number of components is reduced to thereby improve the mountability, and the structure is simplified to thereby also improve the durability.

[Additional Aspect 19]

[0225] The sole according to Additional Aspect 18, wherein

the core portion includes a first core portion, a second core portion, and a third core portion as the plurality of the core portions,
the first core portion is disposed in a portion of the sole, the portion being configured to support an MP joint of the foot of the wearer,
the second core portion is disposed in a portion of the sole, the portion being configured to support a medial foot-side part of a toe portion of the foot of the wearer,
the third core portion is disposed in a portion of the sole, the portion being configured to support a lateral foot-side part of the toe portion of the foot of the wearer,
the first core portion and the second core portion are connected to each other, and
the first core portion and the third core portion are connected to each other.

[0226] By adopting the configuration described in Additional Aspect 19, high resilient force generated in the sole can be appropriately applied to the MP joint and the toe portion of the wearer's foot that serve to strongly kick the ground when the foot pushes off the ground. Thus, it is possible to obtain a sole not only improved in forward propulsive force, but also improved in mountability by reducing the number of components and improved in durability by simplifying the structure.

[Additional Aspect 20]

[0227] A shoe comprising:

the sole according to any one of Additional Aspects 1 to 19; and
an upper located above the sole.

[0228] By adopting the configuration described in Additional Aspect 20, when the sole is compressed in the up-down direction, the core portion is easily deformed. Thus, the amount of deformation resulting from the compressive deformation of the sole and the amount of restoration occurring during reduction of the load increase in the region where the core portion is disposed and the vicinity of this region. Therefore, a shoe provided with a sole having unprecedented shock absorbing performance and resilience can be obtained.

<Other Configurations>

[0229] The number, the shape, the size, the position of arrangement, and the like of the parts disclosed in the above-described embodiments and modifications thereof are not limited thereto, and can be variously changed. For example, the number, the shape, the size, the position of arrangement, and the like of the core portions can be changed as appropriate, and are not limited to the number, the shape, the size, the position of arrangement, and the like of the core portions disclosed in the above-described embodiments and modifications thereof.

[0230] In the above-described embodiments and modifications thereof, the shoe including an upper provided with a shoe tongue or a shoelace has been described by way of example, but the configuration of the upper is not limited thereto. In other words, an upper having various configurations can be applicable. For example, a shoe including a sock-shaped upper or the like made of a knit material may also be provided.

[0231] Further, the characteristic configurations exemplified in the above-described embodiments and modifications thereof can be combined with each other without departing from the gist of the present disclosure.

[0232] Although the embodiments of the present invention have been described, it should be understood that the embodiments disclosed herein are illustrative and non-restrictive in every respect. The scope of the present invention is defined by the terms of the claims, and is intended to include any modifications within the scope and meaning equivalent to the terms of the claims.

Claims

1. A sole having a thickness direction corresponding to an up-down direction that is orthogonal to both: a front-rear direction corresponding to a foot length direction of a wearer; and a left-right direction corresponding to a foot width direction of the wearer, the sole having

a top surface configured as a supporting surface (2a) configured to support a bottom of a foot of the wearer, and
a bottom surface configured as a ground contact surface (2b),

the sole comprising:

- a first base portion (10A) having a layered shape, formed of a foam material, and having a thickness direction corresponding to the up-down direction; and

a core portion (20) located on a side of the ground contact surface (2b) with respect to the first base portion (10A), the core portion (20) being formed of a foam material lower in hardness than a foam material forming the first base portion (10A), wherein the up-down direction is defined as an axial direction,

the core portion (20) at least includes an enlarged portion having a cross-sectional area increasing in the axial direction from one to the other of a side of the supporting surface (2a) and a side of the ground contact surface (2b), and

at least a part of a peripheral surface of the enlarged portion is configured as an unrestrained surface that is opened without being covered by other members.
2. The sole according to claim 1, wherein the core portion (20) includes, as the enlarged portion,

a first enlarged portion (21a) having a cross-sectional area increasing in the axial direction from the side of the supporting surface (2a) to the side of the ground contact surface (2b), and

a second enlarged portion (21b) having a cross-sectional area increasing in the axial direction from the side of the ground contact surface (2b) to the side of the supporting surface (2a).
3. The sole according to claim 2, wherein the core portion (20) has a ball-like shape having a top-side portion including the first enlarged portion (21a) and a bottom-side portion including the second enlarged portion (21b).
4. The sole according to any one of claims 1 to 3, wherein the unrestrained surface is located on each of both sides of the core portion (20) in the left-right direction.
5. The sole according to any one of claims 1 to 3, wherein the unrestrained surface is located on each of both sides of the core portion (20) in the front-rear direction.
6. The sole according to any one of claims 1 to 3, wherein the unrestrained surface is located along an entire periphery of the core portion (20).
7. The sole according to any one of claims 1 to 6, wherein, by providing a cavity portion (S) inside the sole so as to face the core portion (20), a part of a peripheral surface of the core portion (20) that faces the cavity portion (S) is configured as the unrestrained surface.
8. The sole according to any one of claims 1 to 7, further comprising a first high hardness portion (40A) having a plate shape and formed of a member higher in hardness than a foam material forming the first base portion (10A) and the core portion (20), wherein

the first high hardness portion (40A) is disposed between the first base portion (10A) and the core portion (20), and

a top-side end of the core portion (20) is fixed to the first high hardness portion (40A).
9. The sole according to any one of claims 1 to 7, further comprising a second base portion (10B) having a layered shape and having a thickness direction corresponding to the up-down direction, the second base portion (10B) being located on the side of the ground contact surface (2b) with respect to the core portion (20), wherein

the second base portion (10B) is formed of a foam material higher in hardness than a foam material forming the core portion (20).
10. The sole according to claim 9, further comprising a first high hardness portion (40A) having a plate shape and formed of a member higher in hardness than a foam material forming the first base portion (10A) and the core portion (20), wherein

the first high hardness portion (40A) is disposed between the first base portion (10A) and the core portion (20), and

a top-side end of the core portion (20) is fixed to the first high hardness portion (40A).
11. The sole according to claim 9, further comprising a second high hardness portion (40B) having a plate shape and formed of a member higher in hardness than a foam material forming the core portion (20) and the second base portion (10B), wherein

the second high hardness portion (40B) is disposed between the core portion (20) and the second base portion (10B), and

a bottom-side end of the core portion (20) is fixed to the second high hardness portion (40B).
12. The sole according to claim 9, further comprising:

a first high hardness portion (40A) having a plate shape and formed of a member higher in hard-

ness than a foam material forming the first base portion (10A) and the core portion (20); and a second high hardness portion (40B) having a plate shape and formed of a member higher in hardness than a foam material forming the core portion (20) and the second base portion (10B), wherein
 the first high hardness portion (40A) is disposed between the first base portion (10A) and the core portion (20),
 the second high hardness portion (40B) is disposed between the core portion (20) and the second base portion (10B),
 a top-side end of the core portion (20) is fixed to the first high hardness portion (40A), and
 a bottom-side end of the core portion (20) is fixed to the second high hardness portion (40B).

13. The sole according to any one of claims 1 to 8, further comprising an outsole (30) formed of a member higher in hardness than a foam material forming the core portion (20), the outsole (30) constituting the ground contact surface (2b), wherein the outsole (30) is fixed to the core portion (20) so as to cover a bottom-side end of the core portion (20).
14. The sole according to any one of claims 1 to 13, wherein the core portion (20) is disposed in a portion of the sole, the portion being configured to support an MP joint of the foot of the wearer.
15. The sole according to any one of claims 1 to 13, wherein the core portion (20) is disposed in a portion of the sole, the portion being configured to support a toe portion of the foot of the wearer.
16. The sole according to any one of claims 1 to 13, wherein the core portion (20) is disposed in a portion of the sole, the portion being configured to support a heel portion of the foot of the wearer.
17. The sole according to any one of claims 1 to 16, comprising a plurality of the core portions (20), wherein the plurality of the core portions (20) are arranged to be aligned in a direction intersecting the up-down direction.
18. The sole according to claim 17, wherein the plurality of the core portions (20) include at least two core portions connected to each other.
19. The sole according to claim 18, wherein the core portion (20) includes a first core portion (20A), a second core portion (20B), and a third core portion (20C) as the plurality of the core portions,

the first core portion (20A) is disposed in a portion of the sole, the portion being configured to support an MP joint of the foot of the wearer, the second core portion (20B) is disposed in a portion of the sole, the portion being configured to support a medial foot-side part of a toe portion of the foot of the wearer, the third core portion (20C) is disposed in a portion of the sole, the portion being configured to support a lateral foot-side part of the toe portion of the foot of the wearer, the first core portion (20A) and the second core portion (20B) are connected to each other, and the first core portion (20A) and the third core portion (20C) are connected to each other.

20. A shoe comprising:

the sole according to any one of claims 1 to 19; and
 an upper (3) located above the sole.

FIG.1

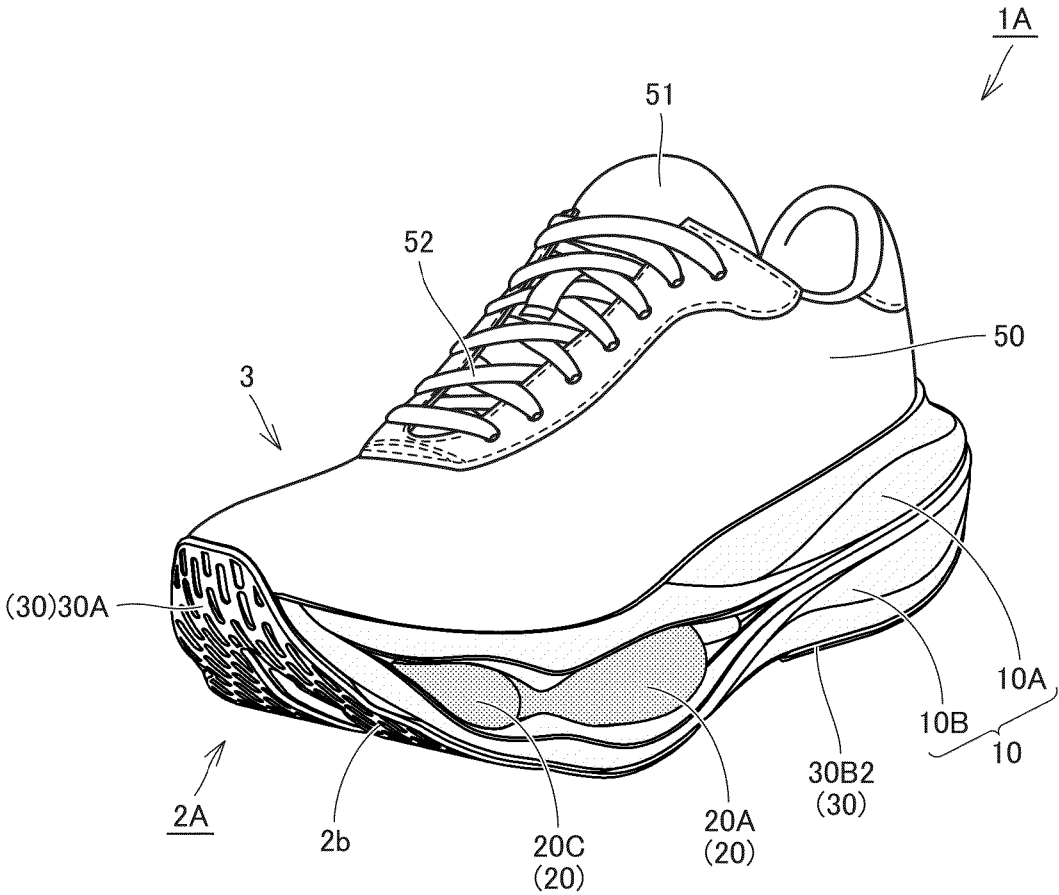


FIG. 2

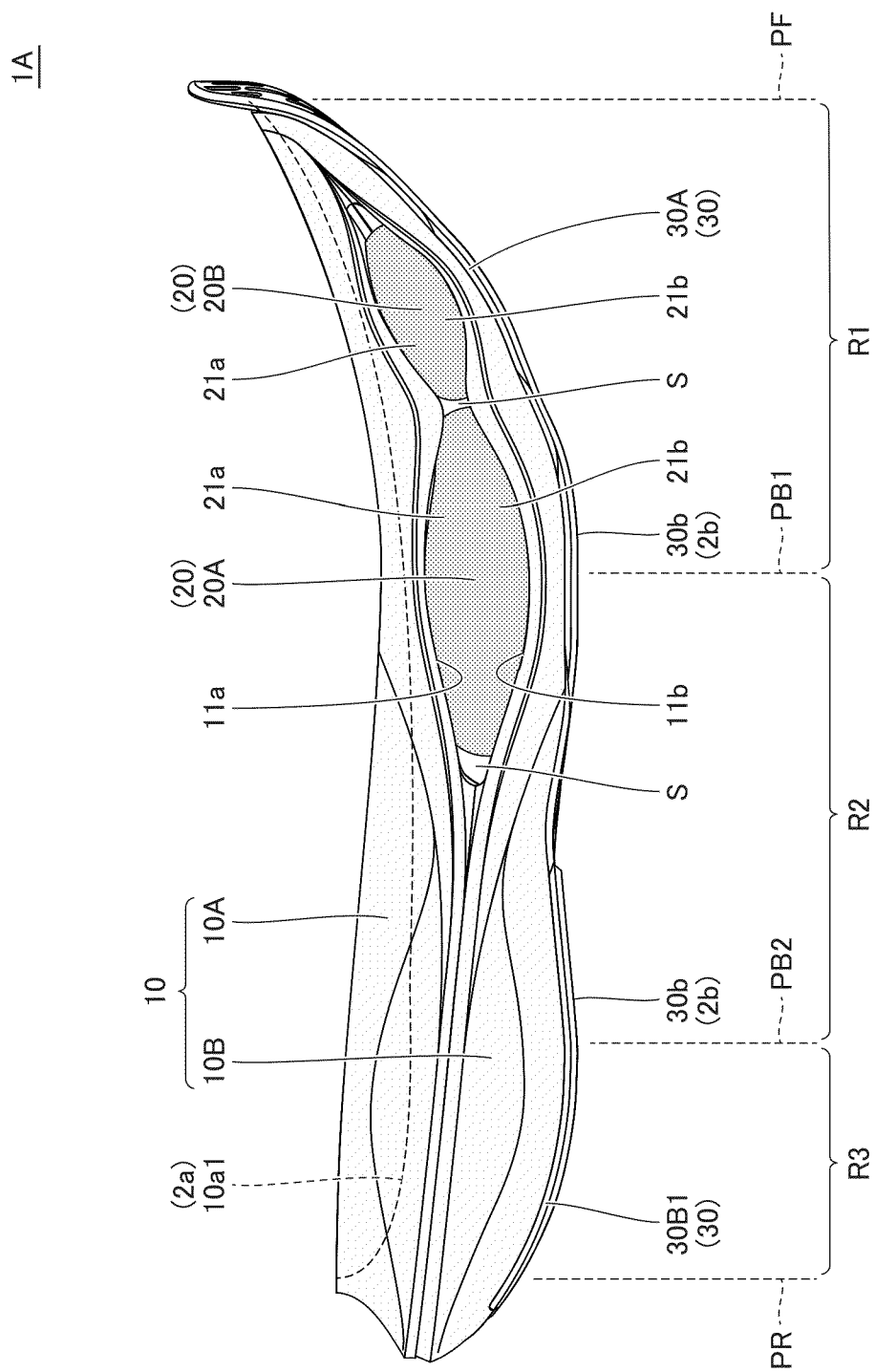


FIG.3

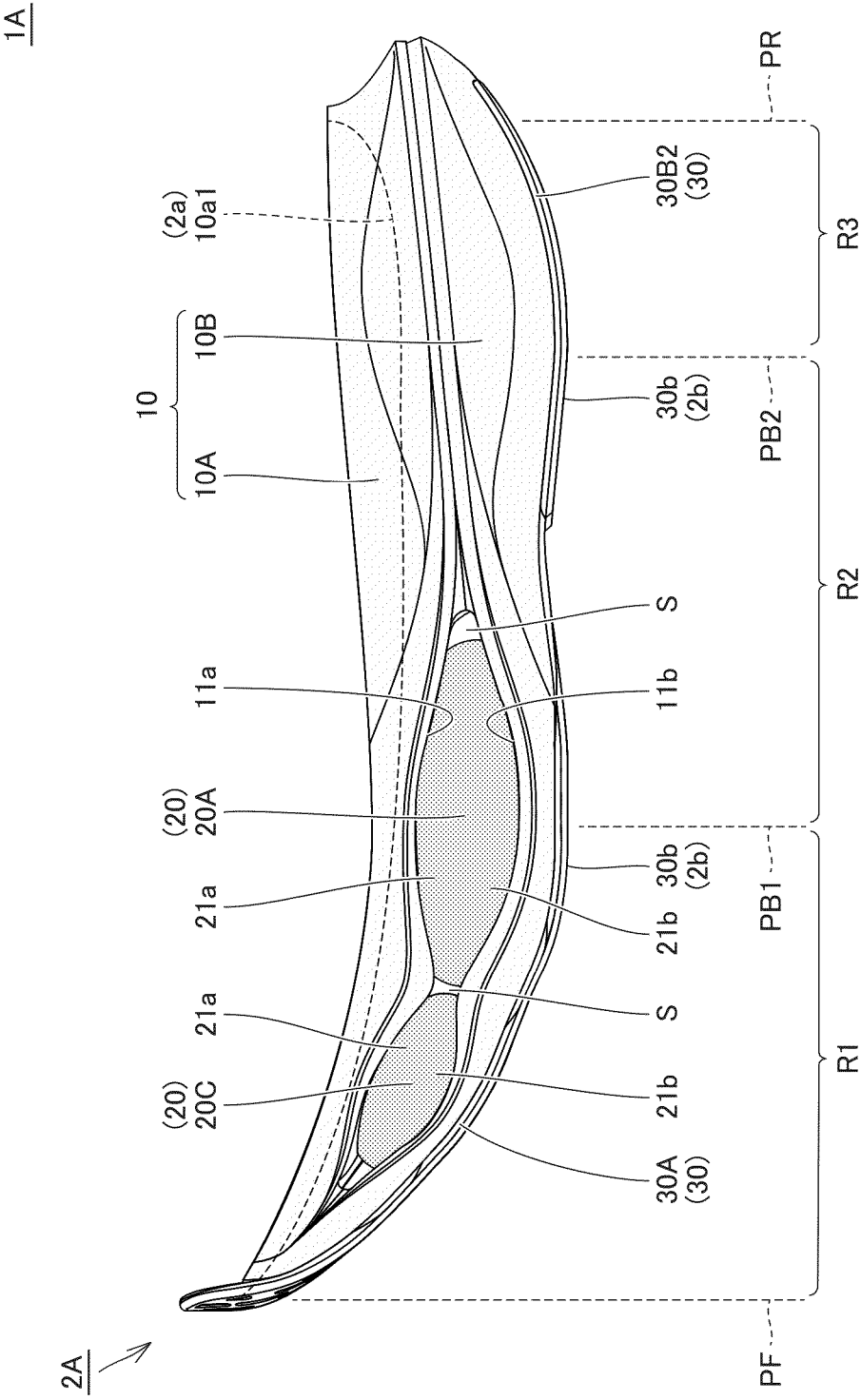


FIG.4

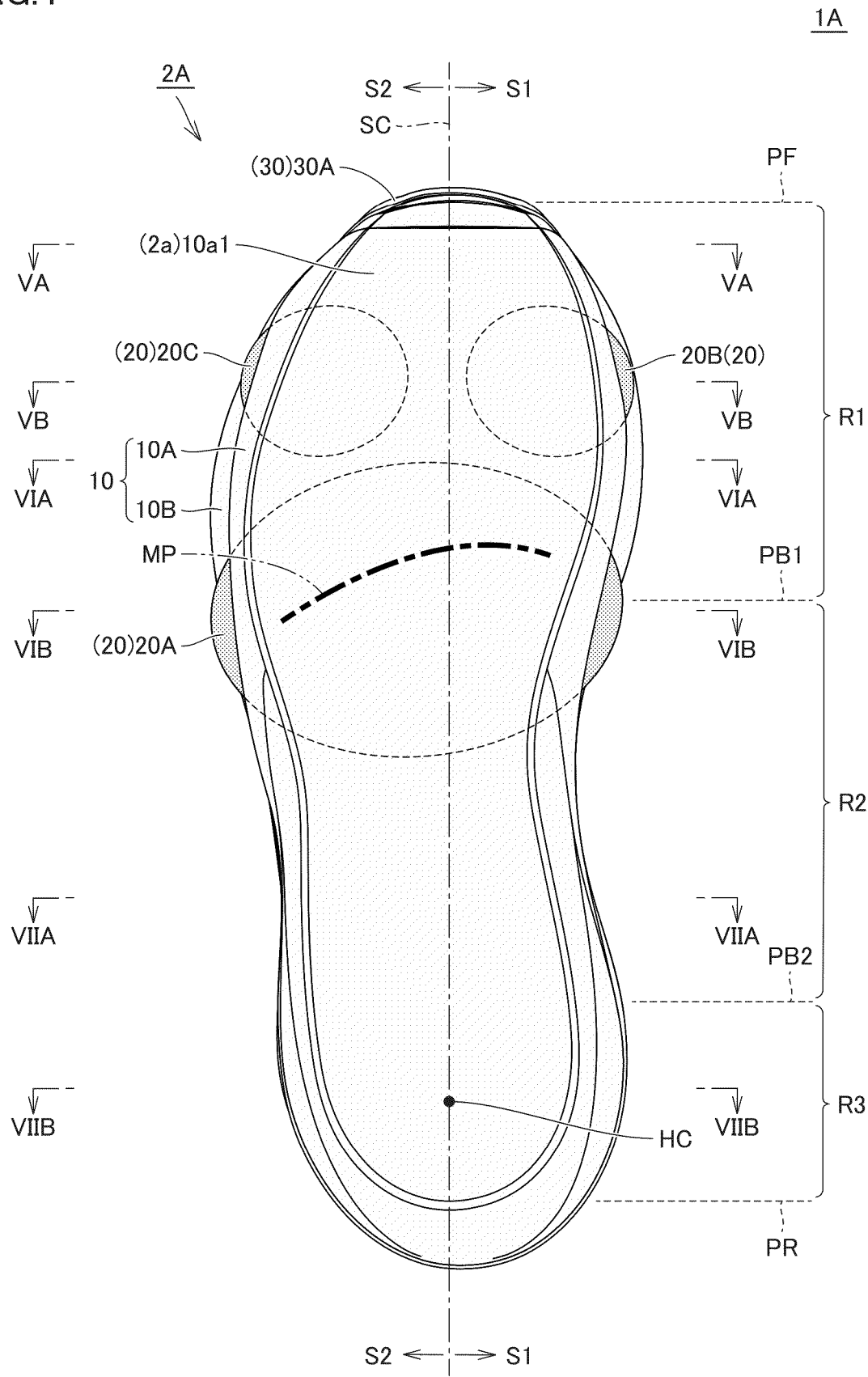


FIG.5A

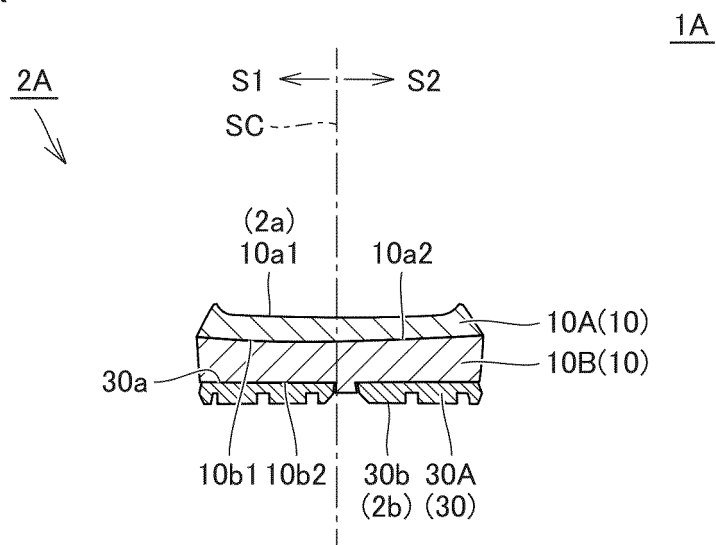


FIG.5B

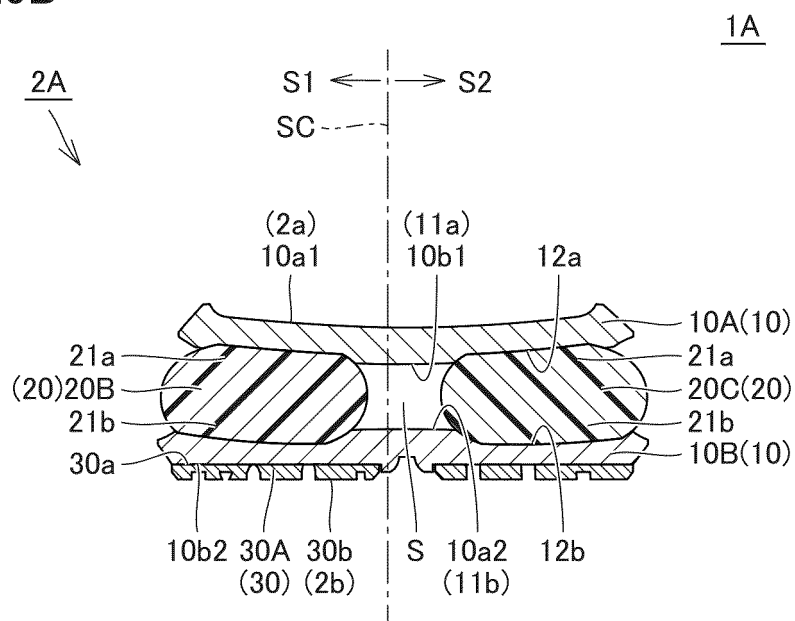


FIG.6A

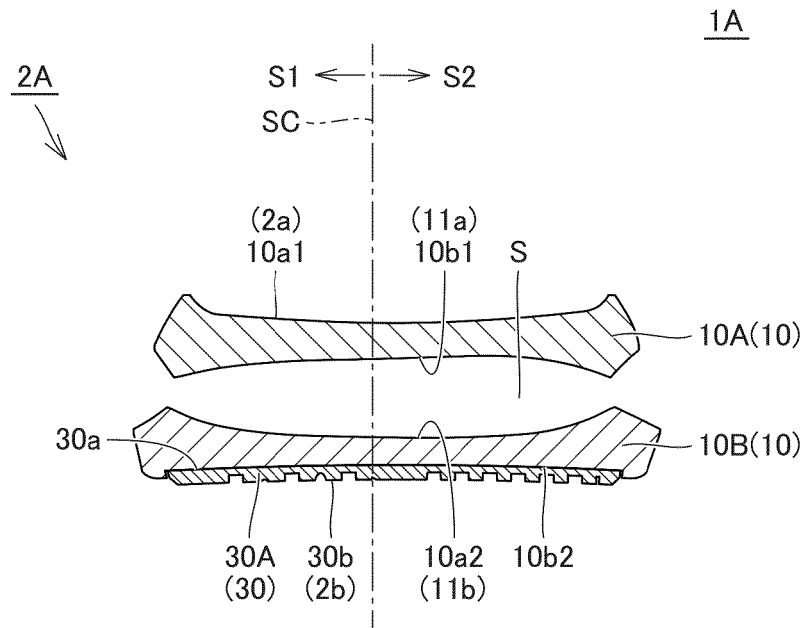


FIG.6B

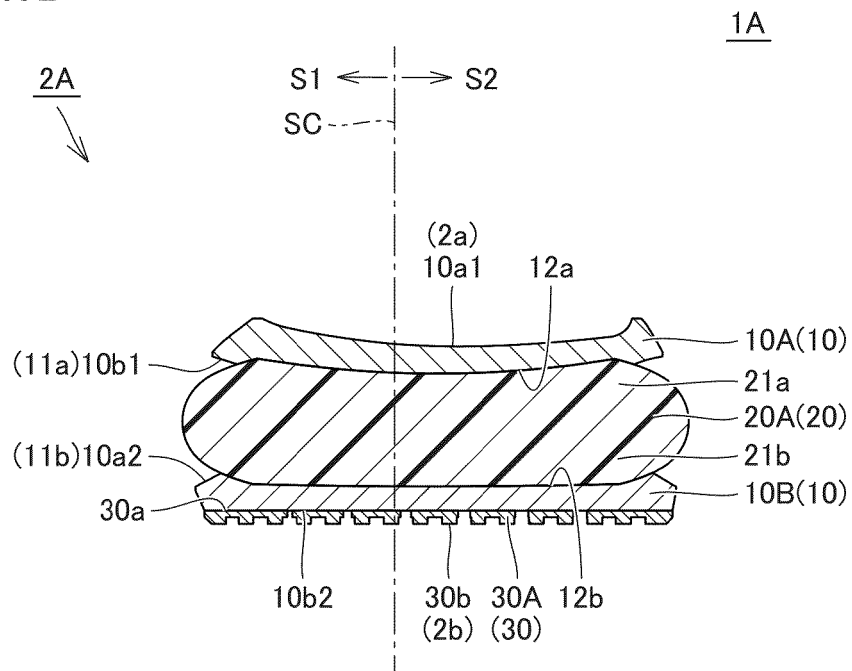


FIG.7A

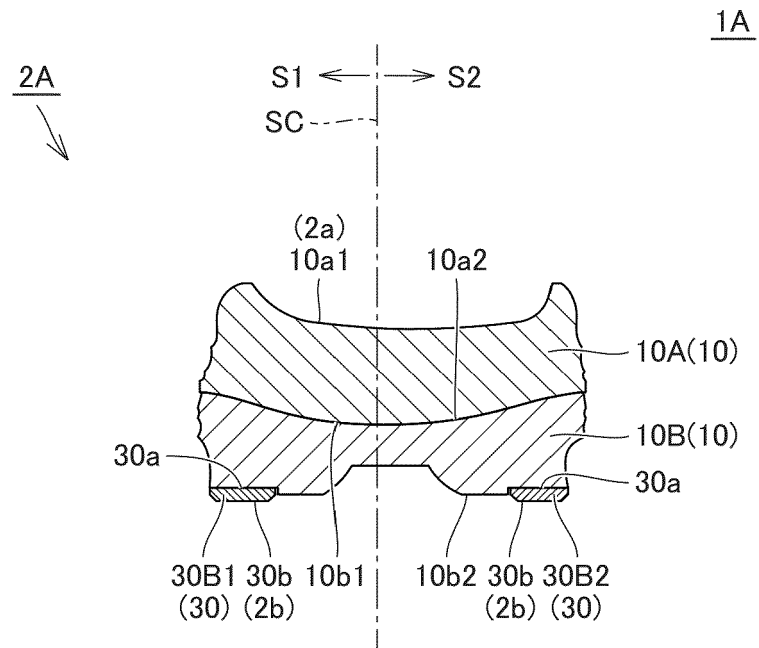


FIG.7B

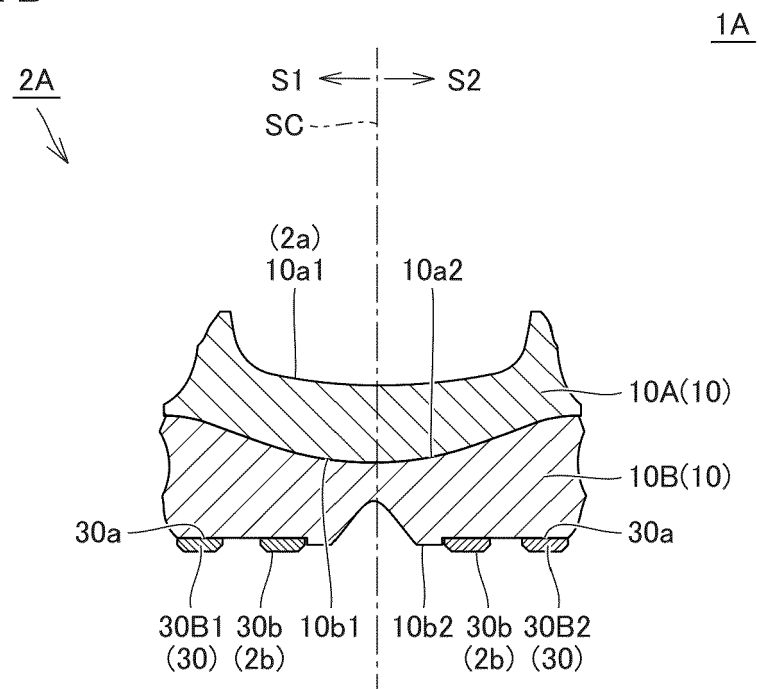


FIG.8

1A

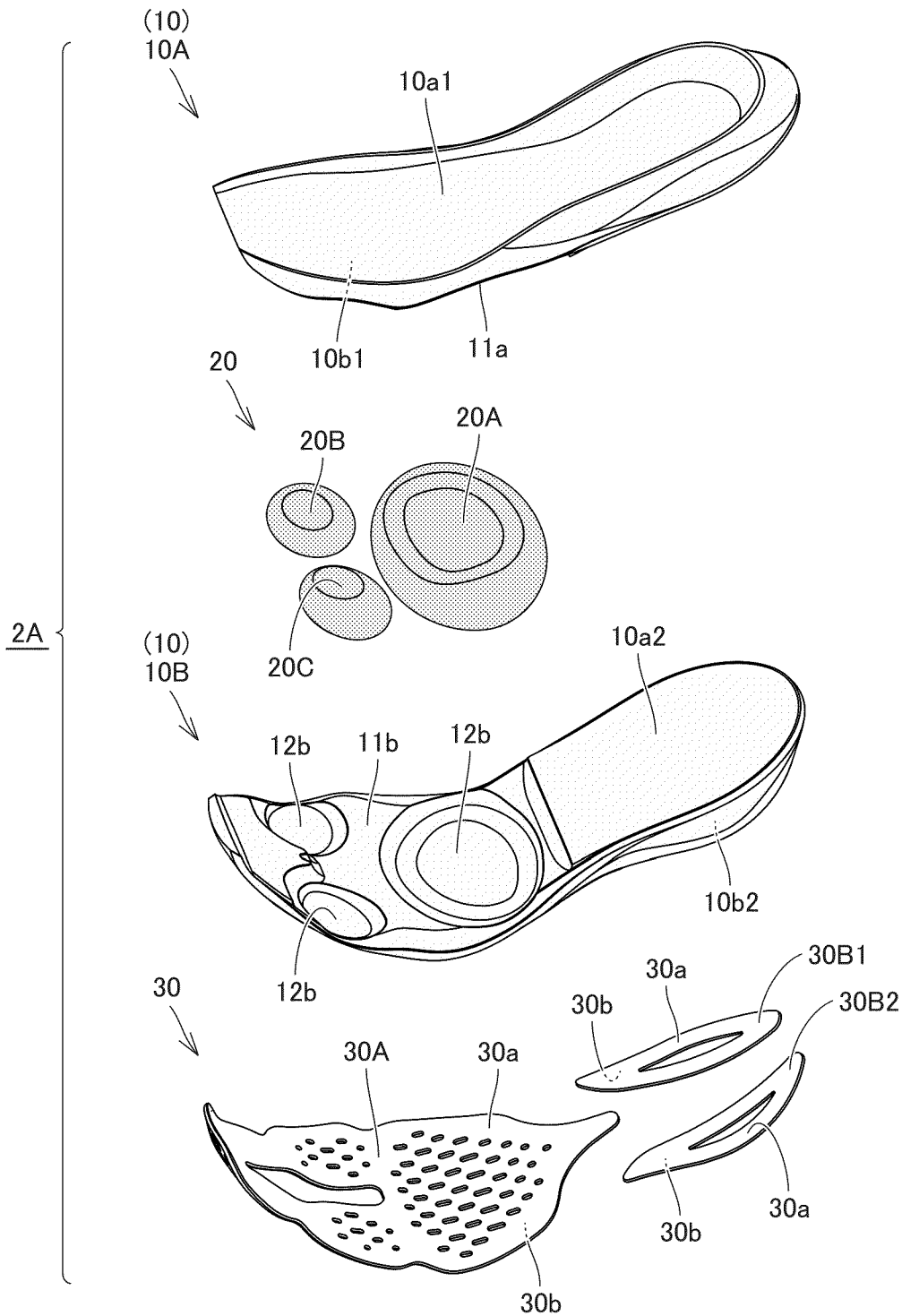


FIG.9

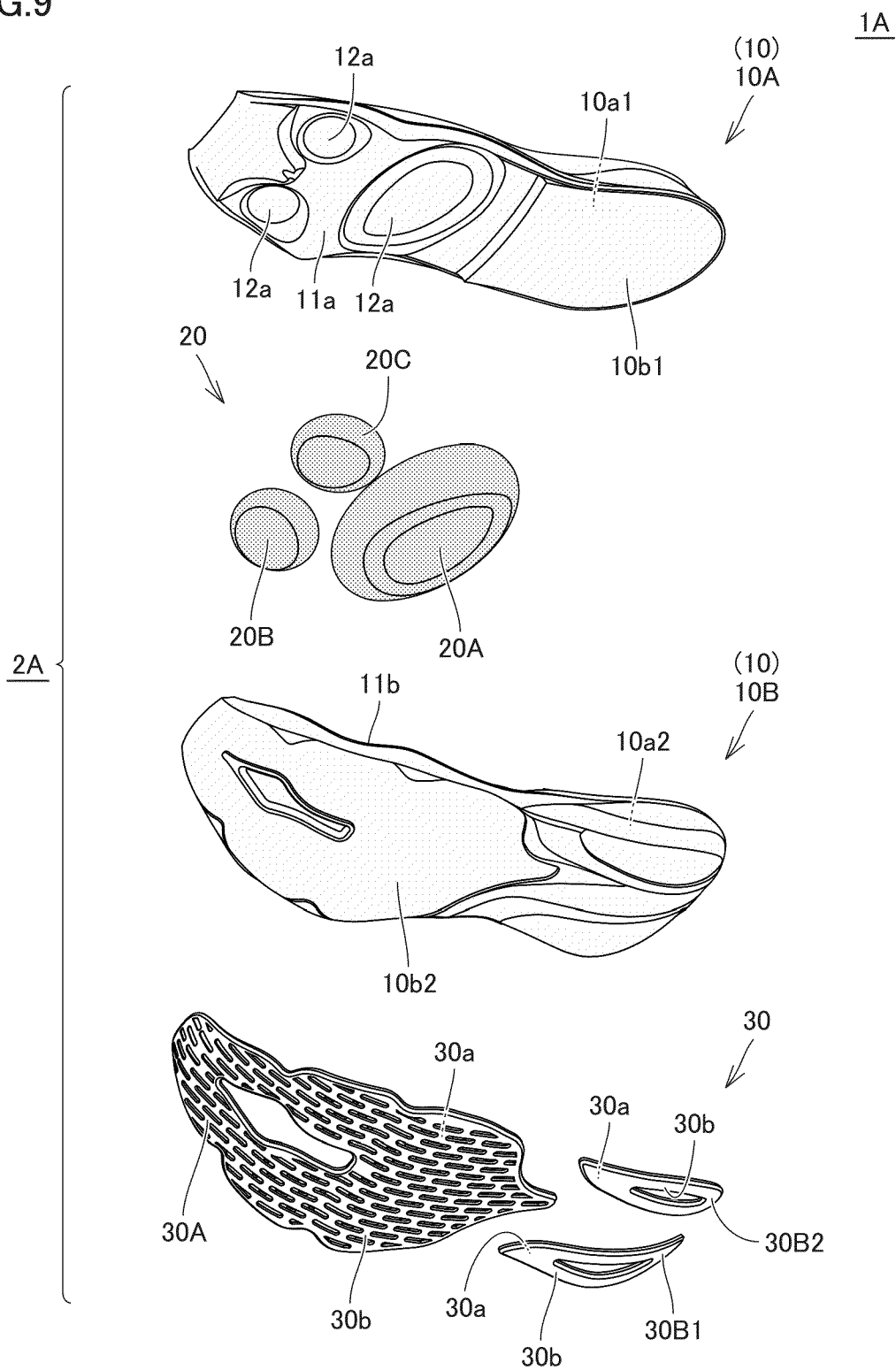


FIG. 10

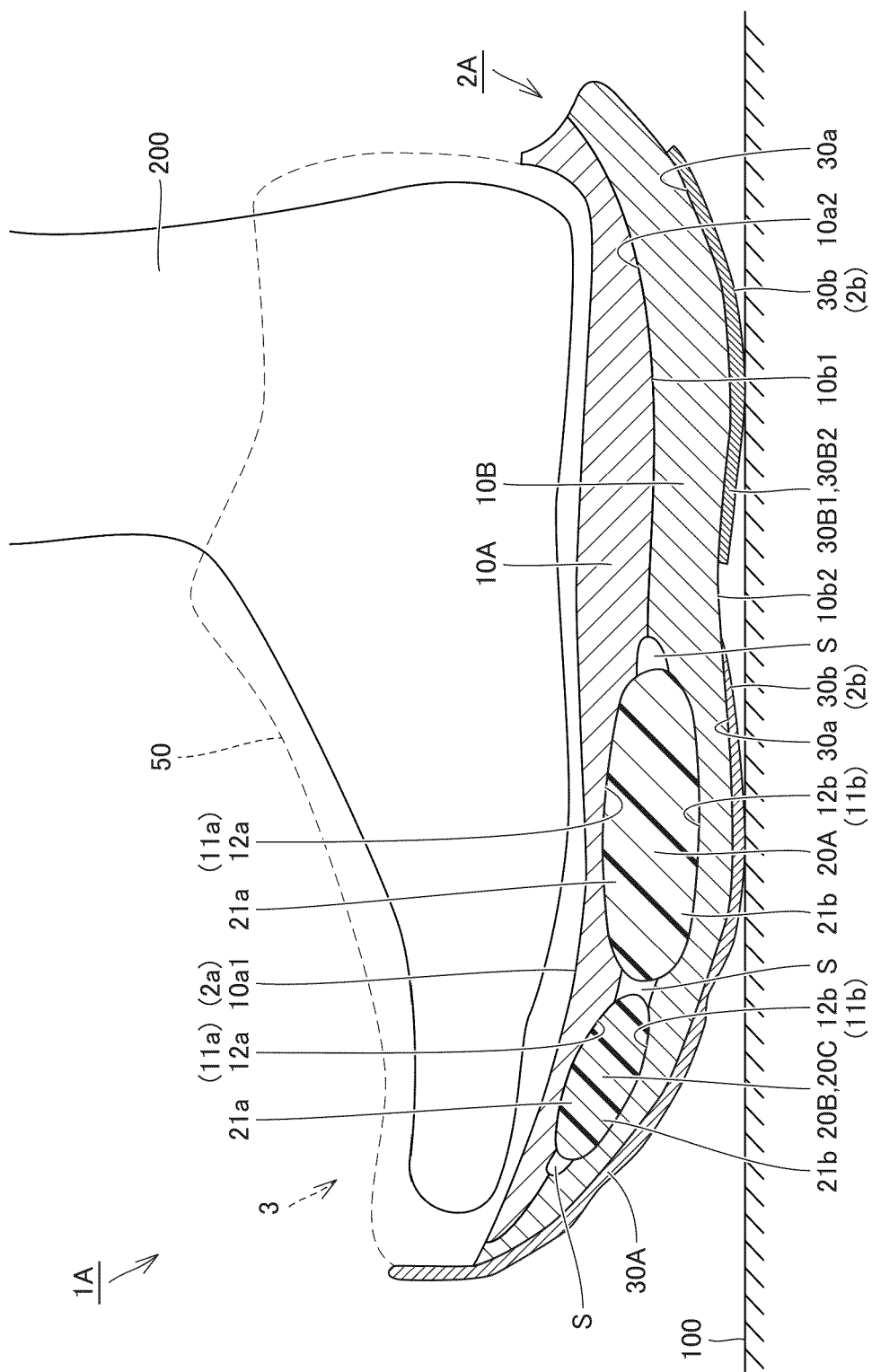


FIG. 11

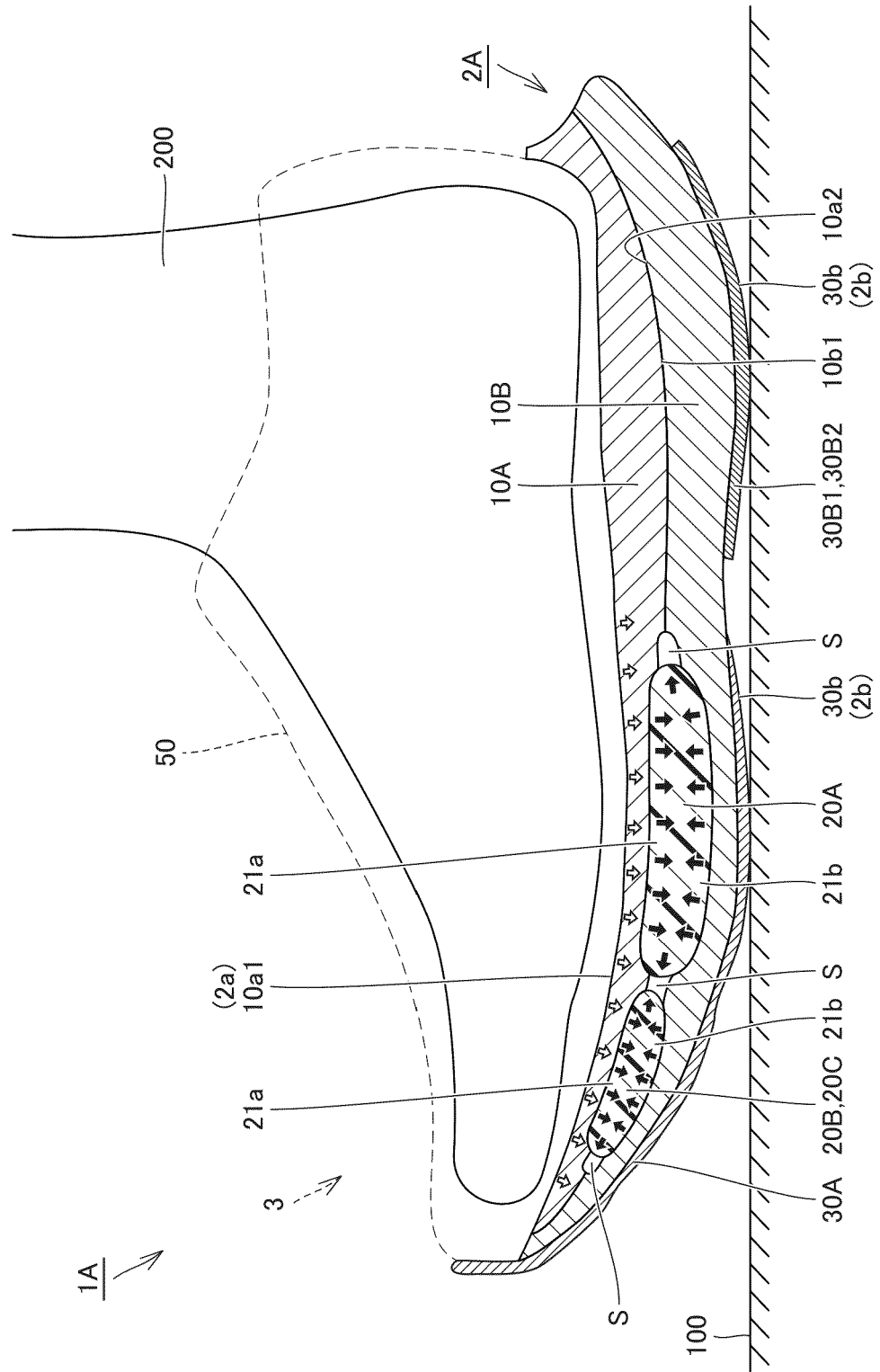


FIG.12

1A

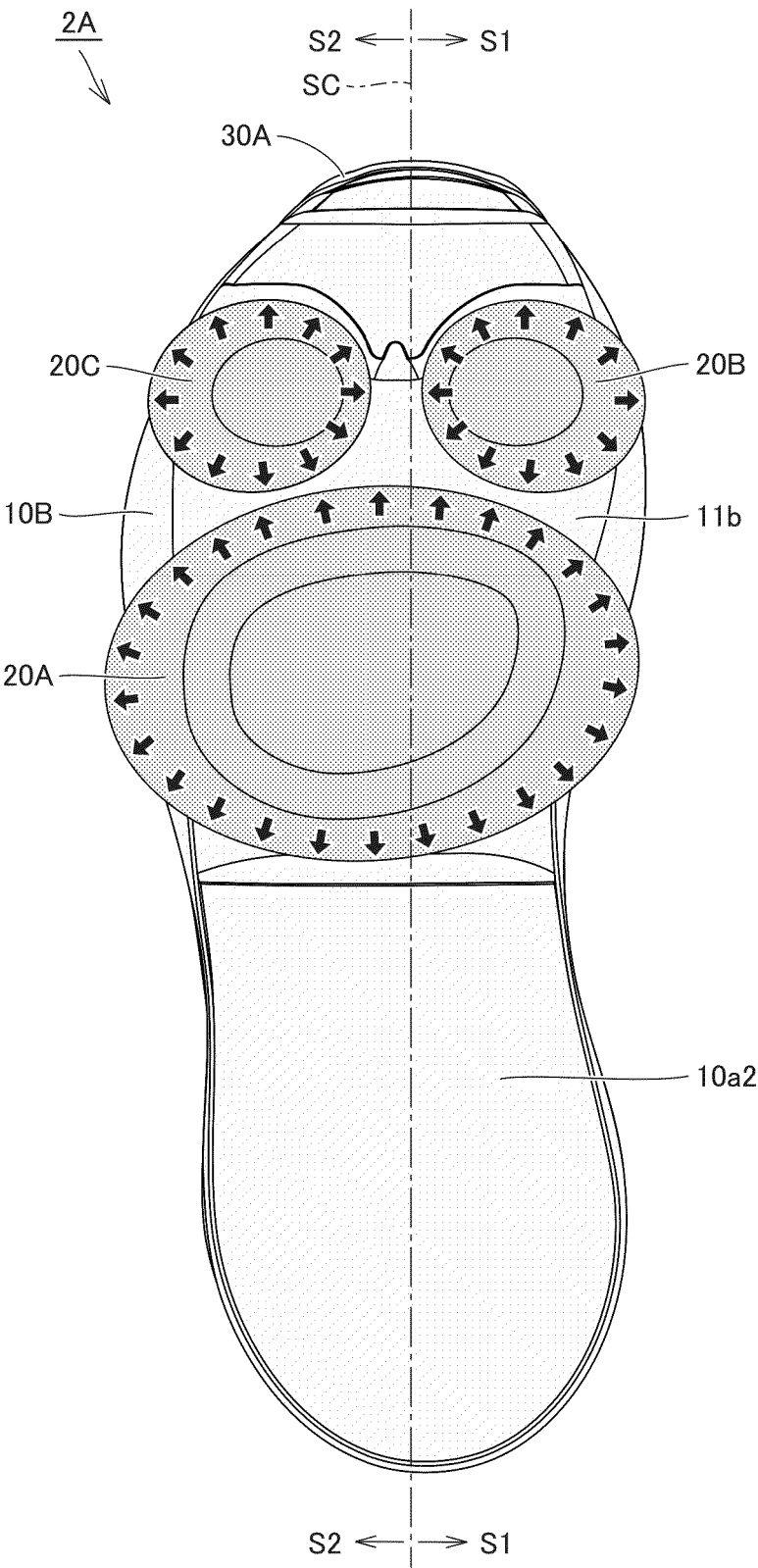


FIG.13A

2A1

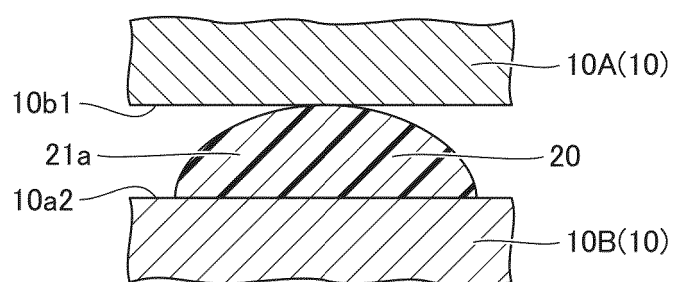


FIG.13B

2A2

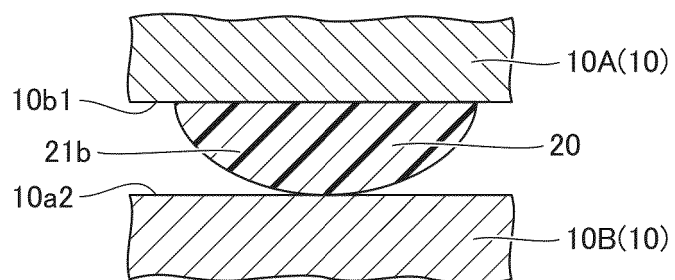


FIG.14A

2A3

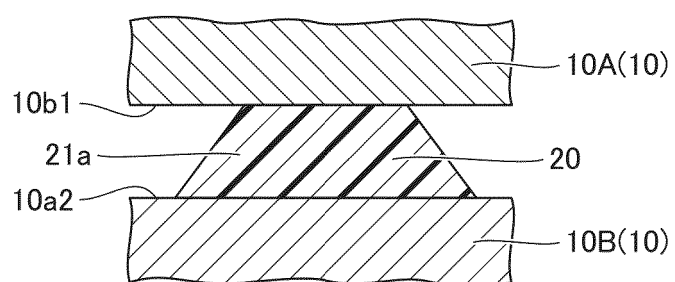


FIG.14B

2A4

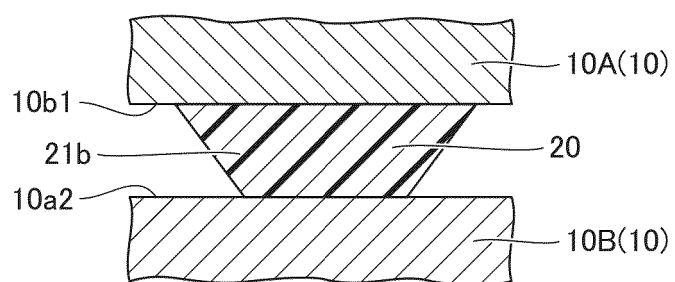


FIG.15A

2A5

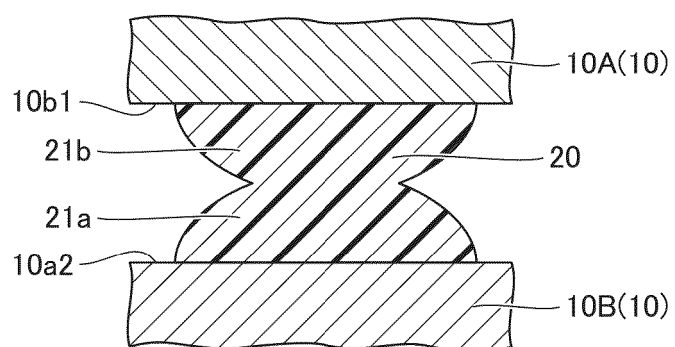


FIG.15B

2A6

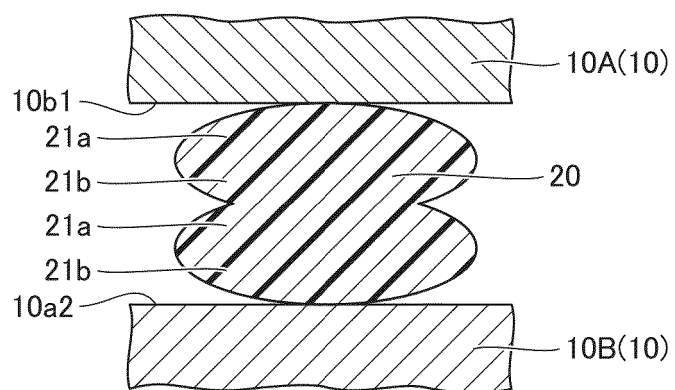


FIG.16

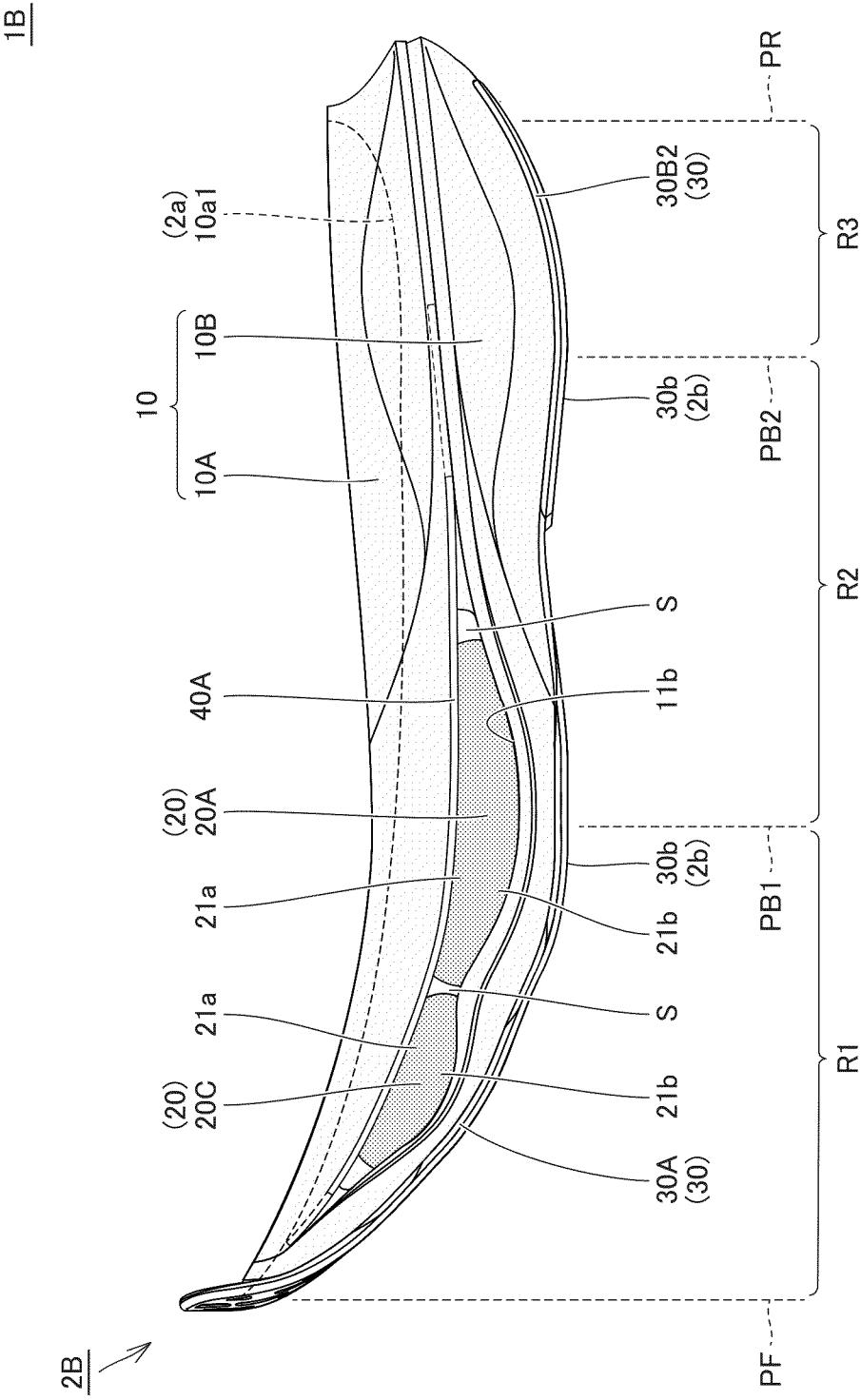


FIG.17

1B

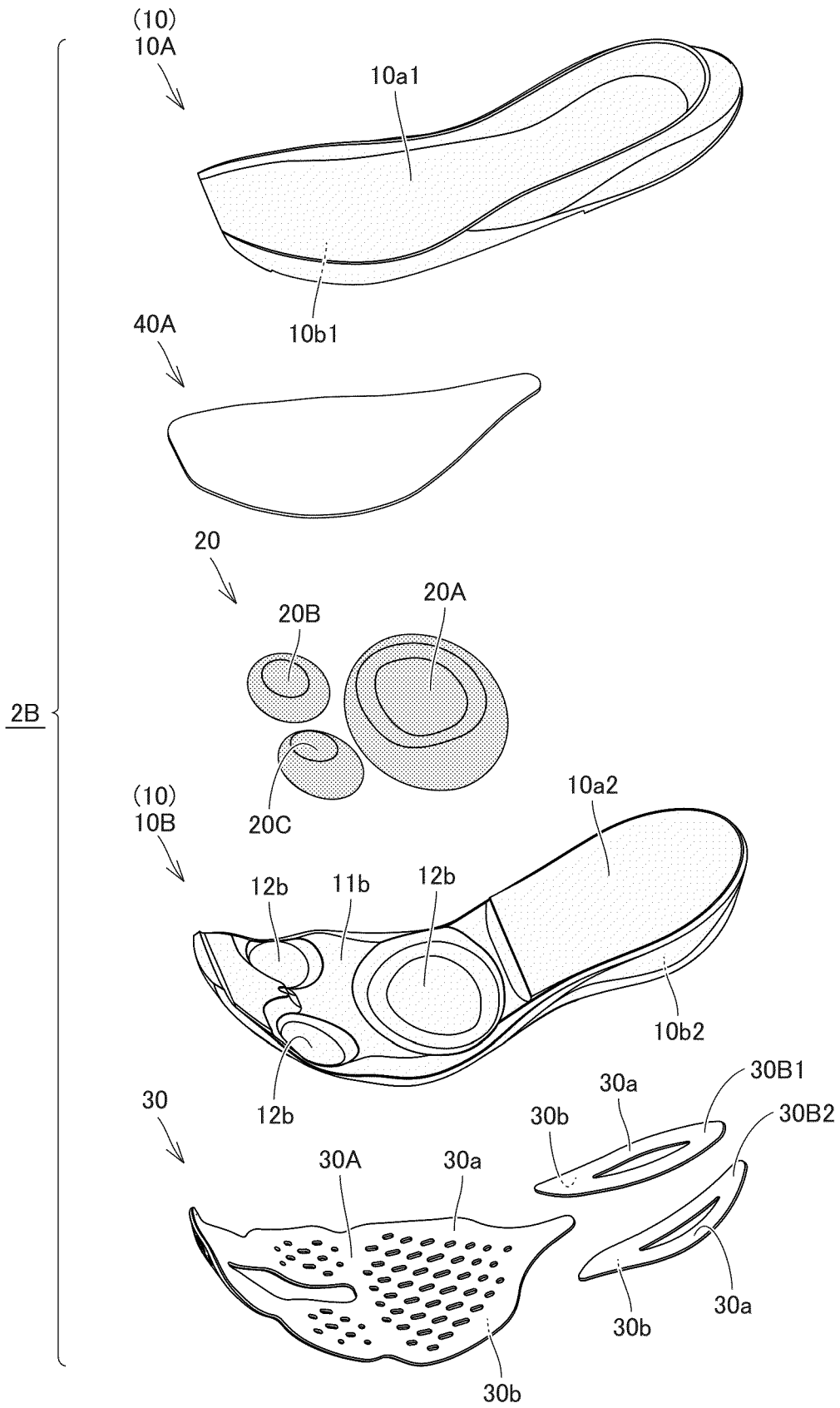


FIG.18A

2B1

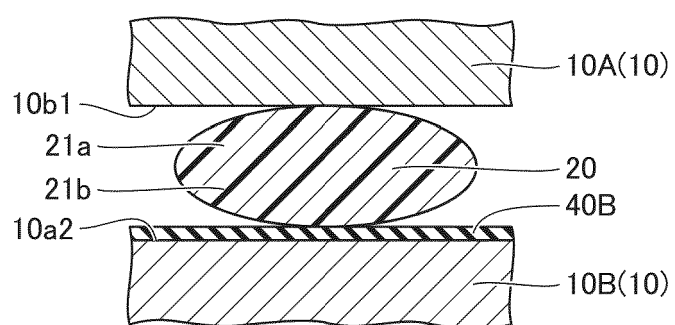


FIG.18B

2B2

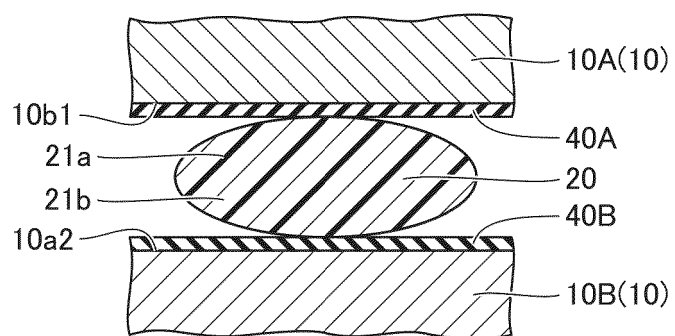


FIG. 19

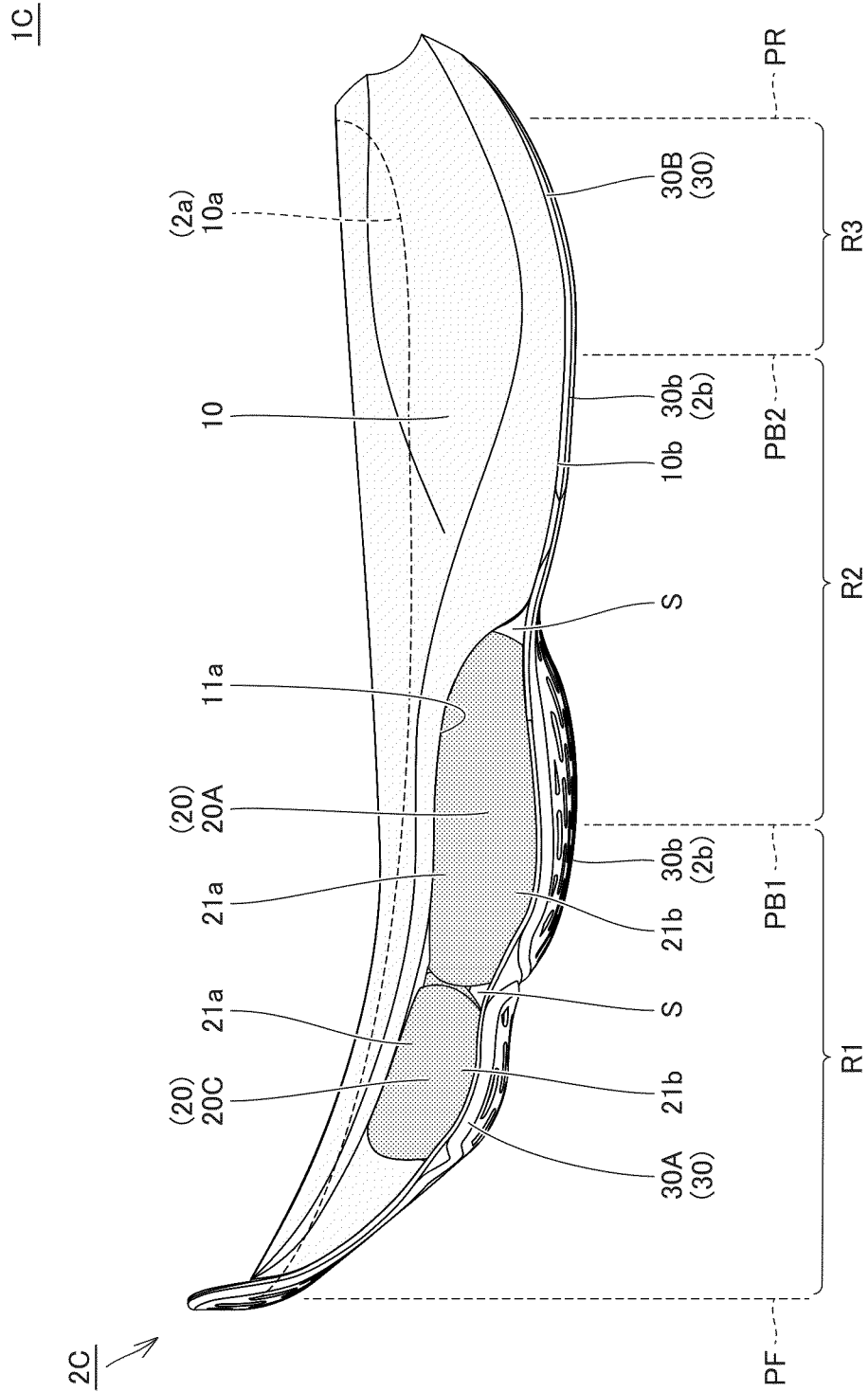


FIG.20

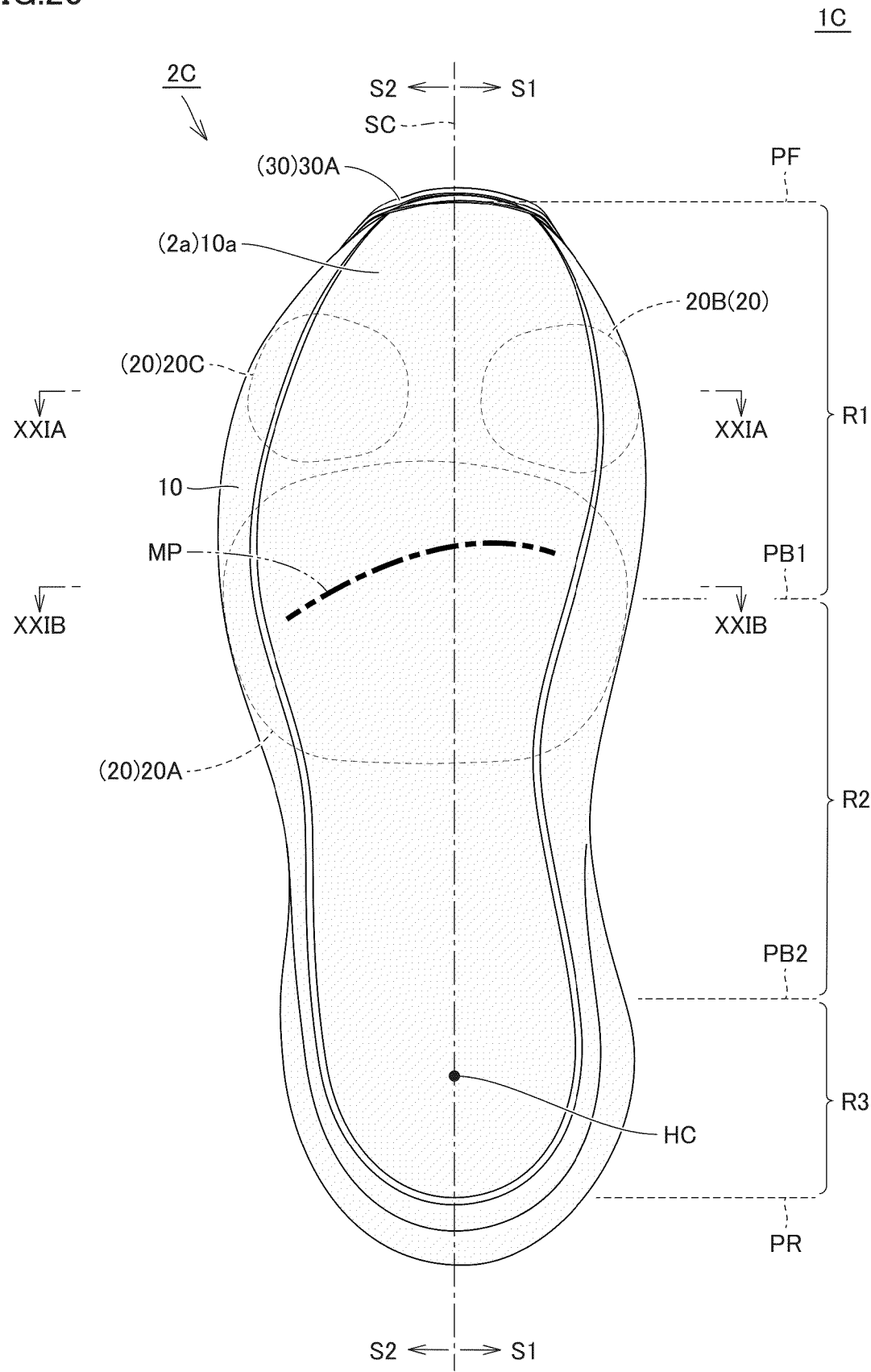


FIG.21A

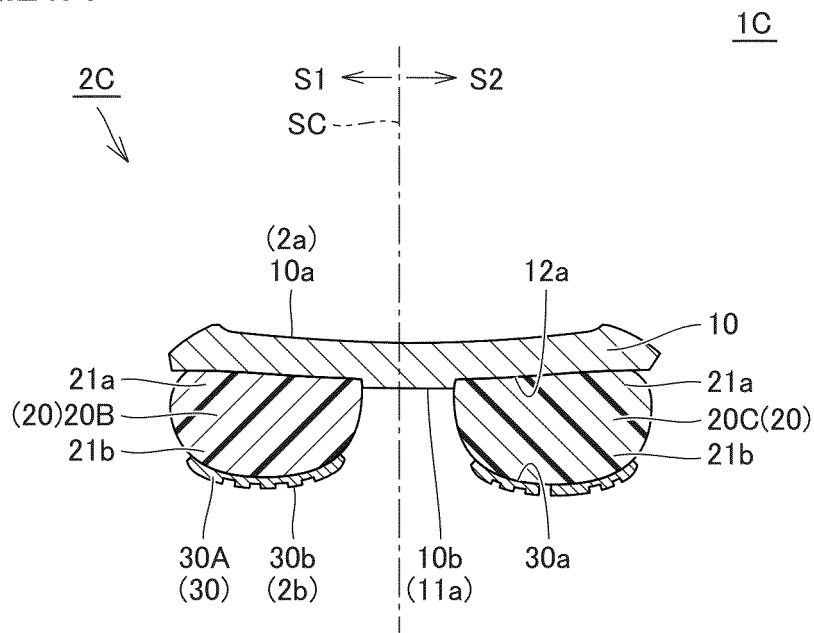


FIG.21B

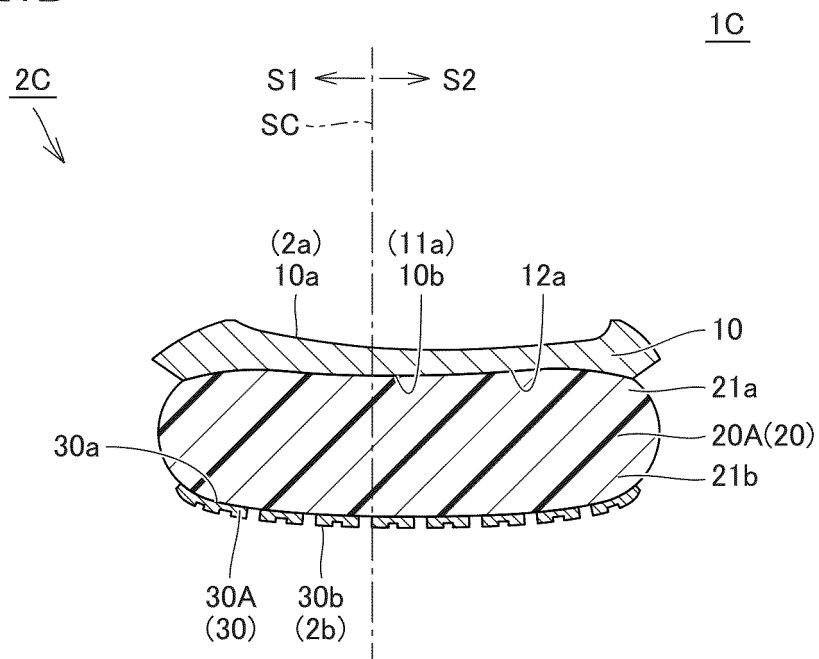


FIG.22

1C

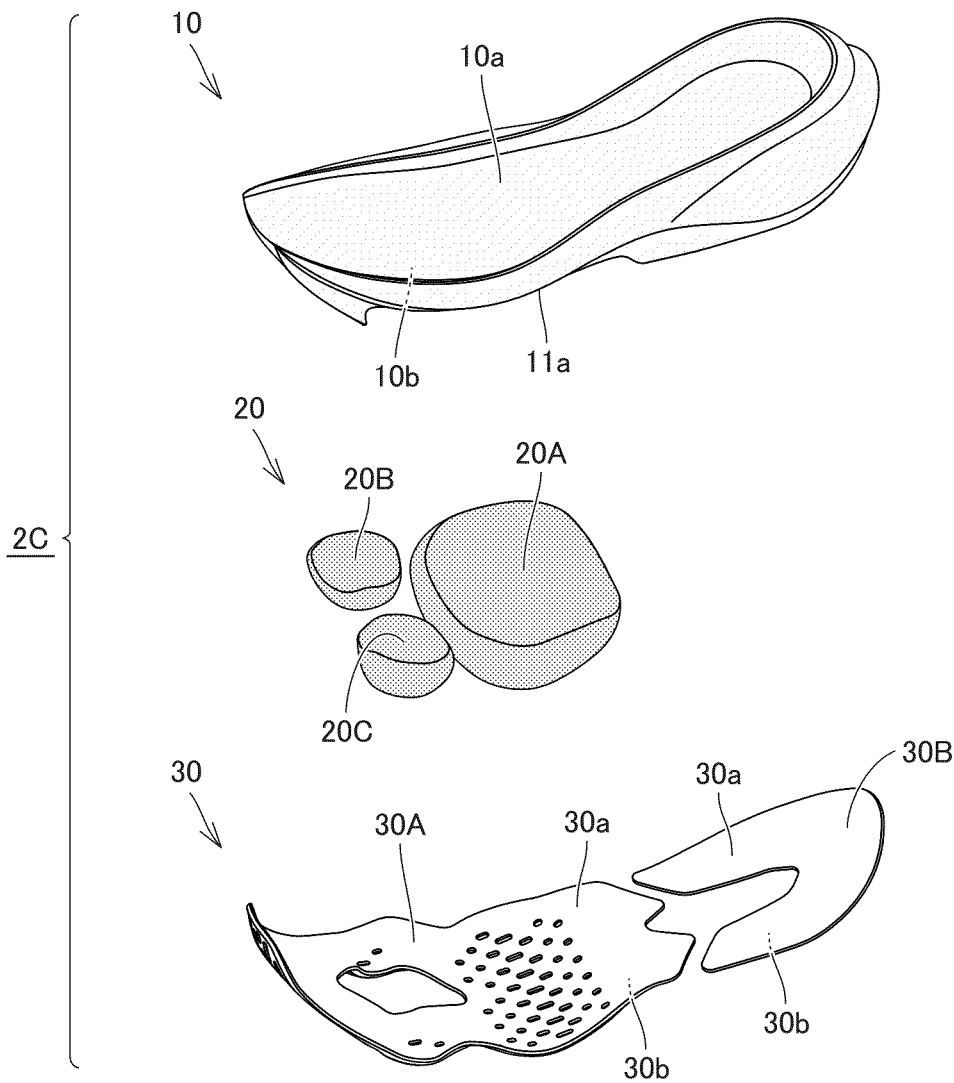


FIG.23

1C

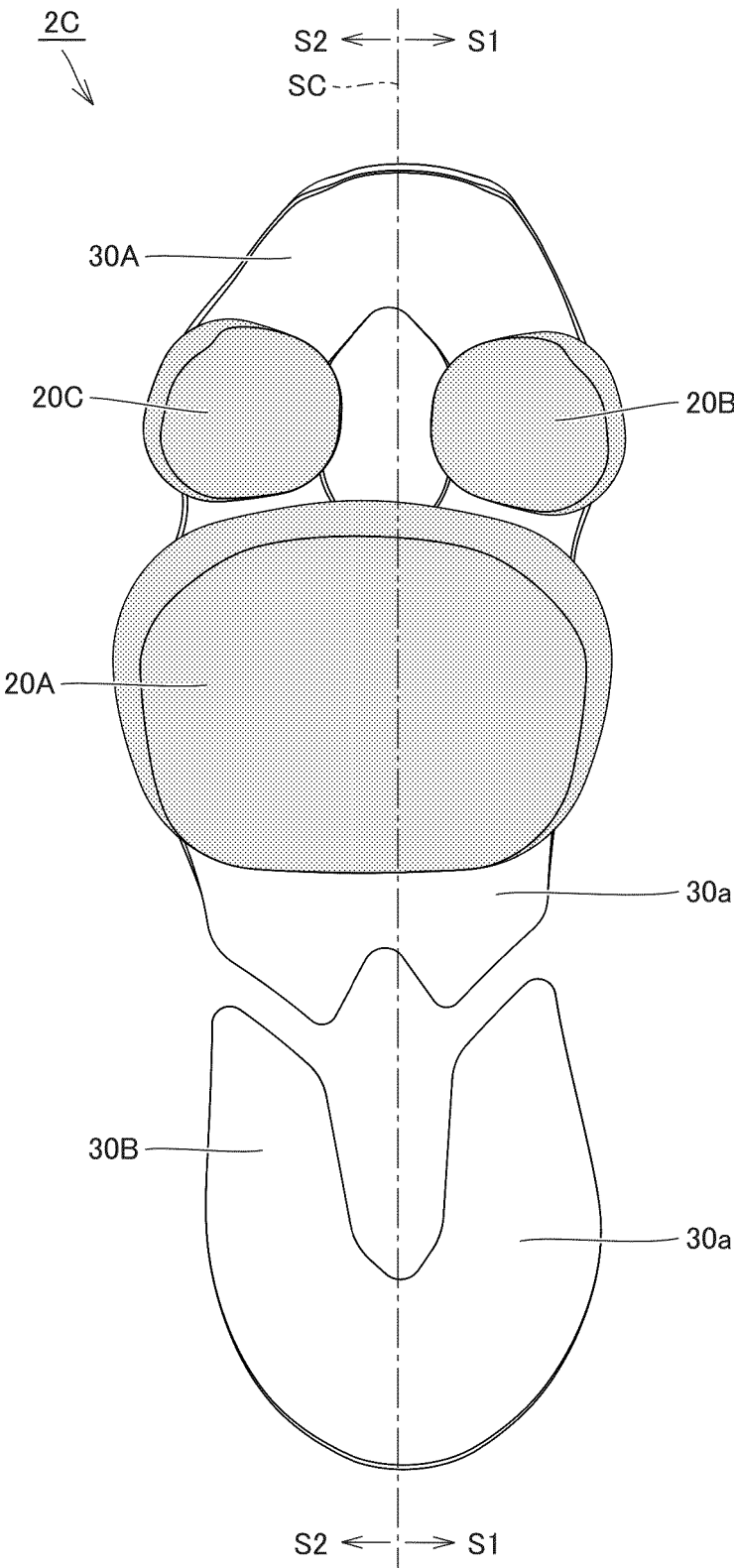


FIG. 24

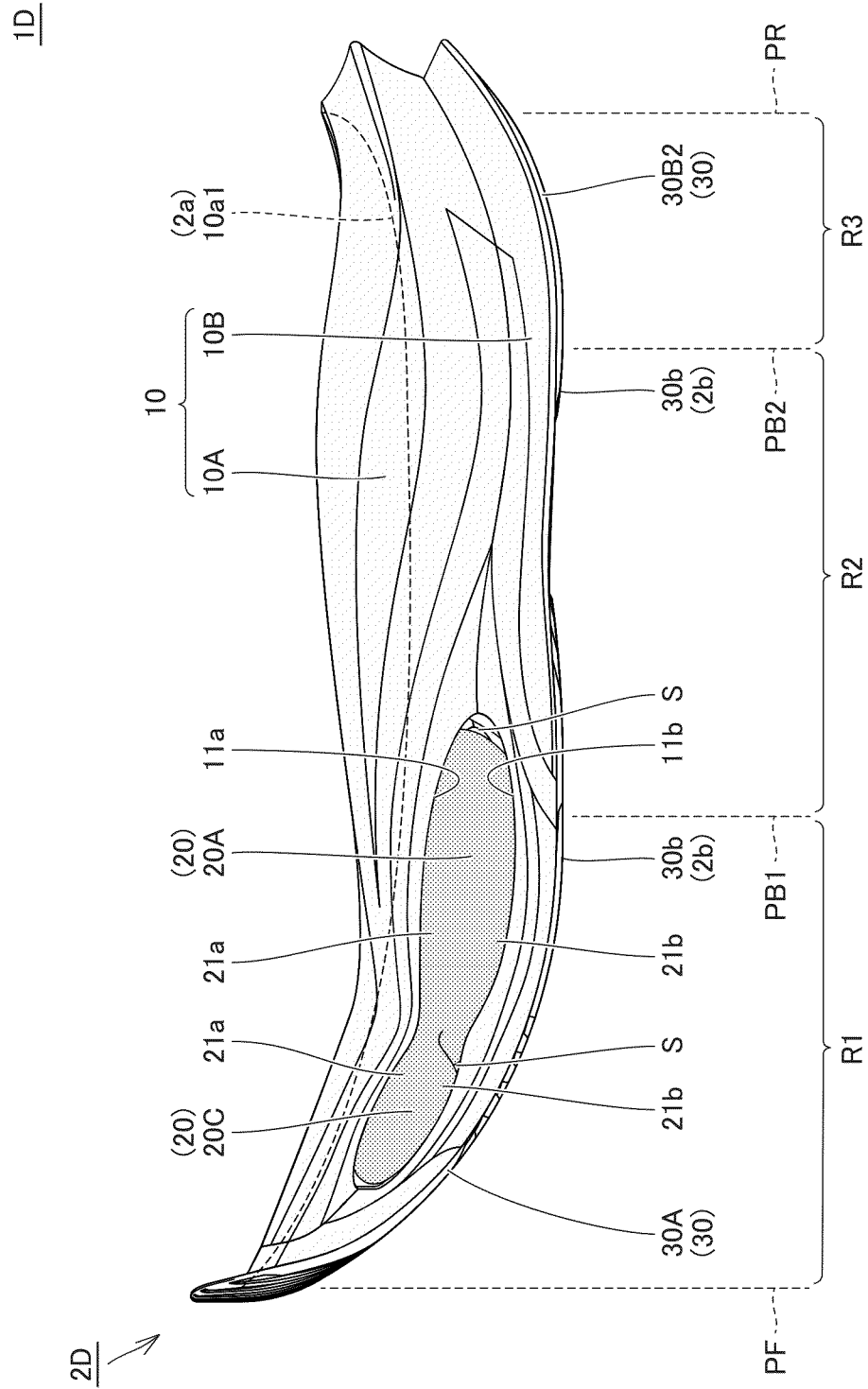


FIG.25

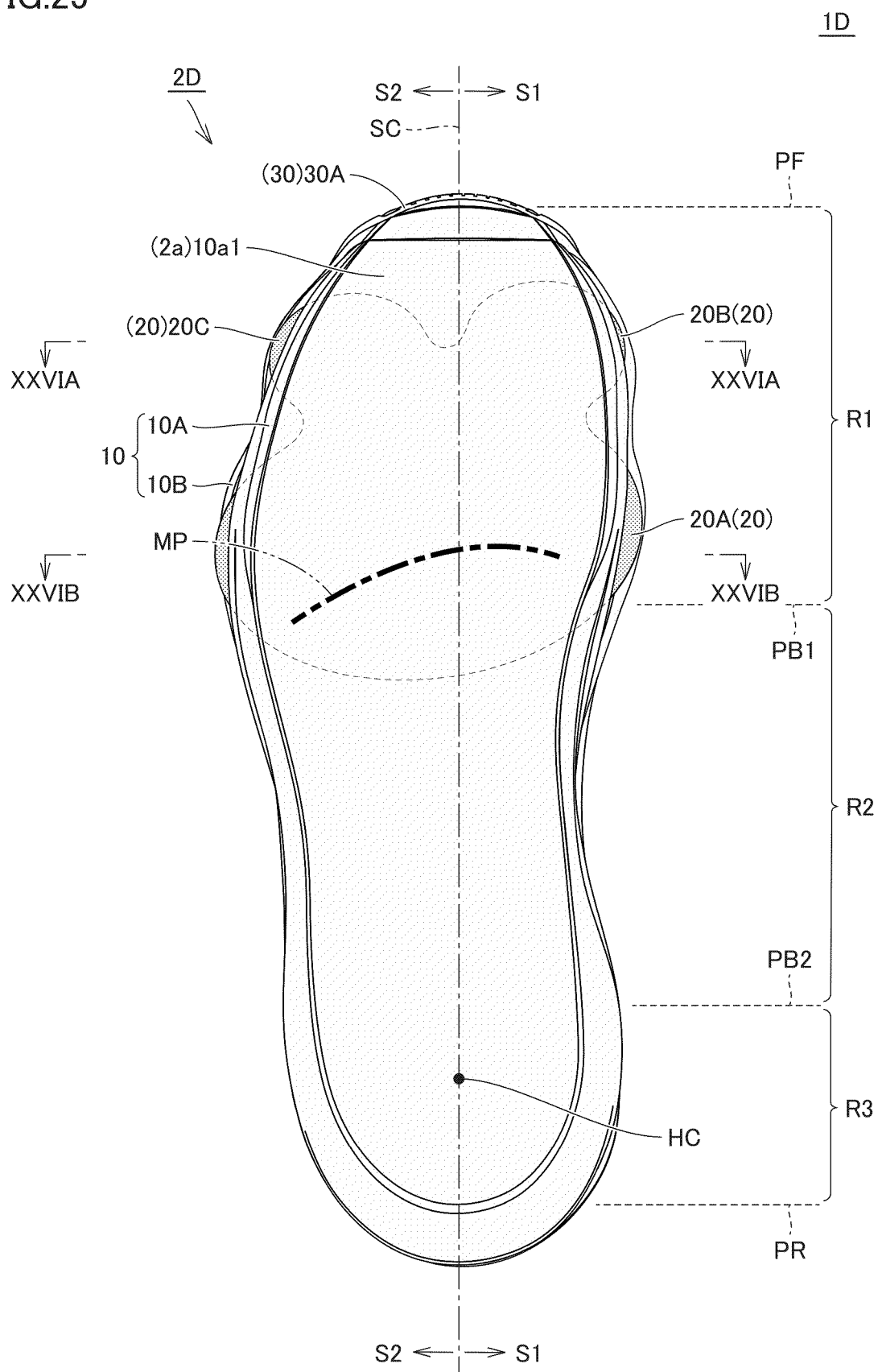


FIG.26A

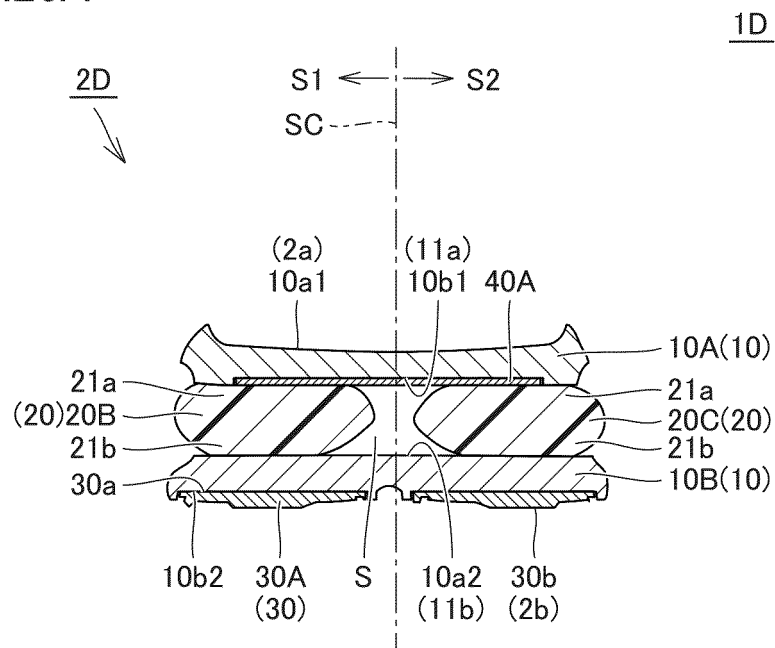


FIG.26B

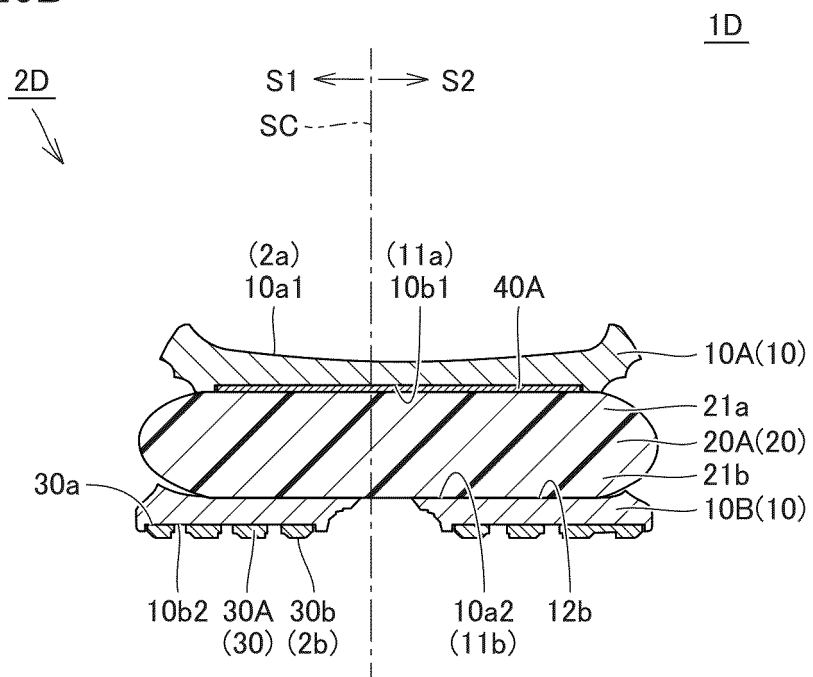


FIG.27

1D

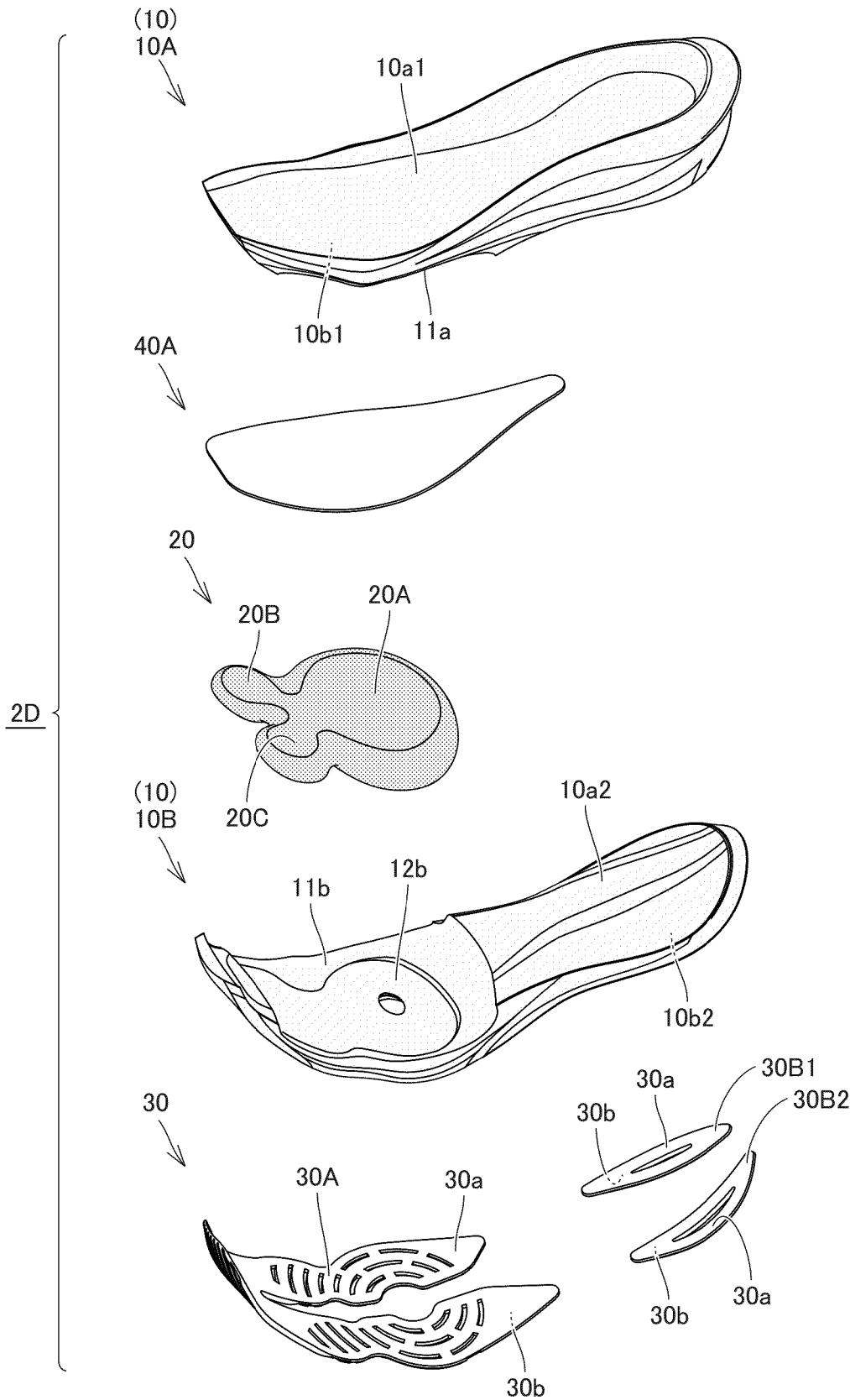


FIG.28

1D

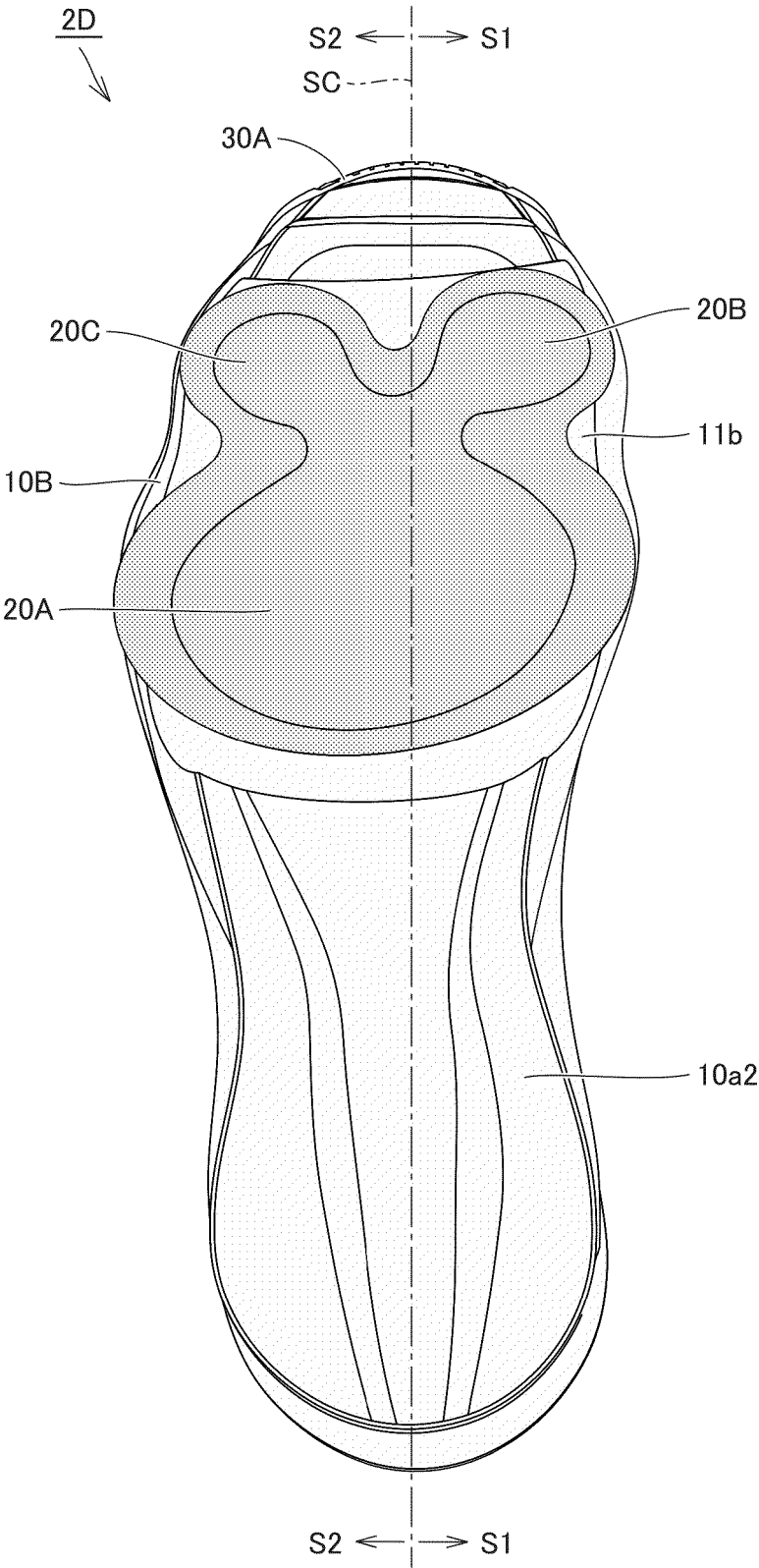


FIG.30

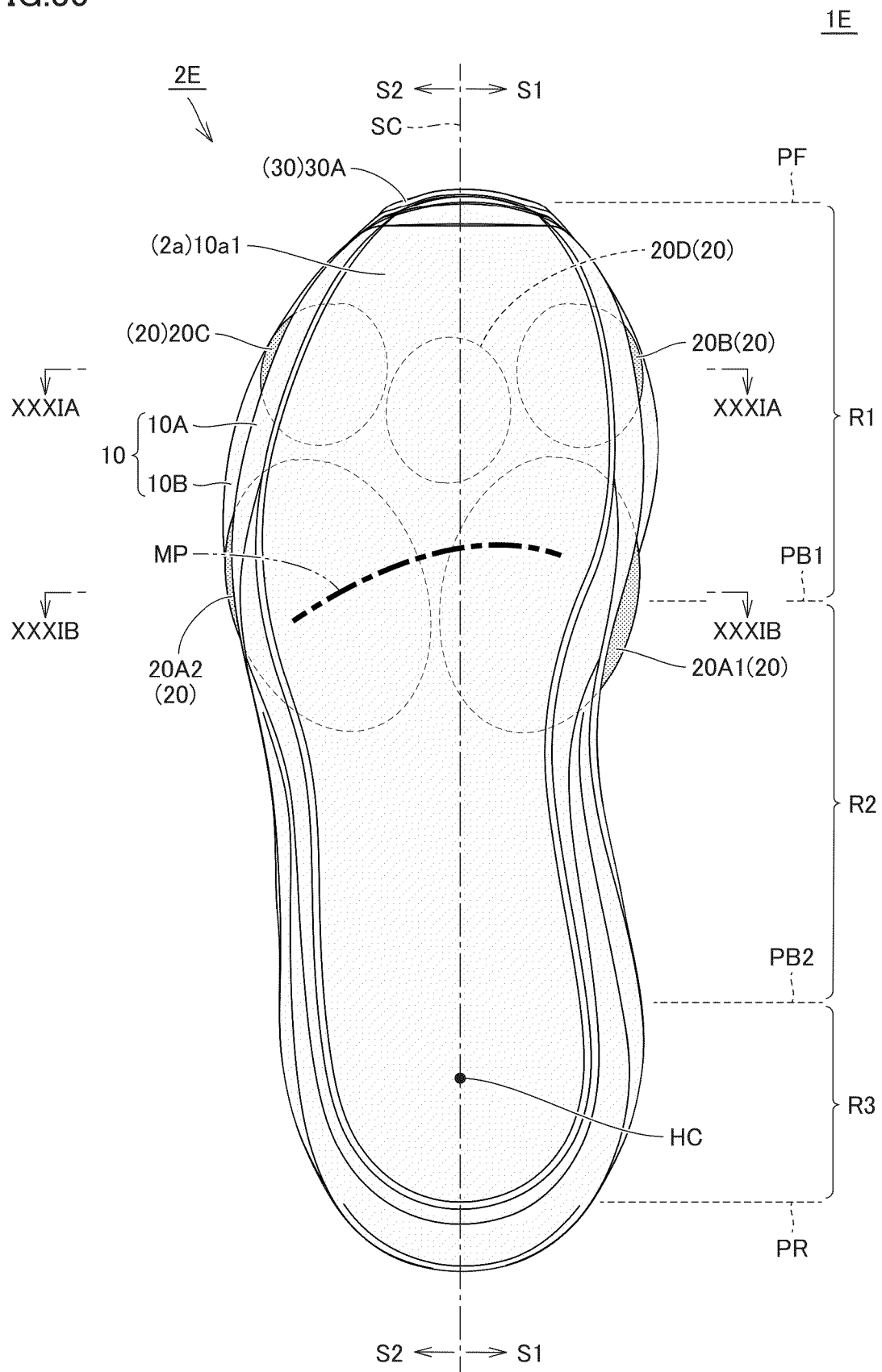


FIG.31A

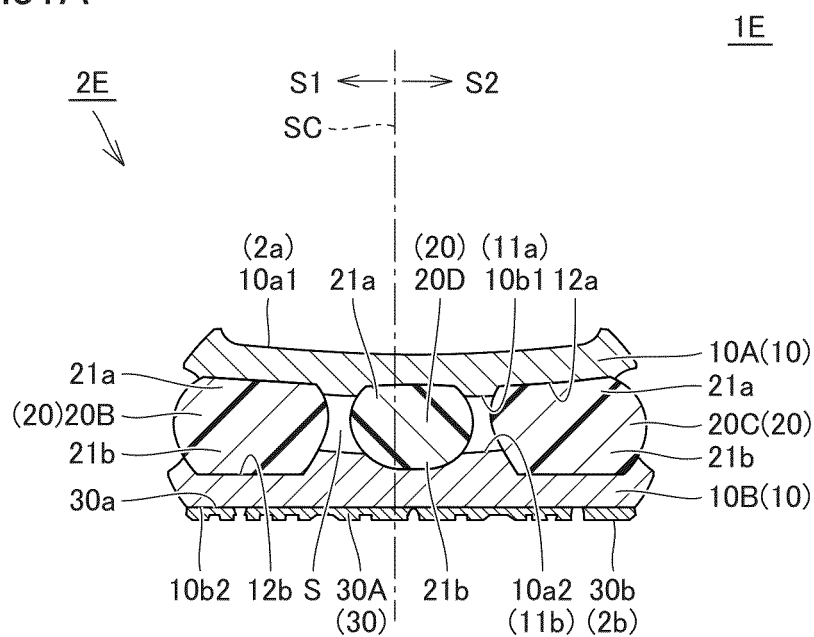


FIG.31B

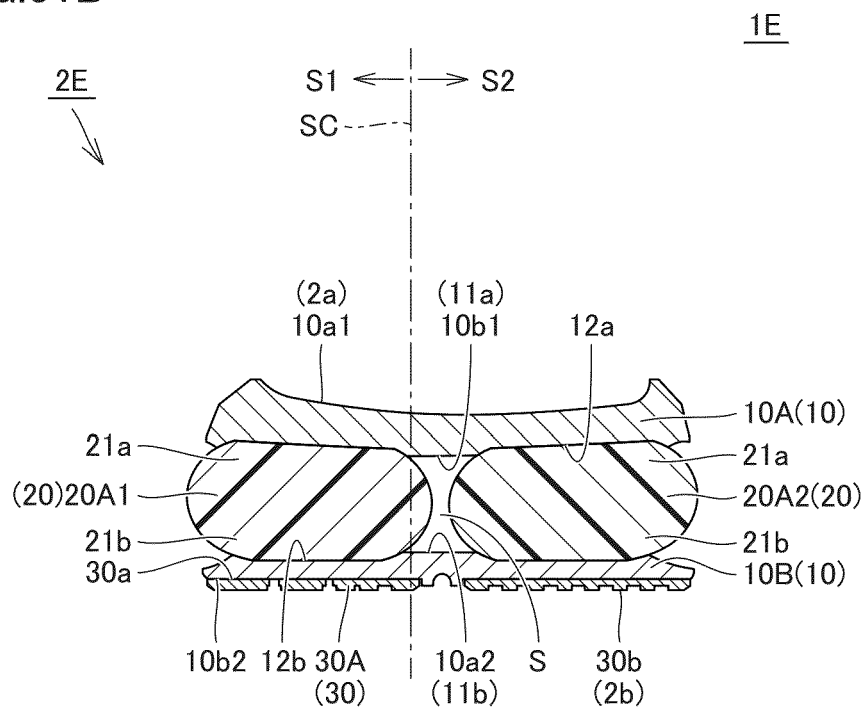


FIG.32

1E

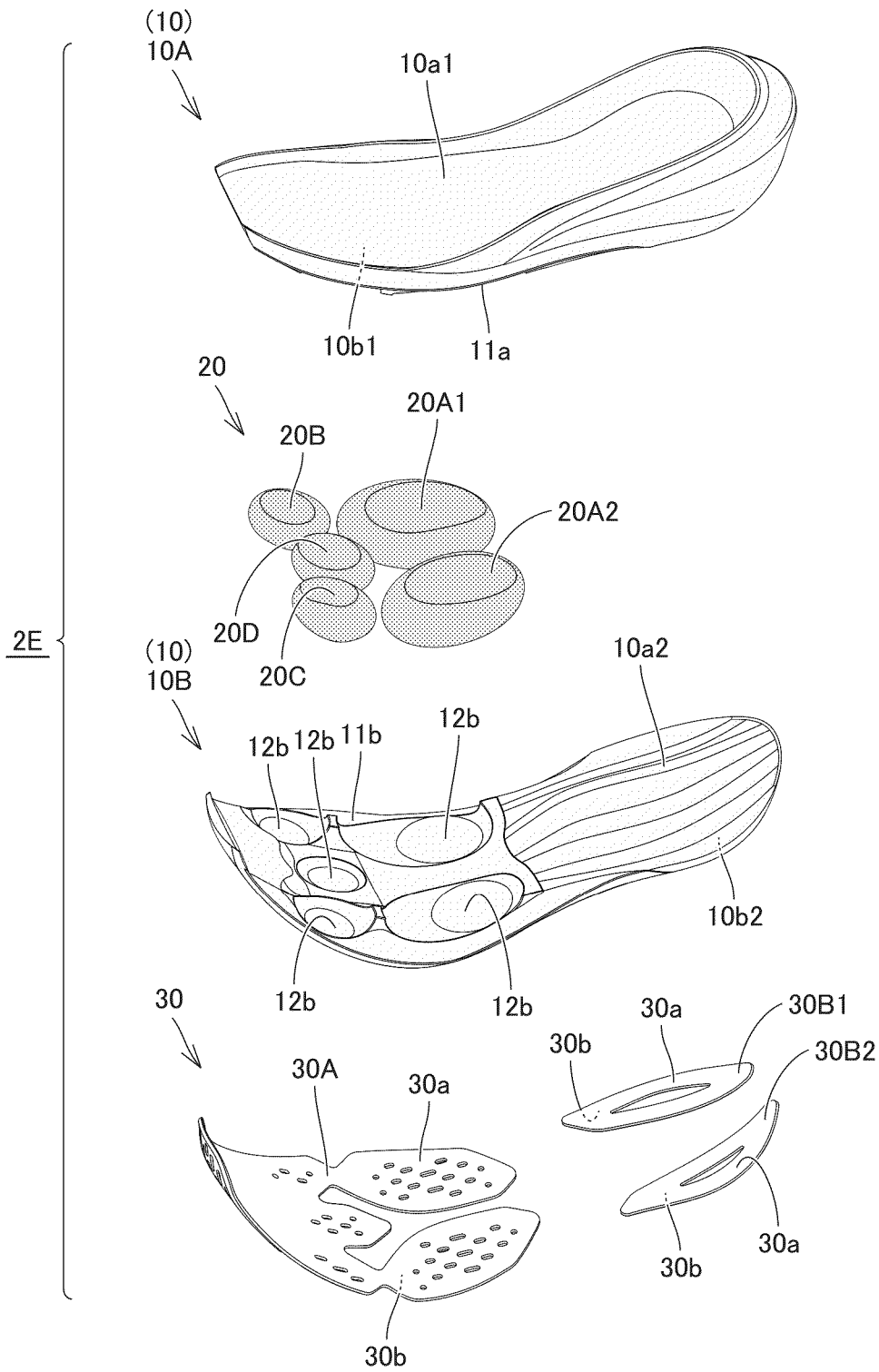


FIG.33

1E

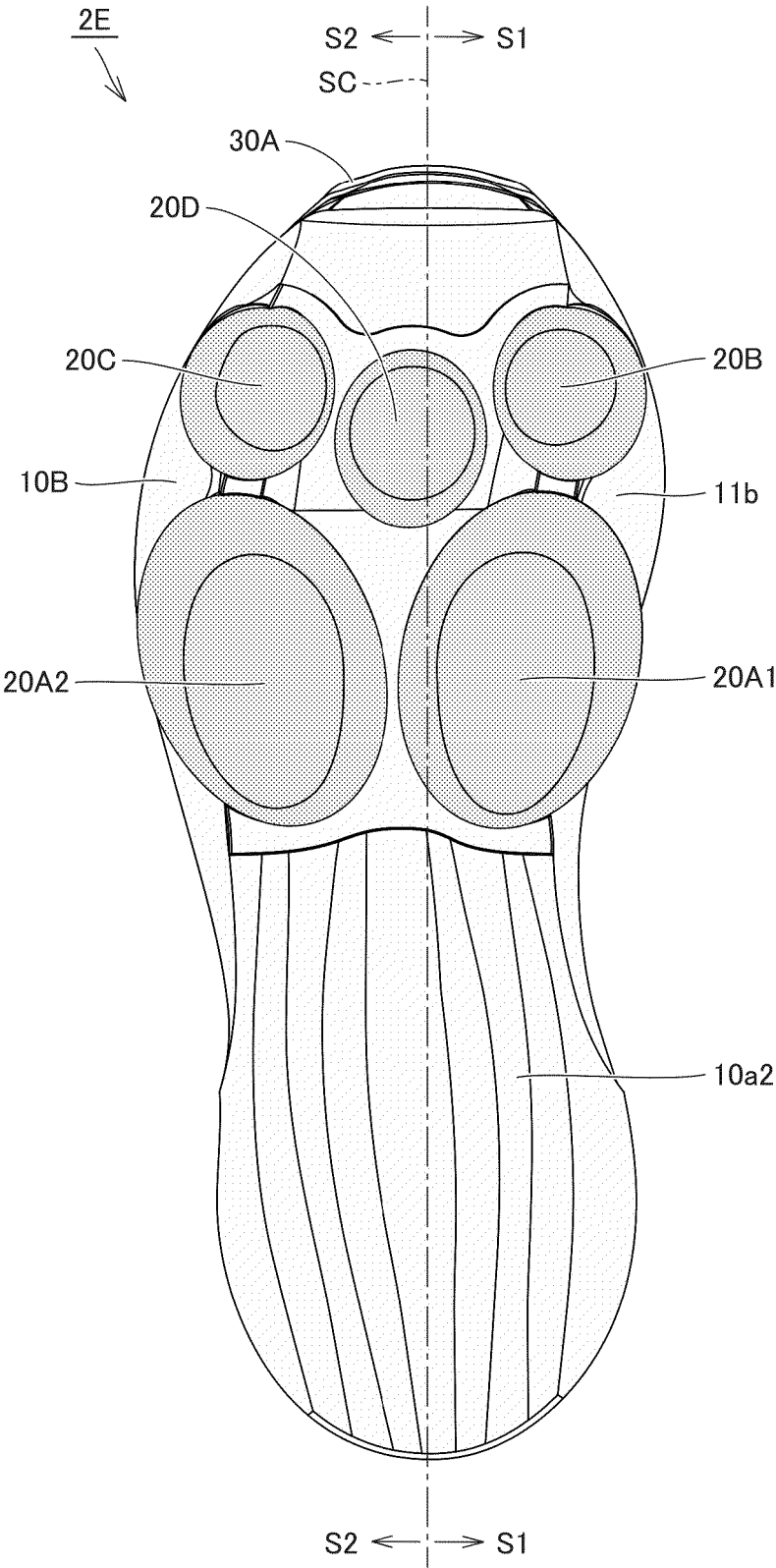


FIG.34

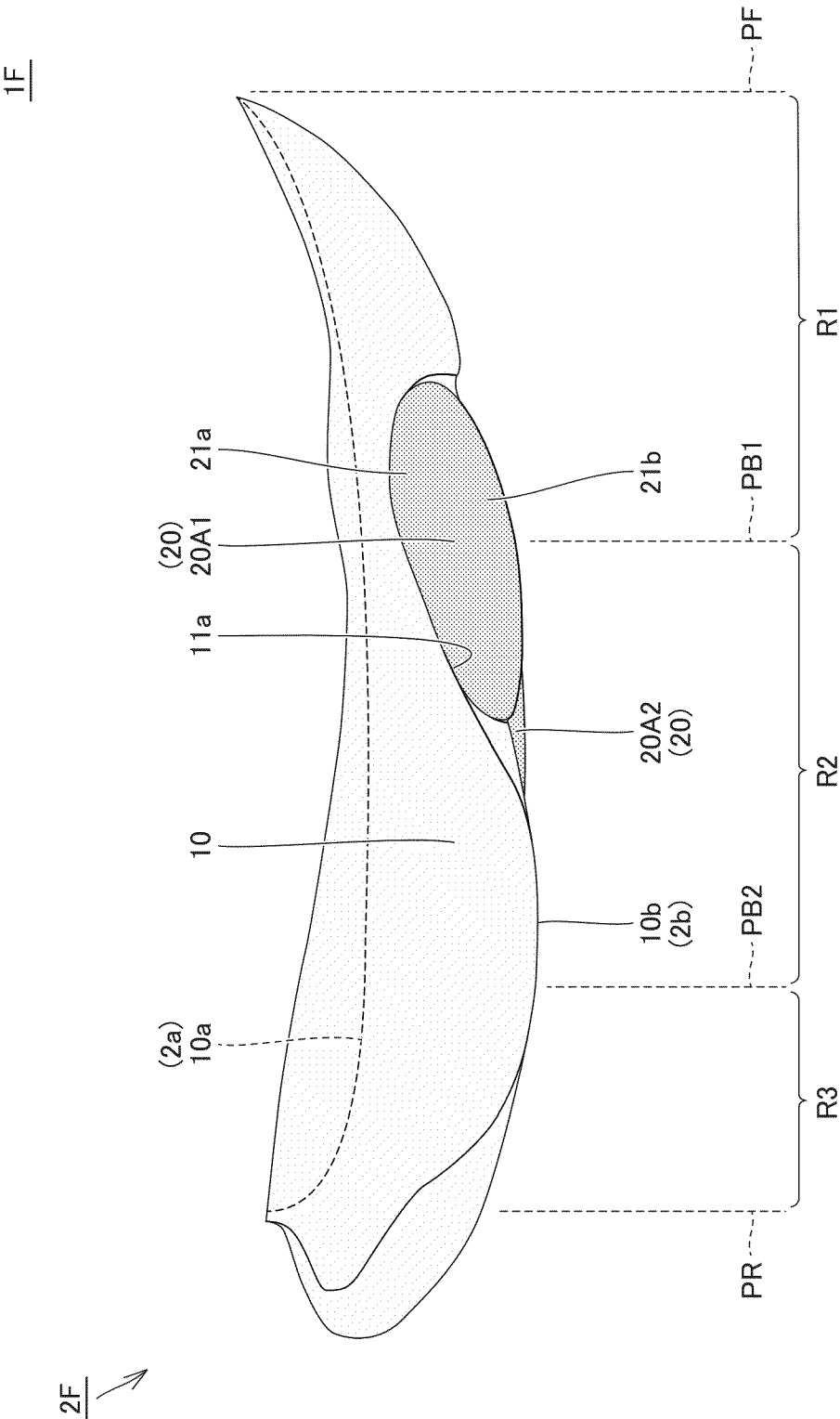


FIG.35

1F

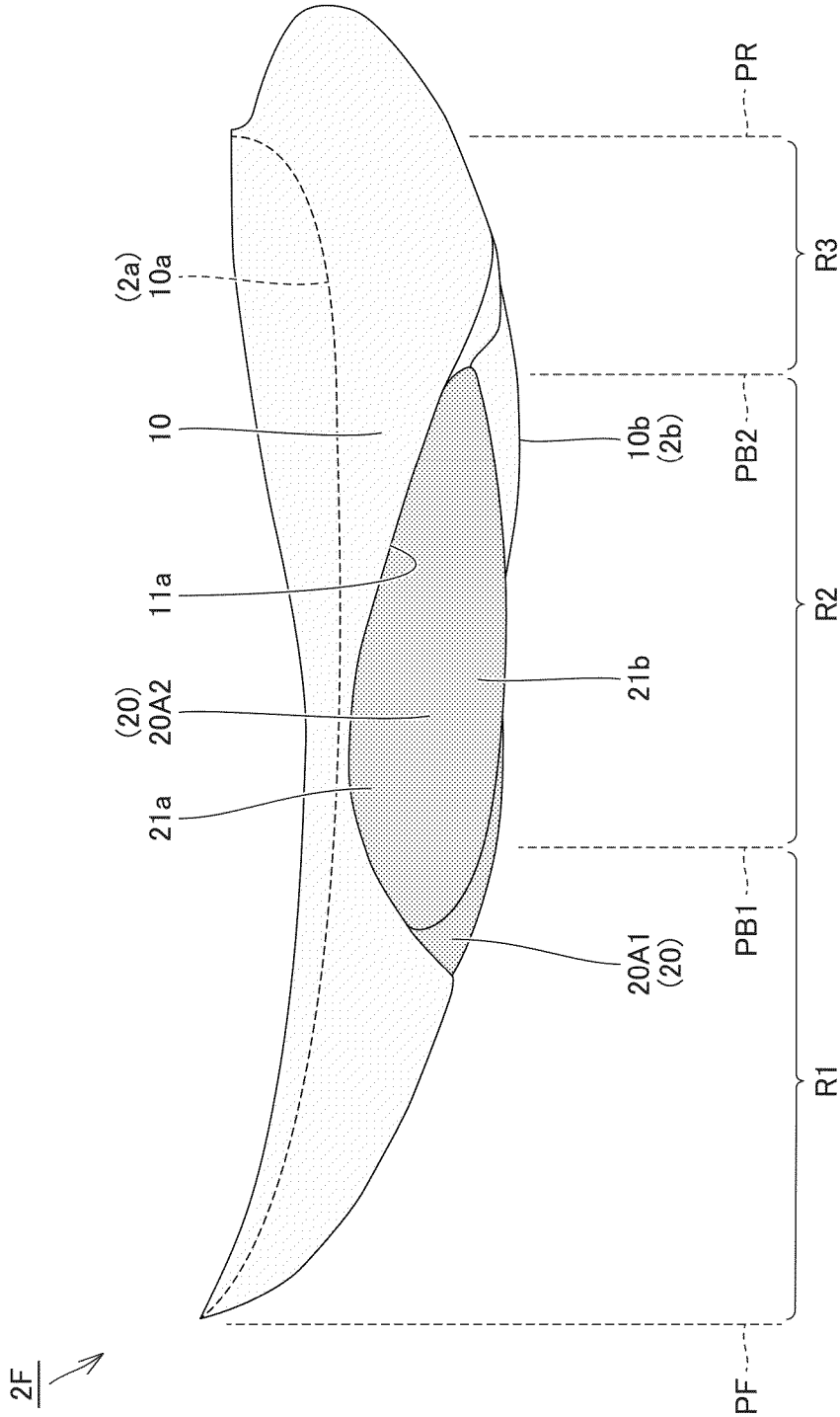


FIG.36

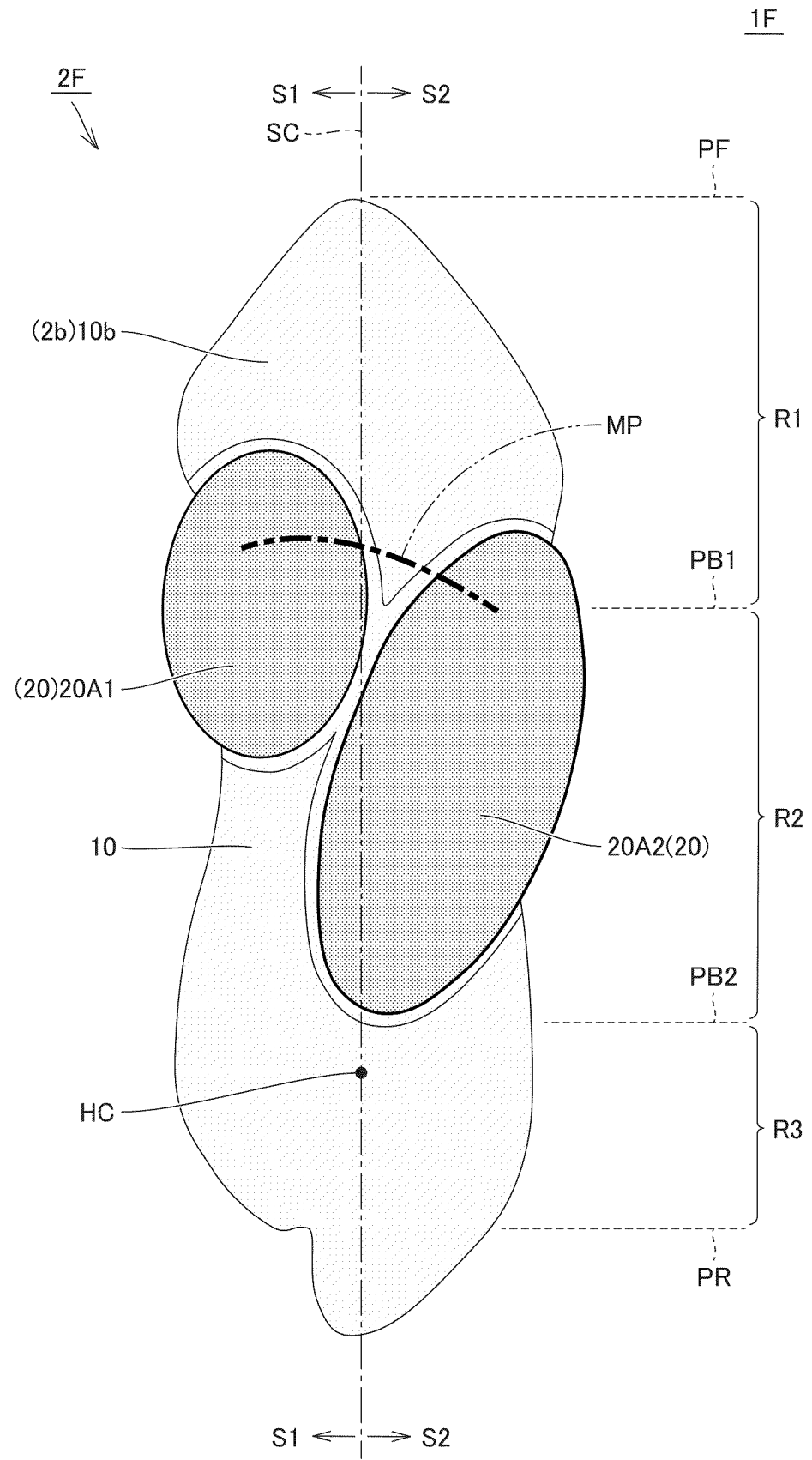


FIG.37

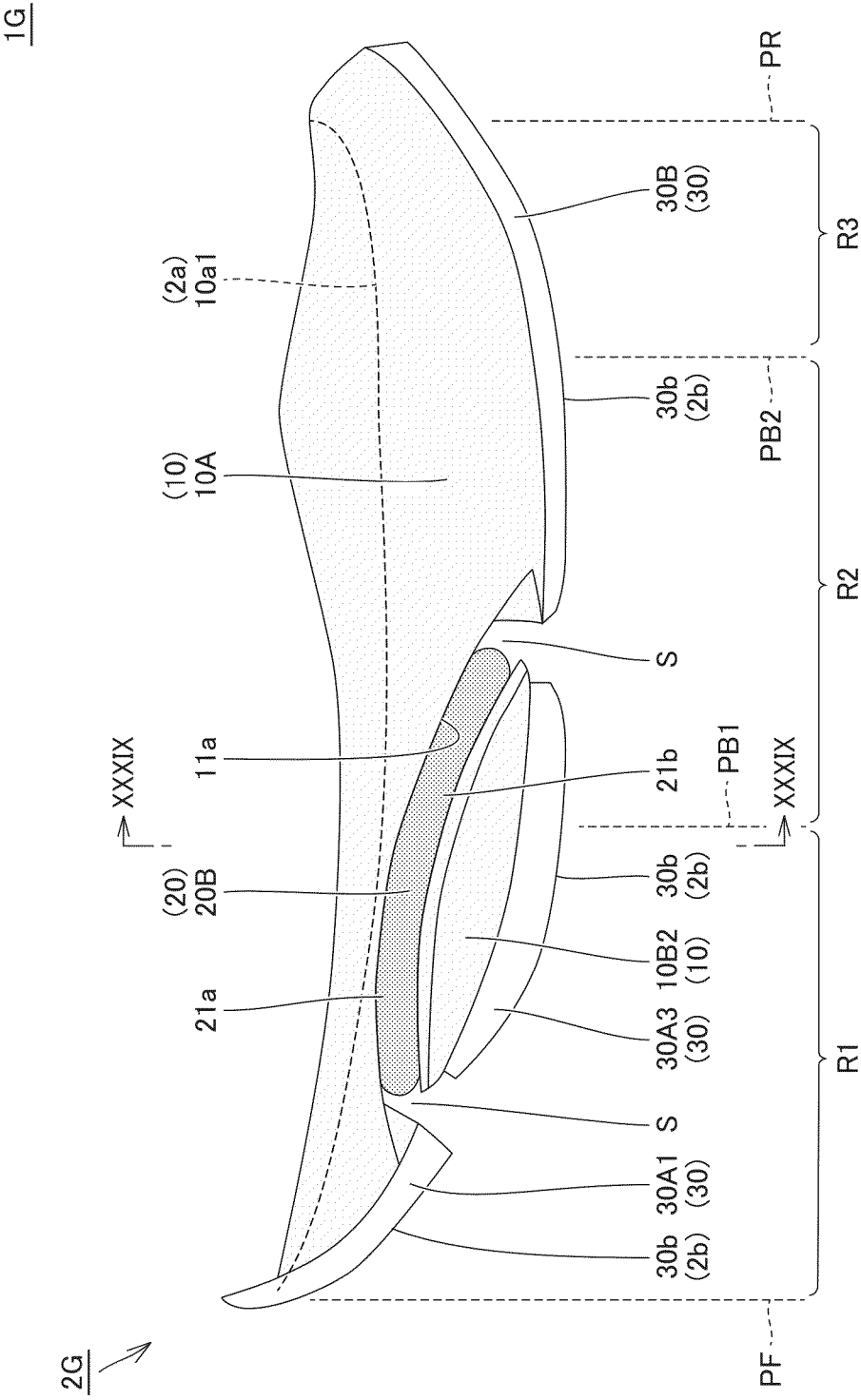


FIG.38

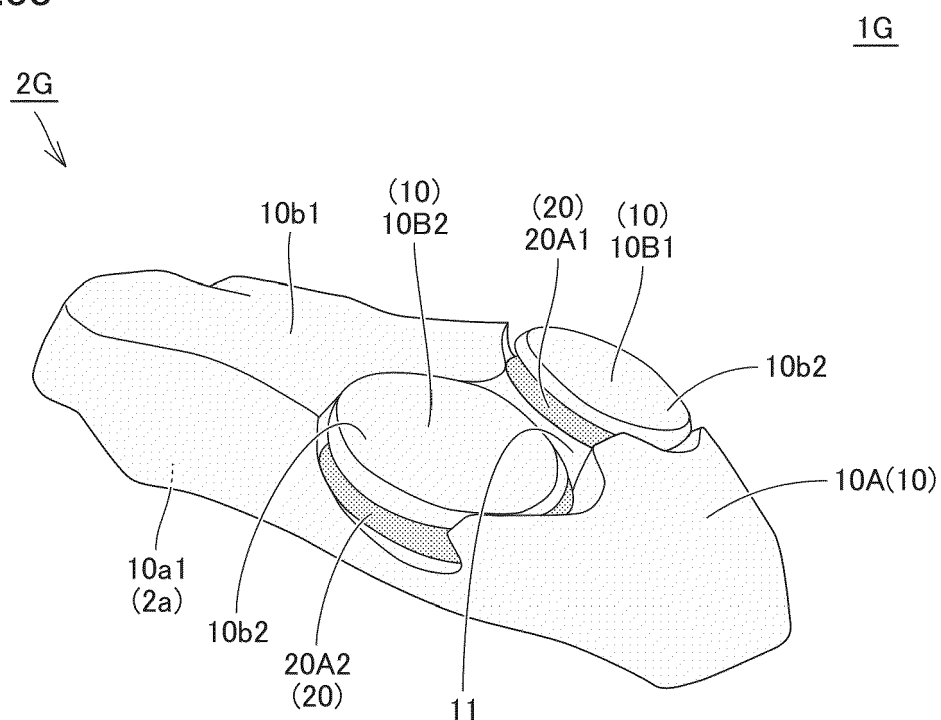


FIG.39

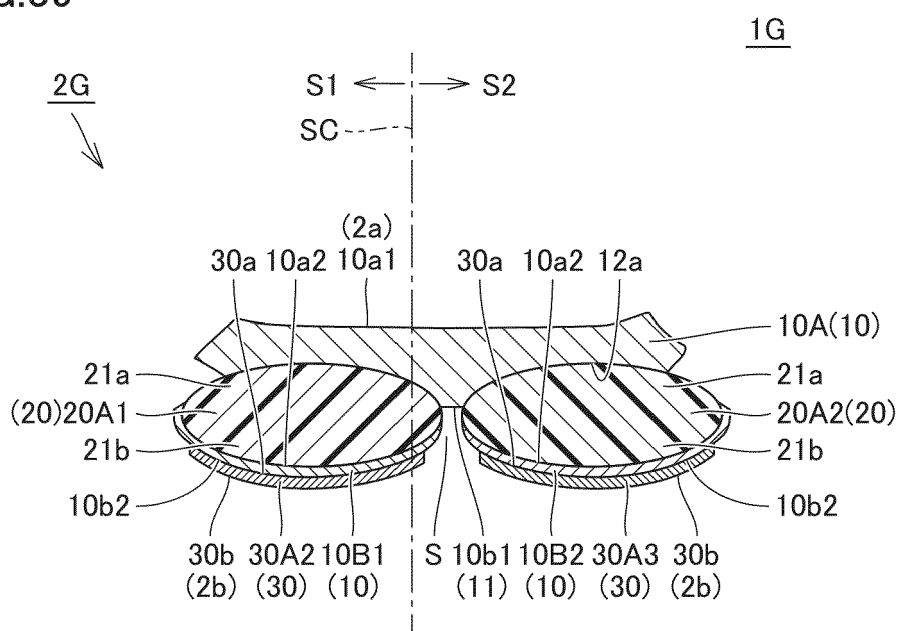


FIG.40

1H

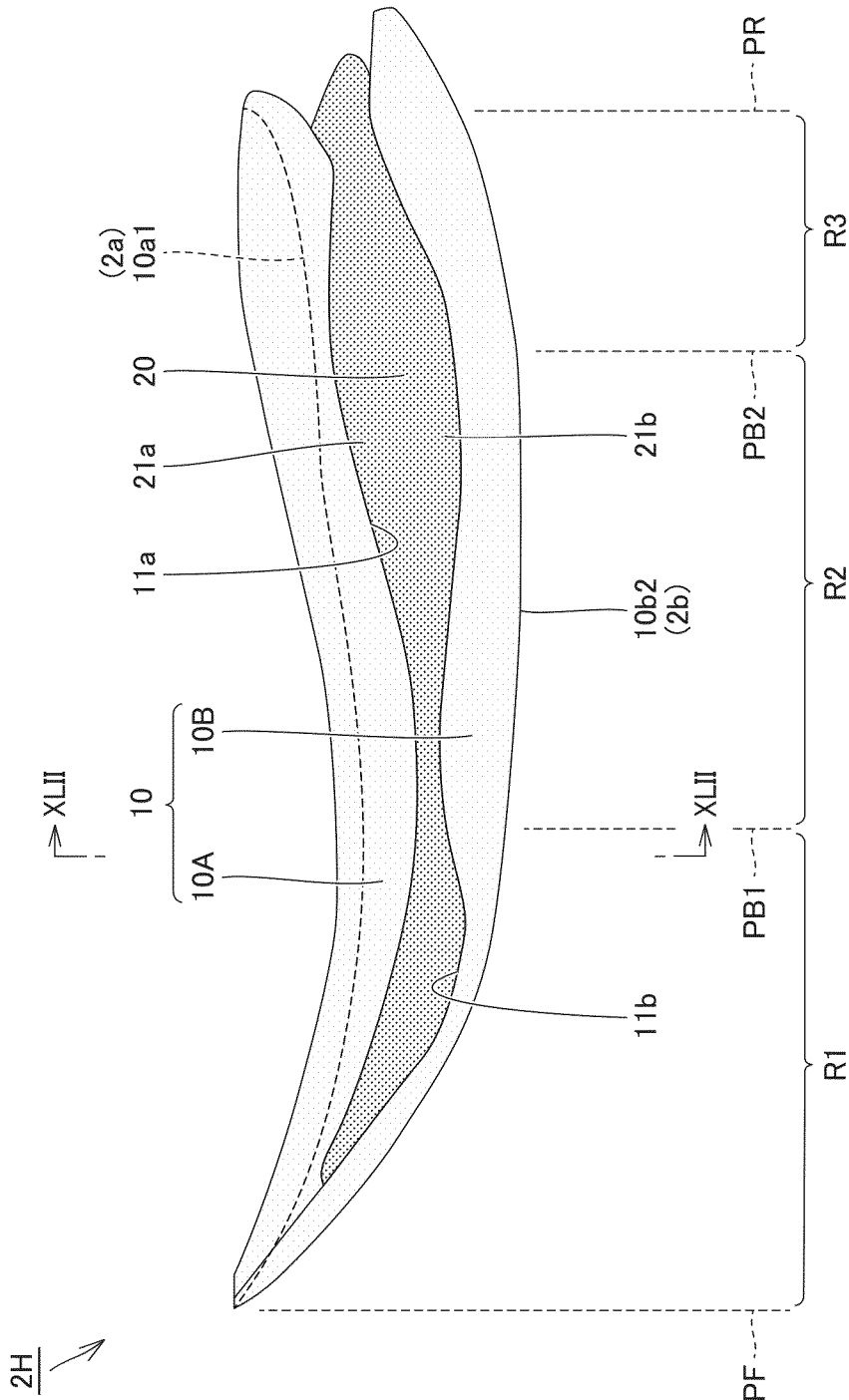


FIG.41

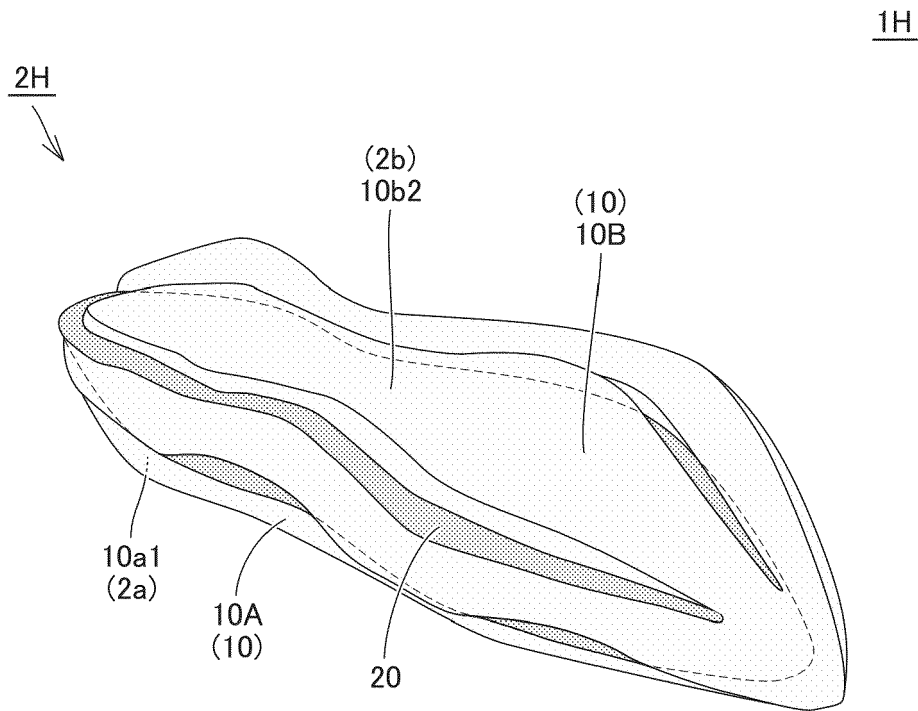


FIG.42

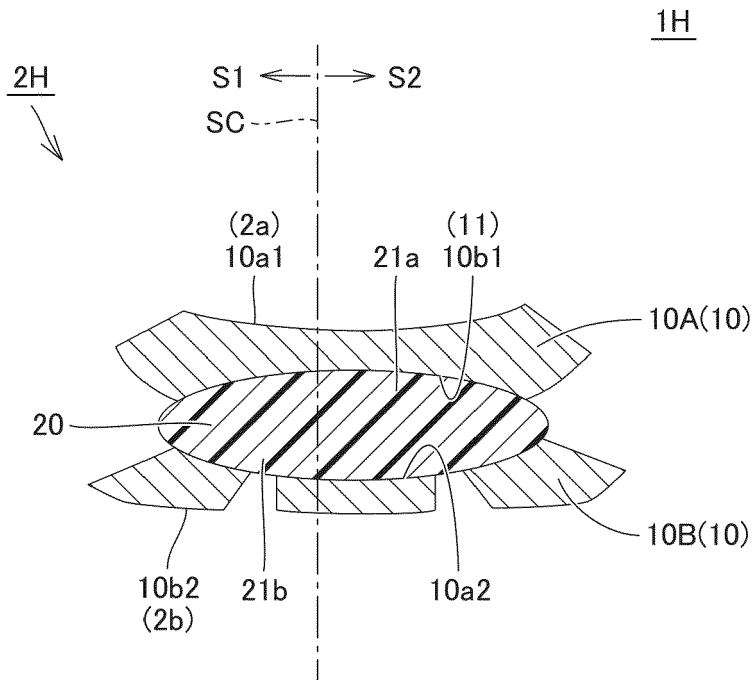


FIG.43

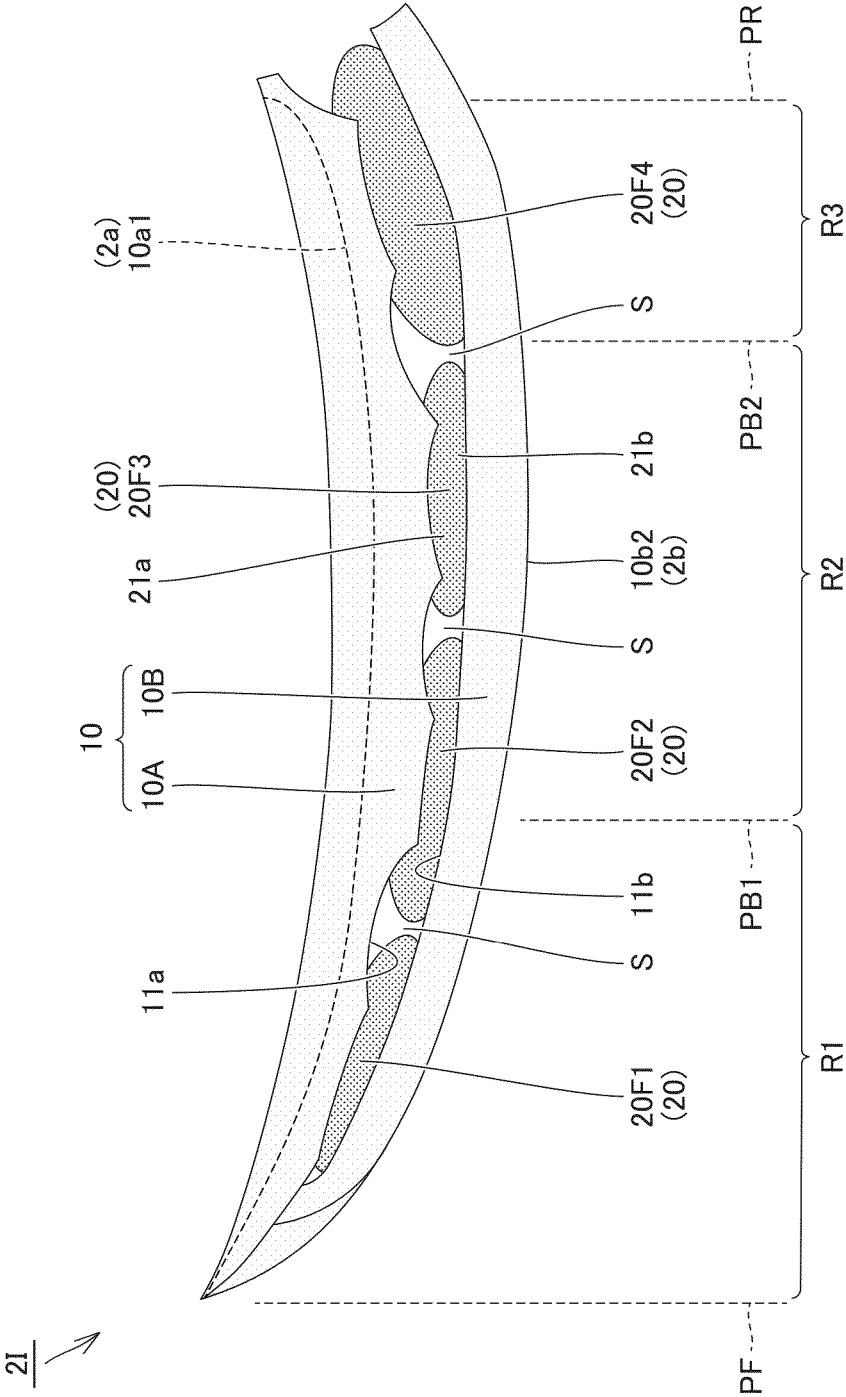
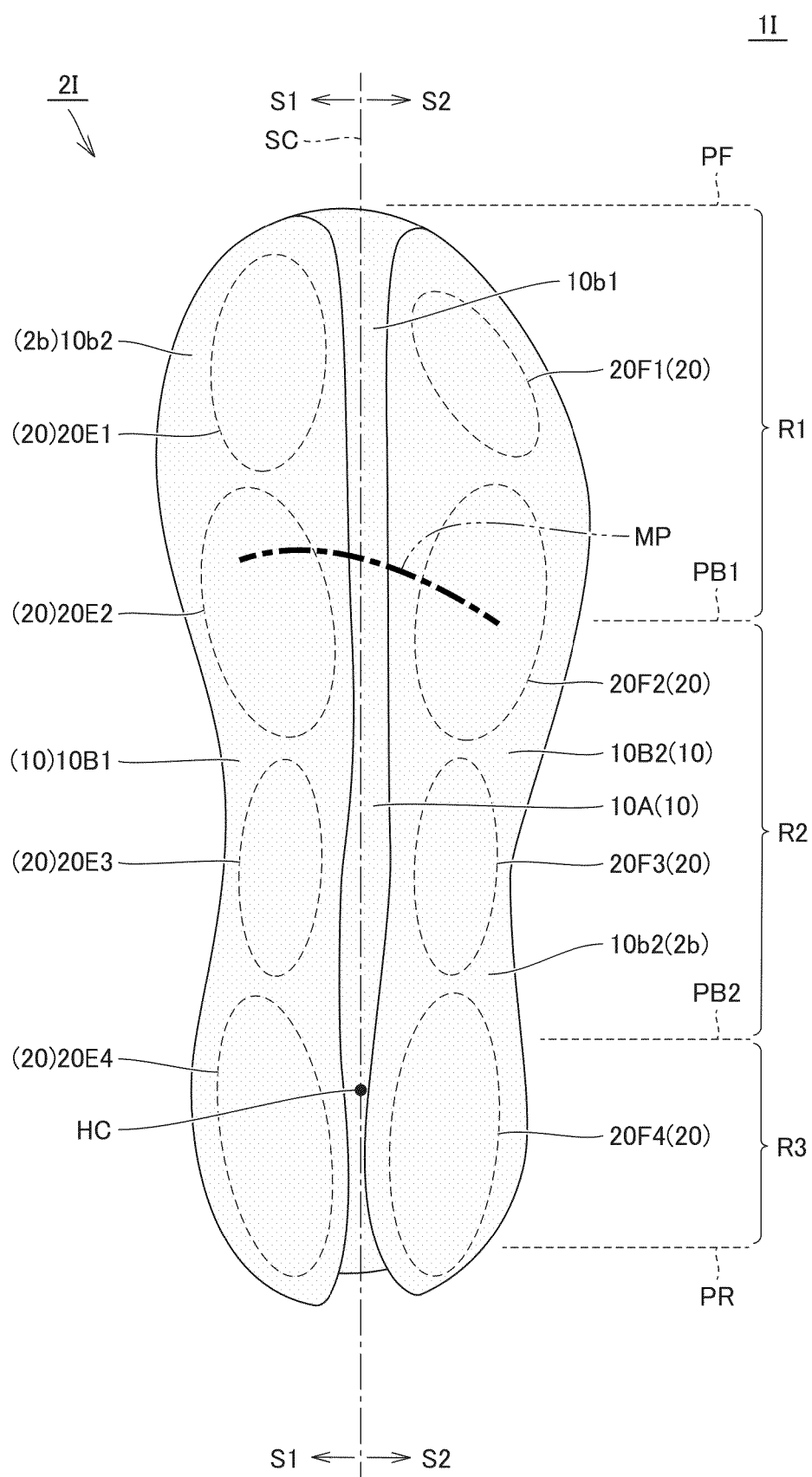


FIG.44





EUROPEAN SEARCH REPORT

Application Number

EP 25 22 6737

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 116 075 245 A (NIKE INNOVATE CV) 5 May 2023 (2023-05-05)	1-5, 8-10, 13-18,20	INV. A43B13/18 A43B13/12
A	* paragraphs [0040], [0041], [0047], [0048], [0049], [0066]; figures * -----	6,7,11, 12,19	
A	CN 117 835 864 A (NIKE INNOVATE CV) 5 April 2024 (2024-04-05) * figures * -----	1-20	
A	US 11 889 892 B2 (NIKE INC [US]) 6 February 2024 (2024-02-06) * figures * -----	1-20	
A	WO 2023/164598 A1 (NIKE INNOVATE CV [US]; NIKE INC [US]) 31 August 2023 (2023-08-31) * figures * -----	1-20	
			TECHNICAL FIELDS SEARCHED (IPC)
			A43B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		18 May 2026	Gkionaki, Angeliki
CATEGORY OF CITED DOCUMENTS			
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 116075245 A	05-05-2023	CN 116075245 A	05-05-2023
		EP 4185153 A1	31-05-2023
		EP 4477101 A2	18-12-2024
		US 2022022597 A1	27-01-2022
		US 2023225454 A1	20-07-2023
		WO 2022020484 A1	27-01-2022

CN 117835864 A	05-04-2024	CN 117835864 A	05-04-2024
		EP 4436435 A1	02-10-2024
		US 2023127595 A1	27-04-2023
		WO 2023076877 A1	04-05-2023

US 11889892 B2	06-02-2024	CN 114521115 A	20-05-2022
		CN 119366729 A	28-01-2025
		EP 4033930 A1	03-08-2022
		KR 20220062414 A	16-05-2022
		US 2021085028 A1	25-03-2021
		US 2022211145 A1	07-07-2022
		US 2024138519 A1	02-05-2024
		WO 2021061883 A1	01-04-2021

WO 2023164598 A1	31-08-2023	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- JP 2021105153 A [0002]