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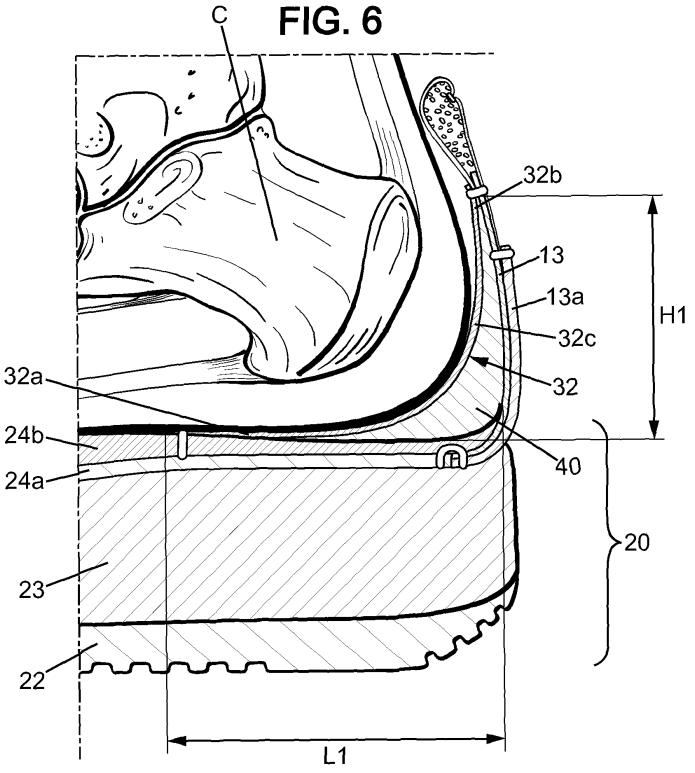
(54) Footwear articles with a shock-prevention system for the footheel

(57) The closed heel footwear article (10) comprises:
- a sole structure (20) comprising superposed layers with the top layer formed by an insole or a sock liner;
- an upper member comprising a rigid element, at the rear of the footwear article, the top layer and the upper member forming an assembly, which wraps around the foot insertion region;
- a suspension sheet (32) above said top layer in the heel region, the sheet comprising:
- a first end portion (32a) attached to the sole structure;
- a second end portion (32b) connected to the sole structure through said rigid element, at a determined level upper than the first end portion;
- a main portion (32c), suspended between the end portions, spaced above said top layer through attachment of the second end portion at said determined level, and spaced from said rigid element through attachment of the first end portion.

FIG. 6



EP 2 319 344 A1

Description

FIELD OF THE INVENTION

[0001] The present invention relates generally to closed heel footwear items and to foot-receiving devices which reduce, absorb, or prevent shock transmission to the foot heel at heel strike and relieve pressure at foot heel upload.

BACKGROUND OF THE INVENTION

[0002] Conventional closed heel footwear items comprise three primary elements: a flexible and breathable upper member covering the back and sides of the foot heel, a stable insole disposed beneath and all along the foot's plantar surface and a replaceable abrasion-resistant outsole in contact with the ground.

[0003] The lower portion of the upper member is generally assembled to the edge of the insole around a solid form, called a last, shaped to the volume of a foot with each footwear size requiring a particular last size. The outsole is fixed to the upper-insole assembly to protect such assembly and the foot from outside elements and to enable traction.

[0004] Known pathological dysfunctions resulting from the foot heel's repetitive interaction with the rear of closed heel footwear are: nerve entrapment, generally called heel pain (heel neuroma); inflammation of the Achilles tendon and of the rear plantar surface below the foot (bursitis and plantar fasciitis); heel bone fracture (calcaneal stress fracture); soreness located under the foot heel in its center and at the front (fat pad syndrome and heel spurs); low back pain; cracked heel or heel skin fissures and blisters. Shock, pressure and friction between the foot heel and the back of current closed heel footwear are at the source of said dysfunctions.

[0005] In an attempt to prevent the development of said known pathologies, footwear manufacturers have included intermediary members in the footwear assembly placed either directly beneath the foot's plantar surface within the sole structure, or around the foot heel in the upper member structure.

[0006] A number of solutions have been developed to inhibit sideward foot rolling. For example, European Patent n°0096542 discloses an athletic shoe with a heel counter reinforcement comprising a sock liner which inhibits sideward rolling during heel strike. Similarly, European Patent n°0664970 discloses a cup-like insole for improved heel stability. However, such solutions prove insufficient to dampen the downward force exerted at heel strike on the foot heel against the rear footwear (see FIG. 1A, FIG. 1B and FIG. 5). Therefore, neither shock transmission nor damage to the foot heel is prevented.

[0007] Several footwear suspension systems have been disclosed, such as World patents n°2009062030 and n°02100205, with a footwear assembly in which the foot is suspended via a sock liner attached solely to the upper member of the footwear to eliminate downward force during heel strike. However, the absence of a stable insole or midsole for the foot's plantar surface coupled with a lack of rear and lateral foot heel support deprives the foot from necessary sensory information for appropriate balance. The stability of the foot's support triangle is also severely compromised (see FIG. 2) to ensure normal gait. Backward and sideward forces during phases of heel strike and foot heel upload (see FIG. 1A and FIG. 1B) are overtly emphasized lacking an appropriate retaining structure and cushioning for the foot heel. As an adverse consequence, interaction between the foot heel and the rear footwear structure increases, particularly at the level of the foot's Achilles tendon, which can result in the development of said known pathologies described above.

[0008] Various suspension and shock-attenuation devices have also been placed in the midsole like, for example, World patent n°0028849 which discloses a skeletal suspension device located in the midsole, underneath the foot heel, which stores and returns energy to the wearer. Such foot-receiving devices comprised in the midsole cannot prevent foot heel interaction with the back of a footwear structure and do not prevent foot heel damage created by backward and sideward forces at heel strike and foot heel upload.

[0009] Said known intermediary members contribute to attenuate forces during the midstance (FIG. 1C) and propulsion (FIG. 1D) phases of gait but prove either insufficient or ineffective at the phases of heel strike (FIG. 1A) and foot heel upload (FIG. 1B) when forces peak and are concentrated around one main pressure point at the rear of the foot (FIG. 1A, 1B and 2). By contrast, forces are divided between all three pressure points of the foot's support triangle at midstance (see FIG. 1C and FIG. 2) and by the forefoot's two main pressure points at propulsion (see FIG. 1D and FIG. 2).

[0010] At heel strike, the foot generally forms a 30-degree angle to the ground (angle α, FIG. 1A) and a 10 to 14-degree angle from the walk line (not shown). Bare foot, the shock is concentrated around one pressure point below the support triangle at the very rear of the foot where, at said angles, the protective adipose tissue (fat pad) of the foot's heel bone C is naturally thicker (see FIG. 1A, compare to FIG. 1D and see FIG. 2). With footwear, the foot heel also experiences significant shock with a downward force abruptly rising to almost 400 Newtons at gait (see FIG. 4) of which only a small portion may be attenuated by the sole structure. The remnant shock and the resultant friction generally affect the rear, side and underneath of the foot heel as it is forced into the recipient structure at the back of the closed heel footwear (see FIG. 5). Shock is transmitted to the heel bone onto the wearer's back, the foot heel's 16-18 mm thick adipose tissue (fat pad) is crushed by the heel bone diminishing in thickness by 45%-55% (compare figures 1A and 1D) and severe friction between the foot heel and the back of the footwear damages the skin (see FIG. 5).

[0011] Following heel strike, the angle of the foot to the ground closes, full foot heel upload ensues with forces concentrated at the back pressure point of the foot's support triangle (see FIG. 1b and FIG. 2). Forces outreach 900 Newtons downward, approximate 75 Newtons sideward and can surpass 100 Newtons backward at normal gait (FIG. 4) whilst, with running, these forces can multiply two to three-fold. Internal rotation of the lower limb under said forces causes the foot heel to roll outwards (see FIG. 3). With footwear, the foot heel is further pressured into the rear footwear structure because of the coupling of a rising downward force and significant backward and sideward forces (see FIG. 4 and FIG. 8).

[0012] Known footwear structures either provide insufficient cushioning in the areas of interaction between the foot heel and the back of the footwear, none at all, or fail to provide a stable surface for the foot's support triangle to enable normal gait with appropriate foot equilibrium, body balance and traction. Therefore there is a need to improve the attenuation of backward, sideward and vertical forces in the area of interaction between the foot heel and the rear structure of closed heeled footwear, to preserve the rear foot's natural skin cushion from impact and pressure leading to its erosion, to minimize foot heel friction with the back of the footwear and to facilitate the foot's transition from phases of heel strike to foot heel upload and from foot heel upload to midstance.

SUMMARY OF THE PRESENT INVENTION

[0013] Embodiments of the present invention provide a footwear article according to claim 1.

[0014] By virtue of this arrangement, the downward, backward and sideward forces of the bodyweight acting upon the foot heel pictured in FIG. 4 are advantageously attenuated, particularly during phases of heel strike and foot heel upload. Generally the foot heel is prevented from impacting the rear part of the footwear structure and transmitting resulting ground reaction forces.

[0015] Most importantly, said arrangement prevents shock transmission to the heel bone, lessening significantly the strain on the ligaments of the body's lower extremities and incidentally alleviating shocks on the lower back of the wearer. Consequently, the risks of development of know related pathologies from the interaction of the foot heel and the footwear are minimized. In particular, this arrangement avoids an irreversible degradation of the adipose tissue (fat pad) that covers the calcaneus bone (heel bone), which acts as a natural cushion to the foot (see FIG. 1A, FIG. 1C and FIG. 6) because its natural shape is maintained by the suspension sheet in spite of the forces acting upon the foot heel area. The forces are dissipated along the whole surface of the suspension sheet in contact with the foot heel surface (see FIG. 7).

[0016] Indeed, the rear wall of the footwear article is not contacting the suspended main portion where the foot heel is received. Accordingly, the stresses induced by the initial shock are not orientated to the foot. Actually, the corresponding forces are retained longitudinally via attachment of the suspension sheet to the sole structure and vertically by attachment of said suspension sheet at an upper level of the rear part of the footwear's upper member, preferably through the counter, located behind the foot. As the main portion of the suspension sheet is suspended above the sole structure, efficient shock prevention is obtained resulting in an absence of shock transmission to the calcaneus bone (heel bone). Advantageously, the suspension sheet is localized in the heel region only and thus does not impact the global positioning of the foot with respect to the footwear. In fact, by virtue of this arrangement friction between the foot heel and the rear footwear is minimized and the transition from heel strike to foot heel upload and from foot heel upload to midstance is facilitated.

[0017] According to another feature, the suspension sheet being curved, the ratio between length of the curved suspension sheet and length of the footwear article is not superior to 1:3 and not inferior to 1:8. With such an arrangement, the shock prevention system does not deprive the footwear article of important sensory information for foot stability and overall body balance during gait.

[0018] According to one particularity, the main portion of the suspension sheet is cup-shaped and corresponds to a heel insertion region, a cavity being defined between the top layer, the suspension sheet and the rigid element also called rear upper member of the footwear, said cavity essentially extending above the uppermost level of the insole. Such a cavity defines spacing between solicited layers, thus preventing crushing between the suspension sheet and the rear upper member of the footwear usually caused by the downward, backward and sideward forces at heel strike and foot heel upload.

[0019] According to one particularity, the ratio between height of the cavity and height of the upper member is superior to 1:4, preferably superior to 1:2. Accordingly, the cavity is sufficiently high to avoid shock propagation toward the calcaneus bone (heel bone) when the footwear is inclined by approximately 30°.

[0020] According to one particularity, the cavity is filled with air and an elastically compressible material, the volume of said material at a non compressed state being preferably slightly inferior to the volume of the cavity. Accordingly, the suspension sheet may be compressed with a low deformation to enhance comfort. Of course, fixing of the suspension sheet through the first and second end portions prevents the collapse of the suspension sheet. The compressible material may be chosen to prevent creep of the material forming the suspension sheet. This material may be adapted to be in contact with the whole external surface of the suspension sheet, except the first end portion and the second end portion, when a force of 1000 N (vertical plus backward force) is applied to the suspension sheet.

[0021] According to another feature, the cavity is de-

fined between a convex surface of the cup-shaped suspension sheet and a concave surface defined by the junction of the sole structure and the rigid member also called rear upper member. The radius of curvature of the cup-shaped suspension sheet is preferably much longer than the radius of curvature of said junction, so that distance between the suspension sheet and the rear end of said top layer is increased.

[0022] According to another feature, the suspension sheet is a single piece and comprises an upper extension having a length of at least 2 cm and being almost parallel to the rigid member. With such an arrangement, the suspension sheet may be relatively thin and adapted to receive the foot heel.

[0023] According to a particularity, the suspension sheet provided with said upper extension forms a recipient surface (upper heel) for the foot heel, air and/or a material stored in the cavity defined under the suspension sheet preventing transmission to the foot heel of shocks received by the heel of the footwear. Such a configuration advantageously maintains the foot heel remote from the contact areas where the shocks are transmitted.

[0024] In various embodiments of the closed heel footwear article according to the present invention, the following arrangements may also be envisaged:

- the sole structure comprises a midsole in-between the insole and the outsole;
- the suspension sheet comprises a wall permeable to air;
- the suspension sheet is integral with the counter and the sole structure in a non removable manner;
- the respective first end portion and second end portion of the suspension sheet are respectively provided with anchoring means for removable attachment; optionally, a sock liner adapted to cover the insole, whereby the suspension sheet can also either be removably positioned or solidly fixed to the insole and an integral part of sole structure;
- the cavity is closed and is crescent-shaped in cross-section, the footwear thus being a closed-back footwear;
- a sock liner is provided for covering the insole, the thickness of the suspension sheet being inferior to the thickness of the sock liner;
- the footwear article comprises one amongst a high heel and a flat wide heel, fixed under the sole structure, and further comprising a shank under the insole.

[0025] Other features and advantages of the invention will become apparent to those skilled in the art during the description which will follow, given by way of a nonlimiting example, with reference to the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

FIG. 1A, 1B, 1C and 1D show respective cutaway side and back views of a bare human foot in ground contact at respective phases of heel strike, foot heel upload, midstance and propulsion in a gait cycle;

FIG. 2 shows a cutaway top view of a right foot with its outline, bone and ligament structure and the foot support triangle drawing out the three main pressure points exerted on the foot during gait, barefoot and with footwear. The point drawn below the support triangle shows the impact point on the foot at heel strike.

FIG. 3 shows a front view of a bare right foot with force directions under body weight load at the transition of foot heel upload to midstance.

FIG. 4 is a diagram showing the forces under body-weight load exerted on the on-ground foot during activity from heel strike phase to propulsion phase; the hatched areas show anterior and posterior forces during heel strike and during and up to full foot heel upload.

FIG. 5 shows respective cutaway side and back views of a footwear article according to prior art at heel strike, with force directions and main interaction points of the foot heel with the footwear;

FIG. 6 and 7 are respective cutaway side and back views of a footwear article according to a first embodiment of the present invention, FIG. 7 showing the dissipation of the downward force at heel strike;

FIG. 8 shows respective cutaway side and back views of a footwear article according to prior art at foot heel upload, with force directions and main interaction points of the foot heel with the footwear;

FIG. 9 and 10 show respective cutaway side and back views of a footwear article in accordance with a first embodiment of the present invention, FIG. 9 showing force directions and their dissipation at foot heel upload;

FIG. 11 is an exploded view of a footwear article according to a second embodiment of the present invention;

FIG. 12A and 12B are respective cutaway side and rear views of a footwear article according to a third embodiment of the invention;

FIG. 13 is a side cut view of a footwear article according to a fourth embodiment of the present invention;

FIG. 14 is an exploded view of the footwear article in accordance with the third embodiment of the present invention;

FIG. 15 is an exploded view of the footwear article in accordance with the fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0027] In the various figures, the same references are used to designate identical or similar elements.

[0028] As shown in FIG. 6 and 7, the footwear 10 es-

sentially comprises an upper member 12, and a sole structure 20. The sole structure 20 comprises an outsole 22, a midsole 23, and an insole 24a. The upper member 12 comprises a rigid element in a heel region, at the rear of the footwear 10. The rigid element is here a counter 13 that may be associated with a back reinforcement 13a also called quarter. This counter 13 may be U-shaped and is provided to appropriately position the foot heel with respect to the rear footwear structure and to prevent the foot heel from moving. The rigid element may also have a different shape, preferably extending vertically from the sole structure.

[0029] In a preferred embodiment of the invention and in accordance with a most common and generally accepted footwear manufacturing technique, the insole 24a is an integral part of the sole structure 20 and is thus not adapted to be removably positioned. The insole 24a may be located under a sock liner 24b directly in contact with the foot. The insole 24a can be made of cellulose or non-woven material and is more rigid than the sock liner 24b. For instance, this sock liner 24b comprises a flexible resilient base material, preferably a moldable polymeric material. The insole 24a is directly fixed to the midsole 23. In a less preferred embodiment, the sock liner 24b is adapted to be removably positioned. In this case, the respective first end portion 32a and second end portion 32b of the suspension sheet 32 may be respectively provided with anchoring means for removable attachment. Recesses and/or protrusions for example are provided in the counter 13 and in the sole structure 20 for allowing said removable attachment.

[0030] While the outsole 22 is composed of a relatively hard resilient material so that it will wear through repeated ground contact, the midsole 23 should be made of a resilient and preferably cushioning material to absorb the shocks of walking or running. The midsole 23 may be formed of EVA, foamed polyurethane or any other suitable material. In a known manner, hardness of the midsole 23 may be in the range of 20 to 55 durometer on the Shore A scale.

[0031] Referring now to FIG. 7, the upper member 12 is provided with generally conventional or convenient construction for the type of shoe desired, and is preferably a closed toe and closed heel upper member. In a less preferred embodiment, an open toe upper member for the sandal-type shoe (not shown) may be used, provided that such an upper member 12 comprises a closed heel rear member, preferably comprising the rigid counter 13. The upper member 12 can thus be provided in various styles and is coupled with the insole 24a to define an assembly 30 adapted to wrap around the foot insertion region as illustrated in FIG. 11, 14 and 15. The assembly 30 is thus adapted to prevent foot movement with respect to the sole structure when the foot is inserted inside the assembly 30, as illustrated in particular in FIG. 7, 9, 12A-12B and 13. Fixing of the upper member 12 to the sole structure 20 will not be described as the way of fixing such an upper member 12 is well-known in the art.

[0032] In the embodiments of the invention, the sole structure 20 and the counter 13 define a rigid reference structure that will be exposed to the external shocks, in particular at heel strike. In order to prevent the downward, sideward and backward forces of the bodyweight load shown in FIG. 4 from impacting the footwear and transmitting the upward ground reaction forces, the foot heel is maintained at a distance of this rigid reference structure through a suspension sheet 32.

[0033] As shown in FIG. 6, 7 and 11, the suspension sheet 32 is arranged above the insole 24a in the heel region and is curved to the natural shape of the foot heel. Referring to FIG. 6, the suspension sheet 32 is fixed in a manner to maintain the foot heel at a sufficient distance from the rigid reference structure that is exposed to the external shocks. The ratio between length L1 of the curved suspension sheet 32 and length of the footwear 10 is preferably not superior to 1:3 and not inferior to 1:10 (and preferably not inferior to 1:8). The suspension sheet 32 may be moulded or shaped with a container-shape, the suspension sheet 32 extending around a central axis or an axis of symmetry, which is orientated at about 45° relative to the sole structure 20.

[0034] In the shown embodiments, the suspension sheet 32 is a single piece. This suspension sheet 32 defines a foot heel receiving surface and retaining member spaced from the rigid heel of the footwear that belongs to said rigid reference structure in contact with the ground. The suspension sheet 32 may comprise a wall permeable to air. In this case, a circulation of air can optionally be used in the footwear 10.

[0035] The suspension sheet 32 comprises a first end portion 32a attached to the sole structure 20 and a second end portion 32b connected to the sole structure 20 through the rigid counter 13 (or optionally through the quarter 13a). The second end portion 32b is physically secured to the rigid counter 13 directly (or optionally through the quarter 13a directly) and may be U-shaped. In the non limitative embodiment shown in Fig. 6, the rigid counter 13 and the back reinforcement 13a are two layers rigidly fixed to the insole 24a creating an upper-insole assembly which is fixed to the midsole 23 and outsole 22 by injection moulding and the sock liner 24b is attached inside said upper-insole assembly in a non-removable manner to the sole structure 20 by means of gluing.

[0036] The second end portion 32b is upper than the first end portion 32a, the suspension sheet 32 being provided with an upper extension that is almost parallel to the rigid counter 13. For example, the angle between the upper extension and the counter 13 is less than 15°, preferably less than 10°. Such an upper extension may have a length of at least 2 cm, for example about 3-4 cm. The global curving of the suspension sheet 32 corresponds to a bending angle that is equal or slightly superior to 90°. The suspension sheet 32 comprises a main portion 32c suspended between the first end portion and the second end portion. This main portion 32c is spaced above the

insole 24a through attachment of the second end portion 32b to the rear wall structure of the upper member 12, preferably through the rigid counter 13 at a determined upper level, and spaced from said rigid counter 13 through attachment of the first end portion 32a. This suspension design provides shock absorption for upward, downward and side-to-side forces. When the footwear 10 is in use and hits the ground at full force on a very small surface area (at the rear of the outsole or heel lift, the foot forming a 30-degree angle to the ground), this force is advantageously deflected outwardly to the sides of the rigid reference structure including the sole structure 20 and the rear wall of the upper member 12. This deflection is possible due to the absence of a heel strike area. The main portion 32c of the suspension sheet 32 remains suspended upon impact, therefore causing the force to radiate outwardly to the side periphery. In prior art as shown in FIG. 5, the heel strike area S of the footwear corresponds to a rigid wall. Also, as illustrated in FIG. 5, the adipose tissue (fat pad) surrounding the foot where it interacts with the rear of the footwear at heel strike area S is too thin and fragile to protect a very sensitive area of the foot where the foot's Achilles tendon links with the calcaneus bone C (heel bone). Adjunction of a cushioning layer coated onto the rigid layer of the footwear is inefficient because the force is essentially transmitted to a very small surface area, the cushioning material thus being crushed when the foot forms a 30-degree angle to the ground.

[0037] As shown in FIG. 6-7, the suspended main portion 32c, which may correspond to 90% or more of the suspension sheet 32, cannot be crushed because respective attachment of end portions 32a and 32b hold the main portion 32c in a suspended state. The main portion 32c is cup-shaped, with an inclined general orientation. A cavity 40 having a crescent-shape in cross-section is defined between the insole 24a, the suspension sheet 32 and the counter 13. This cavity 40, which is closed, essentially extends above the uppermost level of the sock liner 24b. This cavity 40 may be filled with air and/or with an elastically compressible material, for example a gel. The volume occupied by a filling material at a non compressed state is preferably slightly inferior to the volume of the cavity 40. In other words, in embodiments with the cavity 40 containing a specific material, the amount of this material does not suppress the suspension effect for the main portion 32c of the suspension sheet 32.

[0038] In the embodiment shown in FIG. 6, the cavity 40 is defined between a convex surface of the cup-shaped suspension sheet 32 and a concave surface defined by junction of the sole structure 20 and the counter 13. The ratio between height H1 of the cavity 40 and height of the upper member 12 is superior to 1:4 and preferably superior to 1:2. Such a high cavity 40 enables absorption of the side-to-side forces as illustrated also in FIG. 10. The thickness of the cavity 40 between the suspension sheet 32 and the rigid reference structure is preferably higher near the second end portion 32b than near the first end portion 32a as illustrated in FIG. 6. The radius of curvature of the cup-shaped suspension sheet 32 is preferably much longer that the radius of curvature at rear of the rigid reference structure including the sole structure 20 and the counter 30. As a result, any contact between the suspended main portion 32c and the counter 13 or the sole structure 20 is prevented.

[0039] As shown in FIG. 6, 7, 9 and 11, the rigid counter 13 is associated with a quarter 13a forming a back and side reinforcement visible from the outside. In the non limitative embodiment of FIG. 11, the counter 13 is a piece of cellulose, punched in its middle upper part for appropriate placement with respect to the rear upper member. This rigid counter 13 may be placed between the back reinforcement or quarter 13a and an inside lining of the upper member 12 (not shown). After the fixing of the counter 13 to the upper member 12, the upper member comprising the counter 13, and optionally quarter 13a, is fixed to the insole 24a. The sock liner 24b can either be removably positioned or securely fixed, by gluing for example, inside the upper-insole assembly made of upper member 12, counter 13, quarter 13a and insole 24a because the suspension sheet 32 is fixed independently to the insole 24a through the first end portion 32a and to the counter 13 (optionally through quarter 13a) through the second end portion 32b. By contrast, in the other non limitative embodiment of the present invention illustrated in FIG. 6, 7 and 9, the sock liner is irremovable because the suspension sheet 32 is fixed at a first end portion 32a to the sock liner 24b and at a second end portion 32b to the inner counter 13, the sock liner 24b being itself permanently fixed to the insole 24a, which itself is an integral part of the sole structure 20.

[0040] In the example shown in FIG. 11, the cavity 40 between the suspension sheet 32 and the sock liner 24b is filled with a piece of elastically compressible material 40a. This piece 40a may be fixed to the sock liner 24b only through its bottom 40b. The concave conformation of this piece 40a is adapted to follow the shape of the suspension sheet 32, even during the shocks. The elastically compressible material is thus as deformable as a viscous fluid.

[0041] FIG. 9-15 show that such a suspension sheet 32 may be used in any kind of footwear. While FIG. 9-11 illustrate a sports footwear, FIG. 12A, 12B and 14 show the absorption system used in a town shoe 110. The sole structure 20 of such shoes is thinner than in sport footwear and comprises a rigid heel 41 and a heel lift 41a as illustrated in FIG. 14. A shank 42 is also provided under the insole 24a. The shank is thus maintained between the insole 24a and the shank cover 44. The rigid heel 41 is typically wide and flat for a man's foot. In one alternative embodiment for such a town shoe 110, the insole 24a may be in direct contact with the outsole 22.

[0042] In a high heel shoe 210 as illustrated in FIG. 13, the cavity 40 has a height H1 corresponding to one-quarter of the whole height of the shoe. A shank 42 is

also provided between the insole 24a and the shank cover 44 as illustrated in FIG. 15. The high heel 43 is thin, except an enlarged portion attached to the outsole 22. As shown in FIG. 15, heel lift 43a may be used as a replaceable piece in contact with the ground.

[0043] It is understood that the suspension sheet 32 extends in the heel region, in particular at the rear of the foot heel. The ratio between height and length of the curved suspension sheet 32 attached to the sole structure 20 and the counter 13 or quarter 13a may be comprised between 1:1 and 1:1.7. Of course any other suitable ratio close to this range may be used and this does not exclude different arrangements of the curved suspension sheet 32.

[0044] One advantage of the present invention is the ability of the suspension system to absorb shock by dissipating vertical impact in the heel area of the footwear at heel strike and to attenuate downward, sideward and backward forces at foot heel upload. Another advantage is the gain in stability by suspending a specific portion of the foot heel, in the area at the rear of the footwear. The main portion 32c of the suspension sheet 32 extends gradually upwards from the insole-sock liner assembly 24a-24b so as to cover the rear of the foot heel, which limits friction and prevents the erosion of the adipose tissue (fat pad) covering the calcaneus bone (heel bone) of the foot. Accordingly, the impact inclined at an angle of 30° is adequately dissipated and not only the vertical impact but also the backward and sideward forces. Still another advantage of the invention is that a specific sole structure construction is not required. In complete contrast, various sole structures may be used and the absorption system is still adapted to a wide range of shoes without changing the various known structures and manufacturing techniques currently used to make those shoes in the footwear industry.

[0045] The present invention has been described in connection with the preferred embodiments. These embodiments, however, are merely for example and the invention is not restricted thereto. It will be understood by those skilled in the art that other variations and modifications can easily be made within the scope of the invention as defined by the appended claims, thus it is only intended that the present invention be limited by the following claims. For instance, the invention may be implemented in any shoes having a sole structure 20 and a counter 13. Also, the counter 13 or similar element may be located in any suitable place. In some alternative preferred embodiments, the rigid counter is located at an upper position in the upper member 12.

Claims

1. A closed heel footwear article (10) comprising:

- a sole structure (20) adapted to be in contact with the ground, the sole structure comprising a plurality of superposed layers (22, 23, 24a, 24b) with the top layer formed by either an insole (24a) or a sock liner (24b);
- an upper member (12) that comprises a rigid element in a heel region, at the rear of the footwear article (10), the rigid element being preferably a rigid counter (13); wherein said top layer and said upper member (12) form an assembly (30) intended to wrap around a foot; **characterized in that** the footwear article (10) further comprises a suspension sheet (32) disposed above said top layer in the heel region, the suspension sheet comprising:

  - a first end portion (32a) directly attached to the sole structure (20);
  - a second end portion (32b) connected to the sole structure (20) through the rigid element, the second end portion being upper than the first end portion; and
  - a main portion (32c) suspended between the first end portion (32a) and the second end portion (32b), the main portion (32c) being spaced above said top layer through attachment of the second end portion to the rigid element at a determined upper level, and being spaced from said rigid element through attachment of the first end portion.

2. The footwear article according to claim 1, wherein the suspension sheet (32) is curved, the ratio between length (L1) of the curved suspension sheet (32) and length of the footwear article (10) being not superior to 1:3 and not inferior to 1:8.

3. The footwear article according to claim 1 or 2, wherein said main portion (32c) of the suspension sheet (32) is cup-shaped and corresponds to a heel insertion region, a cavity (40) being defined between said top layer, the suspension sheet and the rigid element, said cavity essentially extending above the uppermost level of said top layer.

4. The footwear article according to claim 3, wherein the ratio between height (H1) of the cavity (40) and height of the upper member (12) is superior to 1:4, preferably superior to 1:2.

5. The footwear article according to claim 3 or 4, wherein said cavity (40) is filled with air and an elastically compressible material, the volume occupied by said material at a non compressed state being preferably slightly inferior to the volume of the cavity.

6. The footwear article according to one of claims 3-5, wherein said cavity (40) is defined between a convex surface of the cup-shaped suspension sheet and a concave surface defined by junction of the sole struc-

ture (20) and the rigid element that form either a counter (13) or a quarter (13a).

7. The footwear article according to one of claims 1-6, wherein the suspension sheet (32) is a single piece and comprises an upper extension having a length of at least 2 cm and being almost parallel to the rigid element.

8. The footwear article according to claim 7, wherein the suspension sheet (32) provided with said upper extension forms an upper heel, air and/or material stored in the cavity (40) defined under the suspension sheet (32) preventing transmission to the upper heel of shocks received by the lower heel.

9. The footwear article according to one of claims 1-8, wherein said sole structure (20) comprises an insole (24), a midsole (23) and an outsole (22).

10. The footwear article according to one of claims 1-9, wherein the suspension sheet (32) comprises a wall permeable to air.

11. The footwear article according to one of claims 1-10, wherein the suspension sheet (32) is integral with the rigid element and the sole structure (20) in a non removable manner.

12. The footwear article according to one of claims 1-10, wherein the respective first end portion (32a) and second end portion (32b) of the suspension sheet (32) are respectively provided with anchoring means for removable attachment.

13. The footwear article according to one of claims 1-12, wherein said cavity (40) is closed and is crescent-shaped in cross-section.

14. The footwear article according to one of claims 1-13, comprising a sock liner (24b) covering the insole (24a), wherein said thickness of said suspension sheet (32) is inferior to thickness of the sock liner (24b).

15. The footwear article according to one of claims 1-14, comprising one amongst a high heel and a flat wide heel, fixed under the sole structure (20), and further comprising a shank (42) under the insole (24a).

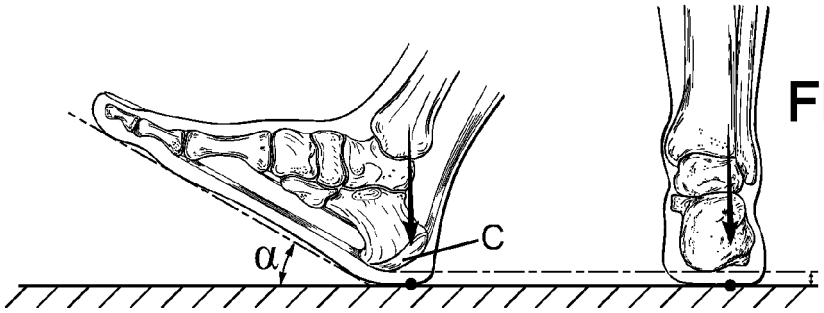
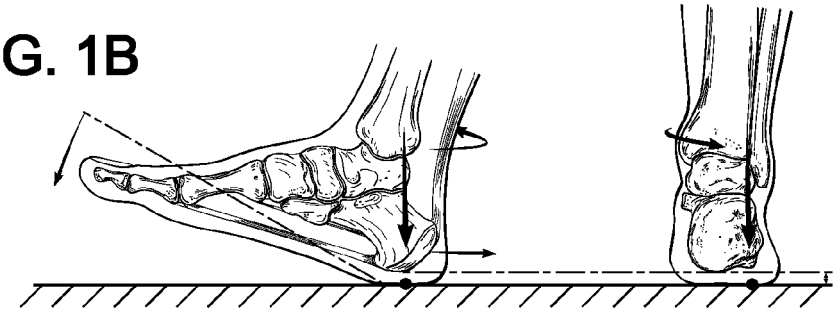


FIG. 1A

FIG. 1B



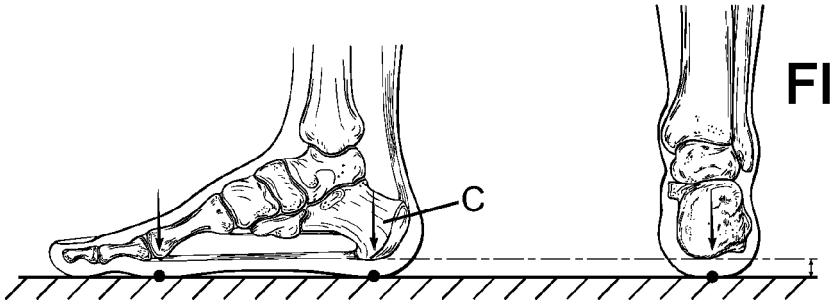


FIG. 1C

FIG. 1D

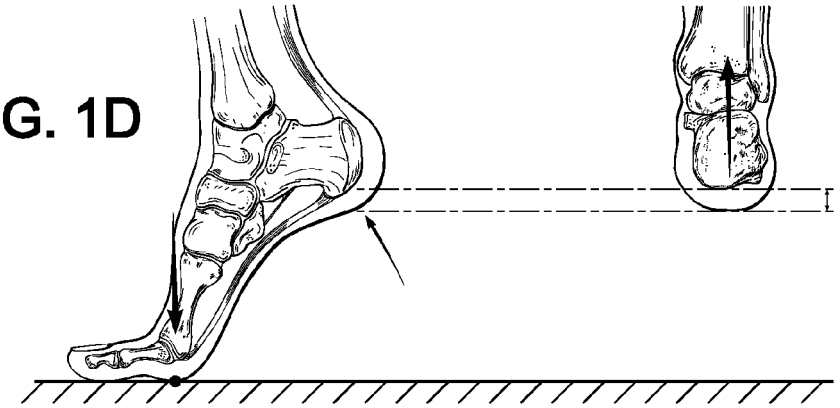
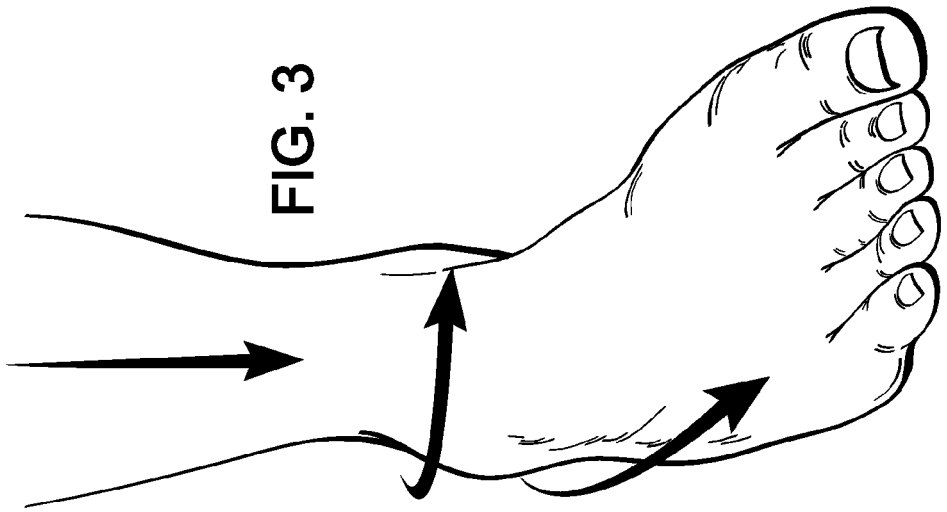


FIG. 3



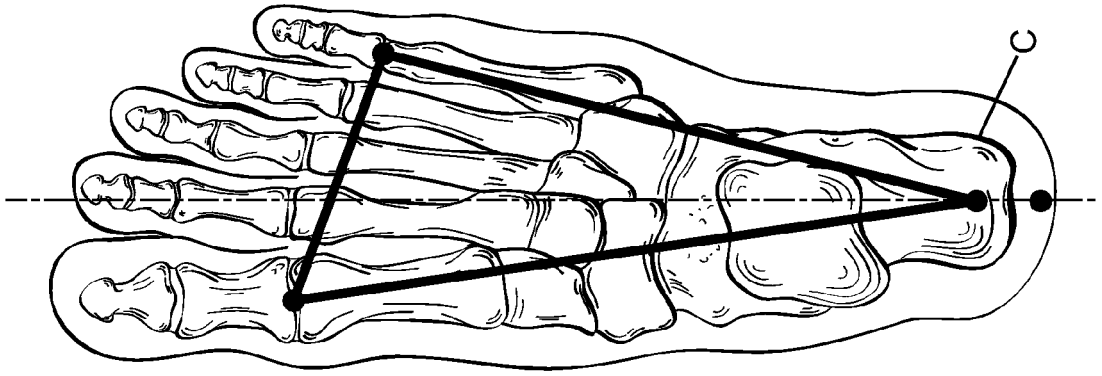


FIG. 2

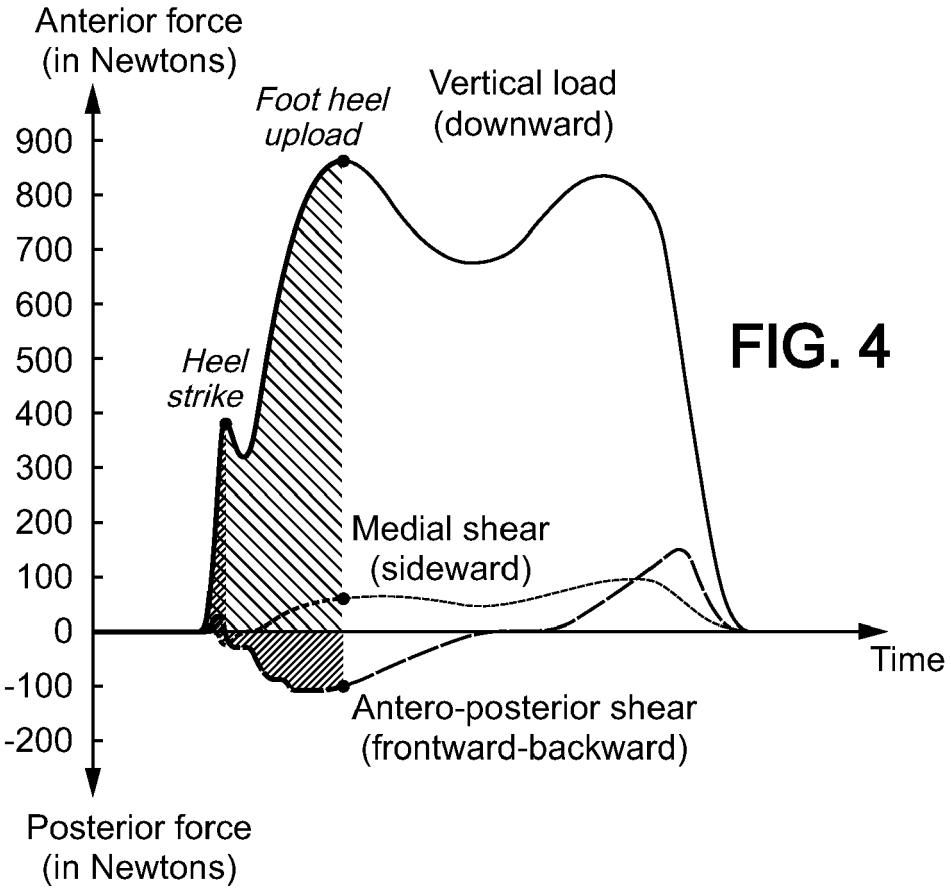

Anterior force
(in Newtons)
900
800
700
600
500
400
300
200
100
0
-100
-200
Posterior force
(in Newtons)
Foot heel
upload
Vertical load
(downward)
Heel
strike
Medial shear
(sideward)
Time
Antero-posterior shear
(frontward-backward)

FIG. 4

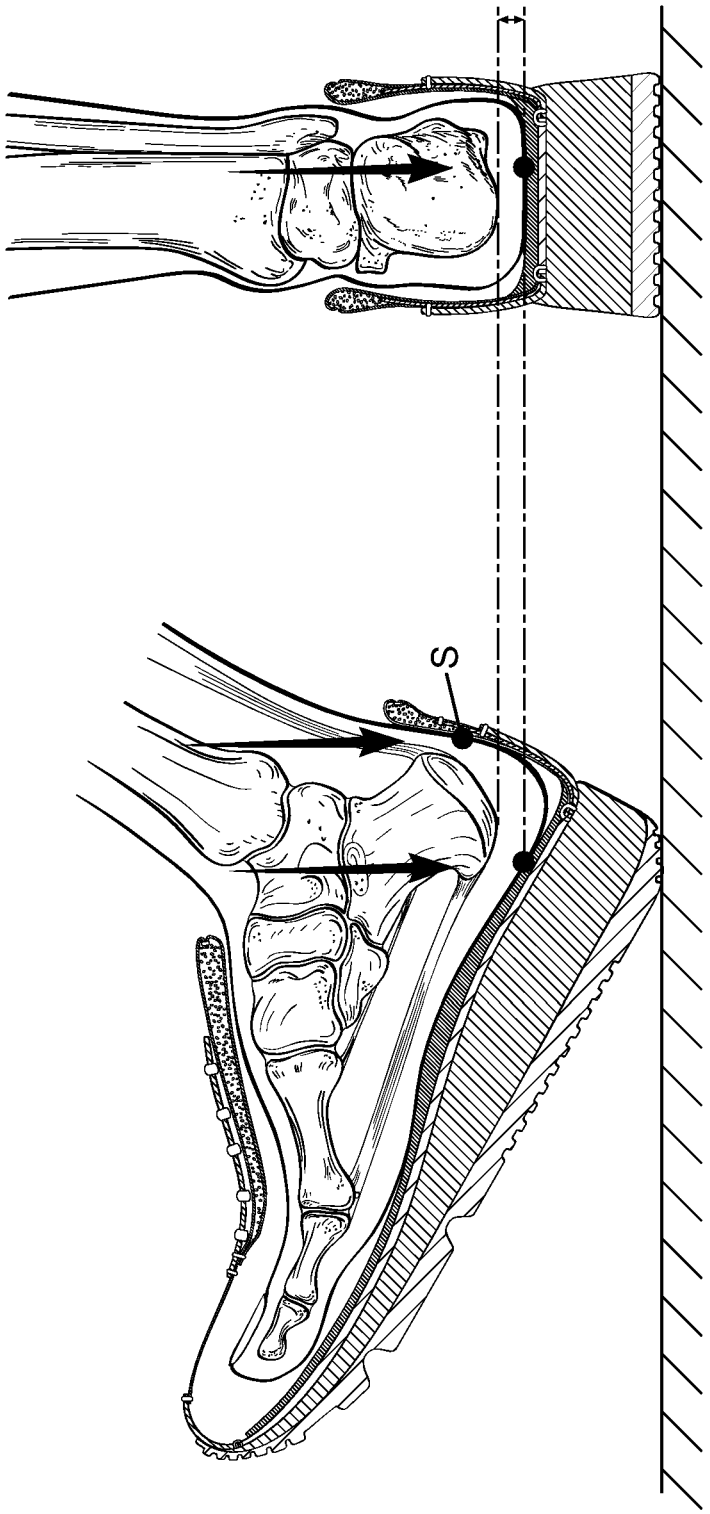
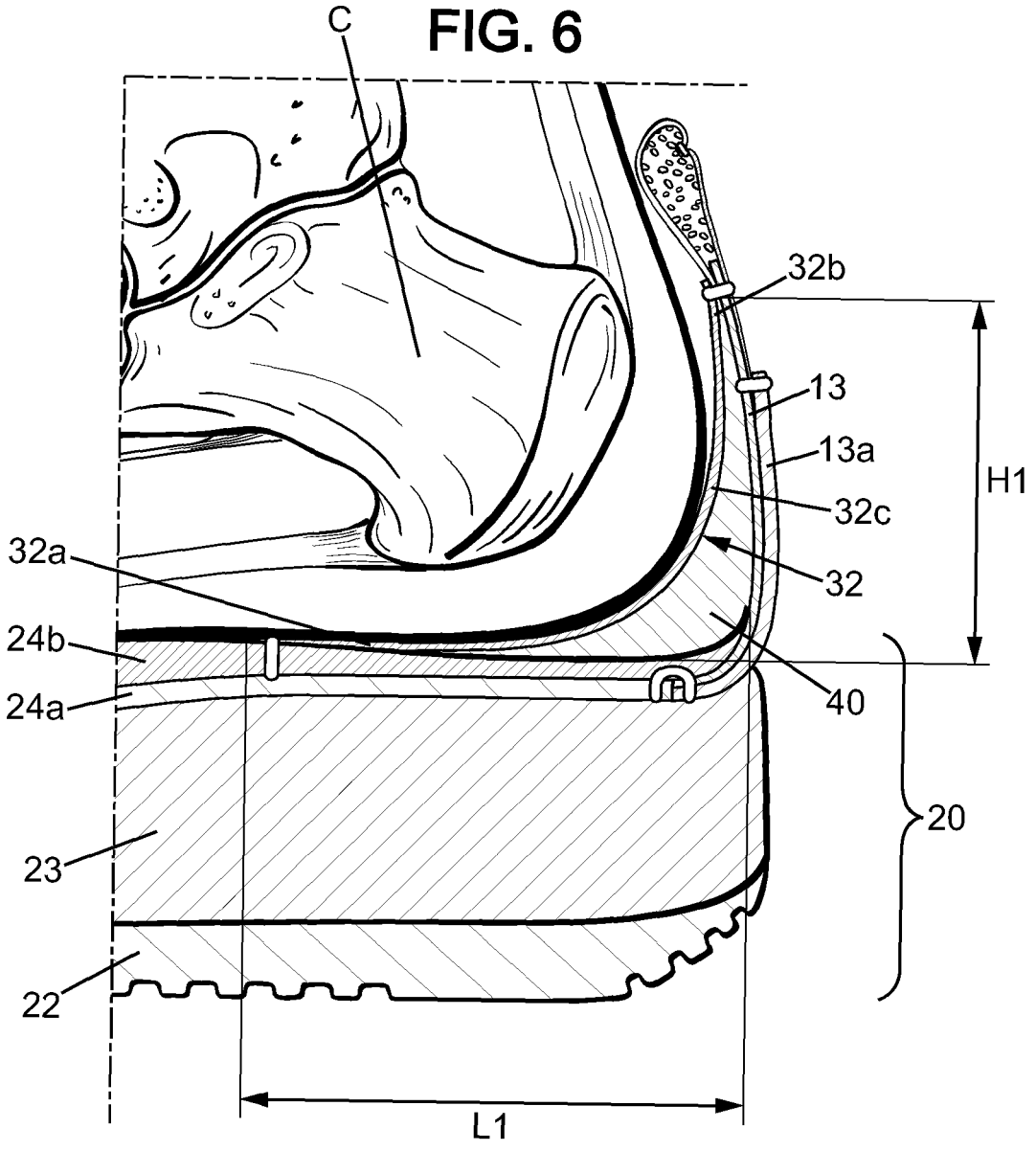


FIG. 5
(PRIOR ART)

FIG. 6



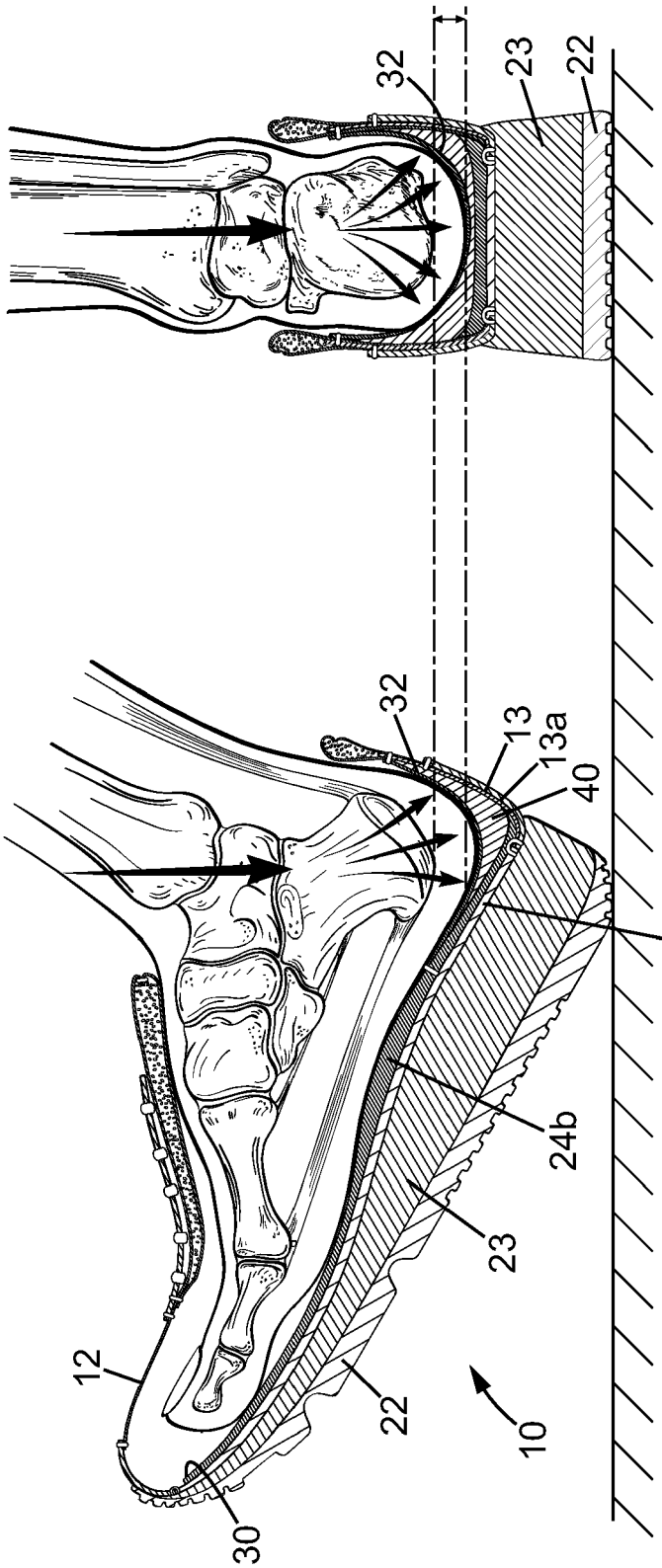


FIG. 7

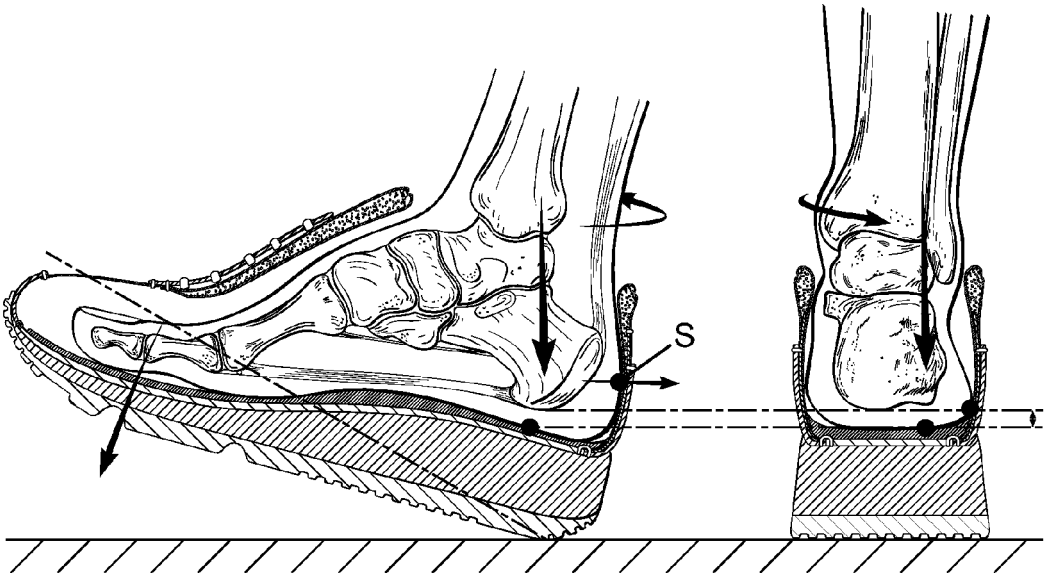


FIG. 8
(PRIOR ART)

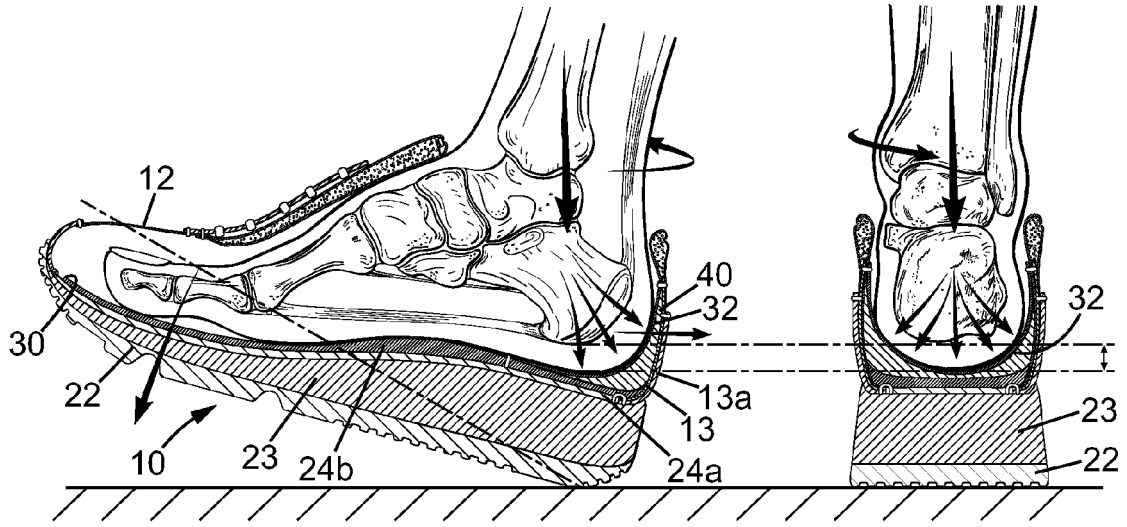


FIG. 9

FIG. 10

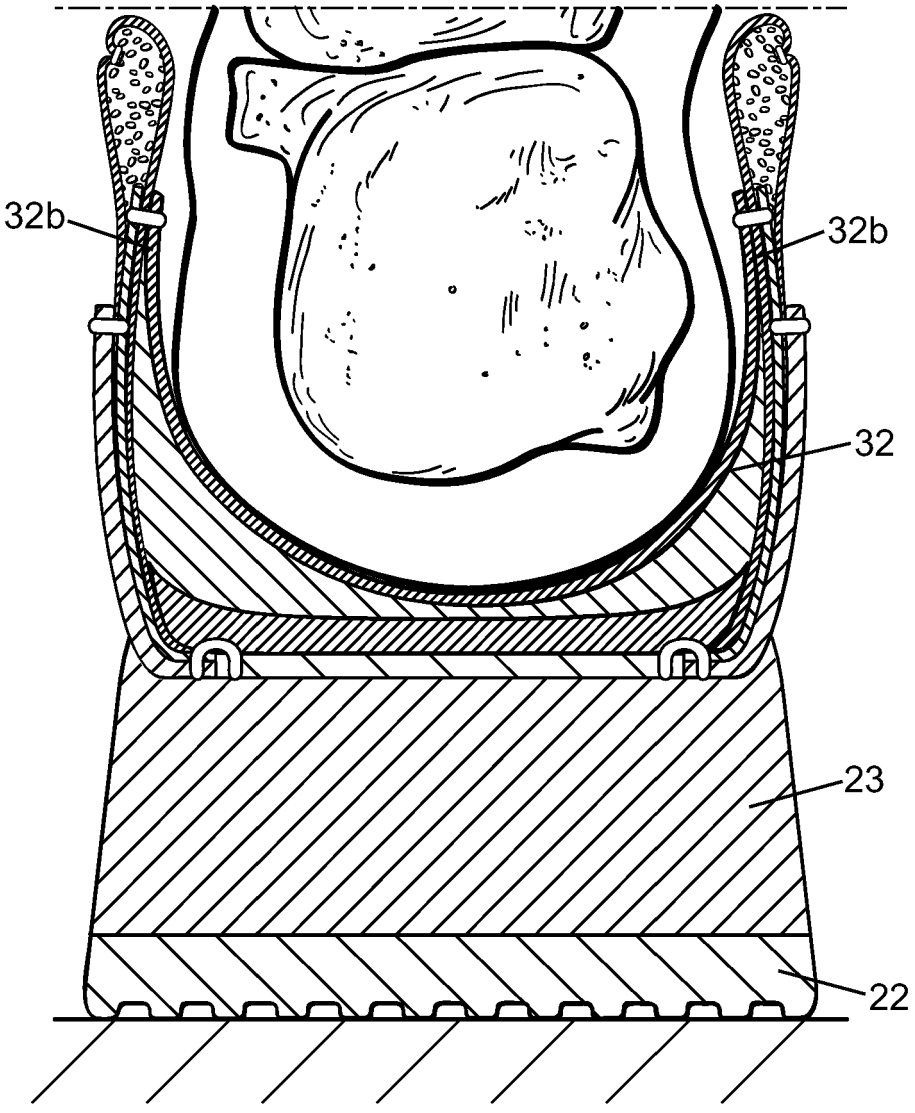
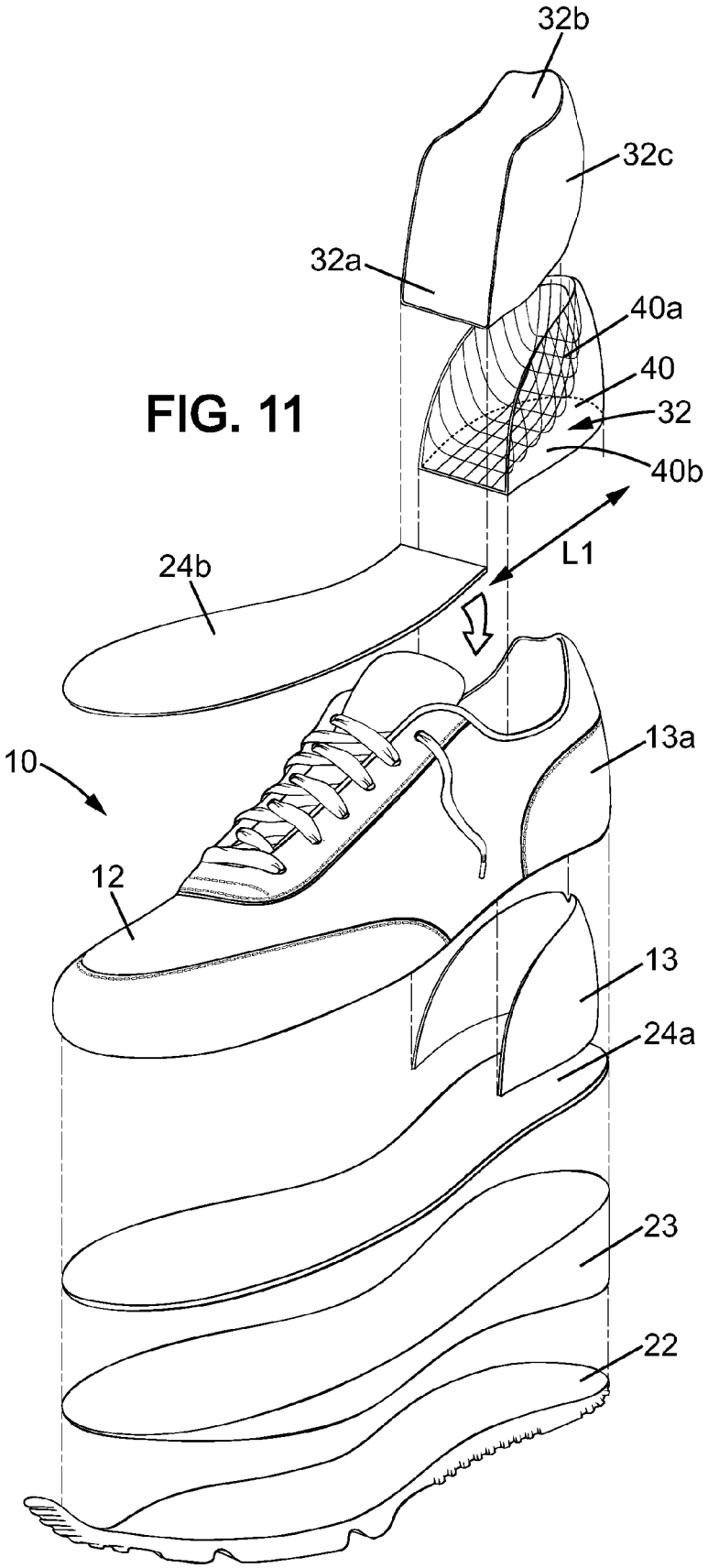


FIG. 11



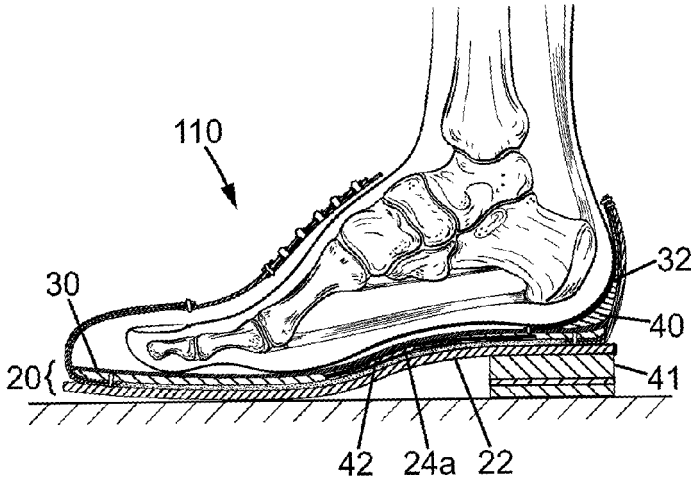


FIG. 12A

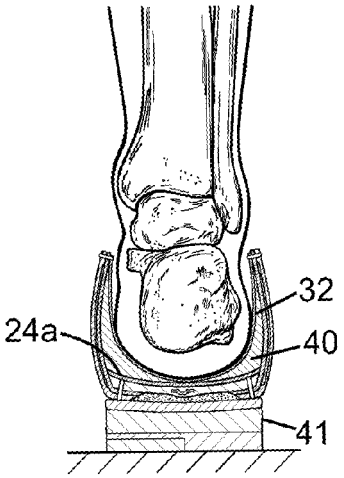


FIG. 12B

FIG. 13

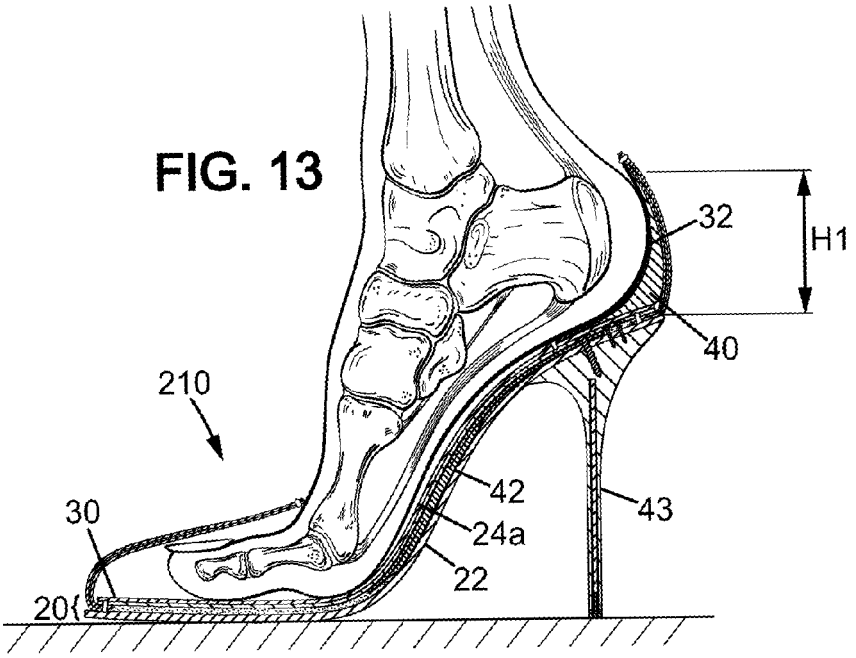


FIG. 14

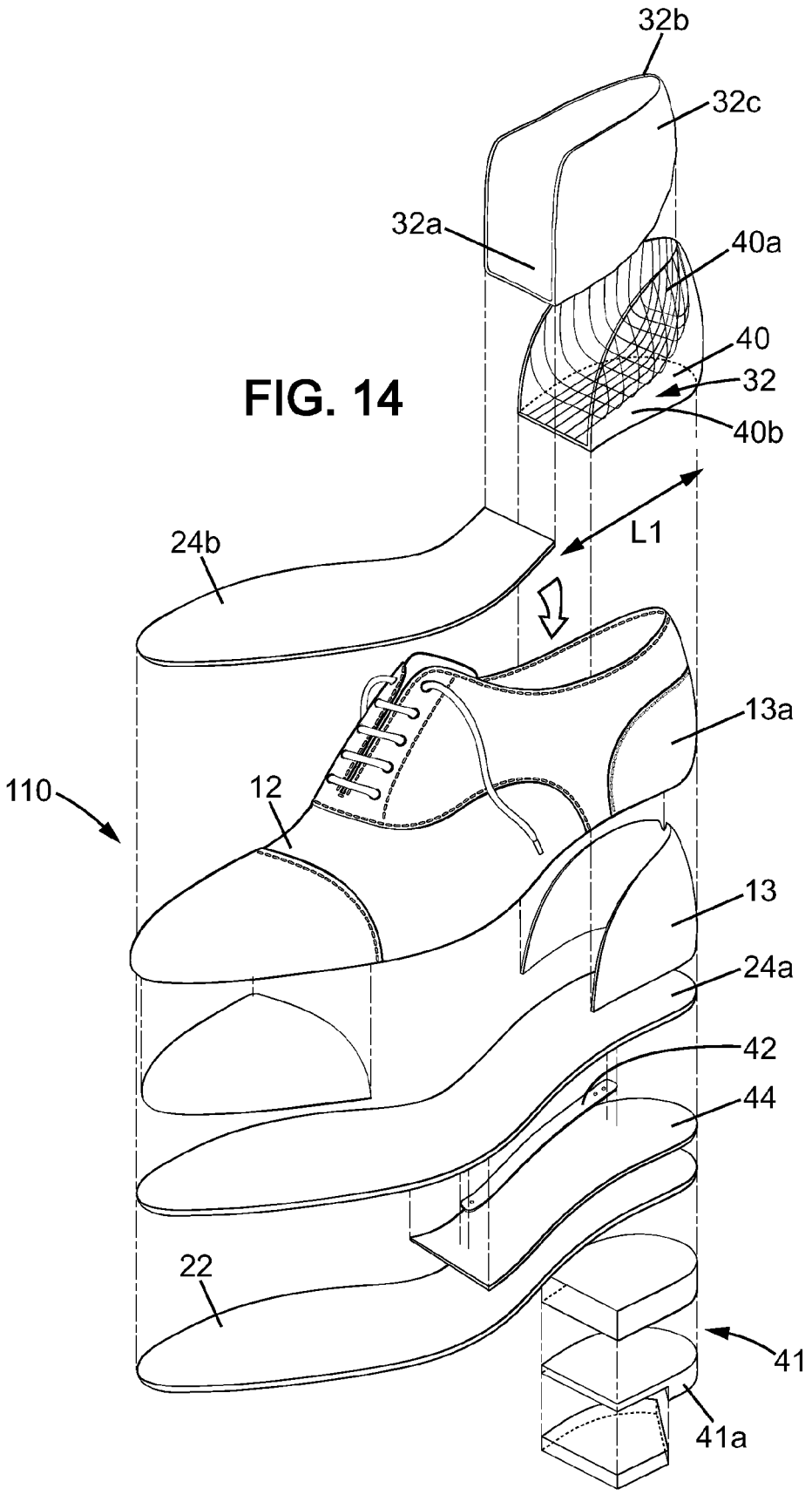
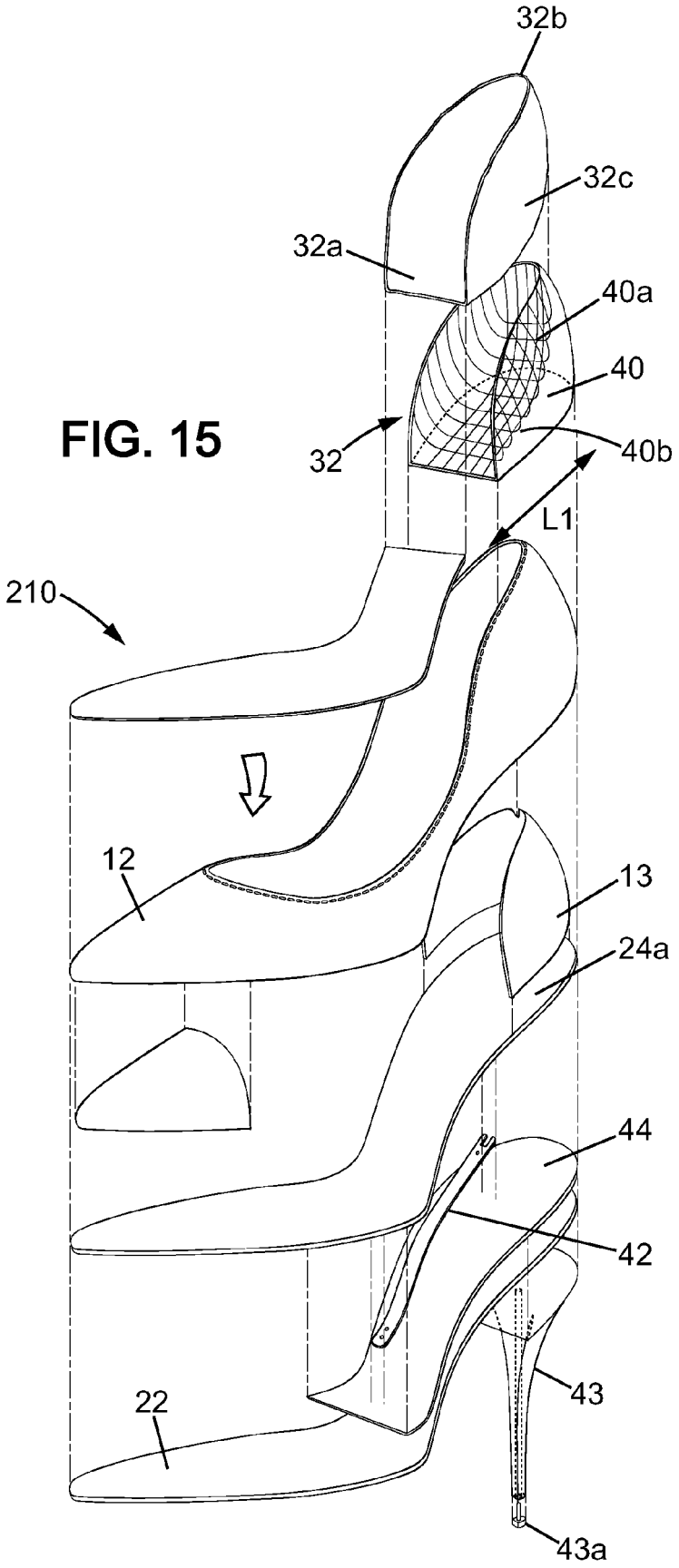


FIG. 15



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EUROPEAN SEARCH REPORT

Application Number
EP 09 30 6085

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2005/077216 A1 (GEN BUILDING S A S DI DE GIACO [IT]; DE GIACOMI GIANCARLO [IT]) 25 August 2005 (2005-08-25) * the whole document *	1-15	INV. A43B17/02 A43B17/16 A43B21/26 A43B21/32
X	US 4 187 620 A (SELNER ALLEN J [US]) 12 February 1980 (1980-02-12) * column 2, lines 47,48 * * figures 3,4 * * column 3 *	1-15	
X	EP 0 019 673 A1 (DAVIDSON MURRAY RICHARD) 10 December 1980 (1980-12-10) * figure 6 * * page 6, lines 3-15 *	1-15	
X	DE 555 663 C (WILHELM DEUKER) 22 February 1936 (1936-02-22) * the whole document *	1-15	
A	US 2 598 782 A (GILLIS GEORGE H) 3 June 1952 (1952-06-03) * column 2, lines 16-26 * * figures 1,2 *	1	TECHNICAL FIELDS SEARCHED (IPC) A43B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 April 2010	Tejada Biarge, Diego

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22-04-2010

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

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- EP 0664970 A **[0006]**
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