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(54) Title: SHOE AND METHOD FOR THE CONSTRUCTION THEREOF

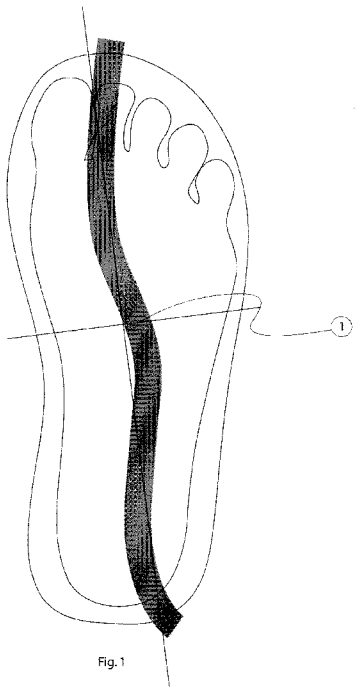



Fig. 1

(57) Abstract: Shoe comprising a sole and at least a part of an upper leather fastened to the sole, distinctive in that the shoe is constructed or adapted so that the resultant force vertically up from the base during walking, in the main, moves along a certain line or path, called SGL (sensory gait line) as the line, for the right foot seen from above, starts from the back, tilting from the outside at the setting down of the heel, the line goes forwards and turns outwards so that it goes under the middle of the calcaneus (heel bone), from where the line further forwards has a shape as an extended S that runs out between the first and the second toe.

# SHOE AND METHOD FOR CONSTRUCTION THEREOF

## Area of the invention

The present invention relates to shoes or footwear. In more detail the invention relates to shoes that are specially constructed for walking with a balancing influence on the body above the shoes.

## Background of the invention and prior art

It is known that footwear greatly influences the strain on the skeleton and the rest of the body. Poor shoes give an uneven load on joints in the foot and ankle, which spreads out further to the skeleton and the rest of the body above the feet, which can lead to much pain and suffering.

During walking or running a foot that hits a base will normally hit it at an angle towards the outer side of the heel bone. As the foot rolls forward when the step is carried out, the weight will move in towards the middle of the body. At the end of the step the weight goes over to the ball of the foot and further to the big toe. Thus, the weight is transferred diagonally or across the sole of the foot as the step is carried out. Such transfer or rotation is called pronation. If the rotation is too pronounced, whereby the resultant force comes too near the vertical centre-line of the body, as under the big toe, it is called over-pronation. If the rotation inwards about the ankle joint is normal, as described above, it is called normal pronation. If the rotation is too small, so that the force at the end of the step comes nearer the little toe, it is called under-pronation or supination.

It is known that the wrong pronation leads to an uneven strain that spreads upward in the body from the leg and up to the back and neck. Great pain will occur particularly after prolonged uneven strain.

It is known that running shoes can be chosen with regard to the right pronation, which can be decided, for example, by visual consideration of the running step.

The shoes one chooses have an adapted inclined heel position and side support from the heel cap and upper leather with adapted rigidity, so that an over-pronation or under-pronation shall be avoided. The concepts of over pronation and under-pronation appear in connection with running shoes only to be associated to where the pressure comes into the sole of the shoe when setting down the heel and where the pressure comes out in relation to the toes, while the pressure between said positions appears to be able to follow a straight line.

There are shoes other than running shoes which are adapted to give the correct pronation. These shoes seem to be constructed with adapted side support and adapted tilted heel to give the right pressure at the heel on setting down, and out to the correct location in relation to the toes, without defining any definite line or path the weight should follow diagonally across the sole. Some examples are found in the publications WO 2009083098, GB 2456766, US 2008276491, US 5323549, US 6341432 and US 2008229624.

In NO 328090 (corresponds to WO2005067754 and US2008229624), page 1, lines 25-27, it is described that "*The load placed on the sole of the foot moves diagonally across it. From the heel, which is loaded on the outside, the load line moves diagonally inwards over the sole of the foot all the way to the ball of the foot and the big toe*". This relates to healthy people moving naturally without any deformation of the foot. As described in NO 328090, page 2, lines 1-3, the situation is often different in civilised societies: "*This turning of the load exerted on the foot is not found in the population in civilised societies used to shoes and hard surfaces. When one walks on a flat surface the flat sole forces the shoe into a straight heel-to-toe movement*". The invention according to NO 328090 provides a diagonally twisted sole, and a shoe with such sole, to correct the wrong placing of the heel and the wrong heel-to-toe movement so that a diagonal load curve of the sole of the feet is achieved. Anything else about the load curve is not described other than it being diagonal. For the diagonally twisted sole, it is mentioned on page 4, lines 34-36 that "*In special cases it can*

*be imagined that it is not systematically twisted, but instead is adapted to a deformity, a wrong position or a restriction in the foot".* But there are no instructions concerning a given load curve in preference to other load curves. According to the description in the patent NO 328090, it is described in the patent WO 01/15560 (corresponding to US 6782639) how different types of load of the foot can be achieved by hard inserts in the sole. It is given that different types of insert 15 of a different hardness on the middle sole bottom11 are arranged, and the under-sole 12 has a "sand-like elasticity". By these features alone a diagonal or freely definable form of the load line can probably be established.

But what a person skilled in the arts learns from WO 01/15560 / US 6782639 is that a lack of dynamic, active walking is the underlying problem for many pain related problems, and the invention according to said publication provides a shoe with which active walking is a necessity, as the sole is convex so that the sole rolls against the base when a step is taken. It is pointed out that the shape of the sole parts is incidental (random – US 6782639) or chosen freely (WO 01/15560) and consequently the load curve can not follow any particular line.

Although many are helped by special shoes such as those mentioned or referred to above, it has been shown that many are not being helped, of whom some suffer more damage than benefit from using the shoes. Therefore, there is still a need for an improved shoe so that the suffering associated with wearing wrong shoe and wrong gait can be reduced. The need is met by the present invention, which is the aim of the invention.

Summary of the invention

In more detail, the invention provides a shoe comprising a sole and at least a part of an upper leather fastened to the sole, distinctive in that the shoe is constructed or adapted so that the resultant force vertically up from the base during a step is, in the main, displaced or moved along a defined line or path, denoted SGL (sensory gait line), the line extending along the sole, as the line

for the right foot seen from above starts at the back slanting from the outside at the setting down of the heel and running forwards and turning outwards so that it goes under the middle of the calcaneus (heel bone) from where the line further forwards has the shape of an extended S that runs out between the first and the second toe.

In more detail the shoe is beneficially constructed or adapted so that the resultant force vertically up from the base, or the centre of the pressure from the foot vertically down during a step is, in the main, displaced along a defined line, denoted SGL (sensory gait line), as the line, for the right foot seen from above starts at the back, typically slanting 40° ±10°, from the outside at the setting down of the heel, the line turns or swings laterally outwards while it runs forwards so that it runs, in the main, straight forwards under the middle of the heel bone calcaneus (heel bone), from where the line continues up to under the middle of the cuboid from where the line further forwards at first turns or swings medially inwards towards the basis between the second and the third metatarsal and thereafter turns forwards in the longitudinal direction of the foot, so that the line touches the medial side of the corpus second metatarsal and thereafter further forwards along the medial side of the second toe. From the middle under the cuboid and up to the tip of the toe, the SGL will have the form of an extended S that runs out between the first and the second toes. From the middle under the cuboid the SGL runs forwards and medially inwards so that the line goes to under the outer part of the second metatarsal (second intermediate foot bone) under the inner side of the outer end thereof, from where the line runs further forwards between the first and second toe bones along the inner side of the second toe bone, so that the line SGL, from under the middle of the cuboid and forwards has the shape of an extended S. From under the middle of the cuboid the SGL runs further forwards to the area under the basal of the third and the fourth metatarsal, from where the SGL goes forwards and swings medially between the first and the second basal joint and tapers off forwards to the end as the SGL runs out between the first and the second toe. From in front of the rear sharp deflection forwards at the heel set

the SGL follows the heel bone and the cuboid so that the SGL goes under the middle of the heel bone and the cuboid before the SGL continues further forwards.

Surprisingly, it is found that the resultant force or pressure against and along the curved line SGL, with the form as an extended S that swings out at the back by the heel, leads to the foot getting a natural movement pattern with a balanced muscle activation along and about all axis in the foot and ankle. Thus, the basis is made for an efficient walking movement and natural movement of the joints of the foot, ankle, knee, hip and backbone, with the resulting reduced mechanical loads. Contrary to previous constructions a more anti-pronation heel construction is achieved, as the shape of the shoe guides the step or the placing of the foot through the intermediate foot area, up to and through the forefoot. Thus over-pronation in the forefoot and resulting negative loads on different joints and elastic structures in the forefoot as well as the intermediate foot, are prevented, whereby the cooperation in the joint mechanics from the foot joints and up through the whole of the body is balanced and thus secure.

That the resultant force or pressure centre from the foot vertically down against the base, or the pressure or the centre of the pressure from the base against the foot during a step, in the main, moves along or follows a defined line alongg the sole longgitudinally, the line is denoted SGL, means that the resultant or the pressure centre along the cross section of the sole of the foot moves along or follows the SGL. With the expression, at least a part of the upper leather fastened to the sole, is meant that the shoe comprises more than a sole to hold the foot securely to the shoe, such as an upper part, for example, an upper leather and a heel cap. The term shoe encompasses everything from the simplest sandals and slippers to the most complex shoes, essential in this context is that the forces or the pressure is controlled so that the line SGL, in the main, is followed along the whole of the foot, from the heel to the toe. The SGL starts at the back, typically slanting at 40° ±20°, more typically 40° ±10° obliquely, which is the angle in relation to the longitudinal direction of the foot of

the sole at the heel set, however, the SGL quickly swings forwards and follows, in the main, the mid-axis or the most pronounced line of the heel bone forwards to the cuboid. From a short distance into the heel bone and up to under the cuboid the line SGL follows the largest bone concentration in the foot or the lower edge of the dominating bone in the foot, while the line from the cuboid and forwards follows another curve which is defined in detail above and below.

With that the line SGL, in the main, is followed is meant that preferably the construction of the sole of the shoe guides the step so that the line is followed to ±20 mm sidewise, more preferred ±10 mm, possibly ±5 mm sidewise, but most preferred is that the sole construction is such that the shoe is unstable inside the SGL, so that the muscles and nerves are activated in that the foot can flip or tilt about the SGL along the whole length of the foot. Thus, the line can be defined as a band where the resultant force shall lie within the band, the breadth of which is as defined by the permitted deviations from the ideal line, as it is defined above.

The shoe is constructed or adapted so that the sole, upper part and any insole which when put together provides guidance, as a whole, as assembled, so that the foot during a step flips around the line SGL such that the force goes down through SGL, which is achieved by adapting features chosen from among elasticity and density, height, support points and support zones, the forming of the lower longitudinal rim or edge on the sole and the concavity in the direction diagonally across the sole and/or insole, and also support points or support zones in the heel cap and upper part besides. This also encompasses insoles and inserts that can be loose or fastened and which are constructed so that those inserted in the shoe adapt the load curve to follow the line SGL.

The definitions are given for the right foot seen from above. The corresponding is relevant for the left foot, but everything is the wrong way round about the vertical mid-line of the body, seen in anterior-posterior plane (back to front). Forwards means forwards in the direction of the step and the toes, in the

longitudinal direction of the foot, while backwards is the opposite direction. Outwards or laterally means the direction across the longitudinal direction of the foot, in the direction outwards from the vertical mid-line of the body. Inwards or medially is across in towards the mid-line of the body. The longitudinal axis of the sole of the foot in the direction forwards is typically diverging to a different degree for different people, so that the definitions in relation to joints are more precise.

It is advantageous for the shoe to have some embodiments with a convex sole in the longitudinal direction against the base. Thus, an instability is generated which gives a dynamic, active gait that leads to a balanced activation and training of muscles, ligaments and tendons.

In many embodiments the sole of the shoe is preferably concave in the cross direction against the base and the outer longitudinal rims have preferably variable heights that control the weight along the SGL during a step, the sole is as seen from behind for the right foot preferably twisted clockwise in the heel and the intermediate foot area, but, in the main, plane in the forefoot area. Thus, the shoe is lower (possibly softer) on the outside laterally for the SGL in the heel and intermediate foot in relation to the inner side medially for the SGL.

The upper or inner sole of the shoe lies advantageously against the foot sole on both sides of the SGL to better activate and stimulate the sensory system in the sole of the foot.

It is advantageous for the shoe to have an instability by flipping about the line SGL so that muscles on both the inside and outside of the foot and ankle are activated and trained, the instability is preferably achieved in that the intermediate sole is softer and more elastic than the upper and lower parts of the sole which provides the correct flipping about the line SGL. It is an advantage if the sole of the shoe has an increased elasticity module or rigidity against being pressed together for harder applications and heavier people, for

example, so that running shoes are stiffer than walking shoes which in turn are stiffer than party shoes. Small shoe sizes are advantageously softer than larger shoes. A regulated elasticity module or rigidity against being pressed together can be achieved in known ways, for example, by controlling the amount of material, for example, PU (polyurethane), per volumetric unit injected into a casting mould.

The sole can advantageously be twisted with regard to the SGL. Similarly, permanent, loose and/or inserts that can be fastened can be adapted to twist around the line SGL so that the resultant force follows the SGL. Similarly, rigidity and elasticity and/or supporting points or zones can be, with greater or smaller rigidity and/or elasticity, arranged alternately at the side of the line SGL so that the resultant force from the foot during a step follows the SGL.

The line SGL can be regarded to be the natural line for weight, pressure through the foot so that joints, nerves (sensory) and muscles are activated in a balanced way through the step (gait line). In more detail, the joints, nerves, ligaments and connecting tissue structures are actively balanced on each side of the line SGL if the weight follows the SGL, so that any suffering due to an imbalanced gait is reduced or eliminated.

The invention also provides a method for the manufacture of a shoe according to the invention, characterised by adapting the compressive rigidity and/or height of the sole construction on each side of the line SGL so that the pressure centre from the foot during a step moves along the SGL. The invention also provides an application of a shoe according to the invention, on the foot of a person to adjust the person's gait.

Figures

The invention is illustrated with the help of figures, where

Fig. 1 illustrates the line SGL seen from above with a foot inside a shoe.

Fig. 2 illustrates the line SGL in relation to the bones of the foot, and

the Figures 3a and 3b illustrate a shoe according to the invention.

Detailed description

Reference is made to Fig. 1 which illustrates a foot, more specifically a foot seen from the underside or a footprint as seen from above, inside a right shoe or on right sole. The purpose is to illustrate how the line 1, or more specifically the curve 1, SGL, runs in relation to the sole of the foot and footprint. The SGL 1 is shown as a thick line or a band, as a certain tolerance for deviations from the ideal line must be included in practice, which is illustrated in that the SGL has a breadth of about 10 mm, which will permit deviations to within ± 5 mm. The tolerance is given as an example only. The illustrated line SGL (sensory gait line) starts at the setting down of the heel at an angle from the outside of the heel bone calcaneus, the line runs forwards and turns laterally outwards so that at about under the middle of the heel bone the direction is approximately directly forwards, while further forwards the SGL has the shape of an extended S that runs from the foot up to along the inside of the second toe. It can be clearly seen that the S-shape goes somewhat out from the mid-line of the body and out and forwards from the heel bone, while further forwards the SGL goes inwards and forwards while it turns, or swings, laterally outwards. At the points for changing the turning direction, the SGL is a straight line and if the SGL was described by a mathematical function the second derivative would be equal to zero at said points while the sign would change according to the turning changes. The curvature of the SGL is open outwards in the rear part of the sole of the foot, it changes to be open inwards in an intermediate area before it is open outwards again at the forward part of the sole of the foot.

Reference is further made to Fig. 2 which defines the SGL 1 in more detail by relating the SGL to the joints of the foot. The SGL is drawn in and meant to lie correctly in relation to the joints. It is meant that the definitions in the description and claims shall define the SGL as illustrated in the figures 1 and 2.

Reference is further made to Figure 3a which illustrates a shoe according to the invention, as seen from the side. The illustrated embodiment has a sole which is convex in the longitudinal direction. Reference is further made to Figure 3b which illustrates the same shoe seen from behind. As can be seen in Fig. 3b, the sole is concave in the cross direction, as the outer rim or edge in the longitudinal direction of the sole guides the foot to correctly flip about the SGL as a step is taken. Something which is difficult to see is that the sole is somewhat twisted and has somewhat varying height at the sides. However, the shoe is built so that if the cross section is taken along the SGL, the edge is higher and/or more rigid along the side of the SGL which the SGL shall turn away from. A more rigid and/or higher outer side ensures that the right foot seen from behind flips anti-clockwise and the resultant force moves inwards along the length of the cross section. The resultant force is controlled in this way to be moved along the SGL.

Claims

1.

Shoe comprising a sole and at least a part of an upper leather fastened to the sole, characterised in that the shoe is constructed or adapted so that the resultant force vertically up from the base during walking is, in the main, displaced along a fixed line (1), designated SGL (sensory gait line), as the line (1), for the right foot seen from above starts at the back tilted from the outside on the setting down of the heel, the line (1) goes forwards and turns outwards so that it goes below the middle of the calcaneus (the heel bone) from where the line (1) further forwards has the shape of an extended S that goes out between the first and the second toe.

2.

Shoe according to claim 1, characterised in that the shoe is constructed or adapted so that the resultant force vertically up from the base during walking is, in the main, displaced along a fixed line, designated SGL (sensory gait line), as the line, for the right foot seen from above, starts at the back tilted typically $40^{\circ} \pm 10^{\circ}$, from the outside at the setting down of the heel, the line turns laterally outwards while it goes forwards so that it, in the main, goes straight forwards under the middle of the heel bone calcaneus (heel bone), from where the line continues forwards to under the middle of the cuboid, from where the line continues forwards first turning medially inwards and thereafter forwards so that the line goes to under the outer part of the second metatarsal (second intermediate foot bone), below the inside of the outer end thereof, from where the line goes further forwards between the first and the second toe bone, along the inside of the second toe bone so that the line SGL from the middle under the cuboid and further forwards has a shape as an extended S and with a lateral swing outwards back to the heel set.

3.

Shoe according to claim 1 or 2, c h a r a c t e r i s e d i n that the line SGL from under the middle of the cuboid runs further forwards to the area between the basis of the third and the fourth metatarsal, from where the SGL goes forwards and swings medially to between the first and the second basal joints and turns further forwards till it ends as the SGL runs out between the first and the second toe.

4.

Shoe according to one of the claims 1-3, c h a r a c t e r i s e d i n that the shoe is constructed or adapted so that the sole, upper part and any insole as put together provide support so that the foot during walking tilts round the line SGL so that the pressure centre goes down through the SGL, which is achieved by adapting features chosen amongst elasticity and density, height, supporting points and supporting zones, shape of the lower longitudinal rim or edge of the sole and the concave curvature in the direction across the sole and/or insole, and also support points or support zones in the heel cap and also the upper part.

5.

Shoe according to one of the preceding claims, c h a r a c t e r i s e d i n that the sole of the shoe in the longitudinal direction is convex against the base.

6.

Shoe according to one of the preceding claims, c h a r a c t e r i s e d i n that the sole of the shoe is concave in the transverse direction against the base, and that the outer longitudinally running edges have a variable height that controls the weight along the SGL when walking, preferably the sole as seen from behind of the right foot is turned clockwise in the heel and the intermediate foot area, i.e. higher, possible stiffer, on the inside, medially for the SGL, but, in the main, plane in the front foot area.

7.

Shoe according to one of the preceding claims, c h a r a c t e r i s e d i n that the upper or inner sole of the shoe lies against the sole of the foot on both sides of the SGL, to better activate and stimulate the sensory system in the sole of the foot.

8.

Shoe according to one of the preceding claims, c h a r a c t e r i s e d i n that the shoe has an instability in the tilting about the line SGL so that muscles on both the outside and the inside of the foot are activated and exercised, the instability is preferably generated by the intermediate sole being softer and more elastic than the lower parts of the sole which provides the correct tilting about the SGL.

9.

Shoe according to one of the preceding claims, c h a r a c t e r i s e d i n that the sole of the shoe has an increased elasticity module or rigidity against being pressed together for harder application.

10.

Method for manufacture of a shoe according to one of the claims 1-9, c h a r a c t e r i s e d b y adapting the stiffness or elasticity of compression and/or height of the sole construction on both sides of the line SGL so that the centre of the pressure from the foot during walking is displaced or moved along the line SGL.

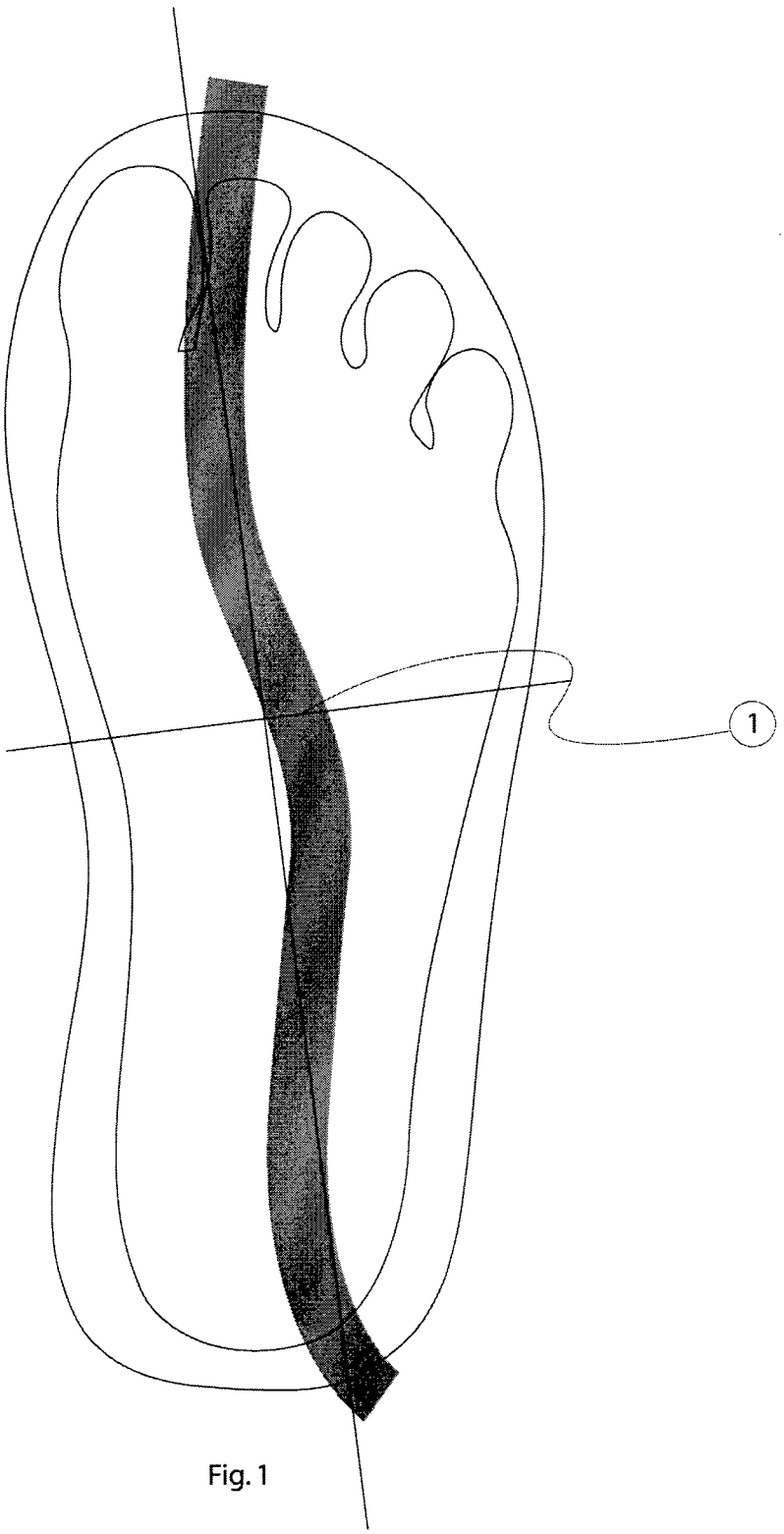



Fig. 1

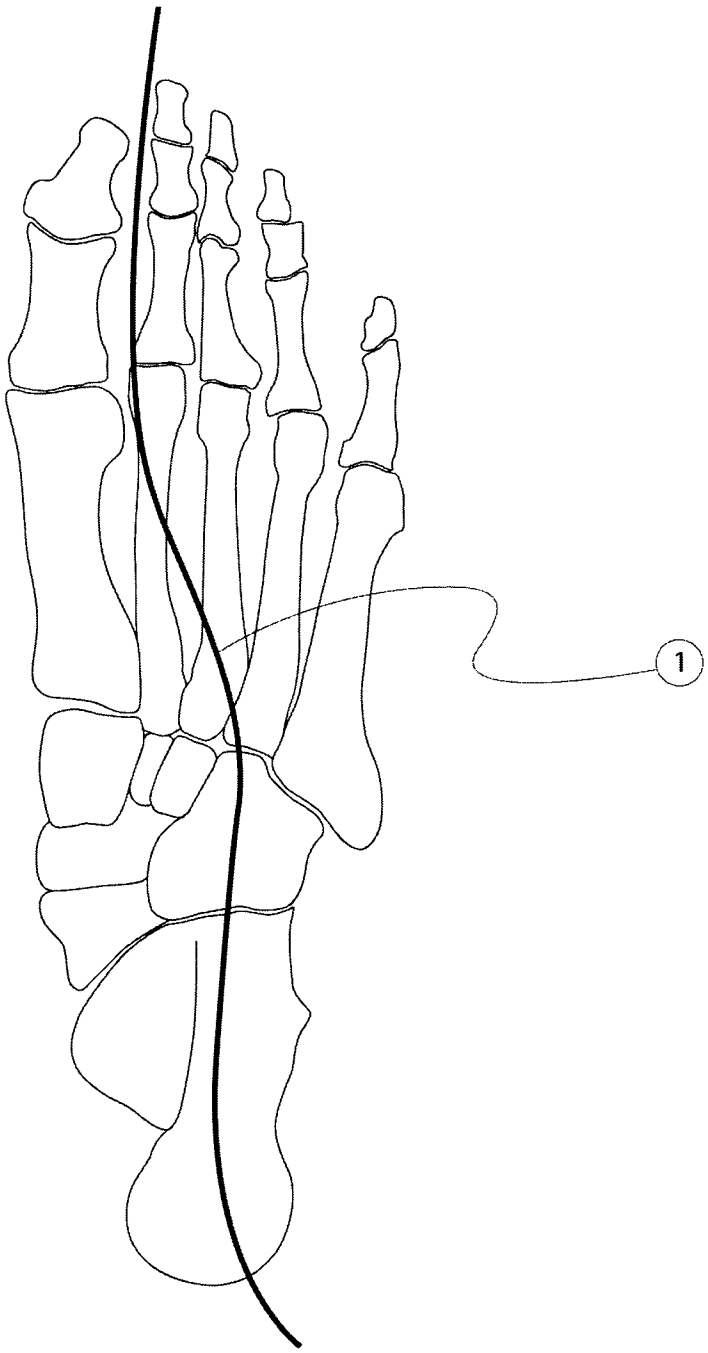



Fig. 2

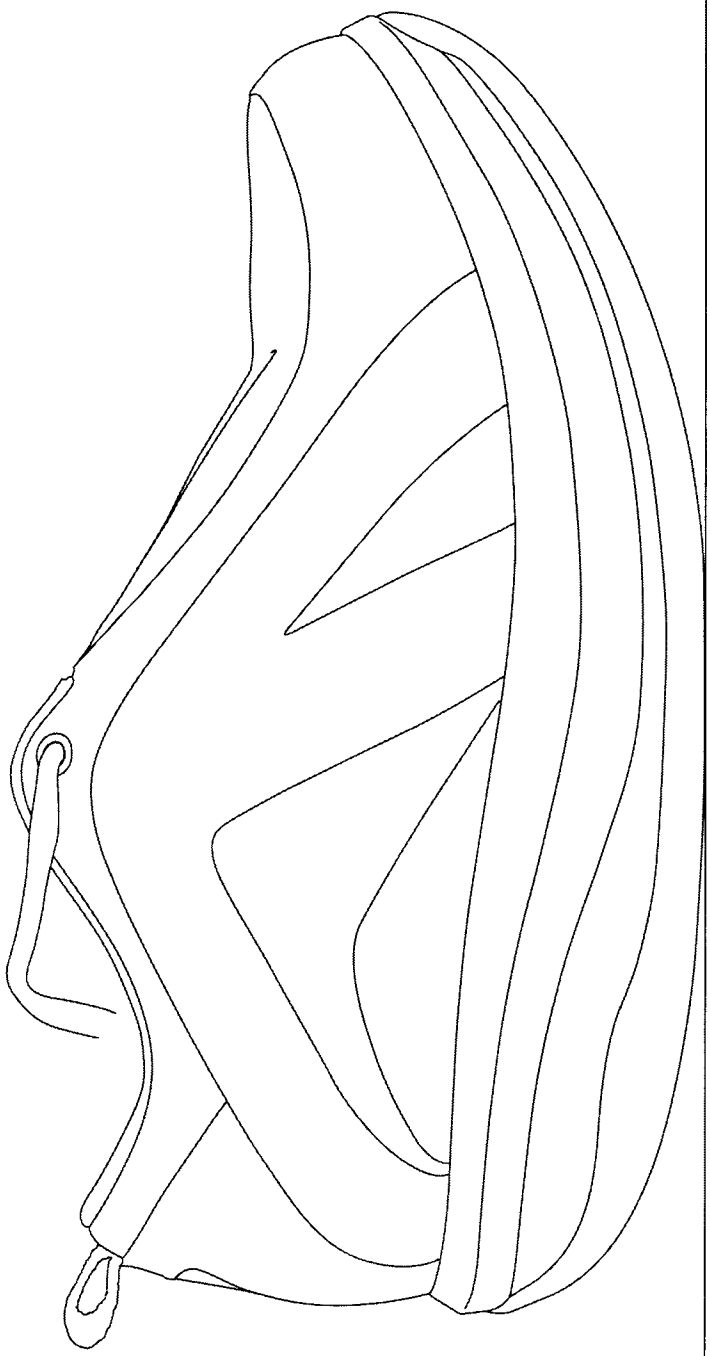


Fig 3a

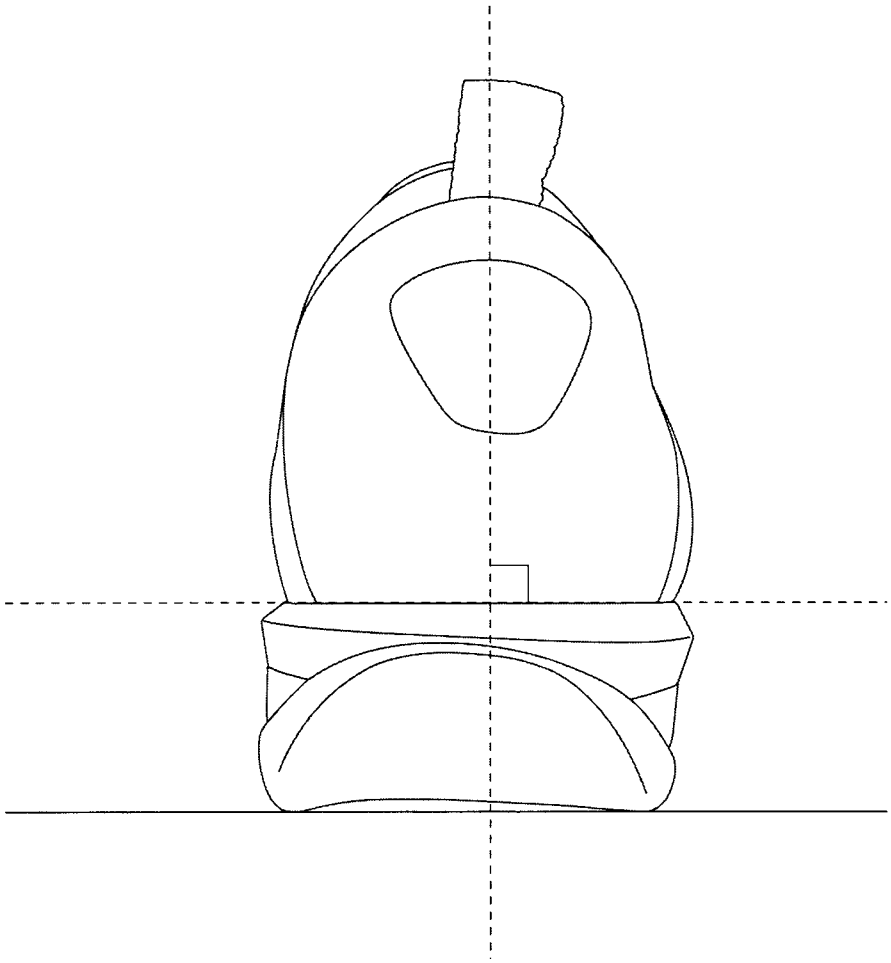


Fig 3b

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO2011/000229

A. CLASSIFICATION OF SUBJECT MATTER

A43B13/14

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC-8 A43B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
DK, FI, SE, NO

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | WO 03/002042 A1 (CAMP SCANDINAVIA AB) 2003.01.09 Fig 1. | 1-4, 7-9 |
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| A | | 6, 10 |
| X | CA 2597285 A1 (I-ROC SHOE COMPANY INC) 2008.07.04 Fig 1, 4. | 5 |

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

☒ See patent family annex.

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 13/03/2012 | 16/03/2012 |
| Name and mailing address of the ISA/<br>Helgeshoj Allé 81 DK-2630 Taastrup<br>Denmark<br>Facsimile No. +45 43 50 80 08 | Authorized officer<br>Christen Bryn<br>Telephone No. +47 22 38 76 24 |

**INTERNATIONAL SEARCH REPORT**
Information on patent family members

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