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(54) **AN ARTICLE OF FOOTWEAR WITH AN INTEGRATED BOW STRUCTURE**

(57) An article of footwear comprising an upper, and a sole structure connected to the upper, the sole structure comprising a first dampening element to cushion a forefoot region of the sole structure, a second dampening element to cushion a heel region of the sole structure, the first dampening element and the second dampening element being spaced by a first gap between the forefoot region and the heel region, a plate structure extending between the forefoot region and the heel region of the sole structure, such that the plate structure spans the first gap between the first dampening element and the second

dampening element, wherein the plate structure comprises an upper plate and a lower plate connected to each other in the forefoot region and in the heel region, wherein the upper plate and the lower plate are separated from each other in a midfoot region by a second gap, wherein the lower plate is connected to the first dampening element and the second dampening element, and wherein the upper plate is connected to the upper, such that the upper is spaced from the lower plate by the second gap in the midfoot region of the sole structure.

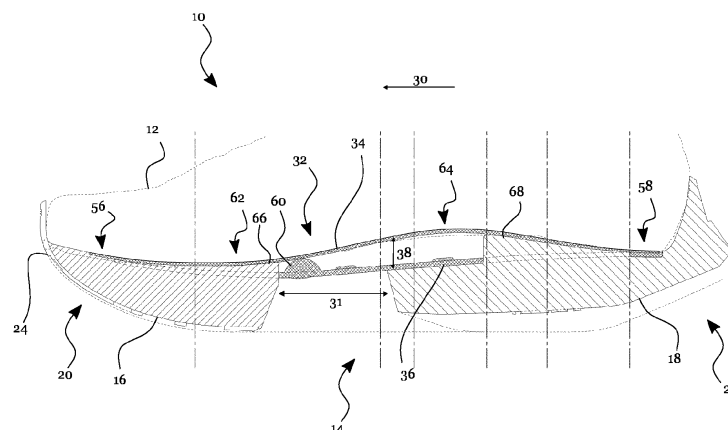


Fig. 3

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Description

FIELD OF THE INVENTION

[0001] The present invention is in the field of footwear. More precisely, the present invention relates to an article of footwear with an integrated plate structure for assisting the wearer during running or walking.

BACKGROUND

[0002] Articles of footwear support a wearer's foot through a combination of a sole structure for supporting the wearer's foot above a ground surface and an upper for enclosing the foot. The upper may be formed from any suitable material(s) to receive, secure, and support a foot on the sole structure. The upper may cooperate with laces, straps, or other fasteners to adjust the fit of the upper around the foot. A bottom portion of the upper, proximate to a bottom surface of the foot, attaches to the sole structure.

[0003] Human feet generally provide both a cushioning function as well as providing a lever for generating a forward force during walking or running. Articles of footwear may be adapted to improve both the cushioning function as well as the force transfer to the ground to assist the wearer and make walking or running more comfortable during different stages of the human stance phase, in which the foot receives the weight of the body and propels it forward. In case the natural function of the foot is disrupted, specialized footwear or orthopedic insoles may be used to improve cushioning or promote a transfer of force in the forward direction.

[0004] WO 2020/025467 A1 discloses an orthopedic insole with two layers and a deflection element, wherein, with dorsiflexion of the insole, a lower layer is designed to transmit tension acting in a forefoot region via the deflection element to an upper layer in the forefoot region, in such a way that the dorsiflexion leads to an increase in the height of an arch formed by the upper layer.

SUMMARY OF THE INVENTION

[0005] However, the known articles of footwear may be limited in the efficiency of storing and returning an impact reaction force during different stages of the stance phase of the human gait cycle. The insoles known in the prior art for improving arch support are further limited by the properties and the geometry of the shoe in which the insole are used.

[0006] In view of this state-of-the-art, the object of the invention is to provide an article of footwear, which improves the support of the wearer during walking and running while providing the wearer with assistance to propel the body forward as part of the gait cycle.

[0007] According to a first aspect, an article of footwear is provided, the article of footwear comprising an upper and a sole structure connected to the upper. The sole

structure comprises a first dampening element to cushion a forefoot region of the sole structure, and a second dampening element to cushion a heel region of the sole structure, wherein the first dampening element and the second dampening element are spaced by a first gap between the forefoot region and the heel region. The sole structure further comprises a plate structure extending between the forefoot region and the heel region of the sole structure and connected to the first dampening element and the second dampening element, such that the plate structure spans the first gap between the first dampening element and the second dampening element. The plate structure comprises an upper plate and a lower plate, wherein the lower plate and the upper plate are connected to each other in the forefoot region of the sole structure and in the heel region of the sole structure, and wherein the upper plate and the lower plate are separated from each other in a midfoot region of the sole structure by a second gap. The lower plate is connected to the first dampening element and the second dampening element, and wherein the upper plate is connected to the upper, such that the upper is spaced from the lower plate by the second gap in the midfoot region of the sole structure.

[0008] The first and second dampening elements are associated with the forefoot and the heel region, respectively, to cushion the wearer's foot during ground impact and force transfer. The second dampening element may be arranged for supporting the calcaneus bone of the wearer, and the forefoot region may be configured to support the phalanges and may also support a joint with the metatarsal bones as well as associated soft tissue. The first gap may separate the first and second dampening elements in an arch region of the foot, and the gap may extend from a lateral to a medial side of the article of footwear, such as to split the first and second dampening elements into distinct dampening elements. The first dampening element and/or the second dampening element may comprise medial and lateral ridges for defining respective recesses to receive the mid and/or forefoot portion and the heel portion of the wearer's foot.

[0009] The first gap may enable a relative movement of the first dampening element and the second dampening element during the gait cycle, specifically during the stance phase. The first gap may enable or facilitate a flexing of the sole structure through a dynamic increase and decrease of the first gap between the first dampening element and the second dampening element. With the first dampening element and the second dampening element separated by the first gap, the first dampening element and the second dampening element may be approach and distanced from each other and/or rotated relative to each other during the different stages of the stance phase.

[0010] In some examples, the first dampening element and the second dampening element are distinct from each other, such that relative movement of the first dampening element and the second dampening element

during flexion of the article of footwear is enabled.

[0011] The plate structure extends across the first gap to connect the first dampening element and the second dampening element. The plate structure is fixedly connected to the first dampening element in the forefoot region and to the second dampening element in the heel region, such that the plate structure may define a relative geometry of the first dampening element and the second dampening element. The upper plate may extend from a forefoot portion of the sole structure supporting the phalanges of the wearer up to a heel portion of the sole structure supporting the calcaneus bone of the wearer. The lower plate may extend below the upper plate over substantially the entire length of the upper plate, such as over 70%, over 80%, or over 90% of the length of the upper plate, along a longitudinal direction parallel to a ground surface. The plate structure may be joined directly with the first dampening element and the second dampening element, such as through a bonded connection, e.g. by gluing or welding. A relative motion of the first dampening element and the second dampening element may be mediated and/or constrained by the plate structure.

[0012] In some examples, the second gap is arranged in the midfoot region of the sole structure overlying the first gap.

[0013] During ground impact, the plate structure may be deformed based on a relative deformation of the upper plate and the lower plate, e.g. by reducing or shifting the second gap, such as to temporarily store energy in the plate structure. For example, the upper plate and the lower plate may approach each other to reduce the second gap at least in a portion of the plate structure to store energy in the plate structure. The upper plate and the lower plate may approach each other at different positions along a longitudinal direction of the article of footwear during different stages of the stance phase, with the longitudinal direction extending between the heel region and the forefoot region. As a result, the second gap may be shifted along the longitudinal direction, such as to transfer a stored force between different regions of the article of footwear, e.g. during a transition of the mid stance stage to the heel-off position. During the heel-off and toe-off stages, the stored energy in the plate structure may be released to assist in propelling the wearer forward and/or the plate structure may deform to assist the wearer in forming a longitudinal arch.

[0014] In some examples, the upper plate and a lower plate approach each other in the forefoot region of the article of footwear during the heel-off and/or toe-off stages, such that the second gap is shifted towards the heel region to promote a vertical motion of the heel away from the ground surface and/or to support a longitudinal arch of the wearer's foot. Additionally or alternatively, the upper plate and the lower plate may be adapted to provide tarsal arch support during the transition of the mid stance stage to the heel-off position as a result of the deformation of the plate structure in response to receiving

the weight of the user during the gait cycle.

[0015] In some examples, the maximum height of the second gap is increased during the heel-off and toe-off stages, while the upper plate and the lower plate approach each other in the forefoot region of the article of footwear.

[0016] During the deformation of the plate structure, the first gap can promote a relative motion of the heel region of the article of footwear with respect to the forefoot region, e.g. by facilitating a distancing and/or flexing of the first dampening element and the second dampening element with respect to each other, such as to assist in propelling the wearer forward and/or to accommodate a deformed configuration of the plate structure. In particular, the deformation of the plate structure may support and/or mimic the windlass mechanism of the human foot by increasing a longitudinal arch during a transition of the mid stance stage to the heel-off position.

[0017] During the foot transition from the mid stance stage to the toe-off stage, the toes generally move from a plantar flexed or neutral position to a dorsiflexed position. The dorsiflexion of the toes produces the windlass mechanism utilizing the plantar fascia. The "wrapping" of the plantar fascia around the metatarsal heads can "pull" the calcaneus towards the toes. The mid tarsal arches raise up off the ground and the foot transitions from a supple, pronated position to rigid, supinated position. The rigidity of the foot in this configuration generally enables forming a lever that is capable of propelling someone as they walk.

[0018] The deformation of the plate structure, in which the upper plate approaches the lower plate in the forefoot region, while the second gap is increased between the metatarsal bones and the tarsal bones, may assist in the wearer in the raising of the mid tarsal arches, such as to assist the wearer in propelling himself forward.

[0019] The support of the tarsal arches maybe particularly beneficial if the wearer suffers from plantar fasciitis, but can also be beneficial in the absence of a medical condition, e.g. to reduce fatigue or increase a kick effect during running to propel the wearer forward.

[0020] In some examples, the lower plate and/or the upper plate features a deflection element arranged between the metatarsal heads and the calcaneus for deflecting a midfoot portion of the upper plate away from the lower plate, when the upper plate approaches the lower plate in the forefoot region of the article of footwear. The deflection element may act as a fulcrum for the upper plate, and may promote an increase of the second gap close to the tarsal arch during the transition of the flatfoot stage to the heel-off stage and toe-off stage. In some examples, the deflection element is arranged on the lower plate to contact the upper plate during a deformation of the plate structure. In some examples, the lower plate comprises a deflection element protruding towards the upper plate, wherein the protrusion contacts the upper plate during a flexion of the article of footwear to increase a height of the second gap during flexion.

[0021] The relative motion of the first dampening element and the second dampening element can facilitate a deformation of the plate structure, such that the assistance to the wearer of the article of footwear through the rigid plate structure may be consolidated with an optimal cushioning during the different stages of the stance phase. In particular, the first gap between the first and second dampening elements may be free from material for forming an air gap.

[0022] In some examples, the sole structure further comprises a first outsole and a second outsole, the first outsole and the second outsole being connected to the first dampening element and the second dampening element, respectively, for forming a contact surface of the article of footwear with a ground surface.

[0023] The first outsole and the second outsole can be joined to the first dampening element and the second dampening element through a bonded connection, such as by molding the outsoles onto the dampening elements, or by gluing or welding. The outsoles may be formed of a harder material than the dampening elements for engaging the ground surface and may be spaced from the plate structure by the respective dampening elements. Each of the first and the second outsoles may be fixedly joined with the respective dampening elements, such as to define two separate contact surfaces for engaging the ground surface which can be separated by the first gap.

[0024] In some examples, the upper plate of the plate structure comprises a curved forefoot section arranged in a forefoot region of the sole structure, wherein the curved forefoot section forms a concave shape, in particular according to a radius of curvature extending throughout the forefoot region.

[0025] The curved forefoot section may promote an approach of the upper plate and the lower plate in the forefoot region and/or the increase of the second gap at the tarsal arches and/or may promote dorsiflexion of the toes to propel the wearer forward. The curved forefoot section may be combined with a curved section of the first outsole and/or the first dampening element, such as to provide toe spring for the article of footwear, whereby the curved forefoot section may consolidate a minimal thickness of the first dampening element for cushioning with a degree of toe spring, such as to assist the wearer in forward propulsion.

[0026] In some examples, a curvature of the upper plate reverses between the forefoot section and the heel region of the sole structure.

[0027] The curvature of the upper plate may reverse such as to predefine an arch portion for supporting tarsal arches of the wearer's foot. The point where the curvature of the upper plate reverses may be arranged between the metatarsal joint with the phalanges and the heel region.

[0028] In some examples, the lower plate comprises a forefoot section, which is connected to the upper plate in a forefoot region of the sole structure, a midfoot region, which is spaced from the upper plate by an air gap in the

vertical direction, and a heel section, which is connected to the upper plate in the heel region of the sole structure.

[0029] The lower plate may extend substantially linearly between the forefoot section and the heel section, such as to improve absorption of forces by the upper plate, wherein the lower plate may act as a counter support by fixing respective end portions of the upper plate in the forefoot region and the heel region of the sole structure.

[0030] In some examples, the lower plate extends straight between respective connections to the upper plate in the forefoot region and in the heel region of the sole structure.

[0031] The lower plate may feature a greater rigidity than the upper plate. In some examples a thickness of the lower plate is greater than a thickness of the upper plate in the vertical direction. A width of the lower plate in the lateral direction may be smaller than a width of the upper plate, such as to facilitate a tilt of the upper plate with respect to the lower plate about a longitudinal axis during a dynamic movement.

[0032] In some examples, the forefoot section and/or the heel section of the lower plate comprises a medial connection element and a lateral connection element, wherein each of the medial connection element and the lateral connection connect the midfoot section of the lower plate to the upper plate, and the medial connection element and the lateral connection are separated from each other in a transverse direction between a medial side and a lateral side of the article of footwear.

[0033] The medial connection element and the lateral connection element may be spaced from each other by a third gap extending in the transverse direction. For example, the lower plate may feature a forked structure in the forefoot section and/or the heel section, wherein the medial connection element and a lateral connection element may define respective prongs of the forked structure. The medial connection element and/or the lateral connection element may be joined to each other, such as to form a loop, or may extend separately towards respective connection regions with the upper plate.

[0034] A separation of the medial connection element and the lateral connection element may facilitate relative movement of the medial side and the lateral side of the upper plate, such as to respond to an uneven ground surface or asymmetric forces.

[0035] In some examples, the first dampening element and/or the second dampening element comprises a protrusion to slot into a third gap between the medial connection element and the lateral connection element of the lower plate.

[0036] The protrusion may extend through the third gap towards the upper plate, such as to contact the upper plate, when the upper plate and the lower plate approach each other, and/or to cushion an approach of the upper plate and the lower plate. In some examples, a protrusion of the second dampening element extends to the upper plate in the heel region for cushioning impact reaction

forces during the heel strike stage. The protrusion of the first dampening element and/or the second dampening element may further reduce rattling of the plate structure as a result of an approach of the upper plate and the lower plate.

[0037] In some examples, the protrusion slots into the third gap to form a positive connection between the lower plate and the respective dampening element in the lateral and/or the longitudinal direction. As part of manufacturing the article of footwear, the protrusion may be slotted into the gap between the medial connection element and the lateral connection element of the respective dampening element as part of or before forming a bonded connection between the lower plate and the respective dampening element. An upper surface of the lower plate, which faces the upper plate, may be free from the material of the dampening element.

[0038] In some examples, the second gap extends from a medial side to a lateral side of the sole structure and/or of the article of footwear.

[0039] The upper plate may be separated from the lower plate throughout a midfoot region of the article of footwear, with an empty gap region formed between the lower plate and the upper plate. The empty gap region may extend from the medial side to the lateral side of the article of footwear. In some examples, the second gap may be defined in a connecting passage extending from a medial side to a lateral side of the article of footwear, e.g. when viewed from the lateral or medial side of the article of footwear.

[0040] An inner sole board may be arranged on an upper surface of the upper plate between a wearer's foot and the upper plate. The inner sole board may support a wearer's foot and/or an insole above the upper plate. In some examples, the inner sole board is joined to the upper, e.g. through a bonded or stitching connection, and the upper may be connected to the upper plate via the inner sole board. In some examples, portions of the inner sole board are configured for relative movement to the upper plate, such as to facilitate deformation of the upper plate with respect to the lower plate during the gait cycle.

[0041] In some examples, the sole structure further comprises an inner sole board fixedly connected to the upper plate by a bonded connection.

[0042] In some examples, a fixed connection between the upper plate and the inner sole board may not extend over the entire surface area of the upper plate. In some examples, a fixed connection between the upper plate and inner sole board is limited to a medial and lateral side of the upper plate in the midfoot region, e.g. by fixing the inner sole board to the upper plate around the perimeter of the upper plate, e.g. in a region spaced from the perimeter by less than 2.5 cm, e.g. less than 2 cm, such as 1.5 cm. In some examples, the inner sole board is not connected to the upper plate in a portion of the upper plate in the midfoot region. When portions of the inner sole board in the midfoot region are free to move with

respect to the upper plate, the inner sole board may distribute a bending and/or stretching of the inner sole board over a larger area to accommodate a deformation of the upper plate during the gait cycle.

[0043] The inner sole board may feature openings and/or recesses in the midfoot region for increasing a flexibility of the inner sole board. For example, the inner sole board may feature holes and/or slits for reducing a rigidity of the inner sole board in the midfoot region, such as to accommodate the deformation of the upper plate during the gait cycle.

[0044] In some examples, the upper is connected to the upper plate via the inner sole board, wherein the connection between the inner sole board and the upper in particular comprises stitching. In some examples, the upper is not joined directly to the upper plate and/or the lower plate.

[0045] The upper may be fixedly bonded to the dampening elements to form an enclosure of the wearer's foot while enabling a greater deformation of the upper in response to a deformation of the plate structure.

[0046] In some examples, a footprint of the upper plate in the forefoot region and/or the heel region is smaller than a footprint of the first dampening element and/or the second dampening element, respectively, wherein the upper is connected to the first dampening element and/or the second dampening element for enabling relative movement of the upper plate and the upper.

[0047] In some examples, the article of footwear further comprises a foot cage connected to the upper plate in the midfoot region, in which the upper plate is separated from the lower plate by the second gap, but the foot cage is not connected to upper plate in the heel region and the forefoot region, where the lower plate and the upper plate are connected, wherein the foot cage overlies the upper and extends from the upper plate along a first arm towards a lacing of the article of footwear and along a second arm towards a heel receiving opening of the upper.

[0048] The foot cage may be formed of a material of the upper, such as a textile material, and may control a fit of the article of footwear in the midfoot region, wherein the foot cage may pull an upper arch of the wearer's foot towards the midfoot region of the upper plate through the lacing. The lacing may connect opposite portions of the foot cage on the medial side and the lateral side of the article of footwear.

[0049] In some examples, the first arm of the foot cage comprises an eyelet for receiving a lace.

[0050] Laces may be threaded through respective openings in the upper and the foot cage for adapting the fit of the article of footwear. In some examples, the foot cage is at least partially disconnected from the upper, such as to enable relative movement between the upper and the foot cage.

[0051] In some examples, the foot cage is connected to the upper plate on a lower side of the upper plate facing the lower plate.

[0052] For example, the foot cage may wrap around the upper plate for pulling the wearer's foot towards the upper plate via the lacing, such that medial and lateral sides of the foot cage are joined below the upper plate.

[0053] In some examples, the foot cage is connected to the upper plate on an upper side of the upper plate facing away from the lower plate.

[0054] For example, the foot cage may be bonded to the upper plate and/or the inner sole board. In some examples, the foot cage may wrap around the inner sole board for pulling the wearer's foot towards the midfoot region of the upper plate via the lacing, such that medial and lateral sides of the foot cage are joined below the inner sole board. Additionally or alternatively, the foot cage may be bonded to an upper surface of the upper plate, facing away from the lower plate, and/or connected to the inner sole board by a stitched or bonded connection.

[0055] In some examples, the second arm of the foot cage is fixed to the upper at the heel receiving opening.

[0056] For example, the foot cage may be Y-shaped on the medial side and/or the lateral side of the article of footwear, with a first arm extending towards the lacing and the second arm extending and fixed to a heel portion of the upper.

[0057] In some examples, the second arms of the medial and lateral sides of the foot cage wrap around a heel receiving opening of the upper.

DETAILED DESCRIPTION OF EMBODIMENTS

[0058] The features and numerous advantages of the articles of footwear and sole structures according to the present disclosure will best be understood from a detailed description of preferred embodiments with reference to the accompanying drawings, in which:

- Fig. 1 schematically illustrates an example of an article of footwear in a side view;
- Fig. 2 schematically illustrates a sectional side view of a sole structure according to an example;
- Fig. 3 schematically illustrates a sectional side view of another example of an article of footwear, which can be similar to the example of Fig. 1;
- Fig. 4 illustrates an example of a sole structure according to a schematic top view, similar to the sole structure illustrated in Fig. 3;
- Figs. 5A, B illustrates an example of a sole structure according to a schematic side view and a schematic bottom view, respectively, wherein the sole structure is similar to

the sole structure illustrated in Figs. 3 and 4;

Figs. 6A-7B illustrate different sectional views of an article of footwear with the sole structure illustrated in Figs. 5A, 5B; and

Figs. 8A-8C schematically illustrates three further examples of plate structures for sole structures.

[0059] Fig. 1 schematically illustrates an example of an article of footwear 10 in a side view. The article of footwear 10 comprises an upper 12 and a sole structure 14 connected to the upper 12. The sole structure 14 comprises a first dampening element 16 and a second dampening element 18, wherein the first dampening element 16 is configured to cushion a forefoot region 20 of the article of footwear 10, and the second dampening element 18 is configured for cushioning a heel region 22 of the article of footwear 10. The first dampening element 16 and the second dampening element 18 comprise a first outsole 24 and a second outsole 26, respectively, arranged on a bottom surface of the respective dampening element 16, 18 and configured to engage a ground surface 28 during use of the article of footwear 10.

[0060] The first dampening element 16 and the second dampening element 18 may be separate cushioning elements, which define a first gap between each other in the longitudinal direction 30 of the article of footwear 10. Each of the first dampening element 16 and the second dampening element 18 may be formed from a foamed material, such as EVA foam or (super-) critical EVA foam. In some examples, the materials of the first dampening element 16 and the second dampening element 18 are different, such as for providing different dampening and forced transfer characteristics for the heel region 22 and the forefoot region 20 of the article of footwear 10. In some examples, a density of the first dampening element 16 is greater than a density of the second dampening element 18. In some examples, an average and/or maximum thickness of the first dampening element 16 is smaller than an average and/or maximum thickness of the second dampening element 18. In some examples, the first dampening element 16 is formed of a (super-) critical EVA foam, whereas the second dampening element 18 is formed from a non-critical EVA foam. In some examples, the first dampening element 16 and/or the second dampening element 18 is formed from a layered material comprising a plurality of different dampening materials stacked on top of each other.

[0061] The first outsole 24 and the second outsole 26 may be formed from a material which is harder than the material of the first dampening element 16 and the second dampening element 18, respectively, such as to protect the sole structure 14 during ground impact of the article of footwear and for limiting abrasion. For example, the first and the second outsole 24, 26 may be

formed from a high carbon rubber material for protecting the dampening elements 16, 18 and providing traction for the sole structure 14.

[0062] As also illustrated in the schematic sectional side view of a sole structure 14 connected to an upper 12 in Fig. 2, the first dampening element 16 and the second element 18 are spaced by the first gap 31 and connected by a plate structure 32, the plate structure 32 comprising an upper plate 34 and a lower plate 36, each extending along the long to direction 30 from the heel region 22 to the forefoot region 20. The upper plate 34 and the lower plate 36 are firmly bonded to each other in the forefoot region 20 and in the heel region 22. In between the forefoot region 20 and the heel region 22, the upper plate 34 and the lower plate 36 are spaced from each other in the vertical direction thereby forming a second gap 38, with the upper plate 34 forming an arched structure over the lower plate 36.

[0063] The first dampening element 16 and the second dampening element 18 are each firmly bonded to the lower plate 36 as well as to end portions of the upper plate 34 in the forefoot region 20 and the heel region 22, in which the upper plate 34 is firmly bonded to the lower plate 36.

[0064] The upper plate 34 may be configured to support a foot of a wearer of the article of footwear 10 suspended over the lower plate 36, wherein a reaction force during ground impact may deform the plate structure 32 to advantageously support the wearer during walking or running with the article of footwear 10. The plate structure 32 may store energy as a result of a deformation of upper and lower plate 34, 36, and may dynamically improve arch support of a wearer's foot during the different stages of the stance phase of the gait cycle and/or provide a "kick"-effect for propelling the wearer forward.

[0065] The upper plate 34 and the lower plate 36 may be formed from a material which features a greater rigidity than the material of the dampening elements 16, 18. For example, the plate structure 32 may be formed from a glass fiber reinforced polymer material, such as fibre-glass reinforced polyamide, with a hardness of more than 50, in particular more than 70, such as about 75 or 80, on the shore hardness scale (D). The fiberglass content of the material of the plate structure may be greater than 20%, such as 30%. The material of the upper plate and/or the lower plate 36 may feature a tensile modulus of more than 3000 MPa, in particular more than 5000 MPa, such as 6000 MPa or more and/or a flexural modulus of more than 2000, in particular more than 4000 MPa, such as about 5000 MPa or more. As an example, the upper plate 34 and the lower plate 36 may be formed from fiberglass reinforced polyamide 11, with a fiberglass content of 30%, e.g. through an injection molding process.

[0066] The upper plate 34 may feature a thickness (i.e. perpendicular to a surface for supporting a wearer's foot), which is smaller than a thickness of the lower plate 36 for promoting a greater deformation of the upper plate 34

than the lower plate 36, which may act as an artificial tendon for supporting a longitudinal arch formed by the upper plate 34. In particular, the axial section modulus and the moment of inertia of the lower plate 36 should be higher compared to the axial section modulus and the moment of inertia of the upper plate 34. The axial section modulus is a measure of the resistance that an object offers to the development of internal bending stresses under load and depends for example on the shape and geometry of its cross sections, the height and width of an object.

[0067] As illustrated in Figs. 1 and 2, the upper 12 is fixedly connected to the first dampening element 16 and the second dampening element 18, e.g. through a firmly bonded connection, such as gluing or welding. The upper 12 may be connected to the upper plate 34 directly, e.g. through gluing, or maybe connected to an inner sole board (not shown in Fig. 1) overlying the upper plate 34 in the article of footwear 10, e.g. through a firmly bonded or stitched connection. For example, a Strobel board of a foamed material may overlie the upper plate 34 in the article of footwear 10 and may be connected to the upper 12 through stitching.

[0068] The upper 12 may be formed from a plurality of layers of textile material, such as natural or synthetic fiber-based materials, and may comprise mesh materials for providing a breathable fabric.

[0069] The upper 12 comprises a forefoot receiving cavity and a heel receiving opening 40 for receiving a wearer's foot close to the heel portion 22 of the article of footwear 10 and surrounding the wearer's foot, e.g. close to an ankle portion of the wearer's foot. A lacing 42 may be provided for adjusting a fit of the upper 12 around a wearer's foot, e.g. by adjusting a length of laces 43 threaded to respective eyelets of the upper 12. A front portion of the upper 12, fixedly connected to the first dampening element 16 may wrap around a forefoot and midfoot portion of the wearer's foot, and the upper 12 may further comprise a heel portion, fixedly connected to the second dampening element 18, for enclosing the heel of the wearer and comprising a heel connection arm 44 extending from a back of the article of footwear towards the lacing 42 article of footwear 10. The front portion and the heel portion of the upper 12 may be formed separate from each other.

[0070] In the illustrated example, a foot cage 46 is further provided, which may overlie the upper 12 and may extend vertically upwards from a midfoot portion of the upper plate 34 overlying the second gap 38. The foot cage 46 may be provided at a medial side of the article of footwear (shown in Fig. 1) as well as at a lateral side of the article of footwear, opposite the medial side. The foot cage 46 comprises a first arm 48 and a second arm 50 extending upward from the upper plate 34 and forming a Y-shape.

[0071] The first arm 48 extends from the upper plate 34 towards the lacing 42 and features foot cage eyelets 52 for receiving laces 43 of the lacing 42. As illustrated in Fig.

1, the first arm 48 may extend through a bridge portion 54 of the upper 12, which may extend from the first dampening element 16 towards the heel receiving opening 40 overlying the first arm 48. The bridge portion 54 may connect the first dampening element 16 to an eyelet of the lacing 42 arranged above the foot cage eyelets 52, and maybe connected to the heel connection arm 44.

[0072] The second arm 50 may extend to a backside of the upper 12 above the calcaneus bone of the wearer, and may in some examples form an arc from the medial side to the lateral side of the article of footwear 10 around the heel of the wearer.

[0073] The foot cage 46 may improve a fit of the article of footwear 10 by retaining the wearer's foot over the upper plate 34, while the upper plate 34 is deformed, such as to improve force transmission from the upper plate 34 to the wearer's foot, e.g. as part of providing assistance of the wearer during the stance phase of the gait cycle as a result of the deformation and/or relaxation of the upper plate 34.

[0074] Fig. 3 schematically illustrates a sectional side view of an example of an article of footwear 10, which may run through a center line of the article of footwear 10 illustrated in Fig. 1. The sole structure 14 comprises separate first and second dampening elements 16, 18 spaced by a first gap 31 in the longitudinal direction 31 and connected to first and second outsole elements 24, 26, respectively, for engaging a ground surface 28. The sole structure 14 comprises a plate structure 32 comprising an upper plate 34 and a lower plate 36 arranged below the upper plate 34. The upper plate 34 and the lower plate 36 are firmly bonded to each other in a front section 56 and a heel section 58 of the sole structure 14, which may be arranged at opposite ends of the sole structure 14 with respect to the longitudinal direction 30. In the midfoot region, the upper plate 34 and the lower plate 36 are spaced from each other, forming a second gap 38 extending along the vertical direction.

[0075] The sole structure 14 illustrated in Fig. 3 further comprises a deflection element 60 arranged between the forefoot section 56 and the heel section 58. The deflection element 60 is firmly bonded to the lower plate 36 and protrudes towards the upper plate 34. The deflection element 60 may act as a fulcrum for the upper plate 34 to promote an increase of a height a longitudinal arch portion 62 arranged between the heel section 58 and the deflection element 60 in response to a weight applied to a phalange supporting portion 64 arranged between the deflection element and the forefoot section 56 and configured to support the phalanges and/or distal portions of the metatarsal bones of a wearer's foot. Specifically, as weight from a wearer's forefoot portion is applied to the phalange supporting portion 64 of the upper plate 34, the upper plate 34 may locally approach the lower plate 36 to reduce the second gap 38 in the phalange supporting portion 64 of the sole structure 14. As a result, the upper plate 34 will be deflected by the deflection portion 60 as a fulcrum, deflecting the longitudinal arch portion 62 of the

upper plate away from the lower plate 36 and increasing the second gap 38 in the longitudinal arch portion 62 of the sole structure 14.

[0076] As a result, the sole structure 14 of Fig. 3 may mimic the windlass mechanism of the human foot for increasing a height of the longitudinal arches of the wearer's foot in response to the shifting reaction forces arising during the stance phase, e.g. during the transition from the midstance stage to the toe-off stage. As illustrated in Fig. 3, the deflection element 60 may feature an upper side with a curved cross section along the longitudinal direction 30 to provide a smooth surface geometry for deflecting the upper plate 34, as weight is shifted onto the forefoot portion 20 of the sole structure 14.

[0077] As further illustrated in Fig. 3, the first dampening element 16 and the second dampening element 18 may comprise a first protruding portion 66 and a second protruding portion 68, respectively, protruding past the lower plate 36 towards a bottom surface of the upper plate 34, the bottom surface facing the lower plate 36. For example, the lower plate 36 may comprise an opening between a medial side and a lateral side of the lower plate 36, such as a cutout or slot, for receiving the protruding portion 66, 68 during an assembly of the article of footwear 10, with the protruding portion 66, 68 extending through the opening.

[0078] Additionally or alternatively, a dampening material may be (selectively) arranged between the lower plate 36 and the upper plate 34 to prevent rattling and/or to provide dampening against shocks when the lower plate 36 and the upper plate 34 are brought in contact with each other.

[0079] An upper surface of the first protruding portion 66 and/or the second protruding portion 68 may be arranged between the upper plate 34 and an upper surface of the lower plate 36, enabling the upper plate 34 to contact and compress the first protruding portion 66 and/or the second protruding portion 68, when the upper plate 34 and the lower plate 36 approach each other. The first protruding portion 66 and/or the second protruding portion 68 may be configured to allow the upper plate 34 to detach from the first protruding portion 66 and/or the second protruding portion 68, when the upper plate 34 and the lower plate 36 are distanced from each other, e.g. as part of the deformation of the plate structure 32.

[0080] Fig. 4 illustrates an example of a sole structure 14 according to a schematic top view similar to the sole structure 14 illustrated in Fig. 3, with the plate structure 32 drawn in solid lines and the dampening elements 16, 18 illustrated with dashed lines.

[0081] The lower plate 36 features a forked structure on both ends with respect to longitudinal direction 30, wherein forefoot connection elements 70a, 70b extend from a central structure 72 of the lower plate 36 towards the forefoot section 56 of the plate structure 32, and heel connection elements 74a, 74b extend from the central structure 72 of the lower plate 36 to the heel section 58 of the plate structure 32. Each of the forefoot connection

elements 70a, 70b is firmly bonded with the upper plate 34 in the forefoot section 56, and each of the heel connection elements 74a, 74b is firmly bonded with the upper plate 34 in the heel section 58 of the plate structure 32.

[0082] The forked structure of the lower plate may facilitate an asymmetric flexing of the plate structure 32 between a medial and a lateral side of the article of footwear 10.

[0083] The heel connection elements 74a, 74b are connected to each other in the heel section 58, forming a cut out portion of the lower plate through which a protruding portion 68 of the second dampening element 18 can protrude. The forefoot connection elements 70a, 70b are separate from each other and are independently bonded to the upper plate 34. As a result of the different geometry, the forefoot connection elements 70a, 70b may define a different transverse flexing behavior than the heel connection elements 74a, 74b. In the slot defined between the forefoot connection elements 70a, 70b, a protruding portion 66 (not shown in Fig. 4) of the first dampening element 16 may protrude towards the upper plate 34, e.g. to prevent rattling when the upper plate 34 approaches the lower plate 36 in the phalange supporting portion 64.

[0084] The deflection element 60 is arranged between the central structure 72 and the forefoot connection elements 70a, 70b to provide a fulcrum for the upper plate 34. In the illustrated example, the deflection element 60 is provided at a longitudinal end of the central structure 72 between the forefoot connection elements 70a, 70b. However, in some examples, the deflection element 60 may bridge a gap between the forefoot connection elements 70a, 70b and may be spaced from the central structure 72 by a gap. In some examples, the deflection element 60 is arranged on the central structure 72 of the lower plate 36 and is spaced from the longitudinal front end of the central structure 72, i.e. shifted towards the heel region 22 of the sole structure 14.

[0085] As illustrated in the insert Fig. 4(a), illustrating a sectional view through the deflection element 60 along a transverse direction of the sole structure 14 of Fig. 4, the deflection element 60 may feature an upper side which is curved along a transverse direction, such as to enable a tilting and/or rolling motion of the upper plate 34 about the longitudinal direction 30.

[0086] Figs. 5A, 5B illustrates an example of a sole structure 14 according to a schematic side view and a schematic bottom view, respectively, wherein the sole structure 14 is similar to the sole structure 14 illustrated in Fig. 3 and 4. In Figs. 5A, 5B, the dashed line indicated with "A-A'" corresponds to the sectional view illustrated in Fig. 3. The sole structure 14 in the illustrated example comprises first and second dampening elements 16, 18 spaced by a first gap 31, wherein the first dampening element 16 defines a recess between longitudinal ends of the first dampening element 16 arranged on medial and lateral sides of the article of footwear 10. The second dampening element 18 protrudes into the recess defined

between the longitudinal ends of the first dampening element 16, with the first dampening element 16 and the second dampening element 18 separate from each other, such as to enable independent movement of the dampening elements 16, 18.

[0087] The dampening elements 16, 18 are connected by the plate structure 32 comprised of an upper plate 34 and a lower plate 36 with the deflection element 60 arranged therebetween as in the examples of Figs. 3 and 4.

[0088] The first dampening element 16 and the first outsole 24 curve upward towards the front tip of the article of footwear 10 to provide a toe spring during walking or running. The plate structure 32 curves upward in the forefoot region 20 between the deflection element 60 and the front tip of the plate structure 32, e.g. to compensate for the increased rigidity of the plate structure 32 with respect to conventional articles of footwear in combination with the toe spring of the article of footwear 10, wherein a height of the toe spring, by which the front of the lower plate 36 curves up from a bottom part of the lower plate 36, when the article of footwear is free from external forces, is at least 4 mm. In some examples, the lower plate 36 and/or the upper plate 34 monotonically curve upward between the deflection element 60 and the front tip of the plate structure 32.

[0089] The first dampening element 16 and the second dampening element 18 further comprise vertically protruding ridges protruding vertically upward over the upper plate 34 for defining respective receptacles for receiving the forefoot and the heel of the wearer, respectively. In some examples, e.g. as illustrated in Fig. 1, a portion of the first dampening element 16 may extend along the upper plate 34 up to a position arranged above the second dampening element 18, such as to protect medial and lateral side portions of the midfoot of the foot of the wearer along the longitudinal direction 30 of the article of footwear 10 and/or to provide a flexible attachment geometry for the upper 12 over a greater extension along the longitudinal direction 30.

[0090] Figs. 6A-7B illustrate different sectional views of an article of footwear with the sole structure 14 illustrated in Figs. 5A, 5B as specified by the dashed lines indicated with "B-B'"-"E-E'", respectively.

[0091] Fig. 6A illustrates a sectional view along dashed line "B-B'" in Figs. 5A, 5B, corresponding to a transverse cut through the forefoot portion 20 of the article of footwear 10. In the illustrated figure, the first dampening element 16 comprises a recessed portion for receiving the lower plate 36. In particular, forefoot connection elements 70a, 70b are received in respective recessed portions of the first dampening element 16. A protruding portion 66 protrudes through a slot between the forefoot connection elements 70a, 70b towards the upper plate 34, wherein an upper surface of the protruding portion 66 may be arranged above the upper surface of the forefoot connection elements 70a, 70b.

[0092] As further illustrated in Fig. 6A, the first dampening element 16 may additionally feature raised struc-

tures 76a, 76b arranged on the lateral and medial sides of the article of footwear, which may protrude vertically above an upper surface of the lower plate 36, e.g. above upper surfaces of the forefoot connection elements 70a, 70b. As a result, the lower plate 36 may be slotted into a recessed portion of the first dampened element 16, which is bounded in a transverse direction of the article of footwear 10 on both sides, in particular forming respective recessed portions for receiving the forefoot connection elements 70a, 70b.

[0093] In some examples, the upper plate 34 may rest on the protruding portion 66, when the article of footwear 10 is placed on an even ground surface 28, free from external forces. In some examples, the upper plate 34 may be free to move respect to the protruding portion 66 and the raised structures 76a, 76b, such as to move towards or away from the lower plate 36. In some examples, the upper plate 34 is fixedly bonded to the raised structures 76a, 76b.

[0094] In addition, as illustrated in Fig. 6A the first dampening element 16 may comprise medial and lateral ridges 78a, 78b protruding further than the raised structures 76a, 76b, such as past an upper surface of the upper plate 34 for providing transverse dampening portions for protecting the foot of a wearer of the article of footwear 10 and/or for providing an attachment surface for firmly bonding the upper 12 to the first dampening element 16.

[0095] Fig. 6B illustrates a sectional view along dashed line "C-C" in Figs. 5A, 5B, corresponding to a transverse cut through the midfoot region of the article of footwear 10. In illustrated section, the first dampening element 16 has forked into medial and lateral extensions 16a, 16b featuring respective extensions of the raised structures 76a, 76b. The lower plate 36 features a central structure 72 suspended between the medial and lateral extensions 16a, 16b of the first dampening element 16.

[0096] In the illustration, the upper plate 34 rests on and may be bonded to the raised structures 76a, 76b. In response to a weight transfer from the forefoot of the wearer onto the forefoot region 20 of the article of footwear 10, the upper plate 34 may be approached towards the central structure 72 of the lower plate 36, which may be accompanied by a deflection of the medial and lateral extensions 16a, 16b towards the ground surface 28. To enable the deflection of the medial and lateral extensions 16a, 16b towards the ground surface 28, the medial and lateral extensions 16a, 16b may curve up from the ground surface 28 in the midfoot portion towards the heel region 22, e.g. behind the deflection element 60 and/or behind the joint between the metatarsal bones and the phalanges.

[0097] However, as also discussed in conjunction with Fig. 6A, the upper plate 34 may alternatively be free to move respect with respect to the raised structures 76a, 76b, such as to move towards and/or lift from the raised structures 76a, 76b during a deformation of the plate structure 32, in some examples.

[0098] Fig. 7A illustrates a sectional view along dashed line "C1-C2" in Figs. 5A, 5B, corresponding to a transverse cut through the midfoot region of the article of footwear 10 closer to the heel region 22 than the sectional view along dashed line "C-C". In the illustrated figure, a portion of the second dampening element 18 protrudes into the gap defined between the medial and lateral extensions 16a, 16b of the first dampening element 16 and supports the lower plate 36. Specifically, the lower plate 36 may be fixedly bonded to the second dampening element 18.

[0099] Fig. 7B illustrates a sectional view along dashed line "D1-D2" in Figs. 5A, 5B, corresponding to a transverse cut through a transition between the midfoot region and the heel region 22 of the article of footwear 10. In illustrated sectional view, the lower plate 36 transitions towards a forked configuration with heel connection elements 74a, 74b arranged on medial and lateral sides of the article of footwear 10. The lower plate 36 rests on and is fixedly bonded to the second dampening element 18. The upper plate 34 is no longer connected to and/or supported by the first dampening element 16 in the illustrated sectional view.

[0100] A protruding portion 68 protrudes through a transverse gap defined between the heel connection elements 74a, 74b towards the upper plate 34, wherein the protruding portion 68 may contact the upper plate 34 in the absence of external forces. The upper plate 34 may rest on the protruding portion 68 and may be free to move respect to the protruding portion 68 such as to move away from the lower plate 36 during deformation of the plate structure 32. In response to a weight transfer onto the respective portion of the upper plate 34, the protruding portion 6 may be compressed to absorb a portion of the weight resting on the upper plate 34, e.g. for cushioning a ground impact of the article of footwear 10 during walking or running. In the illustrated example, the protruding portion 68 slots into the transverse gap between the heel connection elements 74a, 74b to form a positive connection with the lower plate 36.

[0101] Fig. 6C illustrates a sectional view along dashed line "D-D" in Figs. 5A, 5B, corresponding to a transverse cut through the heel region 22 of the article of footwear 10. The geometry of the sole structure 14 is similar to the geometry illustrated in Fig. 7 B, however a height of the protruding portion 68 is reduced, following a smaller gap between the upper plate 34 and the lower plate 36. In other words, the protruding portion 68 of the second dampening element 18 may be slanted with respect to the longitudinal direction 30 (extending into the plane of projection of Figs. 6A-7B). In particular, the protruding portion 68 may follow a curvature of the upper plate 34 for supporting the upper plate 34 above the lower plate 36, e.g. for cushioning and approach of the upper plate 34 and the lower plate 36 in the heel region 22 of the article of footwear 10.

[0102] Fig. 6D illustrates a sectional view along dashed line "E-E" in Figs. 5A, 5B, corresponding to a transverse

cut through the heel region 22 of the article of footwear 10 in the heel section 58 of the plate structure 32. In the illustrated sectional view, the upper plate 34 and the lower plate 36 are bonded to each other and are jointly received in a recess of the second dampening element 18. The second dampening element 18 features medial and lateral ridges 80a, 80b arranged on the medial and lateral sides of the article of footwear 10 for receiving and laterally cushioning the heel of a wearer of the article of footwear 10. The upper 12 may be bonded to inner surfaces of the medial and lateral ridges 80a, 80b of the second dampening element 18 for reliably retaining the heel of the wearer, while enabling flexibility between the upper 12 and the plate structure 32 during walking or running. The medial and lateral ridges 80a, 80b may extend around the heel of the wearer to form an U-shaped ridge at the back side of the sole structure 14.

[0103] Figs. 8A-8C schematically illustrates three further examples of plate structures 32 for integration in a sole structure 14 of an article of footwear 10 comprising first and second dampening elements 16, 18 for cushioning a forefoot and heel region 20, 22, respectively, according to a bottom view.

[0104] In the example of Fig. 8A, both the lower plate 36 and the upper plate 34 are forked in a forefoot region 20 of the article of footwear 10, with the upper plate 34 comprising medial and lateral prongs 82a, 82b, respectively, extending towards respective forefoot sections 56, where the medial and lateral prongs 82a, 82b are bonded to corresponding sections of the forefoot connection portions 70a, 70b.

[0105] The heel connection portions 74a, 74b define an oval cut out portion between each other, with a tapered front tip. The oval cut out portion with the tapered front tip may facilitate fitting a protruding portion 68 of the second dampening element 18 during fabrication.

[0106] In the example of Fig. 8B, the lower plate 36 and the upper plate 34 feature a similar geometry as in the example of Fig. 8A, with the upper plate 34 further comprising elongated slots 84, 86 extending along the longitudinal direction 30 of the article of footwear 10 and through the upper plate 34. The elongated slots 84, 86 may reduce a flexibility in the corresponding sections of the upper plate 34 for facilitating a deformation of the upper plate 34. The elongated slot geometry may promote a transverse bending mode of the upper plate 34 for adapting the article of footwear 10 to different users and/or for compensating an uneven ground surface 28.

[0107] In the illustrated example, the elongated slots 84, 86 are substantially arranged in a back half of the upper plate 34 in the midfoot region and behind the deflection element 60. The elongated slots 84, 86 arranged behind deflection element 60 may preserve a rigidity of the upper plate in the forefoot region 22, which may promote the formation of an increased tarsal arch, with the deflection element 60 acting as a fulcrum between a forefoot portion of an effectively higher rigidity than the mid foot portion of the upper plate 34. However,

in some examples, e.g. when the upper plate 34 does not feature a forked structure, further elongated slots 84, 86 may be arranged in the phalange supporting portion 64 for varying an effective rigidity of the upper plate 34.

[0108] Further, the elongated slots 84, 86 are evenly distributed from a medial side to a lateral side of the article of footwear 10. However, in some examples, the upper plate 34 may predominantly feature medial elongated slots 84 or predominantly feature lateral elongated slots 86 for adapting an effective rigidity of the upper plate 34 in a medial half and a lateral half of the plate structure 32, respectively. For example, a density and/or length of the elongated slots 84, 86 may differ between the medial half and the lateral half of the upper plate 34. As an example, a length of the elongated slots may increase towards the medial and/or lateral edges of the upper plate 34.

[0109] Further, in comparison to the example illustrated in Fig. 8A, the cut out portion between the heel connection elements 74a, 74b features a front part extending substantially perpendicular to the longitudinal direction 30, e.g. to reduce a local cushioning of the midfoot portion by a protruding portion 68 protruding through the cut out portion between the heel connection elements 74a, 74b, such as to improve force transfer and/or energy storage during the later stages of the stance phase.

[0110] Fig. 8C illustrates a further example of a plate structure 32, in which the upper plate 34 does not feature a forked structure. Instead, the lower plate 36 features an elongated forked structure, such that the deflection element 60 is arranged and bridges a gap between the forefoot connection elements 70a, 70b. In other words, the deflection element 60 is bonded to the forefoot connection portions 70a, 70b on opposite sides and is spaced from a central structure 72 of the lower plate by a gap in the longitudinal direction 30 of the plate structure 32.

[0111] In the example of Fig. 8C, the forefoot connection elements 70a, 70b are further joined to each other in the forefoot section 56 of the plate structure 32, forming a loop with the central structure 72, which may increase a rigidity of the forefoot section 56.

[0112] The skilled person will appreciate that the different features of the detailed examples described above may be isolated and combined freely with each other in examples implementing the above disclosure. The skilled person will further appreciate that the foot of the wearer and the various bones are provided for specifying the geometry of the article of footwear 10, when the fit of the article of footwear 10 is properly adapted to the wearer.

[0113] The description of the preferred embodiments and the figures merely serve to illustrate the invention and the beneficial effects associated therewith, but should not be understood to imply any limitation. The scope of the invention is to be determined solely by the appended claims.

LIST OF REFERENCE SIGNS

[0114]

10	article of footwear	5
12	upper	
14	sole structure	
16	first dampening element	
18	second dampening element	
20	forefoot region	10
22	heel region	
24	first outsole	
26	second outsole	
28	ground surface	
30	longitudinal direction	15
32	plate structure	
34	upper plate	
36	lower plate	
38	second gap	
40	heel receiving opening	20
42	lacing	
43	laces	
44	heel connection arm	
46	foot cage	
48	first arm	25
50	second arm	
52	foot cage eyelets	
54	bridge portion	
56	forefoot section	
58	heel section	30
60	deflection element	
62	arch portion	
64	phalange supporting portion	
66	first protruding portion	
68	second protruding portion	35
70a, 70b	forefoot connection elements	
72	central structure	
74a, 74b	heel connection elements	
76a, 76b	raised structures	
78a, 78b	medial and lateral ridges	40
80a, 80b	medial and lateral ridges	
82a, 82b	medial and lateral prongs of the upper plate	
84, 86	medial and lateral elongated slots	

Claims

1. An article (10) of footwear comprising an upper, and a sole structure (14) connected to the upper, wherein the sole structure (14) comprises:

a first dampening element (16) to cushion a forefoot region (20) of the sole structure (14);
a second dampening element (18) to cushion a heel region (22) of the sole structure (14), wherein the first dampening element (16) and the second dampening element (18) are spaced by a first gap (31) between the forefoot region (20) and the heel region (22);

a plate structure (32) extending between the forefoot region (20) and the heel region (22) of the sole structure (14) and connected to the first dampening element (16) and the second dampening element (18), such that the plate structure (32) spans the first gap (31) between the first dampening element (16) and the second dampening element (18);

wherein the plate structure (32) comprises an upper plate (34) and a lower plate, wherein the lower plate and the upper plate (34) are connected to each other in the forefoot region (20) of the sole structure (14) and in the heel region (22) of the sole structure (14), and wherein the upper plate (34) and the lower plate are separated from each other in a midfoot region of the sole structure (14) by a second gap (38);

wherein the lower plate is connected to the first dampening element (16) and the second dampening element (18), and wherein the upper plate (34) is connected to the upper, such that the upper is spaced from the lower plate by the second gap (38) in the midfoot region of the sole structure (14).

2. The article (10) of footwear of claim 1, wherein the first dampening element (16) and the second dampening element (18) are distinct from each other, such that relative movement of the first dampening element (16) and the second dampening element (18) during flexion of the article (10) of footwear is enabled.

3. The article (10) of footwear of claim 1 or 2, wherein the second gap (38) extends from a medial side to a lateral side of the sole structure and/or of the article (10) of footwear; and/or wherein the second gap (38) is arranged in the midfoot region of the sole structure (14) overlying the first gap (31).

4. The article (10) of footwear of any one of the preceding claims, wherein the sole structure (14) further comprises a first outsole (24) and a second outsole (26), the first outsole (24) and the second outsole being connected to the first dampening element (16) and the second dampening element (18), respectively, for forming a contact surface of the article (10) of footwear with a ground surface (28).

5. The article (10) of footwear of any one of the preceding claims, wherein the upper plate (34) of the plate structure (32) comprises a curved forefoot section arranged in a forefoot region (20) of the sole structure (14), wherein the curved forefoot section forms a concave shape, in particular according to a radius of curvature extending throughout the forefoot region (20),

wherein a curvature of the upper plate (34) optionally reverses between the forefoot section (56) and the heel region (22) of the sole structure (14).

6. The article (10) of footwear of any one of the preceding claims, wherein the lower plate comprises a forefoot section (56), which is connected to the upper plate (34) in a forefoot region (20) of the sole structure (14), a midfoot region, which is spaced from the upper plate (34) by an air gap in the vertical direction, and a heel section (58), which is connected to the upper plate (34) in the heel region (22) of the sole structure (14). 5
7. The article (10) of footwear of claim 6, wherein the forefoot section (56) and/or the heel section (58) of the lower plate comprises a medial connection element and a lateral connection element, wherein each of the medial connection element and the lateral connection connect the midfoot section of the lower plate to the upper plate (34), and the medial connection element and the lateral connection are separated from each other in a transverse direction between a medial side and a lateral side of the article (10) of footwear. 10
8. The article (10) of footwear of claim 7, wherein the first dampening element (16) and/or the second dampening element (18) comprises a protrusion to slot into a third gap between the medial connection element and the lateral connection element of the lower plate. 15
9. The article (10) of footwear of any one of the preceding claims, wherein the lower plate extends straight between respective connections to the upper plate (34) in the forefoot region (20) and in the heel region (22) of the sole structure (14). 20
10. The article (10) of footwear of any one of the preceding claims, wherein the lower plate comprises a deflection element (60, 62) protruding towards the upper plate (34), wherein the protrusion contacts the upper plate (34) during a flexion of the article (10) of footwear to increase a height of the second gap (38) during flexion. 25
11. The article (10) of footwear of any one of the preceding claims, wherein the sole structure (14) further comprises an inner sole board fixedly connected to the upper plate (34) by a bonded connection, wherein the upper is connected to the upper plate (34) via the inner sole board, wherein the connection between the inner sole board and the upper optionally comprises stitching. 30
12. The article (10) of footwear of any one of the preceding claims, wherein a footprint of the upper plate 35

(34) in the forefoot region (20) and/or the heel region (22) is smaller than a footprint of the first dampening element (16) and/or the second dampening element (18), respectively, wherein the upper is connected to the first dampening element (16) and/or the second dampening element (18) for enabling relative movement of the upper plate (34) with respect to the upper. 40

13. The article (10) of footwear of any one of the preceding claims, wherein the article (10) of footwear further comprises a foot cage (46) connected to the upper plate (34) in the midfoot region, in which the upper plate (34) is separated from the lower plate by the second gap (38), but the foot cage (46) is not connected to upper plate (34) in the heel region (22) and the forefoot region (20), where the lower plate and the upper plate (34) are connected, wherein the foot cage (46) overlies the upper and extends from the upper plate (34) along a first arm (48) towards a lacing (42) of the article (10) of footwear and along a second arm (50) towards a heel receiving opening of the upper. 45
14. The article (10) of footwear of claim 13, wherein the foot cage (46) is connected to the upper plate (34) on a lower side of the upper plate (34) facing the lower plate; or wherein the foot cage (46) is connected to the upper plate (34) on an upper side of the upper plate (34) facing away from the lower plate. 50
15. The article (10) of footwear of any one of claims 13 or 14, wherein the second arm (50) of the foot cage (46) is fixed to the upper at the heel receiving opening; and/or wherein the first arm (48) of the foot cage (46) comprises an eyelet (52) for receiving a lace (43). 55

Amended claims in accordance with Rule 137(2) EPC.

1. An article (10) of footwear comprising an upper, and a sole structure (14) connected to the upper, wherein the sole structure (14) comprises:

a first dampening element (16) to cushion a forefoot region (20) of the sole structure (14);
a second dampening element (18) to cushion a heel region (22) of the sole structure (14), wherein the first dampening element (16) and the second dampening element (18) are spaced by a first gap (31) between the forefoot region (20) and the heel region (22);
a plate structure (32) extending between the forefoot region (20) and the heel region (22) of the sole structure (14) and connected to the first dampening element (16) and the second dampening element (18), such that the plate struc-

- ture (32) spans the first gap (31) between the first dampening element (16) and the second dampening element (18);
 wherein the plate structure (32) comprises an upper plate (34) and a lower plate, wherein the lower plate and the upper plate (34) are connected to each other in the forefoot region (20) of the sole structure (14) and in the heel region (22) of the sole structure (14), and wherein the upper plate (34) and the lower plate are separated from each other in a midfoot region of the sole structure (14) by a second gap (38);
 wherein the lower plate is connected to the first dampening element (16) and the second dampening element (18), and wherein the upper plate (34) is connected to the upper, such that the upper is spaced from the lower plate by the second gap (38) in the midfoot region of the sole structure (14),
 wherein the lower plate comprises a deflection element (60, 62) protruding towards the upper plate (34), wherein the protrusion contacts the upper plate (34) during a flexion of the article (10) of footwear to increase a height of the second gap (38) during flexion.
2. The article (10) of footwear of claim 1, wherein the first dampening element (16) and the second dampening element (18) are distinct from each other, such that relative movement of the first dampening element (16) and the second dampening element (18) during flexion of the article (10) of footwear is enabled.
 3. The article (10) of footwear of claim 1 or 2, wherein the second gap (38) extends from a medial side to a lateral side of the sole structure and/or of the article (10) of footwear; and/or
 wherein the second gap (38) is arranged in the midfoot region of the sole structure (14) overlying the first gap (31).
 4. The article (10) of footwear of any one of the preceding claims, wherein the sole structure (14) further comprises a first outsole (24) and a second outsole (26), the first outsole (24) and the second outsole being connected to the first dampening element (16) and the second dampening element (18), respectively, for forming a contact surface of the article (10) of footwear with a ground surface (28).
 5. The article (10) of footwear of any one of the preceding claims, wherein the upper plate (34) of the plate structure (32) comprises a curved forefoot section arranged in a forefoot region (20) of the sole structure (14), wherein the curved forefoot section forms a concave shape, in particular according to a radius of curvature extending throughout the forefoot region (20),
 wherein a curvature of the upper plate (34) optionally reverses between the forefoot section (56) and the heel region (22) of the sole structure (14).
 6. The article (10) of footwear of any one of the preceding claims, wherein the lower plate comprises a forefoot section (56), which is connected to the upper plate (34) in a forefoot region (20) of the sole structure (14), a midfoot region, which is spaced from the upper plate (34) by an air gap in the vertical direction, and a heel section (58), which is connected to the upper plate (34) in the heel region (22) of the sole structure (14).
 7. The article (10) of footwear of claim 6, wherein the forefoot section (56) and/or the heel section (58) of the lower plate comprises a medial connection element and a lateral connection element, wherein each of the medial connection element and the lateral connection connect the midfoot section of the lower plate to the upper plate (34), and the medial connection element and the lateral connection are separated from each other in a transverse direction between a medial side and a lateral side of the article (10) of footwear.
 8. The article (10) of footwear of claim 7, wherein the first dampening element (16) and/or the second dampening element (18) comprises a protrusion to slot into a third gap between the medial connection element and the lateral connection element of the lower plate.
 9. The article (10) of footwear of any one of the preceding claims, wherein the lower plate extends straight between respective connections to the upper plate (34) in the forefoot region (20) and in the heel region (22) of the sole structure (14).
 10. The article (10) of footwear of any one of the preceding claims, wherein the sole structure (14) further comprises an inner sole board fixedly connected to the upper plate (34) by a bonded connection, wherein the upper is connected to the upper plate (34) via the inner sole board, wherein the connection between the inner sole board and the upper optionally comprises stitching.
 11. The article (10) of footwear of any one of the preceding claims, wherein a footprint of the upper plate (34) in the forefoot region (20) and/or the heel region (22) is smaller than a footprint of the first dampening element (16) and/or the second dampening element (18), respectively, wherein the upper is connected to the first dampening element (16) and/or the second dampening element (18) for enabling relative movement of the upper plate (34) with respect to the upper.

12. The article (10) of footwear of any one of the preceding claims, wherein the article (10) of footwear further comprises a foot cage (46) connected to the upper plate (34) in the midfoot region, in which the upper plate (34) is separated from the lower plate by the second gap (38), but the foot cage (46) is not connected to upper plate (34) in the heel region (22) and the forefoot region (20), where the lower plate and the upper plate (34) are connected, wherein the foot cage (46) overlies the upper and extends from the upper plate (34) along a first arm (48) towards a lacing (42) of the article (10) of footwear and along a second arm (50) towards a heel receiving opening of the upper.
13. The article (10) of footwear of claim 12, wherein the foot cage (46) is connected to the upper plate (34) on a lower side of the upper plate (34) facing the lower plate; or
wherein the foot cage (46) is connected to the upper plate (34) on an upper side of the upper plate (34) facing away from the lower plate.
14. The article (10) of footwear of claim 12 or 13, wherein the second arm (50) of the foot cage (46) is fixed to the upper at the heel receiving opening; and/or
wherein the first arm (48) of the foot cage (46) comprises an eyelet (52) for receiving a lace (43).

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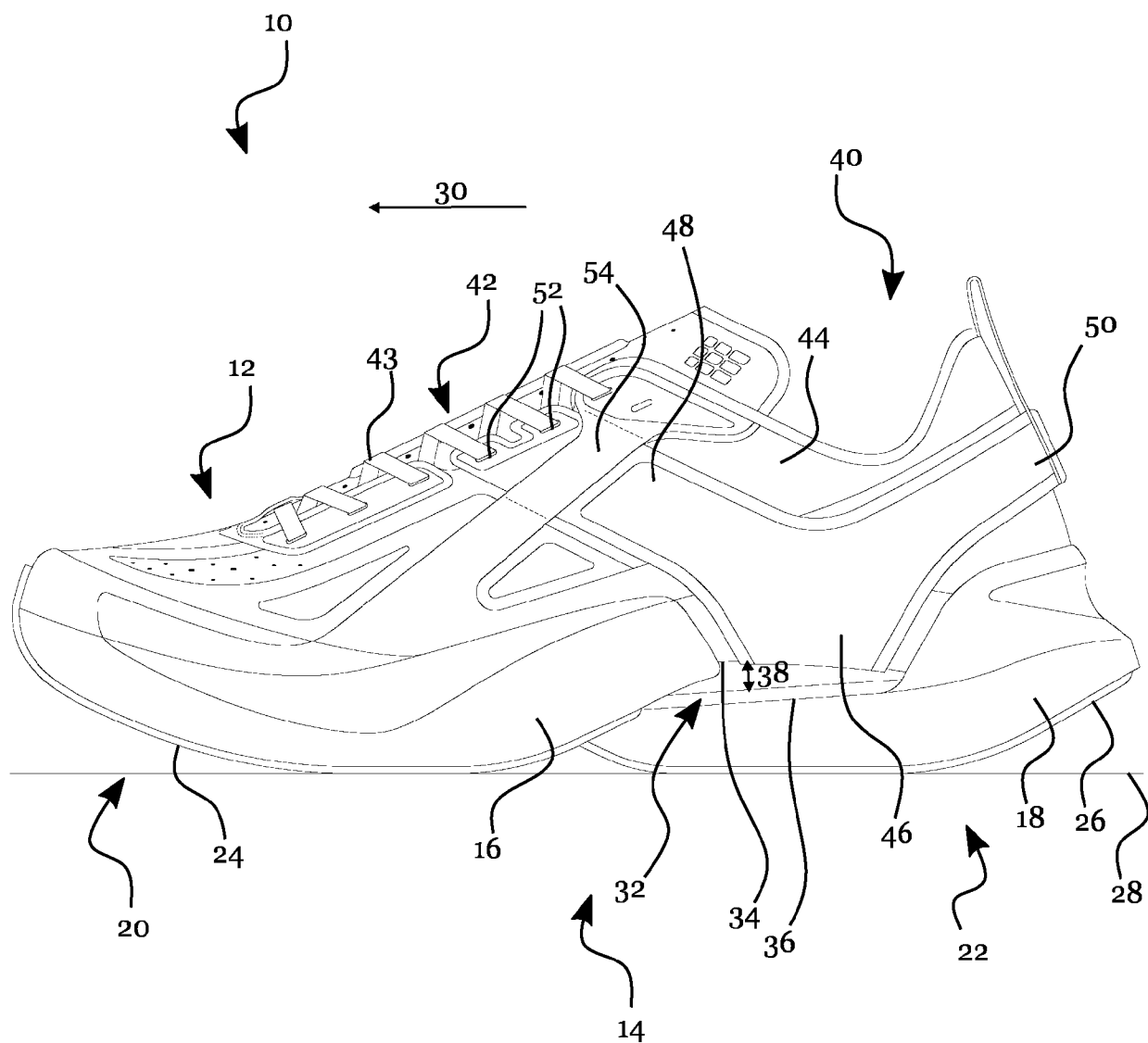


Fig. 1

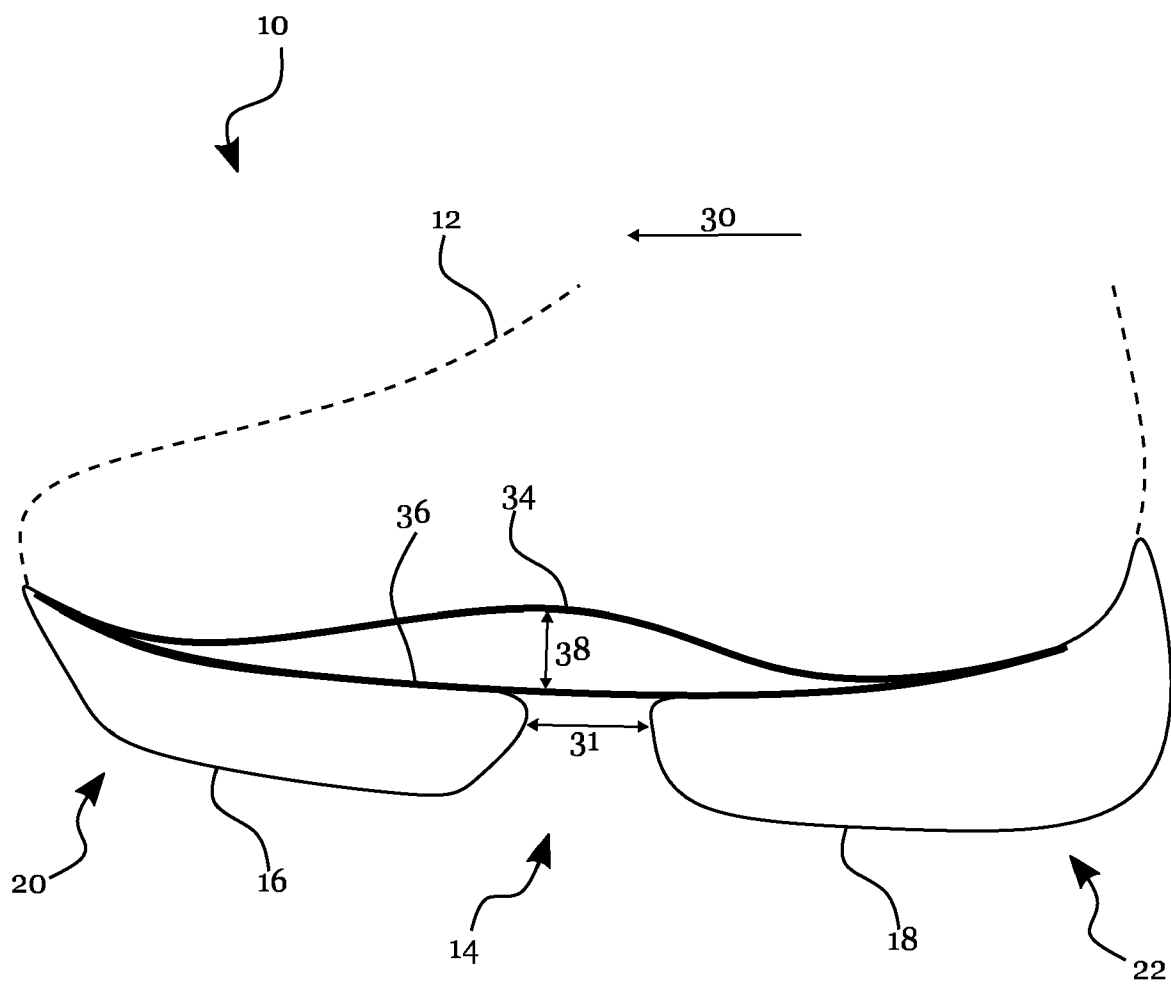


Fig. 2

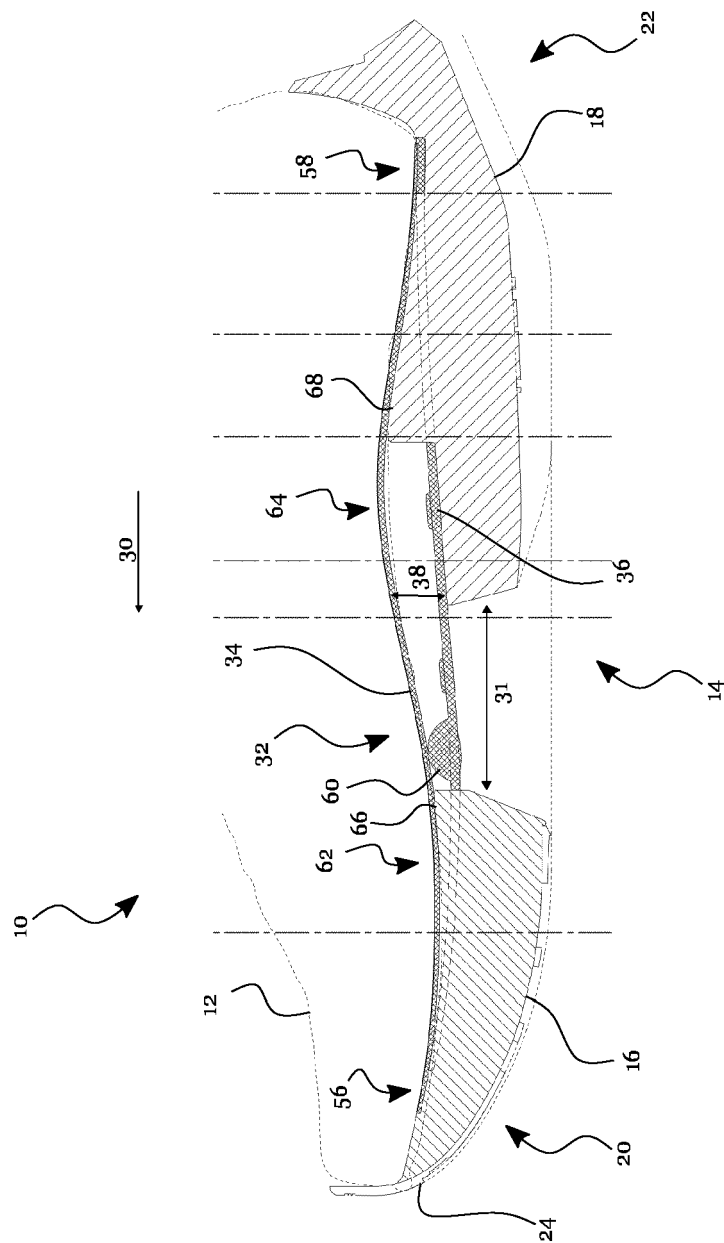


Fig. 3

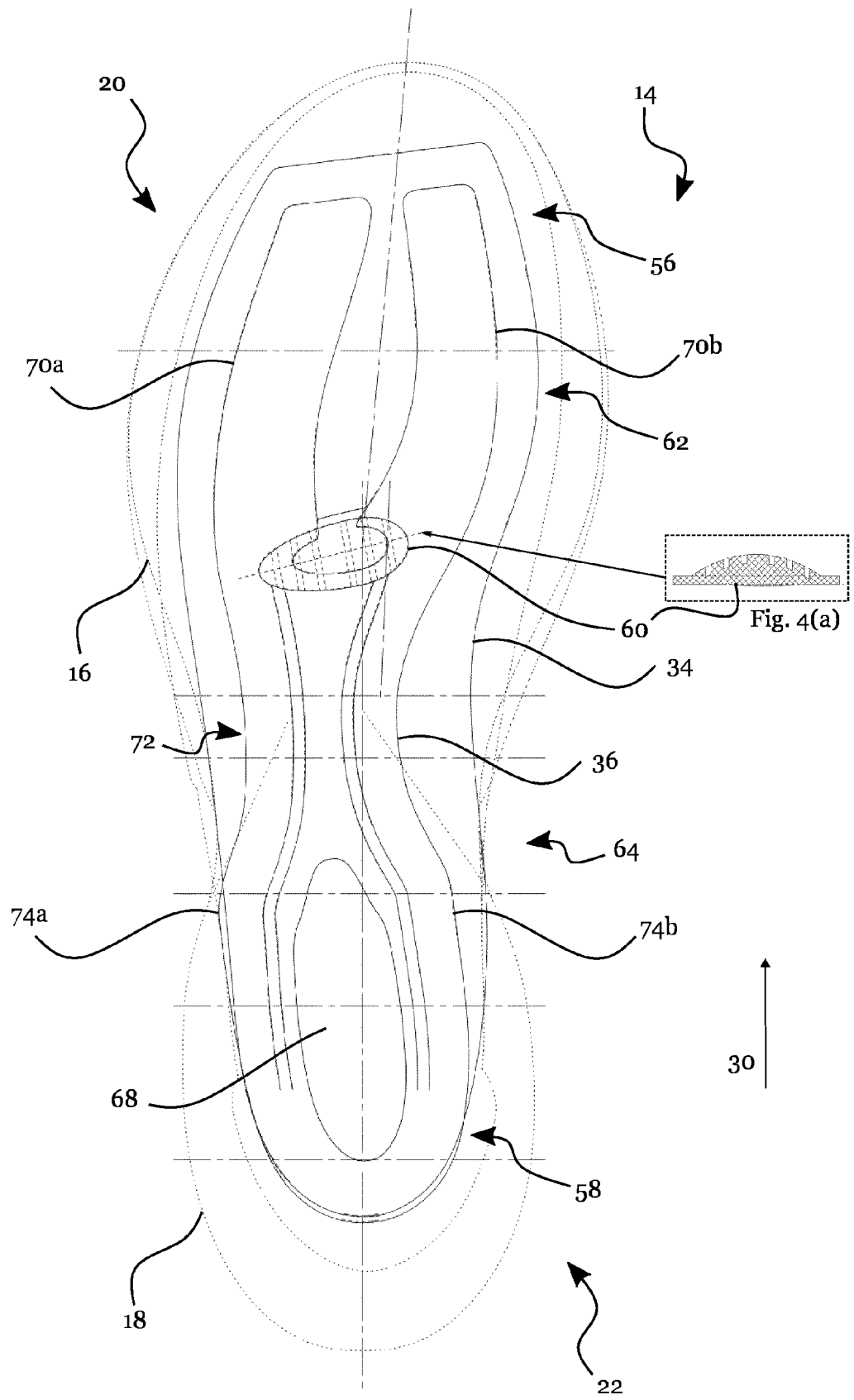


Fig. 4

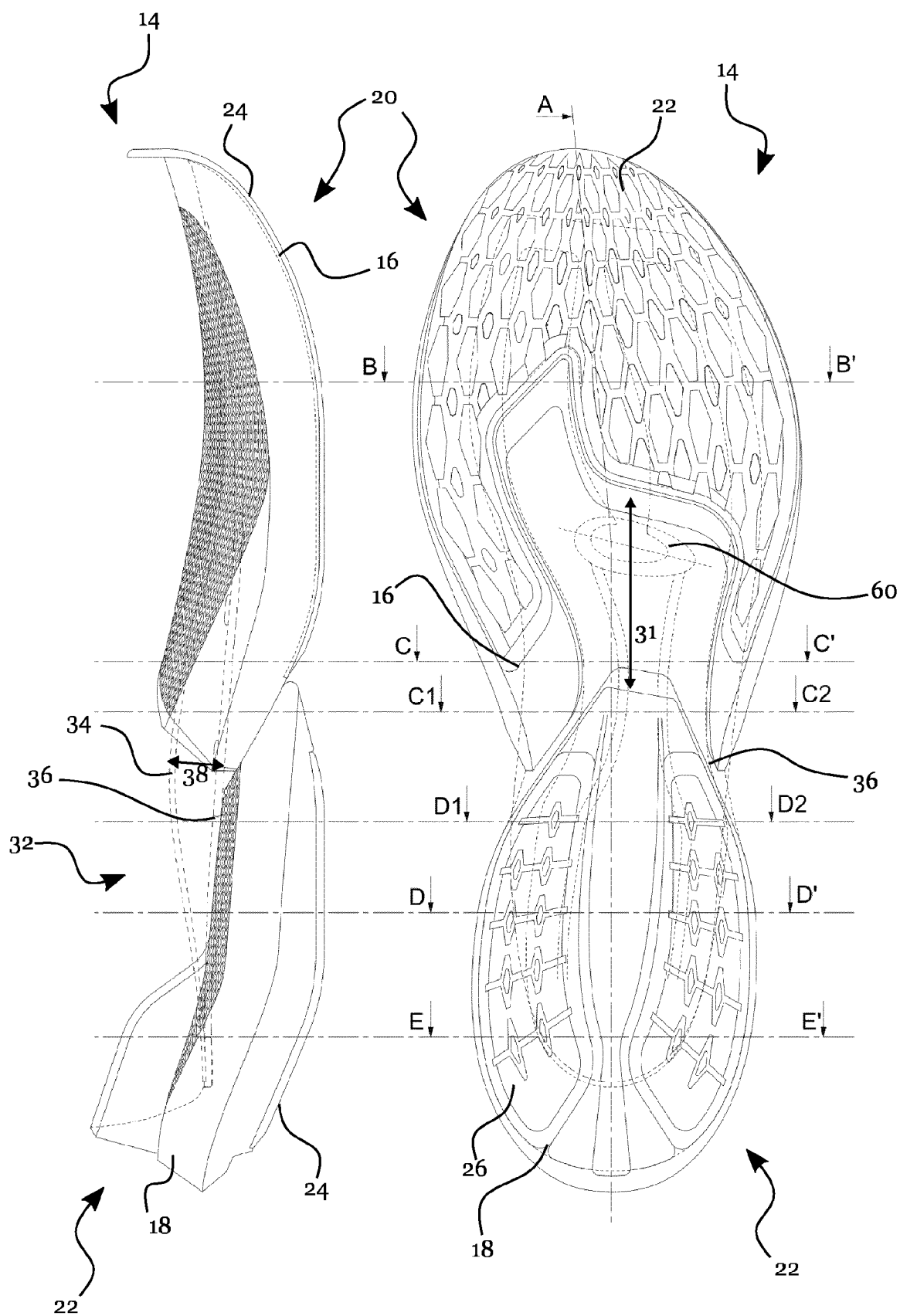


Fig. 5A

Fig. 5B

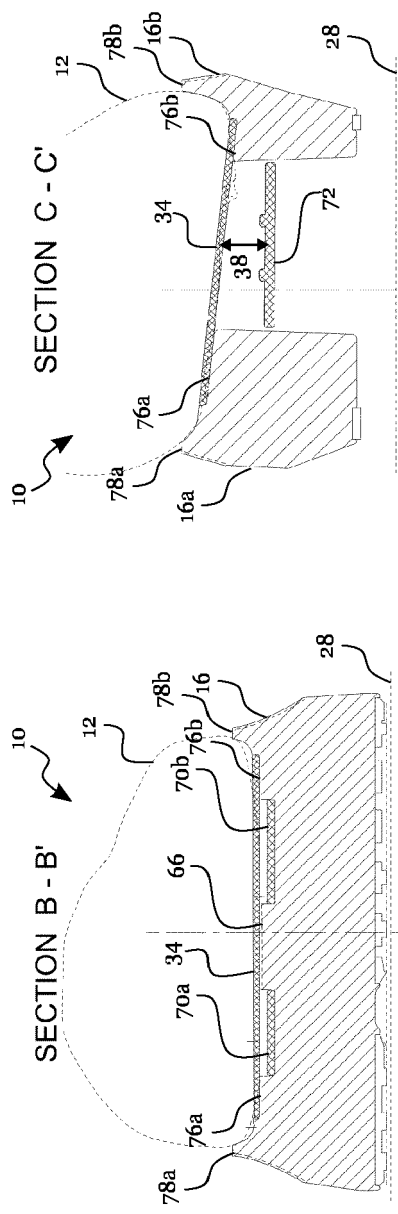


Fig. 6B

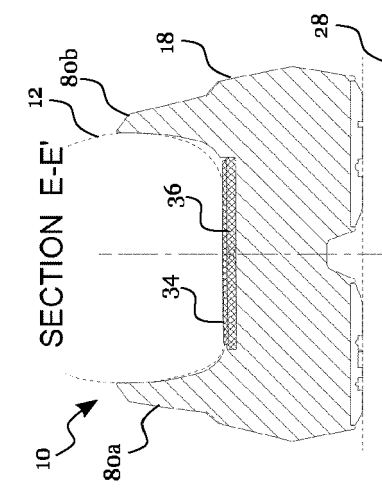


Fig. 6D

Fig. 6A

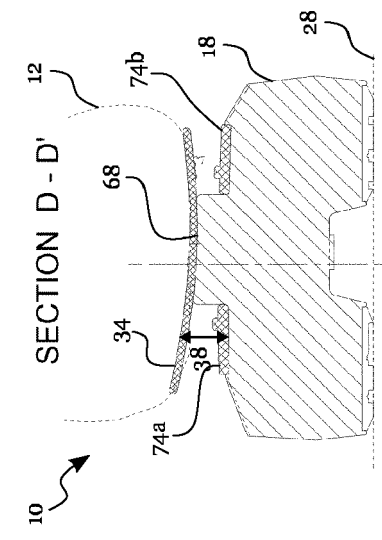


Fig. 6C

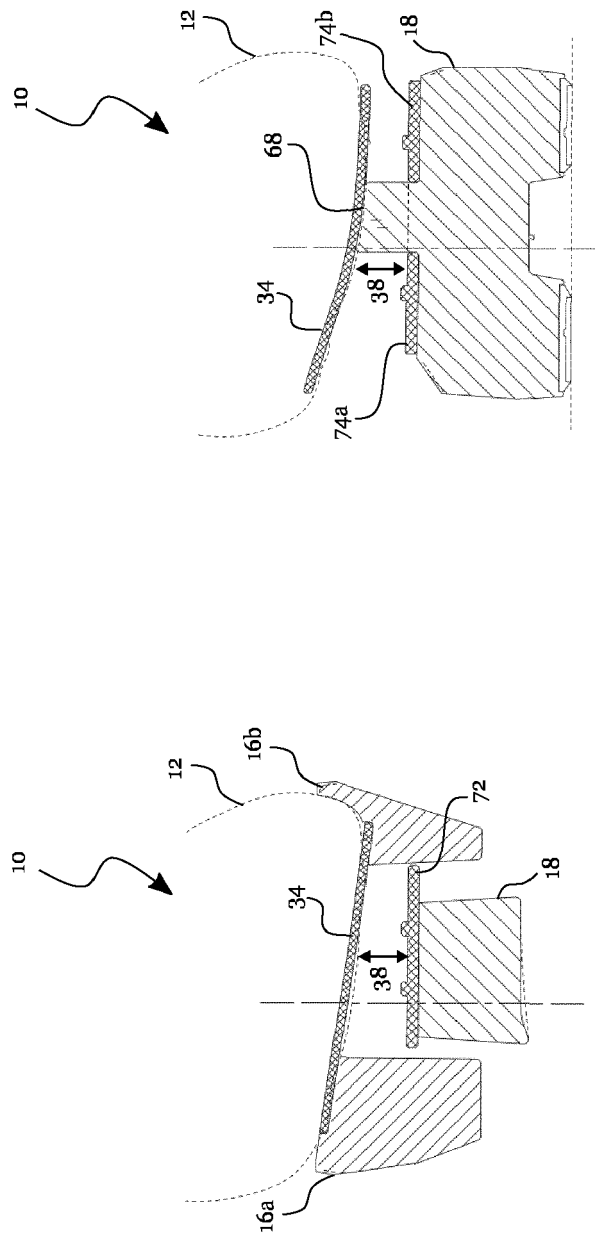
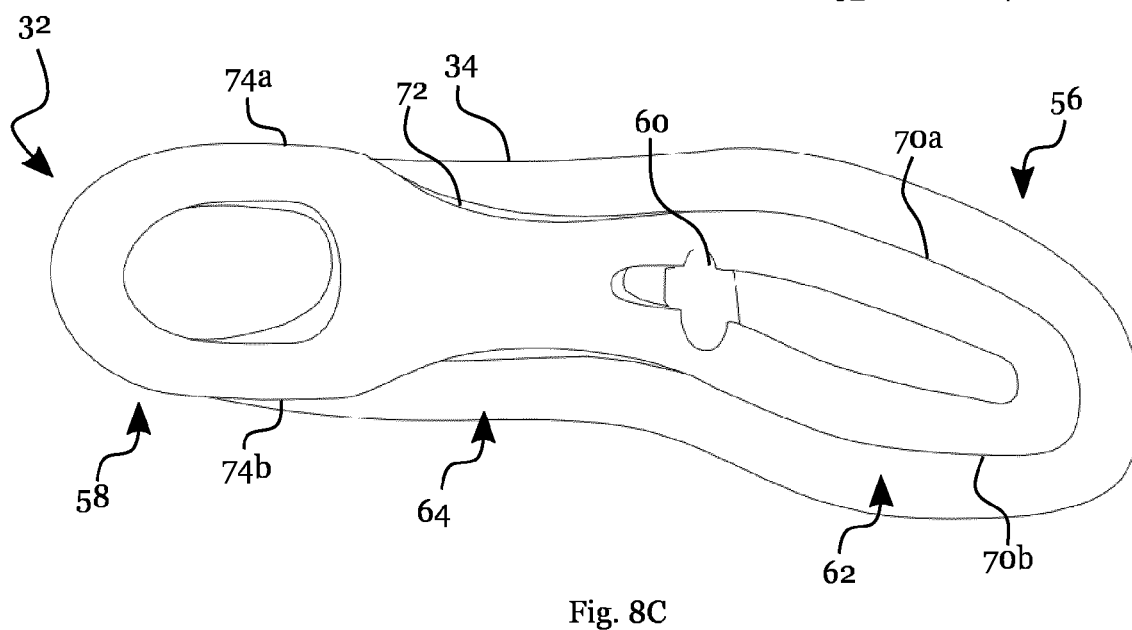
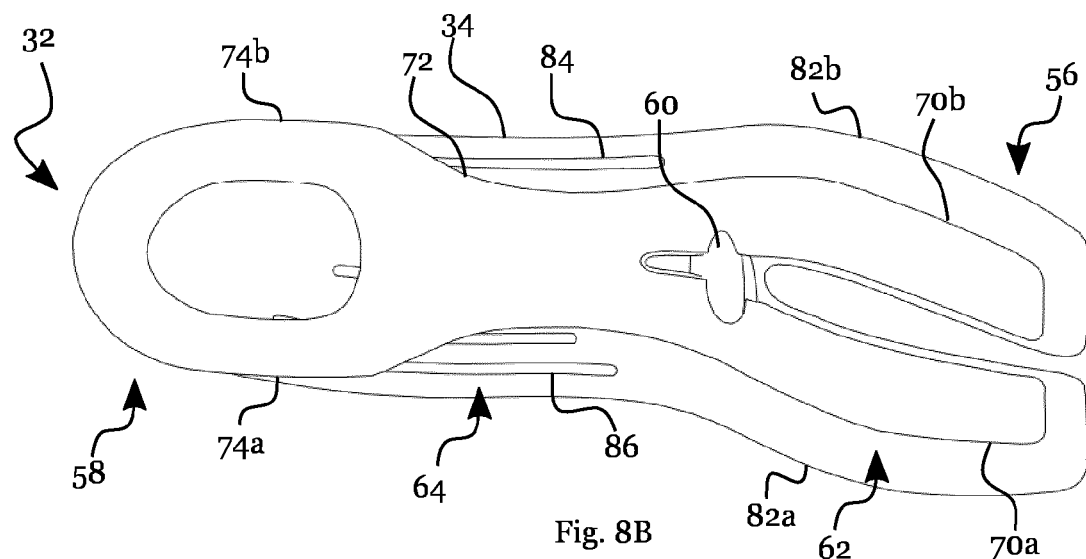
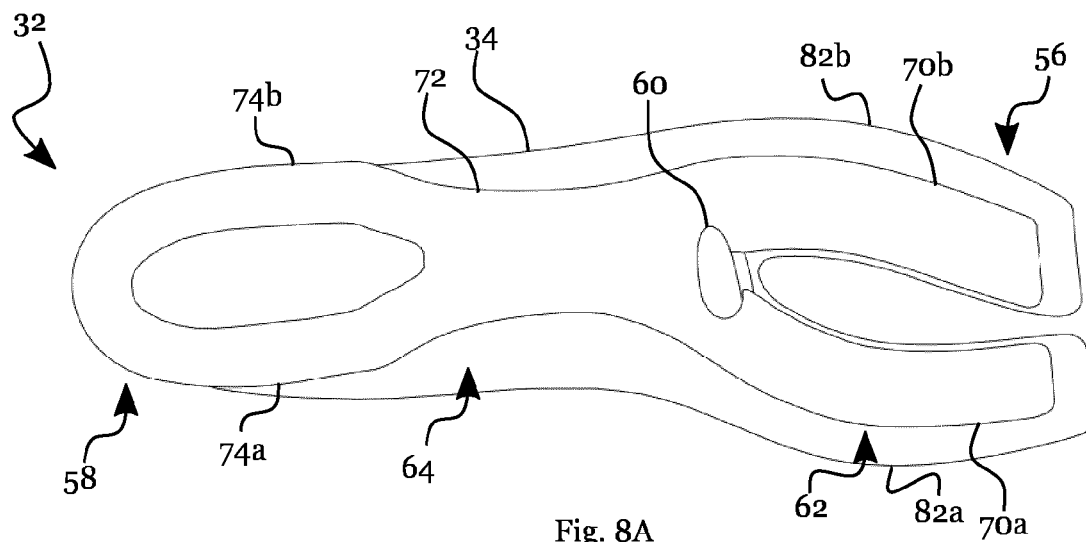


Fig. 7B

Fig. 7A





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Application Number

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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		30 April 2024	Cianci, Sabino
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