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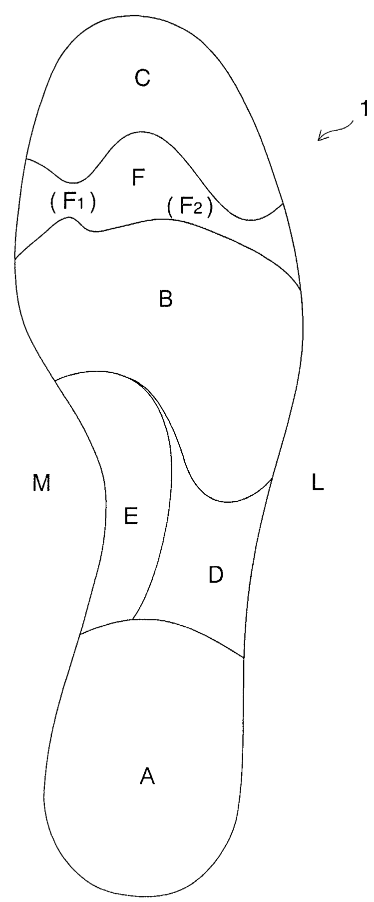
(54) Outsole structure of football shoe

(57) An outsole (1) of a soccer spike shoe is formed of six portions, i.e. a heel portion (A), a tread portion (B), a toe portion (C), a midfoot portion (D), an arch portion (E) and a toe root portion (F). The heel portion (A), tread portion (B), toe portion (C) and midfoot portion (D) are made more rigid, and the arch portion (E) and the toe root portion (F) are made less rigid. First to fifth studs (31-35) are provided on a sole surface of the outsole (1). The first stud (31) is disposed at a central portion of a distal phalanx (DP_1) of a first or great toe of a shoe wearer's foot. The second stud (32) is positioned at a metatarsophalangeal joint (MJ_1) of the first toe. The third stud (33) is placed at a head portion of a metatarsus (MB_4) of a fourth toe. The fourth stud (34) is located at a distal phalanx (DP_3) of a third toe. The fifth stud (35) is deployed at each head portion of metatarsi (MB_2, MB_3) of a second and third toe. Thereby, rigidity and strength as well as bendability of the outsole can be achieved. Also, slippage on the contact surfaces can be prevented from occurring during playing soccer.

FIG. 3



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an outsole structure of a football shoe, and more particularly, to an outsole structure that can improve rigidity and strength as well as flexibility of an outsole.

[0002] In footballs, such as soccer, Rugby, American football or the like, an outsole of a shoe receives various pressures as well as bending at the time of a dash, stopping, kicking or feinting.

[0003] However, a conventional outsole of a football shoe has an equal rigidity and strength at its every portion. Thus, rigidity, strength and flexibility of the outsole that are highly required during games could not be made compatible at the same time.

[0004] Also, in a prior art football shoe, as shown in FIG. 1, which illustrates a sole surface of a soccer shoe, each of studs 100 provided on the sole surface has a nearly equal size to each other and the studs 100 are disposed generally uniformly on the whole sole surface. That is, arrangement of conventional studs on the sole surface is determined in the light of appearance.

[0005] However, in an actual game, various foot movements occur at the time of various actions. In order to achieve a stud structure adapted to correspond to these complicated foot movements, arrangement, configuration and orientation of studs should be considered in designing.

[0006] Also, in a conventional football shoe, shown in FIG. 1, some or all of the studs generally have truncated cone shapes or solid cylindrical shapes, and these studs 100 have relatively greater bottom areas. Therefore, the studs sometimes are not stabbed into the ground. In such a case, a slippage will occur between the stud and the ground during various movements in a game.

[0007] An object of the present invention is to provide a football shoe that can achieve rigidity and strength as well as flexibility as an outsole required in a game.

[0008] Another object of the present invention is to provide an outsole for a football shoe that has a stud structure adapted to correspond to various movements of a foot and that can prevent slippage from occurring between a sole surface and the ground during various actions.

SUMMARY OF THE INVENTION

[0009] FIGS. 4 and 5 each show a sole pressure distribution diagram where a sole pressure actually applied to a pivot foot of a soccer player is indicated. FIG. 4 illustrates a diagram for an instep kick, and FIG. 5 illustrates a diagram for feinting. In these drawings, a sole viewed from a bottom side of a left foot is shown, and a medial side of the foot is shown by a symbol "M" and a lateral side of the foot is shown by a symbol "L". Also, in FIGS. 4 and 5, as it goes toward an inner side of constant-pressure curves , a sole pressure becomes higher. In addition, an outsole is divided into six portions, i.e. a heel portion A, a tread portion B, a toe portion C, a midfoot portion D, an arch portion E and a toe root portion F (see FIG. 3).

[0010] According to FIGS. 4 and 5, at the time of an instep kick or feinting, a sole pressure is relatively high at a heel portion, tread portion, toe portion and midfoot portion of a foot, whereas a sole pressure is relatively low at an arch portion and toe root portion of the foot. Moreover, at the time of an instep kick, a sole pressure of a first toe portion as well as a first toe root portion is also high.

[0011] The present invention has been made by considering the above-mentioned measurement results of an actual sole pressure distribution.

[0012] An outsole structure of a football shoe according to a first invention includes a toe portion corresponding to toes of a shoe wearer's foot, and a toe root portion corresponding to toe roots of the foot, a tread portion, midfoot portion, arch portion and heel portion each corresponding to a tread, midfoot, arch and heel of the foot. With regard to rigidities of these six portions, the heel portion, tread portion, toe portion and midfoot portion are made more rigid and thus less bendable because higher sole pressures will be applied to these portions during various actions. On the other hand, the arch portion and toe root portion are made less rigid and thus more bendable because sole pressures applied to these portions are relatively low during various actions and further bendability is required at these portions.

[0013] The rigidities of the above-mentioned six portions of the first invention may preferably be designed in the order; (heel portion) > (tread portion) > (toe portion) > (midfoot portion) > (arch portion) > (toe root portion). The heel portion is a region where the greatest sole pressure will be applied, as shown in FIGS. 4 and 5. Therefore, according to such a sole pressure distribution diagram, the heel portion is constructed to have the greatest rigidity. The toe root portion is a region where bendability is most required at a dash or other actions. Therefore, the rigidity of the toe root portion is made least and thus, the greatest bendability will be acquired at the toe root portion.

[0014] By considering mainly a sole pressure distribution curve for an instep kick shown in FIG. 4, a toe root portion of an outsole may be defined by a first toe root portion and a second to fifth toe root portion. The heel portion, tread portion, toe portion, first toe root portion and midfoot portion are made more rigid, and the arch portion and second to fifth toe root portion are made less rigid. In this case, since the first toe root portion also has a great rigidity, rigidity distribution according to an actual sole pressure distribution on an instep kick can be achieved. The rigidities of the above-mentioned seven portions may preferably be designed in the order; (heel portion) > (tread portion) > (toe portion) > (first toe root portion) > (midfoot portion) > (arch portion) > (second to fifth toe root portion).

[0015] A first boundary line between the toe portion and the toe root portion may extend from a head portion of a fourth toe middle phalanx through a base portion of a third toe middle phalanx to a head portion of a second toe middle phalanx and further extend to a head portion of a first toe proximal phalanx. The first boundary line is convexly curved at a second toe toward a front side of the shoe. Also, a second boundary line between the toe root portion and the tread portion may extend from a base portion of a fifth toe middle phalanx through a head portion of a fourth toe proximal phalanx to a central portion of a third toe proximal phalanx and further extend from a central portion of a second toe proximal phalanx to a central portion of a first toe proximal phalanx. The second boundary line is arcuately curved toward a front side of the shoe. A third boundary line between the tread portion and the midfoot and arch portions may extend from a base portion of a fifth toe metatarsus through a base portion of a fourth metatarsus toward a front side of the shoe and further extend through a central portion of a second toe metatarsus to a central portion of a first toe metatarsus. A fourth boundary line between the heel portion and the midfoot and arch portions may extend generally along a transverse tarsal joint. A fifth boundary line between the midfoot portion and the arch portion may extend through the outer cuneiform bone along the length of the shoe. In such a manner, by dividing the sole surface of the outsole into six portions through the first to fifth boundary lines, rigidity, strength and flexibility that are required during a game can be achieved at a desired region of the outsole.

[0016] The rigidity of the desired portion of the outsole may be changed according to its thickness. The thicker thickness the outsole has, the greater bending rigidity the outsole acquires, thereby making the outsole less bendable. In contrast, the thinner thickness the outsole has, the smaller bending rigidity the outsole acquires, thereby making the outsole more bendable.

[0017] A reinforcement member such as carbon fiber or the like may be embedded in a portion of greater rigidity, thereby increasing the strength of that portion. Alternatively, a rib structure may be used to improve rigidity. A honeycomb structure may be provided at a portion of smaller rigidity. By a reinforcement action of the honeycomb structure, a lower rigid portion can be strengthened. A plurality of longitudinally extending grooves may be provided at the tread portion to improve bendability of the tread portion in the lateral direction. These longitudinally extending grooves at the tread portion may be disposed based on a load transfer path of the shoe wearer from the start of the sole ground contact of the outsole to a full-surface ground contact of the outsole. Thus, the tread portion can be bent in the shoe width direction along the actual load transfer path. As a result, smooth foot movements can be achieved along the weight transfer during a game, thereby transmitting power to the ground effectively. A plurality of lateral extending grooves may be provided at a position in the tread portion corresponding to a third to fifth toe metatarsus. These grooves improve longitudinal bendability of the tread portion corresponding to the third to fifth toe metatarsus.

[0018] A plurality of lateral grooves provided at the tread portion may be based on a load transfer path of the shoe wearer from the full-surface ground contact of the outsole to a moment immediately before leaving the ground. Thus, the tread portion can be bent in the shoe length direction along the load transfer path. As a result, smooth foot movements can be achieved along the weight transfer route during a game, thereby transmitting power to the ground more effectively.

[0019] In the heel portion, a buffer assembly may be provided to absorb a shock load applied to the heel portion. The buffer assembly is composed of a plurality of band-shaped, wavy corrugated plates each extending along the length of the shoe and interconnected to each other. In this case, when a shock load is applied to the heel portion of the shoe at the time of striking onto the ground during a game, crest portions of wavy corrugations of each wavy corrugated plate deforms downwardly whereas trough portions of wavy corrugation of each wavy corrugated plate deforms upwardly, thereby absorbing the shock load. Also, since each connecting portion of adjacent wavy corrugated plates restrains deformation of the wavy corrugations, the shock load can be effectively absorbed.

[0020] Next, FIGS. 17 to 19 each show directions of forces actually applied from the ground to a pivot foot of a soccer player during a game. FIG. 17 indicates directions of forces at the time of an instep kick, FIG. 18 indicates directions of forces at the time of feinting and FIG. 19 indicates directions of forces at the time of an infront kick. In each drawing, a sole surface viewed from a bottom side of a left foot is shown.

[0021] A second invention has been made by considering such directions of forces acted actually on the sole surface of the outsole as well as the above-mentioned sole pressure distributions shown in FIGS. 4 and 5.

[0022] A plurality of studs are provided on the sole surface of the outsole. These studs are composed of a first stud disposed at a position corresponding to a central portion of a distal phalanx of a first toe of a shoe wearer's foot, a second stud disposed at a position corresponding to a metatarsophalangeal joint of the first toe of the foot, and a third stud disposed at a position corresponding to a head portion of a metatarsus of a fourth toe of the foot. Also, a fourth stud may be disposed at a position corresponding to a distal phalanx of a third toe and a fifth stud may further be disposed at a position corresponding to head portions of metatarsi of a second and third toe. That is, a first to fifth toe is disposed at a position where a sole pressure is relatively high in sole pressure distribution diagrams of FIGS. 4 and 5 and where forces from the ground can be effectively supported, as is clearly seen from active direction distribution diagrams of FIGS. 17 to 19.

[0023] Also, each pressure surface of the studs may be flat or curved and form a predetermined angle with a longitudinal center line of the shoe in order to secure an adequate pressure surface area to prevent a slippage between the sole surface and the ground.

[0024] Each stud may have a cross sectional shape including a partially cut surface of a blade or oval shape. In this case, when the cut surface is disposed toward a front side of the shoe, the cut surface functions as a stop. On the other hand, when the cut surface is disposed toward a rear side of the shoe, the cut surface effectively acts as a pressure surface experiencing a tractional force from the ground at the start of a dash.

[0025] A first sub-stud may be disposed at a position corresponding to a metatarsus of a fifth toe of the wearer's foot. Also, a second sub-stud may be disposed at a position corresponding to an intermediate position between proximal phalanxes of a fourth and fifth toe. Furthermore, a third sub-stud may be disposed at a position corresponding to a distal phalanx of a fourth toe, and a fourth sub-stud may be disposed at a position corresponding to an intermediate position between proximal phalanxes of a second and third toe.

[0026] Also, each pressure surface of the sub-studs may be flat or curved and form a predetermined angle with a longitudinal center line of the shoe in order to ensure a sufficient pressure surface area besides a pressure surface of the studs to securely prevent a slippage between the sole surface and the ground.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] For a more complete understanding of the invention, reference should be made to the embodiments illustrated in greater detail in the accompanying drawings and described below by way of examples of the invention. In the drawings, which are not to scale:

FIG. 1 is a bottom surface view of an outsole of a soccer spike shoe of prior art.

FIG. 2 is a bottom surface view of an outsole of a soccer spike shoe according to one embodiment of the present invention.

FIG. 3 is a schematic illustrating each portion of the outsole of FIG. 1.

FIG. 4 is a sole pressure distribution diagram which indicates a maximum value of a sole pressure actually applied to each portion of the outsole of a pivot foot at the time of an instep kick.

FIG. 5 is a sole pressure distribution diagram which indicates a maximum value of a sole pressure actually applied to each portion of the outsole of a pivot foot at the time of feinting.

FIG. 6 is a perspective view of a portion of a honeycomb structure of the outsole of FIG. 2.

FIG. 7 is a cross sectional view of FIG. 2 taken along line VII - VII.

FIG. 8 is a cross sectional view of FIG. 2 taken along line VIII - VIII.

FIG. 9 is a cross sectional view of FIG. 2 taken along line IX - IX.

FIG. 10 is a load transfer path diagram for a pivot foot at the time of an instep kick, which indicates a variation of a load transfer path of a pivot foot from the start of the ground contact of the sole surface of the outsole to a full-surface contact with the ground.

FIG. 11 is a top surface view of the outsole of FIG. 2.

FIG. 12 is a load transfer path diagram for a pivot foot at the time of an instep kick, which indicates a variation of a load transfer path of a pivot foot from a full-surface contact of the sole surface with the ground to a moment immediately before leaving the ground.

FIG. 13 is a perspective view of a portion of a buffer assembly provided at a heel portion of the outsole of FIG. 2.

FIG. 14 is an enlarged top surface view of the heel portion of the outsole of FIG. 2, not showing the buffer assembly in FIG. 13.

FIG. 15 is a cross sectional view of FIG. 14 taken along line XV - XV.

FIG. 16 is a bottom surface view of an outsole of a soccer spike shoe according to one embodiment of the present invention, illustrating configurations of the studs along with a skeletal drawing of the foot.

FIG. 17 is a distribution diagram illustrating active directions of the forces applied to the sole surface from the ground at the time of an instep kick.

FIG. 18 is a distribution diagram illustrating active directions of the forces applied to the sole surface from the ground at the time of feinting.

FIG. 19 is a distribution diagram illustrating active directions of the forces applied to the sole surface from the ground at the time of an infront kick.

FIG. 20 is a schematic illustrating the condition where first and second studs are forming pressure surfaces most efficiently at the time of an instep kick.

FIG. 21 is a schematic illustrating the condition where third and fourth studs are forming pressure surfaces most efficiently at the time of feinting.

FIG. 22 is a schematic illustrating the condition where fifth stud is forming pressure surfaces most efficiently at the time of an infront kick.

FIG. 23 is an enlarged view of a first stud.

FIG. 24 is an enlarged view of a second stud.

FIG. 25 is an enlarged view of a third stud.

FIG. 26 is an enlarged view of a fourth stud.

FIG. 27 is an enlarged view of a fifth stud.

FIG. 28 is an enlarged view of a first sub-stud.

FIG. 29 is an enlarged view of a second sub-stud.

FIG. 30 is an enlarged view of a third sub-stud.

FIG. 31 is an enlarged view of a fourth sub-stud.

FIG. 32 is a bottom surface view of an outsole of a soccer spike shoe according to a first alternative embodiment of the present invention.

FIG. 33 is a bottom surface view of an outsole of a soccer spike shoe according to a second alternative embodiment of the present invention.

FIG. 34 is a bottom surface view of an outsole of a soccer spike shoe according to a third alternative embodiment of the present invention.

FIG. 35 is a bottom surface view of a heel portion of an outsole of a soccer spike shoe according to a fourth alternative embodiment of the present invention, showing an arrangement of studs at the heel portion.

FIG. 36 is a bottom surface view of a heel portion of an outsole of a soccer spike shoe according to a fifth alternative embodiment of the present invention, showing an arrangement of studs at the heel portion.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] Referring now to the drawings, FIG. 2 is a bottom surface view of an outsole of a left shoe according to one embodiment of the present invention. FIG. 3 is a schematic illustrating each portion of the outsole of FIG. 2. As shown in FIGS. 2 and 3, an outsole 1 is composed of six portions, i.e. a heel portion A, tread portion B, toe portion C, midfoot portion D, arch portion E and toe root portion F each corresponding to a heel region, tread region, toes, midfoot region, arch region and toe root region of a shoe wearer's foot, respectively.

[0029] Boundaries of each portion of the outsole will be explained in greater detail with reference to FIG. 16. As shown in FIG. 16, a first boundary line Y1 between the toe portion C and the toe root portion F extends from a head portion of a middle phalanx MP4 of a fourth toe of the foot through a base portion of a middle phalanx MP3 of a third toe to a head portion of a middle phalanx MP2 of a second toe and extends further to a head portion of a proximal phalanx PP1 of a first toe. The first boundary line Y1 is convexly curved at a second toe toward a front side of the shoe.

[0030] A second boundary line Y_2 between the toe root portion F and the tread portion B extends from a base portion of a middle phalanx MP_5 of a fifth toe of the foot through a head portion of a proximal phalanx PP_4 of a fourth toe to a central portion of a proximal phalanx PP_3 of a third toe and extends further from a central portion of a proximal phalanx PP_2 of a second toe to a central portion of a proximal phalanx PP_1 of a first toe. The second boundary line Y_2 is arcuately curved toward a front side of the shoe.

[0031] A third boundary line Y_3 between the tread portion B and the midfoot and arch portions D, E extends from a base portion of a metatarsus MB_5 of a fifth toe through a base portion of a metatarsus MB_4 of a fourth toe toward a front side of the shoe and extends further through a central portion of a metatarsus MB_2 of a second toe to a central portion of a metatarsus of MB_1 a first toe. A fourth boundary line Y_4 between the heel portion A and the midfoot and arch portions D, E extends generally along a transverse tarsal joint CJ. A fifth boundary line Y_5 between the midfoot portion D and the arch portion E extends through an outer cuneiform bone CO along the length of the shoe.

[0032] In this embodiment, a thickness of each portion of the outsole 1 is designed as follows: thickness of the heel portion A or tA = 3.3(mm); thickness of the tread portion B or t_B = 2.8(mm); thickness of the toe portion C or tc = 2.3(mm); thickness of the arch and toe root portions or tE, tF = 1.7(mm); thickness of the midfoot portion tD is an intermediate value between t_C and t_E, t_F. Thus, with regard to the rigidity or bending rigidity of each portion, the following inequality is satisfied. That is, (heel portion A) > (tread portion B) > (toe portion C) > (midfoot portion D) > (arch and toe root portions E, F). The thickness of each portion of the outsole 1 is not limited to the above-mentioned values. In addition, one or more ribs (not shown) extending along the length of the shoe may be provided at the midfoot portion D. Such ribs will further increase the rigidity of the midfoot portion D as compared to the rigidity of the arch and toe root portions E, F.

[0033] The reason why the rigidity of each portion of the outsole 1 varies is based upon sole pressure distribution diagrams shown in FIGS. 4 and 5. These drawings show measurement results of the sole pressure distribution actually applied to a pivot foot of a soccer player during a game, and FIG. 4 is for an instep kick and FIG. 5 for feinting. As is seen from FIGS. 4 and 5, at the time of an instep kick and feinting, sole pressures of the heel portion A, tread portion B, toe portion C and midfoot portion D of the foot are relatively high, and sole pressures of the arch portion E and the toe root portion F of the foot are relatively low. Also, at the time of the instep kick, the sole pressures of a first toe as well as a first toe root portion is high.

[0034] By considering such measurement results of the actual sole pressure distribution, the heel portion A, tread portion B, toe portion C and midfoot portion D are made more rigid so as to be less bendable during operation, whereas the arch portion E and toe root portion F are made less rigid so as to be more bendable or flexible during operation. In such a manner, rigidity distribution can be achieved according to the actual sole distribution at the time of an instep kick and feinting. In addition, a reinforcement member such as a carbon fiber or the like may be embedded into the heel portion A, tread portion B, toe portion C and midfoot portion D.

[0035] As shown in FIG. 2, a honeycomb structure 11 may be provided at the arch portion E and the toe root portion F. This honeycomb structure 11, shown in FIG. 6, has a plurality of band-shaped ribs that are disposed to form regular hexagons closely arranged. Such a honeycomb structure 11 reinforces the arch portion E and the toe root portion F. Preferably, the toe root portion F is least rigid of all the six portions. Because the toe root portion F is a region where flexibility is most required of the entire outsole. Also, a rib 30 may be provided at the first toe root portion Fi to advance rigidity of the first toe root portion F_1 relative to those of the other toe root portions F_2. In addition, a thickness of the first toe root portion F_1 may be greater than that of the remaining second to fifth toe root portions F_2 to increase rigidity of the first toe root portion F_1 relative to those of the other toe root portions F_2.

[0036] On the heel portion A are provided a first and second stud 20, 21 disposed respectively at the medial and lateral side on the front side of the heel portion A, and a third and fourth studs 22, 23 disposed respectively at the medial and lateral side on the rear side of the heel portion A. The front-side studs 20, 21 are connected by a laterally extending rib 24, also shown in FIG. 7. Similarly, the rear-side studs 22, 23 are connected by a laterally extending rib 25. These ribs 24, 25 improve the strength of the stud and increase the rigidity of the heel portion A. As shown in FIG. 7, an upraised portion 20b extending toward a shoe upper (not shown) is integrally formed with the heel portion A of the outsole 1 to secure a bonding area 20c to the shoe upper as well as to receive a larger buffer assembly 50 in FIG. 13.

[0037] On the tread portion B and the toe portion C are provided main studs 31 to 35. Proximal ends of the studs 31, 34 have a thick bottom portion 36, shown in FIG. 8, to further increase the rigidity of the toe portion C. Similarly, proximal ends of the studs 32, 33, 35 have a thick bottom portion 37 to further increase the rigidity of the tread portion B. Also, at the tread portion B and the toe portion C, relatively small sub-studs 41 to 44 are provided. Shapes, configurations and orientations of these studs will be explained later.

[0038] A plurality of longitudinal grooves 12 extending generally along the length of the shoe are formed on the tread portion B, shown in FIG. 9, to improve bendability of the tread portion B in the width direction. The longitudinal grooves 12 are disposed based upon a load transfer path diagram shown in FIG. 10. FIG. 10 illustrates variations of a load transfer path relative to a pivot foot of the shoe wearer from the start of the ground contact of the sole surface to a full surface contact at the time of an instep kick. As is also seen in FIG. 2, the longitudinal grooves 12 are formed generally along the load path at the tread portion B. Thereby, the tread portion B can be bent in the width direction according to the actual load transfer path of the foot.

[0039] As shown in FIG. 11, or a top surface view of the outsole, a plurality of laterally extending grooves 13 are formed on the top surface of the tread portion B and each groove generally correspond to metatarsi of a third to fifth toe of the foot. These lateral grooves 13 improve bendability of the tread portion B in the longitudinal direction. Also, arrangement of the lateral grooves 13 is based upon a load transfer path diagram shown in FIG. 12. FIG. 12 illustrates variations of a load transfer path relative to a pivot foot of the shoe wearer from the full-surface contact of the sole surface to a moment immediately before leaving the ground at the time of an instep kick. As is also seen in FIG. 11, the lateral grooves 13 are formed generally along the load transfer path at the tread portion B. Thereby, the tread portion B can be bent in the longitudinal direction according to the actual load transfer path of a foot. In addition, the lateral grooves 13 may be formed on a bottom surface side of the outsole 1.

[0040] As shown in FIG. 11, a buffer assembly 50 is provided on a top surface side of the heel portion A. The buffer assembly 50, shown in FIG. 13, is composed of a plurality of band-shaped, wavy corrugated plates 51, 52 each extending along the length of the shoe and disposed alongside of each other. Phase of the wavy corrugated plate 51 is offset by a half wavelength relative to the phase of the adjacent wavy corrugated plate 52. The adjacent wavy corrugated plates 51, 52 are interconnected by a connecting portion 53.

[0041] In this case, when a shock load is applied to the heel portion A of the shoe at the time of striking onto the ground during a game, crest portions of the corrugations of each wavy corrugated plate 51, 52 deforms downwardly and trough portions of the corrugations of the each wavy corrugated plate 51, 52 deforms upwardly, thereby absorbing the shock load applied to the heel portion A. Also, in this case, since each connecting portion 53 restrains deformations of the adjacent wavy corrugated portions 51, 52, the shock load can be absorbed and damped more effectively.

[0042] On the top surface of the heel portion A of the outsole 1, shown in FIGS. 14 and 15, a recess 15 is formed to receive the buffer assembly 50. In the center of the heel portion A, a window portion 18 formed of transparent resin is provided so that the buffer assembly 50 can be seen from the bottom or the sole surface side through the window 18.

[0043] Next, the above-mentioned studs provided at the tread portion B and the toe portion C will be described hereinafter. FIG. 16 is a bottom surface view of the sole surface of the outsole and illustrates each arrangement of the studs as well as bone structures of the foot. In FIG. 16, symbols DP, MP, PP, MB and MJ indicate distal phalanx, middle phalanx, proximal phalanx, metatarsus and metatarsophalangeal joint of the foot, respectively and suffixes 1 to 5 indicate a first to fifth toe of the foot.

[0044] As shown in FIG. 16, the first stud 31 is located at a position corresponding to a central portion of a distal phalanx DP_1 of a first toe of the foot, the second stud 32 is disposed at a position corresponding to a metatarsophalangeal joint MJ_1 of the first toe, and the third stud 33 is disposed at a position corresponding to a head portion of a metatarsus MB_4 of a fourth toe. Also, the fourth stud 34 is disposed at a position corresponding to a distal phalanx DP_3 of a third toe, and the fifth stud 35 is disposed at a position corresponding to each head portion of a metatarsi MB_2, MB_3 of a second and third toe.

[0045] On the other hand, the first sub-stud 41 is located at a position corresponding to a metatarsus MB_5 of a fifth toe of the foot, the second sub-stud 42 is disposed at a position corresponding to an intermediate position between a proximal phalanx PP_4 of the fourth toe and a proximal phalanx PP_5 of the fifth toe, the third sub-stud 43 is disposed at a position corresponding to a distal phalanx DP_4 of the fourth toe, and the fourth sub-stud 44 is disposed at a position corresponding to an intermediate position between a proximal phalanx PP_2 of the second toe and a proximal phalanx PP_3 of the third toe.

[0046] The arrangement of each stud is based on the sole pressure diagrams shown in FIGS. 4 and 5, and each stud is disposed in a well-balanced manner at positions of a higher sole pressure. With regard to a cross sectional shape of each stud, a triangular shape or a partially-cut, arcuately extending blade shape such as the first to fourth studs 31 to 34 may be used. Alternatively, an oval shape such as the fifth stud 35 or a rectangular cross sectional shape may be used. Also, with regard to a vertical cross sectional shape of each stud, a tapered distal end is preferable to improve stickability into the ground, shown in FIG. 7.

[0047] The first to fourth studs 31 to 34 have flat pressure surfaces 31a to 34a, respectively. As for the first, second and fourth studs 31, 32 and 34, each pressure surface 31a, 32a and 34a is disposed toward the rear side of the shoe to effectively experience a tractional force at the time of the start of a dash, thereby preventing a slippage of the shoe. As for the third stud 33, a pressure surface 33a is disposed toward the front side of the shoe to effectively act as a stop at the time of stopping or striking onto the ground, thereby preventing a slippage of the shoe.

[0048] Next, the orientation of each stud is based on the active direction distribution diagrams shown in FIGS. 17 to 19, and each stud is disposed in the orientation adapted to effectively sustain forces actually applied from the ground to the pivot foot of the player. FIG. 17 illustrates the direction of the forces applied from the ground at the time of an instep kick, FIG. 18 illustrates the direction of the forces applied from the ground at the time of feinting, and FIG. 19 illustrates the direction of the forces applied from the ground at the time of an infront kick.

[0049] The first stud 31, shown in FIG. 23, has a flat or slightly concavely curved pressure surface 31b. The pressure surface 31b is disposed toward a rear side of the shoe, and forms an angle α with the longitudinal center line N of the shoe. The angle α is positive when measured from the center line N in a clockwise direction, and is set at 0 to 60 degrees, preferably at about 30 degrees.

[0050] Thus, as shown in FIG. 20, especially at the time of an instep kick, the pressure surface 31b is generally perpendicular to the direction of the forces from the ground, thereby securing a greater area of an active surface of the forces to prevent a slippage on the contact surface.

[0051] The second stud 32, shown in FIG. 24, has a flat or slightly concavely curved pressure surface 32b. The pressure surface 32b is disposed toward a front side of the shoe, and forms an angle β with the longitudinal center line N. The angle β is set at 0 to -45 degrees, preferably at about -20 degrees.

[0052] Thus, as shown in FIG. 20, especially at the time of an instep kick, the pressure surface 32b is generally oppositely disposed to the direction of the forces from the ground, thereby securing a greater area of an active surface of the forces to prevent a slippage on the contact surface.

[0053] The third stud 33, shown in FIG. 25, has a flat or slightly concavely curved pressure surface 33b. The pressure surface 33b is disposed toward the rear side of the shoe, and forms an angle γ with the longitudinal center line N. The angle γ is set at 0 to -45 degrees, preferably at about -20 degrees.

[0054] Thus, as shown in FIG. 21, especially at the time of feinting, the pressure surface 33b is generally perpendicular to the direction of the forces from the ground, thereby securing a greater area of an active surface of the forces to prevent a slippage on the contact surface.

[0055] The fourth stud 34, shown in FIG. 26, has a flat or slightly concavely curved pressure surface 34b. The pressure surface 34b is disposed toward the rear side of the shoe, and forms an angle δ with the longitudinal center line N. The angle δ is set at 0 to -60 degrees, preferably at about -40 degrees.

[0056] Thus, as shown in FIG. 21, especially at the time of feinting, the pressure surface 34b is generally oppositely disposed to the direction of the forces from the ground, thereby securing a greater area of an active surface of the forces to prevent a slippage on the contact surface.

[0057] The fifth stud 35, shown in FIG. 27, has a generally oval shape, and its convexly curved outer surface 35b forms a pressure surface. A major axis of this oval shape forms an angle ε with the longitudinal center line N. The angle ε is set at -60 to -120 degrees, preferably at about -80 degrees.

[0058] Thus, as shown in FIG. 22, especially at the time of an infront kick, the pressure surface 35b is generally oppositely disposed to the direction of the forces from the ground, thereby securing a greater area of an active surface of the forces to prevent a slippage on the contact surface.

[0059] Next, the orientation of each sub-stud 41 to 44 is also base on the active direction distribution diagrams shown in FIGS. 17 to 19, and each sub-stud is disposed in the orientation adapted to effectively sustain forces actually applied from the ground to the pivot foot of the player.

[0060] The first sub-stud 41, shown in FIG. 28, has a generally oval shape, and its convexly curved outer surface 41b forms a pressure surface. A major axis of this oval shape forms an angle α' with the longitudinal center line N. The angle α' is positive when measure from the center line N in a clockwise direction, and is set at 0 to 45 degrees, preferably at 40 degrees.

[0061] Thus, an additional pressure surface is achieved in addition to a first and second stud 31, 32 especially at the time of an instep kick, thereby preventing a slippage on the contact surface more securely.

[0062] The second sub-stud 42, shown in FIG. 29, has a generally oval shape, and its convexly curved outer surface 42b forms a pressure surface. A major axis of this oval shape forms an angle β' with the longitudinal center line N. The angle β' is set at -30 to -90 degrees, preferably at -45 degrees.

[0063] The third sub-stud 43, shown in FIG. 30, has a partially-cut, blade-shaped cross section similar to those of the first to fourth studs 31 to 34. A pressure surface 43b is generally flat or slightly concavely curved, and disposed toward a rear side of the shoe. The pressure surface 43b forms an angle γ' with the longitudinal center line N. The angle γ' is set at -10 to -45 degrees, preferably at -30 degrees.

[0064] By these second and third sub-studs 42, 43, especially at the time of feinting, additional pressure surfaces can be secured in addition to the third and fourth studs 33, 34, thereby preventing a slippage on the contact surface more securely. Also, the third sub-stud 43 has a flat pressure surface 43a on its front side. By this pressure surface 43a, the third sub-stud 43 develops a further stopping function at the time of striking onto the ground or stopping.

[0065] The fourth sub-stud 44, shown in FIG. 31, has a generally oval shape and its convexly curved outer surface 44b forms a pressure surface. A major axis of this oval shape forms an angle δ' with the longitudinal center line N. The angle δ' is set at -60 to -120 degrees, preferably at -80 degrees. Thus, especially at the time of an infront kick, a further pressure surface can be attained in addition to the fifth stud 35, thereby preventing a slippage on the contact surface more securely.

[0066] FIG. 32 illustrates an outsole of a soccer shoe according to a first alternative embodiment of the present invention. In this embodiment, a plurality of arcuately extending ribs 26 are provided at the heel portion. These ribs 26 are formed generally along the sole pressure distribution mainly on an instep kick shown in FIG. 4, thereby making the rigidity distribution of the heel portion in accordance with the sole pressure distribution and thus, smooth landing becomes possible.

[0067] FIG. 33 illustrates an outsole of a soccer shoe for juniors according to a second alternative embodiment of the present invention. As shown in FIG. 33, the outsole is composed of a plurality of portions having different rigidities, and there are provided studs 20 to 23 and 31 to 35 similar to those in the above-mentioned embodiments on a sole surface of the outsole. Also, a plurality of round protrusions 45 are provided on the sole surface and no sub-studs such as those in the above-mentioned embodiments are provided.

[0068] FIG. 34 illustrates an outsole of a soccer shoe according to a third alternative embodiment of the present invention. In this embodiment, an outsole is composed of a plurality of portions having different rigidities , and there are provided studs 20' to 23' and 31' to 35' at the nearly same positions as those in the above-mentioned embodiment, but each of these studs 20' to 23' and 31' to 35' has a truncated cone shape and has a round cross sectional shape. A plurality of sub-studs 46 are also provided on the sole surface.

[0069] FIGS. 35 and 36 illustrate a heel portion of an outsole of a soccer shoe according to a fourth alternative embodiment of the present invention, schematically showing an arrangement of studs. In this embodiment, two studs 28, 29 are provided on the heel portion. In the drawing, a black dot indicates an arrangement of prior-art studs.

[0070] In FIG. 35, a stud 28 is disposed in front of the stud of the prior art, and a stud 29 is disposed at a position where the stud of the prior art is positioned. In FIG. 36, a stud 28 is disposed at a position where the stud of the prior art is positioned, and a stud 29 is disposed at the rear of the stud of the prior art. That is, in both cases, a line S connecting each stud 28 and 29 is not perpendicular to a longitudinal center line N' of the heel portion, and the stud 28 on the medial side M is disposed in front of the stud 29 on the lateral side L. Thus, landing stability of the heel portion is improved and smooth load transfer is achieved when the load or weight transfers to the medial side M after landing onto the ground from the lateral side L.

[0071] The present invention also has application to football shoes other than soccer shoes.

[0072] Those skilled in the art to which the invention pertains may make modifications and other embodiments employing the principles of this invention without departing from its spirit or essential characteristics particularly upon considering the foregoing teachings. The described embodiments and examples are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. Consequently, while the invention has been described with reference to particular embodiments and examples, modifications of structure, sequence, materials and the like would be apparent to those skilled in the art, yet fall within the scope of the invention.

Claims

1. An outsole structure of a football shoe,

an outsole (1) being formed of six portions, or a toe portion (C), a toe root portion (F), a tread portion (B), a midfoot portion (D), an arch portion (E) and a heel portion (A), said toe portion (C) corresponding to toes of a shoe wearer' s foot, said toe root portion (F) corresponding to a root of toes of the foot, said tread portion (B), midfoot portion (D), arch portion (E) and heel portion (A) each corresponding to a tread surface of a sole of the foot, a plantar arch portion of the foot, an arch of the foot and a heel of the foot, respectively,

said heel portion (A), tread portion (B), toe portion (C) and midfoot portion (D) being made more rigid, and said arch portion (E) and toe root portion (F) being made less rigid.

2. An outsole structure of a football shoe,

an outsole (1) being formed of six portions, or a toe portion (C), a toe root portion (F), a tread portion (B), a midfoot portion (D), an arch portion (E) and a heel portion (A), said toe portion (C) corresponding to toes of a shoe wearer's foot, said toe root portion (F) corresponding to a root of toes of the foot, said tread portion (B), midfoot portion (D), arch portion (E) and heel portion (A) each corresponding to a tread surface of a sole of the foot, a plantar arch portion of the foot, an arch of the foot and a heel of the foot, respectively,

said six portions being constructed such that each rigidity of said six portions satisfies an inequality, heel portion $(A)_R$ > tread portion $(B)_R$ > toe portion $(F)_R$ > midfoot portion $(D)_R$ > arch portion $(E)_R$ > toe root portion $(F)_R$, wherein suffix R means rigidity of each portion.

3. An outsole structure of a football shoe,

an outsole (1) being formed of seven portions, or a toe portion (C), a first toe root portion (F_1), second to fifth toe root portions (F_2), a tread portion (B), a midfoot portion (D), an arch portion (E) and a heel portion (A), said toe portion (C) corresponding to toes of a shoe wearer' s foot, said first toe root portion (F_1) corresponding to a root of a first toe of the foot, said second to fifth toe root portions (F_2) each corresponding to each root of second to fifth toes of the foot, said tread portion (B), midfoot portion (D), arch portion (E) and heel portion (A) each corresponding to a tread surface of a sole of the foot, a plantar arch portion of the foot, an arch of the foot and a heel of the foot, respectively,

said heel portion (A), tread portion (B), toe portion (C), first toe root portion (F_1) and midfoot portion (D) being made more rigid, and said arch portion (E) and second to fifth toe root portions (F_2) being made less rigid.

4. An outsole structure of a football shoe,

an outsole (1) being formed of seven portions, or a toe portion (C), a first toe root portion (F_1), second to fifth toe root portions (F_2), a tread portion (B), a midfoot portion (D), an arch portion (E) and a heel portion (A), said toe portion (C) corresponding to toes of a shoe wearer's foot, said first toe root portion (F_1) corresponding to a root of a first toe of the foot, said second to fifth toe root portions (F_2) each corresponding to each root of second to fifth toes of the foot, said tread portion (B), midfoot portion (D), arch portion (E) and heel portion (A) each corresponding to a tread surface of a sole of the foot, a plantar arch portion of the foot, an arch of the foot and a heel of the foot, respectively,

said seven portions being constructed such that each rigidity of said seven portions satisfies an inequality, heel portion $(A)_R$ > tread portion $(B)_R$ > first toe portion $(F_1)_R$ > midfoot portion $(D)_R$ > arch portion (E)R > second to fifth toe root portions $(F_2)_R$, wherein suffix R means rigidity of each portion.

5. The outsole structure according to any one of claims 1 to 4, wherein a first boundary line (Y1) between said toe portion (C) and said toe root portion (F) extends from a head portion of a middle phalanx (MP_4) of a fourth toe of the foot through a base portion of a middle phalanx (MP_3) of a third toe to a head portion of a middle phalanx (MP_2) of a second toe and extending further to a head portion of a proximal phalanx (PP_1) of a first toe, said first boundary line (Y_1) being convexly curved at a second toe toward a front side of the shoe,

a second boundary line (Y_2) between said toe root portion (F) and said tread portion (B) extending from a base portion of a middle phalanx (MP_5) of a fifth toe of the foot through a head portion of a proximal phalanx (PP_4) of the fourth toe to a central portion of a proximal phalanx (PP_3) of a third toe and extending further from a central portion of a proximal phalanx (PP_2) of the second toe to a central portion of a proximal phalanx (PP_1) of the first toe, said second boundary line (Y_2) being arcuately curved toward a front side of the shoe,

a third boundary line (Y_3) between said tread portion (B) and said midfoot and arch portions (D, E) extending from a base portion of a metatarsus (MB_5) of the fifth toe through a base portion of a metatarsus (MB_4) of the fourth toe toward a front side of the shoe and extending further through a central portion of a metatarsus of a second toe to a central portion of a metatarsus of a first toe,

a fourth boundary line (Y_4) between said heel portion (A) and said midfoot and arch portions (D, E) extending generally along a transverse tarsal joint (CJ),

a fifth boundary line (Y_5) between said midfoot portion (D) and said arch portion (E) extending through an outer cuneiform bone along the length of the shoe.

6. The outsole structure according to any one of claims 1 to 4, wherein rigidity of each of said portions of said outsole is made varied according to a

thickness of each of said portions of said outsole.

7. The outsole structure according to any one of claims 1 to 4, wherein a reinforcement member is embedded in a portion of a higher rigidity.

8. The outsole structure according to any one of claims 1 to 4, wherein a rib structure is provided at a portion of a higher rigidity.

9. The outsole structure according to any one of claims 1 to 4, wherein said midfoot portion (D) has an elongated rib formed thereon, said rib extending generally along the length of the shoe.

10. The outsole structure according to any one of claims 1 to 4, wherein a honeycomb structure is provided at a portion of a lower rigidity.

11. The outsole structure according to claim 1 or 2, wherein each thickness of said heel portion (A), tread portion (B), toe portion (C) and midfoot portion (D) is made greater than that of said arch portion (E) and toe root portion (F), and a honeycomb structure is provided at said arch portion (E) and toe root portion (F).

12. The outsole structure according to claim 3 or 4, wherein each thickness of said heel portion (A), tread portion (B), toe portion (C), first toe root portion (F_1) and midfoot portion (D) is made greater than that of said arch portion (E) and second to fifth toe root portions (F_2), and a honeycomb structure is provided at said arch portion (E) and second to fifth toe root portions (F_2).

13. The outsole structure according to any one of claims 1 to 4, wherein said tread portion (B) has a plurality of longitudinal grooves formed thereon, said longitudinal grooves extending generally along the length of the shoe.

14. The outsole structure according to claim 13, wherein said longitudinal grooves are disposed based on a load transfer path of a shoe wearer from the start of sole ground contact of said outsole to full-surface ground contact.

15. The outsole structure according to any one of claims 1 to 4, wherein said tread portion (B) has a plurality of lateral grooves formed thereon, said lateral grooves extending generally along the width of the shoe and being disposed at regions that correspond to metatarsi of third to fifth toes of the foot.

16. The outsole structure according to claim 15, wherein said lateral grooves are disposed based on a load transfer path of a shoe wearer from full-surface ground contact of said outsole to a moment immediately before leaving the ground.

17. The outsole structure according to any one of claims 1 to 4, wherein a buffer assembly is provided at said heel portion (A) to absorb a shock load applied to said heel portion (A), said buffer assembly having a plurality of band-shaped, wavy corrugated plates each extending along the length of the shoe, said wavy corrugated plates being disposed adjacent to each other and interconnected to each other.

18. The outsole structure according to claim 17, wherein phase of a wavy configuration of each wavy corrugated plate is offset by a half wavelength relative to that of a wavy configuration of adjacent wavy corrugated plate.

19. The outsole structure according to claim 17, wherein an upwardly extending upraised portion is provided at a circumferential edge portion of said heel portion (A).

20. The outsole structure according to claim 17, wherein a plurality of ribs are provided on a sole surface of said heel portion (A), said ribs being disposed based on a sole pressure distribution curve of a shoe wearer's foot.

21. The outsole structure according to claim 17, wherein first to fourth studs are provided on a sole surface of said heel portion (A), said first and second studs being disposed on a medial and lateral side of a front side of said heel portion (A), respectively, said third and fourth studs being disposed on a medial and lateral side of a rear side of said heel portion (A), respectively, a front side rib that extends along the width of the shoe being provided between said first and second studs to interconnect therebetween, a rear side rib that extends along the width of the shoe being provided between said third and fourth studs to interconnect therebetween.

22. An outsole structure of a football shoe comprising:

an outsole; and
a plurality of studs provided on a sole surface of said outsole;

wherein said studs includes a first stud disposed at a position corresponding to a central portion of a distal phalanx (DP_1) of a first toe of a shoe wearer's foot, a second stud disposed at a position corresponding to a metatarsophalangeal joint (MJ_1) of the first toe, and a third stud disposed at a position corresponding to a head portion of a metatarsus (MJ_4) of a fourth toe.

23. An outsole structure of a football shoe comprising:

an outsole; and
a plurality of studs provided on a sole surface of said outsole;

wherein said studs includes a first stud disposed at a position corresponding to a central portion of a distal phalanx (DP_1) of a first toe of a shoe wearer's foot, a second stud disposed at a position corresponding to a metatarsophalangeal joint (MJ_1) of the first toe, a third stud disposed at a position corresponding to a head portion of a metatarsus (MJ_4) of a fourth toe, and a fourth stud disposed at a position corresponding to a distal phalanx (DP_3) of a third toe.

24. An outsole structure of a football shoe comprising:

an outsole; and
a plurality of studs provided on a sole surface of said outsole;

wherein said studs includes a first stud disposed at a position corresponding to a central portion of a distal phalanx (DP_1) of a first toe of a shoe wearer's foot, a second stud disposed at a position corresponding to a metatarsophalangeal joint (MJ_1) of the first toe, a third stud disposed at a position corresponding to a head portion of a metatarsus (MJ_4) of a fourth toe, a fourth stud disposed at a position corresponding to a distal phalanx (DP_3) of a third toe, and a fifth stud disposed at a position corresponding to head portions of metatarsi (MB_2, MB_3) of a second and third toe.

25. The outsole structure according to claim 22, 23 or 24, wherein each of said studs includes a pressure surface extending generally linearly or slightly concavely curved, said pressure surface of said first stud being disposed toward a rear side of the shoe and at 0 to 60 degrees with a longitudinal center line of the shoe, said pressure surface of said second stud being disposed toward a front side of the shoe and at 0 to -45 degrees with said longitudinal center line of the shoe, said pressure surface of said third stud being disposed toward said rear side of the shoe and at 0 to -45 degrees with said longitudinal center line of the shoe, said pressure surface of said fourth stud being disposed toward said rear side of the shoe and at 0 to -60 degrees with said longitudinal center line of the shoe, said pressure surface of said fifth stud being disposed toward said rear side of the shoe and at -60 to -120 degrees with said longitudinal center line of the shoe, where each of said angles of said pressure surfaces with said longitudinal center line of the shoe is positive when it is measured in a clockwise direction.

26. The outsole structure according to claim 25, wherein some or all of said studs have generally triangular, rectangular or blade-shaped cross sections.

27. An outsole structure of a football shoe comprising:

an outsole; and
a plurality of studs provided on a sole surface of said outsole;

wherein said studs includes a first stud disposed at a position corresponding to a central portion of a distal phalanx (DP_1) of a first toe of a shoe wearer's foot, a second stud disposed at a position corresponding to a metatarsophalangeal joint (MJ_1) of the first toe, a third stud disposed at a position corresponding to a head portion of a metatarsus (MJ_4) of a fourth toe, a fourth stud disposed at a position corresponding to a distal phalanx (DP_3) of a third toe, and a fifth stud disposed at a position corresponding to head portions of metatarsi (MB_2, MB_3) of a second and third toe;

wherein each of said studs having a partially cut, blade-shaped or generally oval-shaped cross section, a cut surface being disposed toward a front side of a rear side of the shoe.

28. The outsole structure according to claim 22, 23 or 24, wherein each of said studs has a generally oval cross sectional shape with a major axis, said major axis of said first stud being disposed at 0 to 60 degrees with a longitudinal center line of the shoe, said major axis of said second stud being disposed at 0 to -45 degrees with said longitudinal center line of the shoe, said major axis of said third stud being disposed at 0 to -45 degrees with said longitudinal center line of the shoe, said major axis of said fourth stud being disposed at 0 to -60 degrees with said longitudinal center line of the shoe, said major axis of said fifth stud being disposed at -60 to -120 degrees with said longitudinal center line of the shoe, where each of said angles of said major axes with said longitudinal center line of the shoe is positive when it is measured in a clockwise direction.

29. The outsole structure according to claim 22, 23 or 24 further comprising:

a first sub-stud disposed at a position corresponding to a metatarsus (MB_5) of a fifth toe of a wearer's foot; and
a second sub-stud disposed at a position corresponding to an intermediate position between proximal phalanxes (PP_4, PP_5) of a fourth and fifth toe of the foot.

30. The outsole structure according to claim 22, 23 or 24 further comprising:

a first sub-stud disposed at a position corresponding to a metatarsus (MB_5) of a fifth toe of a wearer's foot;
a second sub-stud disposed at a position corresponding to an intermediate position between proximal phalanxes (PP_4, PP_5) of a fourth and fifth toe of the foot; and
a third sub-stud disposed at a position corresponding to a distal phalanx (DP_4) of the fourth toe of the foot.

31. The outsole structure according to claim 22, 23 or 24 further comprising:

a first sub-stud disposed at a position corresponding to a metatarsus (MB_5) of a fifth toe of a wearer's foot;
a second sub-stud disposed at a position corresponding to an intermediate position between proximal phalanxes (PP_4, PP_5) of a fourth and fifth toe of the foot; and
a fourth sub-stud disposed at a position corresponding to an intermediate position between proximal phalanxes (PP_2, PP_3) of a second and third toe of the foot.

32. The outsole structure according to claim 22, 23 or 24 further comprising:

a first sub-stud disposed at a position corresponding to a metatarsus (MB_5) of a fifth toe of a wearer's foot;
a second sub-stud disposed at a position corresponding to an intermediate position between proximal phalanxes (PP_4, PP_5) of a fourth and fifth toe of the foot;
a third sub-stud disposed at a position corresponding to a distal phalanx (DP_4) of the fourth toe of the foot; and
a fourth sub-stud disposed at a position corresponding to an intermediate position between proximal phalanxes (PP_2, PP_3) of a second and third toe of the foot.

33. The outsole structure according to any one of claims 29 to 32, wherein each of said sub-studs includes a pressure surface extending generally linearly or slightly concavely curved, said pressure surface of said first sub-stud being disposed toward a rear side of the shoe and at 0 to 45 degrees with a longitudinal center line of the shoe, said pressure surface of said second sub-stud being disposed toward said rear side of the shoe and at -30 to -90 degrees with said longitudinal center line of the shoe, said pressure surface of said third sub-stud being disposed toward said rear side of the shoe and at -10 to -45 degrees with said longitudinal center line of the shoe, said pressure surface of said fourth sub-stud being disposed toward said rear side of the shoe and at -60 to -120 degrees with said longitudinal center line of the shoe, where each of said angles of said pressure surfaces with said longitudinal center line of the shoe is positive when it is measured in a clockwise direction.

34. The outsole structure according to claim 33, wherein some or all of said sub-studs have generally triangular, rectangular or blade-shaped cross sections.

35. The outsole structure according to any one of claims 29 to 32, wherein each of said sub-studs has a generally oval cross sectional shape with a major axis, said major axis of said first sub-stud being disposed at 0 to 45 degrees with a longitudinal center line of the shoe, said major axis of said second sub-stud being disposed at -30 to -90 degrees with said longitudinal center line of the shoe, said major axis of said third sub-stud being disposed at -10 to -45 degrees with said longitudinal center line of the shoe, said major axis of said fourth sub-stud being disposed at -60 to -120 degrees with said longitudinal center line of the shoe, where each of said angles of said major axes with said longitudinal center line of the shoe is positive when it is measured in a clockwise direction.

36. An outsole structure of a football shoe comprising:

an outsole; and
a plurality of studs provided on a sole surface of a forefoot and heel portion of said outsole;

wherein said studs provided on said sole surface of said heel portion include a first stud disposed on a medial side of said heel portion and a second stud disposed on a lateral side of said heel portion;
wherein a line connecting said first stud with said second stud is not perpendicular to a center line of said heel portion, and said first stud is disposed on a front side of said heel portion or said second stud is disposed on a rear side of said heel portion.

37. A sole for a sports shoe, wherein a toe root portion (F) and an arch portion (E) thereof are relatively less rigid than other portions of the sole.

38. A sole for a sports shoe, comprising a plurality of studs extending transversely to a main structure of the sole, the studs being positioned where concentrations of stress on the sole are generally encountered during use.

39. A sole for a sports shoe, comprising a plurality of studs disposed at a heel portion of the sole so that studs positioned on opposite sides of a central longitudinal line of the sole are staggered longitudinally with respect to each other.

FIG. 1

PRIOR ART

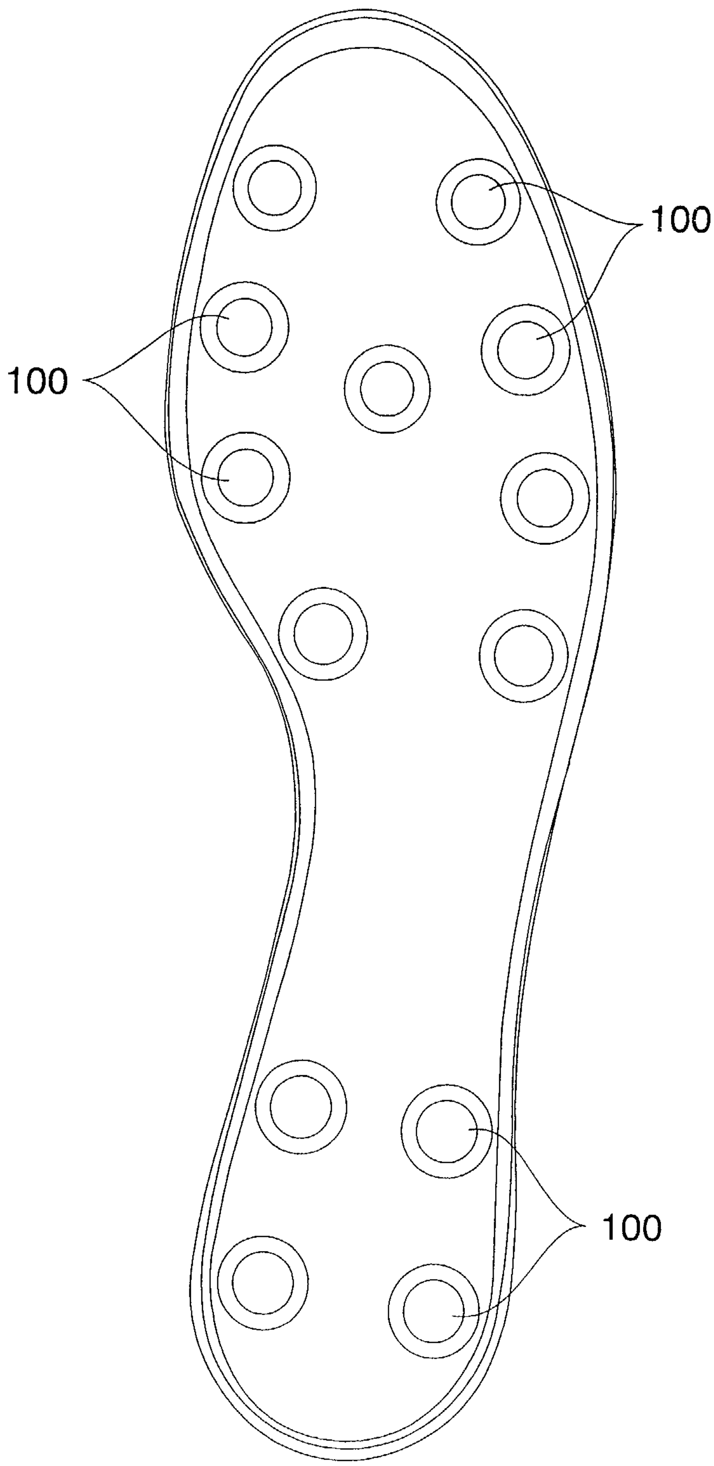

FIG. 2

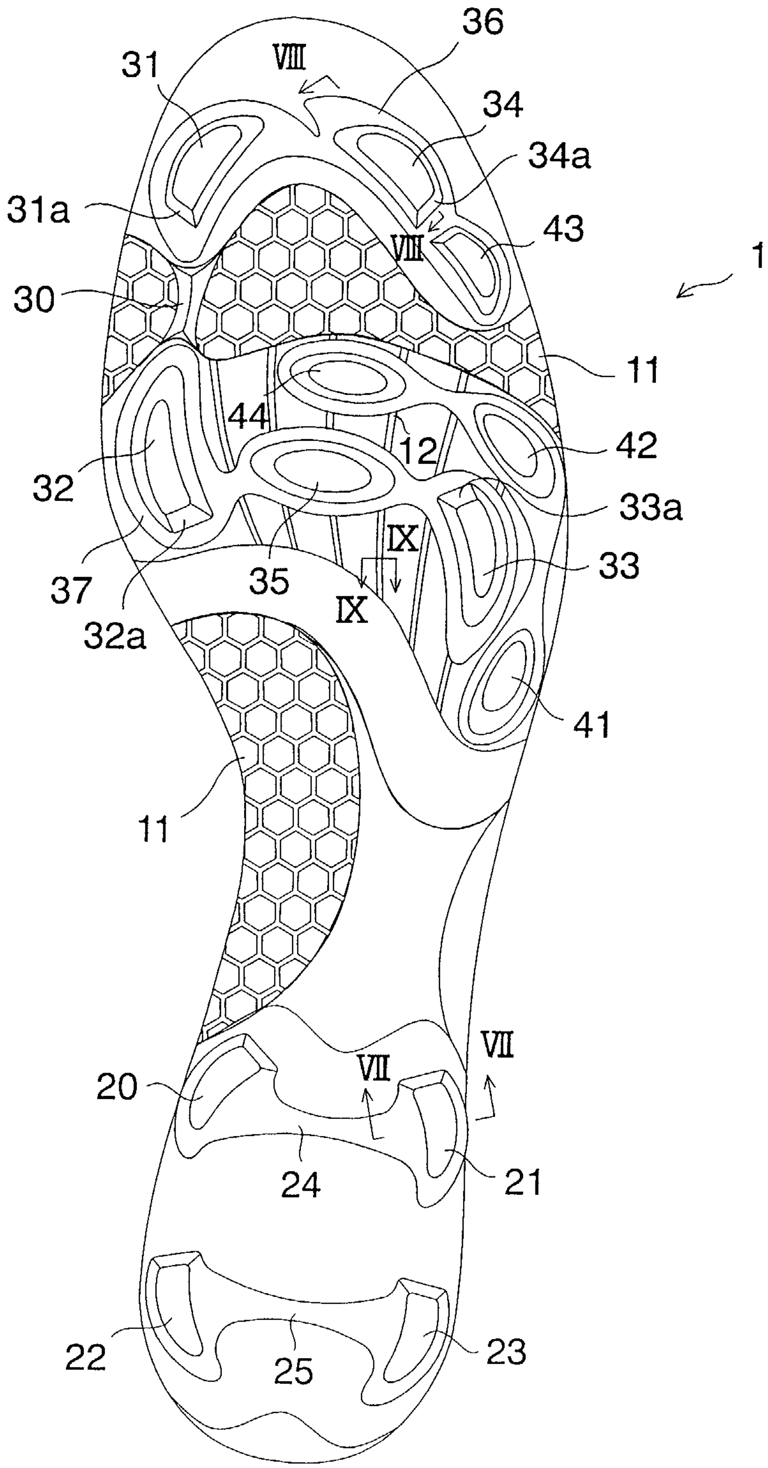
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FIG. 3

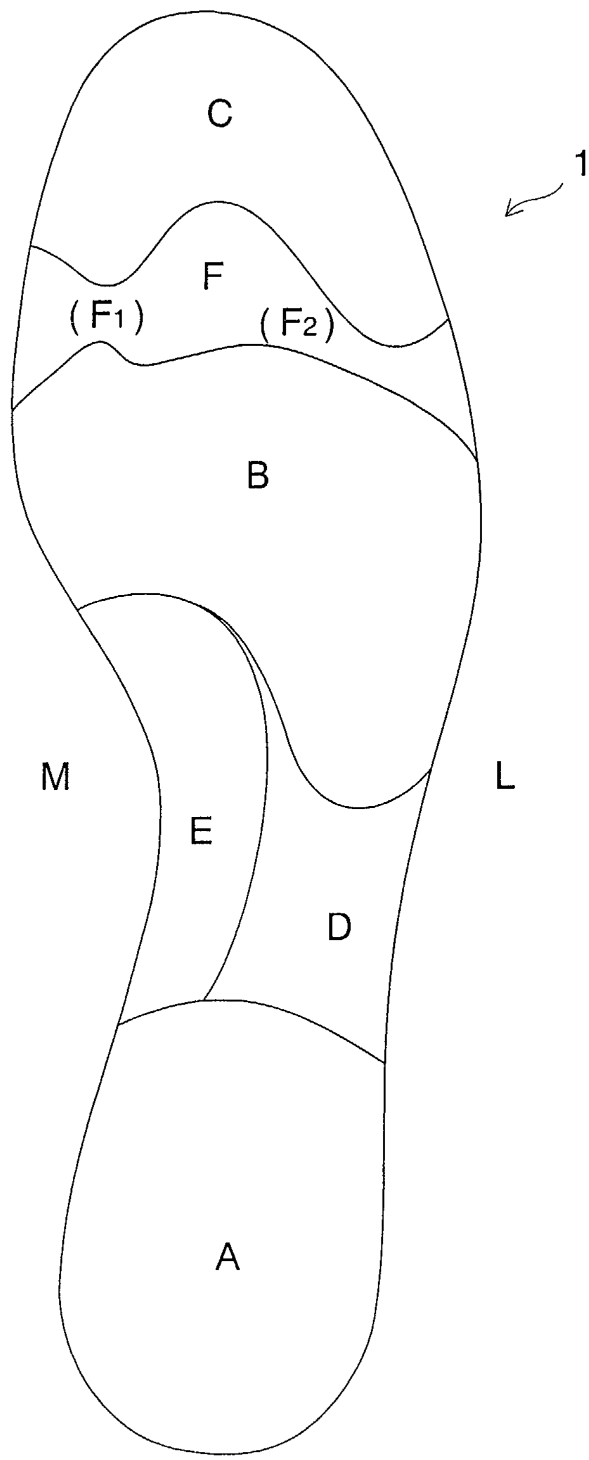


FIG. 4

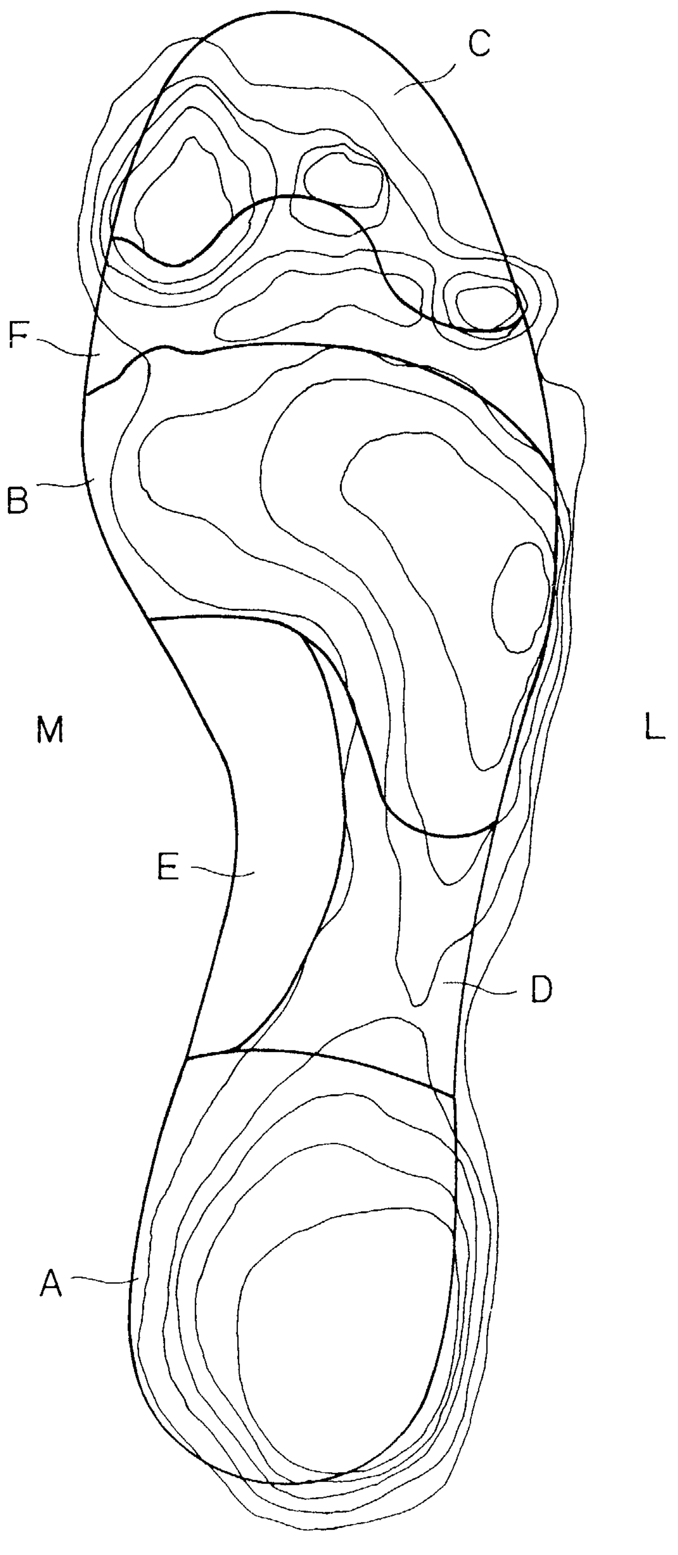


FIG. 5

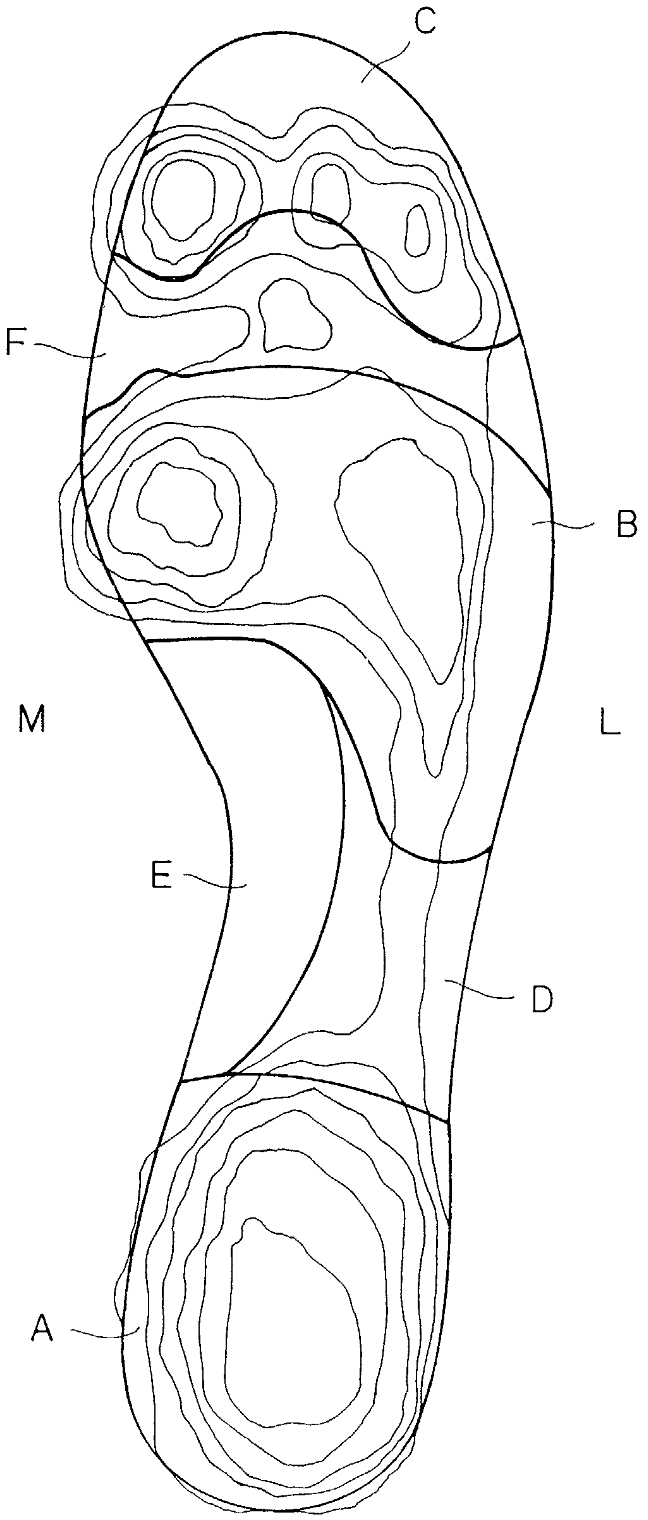


FIG. 6

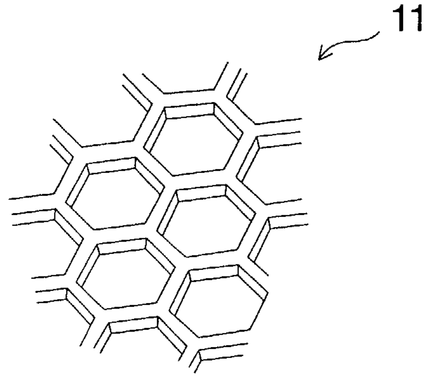


FIG. 7

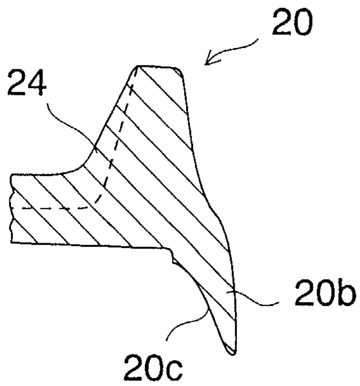


FIG. 8

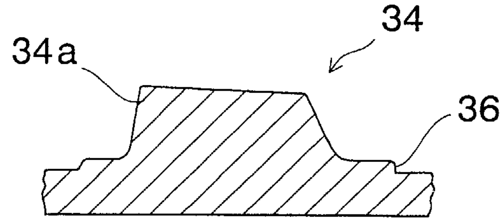


FIG. 9

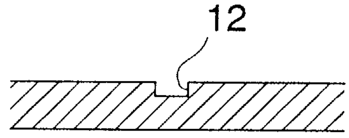


FIG. 10

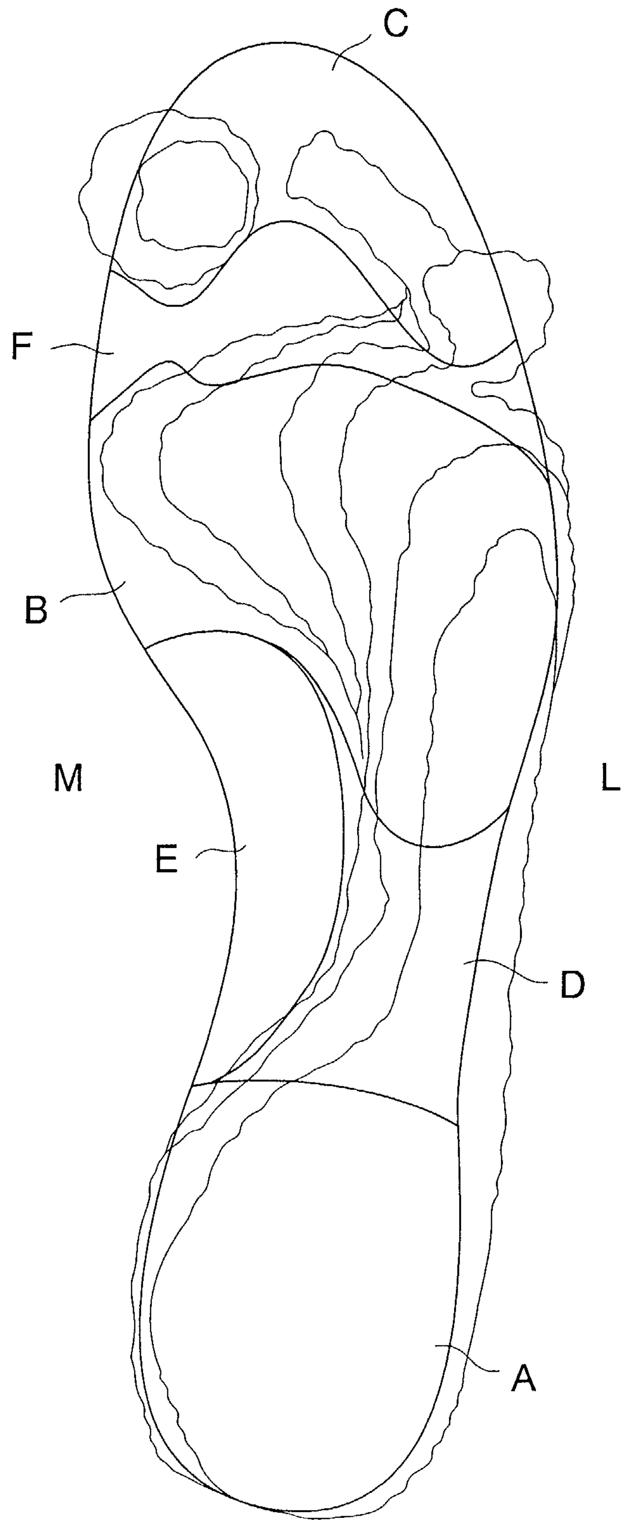


FIG. 11

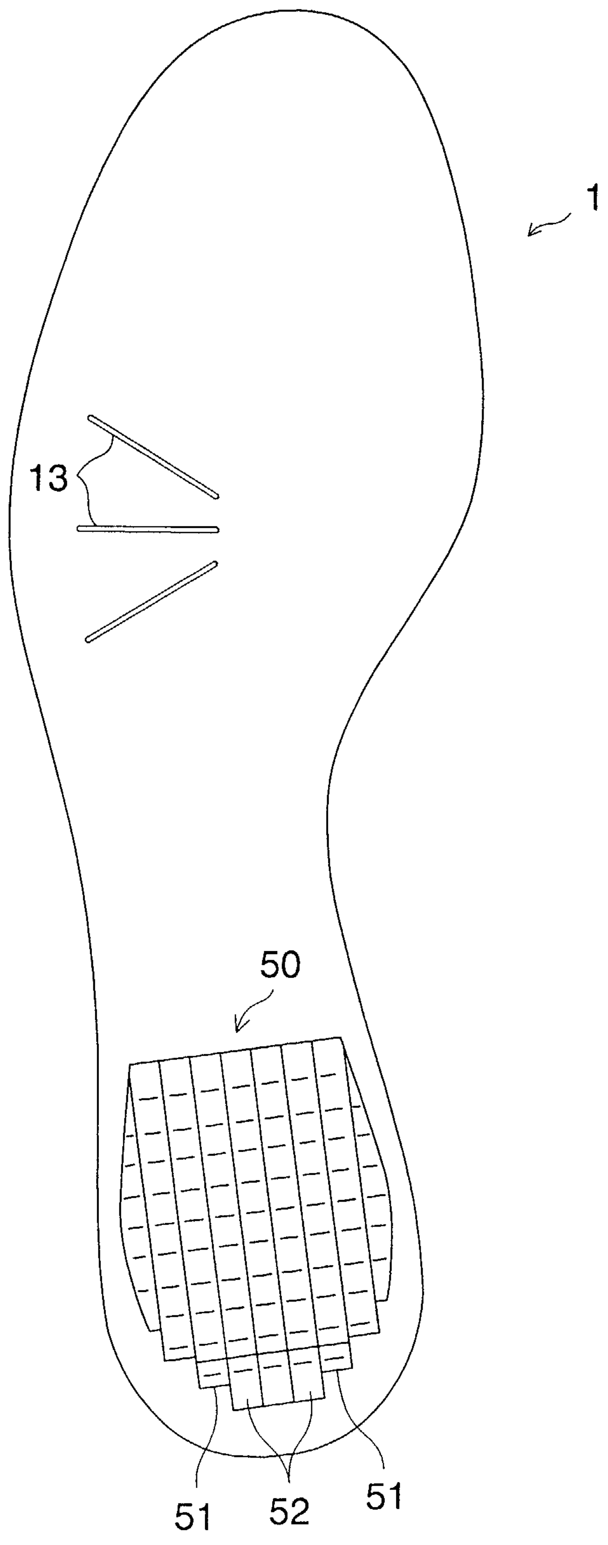


FIG. 12

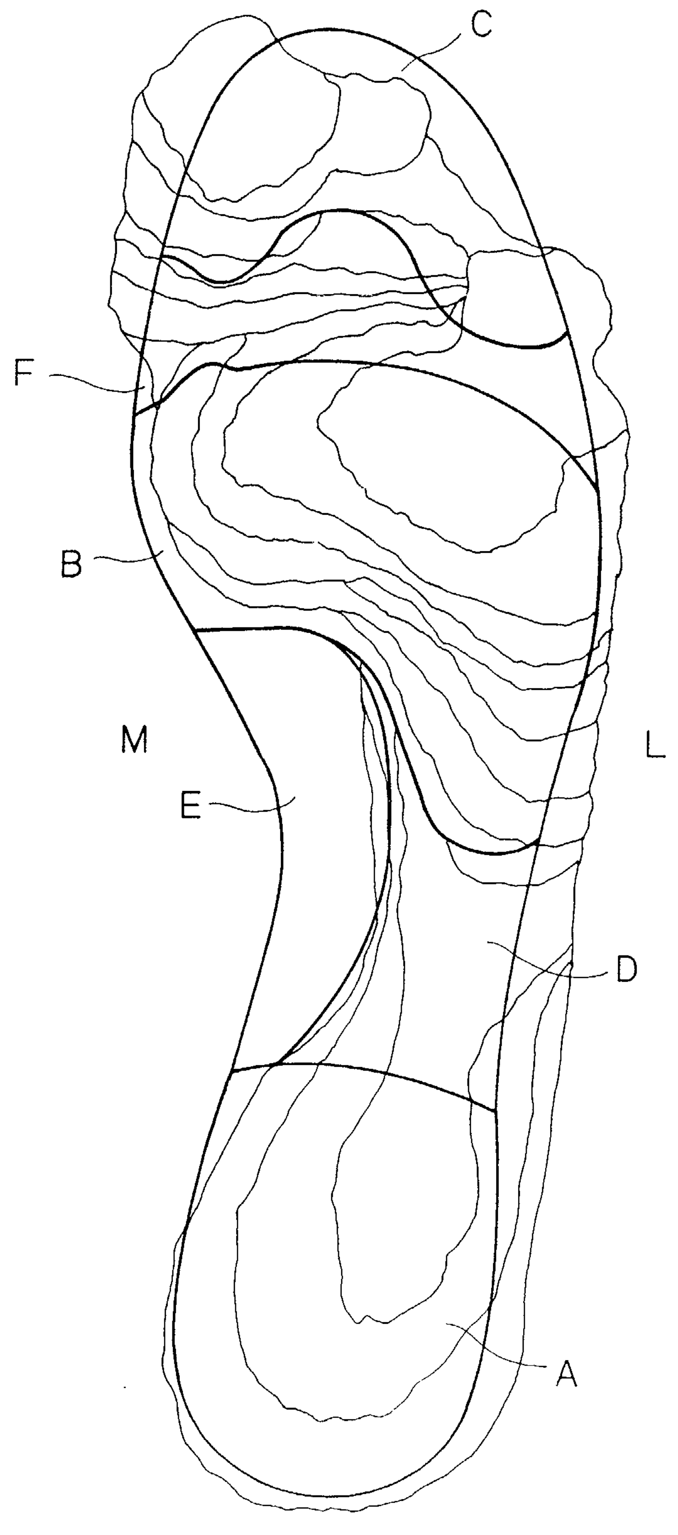


FIG. 13

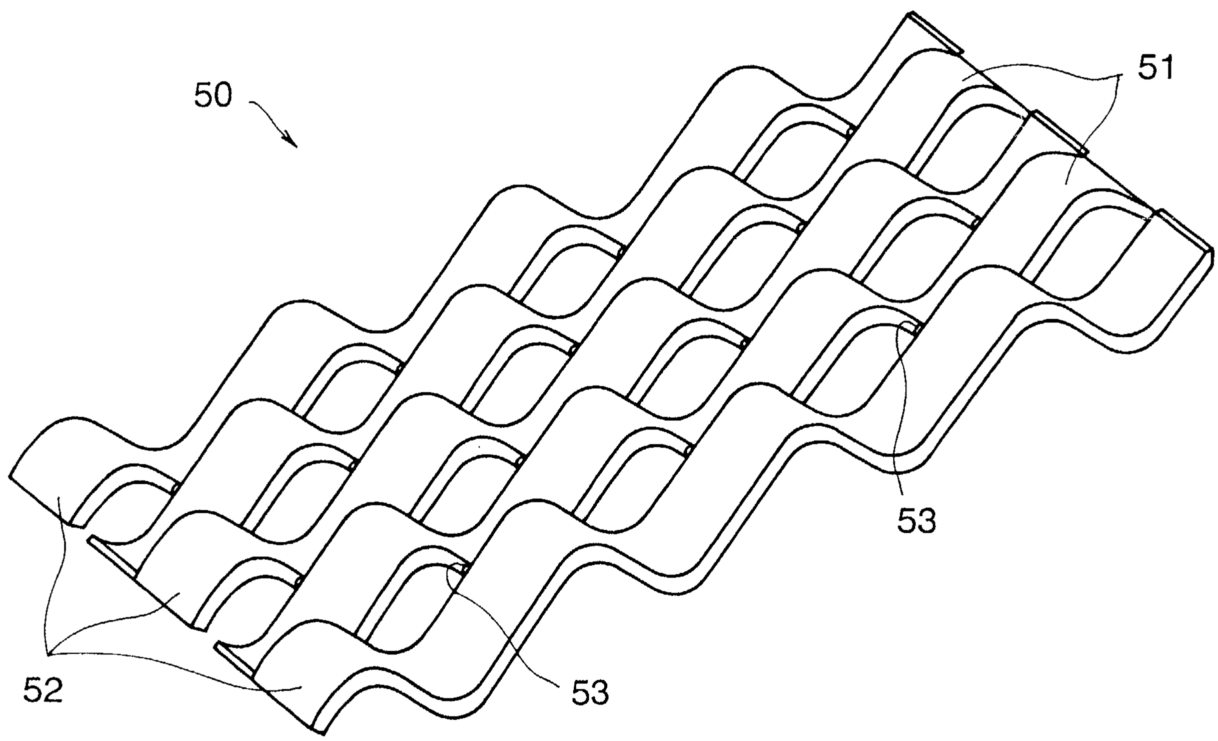


FIG. 14

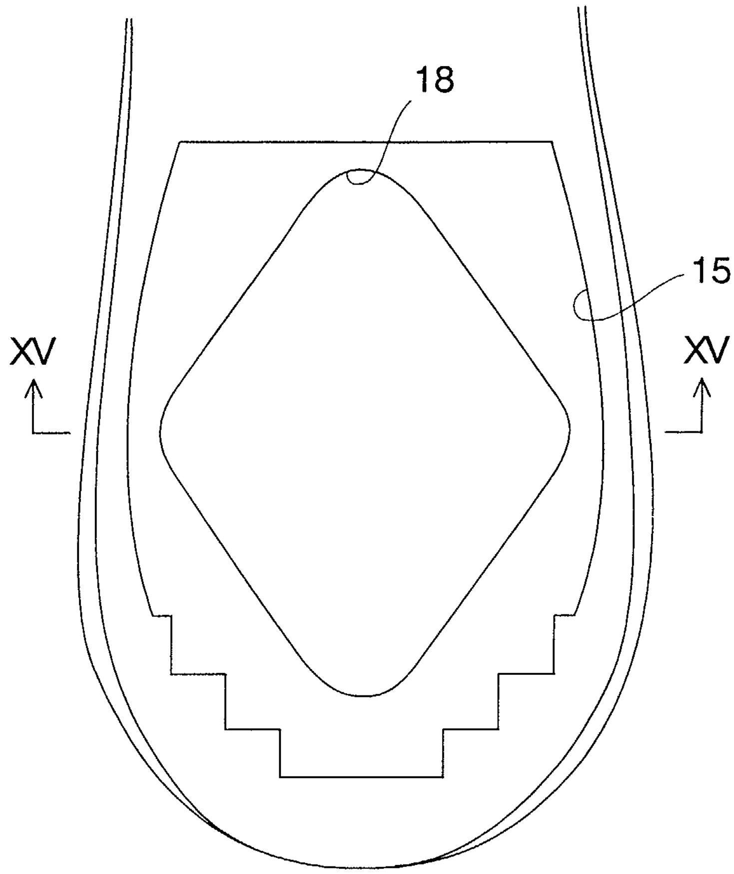


FIG. 15

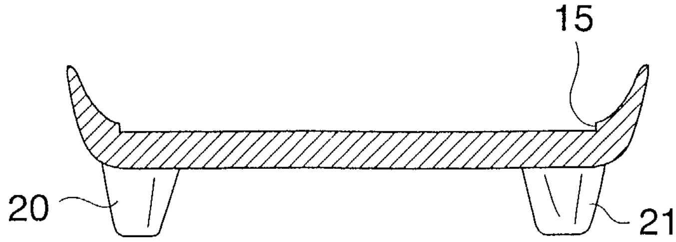
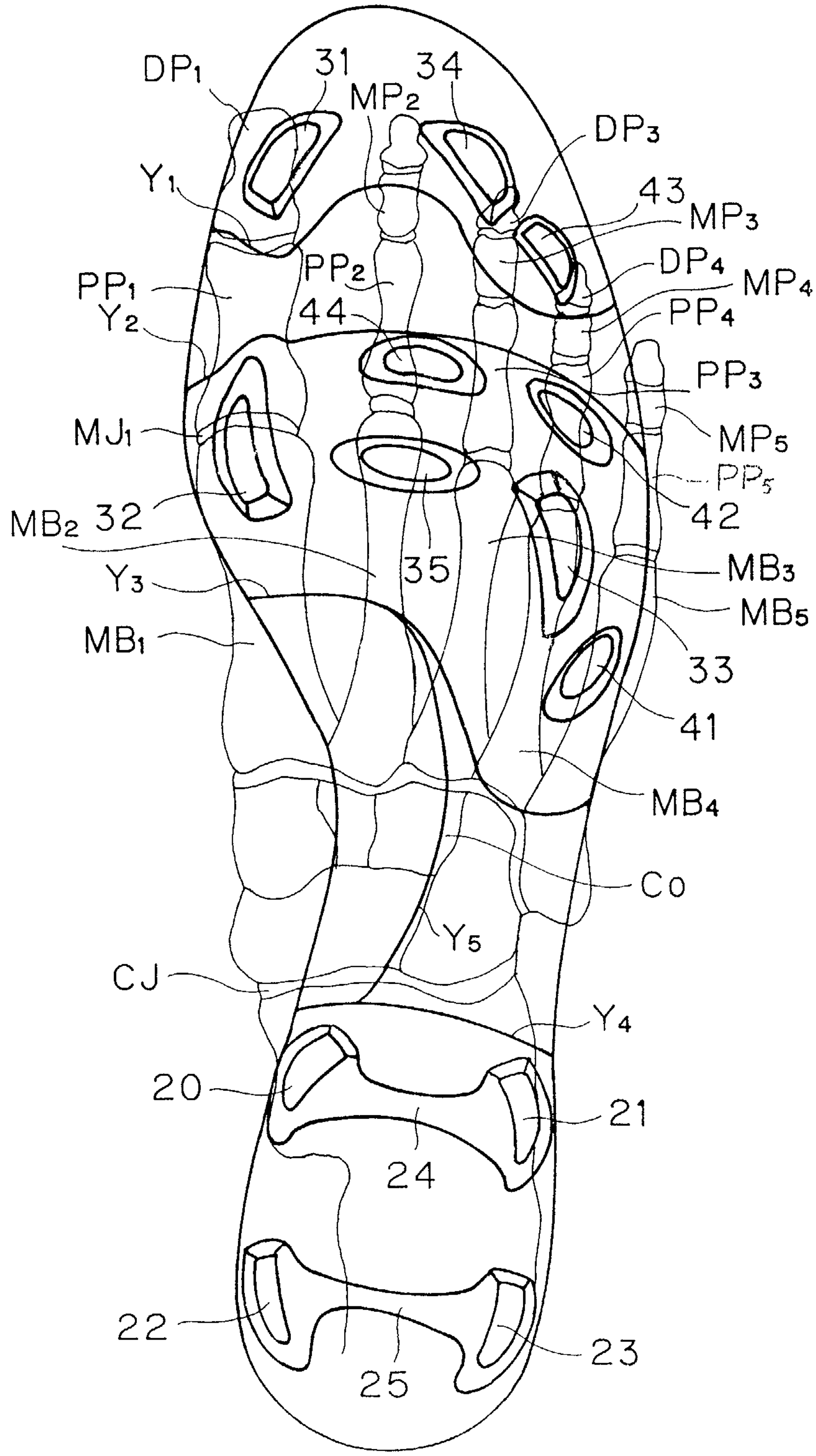


FIG. 16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Y2
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MP5
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MB2
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FIG. 17

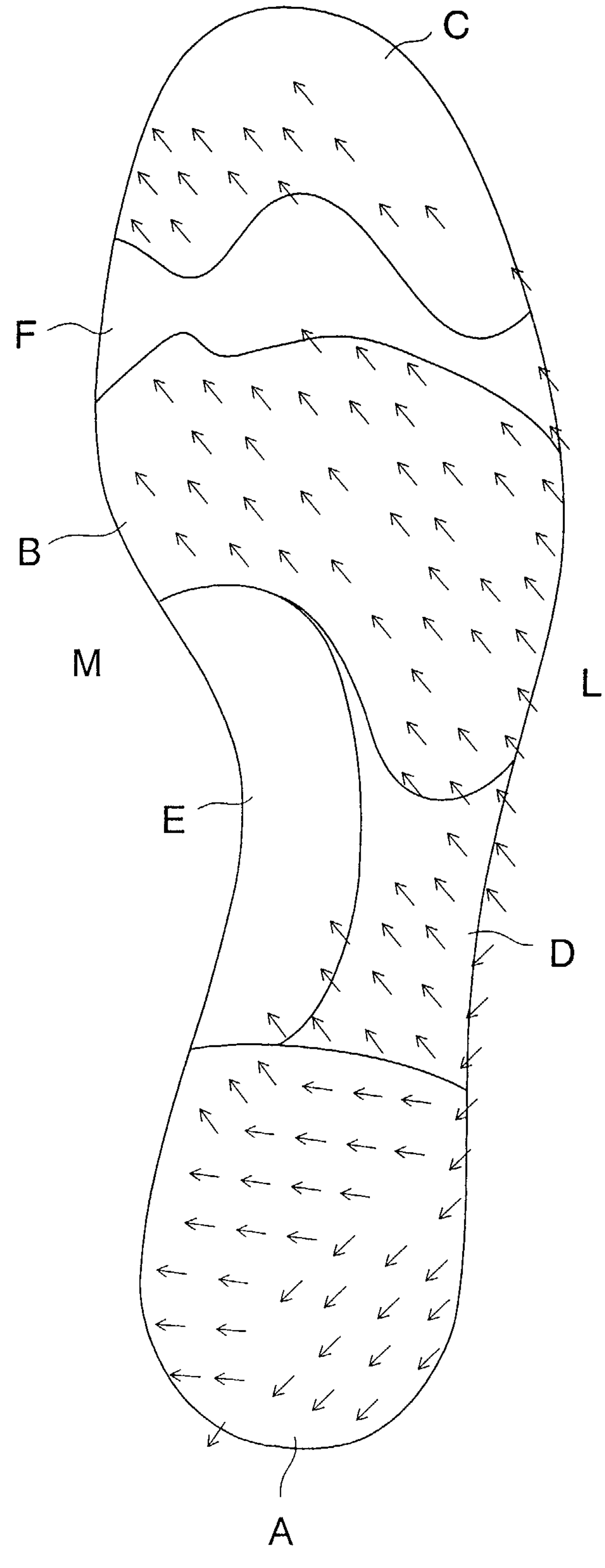

FIG. 18

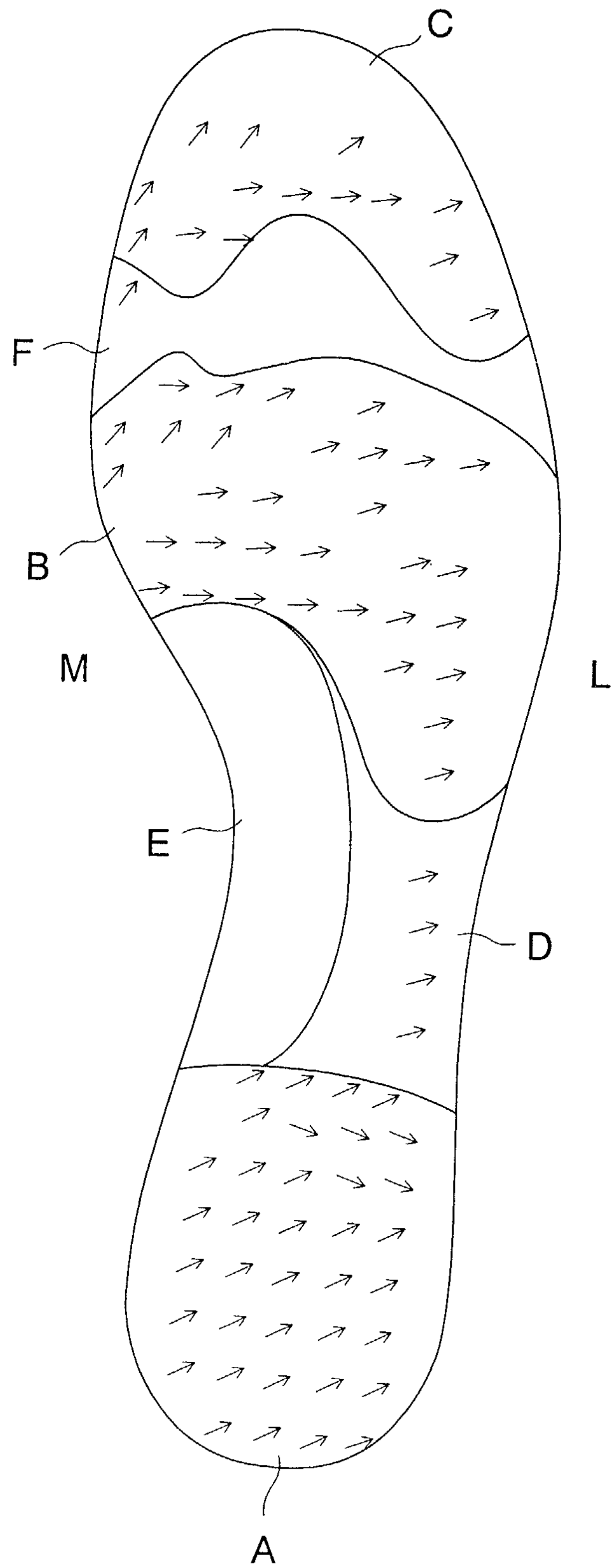

FIG. 19

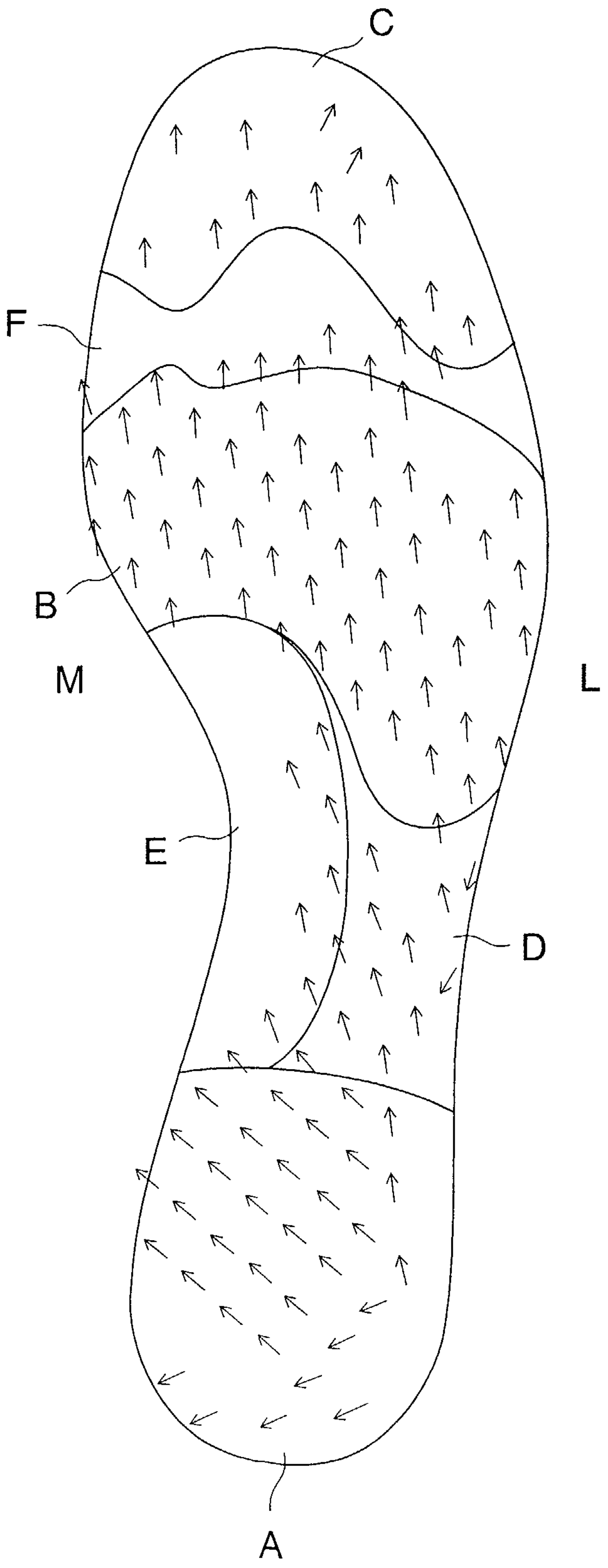

FIG. 20

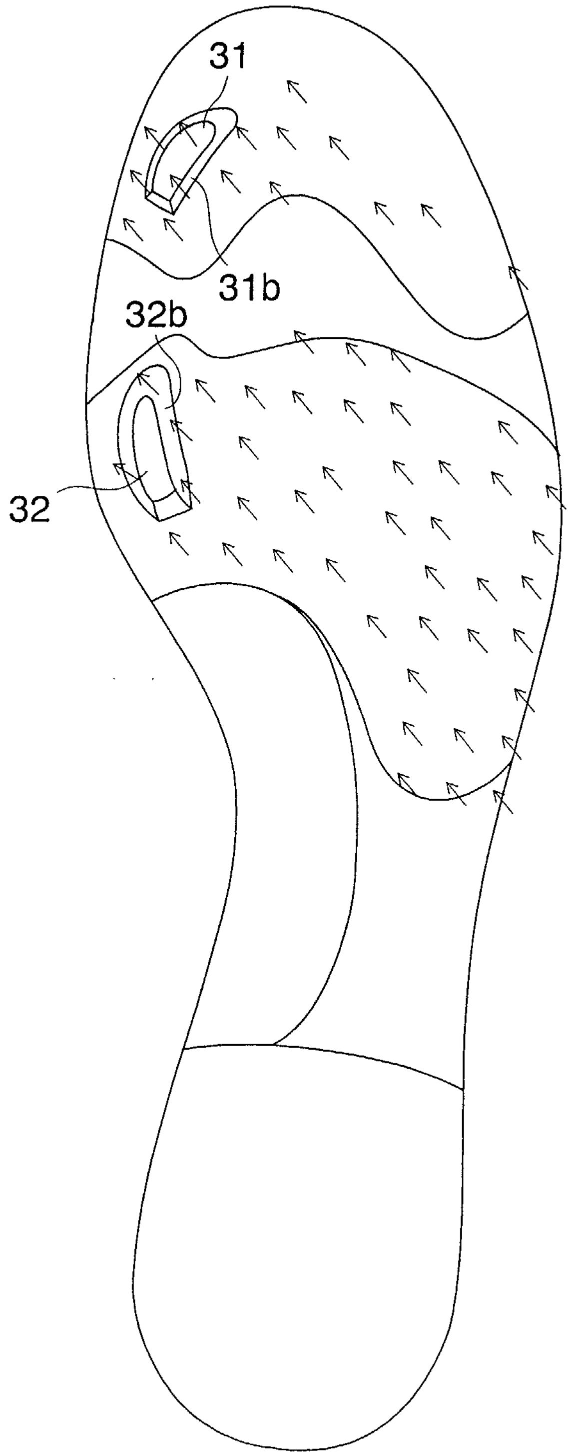

FIG. 21

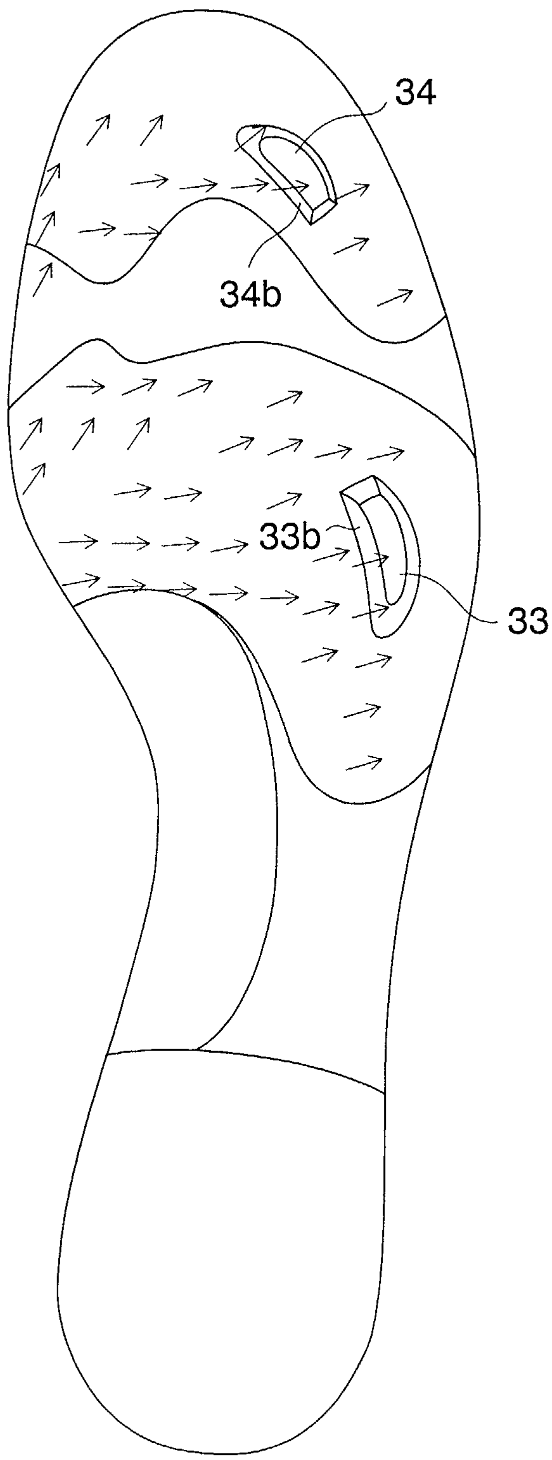

FIG. 22

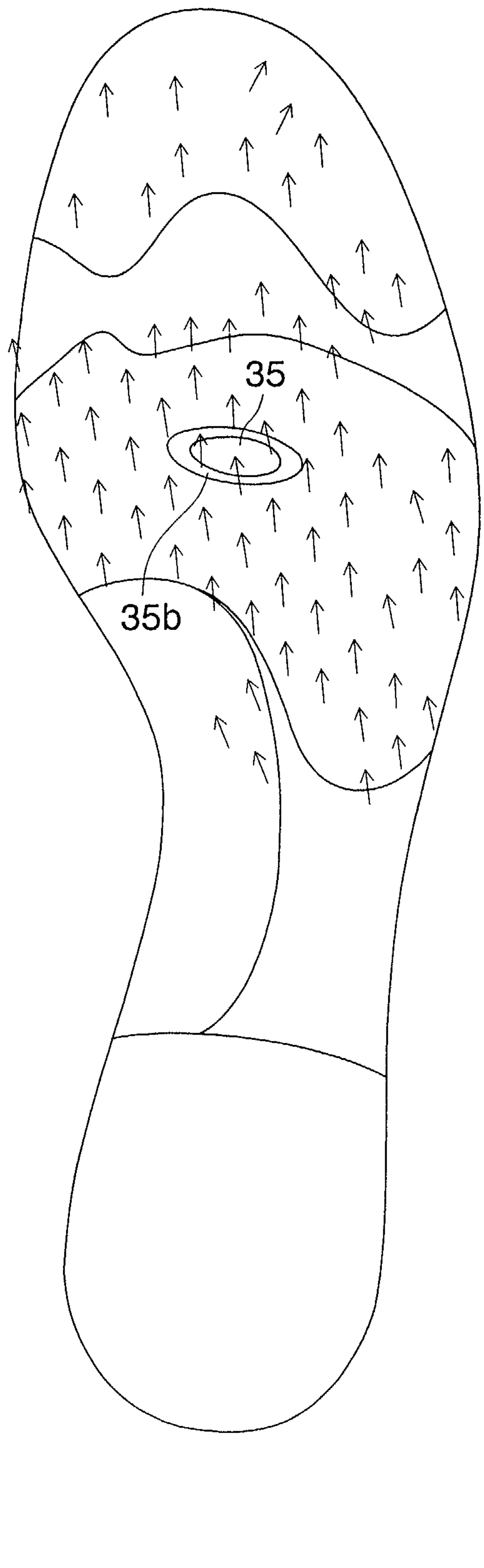

FIG. 23

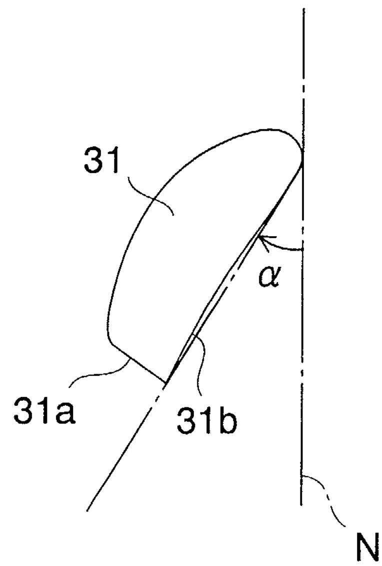

FIG. 24

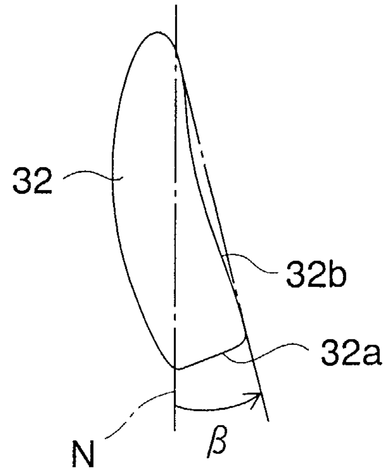

FIG. 25

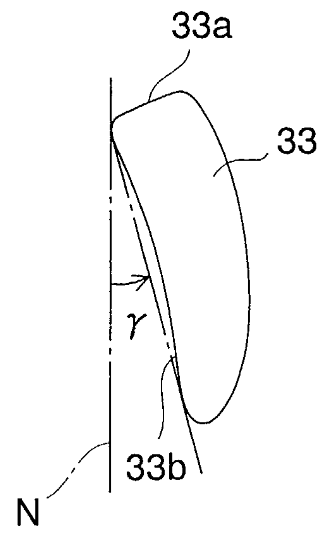

FIG. 26

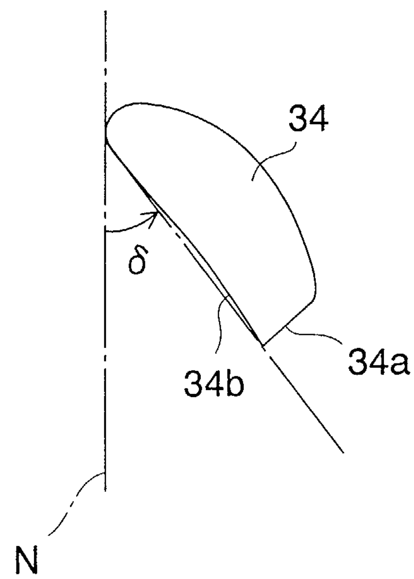

FIG. 27

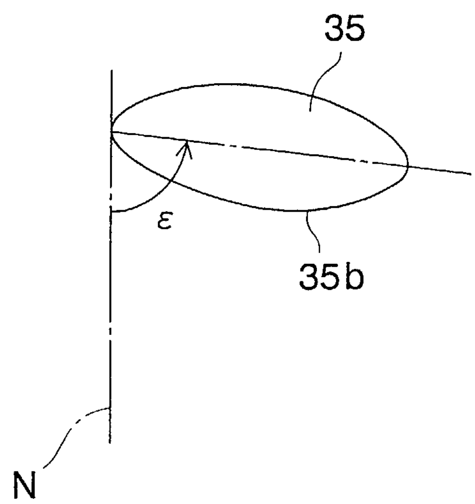

FIG. 28

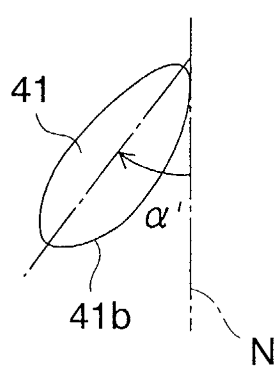

FIG. 29

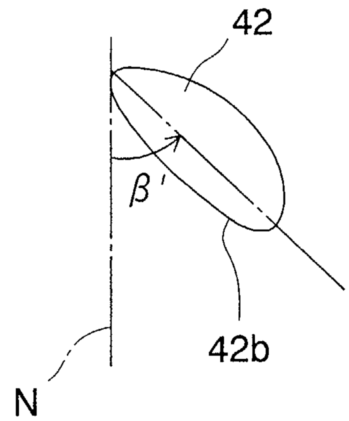

FIG. 30

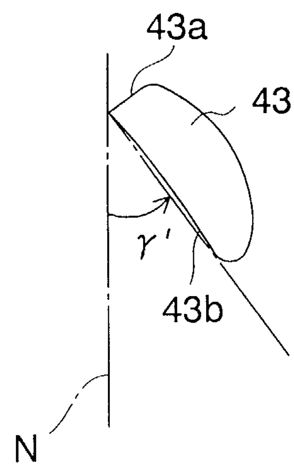

FIG. 31

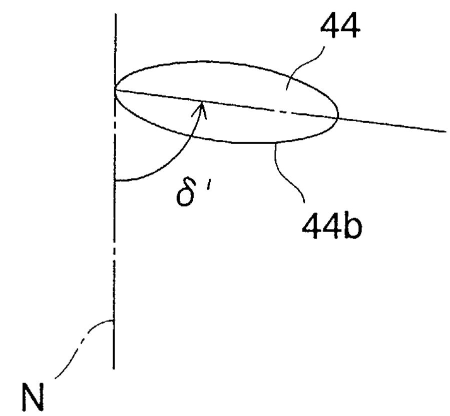

FIG. 32

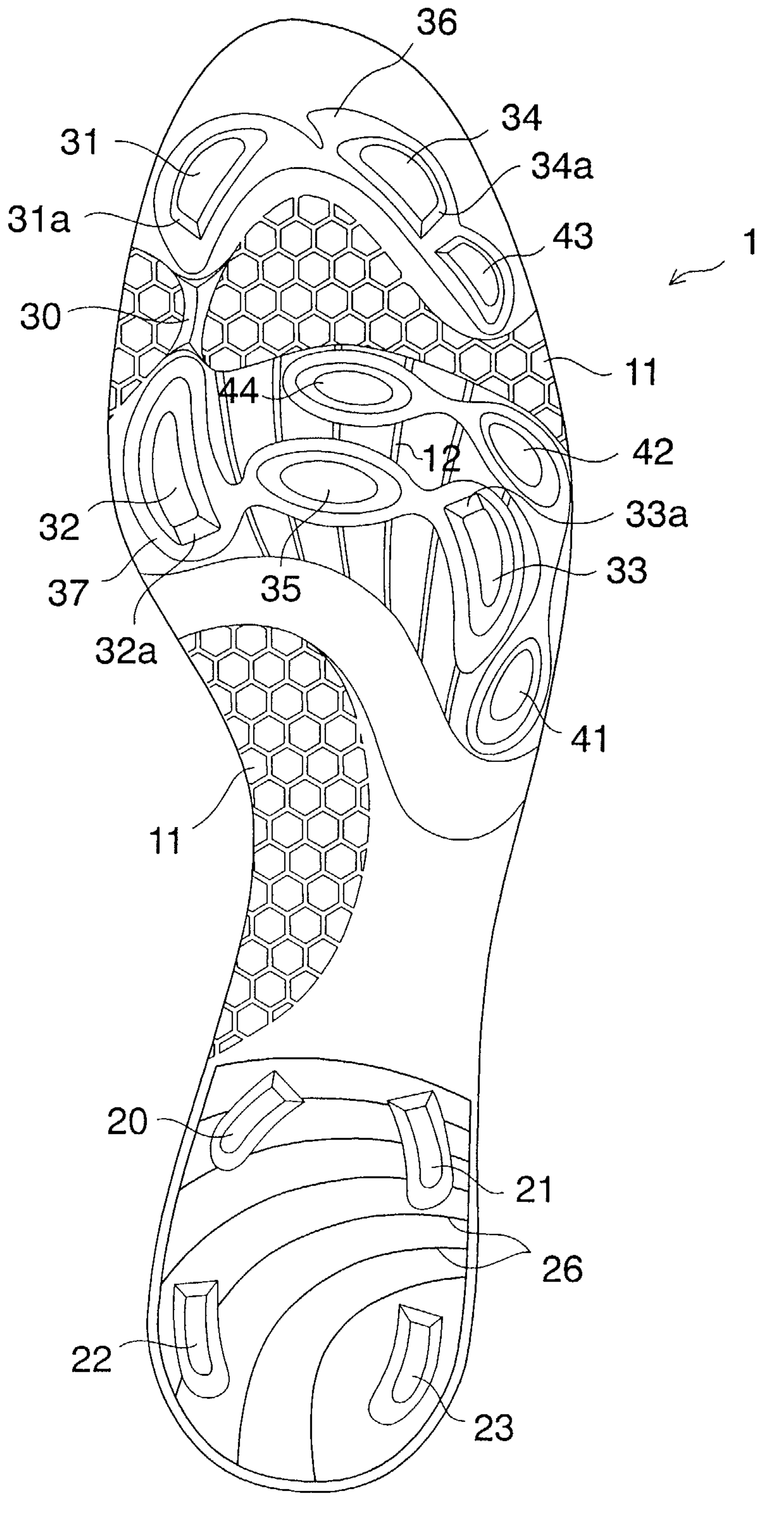
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FIG. 33

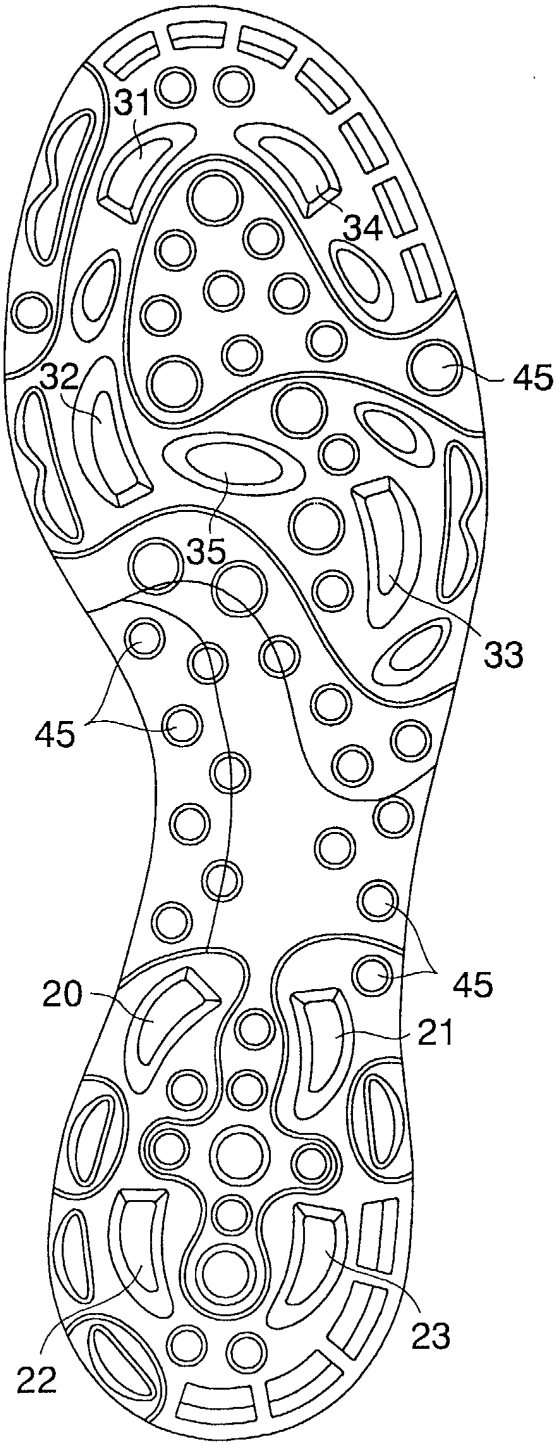

FIG. 34

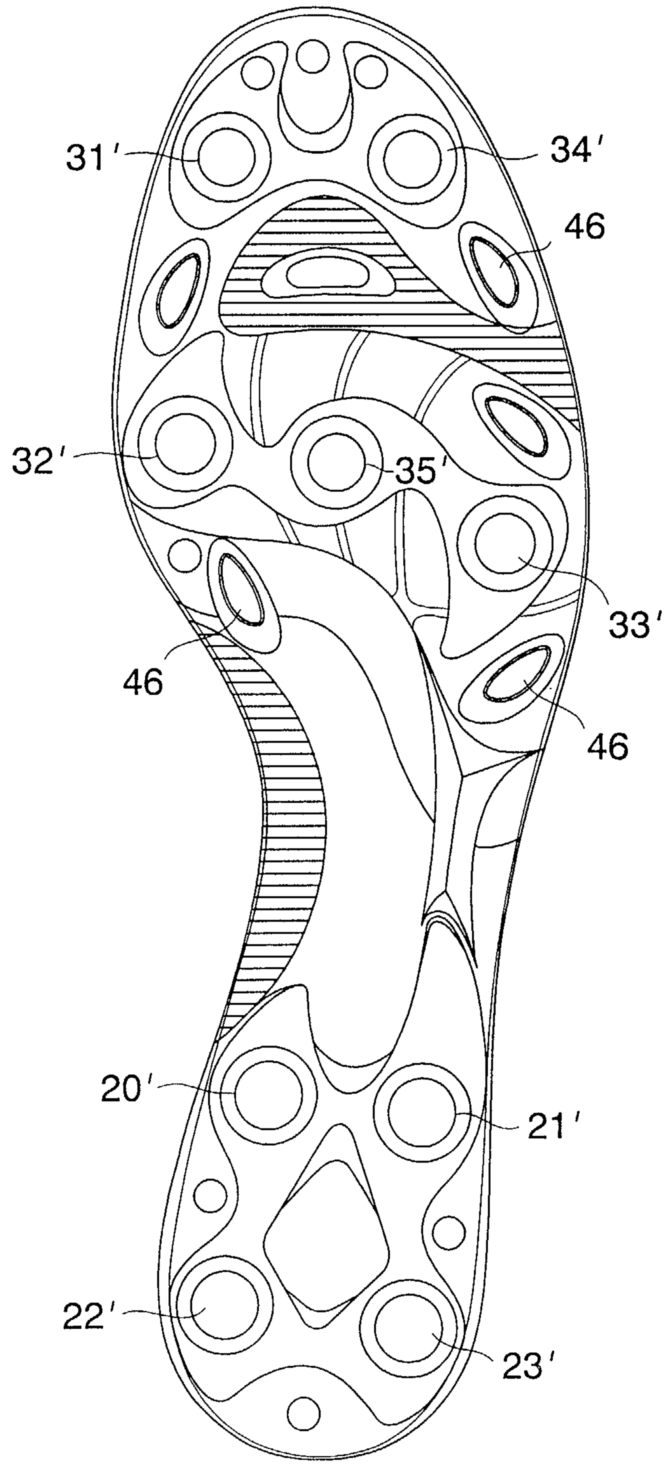

FIG. 35

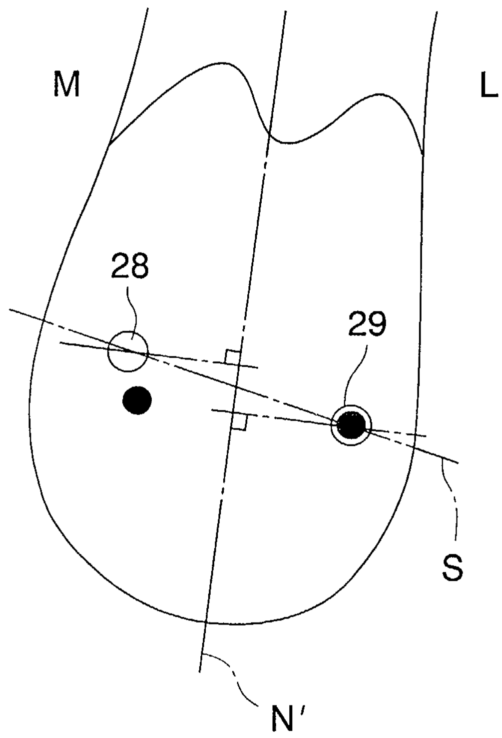

FIG. 36