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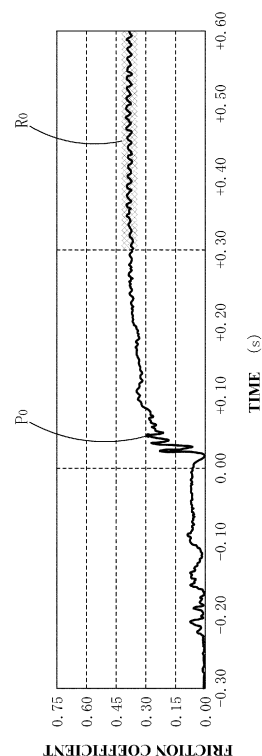
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(54) **SHOE SOLE, SHOE AND ANTISLIP MEMBER**

(57) A shoe sole is provided that allows continuous bracing from a moment immediately after the start of bracing and can exhibit excellent slip resistance for walking on a poor walking surface, e.g., an ice surface. On the shoe sole, a dynamic friction coefficient on the ice surface is higher than a maximum static friction coefficient on the ice surface. The dynamic friction coefficient on the ice surface is preferably at least 0.25. These conditions can be achieved by the shoe sole including, for example, a plurality of antislip protrusions formed downward with undersides of the antislip protrusions coming into contact with the ground, the antislip protrusions each including a funnel-shaped recessed portion formed on the underside of the antislip protrusion, each recessed portion including steps annularly formed on the inner surface of the recessed portion.

Fig. 8



Description

TECHNICAL FIELD

5 **[0001]** The present disclosure relates to a shoe sole that exhibits excellent slip resistance on an ice surface, a shoe having the shoe sole, and an antislip member to which the technique of the shoe sole is applied.

BACKGROUND

10 **[0002]** Various shoe soles with improved slip resistance (antislip shoe soles) have been proposed.
[0003] For example, Patent Literature 1 describes a shoe-sole antislip structure (claim 1 in Patent Literature 1). The antislip structure includes the shoe sole provided under a shoe body and multiple suction cups having conical indentations and is characterized by the suction cups integrated with the shoe sole. Patent Literature 2 describes that the antislip structure allows the suction cups to catch the ground with a suction force, so that the effect of slip resistance can be
 15 obtained on a wet ground surface, a snowy road, a frozen ground surface, or a ground surface with oil-based liquid as well as a ground surface covered with dry asphalt, soil, grass, or the like (paragraph [0016] in Patent Literature 2).
[0004] Moreover, Patent Literature 2 describes an antislip shoe sole having a plurality of ground convex portions formed at predetermined intervals on the ground side of a base part in the longitudinal direction of the base part. Each of the ground convex portions is V-shaped in cross section, has a tilted reinforcing part in the proximal part connecting
 20 to the base part, and is composed of elastomeric polymers having JIS-A hardness of 45 to 80 at 20°C (Claim 1 in Patent Literature 2). Patent Literature 2 also describes that the antislip shoe sole enables stable walking even on a slippery floor and the like (paragraph [0021] in Patent Literature 2).

Citation List

25 Patent Literature

[0005]

30 Patent Literature 1: JP 3096646 U
 Patent Literature 2: WO 2006/003740

SUMMARY

35 Technical Problem

[0006] However, antislip shoe soles according to the related art do not always exhibit excellent slip resistance. This is because such antislip shoe soles are characterized in that a friction force (a friction force received by a shoe sole from a walking surface, the same hereinafter) instantly peaks immediately after the bracing of feet, for example, at the start
 40 of kicking the walking surface, and then the friction force rapidly decreases. A walker wearing shoes with such characteristic shoe soles tends to feel that slip resistance (friction force) produced immediately after the bracing of feet may be kept thereafter, and thus the walker may unconsciously keep kicking a walking surface with a strong force. Even in this case, the walker hardly slips or falls on a walking surface under satisfactory conditions, e.g., on a dry road. However, on a poor walking surface, e.g., an ice surface, the walker is likely to slip and fall.

45 **[0007]** The present disclosure has been devised to solve the problem. An object of the present disclosure is to provide a shoe sole that allows continuous bracing from a moment immediately after the start of bracing and can exhibit excellent slip resistance in walking on a poor walking surface, e.g., an ice surface. Another object of the present disclosure is to provide shoes having the shoe soles. Still another object of the present disclosure is to provide an antislip member to which the technique of the shoe sole is applied.

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Solution to Problem

[0008] The problem is solved by providing a shoe sole characterized in that a dynamic friction coefficient on an ice surface is higher than a maximum static friction coefficient on the ice surface (in the present specification, the lowermost
 55 side (outsole part) of the shoe sole is called "shoe sole" unless otherwise specified).

[0009] In this case, "a dynamic friction coefficient on an ice surface" and "a maximum static friction coefficient on the ice surface" mean friction coefficients measured by a measuring method in accordance with ISO13287 "slip resistance tests on shoe soles", specifically, friction coefficients measured in steps 1 to 6 as will be discussed below. However, for

the measurements of the friction coefficients, the cycle of the following steps 1 to 6 is repeated ten times in total, and then the mean value of maximum static friction coefficients and the mean value of dynamic friction coefficients in five measurements in total from the sixth to the tenth measurements are used as a formal maximum static friction coefficient and a formal dynamic friction coefficient.

[Step 1]

[0010] A shoe sole is placed on a horizontal ice surface (a solid ice surface kept at 0°C. The ice surface is supported by a force F_2 , which will be discussed later, so as to slide in the horizontal direction). The shoe sole is held with a tool or the like so as not to move in the horizontal direction.

[Step 2]

[0011] A force F_1 (500 N) is vertically applied downward to the top surface of the shoe sole so as to press the shoe sole to the ice surface.

[Step 3]

[0012] The force F_2 is horizontally applied to the ice surface while the force F_1 of above (2) is continuously applied to the shoe sole, and then the force F_2 is gradually increased.

[Step 4]

[0013] The force F_2 is measured from the start of application of the force F_2 in step 3 to the start of horizontal sliding on the ice surface. The peak value during the measurement (the maximum value of the force F_2) is divided by the force F_1 to obtain a value as "the maximum static friction coefficient on the ice surface."

[Step 5]

[0014] The force F_2 is increased until a horizontal sliding speed on the ice surface reaches 300 mm/s.

[Step 6]

[0015] The force F_2 is measured when the horizontal sliding speed on the ice surface is stabilized at 300 mm/s. The mean value of the force F_2 during the measurement (the mean value between 0.3 second and 0.6 second after the start of application of the force F_2) is divided by the force F_1 to obtain a value as "the dynamic friction coefficient on the ice surface."

[0016] In this way, the shoe sole is configured such that the dynamic friction coefficient on the ice surface is higher than the maximum static friction coefficient on the ice surface, allowing continuous bracing from a moment immediately after the start of bracing. Thus, the shoe sole can be provided so as to exhibit excellent slip resistance even in walking on a poor walking surface, e.g., walking on an ice surface.

[0017] For the shoe sole of the present disclosure, a specific value of "the dynamic friction coefficient on an ice surface" is not particularly limited but is preferably 0.25 or higher. This can improve the slip resistance of the shoe sole on an ice surface, achieving safer walking. "The dynamic friction coefficient on an ice surface" is more preferably 0.30 or higher, is further preferably 0.35 or higher, and is most preferably 0.37 or higher. For the shoe sole of the present disclosure, "the dynamic friction coefficient on an ice surface" can be set at 0.39 or higher.

[0018] The specific structure of the shoe sole of the present disclosure is not particularly limited as long as the dynamic friction coefficient on the ice surface is higher than the maximum static friction coefficient on the ice surface. This characteristic can be achieved by using, for example, a structure in which a plurality of antislip protrusions are formed downward with undersides of the antislip protrusions coming into contact with the ground, the antislip protrusion each including a funnel-shaped recessed portion formed on the underside of the antislip protrusion, each recessed portion including steps annularly formed on the inner surface of the recessed portion. At this point, the shoe sole preferably includes drain holes for sucking water in the recessed portions and discharging the water to the surroundings of the shoe sole when the undersides of the antislip protrusions come into contact with the ground. Thus, excellent slip resistance can be easily kept even on a poor walking surface, for example, during walking on a melting ice surface.

[0019] On the shoe sole of the present disclosure, a plurality of protrusion rows are preferably disposed at predetermined intervals in the longitudinal direction of the shoe sole, the protrusion row including the antislip protrusions that are disposed along the width direction of the shoe sole while being spaced at predetermined intervals in the width direction

of the shoe sole. In other words, the front and rear positions of the antislip protrusions constituting the same protrusion row (the row in the width direction of the shoe sole) are preferably aligned. For example, this configuration is equivalent to the lattice pattern of the antislip protrusions 20 disposed in the width direction and the longitudinal direction of the shoe sole. This can reduce the occurrence of snow or the like caught in a gap between the adjacent antislip protrusions, thereby improving the slip resistance of the shoe sole. The antislip protrusions 20 disposed in a lattice pattern in the width direction and the longitudinal direction of the shoe sole can reduce the occurrence of snow or the like caught in a gap between the adjacent antislip protrusions. The reason will be discussed later.

[0020] Moreover, the shoe sole of the present disclosure preferably includes a midsole part on the top surface of the shoe sole, the midsole part being made of a material having lower hardness than a shoe sole body (outsole part). Hence, the characteristic (continuous bracing from a moment immediately after the start of bracing) can be more properly exhibited.

[0021] The use of the shoe sole of the present disclosure is not particularly limited and thus the shoe sole can be provided for various shoes. The shoe sole can be properly provided particularly for shoes for commuters, students, athletes, and workers in a cold district. Furthermore, the shoe sole can be properly provided for, for example, work shoes in a skating rink and work shoes in a freezer. The shoe sole of the present disclosure may be provided integrally with a shoe or detachably from an existing shoe.

[0022] Moreover, the technique of "the dynamic friction coefficient on an ice surface is higher than the maximum static friction coefficient on the ice surface" for the shoe sole of the present disclosure is also applicable to antislip members other than the shoe sole. For example, the technique is also applicable to an antislip member on a mat placed on a floor, a road surface, a carrier, or the like, an antislip member at a stick tip, and antislip members on gloves. Thus, the mat, the stick tip, the gloves, and the like can be provided with excellent slip resistance on an ice surface.

Advantageous Effect of Invention

[0023] As described above, the present disclosure can provide a shoe sole that allows continuous bracing from a moment immediately after the start of bracing and can exhibit excellent slip resistance for walking on a poor walking surface, e.g., walking on an ice surface. Moreover, shoes including the shoe soles can be provided and an antislip member can be provided to which the technique of the shoe sole is applied.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

Fig. 1 is a bottom view illustrating a state of a shoe sole viewed from the bottom according to a first embodiment; Fig. 2 illustrates a bottom view of the shoe sole viewed from the bottom according to the first embodiment and an enlarged view of a part A of the shoe sole in Fig. 1;

Fig. 3 illustrates perspective views of an enlarged antislip protrusion on the shoe sole according to the first embodiment;

Fig. 4 is a bottom view illustrating a shoe sole viewed from the bottom according to a second embodiment and is an enlarged view of a part corresponding to the part A of the shoe sole in Fig. 1;

Fig. 5 illustrates perspective views of an enlarged antislip protrusion on the shoe sole according to the second embodiment;

Fig. 6 is a bottom view illustrating a shoe sole viewed from the bottom according to a third embodiment and an enlarged view of a part corresponding to the part A of the shoe sole in Fig. 1;

Fig. 7 illustrates perspective views of an enlarged antislip protrusion on the shoe sole according to the third embodiment;

Fig. 8 is a graph illustrating measurement results on a change of the friction coefficient of the shoe sole of example 1 on a solid ice surface;

Fig. 9 is a graph indicating measurement results on a change of the friction coefficient of a shoe sole of comparative example 1 on the solid ice surface;

Fig. 10 is a graph indicating measurement results on a change of the friction coefficient of the shoe sole of example 1 on a melting ice surface;

Fig. 11 is a graph indicating measurement results on a change of the friction coefficient of the shoe sole of comparative example 1 on the melting ice surface;

Fig. 12 is a bottom view illustrating a state of a shoe sole viewed from the bottom according to a fourth embodiment;

Fig. 13 is a bottom view illustrating the shoe sole viewed from the bottom according to the fourth embodiment and is an enlarged view of a part corresponding to a part A of the shoe sole in Fig. 12;

Fig. 14 is a side view illustrating a state of the shoe sole in walking with a shoe including the shoe sole according

to the fourth embodiment;

Fig. 15 illustrates an example of the layout of antislip protrusions that can obtain the same effect as the shoe sole of the fourth embodiment;

Fig. 16 is a side view illustrating a state of a shoe including a shoe sole according to a fifth embodiment;

Fig. 17 is a bottom view illustrating a state of a shoe sole viewed from the bottom according to a sixth embodiment; and

Fig. 18 is a side view illustrating a shoe including the shoe sole according to the sixth embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0025] Preferred embodiments of the present disclosure will be specifically described below in accordance with the accompanying drawings. For the convenience of explanation, a shoe sole will be discussed as an example to illustrate the present disclosure. The following configuration is not always used for shoe soles and can be properly used for other antislip members of a mat, a stick tip, gloves, and the like. In the following explanation, shoe soles according to six embodiments, that is, first to sixth embodiments will be discussed. However, the technical scope of the present disclosure is not limited to these embodiments. Various structures are usable as long as a dynamic friction coefficient on an ice surface is higher than a maximum static friction coefficient on the ice surface. Moreover, in the following explanation, the shoe sole according to the first embodiment will be mainly discussed. The configuration of the shoe sole according to the first embodiment are properly usable for the shoe soles of other embodiments as long as the configuration is consistent with the shoe soles of other embodiments. Similarly, the configurations of the shoe sole of the second and third embodiments are properly usable for the shoe sole of the first embodiment as long as the configurations are consistent with the shoe sole of the first embodiment.

1. A shoe sole according to a first embodiment

[0026] Fig. 1 is a bottom view illustrating a state of the shoe sole viewed from the bottom according to the first embodiment. Fig. 2 illustrates a bottom view of the shoe sole viewed from the bottom according to the first embodiment and an enlarged view of a part A of the shoe sole in Fig. 1. Fig. 3 illustrates perspective views of an enlarged antislip protrusion on the shoe sole according to the first embodiment. Fig. 3(a) illustrates the overall configuration of the antislip protrusion. Fig. 3(b) indicates that the antislip protrusion of Fig. 3(a) is cut along a plane B parallel to a y-z plane.

[0027] As illustrated in Fig. 1, the shoe sole of the first embodiment includes multiple antislip protrusions 20 formed downward on the bottom of a shoe sole body 10 (outsole part). Typically, the shoe sole body 10 has a thickness of 2 to 30 mm. The antislip protrusion 20 has an underside (an end face on the negative side in the z-axis direction) coming into contact with the ground (a surface coming into contact with a walking surface). On the shoe sole of the first embodiment, the antislip protrusions 20 are provided over the bottom of the shoe sole body 10. The antislip protrusions 20 may be absent in an area that hardly comes into contact with the walking surface on the shoe sole body 10, that is, in an area that hardly contributes to improvement in slip resistance (for example, hatched parts in Fig. 1 (e.g. a part overlapping the arch of a foot on the shoe sole body 10 and an edge part of the shoe sole body 10)). In the following explanation, an area where the antislip protrusions 20 are absent at the bottom of the shoe sole body 10 may be referred to as "protrusion non-formation area", whereas an area where the antislip protrusions 20 are provided on the shoe sole body 10 may be referred to as "protrusion formation area."

[0028] The number of antislip protrusions 20 per unit area is not particularly limited and varies according to, for example, the dimensions of the antislip protrusions 20. However, if the number of antislip protrusions 20 per unit area is extremely small, the total number of antislip protrusions 20 on the shoe sole body 10 also decreases, which may lead to difficulty in raising the maximum static friction coefficient and the dynamic friction coefficient of the shoe sole to required levels. Thus, the number of antislip protrusions 20 per unit area (a value in the protrusion formation area if the protrusion non-formation area is formed at the bottom of the shoe sole body 10, the same hereinafter) is typically at least 0.5 /cm². The number of antislip protrusions 20 per unit area is preferably at least 0.8 /cm² and is more preferably at least 1 /cm².

[0029] In the case of an extremely large number of antislip protrusions 20 per unit area, the dimensions of the antislip protrusions 20 inevitably decrease, which may lead to difficulty in shaping the shoe sole or ensuring the strength of the antislip protrusions 20. Thus, the number of antislip protrusions 20 per unit area is typically 10 /cm² or less. The number of antislip protrusions 20 per unit area is preferably 5 /cm² or less, is more preferably 3 /cm² or less, and is further preferably 2 /cm² or less. On the shoe sole of the first embodiment, the number of antislip protrusions 20 per unit area is substantially equal over the bottom (protrusion formation area) of the shoe sole body 10. The number of antislip protrusions 20 per unit area may vary among locations.

[0030] Furthermore, a width W_0 (Fig. 2) of a gap between the adjacent antislip protrusions 20 is not particularly limited. However, if the width W_0 of the gap is too small, small stones, sand, or the like may be easily caught in the gap between the adjacent antislip protrusions 20. During bracing on the shoe sole, the antislip protrusions 20 are compressed in the height direction and are radially extended, which may lead to difficulty in ensuring desired slip resistance because of

interference between the adjacent antislip protrusions 20. Thus, the width W_0 of the gap (a minimum value is set if the width W_0 of the gap varies among locations, the same in the subsequent sentences) is typically set at 0.1 mm or larger. The width W_0 of the gap is preferably at least 0.3 mm and is more preferably at least 0.5 mm. If the width W_0 of the gap is extremely large, the number of antislip protrusions 20 per unit area cannot be easily increased, which may lead to difficulty in ensuring desired slip resistance. Thus, the width W_0 of the gap (a maximum value is set if the width W_0 of the gap varies among locations, the same in the subsequent sentences) is typically set at 10 mm or less. The width W_0 of the gap is preferably 5 mm or less and is more preferably 3 mm or less.

[0031] Typically, the antislip protrusions 20 are integrally molded with the shoe sole body 10. The molding materials of the shoe sole may be various rubbers, elastomers, and the like that are used for the outsole parts of shoe soles according to the related art. More specifically, the molding materials of the shoe sole may include a rubber compounding ingredient and at least one elastomeric polymer selected from the group consisting of a synthetic rubber, a natural rubber, a thermoplastic styrene-butadiene rubber (SBS), a styrene thermoplastic elastomer (SIS), an ethylene-vinyl acetate copolymer (EVA), polyurethane, and polyvinyl chloride.

[0032] The hardness of the shoe sole (the hardness of the outsole part) varies depending on the molding materials of the shoe sole and is not particularly limited. However, if the outsole part of the shoe sole is too soft, the strength of the antislip protrusions 20 may become hard to keep. Thus, if the outsole part of the shoe sole is made of rubber, the hardness of the outsole part (a value measured by an A hardness tester, also in the case of rubber) is typically at least 10, is preferably at least 20, is more preferably at least 30, and is further preferably at least 35. If the outsole part of the shoe sole is made of EVA, the hardness of the outsole part (a value measured by an E hardness tester, also in the case of EVA) is preferably at least 10, is more preferably at least 20, and is further preferably at least 30. If the outsole part of the shoe sole is too hard, the antislip protrusions 20 are hard to elastically deform. Thus, the antislip protrusions 20 hardly deform along the walking surface, leading to difficulty in ensuring desired slip resistance. Moreover, the cushioning of the shoe sole may decrease so as to cause discomfort in wearing shoes. Thus, if the outsole part of the shoe sole is made of rubber, the hardness of the outsole part is preferably 70 or less, is more preferably 60 or less, and is further preferably 50 or less. Furthermore, if the outsole part of the shoe sole is made of EVA, the hardness of the outsole part is typically 70 or less, is preferably 60 or less, is more preferably 50 or less, and is further preferably 40 or less.

[0033] The antislip protrusions 20 are each typically formed into columnar shapes. As illustrated in Fig. 3(a), on the shoe sole of the first embodiment, the antislip protrusion 20 is formed into a cylindrical shape. However, the shape of the antislip protrusion 20 is not limited to a cylinder and may be a polygonal column, e.g., a triangular prism, a quadratic prism, or a hexagonal column, an elliptic cylinder, or a combination thereof. On the shoe sole of the first embodiment, an outside diameter D_0 (Fig. 3(a)) of the antislip protrusion 20 is kept constant regardless of the height of the antislip protrusion 20. The outside diameter D_0 of the antislip protrusion 20 may vary according to the height of the antislip protrusion 20. For example, the outer surface of the antislip protrusion 20 may be tapered.

[0034] The ratio H_0/D_0 of a height H_0 (Fig. 3(a)) to the outside diameter D_0 (Fig. 3(a)) of the antislip protrusion 20 varies depending on the molding materials, or the like of the antislip protrusion 20. The ratio H_0/D_0 is not particularly limited. However, if the ratio H_0/D_0 is too small, the antislip protrusions 20 may be flattened and lead to difficulty in ensuring desired slip resistance. Thus, the ratio H_0/D_0 is typically set at 0.1 or larger. The ratio H_0/D_0 is preferably at least 0.2 and is more preferably at least 0.3. If the ratio H_0/D_0 is too large, the antislip protrusions 20 have long shapes and may lead to difficulty in keeping high strength for the antislip protrusions 20. Thus, the ratio H_0/D_0 is typically set at 3 or less. The ratio H_0/D_0 is preferably 2 or less and is more preferably 1 or less.

[0035] The outside diameter D_0 (Fig. 3(a)) of the antislip protrusion 20 is typically set at 2 mm or larger. The outside diameter D_0 is preferably at least 5 mm and more specifically, the outside diameter D_0 can be set at 7 mm or larger. Moreover, the outside diameter D_0 of the antislip protrusion 20 is typically 30 mm or less and is preferably 20 mm or less. More specifically, the outside diameter D_0 can be set at 15 mm or less. The height H_0 (Fig. 3(a)) of the antislip protrusion 20 is typically at least 1 mm and is preferably at least 2 mm. More specifically, the height H_0 can be set at 3 mm or larger. Moreover, the height H_0 of the antislip protrusion 20 is typically 15 mm or less and is preferably 10 mm or less. More specifically, the height H_0 can be set at 7 mm or less.

[0036] As illustrated in Fig. 3, on the shoe sole of the first embodiment, a funnel-shaped recessed portion 21 that is circular in cross section is formed on the underside of the antislip protrusion 20. Thus, the antislip protrusions 20 can be sucked like suction cups to the walking surface. The inner surface of the recessed portion 21 may be smoothly formed but on the shoe sole of the first embodiment, steps 22 are formed like rings on the inner surface of the recessed portion 21. Thus, slip resistance can be ensured from a moment immediately after the start of bracing on the shoe sole. The steps 22 are annularly formed and thus slip resistance can be exhibited in all directions. The shoe sole of the first embodiment can achieve excellent slip resistance in lateral bracing (e.g., in side steps) as well as in longitudinal bracing.

[0037] If the steps 22 are provided on the inner surface of the recessed portion 21, the number of steps 22 is not particularly limited. However, if the number of steps 22 is small, the antislip protrusions 20 are likely to be worn so as to eliminate the steps 22. This may lead to difficulty in ensuring desired slip resistance. Thus, the number of steps 22 is preferably two or more and is more preferably three or more. The number of steps 22 is not particularly limited but an

extremely large number of steps 22 may lead to difficulty in molding the antislip protrusions 20. Hence, the number of steps 22 is typically set at ten or less. The number of steps 22 is preferably seven or less and is more preferably five or less.

[0038] The ratio H_1/W_1 of a height H_1 (Fig. 3(b)) of the step 22 to a width W_1 (Fig. 3(b)) of the step 22 is not particularly limited. However, if the ratio H_1/W_1 is too small, the inclination of the inner surface of the recessed portion 21 is inevitably reduced, so that the antislip protrusion 20 is less likely to be sucked onto the walking surface. Thus, the ratio H_1/W_1 is typically set at 0.1 or larger. The ratio H_1/W_1 is preferably at least 0.3 and is more preferably at least 0.5. The steps 22 are located deeper from the underside of the antislip protrusion 20 as the ratio H_1/W_1 is larger. Thus, the corners of the steps 22 are less likely to come into contact with the walking surface, leading to difficulty in ensuring desired slip resistance. Thus, the ratio H_1/W_1 is typically set at 3 or less. The ratio H_1/W_1 is preferably 2 or less and is more preferably 1.5 or less.

[0039] The width W_1 (Fig. 3(b)) of the step 22 varies depending on, for example, the outside diameter D_0 of the antislip protrusion 20 or the number of steps 22 but is typically set at 0.3 mm or larger. The width W_1 is preferably at least 0.4 mm and more specifically, the width W_1 can be set at 0.5 mm or larger. Alternatively, the width W_1 of the step 22 is typically set at 5 mm or less and is preferably set at 3 mm or less. More specifically, the width W_1 is set at 1 mm or less. If the two or more steps 22 are provided, the width W_1 of the step 22 may be equally set for all the steps 22 or may vary among the steps. The height H_1 (Fig. 3(b)) of the step 22 is typically set at 0.1 mm or larger and is preferably set at 0.2 mm or larger, though the height H_1 may vary depending on, for example, the height H_0 of the antislip protrusion 20 or the number of steps 22. More specifically, the height H_1 can be set at 0.3 or larger. Alternatively, the height H_1 of the step 22 is typically set at 3 mm or less and is preferably set at 2 mm or less. More specifically, the height H_1 can be set at 1 mm or less. If the two or more steps 22 are provided, the height H_1 of the step 22 may be equally set for all the steps 22 or may vary among the steps.

[0040] On the shoe sole of the first embodiment, as illustrated in Fig. 3, a drain hole 23 is provided at the center of the recessed portion 21 of the antislip protrusion 20. The drain hole 23 communicates with a drain passage 11 provided in the shoe sole body 10. The drain passage 11 communicates with the outer surface (side) of the shoe sole body 10. Thus, in walking on a wet walking surface, water coming into the recessed portions 21 is sucked through the drain holes 23 and then is discharged out of the shoe sole body 10 through the drain passage 11. Hence, even in walking on the wet walking surface, the slip resistance of the shoe sole can be kept. The configuration of the provided drain passage 11 is not particularly limited. On the shoe sole of the first embodiment, a recessed groove formed on the top surface (a front side in the z-axis direction) of the shoe sole body 10 serves as the drain passage 11. Since a midsole part (not illustrated) is fixed to the top surface of the shoe sole body 10 (outsole part) as will be discussed later, the upper side of the drain passage 11 (recessed groove) is covered with the midsole part.

[0041] A diameter D_1 (Fig. 3(a)) of the drain hole 23 varies depending on, for example, the diameter D_0 of the antislip protrusion 20, the number of steps 22, and the width W_1 of the steps 22 and is not particularly limited. However, if the diameter D_1 of the drain hole 23 is too small, small stones or sand may be easily caught in the drain holes 23. Thus, the diameter D_1 of the drain hole 23 is typically set at 0.5 mm or larger. The diameter D_1 of the drain hole 23 is preferably at least 1 mm and is more preferably at least 1.5 mm. If the diameter D_1 of the drain hole 23 is too large, the outside diameter D_1 of the antislip protrusion 20 also inevitably increases. This may lead to difficulty in increasing the number of antislip protrusions 20 per unit area and ensuring desired slip resistance. Thus, the diameter D_1 of the drain hole 23 is typically set at 20 mm or smaller. The diameter D_1 of the drain hole 23 is preferably 10 mm or smaller and is more preferably 7 mm or smaller.

[0042] On the shoe sole of the first embodiment, a dynamic friction coefficient (denoted as μ_1) on an ice surface is higher than a maximum static friction coefficient (denoted as μ_0) on the ice surface. The ratio μ_1/μ_0 of the dynamic friction coefficient μ_1 to the maximum static friction coefficient μ_0 on the ice surface is not particularly limited as long as the ratio is larger than 1. The ratio μ_1/μ_0 is preferably at least 1.1 and is more preferably at least 1.2. On the shoe sole of the first embodiment, as will be discussed later, the ratio μ_1/μ_0 on the ice surface can be also set at 1.3 or larger. The ratio μ_1/μ_0 is not particularly limited but is estimated to be actually limited to about 1.5 to 2 on the ice surface.

[0043] Moreover, the specific value of the dynamic friction coefficient μ_1 on the ice surface is not particularly limited. However, if the dynamic friction coefficient μ_1 is too small, excellent slip resistance cannot be expected. Thus, the dynamic friction coefficient μ_1 on the ice surface is typically set at 0.3 or higher. As described above, the dynamic friction coefficient μ_1 on the ice surface is preferably at least 0.25, is more preferably at least 0.30, is further preferably at least 0.35, and is optimally at least 0.37. On the shoe sole of the first embodiment, as will be discussed later, the dynamic friction coefficient μ_1 on the ice surface can be also set at 0.39 or higher. The dynamic friction coefficient μ_1 is preferably increased but, in practice, setting the dynamic friction coefficient μ_1 to 0.7 or higher seems to be hard on an ice surface.

[0044] When the shoe sole of the first embodiment is provided for actual shoes, the midsole part (not illustrated) is preferably provided on the top surface of the shoe sole body 10. The hardness of the midsole part is typically set lower than that of the shoe sole body 10. This can easily exhibit a feature properly on the actual shoes so as to continuously perform bracing from a moment immediately after the start of bracing. The molding materials of the midsole part are not particularly limited as long as the midsole part is softer than the outsole part. The molding materials of the midsole part may be various rubbers and elastomers that are used for the midsole parts of the shoe soles according to the related

art. More specifically, the molding materials of the midsole part may include a rubber compounding ingredient and at least one elastomeric polymer selected from the group consisting of a synthetic rubber, a natural rubber, a thermoplastic styrene-butadiene rubber (SBS), a styrene thermoplastic elastomer (SIS), an ethylene-vinyl acetate copolymer (EVA), polyurethane, and polyvinyl chloride. EVA is particularly preferable as a molding material of the midsole part.

[0045] The hardness of the midsole part is not particularly limited to a specific value as long as the hardness is lower than that of the outsole part. The hardness is preferably lower than that of the outsole part by at least 5 to 10 degrees or about 15 to 20 degrees in some cases. For example, if the midsole part is made of EVA, the hardness of the midsole part (a value measured by an E hardness tester, also in the case of EVA) is preferably 50 or less, is more preferably 40 or less, and is further preferably 30 or less. The lower limit of the midsole part is not particularly limited. However, if the midsole part is too soft, the strength of the midsole part may not be kept. Thus, if the midsole part is made of EVA, the hardness of the midsole part is preferably at least 5, is more preferably at least 10, and is further preferably at least 15.

2. A shoe sole according to a second embodiment

[0046] The shoe sole according to the second embodiment will be described below. Fig. 4 is a bottom view illustrating the shoe sole viewed from the bottom according to the second embodiment and is an enlarged view of a part corresponding to the part A of the shoe sole in Fig. 1. Fig. 5 illustrates perspective views of an enlarged antislip protrusion on the shoe sole according to the second embodiment. Fig. 5(a) illustrates the overall configuration of the antislip protrusion. Fig. 5(b) indicates that the antislip protrusion of Fig. 5(a) is cut along a plane B parallel to a y-z plane.

[0047] The shoe sole of the first embodiment has the cylindrical antislip protrusions 20. As illustrated in Figs. 4 and 5, on the shoe sole of the second embodiment, antislip protrusions 20 are each shaped like quadrangular prisms. Accordingly, on the shoe sole of the second embodiment, drain holes 23 are formed like squares in cross section and recessed portions 21 are formed into funnel-shaped squares in cross section. Moreover, steps 22 are shaped like square frames. In this way, the provision of antislip protrusions 20 shaped like quadratic prisms allows a dynamic friction coefficient μ_1 on an ice surface to exceed a maximum static friction coefficient μ_0 on the ice surface.

[0048] According to the shoe sole of the second embodiment, the antislip protrusions 20 can be advantageously disposed with a higher density than on the shoe sole of the first embodiment. Furthermore, multiple linear parts are obtained on the steps 22 and thus slip resistance can be easily raised in a direction perpendicular to the linear parts. Configurations not particularly specified in the shoe sole of the second embodiment may be substantially identical to those of the shoe sole of the first embodiment.

3. A shoe sole according to a third embodiment

[0049] The shoe sole according to the third embodiment will be described below. Fig. 6 is a bottom view illustrating the shoe sole viewed from the bottom according to the third embodiment and an enlarged view of a part corresponding to the part A of the shoe sole in Fig. 1. Fig. 7 illustrates perspective views of an enlarged antislip protrusion on the shoe sole according to the third embodiment. Fig. 7(a) illustrates the overall configuration of the antislip protrusion. Fig. 7(b) indicates that the antislip protrusion of Fig. 7(a) is cut along a plane B parallel to a y-z plane.

[0050] As illustrated in Figs. 6 and 7, the shoe sole of the third embodiment has antislip protrusions 20 each shaped like hexagonal columns. Accordingly, on the shoe sole of the third embodiment, drain holes 23 are formed like hexagons in cross section and recessed portions 21 are formed into funnel-shaped hexagonal shapes in cross section. Moreover, the steps 22 are shaped like hexagonal frames. In this way, the provision of the antislip protrusions 20 shaped like hexagonal columns allows a dynamic friction coefficient μ_1 on an ice surface to exceed a maximum static friction coefficient μ_0 on the ice surface.

[0051] According to the shoe sole of the third embodiment, the antislip protrusions 20 can be advantageously disposed with a high density as on the shoe sole of the second embodiment. Furthermore, multiple linear parts are obtained on the steps 22 and thus slip resistance can be easily raised in a direction perpendicular to the linear parts. Configurations not particularly specified in the shoe sole of the third embodiment may be substantially identical to those of the shoe soles of the first and second embodiments.

4. A shoe sole according to a fourth embodiment

[0052] The shoe sole according to the fourth embodiment will be described below. Fig. 12 is a bottom view illustrating a state of the shoe sole viewed from the bottom according to the fourth embodiment. Fig. 13 is a bottom view illustrating the shoe sole viewed from the bottom according to the fourth embodiment and is an enlarged view of a part corresponding to the part A of the shoe sole in Fig. 12. Fig. 14 is a side view illustrating a state of the shoe sole walking with a shoe including the shoe sole according to the fourth embodiment.

[0053] As illustrated in Figs. 12 and 13, the shoe sole of the fourth embodiment has antislip protrusions 20 shaped

like quadratic prisms. The antislip protrusions 20 on the shoe sole of the fourth embodiment are identical in configuration to the antislip protrusions 20 (Fig. 5) on the shoe sole of the second embodiment. On the shoe sole of the second embodiment, each of the antislip protrusions 20 adjacent to each other in the width direction (x-axis direction) of the shoe sole is displaced by a half pitch in the longitudinal direction (y-axis direction) of the shoe sole as illustrated in Fig. 4, whereas on the shoe sole of the fourth embodiment, the antislip protrusions 20 adjacent to each other in the width direction (x-axis direction) of the shoe sole are not displaced in the longitudinal direction (y-axis direction) of the shoe sole as illustrated in Fig. 13.

[0054] In other words, on the shoe sole of the fourth embodiment, as illustrated in Fig. 12, multiple protrusion rows L (a broken line in Fig. 12 corresponds to the protrusion row L) are disposed at predetermined intervals in the longitudinal direction (y-axis direction) of the shoe sole, the protrusion row L including the antislip protrusions disposed along the width direction (x-axis direction) of the shoe sole at predetermined intervals in the width direction (x-axis direction) of the shoe sole. The antislip protrusions 20 disposed in a lattice pattern can improve the slip resistance of the shoe sole. Even in walking on a snow surface, in particular, the antislip protrusions 20 can exhibit desired slip resistance.

[0055] This is because snow or the like caught in a gap between the adjacent antislip protrusions 20 reduces elastic deformation of the antislip protrusions 20 and flattens the bottom of the shoe sole (covers corners for gripping the walking surface), so that the shoe sole may become slippery. In this respect, on the shoe sole of the fourth embodiment, even if snow or the like is caught in a gap (a hatched part α in Fig. 14) between the adjacent antislip protrusions 20 as illustrated in Fig. 14, the shoe sole is bent around a ground surface when the shoe sole touches and kicks the ground during walking, so that a width W_0' of the gap α increases from the original width between the antislip protrusions 20 adjacent to each other in the longitudinal direction and the gap α penetrates in the width direction of the shoe sole. Thus, snow or the like caught in the gap α can be easily removed.

[0056] Hence, on the shoe sole of the fourth embodiment, a width W_0 (Fig. 13) of the gap between the adjacent antislip protrusions 20 can be smaller than that of the shoe sole of the second embodiment. This can densely dispose the antislip protrusions 20 on the shoe sole of the fourth embodiment, thereby exhibiting higher slip resistance. Configurations not particularly specified in the shoe sole of the fourth embodiment may be substantially identical to those of the shoe soles of the first to third embodiments.

[0057] The effect (the effect of easily removing snow or the like from the gap α between the antislip protrusions 20 adjacent to each other in the longitudinal direction) can be obtained as long as the front and rear positions of the antislip protrusions 20 constituting the same protrusion row L (the row of the shoe soles in the width direction) are aligned, without the need for disposing the antislip protrusions 20 in a lattice pattern in the width and longitudinal directions of the shoe sole as illustrated in Fig. 13. Fig. 15 illustrates an example of the layout of the antislip protrusions 20 that can obtain the same effect as the shoe sole of the fourth embodiment. Fig. 15 is an enlarged view of a part corresponding to the part A of Fig. 12. On the shoe sole of Fig. 15, the positions of the antislip protrusions 20 constituting the protrusion rows L adjacent to each other in the longitudinal direction are displaced from each other by a half pitch in the width direction (x-axis direction) of the shoe sole. The effect can be obtained also by the shoe sole including the antislip protrusions 20 arranged as illustrated in Fig. 15.

5. A shoe sole according to a fifth embodiment

[0058] The shoe sole according to the fifth embodiment will be described below. Fig. 16 is a side view illustrating an example of a shoe including the shoe sole according to the fifth embodiment. Fig. 16 is a perspective view illustrating the peripheral part of the shoe sole of the shoe.

[0059] In the shoe sole of the fifth embodiment, the configurations and layout of antislip protrusions 20 are substantially identical to those of the shoe sole of the fourth embodiment. In the shoe sole of the fifth embodiment, however, a soft midsole part 32 is provided on the top surface of a shoe sole body 10 (outsole part) as illustrated in Fig. 16. The hardness of the soft midsole part 32 is lower than that of the shoe sole body 10 (outsole part). This can easily exhibit a feature properly on the actual shoe so as to continuously perform bracing from a moment immediately after the start of bracing. The molding materials and hardness of the soft midsole part 32 are the same as those of the midsole part discussed in "1. A shoe sole according to a first embodiment".

[0060] In the shoe sole of the fourth embodiment, as illustrated in Fig. 14, the antislip protrusions 20 on a toe part and the antislip protrusions 20 on a heel part are provided on the common shoe sole body 10 (outsole), whereas on the shoe sole of the fifth embodiment, as illustrated in Fig. 16, the antislip protrusions 20 on the toe part and the antislip protrusions 20 on the heel part are provided on the separate shoe sole bodies 10 (outsoles). Thus, the soft midsole parts 32 are separately provided on the toe part and the heel part, respectively. The shoe sole body 10 (outsole part) and the soft midsole part 32 on the toe part and the shoe sole body 10 (outsole part) and the soft midsole part 32 on the heel part are fixed to a common midsole body 31.

[0061] Configurations not particularly specified in the shoe sole of the fifth embodiment may be substantially identical to those of the shoe soles of the first to fourth embodiments.

6. A shoe sole according to a sixth embodiment

[0062] The shoe sole according to the sixth embodiment will be described below. Fig. 17 is a bottom view illustrating a state of a shoe sole viewed from the bottom according to the sixth embodiment. Fig. 18 is a side view illustrating a shoe including the shoe sole according to the sixth embodiment. Fig. 18 is a perspective view illustrating the peripheral part of the shoe sole of the shoe.

[0063] On the shoe sole of the sixth embodiment, the configurations of antislip protrusions 20 are substantially identical to those of the shoe soles of the second, fourth, and fifth embodiments. Moreover, as illustrated in Fig. 17, the shoe sole of the sixth embodiment is substantially identical to the shoe sole of the first embodiment in that the antislip protrusions 20 are provided substantially over the bottom of the shoe sole. Additionally, the shoe sole of the sixth embodiment is substantially identical to the shoe sole of the fourth embodiment in that the antislip protrusions 20 are arranged in a lattice pattern in the width direction and the longitudinal direction of the shoe sole.

[0064] Furthermore, as illustrated in Fig. 18, the shoe sole of the sixth embodiment is identical to the shoe sole of the fifth embodiment in that a soft midsole part 32 is provided on the top surface of a shoe sole body 10 (outsole part). On the shoe sole of the fifth embodiment, however, the shoe sole bodies 10 (outsole parts) and the soft midsole parts 32 are separately provided on the toe part and the heel part as illustrated in Fig. 16, whereas on the shoe sole of the sixth embodiment, as illustrated in Fig. 18, the shoe sole body 10 (outsole part) and the soft midsole part 32 are shared by the toe part and the heel part.

[0065] Configurations not particularly specified in the shoe sole of the sixth embodiment may be substantially identical to those of the shoe soles of the first to fifth embodiments.

7. Measurement

7.1 Measurement method

[0066] For confirmation of the slip resistance of the shoe sole according to the present disclosure, the shoe sole was fabricated according to example 1 belonging to the technical scope of the shoe sole of the present disclosure, and an experiment was conducted to measure a maximum static friction coefficient and a dynamic friction coefficient on an ice surface. Furthermore, for evaluation of the slip resistance of example 1, the same measurement was conducted on a shoe sole fabricated with highest slip resistance on an ice surface by another manufacturer (hereinafter will be referred to as "shoe sole of comparative example 1") among shoe soles currently on the market. The method of measuring the maximum static friction coefficient and the dynamic friction coefficient was performed in the foregoing steps 1 to 6. Although the shoe sole is placed on a solid ice surface in step 1, measurements were conducted on the shoe sole on a wet surface in order to evaluate slip resistance under more slippery conditions, as well as on the shoe sole on a solid ice surface.

[0067] The shoe sole of example 1 corresponds to the shoe sole of the first embodiment and has the cylindrical antislip protrusions 20. On the shoe sole of example 1, the width W_0 (Fig. 2) of the gap between the adjacent antislip protrusions 20 is 1.8 mm and the number of antislip protrusions 20 per unit area is about $1.2/\text{cm}^2$. Moreover, the outside diameter D_0 (Fig. 3(a)) of the antislip protrusion 20 is 8 mm, the height H_0 (Fig. 3(a)) of the antislip protrusion 20 is 4 mm, and the ratio H_0/D_0 of the height H_0 to the outside diameter D_0 of the antislip protrusion 20 is 0.5. Furthermore, the number of steps 22 is three, the width W_1 (Fig. 3(b)) of each of the steps 22 is 0.5 mm, and the height H_1 (Fig. 3(b)) of each of the steps 22 is 0.3 mm. Thus, the ratio H_1/W_1 of the height H_1 to the width W_1 of the step 22 is 0.6. Moreover, the diameter D_1 (Fig. 3(a)) of the drain hole 23 is 3 mm. The hardness of rubber used for the shoe sole (outsole part) ranges from 35 to 50.

7.2 Measurement results

[0068] First, measurement results on a solid ice surface will be described below. Fig. 8 is a graph indicating measurement results on a change of the friction coefficient of the shoe sole of example 1 on the solid ice surface. Fig. 9 is a graph indicating measurement results on a change of the friction coefficient of the shoe sole of comparative example 1 on the solid ice surface. In the graphs of Figs. 8 and 9, a time on the horizontal axis indicates a time from the start of application of the force F_2 in the horizontal direction in step 3. The horizontal axes of graphs in Figs. 10 and 11, which will be discussed later, have the same meanings as those of Figs. 8 and 9.

[0069] From the value of the peak P_0 in the graph of Fig. 8, it is understood that the maximum static friction coefficient μ_0 of the shoe sole of example 1 is 0.29 on the solid ice surface. Moreover, it is understood that the dynamic friction coefficient μ_1 of the shoe sole of example 1 is 0.39 on the solid ice surface by determining the mean value of a range R_0 in the graph of Fig. 8. Similarly, the maximum static friction coefficient μ_0 and the dynamic friction coefficient μ_1 of the shoe sole of comparative example 1 are 0.39 and 0.30, respectively, on the solid ice surface according to the graph

of Fig. 9. Table 1 indicates these results.

[Table 1]

	Maximum static friction coefficient μ_0	Dynamic friction coefficient μ_1
Example 1	0.29	0.39
Comparative Example 1	0.39	0.30

[0070] In the fields of "comparative example 1" in Table 1, it is understood that the dynamic friction coefficient μ_1 of the shoe sole of comparative example 1 is lower than the maximum static friction coefficient μ_0 and the ratio μ_1/μ_0 of the dynamic friction coefficient μ_1 to the maximum static friction coefficient μ_0 is about 0.77. Thus, the shoe sole of comparative example 1 exhibits excellent slip resistance immediately after the start of bracing on the ice surface but tends to slip thereafter. Actually, during walking in shoes with the shoe soles of comparative example 1 on an ice surface, the shoe soles firmly gripped the ice surface immediately after the start of bracing (immediately after landing on a walking surface or immediately after kicking the walking surface) but the shoe soles were likely to slip thereafter. Thus, even during walking in shoes with the shoe soles of comparative example 1 in which the highest slip resistance on an ice surface is evaluated among shoe soles currently on the market, it was understood that a lot of attention needs to be paid. Even with shoes having the shoe soles of comparative example 1, it was difficult to run on an ice surface or make side steps on an ice surface.

[0071] In contrast, in the fields of "example 1" in Table 1, it is understood that the dynamic friction coefficient μ_1 of the shoe sole of example 1 is higher than the maximum static friction coefficient μ_0 and the ratio μ_1/μ_0 of the dynamic friction coefficient μ_1 to the maximum static friction coefficient μ_0 is about 1.34. Additionally, the dynamic friction coefficient μ_1 of the shoe sole of example 1 is 0.39, which is considerably higher than 0.30, the dynamic friction coefficient μ_1 of the shoe sole of comparative example 1. Thus, the shoe sole of example 1 enables continuous bracing from a moment immediately after the start of bracing. Actually, during walking in shoes with the shoe soles of example 1 on an ice surface, firm gripping was felt from landing to separation of the shoe sole on the ice surface. Thus, shoes having the shoe soles of example 1 enabled walking with the same feeling as walking on a dry road without the need for extra caution. Shoes having the shoe soles of example 1 enabled running on an ice surface and side steps on an ice surface.

[0072] Measurement results on a melting ice surface will be discussed below. Fig. 10 is a graph indicating measurement results on a change of the friction coefficient of the shoe sole of example 1 on a melting ice surface. Fig. 11 is a graph indicating measurement results on a change of the friction coefficient of the shoe sole of comparative example 1 on the melting ice surface.

[0073] From the value of the peak P_0 in the graph of Fig. 10, it is understood that the maximum static friction coefficient μ_0 of the shoe sole of example 1 is 0.31 on the melting ice surface. Moreover, it is understood that the dynamic friction coefficient μ_1 of the shoe sole of example 1 is 0.20 on the melting ice surface by determining the mean value of the range R_0 in the graph of Fig. 10. Similarly, the maximum static friction coefficient μ_0 and the dynamic friction coefficient μ_1 of the shoe sole of comparative example 1 are 0.41 and 0.10, respectively, on the melting ice surface according to the graph of Fig. 11. Table 2 indicates these results.

[Table 2]

	Maximum static friction coefficient μ_0	Dynamic friction coefficient μ_1
Example 1	0.31	0.20
Comparative Example 1	0.41	0.10

[0074] In the fields of "comparative example 1" in Table 2, it is understood that the dynamic friction coefficient μ_1 of the shoe sole of comparative example 1 is considerably lower than the maximum static friction coefficient μ_0 and the ratio μ_1/μ_0 of the dynamic friction coefficient μ_1 to the maximum static friction coefficient μ_0 is only about 0.24. Thus, the shoe sole of comparative example 1 exhibits excellent slip resistance immediately after the start of bracing on a melting ice surface but rapidly tends to slip thereafter.

[0075] In contrast, in the fields of "example 1" in Table 2, it is understood that the dynamic friction coefficient μ_1 of the shoe sole of example 1 is lower than the maximum static friction coefficient μ_0 and the ratio μ_1/μ_0 of the dynamic friction coefficient μ_1 to the maximum static friction coefficient μ_0 is about 0.64, which is considerably higher than 0.24, the ratio μ_1/μ_0 of the shoe sole of comparative example 1 under the same conditions. Additionally, the dynamic friction coefficient μ_1 of the shoe sole of example 1 is 0.20, which is twice the dynamic friction coefficient μ_1 of the shoe sole of comparative example 1 under the same conditions, even on a melting ice surface. Thus, it is understood that even on a melting ice

surface, the shoe sole of example 1 has higher slip resistance than the shoe sole having the shoe sole of comparative example 1 in which the highest slip resistance on an ice surface is evaluated among shoe soles currently on the market.

Reference Signs List

[0076]

10	Shoe sole body (outsole part)
11	Drain passage
20	Antislip protrusion
21	Recessed portion
22	Step
23	Drain hole
30	Midsole part
31	Midsole body
32	Soft midsole part
D ₀	Outside diameter of antislip protrusion
D ₁	Diameter of drain hole
H ₀	Height of antislip protrusion
H ₁	Height of step
W ₀	Width of gap between adjacent antislip protrusions
W ₁	Width of step

Claims

1. A shoe sole having a dynamic friction coefficient on an ice surface higher than a maximum static friction coefficient on the ice surface.
2. The shoe sole according to claim 1, wherein the dynamic friction coefficient on the ice surface is at least 0.25.
3. The shoe sole according to claim 1 or 2, further comprising a plurality of antislip protrusions formed downward with undersides of the antislip protrusions coming into contact with a ground, the antislip protrusions each including a funnel-shaped recessed portion formed on the underside of the antislip protrusion, each recessed portion including steps annularly formed on an inner surface of the recessed portion.
4. The shoe sole according to claim 3, further comprising a plurality of protrusion rows that are disposed at predetermined intervals in a longitudinal direction of the shoe sole, the protrusion row including the antislip protrusions that are disposed along a width direction of the shoe sole while being spaced at predetermined intervals in the width direction of the shoe sole.
5. The shoe sole according to claim 3 or 4, further comprising drain holes for sucking water in the recessed portions and discharging the water to surroundings of the shoe sole when the undersides of the antislip protrusions come into contact with the ground.
6. The shoe sole according to any one of claims 1 to 5, further comprising a midsole part on a top surface of the shoe sole, the midsole part being made of a material having lower hardness than a shoe sole body.
7. A shoe comprising the shoe sole according to any one of claims 1 to 6.
8. An antislip member having a dynamic friction coefficient on an ice surface higher than a maximum static friction coefficient on the ice surface.

Fig. 1

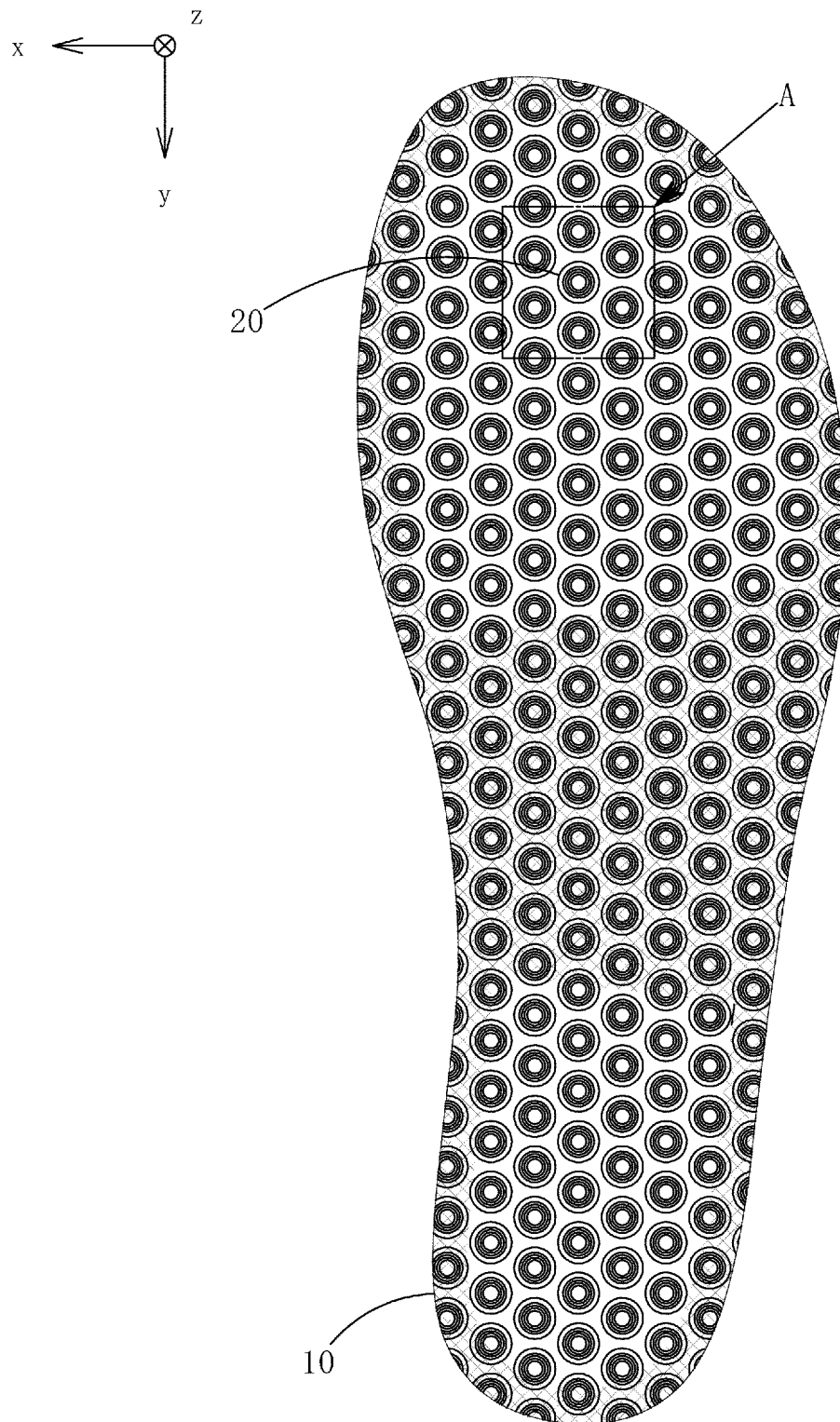


Fig. 2

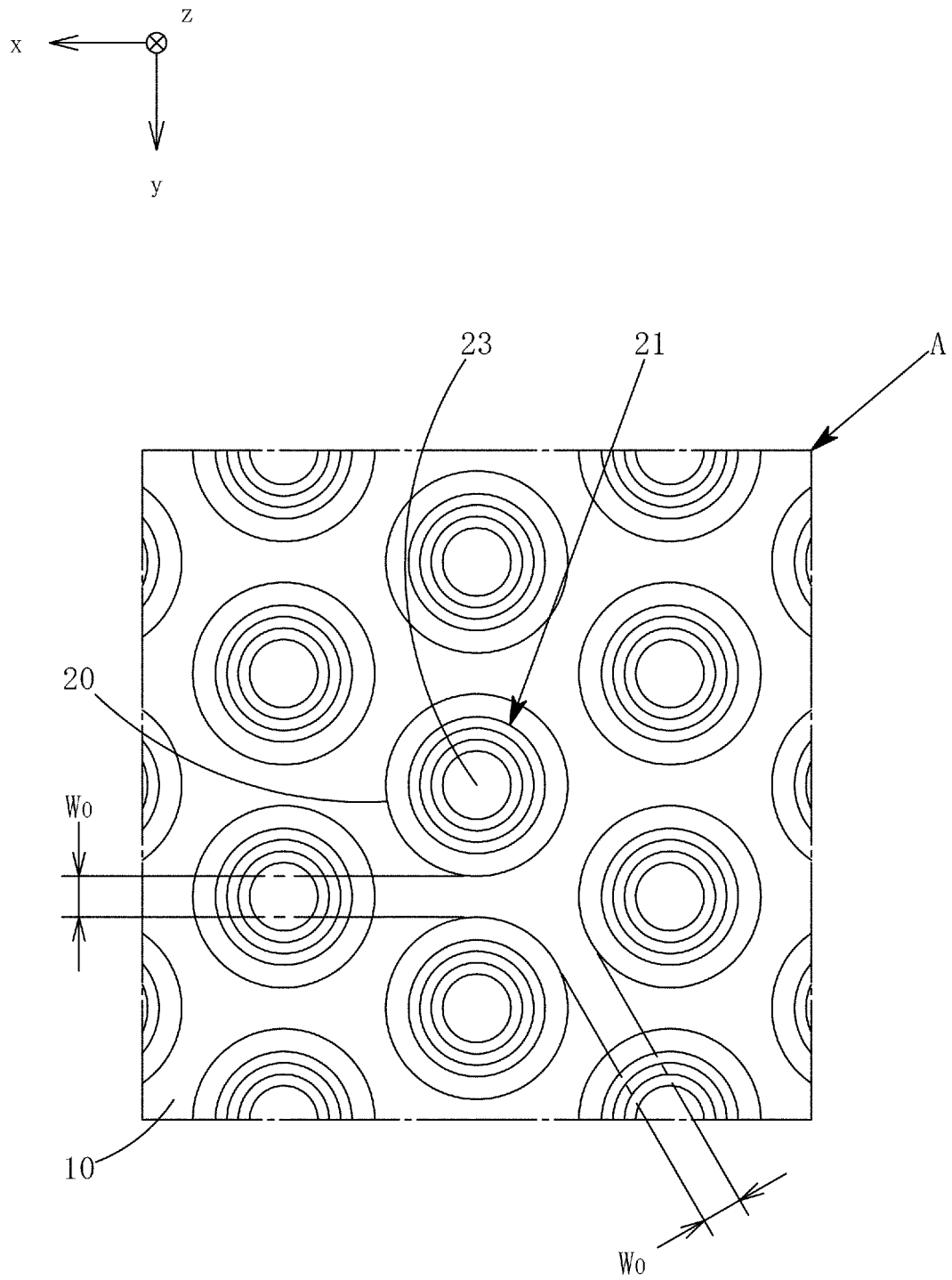


Fig. 3

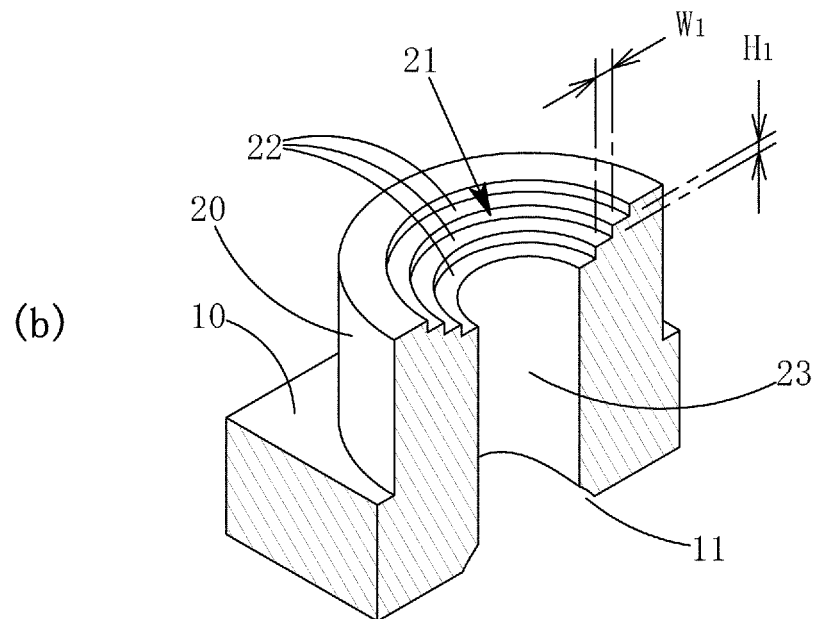
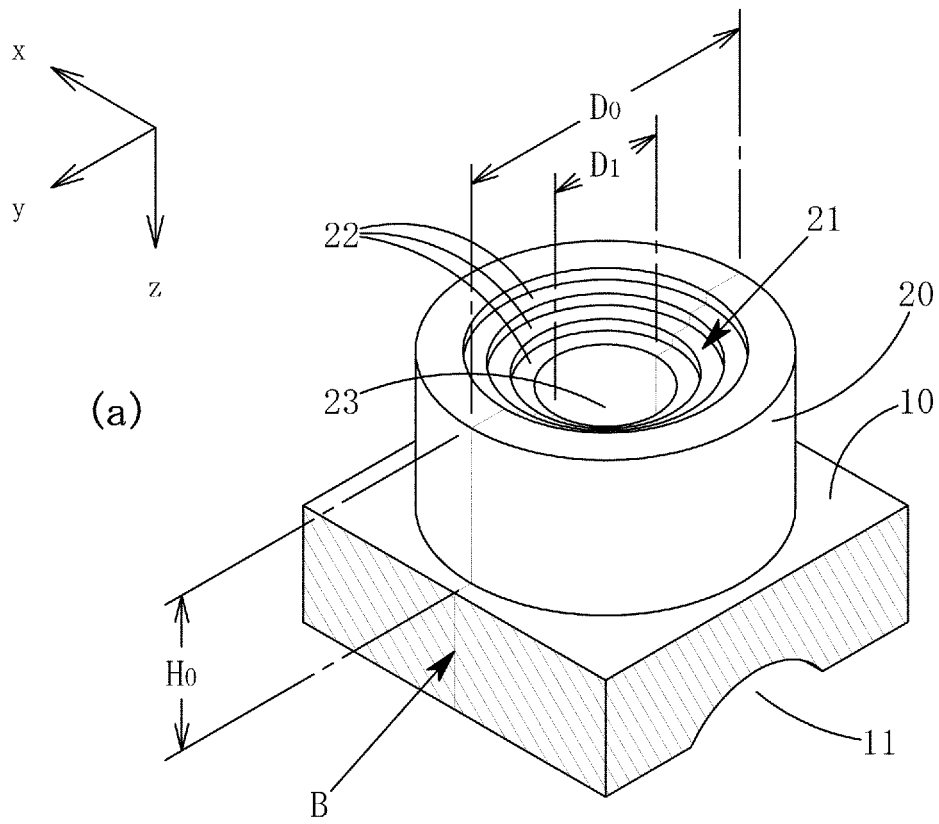


Fig. 4

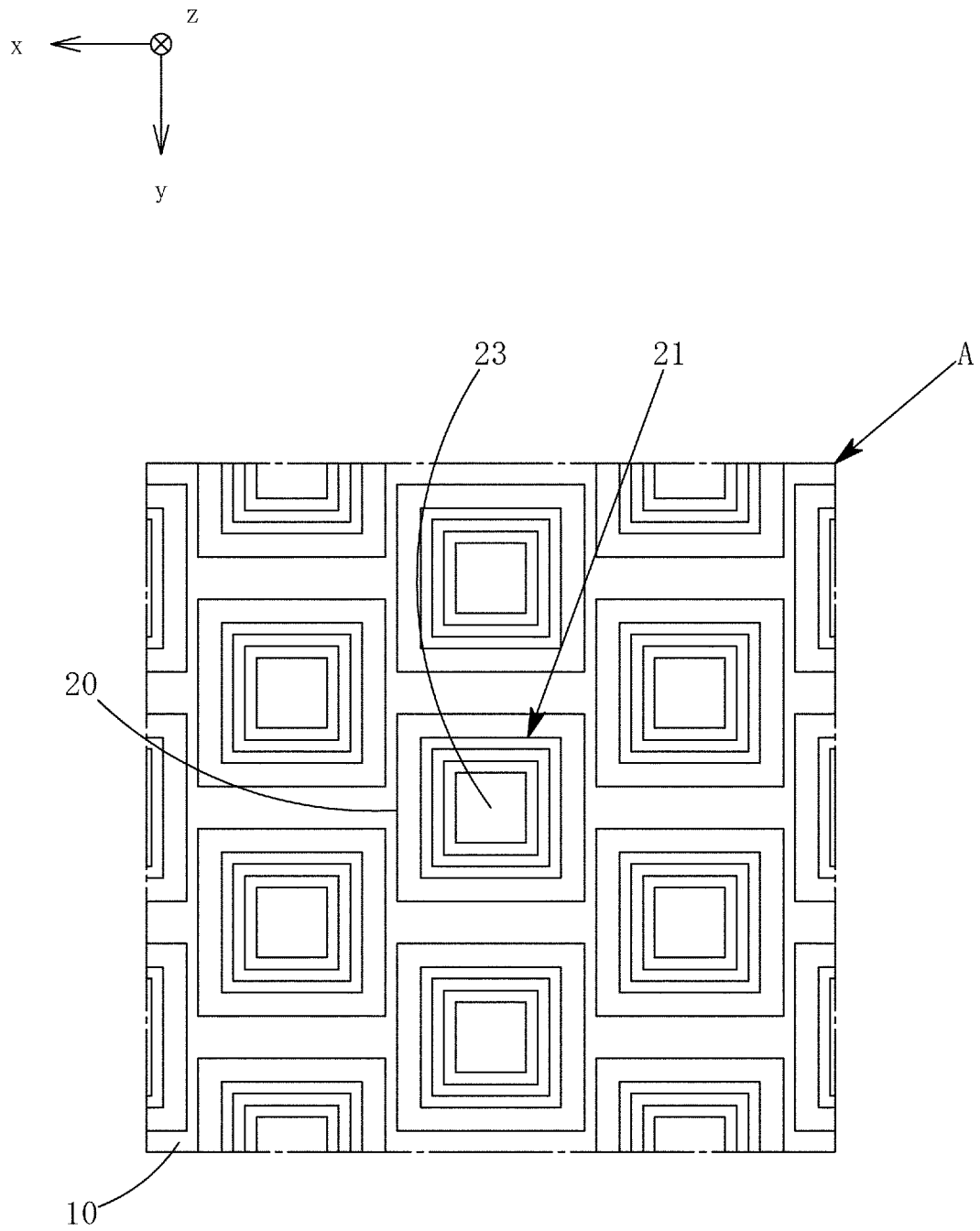
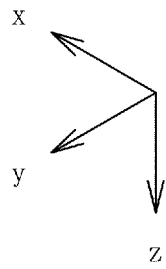
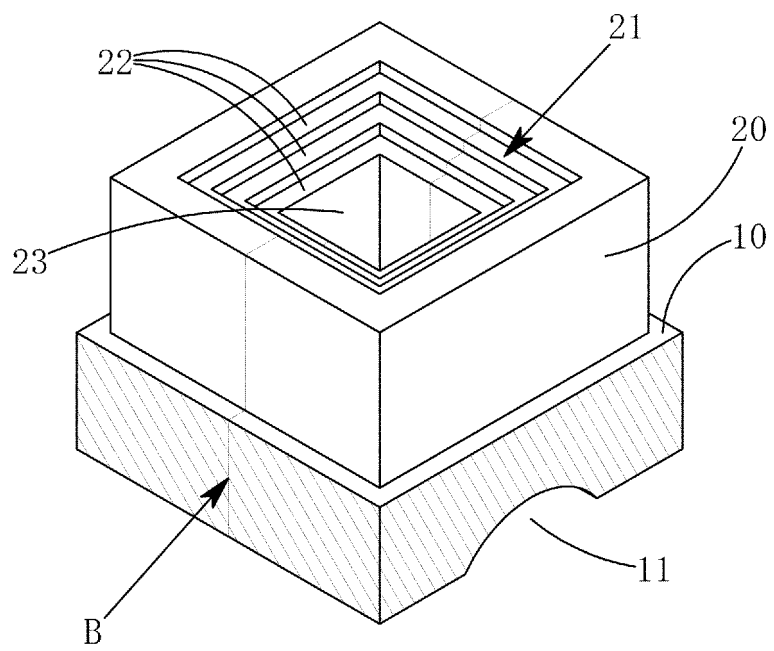


Fig. 5



(a)



(b)

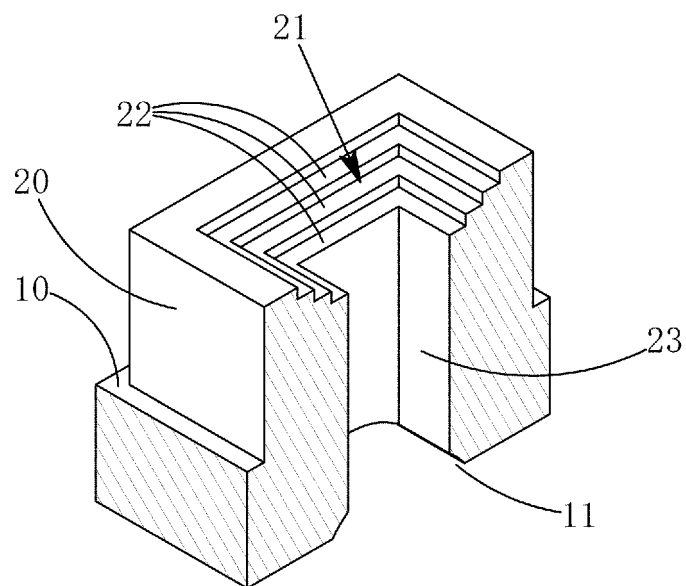


Fig. 6

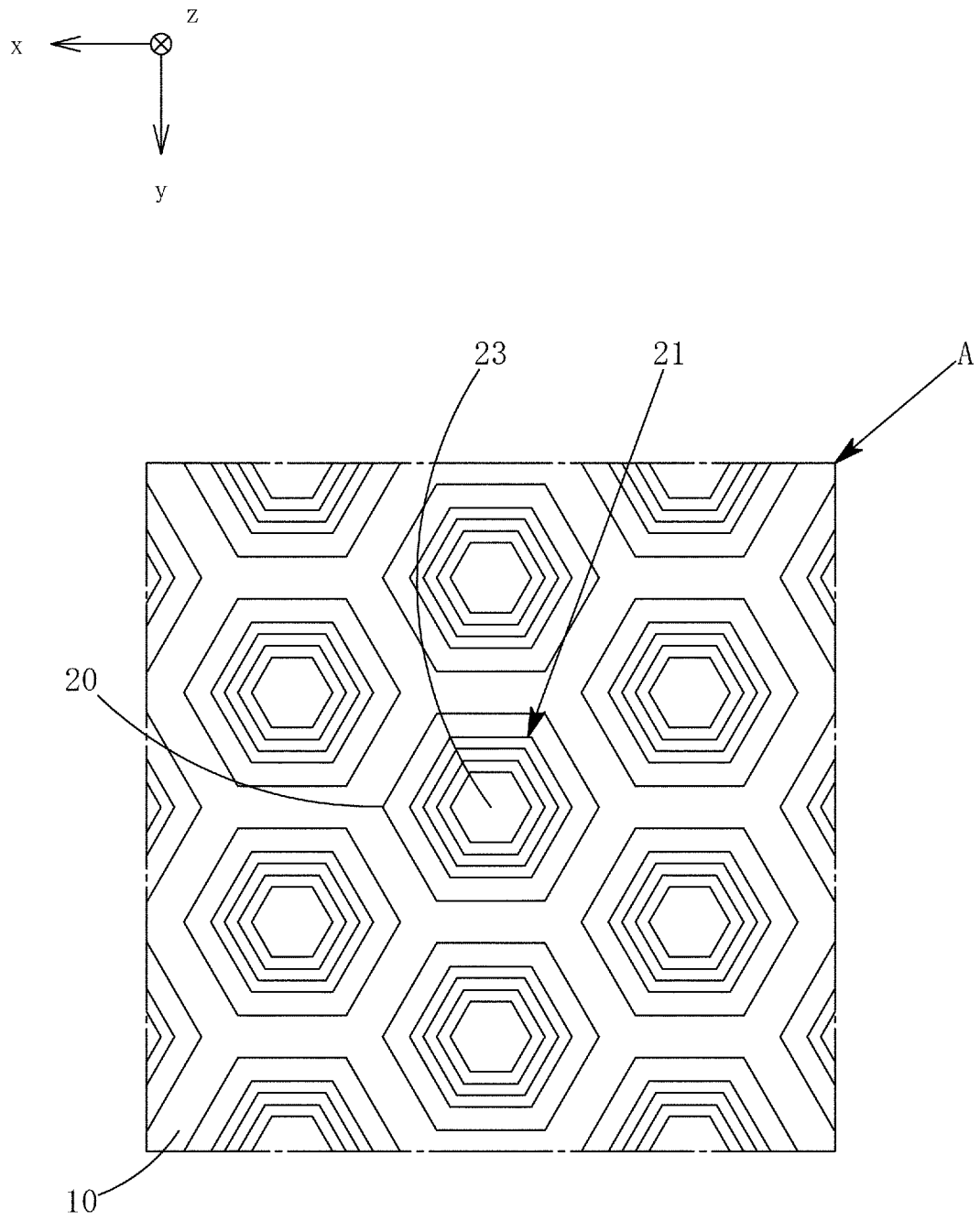
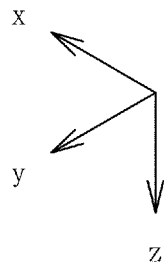
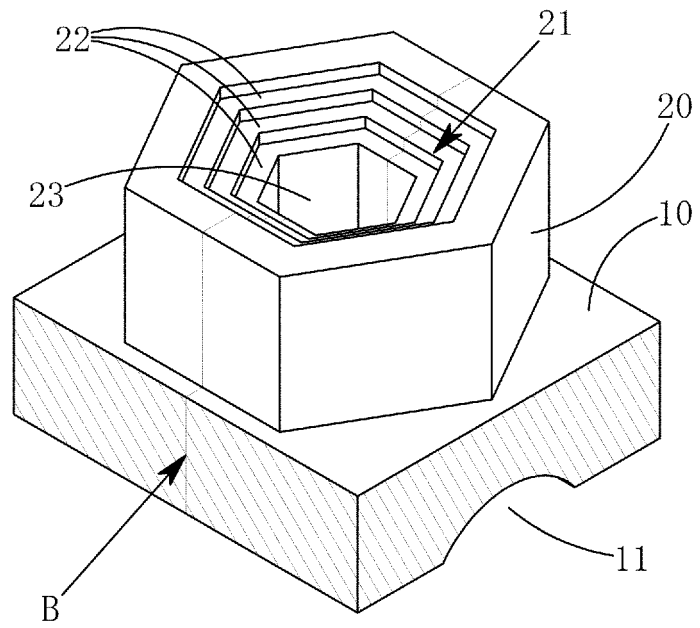


Fig. 7



(a)



(b)

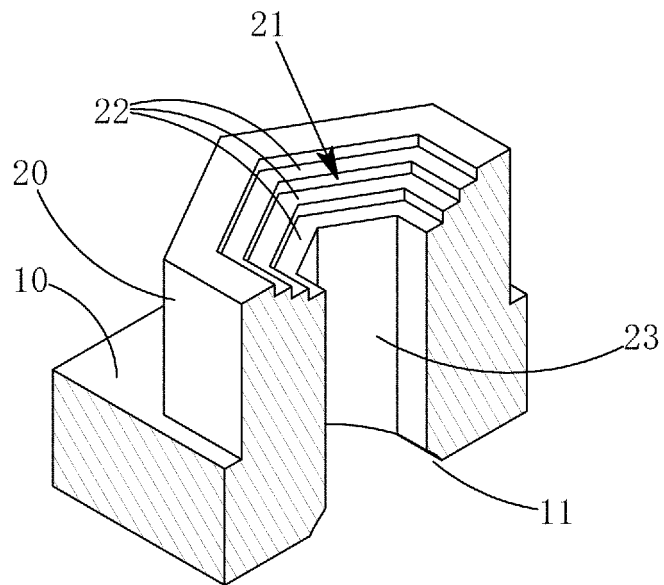


Fig. 8

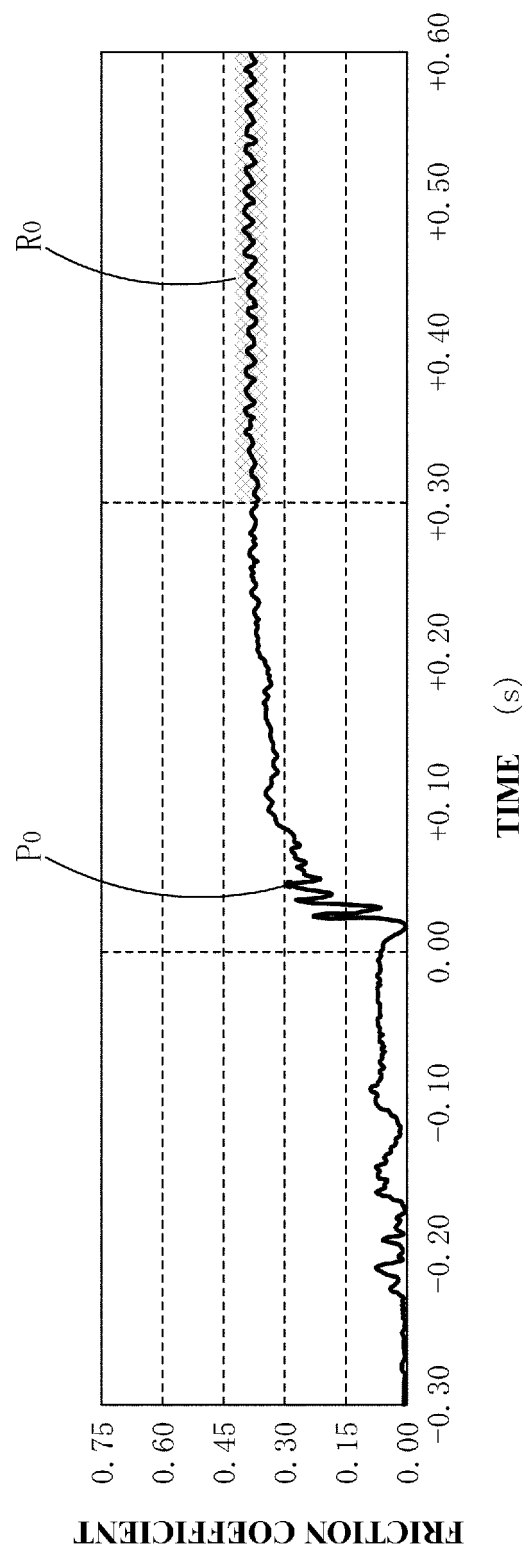


Fig. 9

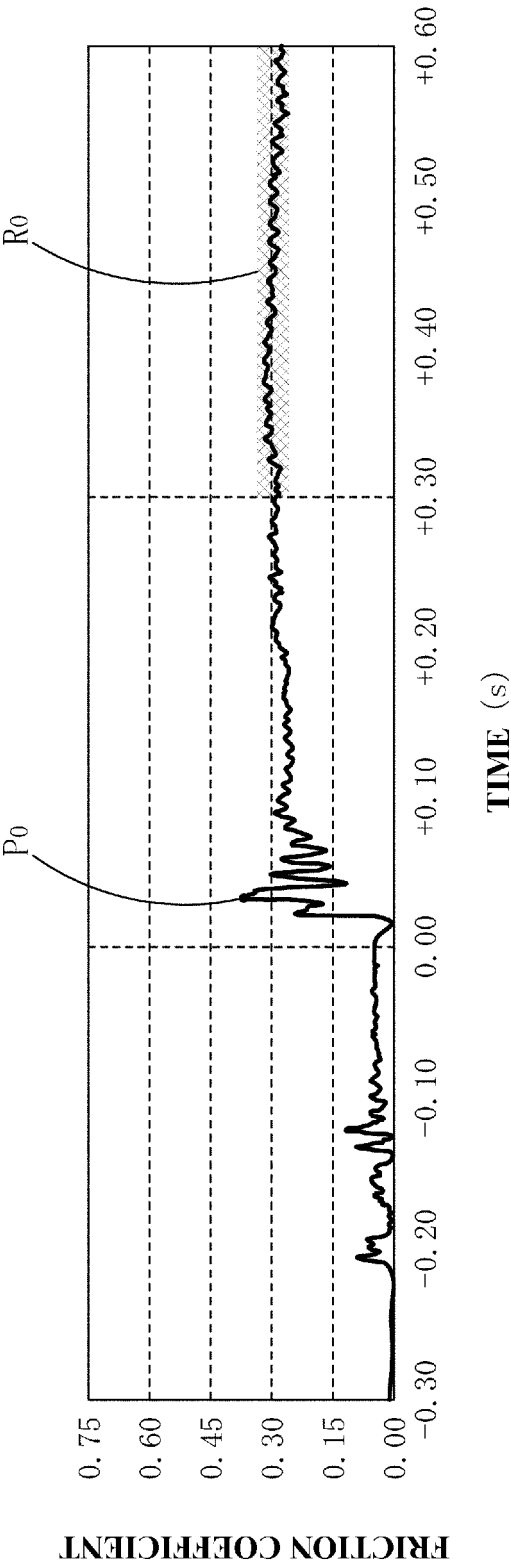


Fig. 10

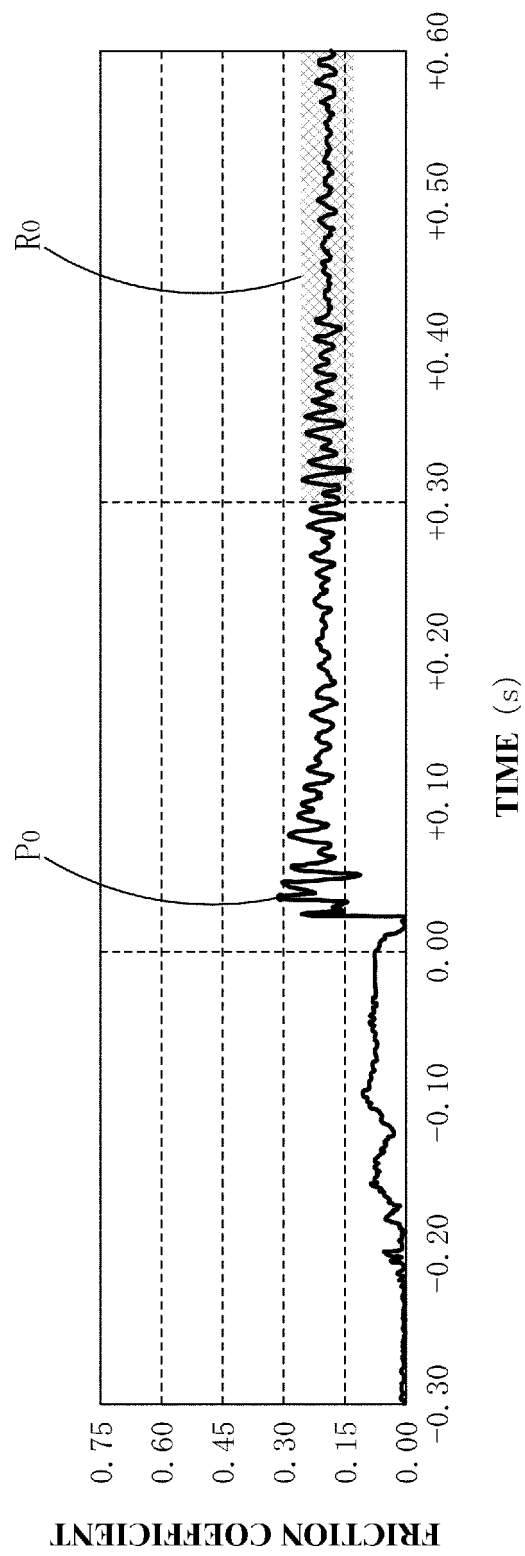


Fig. 11

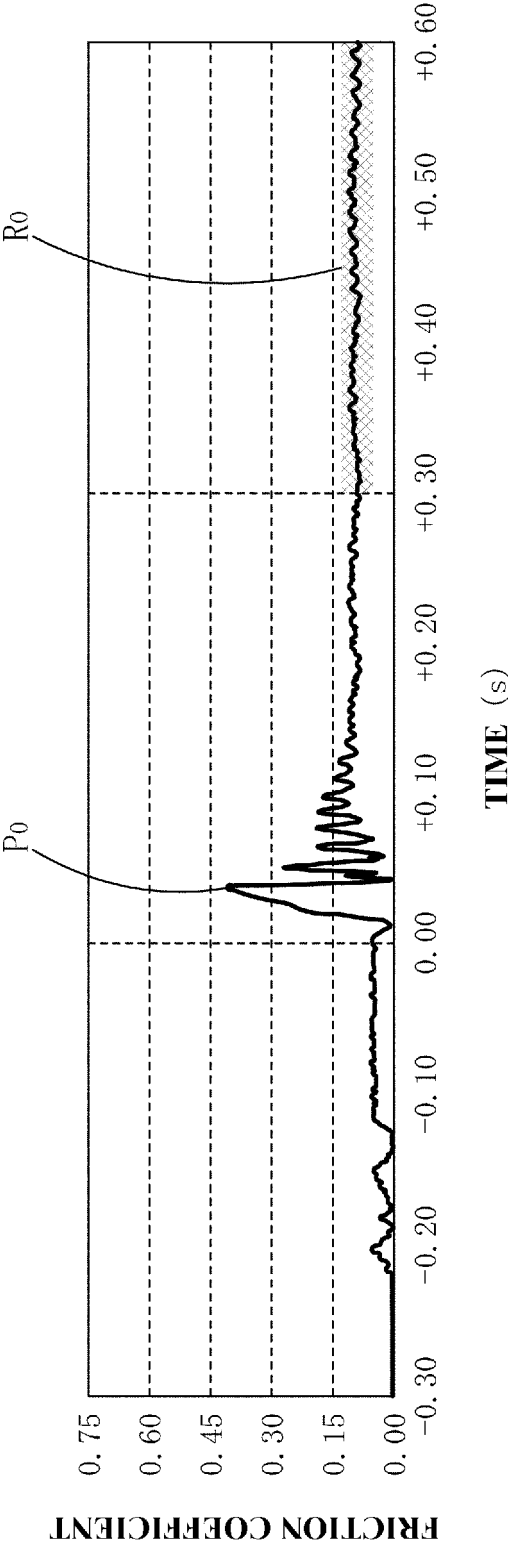


Fig. 12

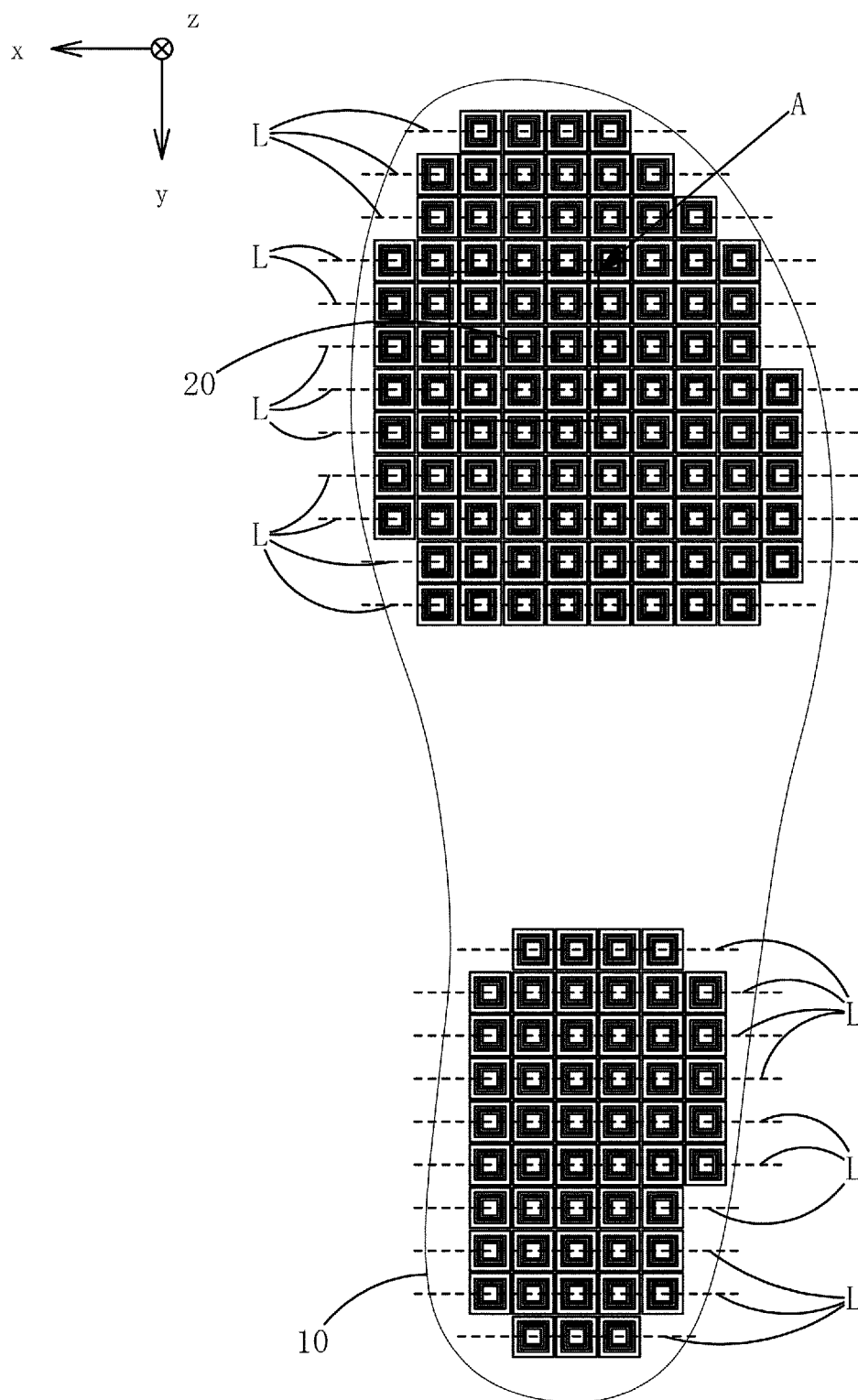


Fig. 13

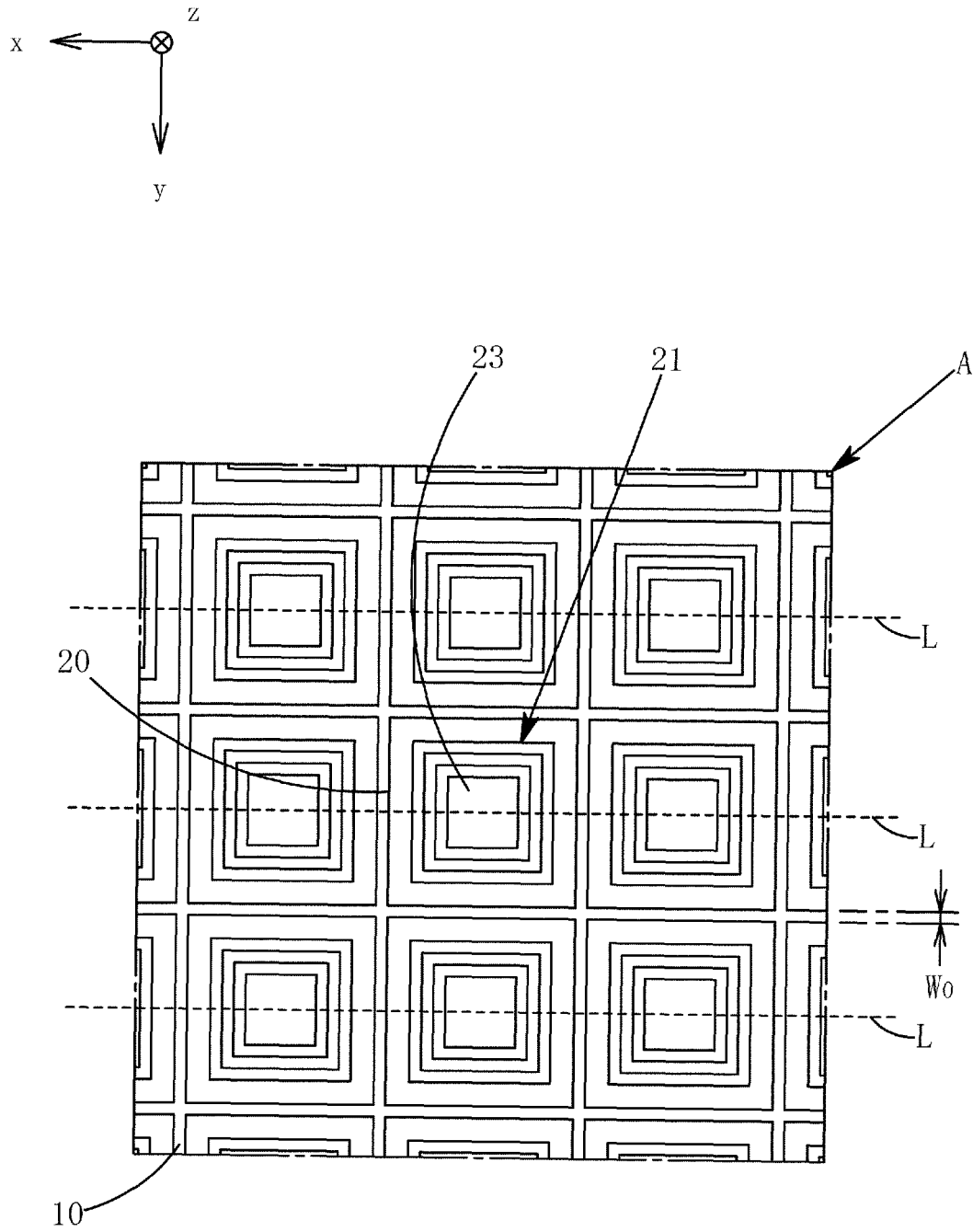


Fig. 14

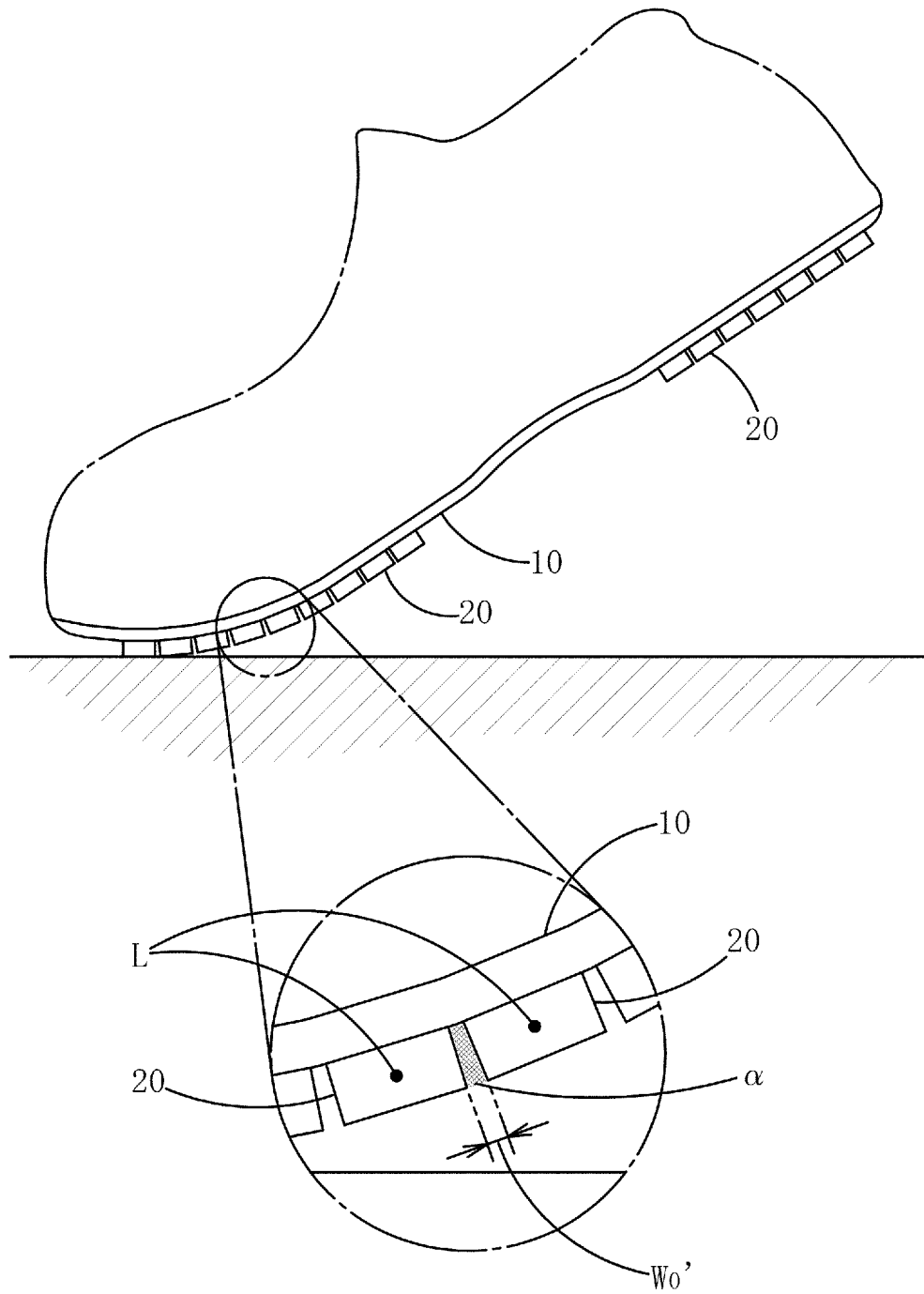


Fig. 15

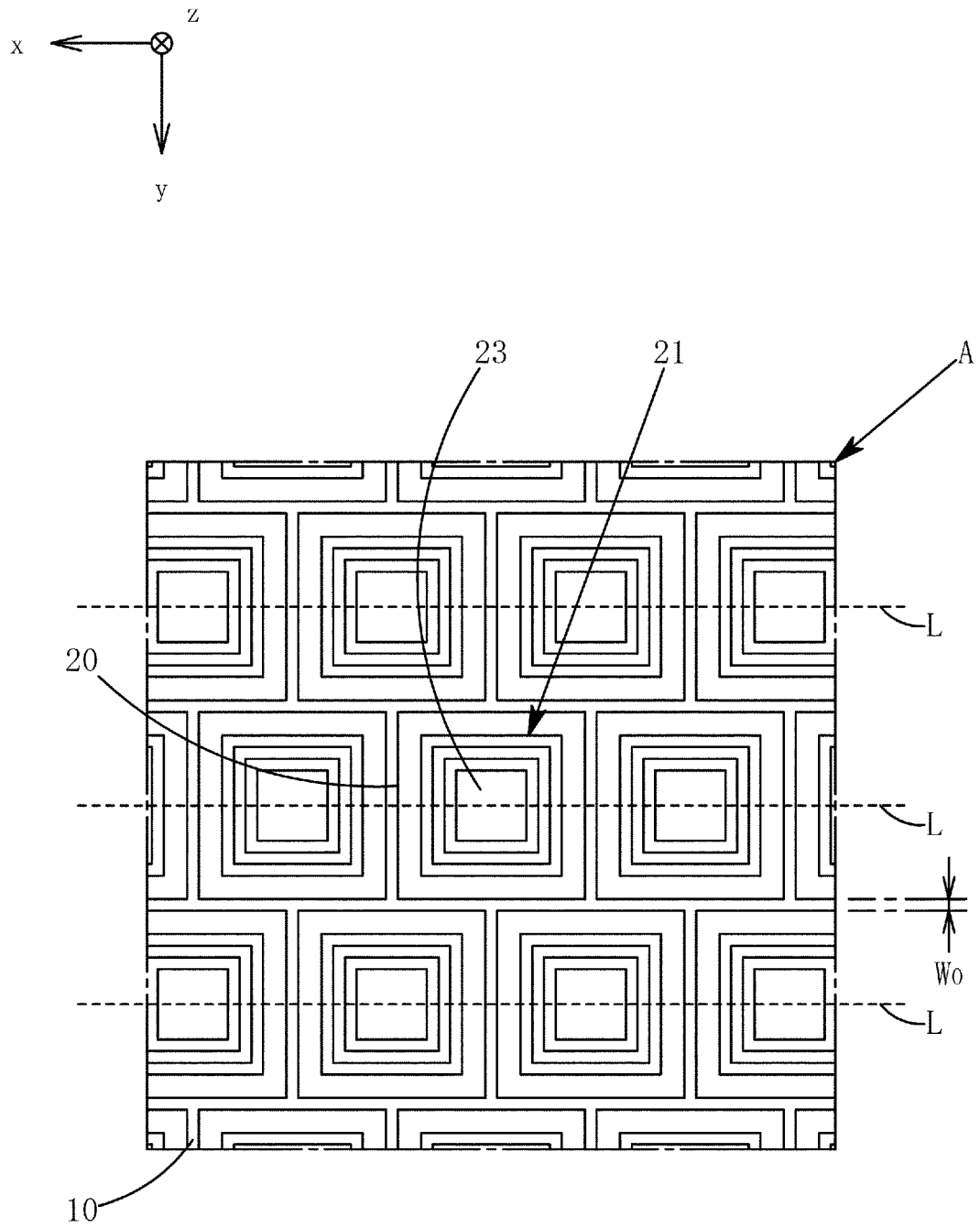


Fig. 16

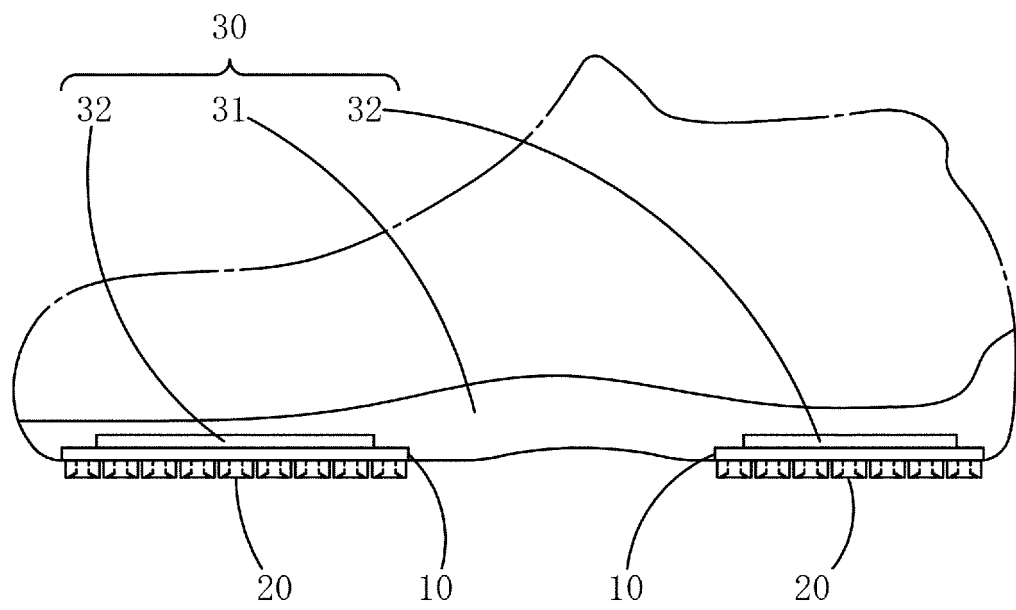


Fig. 17

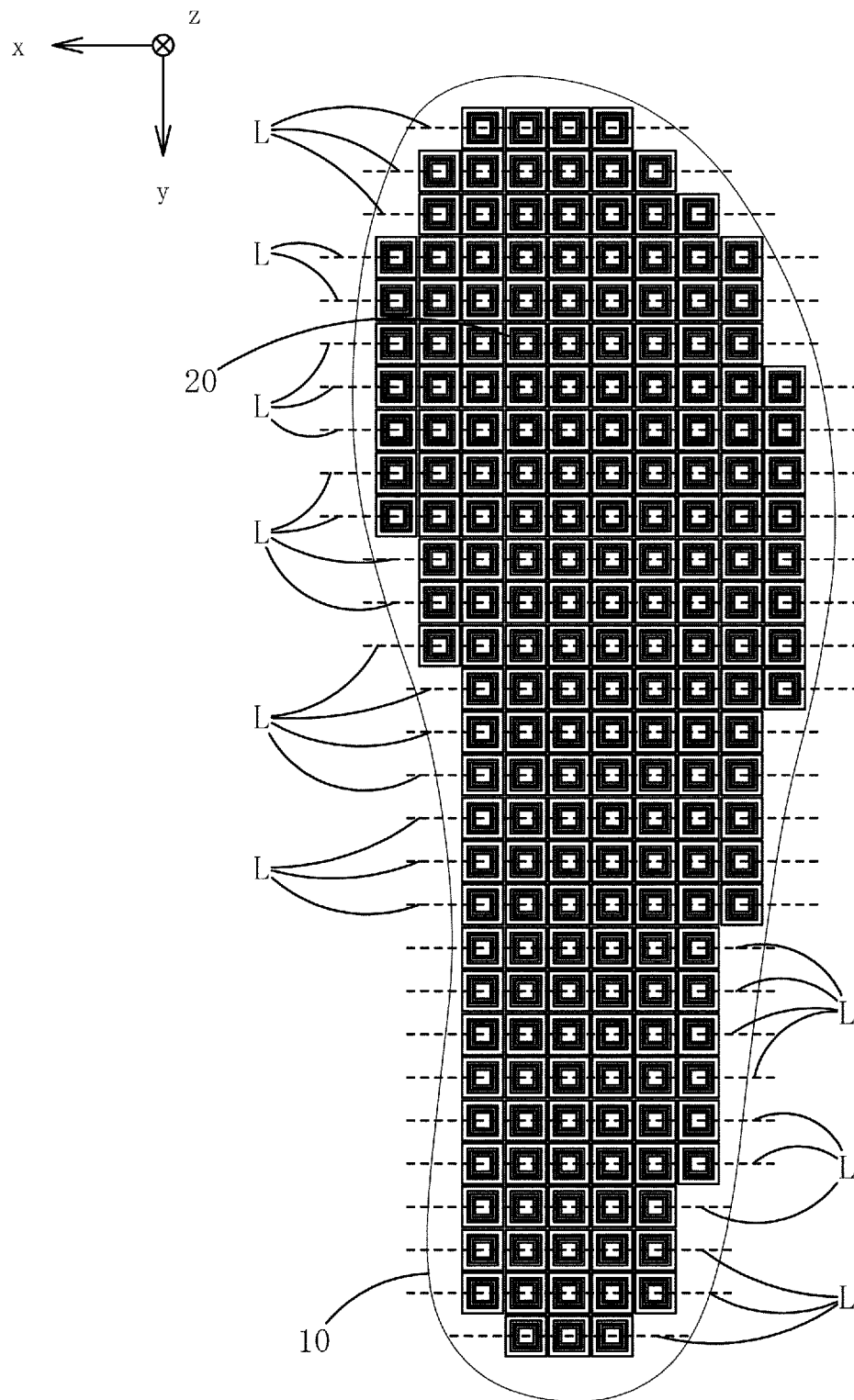
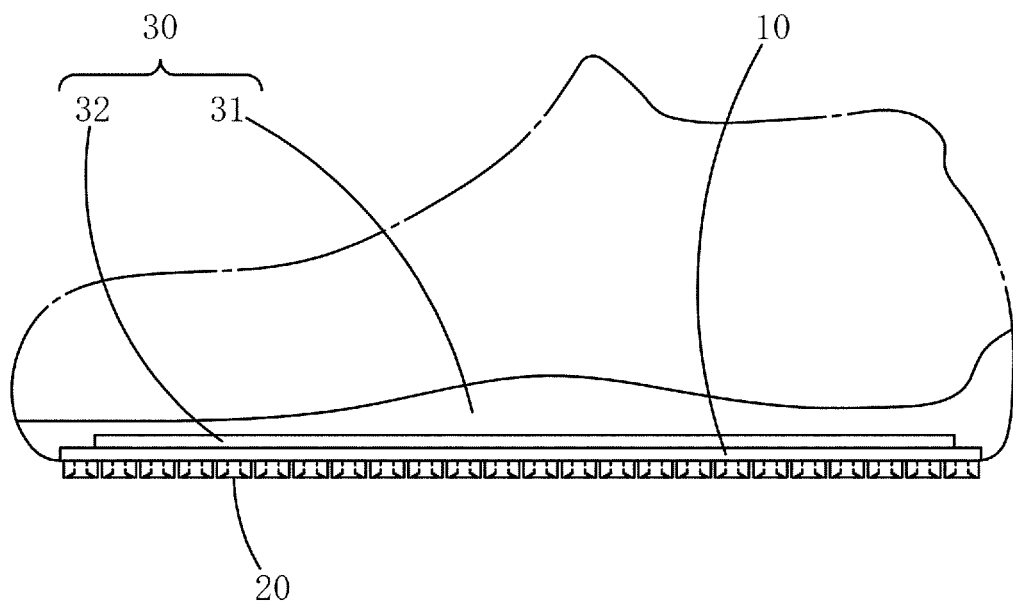


Fig. 18



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/082768

A. CLASSIFICATION OF SUBJECT MATTER
A43B13/22 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A43B1/00-23/30, A43C1/00-19/00, A43D1/00-999/00, B29D35/00-35/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 3096646 U (Tang-Ma PAN), 26 September 2003 (26.09.2003), paragraph [0007]; fig. 2 & US 2004/0163282 A1 paragraph [0022]; fig. 2 & DE 203005468 U1	1-8
A	JP 7-171006 A (Asahi Corporation Co., Ltd.), 11 July 1995 (11.07.1995), paragraphs [0004] to [0006]; fig. 1 to 2 (Family: none)	1-8

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

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
22 November 2016 (22.11.16)

Date of mailing of the international search report
06 December 2016 (06.12.16)

Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/082768

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 050422/1971 (Laid-open No. 8446/1973) (Kabushiki Kaisha Orient Sangyo), 30 January 1973 (30.01.1973), fig. 1 to 3 (Family: none)	1-8

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2016/082768

Object to be covered by this search:

Claims 1-8

Claims 1-8 describe: a shoe sole wherein a dynamic friction coefficient for an ice surface is larger than an maximum static friction coefficient for the ice surface, the dynamic friction coefficient for the ice surface is 0.25 or more, a plurality of antislip protrusions the lower end surfaces of which are each a ground contact plane are formed in a downward direction, a recessed portion recessed in a cone shape is formed in the lower end surface of each of the antislip protrusions, steps are annularly formed on the inner peripheral surface of each of the recessed portions, a plurality of protrusion lines each composed of a plurality of antislip protrusions that are arranged along the width direction of a shoe sole at a predetermined distance from each other in the width direction of the shoe sole are arranged at a predetermined distance from each other in the longitudinal direction of the shoe sole, a drain hole for sucking up water getting into the recessed portion when the lower end surface of the antislip protrusion has come into contact with the ground and discharging the water to the periphery of the shoe sole is provided, and a mid-sole portion formed from a material having a lower hardness than a shoe sole body is provided on the upper surface side; a shoe provided with the aforementioned shoe sole; and an antislip member wherein a dynamic friction coefficient for an ice surface is larger than a maximum static friction coefficient for the ice surface. However, the concrete description in Detailed Description of the Invention of a shoe sole wherein a dynamic friction coefficient for an ice surface is larger than a maximum static friction coefficient for the ice surface is only the shape, dimensions, and material property described in paragraph [0061] of the description regarding the shoe sole and the antislip member included in claims 1-8.

It is common technical knowledge at the time of filing that the dynamic friction coefficient and maximum static friction coefficient for an ice surface of a shoe sole and an antislip member each have a different value according to a combination of the shape and the material property of the shoe sole, and a basis for expanding or generalizing the content disclosed in Detailed Description of the Invention to the scope of the inventions in claims 1-8 including a shoe sole having greatly different shape and material property, which is described in paragraph [0061] of the description, cannot be found.

Therefore, the inventions of claims 1-8 exceed the range set forth in the detailed explanation of invention.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3096646 U [0005]
- WO 2006003740 A [0005]