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• **EP-A- 0 083 449**
• **EP-A- 0 291 874**
• **EP-A- 0 458 174**
• **US-A- 4 722 144**

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EP 0 600 145 B1

Description**BACKGROUND OF THE INVENTION**5 **Field of the Invention**

The present invention relates to sports shoes and, more specifically, to sports shoes allowing stretching and reinforcement of muscle strength.

10 **Description of the Background Art**

Fig. 43 is a front view of conventional standard casual shoes, and Fig. 44 is a front view showing conventional standard sports shoes. Referring to Fig. 43, a conventional casual shoe is formed of an instep 101 and a sole 102. The sole 102 includes a heel portion 103 and a toe portion 104. The heel portion 103 is generally formed to have the height of about 3cm, and a line extending from a lower surface of a ball joint (toe supporting portion) of the wearer to the lower surface of the heel forms an angle of 9 degrees (hereinafter referred to as a toe angle) with the plane of walking. The heel portion 103 occupies 31% of the entire area of the sole 102. The toe portion 104 has a curved shape, and an angle formed by the tip end portion thereof and the walking plane is generally 13°.

Referring to Fig. 44, a conventional sport shoe is formed by an instep 101 and a sole 112. The sole 112 has an approximately flat shape and only the tip end portion thereof forms an angle of 10 degrees with the plane of walking.

Now, configuration of one's foot bones will be described. Fig. 45 schematically shows configuration of foot bones. Referring to Fig. 45, one's foot is constituted by a number of small bones. More specifically, the bones of one's foot include region phalanges 120, region metatarsal bones 130 and region tarsal bones 140. Various joints across the region metatarsal bones and the region tarsal bones 140 are fixed by muscles and ligaments and therefore the joints hardly flex. Namely, foot joints which bent during walking are the ankle joint, the metatarsophalangeal joint (a joint at the root of the region phalanges, between five metatarsal bones and the proximal phalanges in contact therewith), and a joint at the region phalanges. Kicking of one's foot is effected through flexion of the metatarsophalangeal joint with the weight of one's body shifted to the region phalanges 120. Therefore, shoes having their soles corresponding to the metatarsophalangeal joint adopted to bend are considered to be good shoes. Therefore, good shoes must satisfy the condition that the ball joint of the shoes (which will be the fulcrum of flexion when the wearer stands tip toe) precisely matches the portion of the metatarsophalangeal joint of one's foot.

Figs. 46 to 48 are schematic diagrams showing movable range of the ankle joint (ankle). Referring to Figs. 46 to 48, among the complicated movement of the ankle joint, movable ranges of planter flexion in which one's foot is bent toward one's calf and of dorsiflexion in which one's foot is bent toward the sole are most important. The movable range of the planter flexion is from 0 to 20 degrees and the movable range of the dorsiflexion is from 0 to 40 degrees with one's knee bent, though these ranges, particularly the last 10 degrees much depend on personal differences.

Next, the center-of-gravity line of one's body will be described. Fig. 49 is a schematic diagram used for describing the position of the center-of-gravity line of one's body. Referring to Fig. 49, the center-of-gravity line of the body extends from the center-of-gravity of the hip joint, generally passes through the front side of knee joint, and through a position about 2cm in front of the center of one's foot, that is, the ankle. When a person takes standing posture for a long period of time, the position of the center-of-gravity moves toward one's heels because of fatigue of antigravity muscles, such as erector spinae. As the center-of-gravity moves, lumber vertebra bends forward (lordosis) to change one's attitude to relieve burden of antigravity muscles.

However, the change in one's attitude mentioned above is a main cause of low-back pain. The heel portion 103 of the conventional casual shoes shown in Fig. 43 has influence to the movement of the center-of-gravity toward the heels. More specifically, since the heel portion 103 is a higher position than the toe portion 104 the conventional casual shoes shown in Fig. 43, movement rearward is controlled by utilizing the inclination from the toe portion 104 to heel portion 103, by moving the center-of-gravity to the heel portion 103. In this manner, when one wears the conventional casual shoes shown in Fig. 43 and stands for a long period of time and keeps standing posture for a long period of time, the center-of-gravity moves rearward, causing low-back pain.

As for the conventional sports shoes shown in Fig. 44, stretching or training for reinforcing muscle of triceps surae has not been taken into consideration at all, and therefore it was difficult to obtain effects of stretching or effects of reinforcement of muscles.

In addition, in case of the conventional casual shoes and the conventional sports shoes shown in Figs. 43 and 44, respectively, when one kicks while walking, the kicking is weak since only a small area of the sole of the foot kicking is in contact with the ground. This prevents smooth movement of the center-of-gravity during walking, resulting in flexion of the knee joint. Such operation gives a shock as great as about four times the body weight to the knee joint, causes increased burden on the knee, and gradually causes pain and deformity of the knee joint.

It is generally known that the greatest shock is given when the heel of the forward limb reaches on the ground fol-

lowed by the entire sole of the foot during walking. At this time, in case of the conventional casual shoes shown in Fig. 43, since the position of the heel portion 103 is higher than the toe portion 104, there is a force exerted on one's foot to slip forward in the shoe at the moment when the sole touches the floor. As a result, the knee of the forward limb is relaxed to flex, which further gives larger burden to the knee.

In EP 0 458 174, which forms the basis of the preamble of claim 1, a shoe is disclosed for supporting directly the foot of a person providing a rigid supporting structure. Therefore a rigid layer of wood or plastic is arranged between a plane of walking and the inner sole of the shoe. The rigid layer and the walking sole do not have a special inclination but a relatively flat form.

To provide a shoe with a sole having a prescribed inclination is disclosed in EP 0 049 019 describing a running surface consisting of three flat parts whereby the foremost part is curved upwards from the center part under an angle between 25° and 35° and the hindmost part under an angle between 15° and 25°. The purpose of the arrangement of three flat parts is to provide a running surface for approaching a natural movement during the walking process.

SUMMARY OF THE INVENTION

The present invention was made to solve the above described problems and the object of the present invention as stated in claim 1 is to provide sports shoes which effectively prevent low-back pain even when the person wearing the shoes keeps standing posture for a long period of time, which provide effects of reinforcement of muscles and stretching of calves and which improves stability during walking.

This object is accomplished by the characterising features of claim 1.

Thus according to one aspect of the present invention, the sports shoes each includes an inner sole formed to be closely in contact with human foot and an outer sole formed to be in contact with the plane of walking. The outer sole includes a front sole having a first sole surface supporting the toe portion of one's foot which can be in contact with the plane of walking and a rear sole having a second sole surface supporting the heel portion of one's foot, forming a prescribed angle with the first sole surface and which can be in contact with the plane of walking. The inner sole and the front sole are formed such that when the first sole surface is in contact with the plane of walking, a line connecting the lower surface of the toe supporting point and the lower surface of the heel of one's foot forms an angle in the range of 10 to 15 degrees with respect to the plane of walking. The front sole and the rear sole are formed such that when at least a portion of the second sole is in contact with the plane of walking, the first sole surface forms an angle in the range from 20 to 25 degrees with respect to the plane of walking. In addition, the front sole is formed to include a region through which a vertical line including the center-of-gravity of one's body passes and a support point is formed between the front sole portion and the rear sole portion and said support point is formed at a position 30 to 40% of the entire length of said sport shoe from the rear end of the sole portion.

In operation, since the inner sole and the front sole are formed such that when the first sole surface of the front sole is in contact with the plane of walking, a line connecting the lower surface of the toe support point of one's foot and the lower surface of the heel forms an angle in the range of 10 to 15 degrees with respect to the plane of walking, and since this angle in the range of 10 to 15 degrees is most suitable for the muscle to fix the movement of the joint as the tension of muscles around the joints are even, stability in standing posture can be obtained. In addition, when the angle of the sole of the kicking foot during walking becomes about 15 degrees with respect to the plane of walking, the area in contact with the ground of the kicking foot is increased as compared with the prior art because of the inclination in the range from 10 to 15 degrees mentioned above, which improves stability in kicking, and strength of muscles are more effectively exhibited. Further, since the front sole and the rear sole are formed such that when at least a portion of the second sole surface is in contact with the plane of walking, the first sole surface forms an angle in the range from 20 to 25 degrees with the plane of walking, when one wears the sports shoes and brings his or her heel into contact with the plane of walking, the ankle is flexed with the angle in the range of about 7 to about 10 degrees. This contributes to stretching of the triceps surae (calf). Further, because of the angle of the first sole surface with respect to the plane of walking in the range from 20 to 25 degrees mentioned above, when one keeps standing posture in this state, tension of muscles in the front side of the body is induced, which corrects lordosis of lumbar vertebra. This removes major factor of low-back pain.

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

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a front view showing the sport shoe in accordance with the first embodiment of the present invention in the toe standing state.

Fig. 2 is a front view showing the sport shoe in accordance with the first embodiment of the present invention with the toe raised a little.

Fig. 3 is a front view showing the sport shoe in accordance with the first embodiment of the present invention in the heel standing state.

Fig. 4 shows correlation between the length of body sway of the center-of-gravity (A), the area of body sway of the center-of-gravity (B) and the displacement of the center-of-gravity (C) when the toe angle of one's foot is changed.

Fig. 5 shows the center-of-gravity when the toe angle is 5 degrees.

Fig. 6 shows the center-of-gravity when the toe angle is 7 degrees.

Fig. 7 shows the center-of-gravity when the toe angle is 10 degrees.

Fig. 8 shows the center-of-gravity when the toe angle is 15 degrees.

Fig. 9 shows the center-of-gravity when the toe angle is 17 degrees.

Fig. 10 shows the center-of-gravity when the toe angle is 20 degrees.

Fig. 11 is a first schematic diagram showing extension of the hip joint.

Fig. 12 is a second schematic diagram showing the extension of the hip joint.

Fig. 13 is a diagram for comparison showing the states of ankle joint and knee joint during walking with the walker wearing conventional shoes and the shoes of the first embodiment.

Fig. 14 shows correlation between the angle of the ankle and the moment (muscle strength exhibited by the calf) applied to the ankle.

Fig. 15 is a first schematic diagram explaining the force to flex the knee exerted at the time of kicking during walking.

Fig. 16 is a schematic diagram explaining force to flex the knee exerted at the time of kicking during walking.

Fig. 17 shows correlation between the length of body sway of the center-of-gravity (A), the area of body sway of the center-of-gravity (B) and the displacement of gravity (C) when the heel angle is changed.

Fig. 18 shows the center-of-gravity when the heel angle is 15 degrees.

Fig. 19 shows the center-of-gravity when the heel angle is 17 degrees.

Fig. 20 shows the center-of-gravity when the heel angle is 20 degrees.

Fig. 21 shows the center-of-gravity when the heel angle is 25 degrees.

Fig. 22 shows the center-of-gravity when the heel angle is 27 degrees.

Fig. 23 shows the center-of-gravity when the heel angle is 30 degrees.

Fig. 24 is a schematic diagram showing lordosis of lumber vertebra when one keeps standing posture for a long time.

Fig. 25 is a schematic diagram showing correction of lordosis when the sports shoes of the present invention are used when one keeps standing posture for a long period of time.

Fig. 26 is a first schematic diagram for explaining the force of flexing the knee exerted when the heel touches the ground during walking.

Fig. 27 is a second schematic diagram for explaining the force to flex the knee exerted when the heel touches the ground during walking.

Fig. 28 shows a concept of the conventional generally known rocker sole.

Fig. 29 is a front view showing the rocker sole configuration of the sports shoes in accordance with the first embodiment.

Fig. 30 is an illustration of balance training using a conventional kinesthetic board.

Fig. 31 is a first front view showing bending of the sports shoes in accordance with the first embodiment.

Fig. 32 is a second front view showing the bending of the support point of the sport shoe in accordance with the first embodiment.

Fig. 33 is a schematic diagram showing distribution of shock by an arch configuration of the sport shoe in accordance with the first embodiment of the present invention.

Fig. 34 is a first front view showing the bent state of the arch configuration of the sport shoe in accordance with the first embodiment.

Fig. 35 is a second front view showing the bent state of the arch configuration of the sport shoe in accordance with the first embodiment.

Fig. 36 is a graph showing the change in long sitting trunk flexion values when a group A used the sports shoes of the present invention for two weeks in a first experiment.

Fig. 37 is a graph showing the change in the long sitting trunk flexion values when a group B used the sports shoes in accordance with the present embodiment for one week in the first experiment.

Fig. 38 is a front view of a sport shoe in accordance with the second embodiment of the present invention.

Fig. 39 is a front view showing a sport shoe in accordance with the third embodiment of the present invention.

Fig. 40 is a bottom view showing the shape of the sole of a sport shoe in accordance with the fourth embodiment of the present invention.

Fig. 41 is a schematic diagram showing the angle of the step of one's foot toward the direction of walking.

Fig. 42 is a schematic diagram for explaining the movements of inversion and eversion of the foot.

Fig. 43 is a plan view showing a conventional general casual shoe (leather shoe).

Fig. 44 is a front view showing a conventional general sport shoe.

Fig. 45 is a schematic diagram showing structure of foot bones.

Fig. 46 is a first schematic diagram showing movement of a human foot.

Fig. 47 is a second schematic diagram showing the movement of one's foot.

5 Fig. 48 is a third schematic diagram showing the movement of one's foot.

Fig. 49 is a schematic diagram showing the position of the line of the center-of-gravity of one's body.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

10 Embodiments of the present invention will be described with reference to the figures.

Figs. 1 to 3 are plan views showing sport shoes in accordance with one embodiment of the present invention.

Referring to Figs. 1 and 2, the sports shoes of the present invention is each formed of an instep 1 and a sole 2. The sole 2 is formed such that a line extending from a lower surface of the toe support point of the person wearing the sports shoes to the lower surface of the heel is inclined by 10 to 15 degrees (toe angle) with respect to the plane of walking
15 when the surface thereof is in contact with the plane of walking, and the area of the toe portion 4 occupies 65% of the entire sole 2. The heel portion 3 occupies 35% of the sole 2 and is cut to have an arch. As shown in Fig. 3, it is formed such that the surface of the toe portion 4 is inclined by 20 to 25 degrees (heel angle) with respect to the plane of walking with the heel portion 3 and a support point 5 being in contact with the plane of walking. Therefore, when the person wearing the sport shoes takes a posture with the heel portion 3 being in contact with the ground, the ankle joint can be
20 bent rearward (dorsiflexion) by about 7 to 10 degrees, resulting in appropriate stretching of the triceps surae (calf).

In the state shown in Fig. 1, the position of the center-of-gravity of the person wearing the sports shoes passes through a position 52% from the toe. More specifically, when the person wearing the sports shoes takes the toe standing posture as shown in Fig. 1, the line of the center-of-gravity is included in the region of the toe 4, and therefore stability in the standing posture can be obtained even though the heel portion 3 is not in contact with the ground.

25 The reason why the toe angle (toe bending angle) is limited in the range from 10 to 15 degrees and the effects derived therefrom will be described in detail.

First, when the toe angle is limited in the range of 10 to 15 degrees, stability in the standing posture is ensured. More specifically, there is an optimum angle called an intermediate position at a joint, at which state the tension of muscles around the joint are even and most suited for fixing the movement of the muscles and the joint. The intermediate
30 position of the ankle joint corresponds to the sole bending angle of 10 to 15 degrees. Therefore, stability in the standing posture can be obtained when the toe angle is set in the range of 10 to 15 degrees. Fig. 4 shows correlation between the change of the toe angle of the sports shoes in accordance with the present invention shown in Figs. 1 to 3 and the length of body sway of the center-of-gravity (A), the area of body sway of the center-of-gravity (B), and the displacement of gravity (C). Referring to Figs. 4 (A) and (B), if the toe angle is within the range of 10 to 15 degrees, both the distance
35 and area of body sway of the center-of-gravity are small and stable, and if the angle goes out of the range, there is much sway and the center-of-gravity becomes instable. In addition, referring to Fig. 4 (C), the position of the center-of-gravity is at the center (52%) of one's foot if the angle is in the range of 10 to 15 degree.

Figs. 5 to 10 show the center-of-gravity when the toe angle is changed in the range from 5 to 20 degrees, respectively.

40 Referring to Figs. 5 to 10, it can be seen that the center-of-gravity is most stable when the toe angle is at 10 and 15 degrees. When the person wearing the shoes stands with the toe angle of 10 to 15 degrees, the heel portion 3 does not contact the plane of walking (see Fig. 1), and therefore the person stands slightly tiptoe, which stimulates metatarsophalangeal joint. Therefore, antigravity muscles such as represented by the triceps surae (calves) related to the straight standing posture can be reinforced. Further, since the person stands tiptoe, toes of his or her feet are stimulated, function of grasping the ground is improved and thus the strength for supporting the body can be improved.
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Secondly, by setting the toe angle in the range from 10 to 15 degrees, stability of the leg kicking during walking can be improved. More specifically, in order to move smooth the forward limb during walking, the rear limb (kicking leg) must be stable and support the body. Figs. 11 and 12 are schematic diagrams for explaining extension of the hip joint. Referring to Figs. 11 and 12, when forward rotation of the pelvis is limited, the range of movement of extension of the hip joint is 15 degrees. Assuming that the ankle joint is perpendicular, the angle formed by the limb and the sole of the foot is 15 degrees. This corresponds to the kicking foot during walking in the state of kicking. In the present embodiment, the sports shoes has the toe angle in the range from 10 to 15 degrees in the state of kicking and 65% of the entire heel portion is in contact with the ground. Therefore, the kicking foot has sufficient area in contact with the ground, which makes stable the support of the standing legs. Therefore, the knee of the forward limb can be extended at ease, and at
50 the same time, the time of flexion of the knee of the rearward limb can be retarded which increases the strength of the kicking foot, enabling smooth movement of the center-of-gravity. Fig. 13 is a diagram for comparing walking with the conventional casual shoes and with the sports shoes of the present invention. Referring to Fig. 13, it can be understood that the area in contact with the ground of the rear foot in steps 1 to 3 of the operation is larger in the case of the casual shoes (sports shoes) of the present invention than the conventional casual shoes. Noting the left foot in the steps 3 to
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5 of walking, movement of the center-of-gravity is not smooth since the kicking is weak in case of the conventional casual shoes so that the knee joint is flexed. By contrast, stable kicking output can be obtained in the present embodiment, which allows smooth movement of the center-of-gravity, resulting in reduced flexion of the knee joint.

The third effect is that by setting the toe angle in the range from 10 to 15 degrees, strength of muscles can be efficiently exhibited. Fig. 14 shows the force which can be exhibited by the triceps surae (calf) corresponding to the change in the angle of the ankle joint. The force is strongest when the knee joint is extended and the ankle joint is at 10 degrees of planter flexion. It can be also seen from Fig. 14 that the force exhibited by muscles is decreased when one's knee is flexed. Accordingly, the rear leg can exhibit strongest kicking force during walking when his knee is extended and the ankle is at 10 degrees of planter flexion. As already described with reference to Figs. 11 and 12, extension of the hip joint is 15 degrees which corresponds to the kicking foot being about to kick during walking. This angle is the same both in the prior art and in the present embodiment. However, in this state of kicking, sufficient area in contact with the ground cannot be obtained by the conventional casual shoes and by the conventional sports shoes shown in Figs. 43 and 44. By contrast, the sports shoes of the present embodiment shown in Figs. 1 to 3 can provide sufficient area in contact with the ground (65% of the entire sole 2). Therefore, the force of muscles can be efficiently exhibited at the time of kicking. When kicking is to be done at the start of movement of the rear leg during walking, a force to flex one's knee tends to be exerted by the conventional shoes shown in Figs. 43 and 44. Figs. 15 and 16 are schematic diagrams for explaining the force to flex the knee exerted at the time of kicking by the rear limb. Referring to Figs. 15 and 16, it is understood that the force to flex the knee is more easily exerted as the area of toe in contact with the ground is smaller. With this respect also, the sports shoes of the present embodiment shown in Figs. 1 to 3 can provide sufficient area at the toe portion 4 in contact with the ground (65%), and therefore the force to flex the knee can be reduced and the force of muscles can be efficiently exhibit at the time of kicking.

The reason why the heel angle (dorsiflexion angle) is limited in the range from 20 to 25 degrees in the sports shoes of the present embodiment shown in Fig. 3 and effects derived therefrom will be described.

First, by setting the heel angle in the range from 20 to 25 degrees, stability of the standing posture can be obtained. In order to prove this fact, the following experiment was carried out. Fig. 17 is a graph showing length of body sway of the center-of-gravity (A), the area of body sway of the center-of-gravity (B) and the displacement of the gravity (C) with the heel angle changed. Referring to Fig. 17, it can be seen that the length and area of body sway of the center-of-gravity are small if the heel angle is within the range of 20 to 25 degrees, and if the angle goes out of this range, there is considerable fluctuation. The displacement of gravity is 32 to 36% when the heel angle is within the range of 20 to 25 degrees. If the angle goes out of this range, it becomes less than 30% and instable. When the heel angle is 30 degrees, the center-of-gravity goes back to the position of 26% and it is very instable. Figs. 18 to 23 show the center-of-gravity with the heel angle changed in the range from 15 to 30 degrees. Referring to Figs. 18 to 23, it can be well understood that the center-of-gravity is stable when the heel angle is in the range of 20 to 25 degrees. In this manner, by setting the heel angle in the range from 20 to 25 degrees, stability of the standing posture can be obtained.

Secondly, by setting the heel angle in the range from 20 to 25 degrees, the effect of stretching the triceps surae (calves) can be obtained. It is determined that the movable range of dorsiflexion of the ankle joint is measured with the subject setting with his knees flexed to release tension of the two-joint muscle (gastrocnemius) and the ankle moved by another person (manually operated by the measurer). Under this condition of measurement, the movable range of the joint of dorsiflexion shows the range from 0 to 20 degrees. However, when the knee is extended, the tension of the gastrocnemius is increased, and therefore the range is decreased to 14 degrees. Further, if dorsiflexion is effected by the subject himself (by the function of his own muscles), the movable range is decreased to 10 degrees because of resistance of gastrocnemius and soleus, even when the knee is flexed. Further, when the knee is extended and dorsiflexion is done by the subject himself, the measured movable range is about 6 degrees. Therefore, when one stands with the heel 3 of the sports shoes in accordance with the present invention in contact with the plane of walking as shown in Fig. 3, the angle of dorsiflexion of the ankle is in the range from about 7 to about 9 degrees, and as this state, the triceps surae (calves) and hamstrings (muscle on the backside of thigh) are sufficiently stretched.

Thirdly, by setting the heel angle in the range from 20 to 25 degrees, lordosis of lumbar vertebra can be corrected. Fig. 24 is a schematic diagram for explaining lordosis of lumbar vertebra. Referring to Fig. 24, when a person keeps standing posture for a long period of time, the center-of-gravity moves toward the heels because of fatigue of antigravity muscles such as electro spinae and lumbar vertebra is bent forward (lordosis) to change the posture to lessen burden on the antigravity muscles. However, this posture with lumbar vertebra bent forward is a main factor causing low-back pain. The sport shoes in accordance with the present embodiment solves this problem as the sports shoes are formed with the heel angle being in the range from 20 to 25 degrees when the heel portion 3 is in contact with the ground as shown in Fig. 3. Fig. 25 is a schematic diagram for explaining correction of lordosis when one wears the sports shoes of this embodiment. Referring to Fig. 25, when one keeps standing posture wearing the sport shoes of the present embodiment such as in the state shown in Fig. 3, tension of tibialis anterior, quadriceps femoris and aodominal muscle are induced in the front side of the body, so that lordosis of lumbar vertebra can be corrected. Consequently, important factor of the low-back pain can be removed.

As the fourth effect, by setting the heel angle in the range from 20 to 25 degrees, stability of the forward limb during

walking can be obtained. More specifically, it is generally known that largest shock is exerted when the forward limb reaches the ground and thereafter the sole as a whole is brought into contact with the ground during walking, as described above. Further, since the position of the heel portion 103 is higher than the position of the toe portion or toe 104 in the conventional casual shoes shown in Fig. 43, a force is exerted on the foot in the shoes to slip forward when at the moment when the sole 102 reaches the floor, the knee of the forward limb is relaxed and flexed, which applies a large force to the knee. By contrast, the sports shoes of the present embodiment shown in Fig. 3 exhibits the effect of relieving shock when the sole reaches the ground. More specifically, it is generally known that when the heel of the forward limb reaches the ground (heel is in contact with the ground), the angle of the ankle joint assumes 0 degree, that is 90 degrees with respect to the leg. At this time, the angle formed by the sole and the floor is about 7 degrees. This angle contributes to correction of ankle joint when the arch shaped heel 3 of the sports shoes of the present embodiment reaches the ground as shown in Fig. 3. This mechanism will be described with reference to Fig. 13. As can be seen from the steps 2 and 3 of movement of the conventional shoes, the area in contact with the ground of the forward limb is small. In these steps 2 and 3 of movement, there is generated a rotational movement with the point in contact with the ground of the heel portion of the forward limb being the fulcrum, so that the knee is flexed in step 4 of movement. Figs. 26 and 27 are schematic diagrams for explaining the force to flex the knee exerted when the forward limb reaches the ground. Referring to Figs. 26 and 27, the knee tends to flex because of the rotational movement with the point in contact with the ground of the heel being the fulcrum in case of the conventional shoes. By contrast, by the sports shoes of the present embodiment, the area for support across the heel portion 3 to the central portion of the sole can be ensured when the arch shaped heel 3 reaches the ground as shown in steps 3 and 4 of movement in Fig. 13, the angle of dorsiflexion of the ankle joint can be made within the range of 7 to 10 degrees by the heel angle of 20 to 25 degrees so that slip of the foot forward in the shoes can be prevented, and rotational movement to the knee can be suppressed so that the knee is not flexed. Therefore, as shown in step 5 of the movement of Fig. 13, the leg extends straight and the weight can be supported by the entire sole. This way of walking is a highly skilled way of walking popular in competitive walking and it is the basic way of walking fast and smart. The force exerted to the knee can be reduced, and prevention of knee pain and of deformity of joint can be expected.

The scope of arch cutting of the heel 3 of the sports shoes in accordance with the present embodiment shown in Figs. 1 to 3 will be described. The sports shoes of this embodiment has the toe angle in the range from 10 to 15 degrees, and within this range, the center-of-gravity of the wearer keeping standing posture is at a position approximately 52% from the tip end of the toe. Therefore, the support surface is effective when the supporting point 5 is behind this position. However, the support point 5 should not preferably be positioned at the region metatarsal bones, since the region metatarsal bones is not very strong. Further, since the support point 5 also serves to support the arch, it should preferably be positioned at the region tarsal bones constituted by three cuneiform bone, navicular bone and cuboid bone (see Fig. 45) which approximately correspond to the center of the longitudinal arch. Therefore, the support point 5 should preferably be positioned in the range from 30 to 40% from the heel. In this embodiment, correspondingly, the support point is at the position 35% from the heel.

The effects provided by the positioning of the support point 5 in the above manner will be described. At first, by positioning the support point 5 (see Fig. 1) 35% from the heel, rolling action is obtained. Fig. 28 is a schematic diagram showing the concept of rocker sole devised for those who having weak or enfeebled walking capability. Referring to Fig. 28, the rocker sole absorbs shock to knees and hip joints and therefore it is suitable for use in shoes for aged persons, shoes for patients suffering from rheumatoid arthritis or shoes for persons with their legs became rigid. However, the rocker sole is rather inferior in stability at the standing posture. The rocker sole is adapted such that the center thereof is positioned at the central portion of the hip joint. Fig. 29 is a front view for explaining the rocker sole configuration of the sports shoes in accordance with the present invention. Referring to Fig. 29, the sports shoes of the present embodiment each has a shape near an arch, which is similar to the rocker sole shown in Fig. 28. Accordingly, the center-of-gravity can be moved smooth. In addition, the stability, which could not be obtained by the rocker sole, is ensured by the heel portion 3 cut to have arch shaped in the sports shoes of this embodiment.

The sports shoes in accordance with this embodiment may be used for balance training if the support point 5 is provided in the region of the arch of foot. Fig. 30 is a schematic diagram showing balance training using kinesthetic board. The same effect as the balance (proprioceptor kinesthetic sensation) training utilizing the kinesthetic board shown in Fig. 30 can be obtained by standing with the support point 5 of the sports shoes of the present embodiment shown in Figs. 1 to 3 being the center. This contributes to facilitation of muscles and nerves and improves balancing capability of one's body. Such training is called joint training. More specifically, by reinforcing muscles surrounding joints at the intermediate position which is most natural position of the joint, sprain of ankle joint, which is most popular among sport injury, can be prevented.

Further, by providing the support point 5 (see Fig. 1) at a position 35% from the heel, it exhibits the function of supporting the arch of the sole. Figs. 31 and 32 are front views showing state of bending when the toe and the heel are depressed by both hands with the shoes supported only by the support point 5. Referring to Figs. 31 and 32, after loading, the toe and the heel are bent by about 5mm as compared with the state before loading, with the support point 5 being the center. It can be understood that such bending provides the function of supporting the arch of the sole in the

sport shoes of the present embodiment.

The effects provided by the arch shaped (curved shape) of the heel portion 3 of this embodiment will be described. In this embodiment, by forming the heel portion 3 to have an arch shape, shock can be dispersed. Fig. 33 is an illustration showing the mechanism of the arch configuration for dispersing shock. Referring to Fig. 33, when there is a load applied at the upper central portion of the arch configuration, the load is dispersed toward the lateral directions from both ends of the arch configuration. Figs. 34 and 35 are front views showing states before and after loading when the load of stand is applied on one foot wearing the sports shoe of the first embodiment. Referring to Figs. 34 and 35, by the load of stand on one foot, the arch of the heel portion 3 becomes lower by about 3mm, which can relieve the shock when the heel reaches the ground.

The manner of use of the sports shoes in accordance with the present embodiment and effects derived therefrom will be summarized in the following, with reference to Figs. 1 to 3.

First, when the person wearing the shoes stands on the AB surface of the sole 2, he or she stands in a slightly tip toe state, muscles of the legs, waist and back are adequately strained, so that the wearer can keep good posture.

Next, by walking or running by using the AB surface of the sole 2, muscles of ankles and calves (triceps surae) can be reinforced. By climbing a slope by using the AB surface, muscles at the hip and the back of the thighs (knee flexion muscles) are reinforced.

Next, if the wearer stands using the BC arch of the sole 2, the toe is raised, and the muscles of calves which tend to be rigid and muscles behind the thigh can be stretched. Stretching of these muscles is effective to prevent the low-back pain or sports injury such as rupture of the calcaneal tendon, sprain of ankle, and to prevent enfeebling, since stretching softens the ankle joint.

Further, by the see-saw mechanism with the B line of the sole being the fulcrum, when the wearer moves like a see-saw while he or she is standing, muscles below his or her knees are rhythmically constricted. This function of muscles is called a milking action, which helps returning blood at one's foot back to one's heart. Because of this function, legs do not become fatigued. In addition, such see saw movement also improves balancing capability.

If the wearer stands or stamps lightly by using the line B of the sole, the line B stimulates the arch of the foot, stretches the muscles on the sole, promotes blood flow and the effect of so called stamping on green bamboo section can be obtained.

When the wearer walks by using the line B and the AB surface of the sole, the B line simultaneously carries out the function of arch support and of stamping on green bamboo section and in addition, since the center-of-gravity of the shoes is in front, weight of one's body can be moved smooth.

Further, when the wearer walks by using the BC arch, B line and AB surface of the sole, the BC arch absorbs shock during walking, and the wearer naturally walks in the correct manner because of the arch support, the effect of bamboo stamping, and of smooth movement of his or her weight.

In addition, since the forward and rearward limbs become stable, stride can be widened during walking, which contributes to reinforce muscles such as lower limb muscles and gluteus maximums. In order to confirm the effects provided by the sport shoes of the first embodiment described above, the following first and second experiments were carried out.

(First Experiment)

(1) Method

Ten women students are divided into group A (five students) and group B (five students) and the students wore the sports shoes of the first embodiment in campus and on the way to and from the campus.

The students were suggested to bring into contact the arched heel of the sports shoes of the embodiment to stand, and to walk with the arched heel of the shoes reaching the ground first while walking, when they wore the sports shoes of the first embodiment.

The items measured for determining the effects of the shoes were range of movement of ankle dorsiflexion and long sitting trunk flexion. The range of movement of ankle dorsiflexion was measured with the subjects' knees extended with the ankle moved by others (moved by hands of measurers).

The measurement was carried out at the start of experiment, one week after the start of experiment and at the end of the experiment for the group A, while the measurement was carried out at the start of the experiment, at the end of the experiment and one week after the end of the experiment for the group B.

(2) Results

The time of use of the sports shoes in accordance with the first embodiment was about 3.7 hours in average per day for the former one week, and about 3 hours in average per day for the latter one week in group A. The number of steps of the group A was about 2800 in average in the former half, while it was about 2300 in average per day for the

latter week in group A.

The time of use of the sports shoes in accordance with the present invention by the first group was about 4 hours in average per day in group B, and the average number of steps was about 1600 per a day. The change in the range of movement of ankle dorsiflexion under such condition was as shown in Tables 1 and 2 below.

Table 1

Change in the range of movement of ankle dorsiflexion with
knees extended, group A (moved by other person) (degrees)

	right ankle joint			left ankle joint		
	start	one-week after	end	start	one week after	end
1. M. M	20	20	30	15	20	20
2. T. M	25	30	30	20	25	30
3. Y. H	5	10	15	5	5	15
4. J. I	15	20	20	10	15	20
5. M. I	5	10	20	10	10	15
X	14°	18°	21°	12°	15°	20°
S. D.	8.0	7.5	4.9	5.7	7.9	6.1
	-*-	-NS-		-NS-	-*-	
	-----NS-----			-----**-----		

*P level of significance <0.05

**P <0.01. NS no significant difference

X arithmetic mean value

S. D. standard deviation

Table 2

Change in the range of movement of ankle dorsiflexion with

knees extended, group B (moved by other person) (degrees)

		right ankle joint			left ankle joint		
		start	end	one week after end	start	end	one week after end
15	1. R.A	15	20	20	10	20	20
	2. Y.K	15	25	20	15	20	20
	3. H.S	10	20	25	10	15	25
20	4. M.S	10	20	15	10	15	15
	5. S.W	20	25	25	20	20	25
25	X	14°	22°	21°	13°	18°	21°
	S.D	3.7	2.5	3.7	4.0	2.5	3.7
30		---**--		-NS-	---**--		-NS-
		-*-			-*-		

*P < 0.05, **P < 0.01, NS (no significant difference)

Referring to Tables 1 and 2, in group A, significant improvement was observed after two weeks as the range of movement of the right ankle was improved from 14 degrees to 21 degrees in average, and the range of movement of the left ankle was improved from 12 to 20 degrees. Although the time of use of the shoes in group B was as short as one week, there was significant improvement observed, as the range of movement of the right ankle was improved 14 degrees to 22 degrees in average, and the range of movement of the left ankle was improved from 13 degrees to 18 degrees in average.

Fig. 36 is a graph showing the change in the long sitting trunk flexion when the group A used the sports shoes in accordance with the first embodiment for two weeks, and Fig. 37 is a graph showing the change in the long sitting trunk flexion when the group B used the sport shoes of the first embodiment for one week. Referring to Figs. 36 and 37, there was hardly a change in both groups A and B in one week. However, after two weeks' use of the sports shoes in accordance with the first embodiment, significant improvement was observed in group A, that is, from 8.3cm to 12.4cm in average.

As described above, when the sports shoes in accordance with the first embodiment is used in daily life, the movable range of ankle dorsiflexion is improved by about one week, and as for the long sitting trunk flexion, flexibility is improved by about 2 weeks. It means that the effect of stretching of the triceps surae (calves) appears by about one week while the effect of stretching of hamstrings muscle appears by about two weeks. Use of the sports shoes in accordance with the first embodiment prevent decrease of flexibility caused by advance in age, and keeps and promotes function of controlling force exerted on joints.

(Second Experiment)

(1) Method

5 Eleven women students were divided into a group using the sports shoes of the first embodiment (hereinafter referred to as the group used the embodiment), and a group which does not use the sports shoes of the embodiment, and training was done for about 50 to 60 minutes a day.

 Items measured for determining the effects were long sitting trunk flexion, standing long jump, vertical jump, side step and 50m run.

10 The measurement was done on the day before the start of training and on the day after the end of the training, with the subjects wearing the conventional training shoes. The period for training was 11 days. However, training was not carried out on the second and six days, because these days were holidays. In principle, the training was done in accordance with instructions from one instructor, and the group using the sports shoes of the embodiment and the group not using carried out the same training simultaneously.

15 (2) Results

 The comparison of results of measurement of the group used the sports shoes of the embodiment and the group not used the sports shoes of the embodiment before and after the training are as shown in Table 3 below.

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Table 3

Change in physical capability of groups using and not using sports shoes of the embodiment by the same training for 2 weeks

	item		before training	after training	detected deference
group used the sports shoes of the embodiment	long sitting trunk flexion	X	16.5	22.5	*
		SD	7.50	6.35	
	standing long jump	X	190.2	206.2	**
		SD	16.08	15.20	
	vertical jump	X	49.2	54.2	***
		SD	6.11	6.68	
	side step	X	34.4	37.6	***
		SD	2.42	2.24	
	50m run	X	8.4	8.1	NS
		SD	0.48	0.23	
group not used the sports shoes of the embodiment	long sitting trunk flexion	X	14.0	16.3	NS
		SD	3.11	4.61	
	standing long jump	X	192.7	198.3	NS
		SD	10.89	11.76	
	vertical jump	X	45.7	47.0	NS
		SD	5.22	3.96	
	side step	X	36.7	37.2	NS
		SD	1.60	1.77	
	50m run	X	8.2	8.2	NS
		SD	0.33	0.38	

Training period: 14 days (actual training 11 days)

Referring to Table 3, in the group used the sports shoes of the embodiment, the physical capability is improved in every item: long sitting trunk flexion, 6cm; standing long jump, 16cm; vertical jump, 5cm; side step, 3 times; and 50m run, 0.3sec. In addition, except 50m run, these improvements have statistically significant meaning. Although the group not used the sports shoes of the embodiment exhibited improvements in items except 50m run, such improvements are not significant statistically.

As described above, by using the sports shoes of the first embodiment, significant effects of training could be observed at every item except 50m run through a short period of training. The sports shoes of the first embodiment allow zigzag or meandering as well as linear running, and allows free jumps and side steps in which the wearer moves rapidly in left and right directions. Therefore, training can be done in movements very close to the actual movement during sports. Therefore, not only the muscles but the muscular power can be trained.

Fig. 38 is a front view showing a sport shoe in accordance with a second embodiment of the present invention. Referring to Fig. 38, in the sport shoe of the second embodiment, the support point portion 15 at the interface between the heel portion 13 and the toe portion 14 is formed by an area coupling a support point 15a and a support point 15b. Consequently, the rolling effect can be improved as compared with the first embodiment shown in Figs. 1 to 3. In addition, stability at foot flat state (the sole is flat) can be improved, and therefore shock absorbing capability can be improved.

Fig. 39 is a front view showing a sport shoe in accordance with a third embodiment of the present invention. Referring to Fig. 39, the sport shoe of the third embodiment has a heel portion 23 provided with two arches 23a and 23b. By this configuration, the area in contact with the ground when the heel 23 reaches the ground can be enlarged, and as a result, the shock absorbing capability as well as stability can be improved as compared with the first and second embodiments.

Fig. 40 is a bottom view showing the shape of the sole of the sport shoe in accordance with a fourth embodiment of the present invention. Referring to Fig. 40, in the sports shoes of the fourth embodiment, the shape of cutting 35 of the support point B is adapted such that it has inclination of 10 to 15 degrees from a position 35% from the rear end of the heel. In addition, the shape of cutting 33a of the surface 33c in contact with the ground at the heel is adapted to have an inclination in the range from 10 to 15 degrees.

Now, during walking or running, the toe is turned outward by about 10 to 15 degrees in the direction of advance. Fig. 41 is a schematic diagram showing this state. Referring to Fig. 41, the angle of toe turned outward by about 10 to 15 degrees in the direction of walking is referred to as the angle of step. Such angle of step is caused as the tibia of the leg and the axis of the tibiotarsal joint of the foot are positioned at the lateral rotation angle of 10 to 15 degrees, which enables inversion and eversion movements (movement of center-of-gravity from the outer side to the inner side with respect to the ground), and shock absorption and stability are improved. Fig. 42 is a schematic diagram for explaining the movements of inversion and eversion during walking and during running. Referring to Fig. 42, the movements of inversion and eversion during walking is plotted by the solid line while the movement of inversion and eversion during running is plotted by the dotted line. It is understood that the movement of inversion and eversion becomes larger during running than during walking. Since the shape of cutting 35 at the support point B and the shape of cutting 33a at the surface of the heel in contact with the ground 33c are formed to have inclinations in the range from 10 to 15 degrees in the sport shoes of the fourth embodiment shown in Fig. 40, this movement of inversion and eversion can be done smooth. As a result, movement of the ankle joint can be made more smooth.

Though single configuration is disclosed in each of the first to fourth embodiment described above, the present invention is not limited thereto and sports shoes having the configurations disclosed in these embodiments combined may be provided. In that case, sports shoes having the effects of the embodiments combined can be obtained. By modifying the sports shoes of the present invention corresponding to the object, shock absorption and stability during strong movement on a hard ground such as asphalt can be improved, and shock absorption and movement of almost all sports can be enabled.

As described above, by the sports shoes in accordance with the present invention, the inner sole portion and the front sole portion are formed such that a line connecting the lower surface of the toe support point of one's foot and the lower surface of the heel portion forms an angle in the range from 10 to 15 degrees with respect to the plane of walking when a first bottom surface supporting the toe of one's foot which can be in contact with the plane of walking is brought into contact with the plane of walking, whereby when the wearer stands in tip toe state with the first bottom surface being in contact with the ground, muscles of calves can be trained, and the posture can be corrected. In addition, by forming the front sole portion having the first surface and the rear sole portion having the second surface such that the first surface forms an angle in the range from 20 to 25 degrees with respect to the plane of walking when at least a portion of the second surface, which has a prescribed angle with the first surface supports the heel portion of one's foot and is capable of being in contact with the plane of walking, is brought into contact with the plane of walking, when the wearer stands with the second surface being in contact with the plane of walking, the calves can be stretched. By standing or slightly stamping by using the support portion at which the first and second surfaces interface with each other, balancing sensation can be trained and the effect of the so called bamboo stamping can be obtained. By standing using

the first and second surfaces alternately in the manner of a see saw, a so called milking action of bringing back the blood at one's feet to the heart can be obtained.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the scope of the present invention being limited only by the terms of the appended claims.

Claims

1. A sport shoe comprising:

an inner sole portion such that a foot of a person is in close contact therewith; and
an outer sole portion formed to be able to contact with a plane of walking; wherein
said outer sole portion includes

a front sole portion (4) holding the toe portion of the foot of a person and having a first surface which can be in contact with said plane of walking, and
a rear sole portion (3) supporting the heel portion of the foot of a person and having a second surface forming an angle with said first surface and which can be in contact with said plane of walking, **characterized in that**

said inner sole portion and said front sole portion (4) formed such that a line coupling a lower surface of a toe support point of the foot of a person and a lower surface of the heel forms an angle in the range from 10 to 15 degrees with respect to said plane of walking when said first surface is in contact with said plane of walking,

said front sole portion and said rear sole portion formed such that said first surface forms an angle in the range from 20 to 25 degrees with respect to said plane of walking, when at least a portion of said second surface is in contact with said plane of walking, wherein

a support point (5, 15, 25, 35) is formed between said front sole portion (4, 14) and said rear sole portion (3, 13, 23, 33), and

said support point (5, 15, 25, 35) is formed at a position 30 to 40% of the entire length of said sport shoe from the rear end of said sole portion (3, 13, 23, 33),

and said front sole portion (4) is formed to include a region through which a vertical line including center-of-gravity of the person's body passes.

2. The sport shoe according to claim 1, **characterized in that**

said first surface (3) has an arched shape.

3. The sport shoe according to claim 2, **characterized in that**

said second surface (23) includes a plurality of arch portions (23a, 23b).

4. The sport shoe according to claim 1, **characterized in that**

a support region (15a, 15b, 15) having a third surface (15) is formed between said front sole portion (14) and said rear sole portion (13).

5. The sport shoe according to claim 1, **characterized in that**

a support point (35) which is cut inclined by an angle in the range from 10 to 15 degrees with respect to a direction perpendicular to the direction of walking is formed at an interface between said front sole portion and said rear sole portion (33a, 33b, 33c).

Patentansprüche

1. Sportschuh mit:

einem inneren Sohlenabschnitt, so daß ein Fuß einer Person in engem Kontakt damit ist; und
einem äußeren Sohlenabschnitt, der geformt ist, um fähig zu sein, mit einer Lafebene in Kontakt zu sein;

wobei der äußere Sohlenabschnitt einen vorderen Sohlenabschnitt (4), der den Zehenabschnitt des Fußes einer Person hält, und eine erste Oberfläche besitzt, die in Kontakt mit der Lafebene sein kann, und
einen hinteren Sohlenabschnitt (3), der den Fersenabschnitt des Fußes einer Person abstützt, und eine

zweite Oberfläche besitzt, die einen Winkel mit der ersten Oberfläche bildet, und die in Kontakt mit der Lauffläche sein kann, umfaßt, **dadurch gekennzeichnet, daß**

der innere Sohlenabschnitt und der vordere Sohlenabschnitt (4) so geformt sind, daß eine Linie, die eine untere Oberfläche eines Zehenabstützpunkts des Fußes einer Person und eine untere Oberfläche der Ferse verbindet, einen Winkel im Abschnitt von 10 bis 15 Grad hinsichtlich der Lauffläche bildet, wenn die erste Oberfläche in Kontakt mit der Lauffläche ist,

wobei der vordere Sohlenabschnitt und der hintere Sohlenabschnitt so geformt sind, daß die erste Oberfläche einen Winkel im Bereich von 20 bis 25 Grad mit Bezug zu der Lauffläche bildet, wenn zumindest ein Bereich der zweiten Oberfläche in Kontakt mit der Lauffläche ist, wobei ein Stützpunkt (5, 15, 25, 35) zwischen dem vorderen Sohlenabschnitt (4, 14) und dem hinteren Sohlenabschnitt (3, 13, 23, 33) gebildet ist, und

der Stützpunkt (5, 15, 25, 35) an einer Position 30 bis 40 % von der gesamten Länge des Sportschuhs von dem hinteren Ende des Sohlenabschnitts (3, 13, 23, 33) gebildet ist,

und der vordere Sohlenabschnitt (4) ausgebildet ist, um einen Bereich zu umfassen, durch den eine vertikale Linie verläuft, die den Schwerpunkt des Körpers der Person enthält.

2. Sportschuh nach Anspruch 1, **dadurch gekennzeichnet, daß** die erste Oberfläche (3) eine gekrümmte Form hat.

3. Sportschuh nach Anspruch 2, **dadurch gekennzeichnet, daß** die zweite Oberfläche (23) eine Vielzahl an gekrümmten Abschnitten (23a, 23b) umfaßt.

4. Sportschuh nach Anspruch 1, **dadurch gekennzeichnet, daß** ein Stützbereich (15a, 15b, 15) mit einer dritten Oberfläche (15) zwischen dem vorderen Sohlenabschnitt (14) und dem hinteren Sohlenabschnitt (13) geformt ist.

5. Sportschuh nach Anspruch 1, **dadurch gekennzeichnet, daß** ein Stützpunkt (35), der durch einen mit Bezug auf eine Richtung quer zu der Laufrichtung geneigten Winkel im Bereich von 10 bis 15 Grad geschnitten wird, an einer Grenzfläche zwischen dem vorderen Sohlenabschnitt und dem hinteren Sohlenabschnitt (33a, 33b, 33c) gebildet ist.

Revendications

1. Chaussure de sport, comprenant :

une partie de semelle intérieure, telle qu'un pied d'une personne est en contact étroit avec elle ; et
une partie de semelle extérieure formée pour être capable d'entrer en contact avec un plan de marche ; dans laquelle
ladite partie de semelle extérieure, comprend

une partie de semelle antérieure (4) tenant la partie des orteils du pied d'une personne et ayant une première surface qui peut être en contact avec ledit plan de marche ; et

une partie de semelle postérieure (3) soutenant la partie du talon du pied d'une personne et ayant une deuxième surface formant un angle avec ladite première surface et qui peut être en contact avec ledit plan de marche, caractérisée en ce que

ladite partie de semelle intérieure et ladite partie de semelle antérieure (4) sont formées en sorte qu'une ligne joignant une surface inférieure d'un point d'appui des orteils du pied d'une personne et une surface inférieure du talon forme un angle de l'ordre de 10 à 15 degrés par rapport au dit plan de marche lorsque ladite surface est en contact avec ledit plan de marche,

ladite partie de semelle antérieure et ladite partie de semelle postérieure sont formées en sorte que ladite surface forme un angle de l'ordre de 20 à 25 degrés par rapport audit plan de marche, lorsqu'au moins une partie de ladite deuxième surface est en contact avec ledit plan de marche, dans laquelle

un point d'appui (5, 15, 25, 35) est formé entre ladite partie de semelle antérieure (4, 14) et ladite partie de semelle postérieure (3, 13, 23, 33), et

ledit point d'appui (5, 15, 25, 35) est formé en une position de 30 à 40% de la longueur totale de ladite chaussure de sport, depuis l'extrémité postérieure de ladite partie de semelle (3, 13, 23, 33),

et ladite partie de semelle antérieure (4) est formée pour comprendre une région par laquelle passe une ligne verticale passant par le centre de gravité du corps de la personne.

2. Chaussure de sport selon la revendication 1, caractérisée en ce que ladite première surface (3) a une forme arquée.

3. Chaussure de sport selon la revendication 2, caractérisée en ce que ladite deuxième surface **(23)** comprend une pluralité de parties arquées **(23a, 23b)**.

5 4. Chaussure de sport selon la revendication 1, caractérisée en ce qu'une région d'appui **(15a, 15b, 15)** ayant une troisième surface **(15)** est formée entre ladite partie de semelle antérieure **(14)** et ladite partie de semelle postérieure **(13)**.

10 5. Chaussure de sport selon la revendication 1, caractérisée en ce qu'un point d'appui **(35)** qui est coupé, incliné d'un angle de l'ordre de 10 à 15 degrés par rapport à une direction perpendiculaire à la direction de marche, est formé à l'interface entre ladite partie de semelle antérieure et ladite partie de semelle postérieure **(33a, 33b, 33c)**.

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FIG. 1

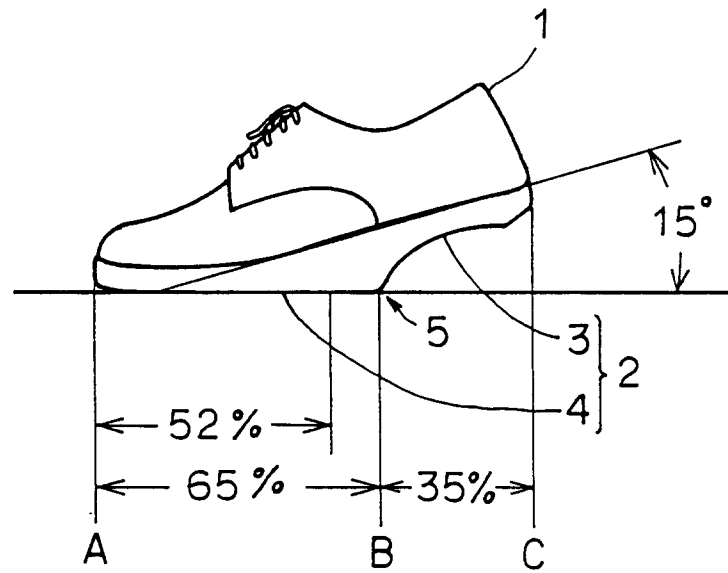


FIG. 2

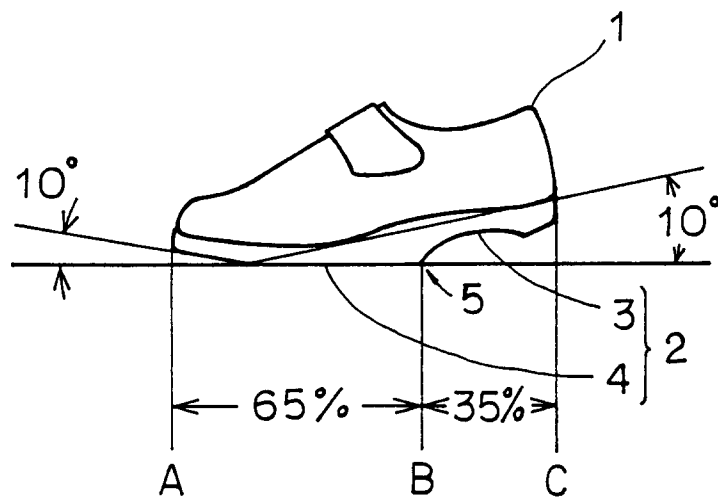


FIG. 3

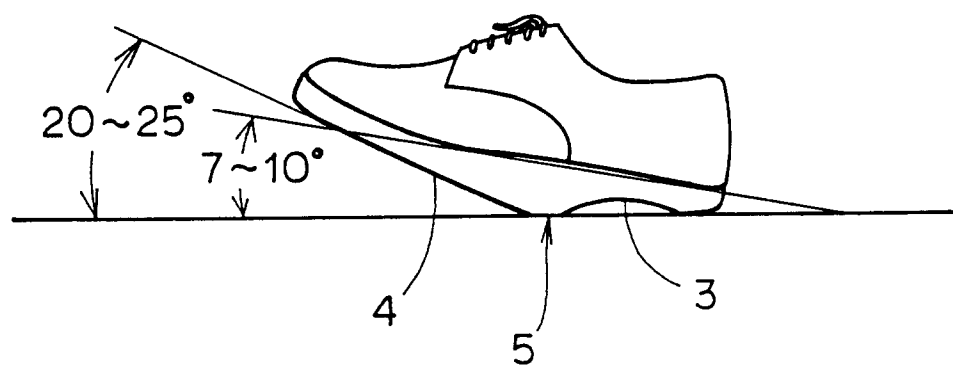


FIG. 4

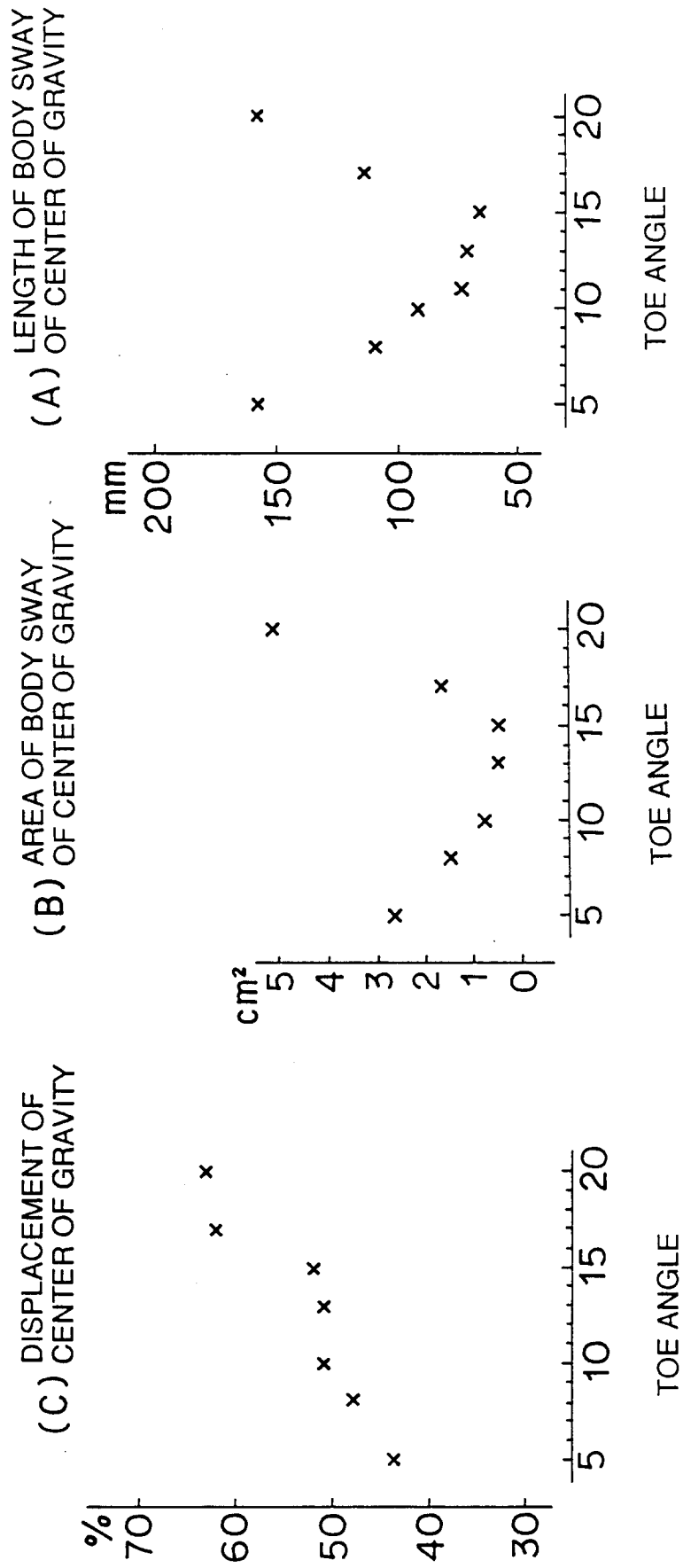


FIG. 5

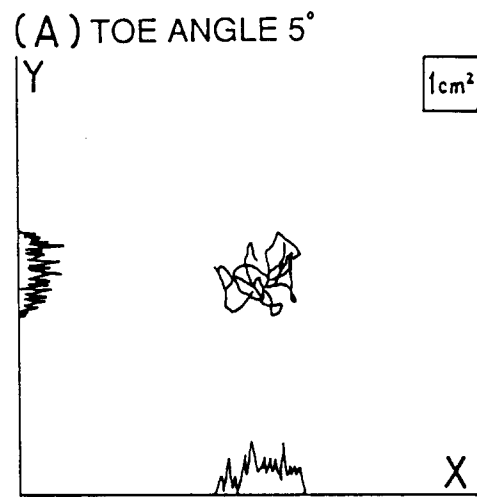


FIG. 6

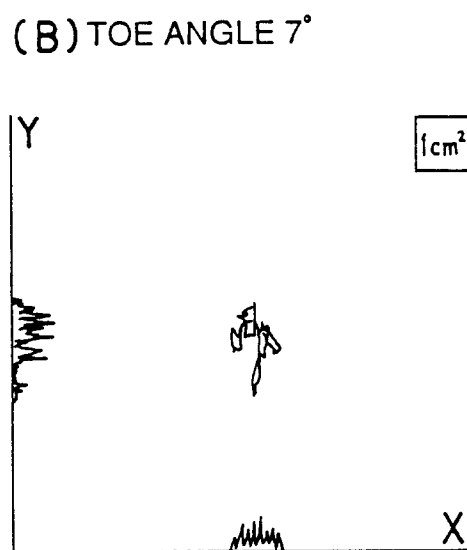


FIG. 7

(C) TOE ANGLE 10°

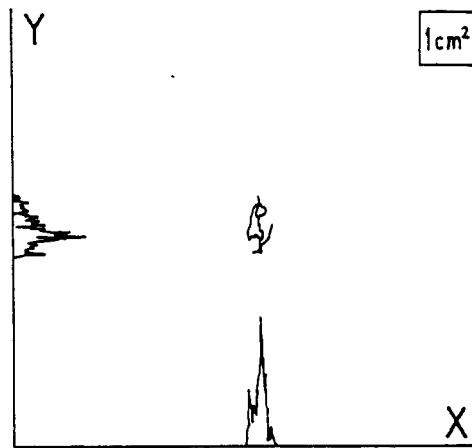


FIG. 8

(D) TOE ANGLE 15°

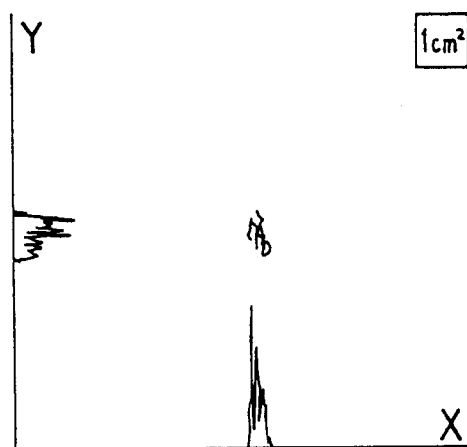


FIG. 9

(E) TOE ANGLE 17°

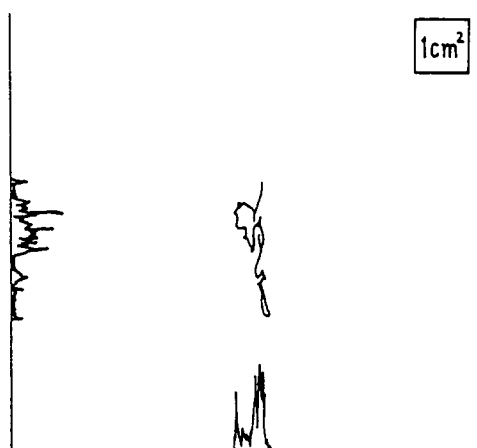


FIG. 10

(F) TOE ANGLE 20°

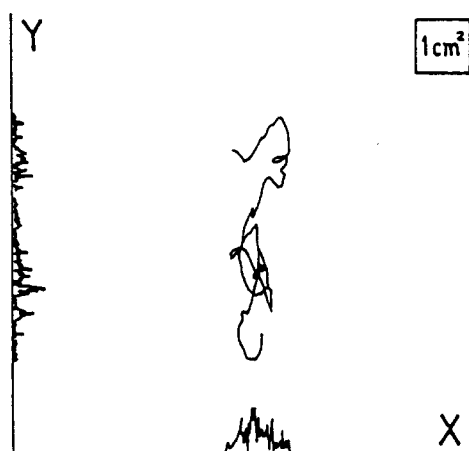


FIG. 11

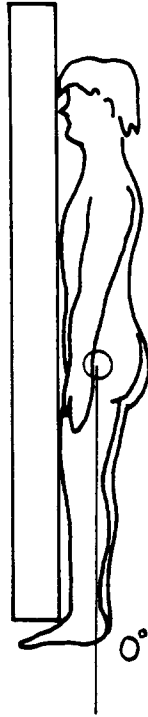


FIG. 12

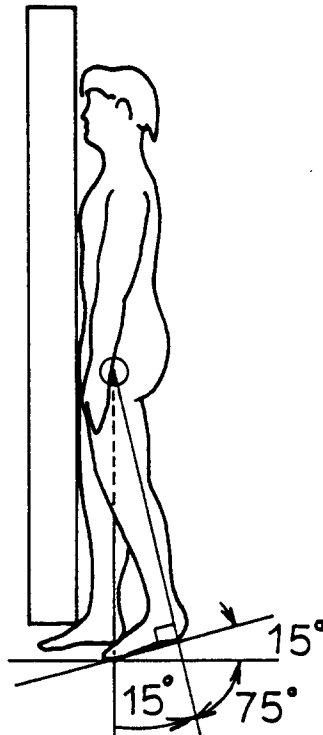


FIG. 13

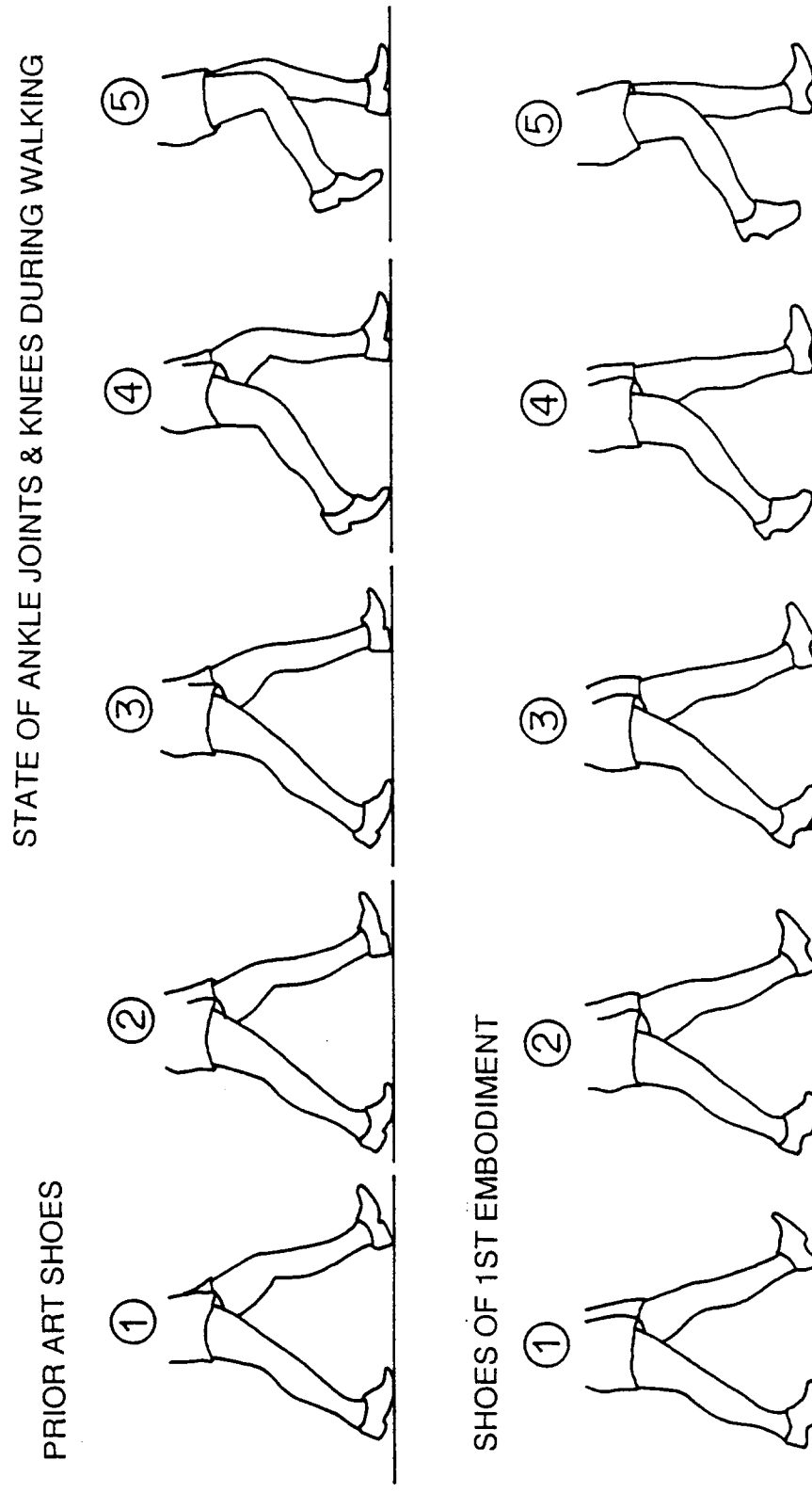


FIG. 14

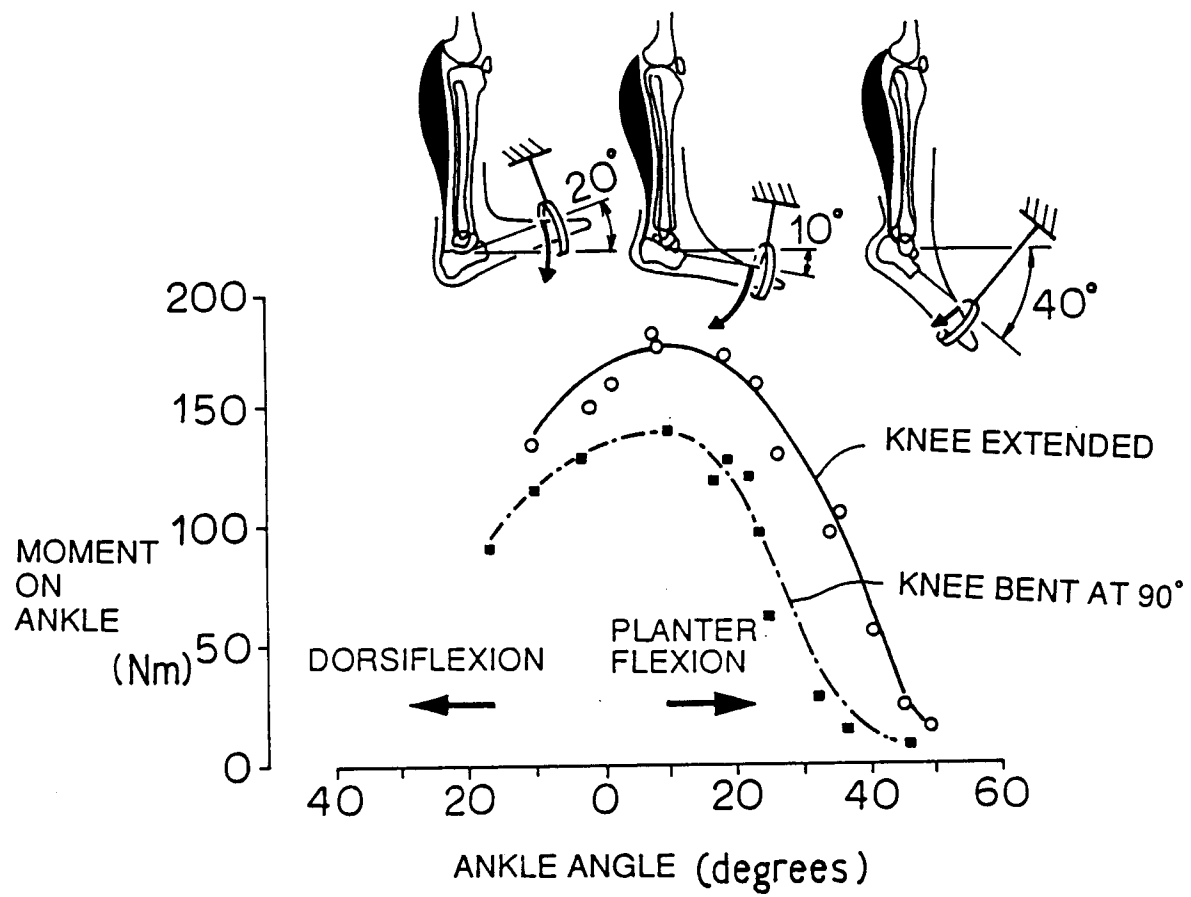


FIG. 15

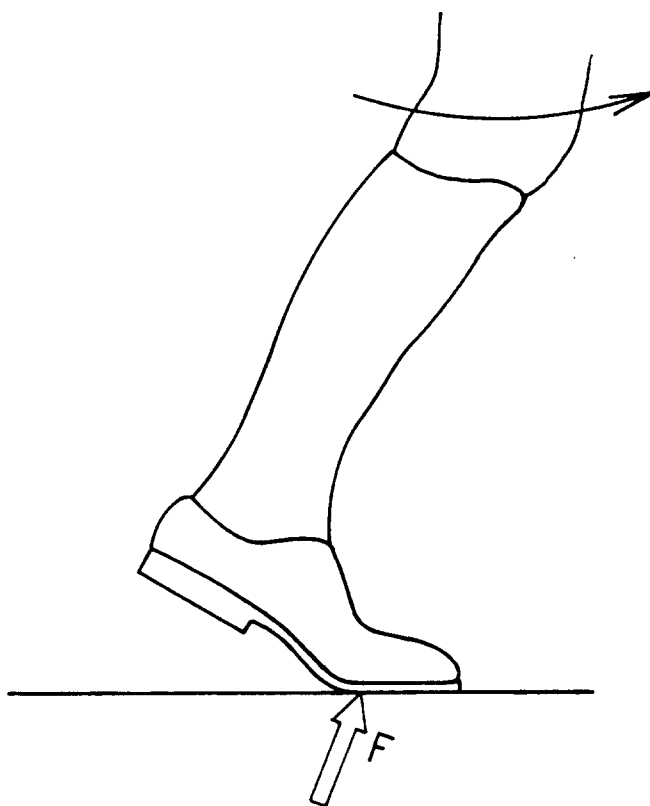


FIG. 16

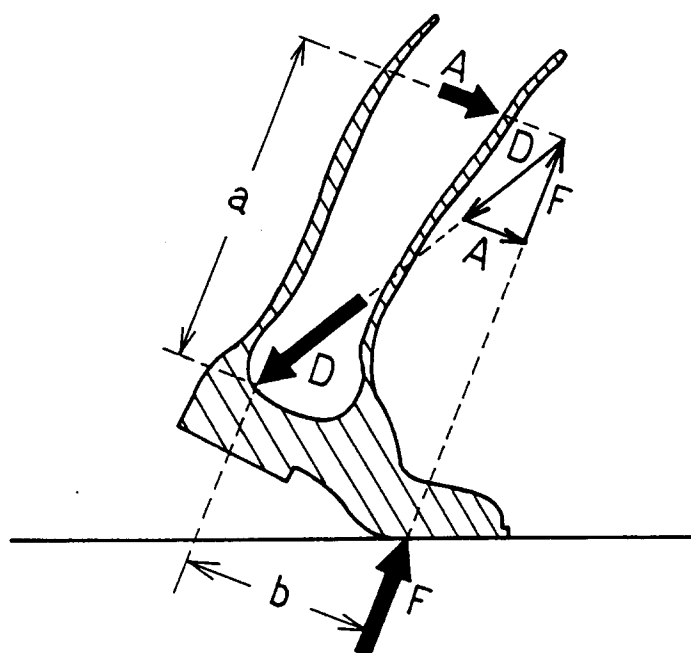


FIG. 17

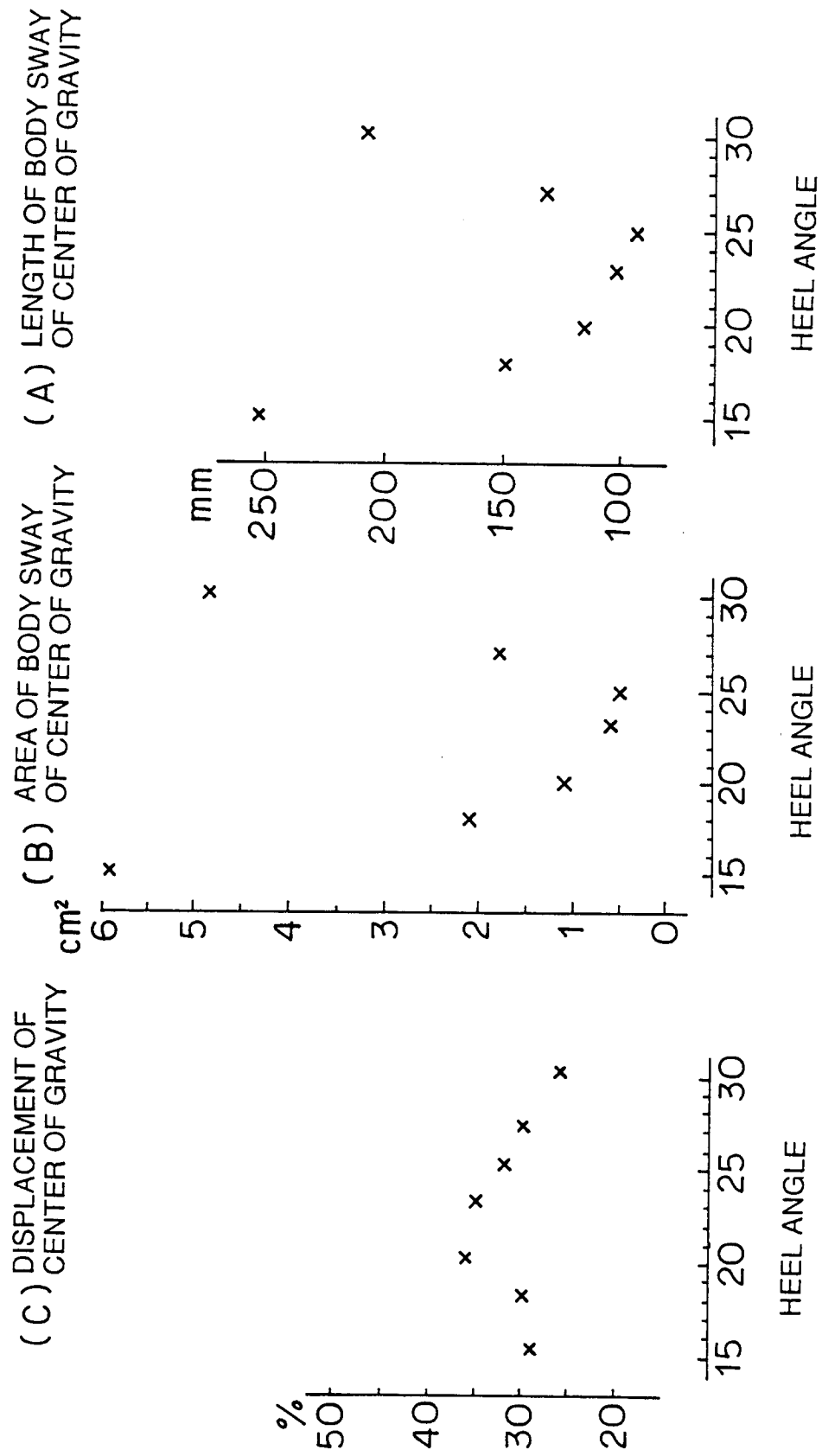


FIG. 18

(A) HEEL ANGLE 15°

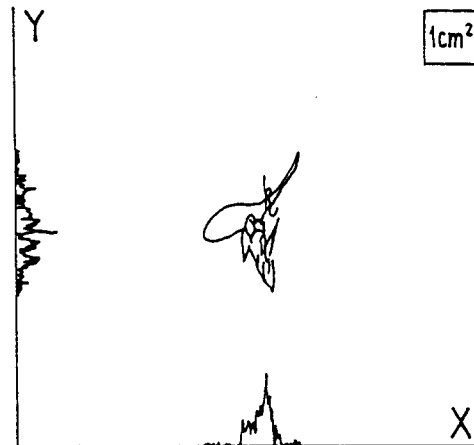


FIG. 19

(B) HEEL ANGLE 17°

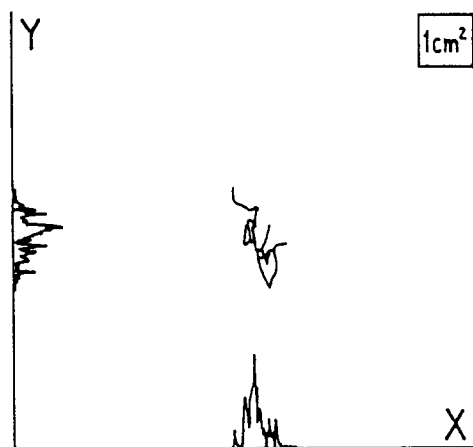


FIG. 20

(C) HEEL ANGLE 20°

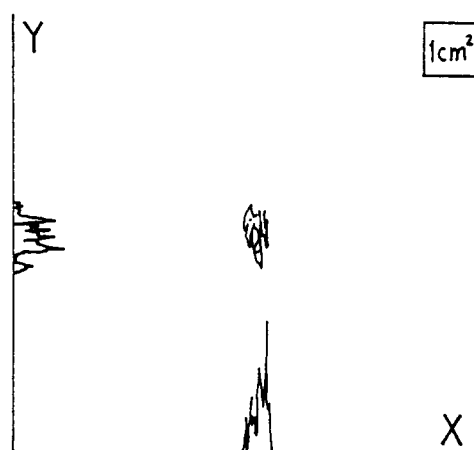


FIG. 21

(D) HEEL ANGLE 25°

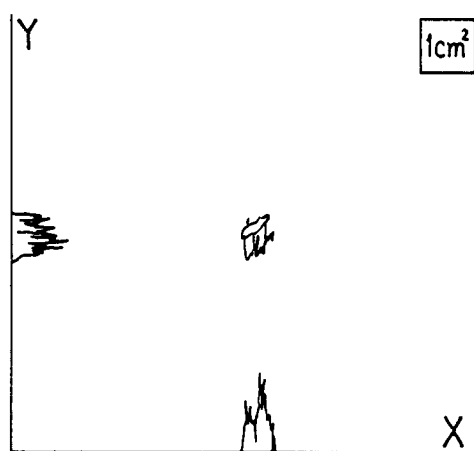


FIG. 22

(E) HEEL ANGLE 27°

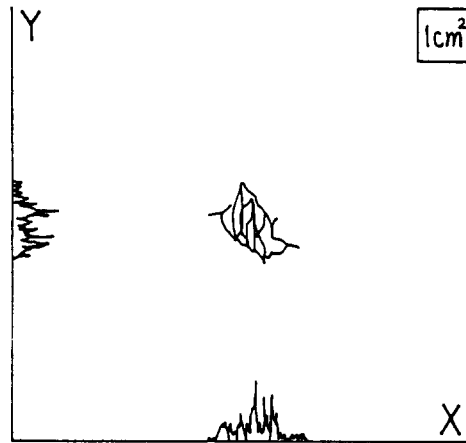


FIG. 23

(F) HEEL ANGLE 30°

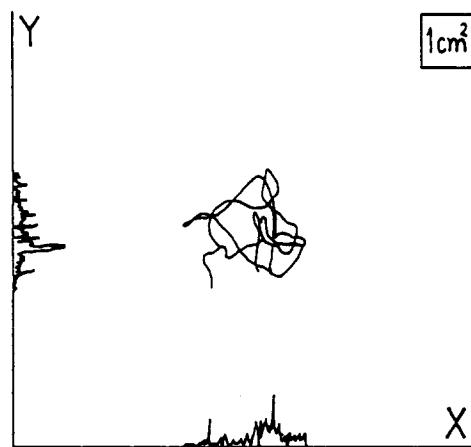
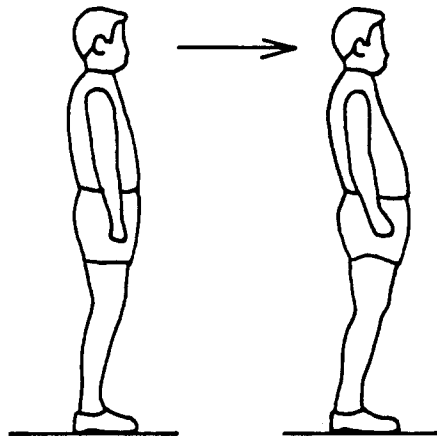
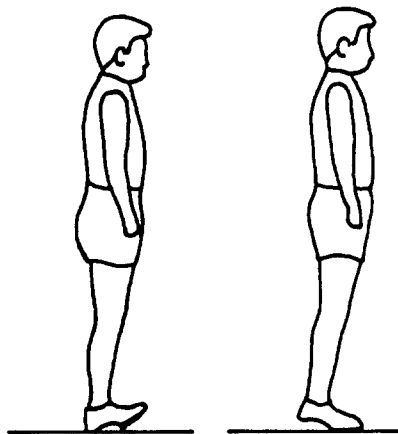


FIG. 24



LORDOSIS OF LUMBER VERTEBRA

FIG. 25



CORRECTION OF LORDOSIS

FIG. 26

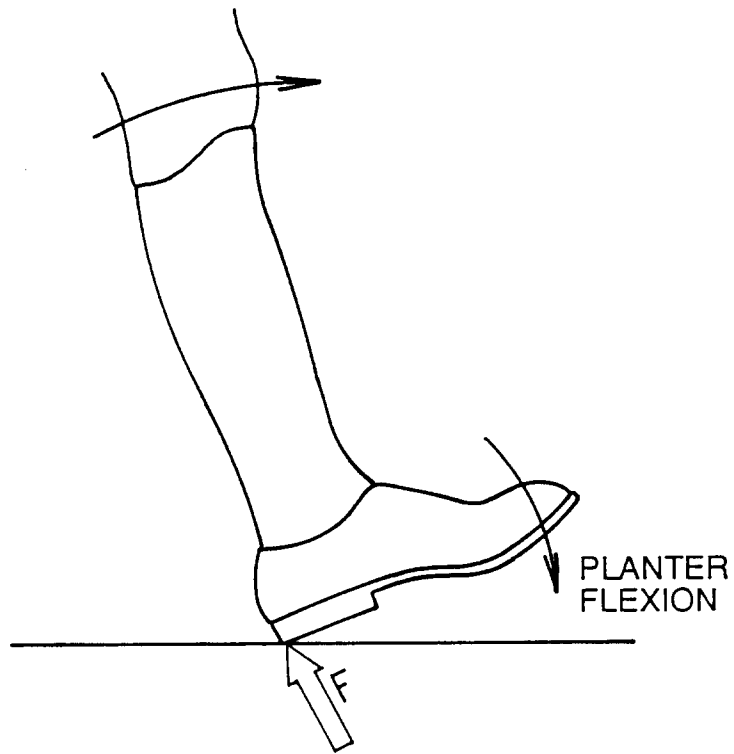


FIG. 27

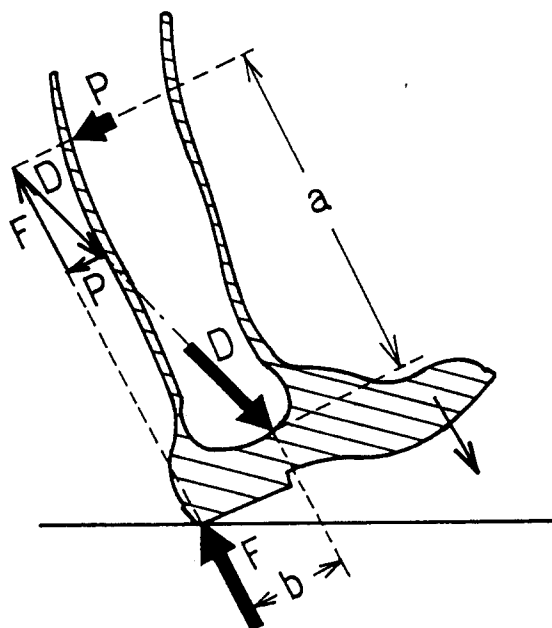


FIG. 28

ROCKER SOLE

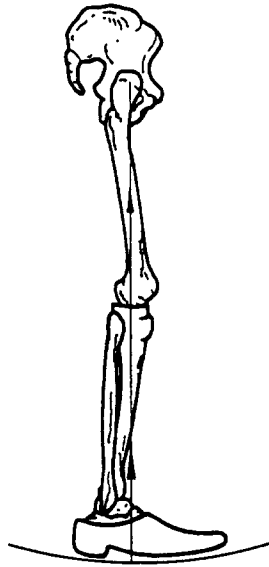


FIG. 29

ROCKER SOLE CONFIGURATION

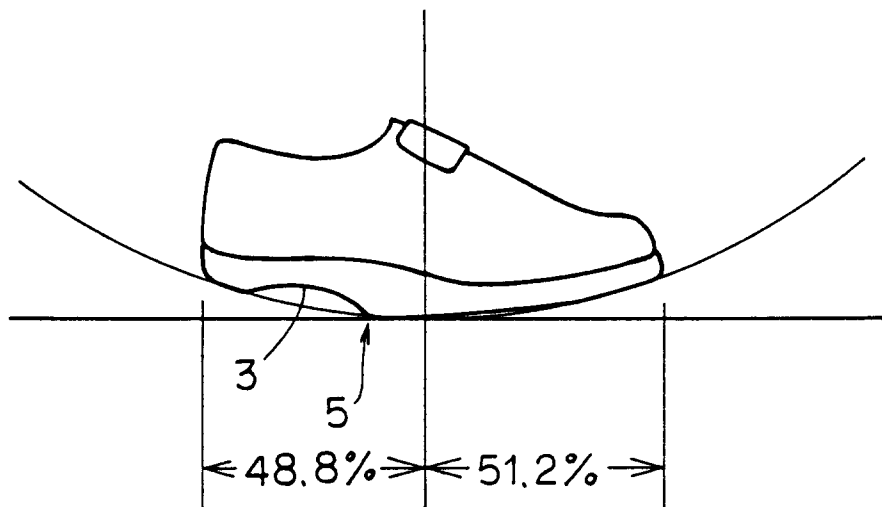
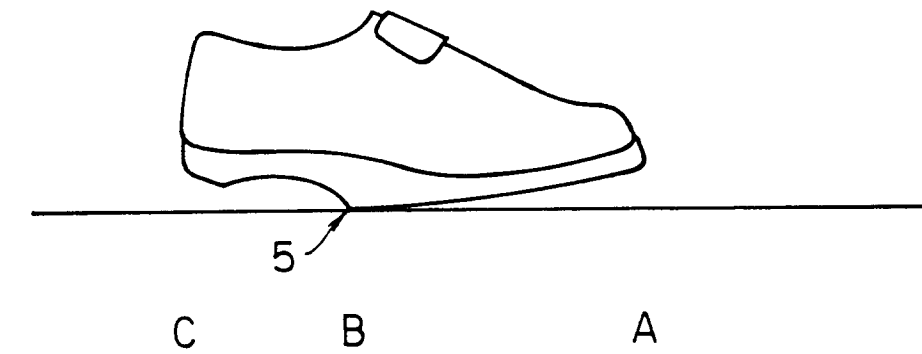


FIG. 30



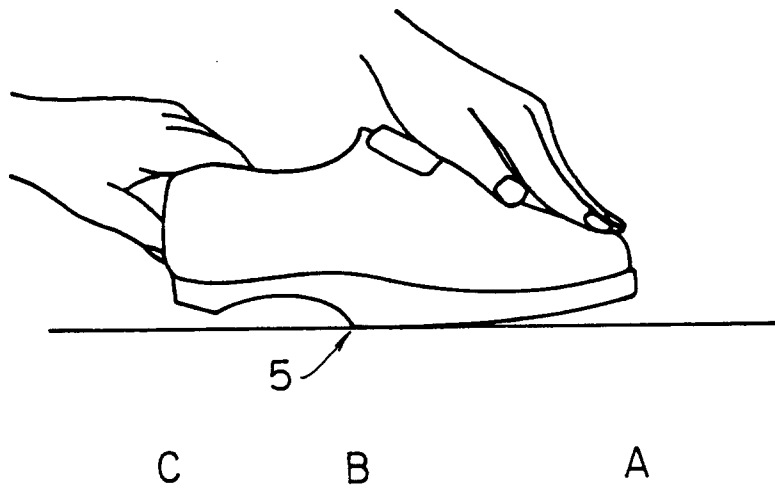
BALANCE TRAINING USING
KINESTHETIC BOARD

FIG. 31



BEFORE LOADING

FIG. 32



AFTER LOADING

FIG. 33

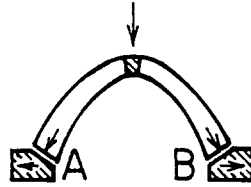


FIG. 34

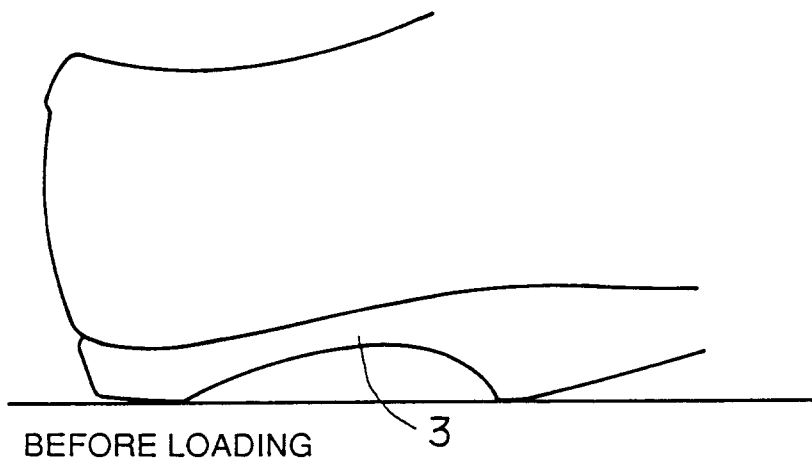


FIG. 35

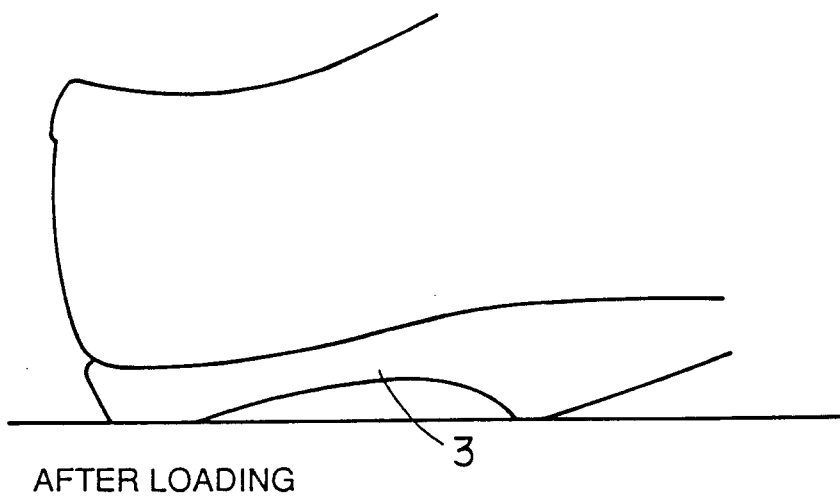
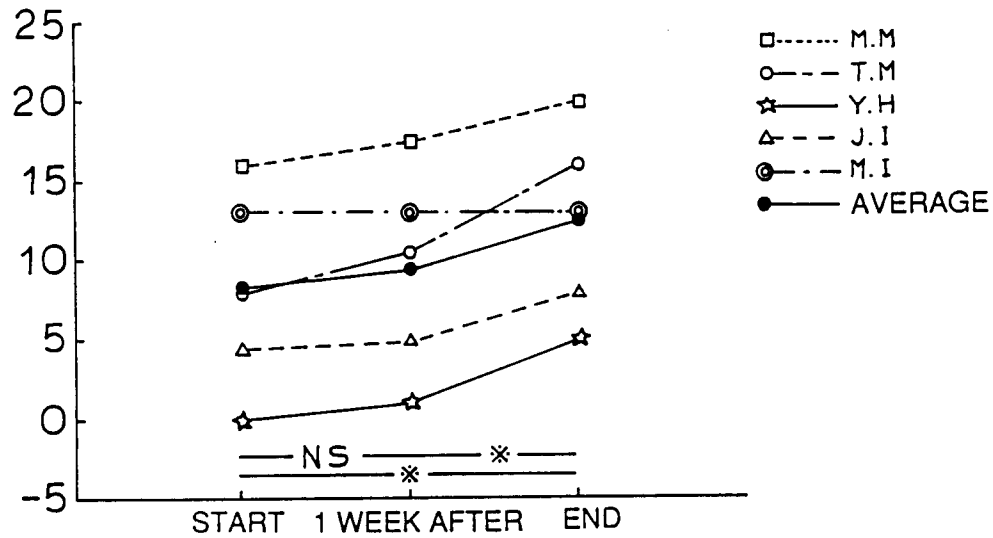


FIG. 36

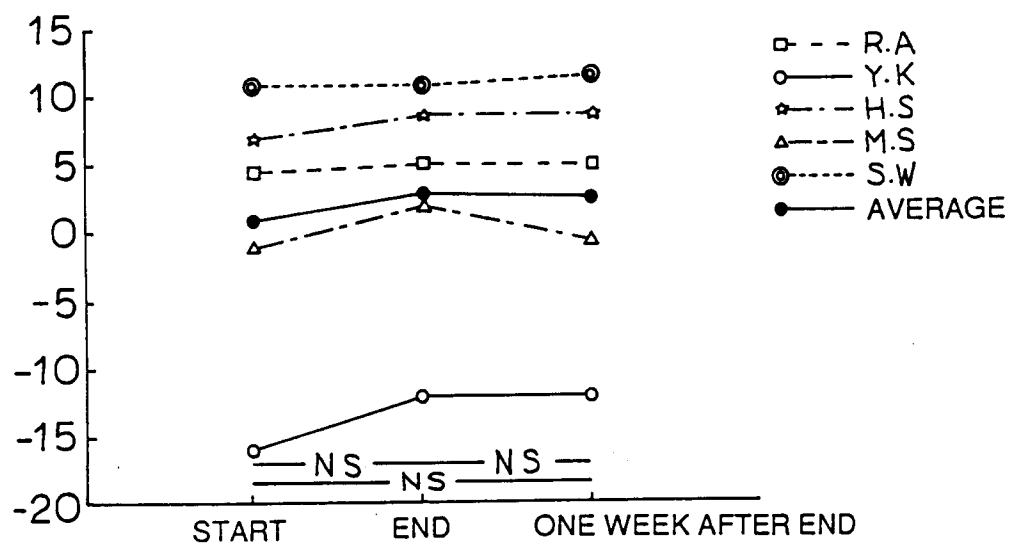
CHANGE IN LONG SITTING TRUNK FLEXION OF GROUP A
THROUGH 2 WEEKS' USE OF SPORTS SHOES OF THE EMBODIMENT



* = P(LEVEL OF SIGNIFICANCE) < 0.05. NS (NO SIGNIFICANT DIFFERENCE)

FIG. 37

CHANGE IN LONG SITTING TRUNK FLEXION OF GROUP B
THROUGH 2 WEEKS' USE OF SPORTS SHOES OF THE EMBODIMENT



NS (NO SIGNIFICANT DIFFERENCE)

FIG. 38

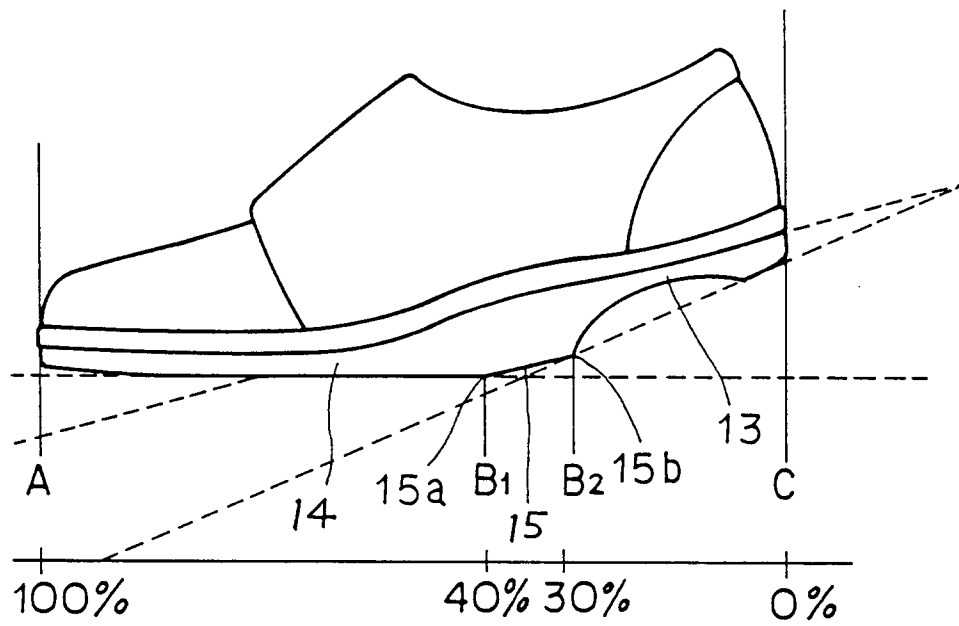


FIG. 39

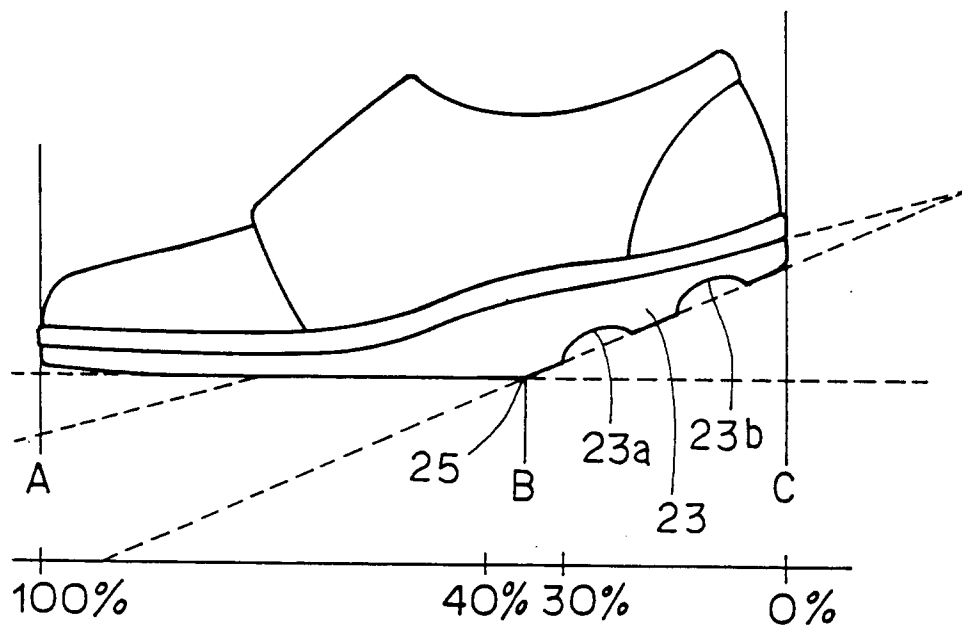


FIG. 40

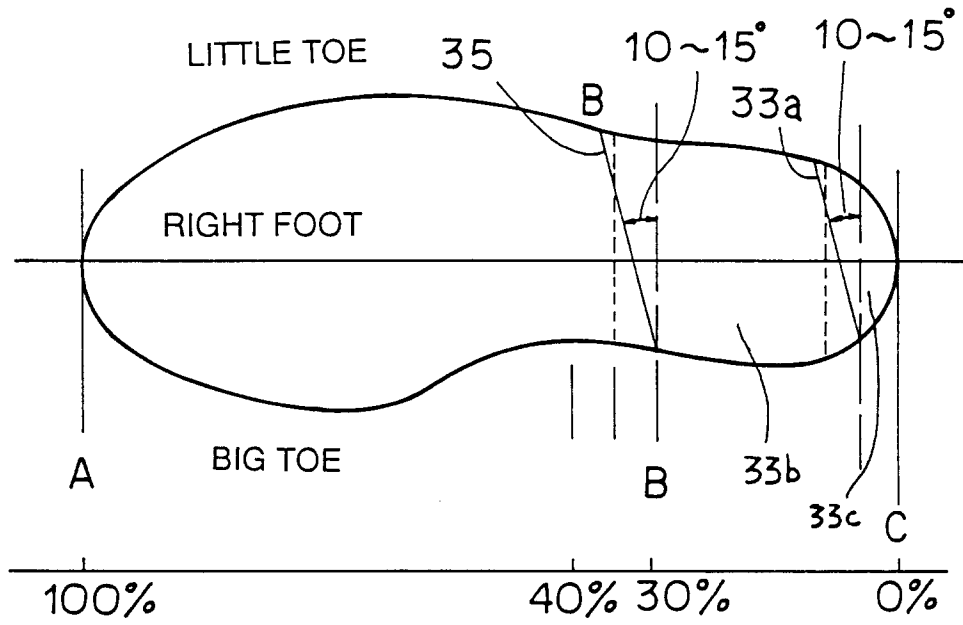


FIG. 41

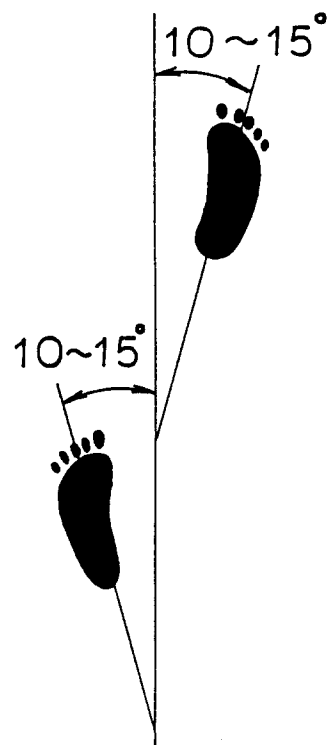


FIG. 42

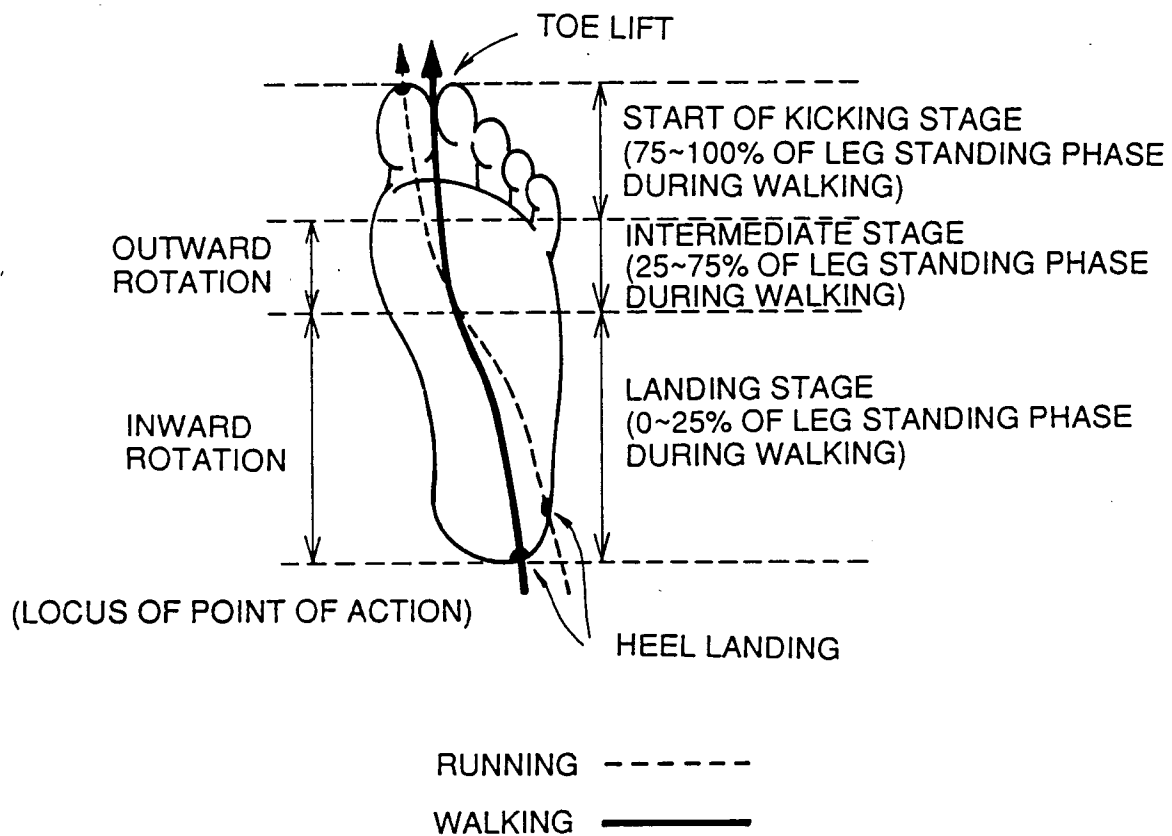


FIG. 43

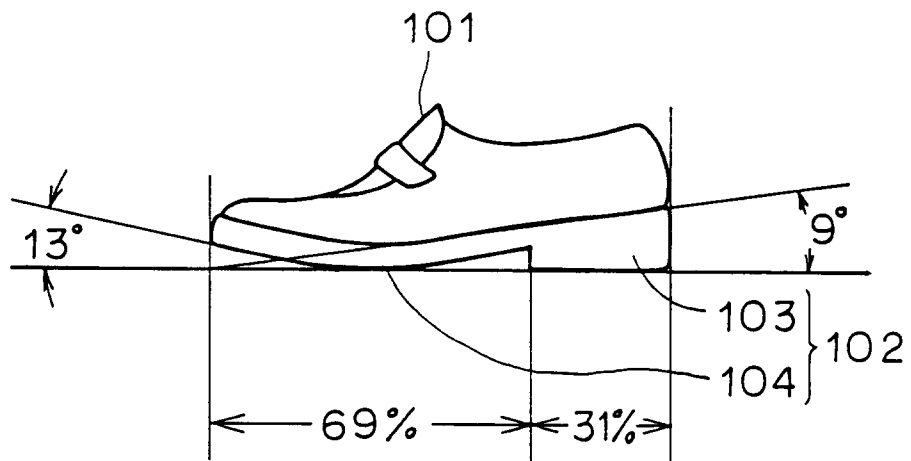


FIG. 44

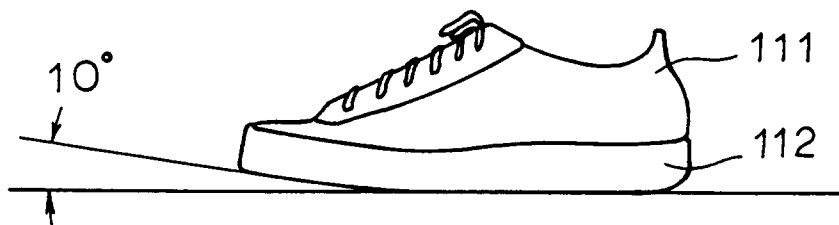


FIG. 45

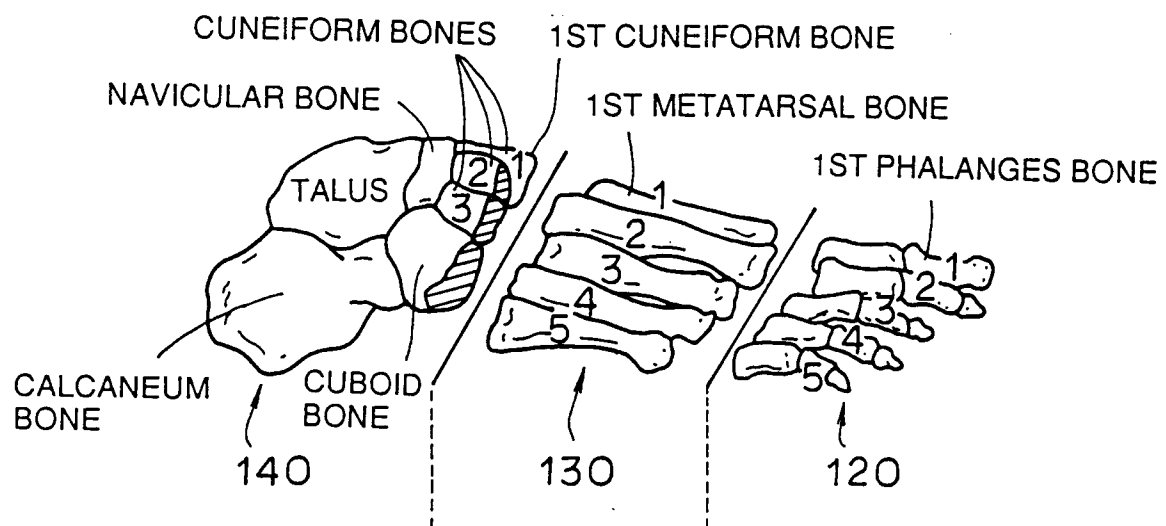


FIG. 46

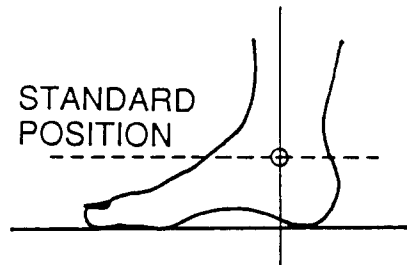


FIG. 47

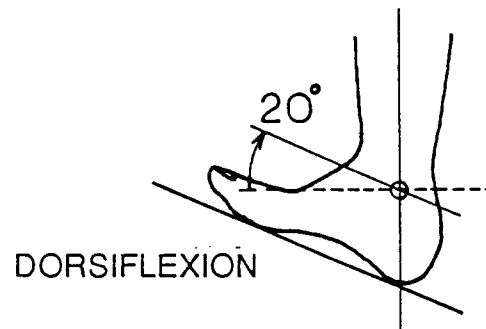


FIG. 48

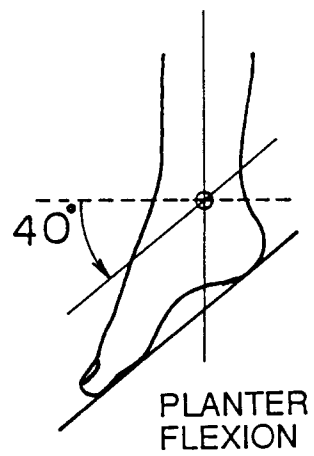


FIG. 49

