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(54) **SUPPORT ELEMENT FOR IMPROVED FOOT SHANK ALIGNMENT**

(57) The present invention relates to a support element (100) which is configured to be arranged in a sole structure (410) of a shoe (400). The support element (100) comprises: a first portion (101a) associated with a lateral side of the sole structure (410), comprising a first segment (110a) exhibiting a wave structure and a second portion (101b) associated with a medial side of the sole structure (410), comprising a second segment (110b) exhibiting a uniform structure.

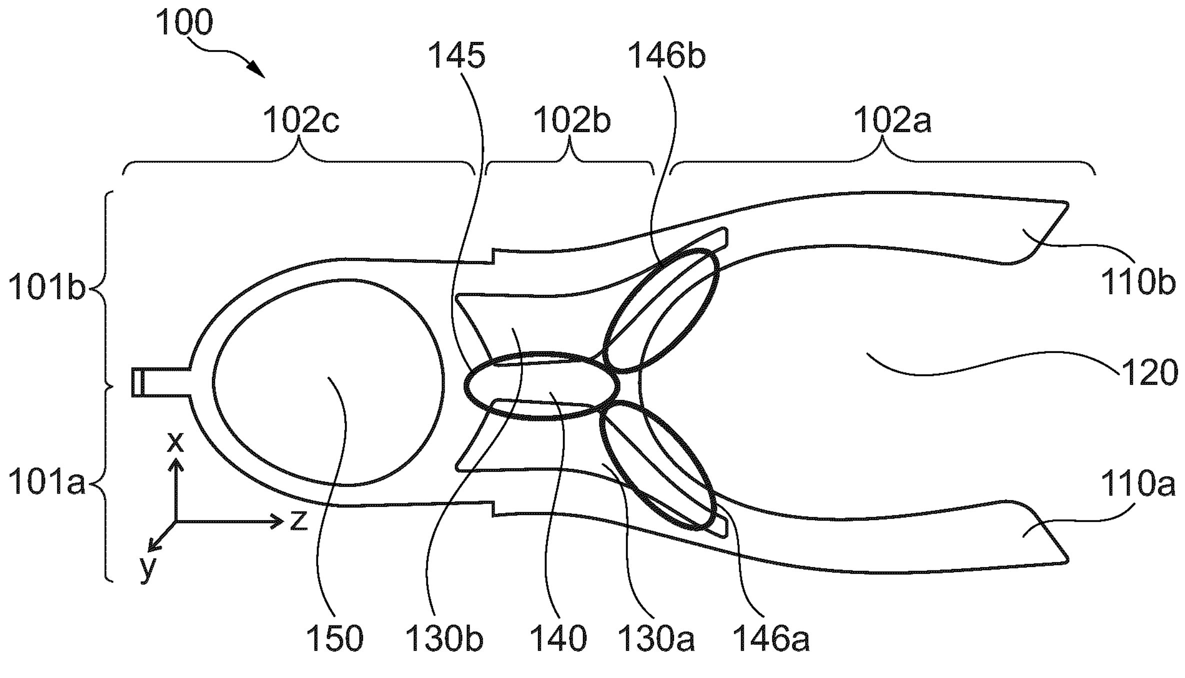

Fig. 1A

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Description

1. Technical field

[0001] The present invention relates to a support element configured to be arranged in a sole structure of a shoe for improving the alignment of a foot and a shank when performing cutting movements by creating a banking effect.

2. Prior art

[0002] For many kinds of sports and in various training drills cutting movements, i.e., movements that involve a quick change of direction, are essential. Popular examples of cutting movements are v-cuts in basketball, skater jumps in coordination- and endurance training and more generally side-shuffle movements.

[0003] The performance of cutting movements is mainly limited due to injury preventive mechanisms. In particular, cutting movements can lead to excessive inversion moments at the ankle joint caused by disadvantageous misalignment of foot and shank segment and, if the ankle joint is close to the limit of its range of motion, the ankle ligaments may be prone to injury, see for instance "The effect of lateral banking on the kinematics and kinetics of the lower extremity during lateral cutting movements", Human Movement Science, 33, 97-107 (2014).

[0004] Such a misalignment can be counteracted by creating a banking, which leads to an improved foot shank alignment and keeps the ankle joint out of dangerous positions, thus increasing the performance and the risk of injury. This protective mechanism has been termed banking effect and leads to an increased performance during cutting movements. The influence of the banking effect on the performance during cutting movements has been evaluated by using wooden wedges of different angles mounted to the floor, see for instance "The effect of lateral banking on the kinematics and kinetics of the lower extremity during lateral cutting movements", Human Movement Science, 33, 97-107 (2014).

[0005] Implementations of the banking effect within footwear have been realized in the form of insoles. Here, lateral banking elements have been incorporated into the footwear, aiming to raise the lateral portion of the foot relative to the medial portion of the foot, see for instance "The influence of lateral wedged insoles on performance and ankle joint biomechanics of lateral movements", Footwear Science, 15, 146-147 (2023). However, in such an implementation the banking of the sole persists over time and is thus also present in situations in which no lateral movements are performed. This permanence of banking can be disruptive when performing linear movements and can degrade the wearing comfort. Linear movements are movements without a lateral component, for example going forward or going backward and more generally movements that involve a straight rolling of the foot. Further, a permanent banking may lead to defective positions harming the knee joint or the femur.

[0006] EP 3 174 419 A1 relates to an article of footwear including a sole structure, the sole structure including a midsole and one or more plates embedded within the midsole. Each of the one or more plates has a downwardly-concave side and an upwardly-concave side. The downwardly-concave side may be positioned on a medial side of the footwear and the upwardly-concave side may be positioned on a lateral side of the footwear.

[0007] US 2021 337 925 A1 describes a sole structure for an article of footwear that has a sole plate. The sole plate may have a foot-facing surface with ridges extending longitudinally in the midfoot region and in at least one of a forefoot region or a heel region. The sole plate may have a ground-facing surface with grooves extending longitudinally in correspondence with the ridges. The ridges and the grooves may be configured such that a thickness of the sole plate from the foot-facing surface to the ground-facing surface varies at a transverse cross-section of the sole plate through the ridges or varies along a length of at least one of the ridges, or varies at both the transverse cross-section and along the length of the at least one of the ridges.

3. Summary of the invention

[0008] Therefore, it is the objective of the present invention to provide an implementation of the banking effect within footwear wherein banking is only present when lateral movements are performed.

[0009] This objective is met by a support element which is configured to be arranged in a sole structure of a shoe, comprising: a first portion associated with the lateral side of the sole structure, comprising a first segment exhibiting a wave structure and a second portion associated with a medial side of the sole structure, comprising a second segment exhibiting a uniform structure.

[0010] The support element according to the invention creates a banking effect during lateral movements due to the uniform structure on the medial side and the wave structure on the lateral side. If the support element is embedded into a part of the shoe comprising foam for example, such as the midsole of the shoe, the wave structure on the lateral side allows less foam compression than the uniform structure on the medial side. This creates a compression gradient, resulting in a banking position when lateral movements are performed. This combination leads to an optimal angle between the foot and shank segment when athletes are changing direction or perform cutting and dynamical movements. Further, the wave structure of the first segment associated with the lateral side contributes to a more responsive and controlled feel when making quick lateral movements. Consequently, athletes can change direction with greater precision and confidence, as the support element helps to maintain a stable base. This makes the transfer of force more effective. The improved performance may include a higher take-off velocity, an increased jumping distance and a reduced contact time.

[0011] It should be noted that the support element according to the invention is not necessarily a single piece. For example, the first segment and the second segment may be disconnected.

[0012] The wave structure of the first segment comprises at least one peak and one valley. Generally, the number of peaks and the number of valleys can be different. In some embodiments, the at least one peak and the at least one valley may be connected smoothly to each other. In particular, the first segment may comprise a smooth surface. Additionally or alternatively, the wave structure may comprise peaks and/or valleys which are non-continuously connected. For example, the non-continuous connection may be a zigzag connection. In particular, the connection may be configured to form a sawtooth wave, a triangle wave and/or a square wave. Generally, the wave structure is not necessarily periodic. The uniform structure may comprise less peaks and/or less valleys than the wave structure. Specifically, the uniform structure may comprise at most one peak or one valley.

[0013] Specifically, a distance between two consecutive peaks of the wave structure may be at least 0.5 cm. In addition, or alternatively, a distance between two consecutive peaks of the wave structure may be at least 0.8 cm. In addition, or alternatively, a distance between two consecutive peaks of the wave structure may be at least 1.1 cm. In addition, or alternatively, a distance between two consecutive peaks of the wave structure may be at least 1.4 cm. In addition, or alternatively, a distance between two consecutive peaks of the wave structure may be at least 1.7 cm.

[0014] In addition, or alternatively, a distance between two consecutive peaks of the wave structure may be at most 8 cm. In addition, or alternatively, a distance between two consecutive peaks of the wave structure may be at most 7 cm. In addition, or alternatively, a distance between two consecutive peaks of the wave structure may be at most 6 cm. In addition, or alternatively, a distance between two consecutive peaks of the wave structure may be at most 5 cm. In addition, or alternatively, a distance between two consecutive peaks of the wave structure may be at most 4 cm.

[0015] In addition, or alternatively, a height of a peak of the wave structure may be at least 0.1 cm. In addition, or alternatively, a height of a peak of the wave structure may be at least 0.3 cm. In addition, or alternatively, a height of a peak of the wave structure may be at least 0.6 cm. In addition, or alternatively, a height of a peak of the wave structure may be at least 0.9 cm. In addition, or alternatively, a height of a peak of the wave structure may be at least 1.2 cm.

[0016] In addition, or alternatively, a height of a peak of the wave structure may be at most 4 cm.

[0017] In addition, or alternatively, a height of a peak of the wave structure may be at most 3.5 cm. In addition, or alternatively, a height of a peak of the wave structure may be at most 3 cm. In addition, or alternatively, a height of a peak of the wave structure may be at most 2.5 cm. In addition, or alternatively, a height of a peak of the wave structure may be at most 2 cm.

[0018] In addition, or alternatively, a depth of a valley of the of the wave structure may be at least 0.1 cm.

[0019] In addition, or alternatively, a depth of a valley of the of the wave structure may be at least 0.3 cm. In addition, or alternatively, a depth of a valley of the of the wave structure may be at least 0.6 cm. In addition, or alternatively, a depth of a valley of the of the wave structure may be at least 0.9 cm. In addition, or alternatively, a depth of a valley of the of the wave structure may be at least 1.2 cm.

[0020] In addition, or alternatively, a depth of a valley of the of the wave structure may be at most 4 cm. In addition, or alternatively, a depth of a valley of the of the wave structure may be at most 3.5 cm In addition, or alternatively, a depth of a valley of the of the wave structure may be at most 3 cm In addition, or alternatively, a depth of a valley of the of the wave structure may be at most 2.5 cm In addition, or alternatively, a depth of a valley of the of the wave structure may be at most 2 cm.

[0021] A height of the peak of the wave structure of at least 0.1 cm and/or depth of a valley of the wave structure of at least 0.1 cm allows for an approximately constant bending stiffness of the support element while at the same time ensuring that the compression increases. Therefore, the above-described configurations of the peaks and/or valleys of the wave structure contribute to an enhancement and optimization of the banking effect.

[0022] Generally, a height of a peak may decrease along the wave structure of the first segment. For example, the height of the peak may decrease along the wave structure of the first segment from a mid portion of the sole structure towards a front part of the sole structure.

[0023] In addition, or alternatively, a depth of a valley may decrease along the wave structure. For example, the depth of the valley may decrease along the wave structure of the first segment from a mid portion of the sole structure towards a front part of the sole structure.

[0024] In addition, or alternatively, a distance between two consecutive peaks may decrease along the wave structure of the first segment. For example, the distance between the two consecutive peaks may decrease along the wave structure of the first segment from a mid portion of the sole structure towards a front part of the sole structure.

[0025] In addition, or alternatively, a distance between two consecutive valleys may decrease along the wave structure of the first segment. For example, the distance between the two consecutive valleys may decrease along the wave structure of the first segment from a mid portion of the sole structure towards a front part of the sole structure.

[0026] Generally, the decrease of the height of the peak and/or the depth of the valley and/or the distance between two consecutive peaks and/or the distance between two consecutive valleys may be based on a decrease function. Specifically, the decrease function may comprise a linear function. In addition, or alternatively, the decrease function may comprise a polynomial function, e.g., a quadratic function. In addition, or alternatively, the decrease function may comprise a exponential and/or logarithmic function.

[0027] For example, a first peak may comprise a first height. The first peak may be located within the wave structure of the first segment at a position associated with a mid portion of the sole structure. In some embodiments, the first peak may comprise a maximal height, e.g., a maximal height among remaining peaks of the wave structure. In addition, the first peak may be located at a first distance from a second peak. Specifically, the second peak may be shifted with respect to the first peak in a direction pointing from a heel portion of the sole element towards a front and/or toe portion of the sole element. Generally, the second peak may comprise a second height. For example, the second height may be smaller than the first height. In some embodiments, the wave structure of the first segment may comprise a third peak. For example, the third peak may be shifted with respect to the second peak in a direction pointing from a heel portion of the sole element towards a front and/or toe portion of the sole element. Specifically, the second and the third peak may be separated by a second distance. For example, the second distance may be smaller than the first distance. In some embodiments, the first distance and the second distance may be essentially equal. In addition, the third peak may comprise a third height. The third height may be smaller than the second height. Generally, the height of the first and/or second and/or third peak may be based on a height function. For example, the first height and/or the second height and/or the third height may be based on the height function. For example, the first height, the second height and the third height may be chosen such as to essentially follow the height function.

[0028] The support element may be configured such that the wave structure of the first segment extends in a direction of a longitudinal axis of the sole structure and/or the uniform structure of the at least one segment extends in the direction of the longitudinal axis of the sole structure.

[0029] The extension of the wave structure of the first segment in a direction of a longitudinal axis of the sole structure and/or the extension of the uniform structure of the second segment in a direction of a longitudinal axis of the sole structure increases the banking effect when performing lateral movements. Further, the extension in a direction of a longitudinal axis of the sole structure maintains the flexibility of the support element with respect to linear movements, thus enhancing the performance for linear movements.

[0030] The first and/or the second segment may be configured to be located in a front part of the sole structure, preferably the first half of the sole structure, most preferably the first third of the sole structure.

[0031] The location of the first and/or second segment in the front part of the sole structure enhances the effect of banking as the front part of a foot is broader than the mid part and the rear part and thus exerts the largest force on the support element when it comes to lateral movements. Furthermore, during lateral movements, more pressure is usually exerted on the forefoot than on the rearfoot such that the banking effect is more pronounced. This particularly increases the performance of lateral movements that involve plantar flexion, that is, the extension at the ankle.

[0032] The first portion associated with the lateral side may exhibit a torsion and/or the second portion associated with the medial side may exhibit a torsion.

[0033] The torsion of the first and/or second portion leads to an adaption of the support element to the foot and increases the performance of linear movements as it promotes the rolling of the foot.

[0034] The first portion may comprise at least one component comprising the first segment, wherein the component preferably is elongate, most preferably wherein the element forms a finger and/or a rod, and/or the second portion may comprise at least one component comprising the second segment, wherein the component preferably is elongate, most preferably wherein the element forms a finger and/or a rod.

[0035] The at least one component comprising the first segment and the at least one component comprising the second segment, which are most preferably fingers or rods, result in an enhanced flexibility of the support element in linear movements. In addition, the use of more than one component for at least one portion enables a more exact positioning and the implementation of a variety of specific configurations. Further, gaps between the fingers or rods make the support element lightweight, thus improving performance during movements.

[0036] There may exist a subset of the components which comprises components which are not connected to one another.

[0037] The existence of a subset of components which are not connected to one another allows for an enhanced movement of the components of the support element relative to one another, in particular with respect to up and down movements. This makes the support element more flexible. Further, due to the absence of connections between the components in the subset, the support element is lightweight, thus improving performance during movements.

[0038] The component may be such that the number of components in the first portion is different from the number of components in the second portion, preferably the first portion comprises at least one component and/or at most six components and/or the second portion comprises at least one component and/or at most four components, most preferably the first portion comprises three components and/or the second portion comprises two components.

[0039] A different number of components in the first and second portion allows for a precise configuration of the component, which leads to an enhancement and optimization of the banking effect. In case of more elements in the first portion than in the second portion, this results in a different stability of the lateral side and the medial side.

[0040] A spacing between the first portion and the second portion leads to a reduced weight of the support element. Further, the spacing ensures that the first segment exhibiting a wave structure and the second element exhibiting a uniform structure are spatially sufficiently separated such that banking is possible.

[0041] The components may be such that the components in the first portion are mutually spaced apart wherein the spacing depends on the number of components in the first portion and/or the second portion, most preferably wherein the spacing is equidistant and/or the components in the second portion are mutually spaced part wherein the spacing depends on the number of components in the second portion and/or the first portion, most preferably wherein the spacing is equidistant.

[0042] Mutually spacing apart the components of the first and/or second portion leads to a more localised banking of the support component, while preserving stability of the support element, especially with respect to linear movements. Equidistant spacing allows for uniform banking over the full width of the foot and/or shoe sole. The dependence of the spacing on number of components guarantees that it can be adapted for a sole of a particular size.

[0043] The wave structure of the at least one segment comprises at least one peak and at least one valley. A height of the peaks may be configured to increase from a first peak to a last peak and/or a height of the peaks may be configured to decrease from a first peak to a last peak and/or a height of the peaks may be configured to increase from a first peak to a turning peak and to decrease from the turning peak to a last peak and/or a height of the peaks may be configured to decrease from a first peak to a turning peak and to increase from the turning peak to a last peak. Further, a depth of the valleys may be configured to increase from a first valley to the last valley and/or a depth of the valleys may be configured to decrease from a first valley to a last valley and/or a depth of the valley may be configured to increase from a first valley to a turning valley and to decrease from a turning valley to a last valley and/or a depth of the valley may be configured to decrease from a first valley until a turning valley and to increase from the turning valley to a last valley.

[0044] The number of peaks and/or valleys and/or the height of the peaks and/or the depth of the valleys may be maximum at the most lateral element and/or may decrease for elements in the first portion closer to the second portion.

[0045] The configuration of the wave structure of the at least one segment may depend on the position of the at least one segment within the first portion. The configuration of the wave structure may comprise a number of peaks, a number of valleys, a height of the respective peaks, a depth of the respective valleys, a spacing between the peaks and/or valleys and/or a pattern of peaks and valleys. For example, the wave structure configuration of the at least one segment of the most lateral component may differ from the wave structure configuration of the at least one segment of a component of the first portion closer to the second portion. Specifically, the height of the peaks and/or the depth of the valleys in the wave structure configuration of the at least one segment may decrease as the segments become closer to the second portion/medial part.

[0046] Dependence of the configuration of wave structure of the at least one segment on the position of the at least one segment within the first portion allows for a smooth transition from the wave structure to the uniform structure of the second element comprised in the second portion. This smooth transition enhances the banking effect and improves the performance during lateral movements.

[0047] Providing the most lateral component with the maximum number of peaks and/or valleys and/or the height of the peaks and/or the depth of the valleys allows least foam compression at the most lateral portion of the sole structure, which enhances the creation of a banking position. The decrease for components in the first portion closer to the second portion yield a smooth increase in foam compression towards the portion comprising components exhibiting a uniform structure.

[0048] The first and/or the second portion may comprise at least one of the materials: polyamide, glass fibre reinforced polyamide, carbon fibre, thermoplastic polyurethane, carbon fibre reinforced thermoplastic polyurethane.

[0049] Such materials can contribute to flexibility and elasticity of the first and/or second portion, the elements and/or fingers and/or rods to provide an optimal toughness. This contributes to an adjustment of the support element with respect to linear movements as well as to a smooth banking, resulting in an improved performance in linear and lateral movements.

[0050] The support element may comprise a first and a second component connected to one another, wherein the first component is part of the first portion and the second component is part of the second portion, or the first and the second component is part of the first portion, or the first and the second component is part of the second portion.

[0051] A support element wherein the first component and the second component are connected is easier to align for example in a sole structure during the manufacturing process and therefore reduces the risk of a misalignment between sole structure/shoe and the support element. Further, it contributes to the stability of the sole structure, as the connection allows for a better distribution of the acting force in lateral movements. In particular, given that the first component is part of the first portion and the second component is part of the second portion, this enhances the banking effect and improves the performance during lateral movements.

[0052] The first and/or the second component may be configured to be arranged in a rim portion of the sole structure, preferably wherein the first component, which is part of the first portion, is configured to be arranged in a lateral rim part of the sole structure, and/or the second element, belonging to the second portion, is configured to be arranged in the medial rim part of the sole structure.

[0053] Arranging the first component in a rim portion which is part of the first portion and/or the second component in a rim portion which is part of the second portion leads to a banking which extends across the whole width of the sole structure. As in such an arrangement the first component and the second component are maximally spaced apart, this additionally results in a maximal possible banking.

[0054] The components of the first portion may be mutually connected, and/or the elements of the second portion may be mutually connected, and/or the elements of the first and the second portion may be mutually connected, preferably wherein the components are connected in a region associated with a mid-portion of the sole structure. Additionally or alternatively, the components may connect in a region associated with a rear part of the sole structure. In some embodiments, the components may connect in a region associated with a heel part of a foot.

[0055] Mutually connecting the components of the first and/or second portion increases the stability of the support element. If all components are connected in a region associated with a mid-portion of the sole structure, the support element yields stability in the mid part maintaining flexibility of the components in the front part for banking. This improves the performance of lateral movements, especially if the lateral movement comprises plantar flexion. In addition, this simplifies the alignment of the support element with the sole structure during the manufacturing process.

[0056] The support element may further comprise a portion associated with a mid-portion of the sole structure, preferably associated with a mid-foot portion, wherein the portion comprises at least one aperture, preferably wherein at least one aperture is associated with the first portion and/or at least one portion is associated with the second portion.

[0057] In some embodiments, the portion associated with the mid portion may comprise a first aperture located within the first portion and a second aperture located within the second portion. Further, the first and second aperture may be arranged symmetrical within the support element. For example, the symmetry axis may be associated with the transition from the first portion to the second portion of the support element. Specifically, the portion associated with the mid portion may further comprise an intermediate section which separates the first aperture from the second aperture. Further, the intermediate section may comprise a portion which splits in at least two portions. In particular, the intermediate section may have the shape of the letter "Y".

[0058] The portion of the support element associated with a mid-portion of the sole-structure yields an additional improvement of the stability of the support element and thus of the sole structure. Further, the portion can be utilized to merge the different components from the first and/or second portion. The apertures reduce the weight of the support element. By associating an aperture to the first and the second portion, the portion of the support element associated with a mid-portion of the sole-structure has a stability with respect to the lateral side similar to the medial side. The apertures of the support element also allow for a ventilation when arranged in a sole structure. The ventilation of the shoe and consequently of the foot results in cooling and less perspiration, thus enhancing the wearing comfort and may also improve the performance during training.

[0059] The support element may further comprise a portion associated with a rear part of the sole structure, preferably associated with a heel part of a foot, wherein the portion comprises at least one aperture, preferably wherein the aperture is enclosed.

[0060] The portion associated with the rear part provides additional stability for the sole structure and the shoe comprising the support element. The at least one aperture leads to a better compressibility of the foam located at the rear part of the sole structure and thus contributes to an enhanced wearing comfort.

[0061] The support element may be configured to be arranged in a midsole of a shoe, preferably such that a mid-part of the support element is gapped from a top component of the midsole but in connection with a bottom component of the midsole.

[0062] The arrangement of the support element in a midsole of a shoe makes it easier to implement the support element within the sole structure. This is especially the case if the midsole comprises a top/upper component as well as a bottom/lower component and the support element is implemented in between the top/upper component and the bottom/lower component. Further, the gap between the top component and the bottom components results in a weight reduction of the sole component and the shoe.

[0063] Generally, the midsole of the shoe can be made of foam. For example, the top and/or the bottom component of the midsole can be made of foam. Further, the hardness of the foam of the top component can differ from the hardness of the foam of the bottom component.

[0064] Another aspect of the present invention relates to a shoe comprising a support element as described herein. The technical properties shown or described for the support element, the advantages and the improvements over the state of the art are likewise applicable to the shoe, which is in particular a sports shoe. Same applies vice versa. The shoe may be a tennis shoe, a football shoe, a basketball shoe or a training shoe.

4. Short description of the figures

[0065] In the following, exemplary embodiments of the invention are described with reference to the figures. The figures show:

Fig. 1A: Top view of one embodiment of the support element according to the present invention, comprising two components;

Fig. 1B: Medial side view of one embodiment of the support element according to the present invention, comprising two components;

Fig. 1C: Lateral side view of one embodiment of the support element according to the present invention, comprising two components;

Fig. 2A: Medial side view of an exemplary sport shoe comprising the support element according to the present invention;

Fig. 2B: Lateral side view of an exemplary sport shoe comprising the support element according to the present invention;

Fig. 2C: Lateral cross section of an exemplary sole structure comprising the support element, the bottom midsole and the top midsole;

Fig. 3A: Top view of an alternative embodiment of the support element comprising five fingers;

Fig. 3B: Medial top side view of an alternative embodiment of the support element comprising five fingers;

Fig. 3C: Medial side view of an alternative embodiment of the support element comprising five fingers;

Fig. 4A: Top view of an embodiment of the support element according to the present invention, comprising two components;

Fig. 4B: Medial side view of an embodiment of the support element according to the present invention, comprising two components;

Fig. 4C: Lateral side view of an embodiment of the support element according to the present invention, comprising two components;

Fig. 5: Lateral side view of an exemplary sport shoe comprising the support element according to the present invention.

5. Detailed description of preferred embodiments

[0066] In the following, only some possible embodiments of the invention are described in detail. It is to be understood that these exemplary embodiments can be modified in a number of ways and combined with each other whenever compatible and that certain features may be omitted in so far as they appear dispensable. In particular, the disclosed embodiments may be modified by combining certain features of one embodiment with one or more features of another embodiment.

[0067] It is to be understood that not all features of the described aspects / embodiments have to be present for realizing the technical advantages provided by the present disclosure, which is defined by the subject-matter of the claims. The disclosed aspects / embodiments may be modified by combining certain features of one aspect / embodiment with one or more features of another aspect / embodiment. Specifically, the skilled person will understand that features, and / or functional elements of one aspect / embodiment can be combined with technically compatible features, and / or functional elements of any other aspect / embodiment of the present disclosure given that the resulting combination falls within the definition of the present disclosure.

[0068] Throughout the present figures and specification, the same reference numerals refer to the same elements. For the sake of clarity and conciseness, certain aspects of components or steps of certain embodiments are presented without undue detail where such detail would be apparent to those skilled in the art in light of the teachings herein and / or where such detail would obfuscate an under-standing of more pertinent aspects of the embodiments.

[0069] As understood by the skilled person and / or in order to avoid redundancies, reference is also made to the explanations in the preceding sections, which also apply to the following detailed description. Further, not all features, parts, elements, aspects, components and / or steps are expressly indicated by reference signs for the sake of brevity and clarity. This particularly applies, where the skilled person recognizes that such features, parts, elements, aspects, components and / or steps are present in a plurality.

[0070] In some of the figures a coordinate system has been added to facilitate the description, in particular with reference to certain directions. Thus, whenever reference is made to "x-axis", "y-axis" or "z-axis", it is to be understood that such terms refer to the depicted coordinate system.

[0071] Fig. 1A shows an embodiment of the support element 100 according to the present disclosure in top view. The support element 100 is configured to be arranged in a sole structure and the sole structure may belong to a shoe used in any athletic activity. For instance, the shoe may be used in soccer, basketball, volleyball, rugby, football, tennis, training or the like.

[0072] The support element 100 comprises a first component, which forms a finger 110a, associated with the lateral side 101a of the sole structure and a second component, which forms a finger 110b, associated with the medial side 101b of the sole structure. The first finger 110a and the second finger 110b extend in a direction of the longitudinal axis associated with the sole structure. This longitudinal axis may be parallel to the z-axis. Further, the first finger 110a and the second finger 110b are located in the front part 102a of the support element 100, which is associated with the front part of the sole structure. The first 110a and second finger 110b may define an aperture 120, which may be not fully enclosed by fingers. The two fingers converge when approaching the mid part 102b of the support element. The mid part 102b may comprise two apertures 130a and 130b, which may have the same shape. The two apertures 130a and 130b are separated by an intermediate section 140.

[0073] The intermediate section 140 comprises a portion 145 which splits into two components 146a, 146b wherein one component 146a transitions to the first finger 110a and the second component 146b transitions to the second finger 110b. By splitting into the two components 146a, 146b, the intermediate section 140 has the shape of the letter "Y".

[0074] In other embodiments, the mid part may comprise no apertures or more than two apertures, which may be separated by more than two intermediate sections. Further, the different apertures can have a different shape. The rear part 102c prolon-gates the mid part 102b and comprises an aperture 150 which is fully enclosed by material. The aperture is configured to be placed in a portion of the sole element and/or shoe which is associated with the tarsus or the heel of a foot. The shape of the aperture 150 can be arbitrary or symmetric with respect to a symmetry axis. The shape of the aperture 150 is relates to the shape of the tarsus of the foot. In a different embodiment, the rear part may comprise no apertures or more than one aperture which can have independent shapes.

[0075] Fig. 1B shows a medial side view of the support element 100 of Fig. 1A and particularly of the second finger 110b. The second finger 110b exhibits a uniform structure. With respect to this embodiment, the uniform structure can be illustrated emerges via a cross-section of the first finger 110b with respect to the y-z plane and/or a plane derived from the longitudinal axis of the support element 100. This cross-section of the second finger 110b comprises at most one extremal point. The extremal point in the second finger 110b is realized by the dip/valley 210, which separates a portion 220a wherein the y-component of the cross-section of the second finger decreases from a portion 220b wherein the y-component of the cross-section of the second finger increases. Therefore, in this embodiment, the second finger 110b exhibits a torsion, which bends the second finger 110b out of the x-z plane.

[0076] The intermediate section 140 in the mid part 102b which separates the two apertures 130a and 130b bents downwards and is configured to define a parabolic cross-section of the intermediate element with respect to the y-z plane. The combination of the apertures 130a, 130b with the downward bent of the intermediate section 140 yields a spacing 230 with respect to the y-z plane.

[0077] Fig. 1C shows a lateral side view of the support element 100 of Fig. 1A and particularly of the first finger 110a. The first finger 110a exhibits a wave structure. In this embodiment, the wave structure is characterized by two valleys 310a and 310b and one peak 320. The wave structure begins with the first valley 310a which is deeper than the second valley 310b. The first valley 310a is separated from the second valley 310b by the peak 320. Further, the first finger exhibits a torsion, which bends the finger out of the x-z plane and the wave structure is configured to follow this torsion. This torsion and the depth of the valleys 310a and 310b is configured such that the minimal turning point of the first valley 310a has a smaller y-component than the minimal turning point of the second valley 310b. The torsion of the first finger 110a and the second finger 110b may be similar.

[0078] The first finger 110a and the second finger 110b further bend inwards, that is, the first finger 110a bends towards the medial side 101b and the second finger 110b bends towards the lateral side 101a.

[0079] In other embodiments the uniform structure and the wave structure may be defined with respect to each other. For instance, the uniform structure of the second element may comprise fewer extremal points than the wave structure.

[0080] Further, the number of extremal points of the wave structure may be different, for example, the wave structure may comprise more valleys or fewer valleys and/or more peaks. Further, at least one of the fingers may not exhibit a torsion or an inward bending.

[0081] Fig. 2A shows a medial side view of a sport shoe 400 in which an exemplary embodiment of a support element 100 according to the invention is embedded. In this embodiment the support element 100 is positioned inside of the midsole 410 of the shoe 400, which comprises a lower part 410a and an upper part 410b. The support element 100 may be positioned between the lower part 410a and the upper part 410b. The lower part 410a may be connected to the outer sole 420 while the upper part 410b may be connected to the upper 430. The two apertures 130a and 130b together with the downward-bending intermediate element 140 define the spacing 230 which results in a spacing between the lower part 410a of the midsole and the upper part 410b of the midsole. This spacing 230 reduces the weight of the shoe which increases the wearing comfort and additionally makes the shoe more responsive when making movements.

[0082] The torsion of the second finger 110b in the front part 102a is adapted to follow the torsion of the lower part 410a and/or upper part 410b of the midsole. This makes the sole structure and the shoe 400 itself more flexible with respect to movements which include a rolling of the foot.

[0083] Fig. 2B shows a medial side view of the sport shoe 400 of Fig. 2A wherein the support element 100 is embedded between the lower part 410a and the upper part 410b of the midsole 410. In this embodiment of the support element, the wave structure of the first finger comprises in addition to the peak 310 a second peak 510 at the very front part 102a of the sole structure or shoe 400. Like the second finger 110b comprising the uniform structure, also the torsion of the first finger 110a is adapted to follow the torsion of the lower part 410a and the upper part 410b of the midsole 410.

[0084] The support element is configured such that the first element 110a is located at the lateral rim part of the sole structure and/or the shoe 400 and that the second element 110b is located at the medial rim part of the sole structure and/or the shoe 400.

[0085] In the embodiment shown in Fig. 2A and Fig. 2B, the support element 100 is arranged in between the lower part 410a and the upper part 410b of the midsole 410 and therefore the first 110a and the second 110b finger is embedded within the midsole 410.

[0086] Specifically, the lower part 410a and the upper part 410b of the midsole 410 can be made of foam. In this case, the sole structure and particularly the first 110a and the second 110b finger would be embedded into foam.

[0087] The support element 100 is configured to support the lower part 410a of the midsole 410, specifically the lower foam part of the midsole 410, if the midsole 410 comprises foam. Further, the support element 100 may follow the shape of the foam. In some embodiments, the support element 100 may be arranged within the midsole 410 such that it sits 1 mm inside the foam.

[0088] The wave structure of the first finger 110a on the lateral side 101a allows less foam compression of the midsole during lateral movements, especially in extreme lateral movements, compared to the foam compression allowed by the uniform structure of the second finger 110b on the medial side 101b. This leads to a gradient in foam compression from the lateral side 101a to the medial side 101b and thus creates a banking position for the foot in lateral movements. However, it should be noticed that the midsole may not comprise foam, but different materials, preferably materials that offer compressibility properties that are advantageous for creating banking.

[0089] This banking effect improves the disadvantageous misalignment of the foot and the shank segment and thus results in an improved performance of movements involving a change of direction. Further, the waved structure of the first finger on the lateral side contributes to a more responsive and controlled feel when making quick lateral movements, allowing athletes to change direction with a greater precision and confidence, as the support element helps to maintain a stable base. This makes the transfer of force more effective. The improvement in performance can be quantified by a higher take-off velocity, an increased jumping distance or a reduced contact time.

[0090] Fig. 2C shows the arrangement of the support element within the sole structure, especially within the midsole 410, from a lateral perspective. In particular, the support element 100 is located in between the lower part 410a and the upper part 410b of the midsole 410. In some embodiments, the lower part 410a and/or the upper part 410b of the midsole 410 can be made of foam. Further, the intermediate section 140 is in direct contact with the lower midsole 410a due to the parabolic shape of the intermediate section 140, which defines the spacing 230. Due to this direct contact of the intermediate section 140 with the lower midsole 410a, the midfoot area is supported.

[0091] Fig. 3A, Fig. 3B and Fig. 3C show another embodiment of a support element 600 according to the present disclosure from different perspectives. The support element 600 comprises a front part 602a, a mid-part 602b and a rear part 602c. The front part 602a is configured to be placed in the sole structure and/or shoe at a portion associated with the forefoot region, for example a region comprising at least one of the metatarsal bones and the phalanges. The front part 602a comprises five fingers 610a-610e. The fingers 610a-610e bend inwards, that is, a subset 610a, 610b of the fingers of the lateral side 601a bend towards the medial side 601b and the fingers 610d, 610e of the medial side 601b bend towards the lateral side 601a. Further, the finger 610d belonging to the lateral side 601a bends towards the lateral side 601a. Further, the width of the fingers increases from the beginning of the front portion 602a until the middle of the front portion 602a and then decrease until the end of the front portion 602a. The fingers 610a-610e converge when approaching the mid-part 602b. The mid-part 602b of the structure element 600 is connected without comprising one or more apertures and smoothly extends the front part 602a. The mid-part is configured to be placed in the sole structure and/or shoe at a portion associated with the arch of a foot. The rear part 602c may smoothly extend the mid-part 602b and may be configured to be placed in the sole structure and/or shoe at a portion associated with the tarsus or the heel of a foot. The rear part 602c comprises an aperture 620 which is not enclosed by material. The form of the aperture may be arbitrary or symmetric with respect to a certain axis. In this embodiment the form of the aperture 620 relates to the form of the tarsus or the heel of a foot.

[0092] The fingers 610a-610c belonging to the lateral side 601a exhibit a wave structure. The configuration of the wave structure is different for each of the three fingers 610a-610c. The fingers 610d and 610e belonging to the medial side 601b of the support element 600 exhibit a uniform structure. Here, the uniform structure can be illustrated by the pathway of the fingers 610d and 610e as both uniformly bend in the y-direction, i.e., the pathway does not exhibit peaks or valleys. In another embodiment, like the embodiment 100, the at least one finger of the medial side 601b may exhibit a valley.

[0093] The configuration of the wave structure of the fingers 610a-610c of the lateral side 601a comprises properties such as the number of peaks, the number of valleys, the heigh of the peaks, the depth of the valleys and the arrangement of such properties. In the embodiment 600 each finger 610a-610c comprises three peaks and three valleys. In particular, the finger 610a comprises peaks 710a, 730a, 750a and valleys 720a, 740a, 760a. The finger 610b comprises peaks 710b, 730b, 750b and valleys 720b, 740b, 760b and the finger 610c comprises peaks 710c, 730c, 750c and valleys 720c, 740c, 760c. The characteristic of the wave structure may depend on the position of the corresponding finger 610a-610c within the first portion associated with the lateral side 601a. For example, the height of the peaks and the depth of the valleys may be maximal for the most lateral finger 610a and may decrease as the fingers approach the medial side 601b. For the support element 600, the height of the peaks and the depth of the valleys of the finger 610a is larger than the heigh of the peaks and the depth of the valleys of the fingers 610b and 610c. Similarly, the height of the peaks and the depth of the valleys of the finger 610b is larger than the heigh of the peaks and the depth of the valleys of the fingers and 610c.

[0094] As best seen in Fig. 3C, the fingers 610a-610e exhibit a torsion which bends the fingers out of the x-z plane. The wave structure of the fingers 610a-610c is configured to follow the torsion of the respective finger. In another embodiment, only a subset of the fingers may exhibit a torsion.

[0095] Figures 4A to 4C illustrate a further exemplary embodiment of a support element 800 according to the present invention. The support element 800 is configured to be arranged in a sole structure. For example, the sole structure may belong to a shoe used in any athletic activity. Specially, the shoe may be used in soccer, basketball, volleyball, rugby, football, tennis, training or the like.

[0096] The support element 800 comprises a first portion 810a associated with a lateral side 801a of the sole structure. The first portion 810a comprises a shape of a finger. In addition, the support element 800 comprises a second portion 810b associated with a medial side 801b of the sole structure. The first portion 810a and the second portion 810b extend in a direction of a longitudinal axis associated with the sole structure. The first portion 810a and he second portion 810b are located in a front part 802a of the support element 800. The front part 802a of the support element 800 may be associated with a front part of the sole structure. The first portion 810a and the second portion 810b define an aperture 820. The aperture 820 is not fully enclosed by the first portion 810a and the second portion 810b. In particular, the first portion 810a and the second portion 810b define an opening of the aperture 820 in the front portion 802a of the support element 800. In other words, the first portion 810a and the second portion 810b define the aperture 820 such that the aperture 820 comprises a U-shape.

[0097] The second portion 810b comprises an essentially flat portion, e.g., flat with respect to a horizontal plane associated with the support element. A diameter of the first portion 810a essentially corresponds to a diameter of the second portion 810b. For example, the diameter of the first portion 810a and/or the second portion 810b may be at least 1 cm. For example, the diameter of the first portion 810a and/or the second portion 810b may be 1.5 cm, and/or 1.7 cm and/or 2 cm.

[0098] The first portion 810a of the support element 800 comprises a zigzag structure. The zigzag structure of the first portion comprises a plurality of peaks and valleys. For example, the zigzag structure comprises the peaks 860b, 86od, 86of. In addition, the zigzag structure comprises the valleys 860a, 860c, 86oe. Specifically, the peaks and the valleys of the zigzag structure are interleaved. For example, the peak 860b follows on the valley 860a and the valley 860c follows on the peak 86ob. In addition, the peak 86od follows on the valley 860c and the valley 860e follows on the peak 86od.

[0099] The valley 860a comprises a first depth, the valley 860c comprises a second depth and the valley 86oe comprises a third depth. Specifically, the first depth of the valley 860a is deeper than the second depth of the valley 86oc. Similarly, the first depth of valley 860a and the second depth of valley 860c may be deeper than the third depth of valley 860e. For example, the first depth of valley 860a may be at least 0.4 cm. Alternatively, the first depth of valley 860a may be at least 0.6 cm. In some embodiments, the first depth of valley 860a may be essentially 1 cm.

[0100] The peak 86ob comprises a first height, the peak 86od comprises a second height and the peak 86of comprises a third height. Specifically, the first height of the peak 86ob is higher than the second height of the peak 86od. Similarly, the first height of peak 860b and the second height of peak 86od may be higher than the third height of peak 86of.

[0101] The peak 860b of the zigzag structure of the first portion 810a is arranged at a first distance from the peak 86od. Similarly, the peak 860d is arranged at a second distance from the peak 86of. For example, the first distance may be larger than the second distance. In other words, the distance between two consecutive peaks, e.g., the peaks 86ob, 86od, and the peaks 86od, 86of, may decrease in a direction pointing from the rear portion 802c towards the front portion 802a. Similarly, the valley 860a of the zigzag structure of the first portion 810a is arranged at a first distance from the valley 860c. Similarly, the valley 860c is arranged at a second distance from the valley 860e. For example, the first distance may be larger than the second distance. In other words, the distance between two consecutive valleys, e.g., the valleys 860a, 860c, and the valleys 860c, 860e, may decrease in a direction pointing from the rear portion 802c towards the front portion 802a.

[0102] The first portion 810a and the second portion 810b converge when approaching the mid part 802b of the support element 800. The mid portion 802b comprises two apertures 830a and 830b. For example, the aperture 830a is located in a lateral portion 801a of the mid part 802b and the aperture 830b is located in a medial portion 801b of the mid part 802b. In some embodiments, the support element 800 may comprise only one aperture. Alternatively, the support element 800 may comprise more than 2 apertures in the mid part 802b. For example, the support element 800 may comprise at least three, preferably at least four apertures 830a, 830b in the mid part 802b. The apertures 830a, 830b are essentially symmetric. In particular, the apertures 830a, 830b are essentially symmetric with respect to a portion 845 which separates and/or defines the two apertures 830a, 830b. In some embodiments, the apertures 830a, 830b may be unsymmetric. For example, the aperture 830a may comprise a first geometry and/or a first size. The second aperture 830b may comprise a second geometry and/or a second size. Specifically, the first geometry may be different from the second geometry and/or the first size may be different from the second size.

[0103] The portion 845 splits into two components 846a, 846b, wherein the component 846a transitions to the first portion 810a at the lateral side 801a and the component 846b transitions to the second portion 810b at the medial side 801b. In particular, the first component 846a and the second component 846b comprise a curvature. For example, the first component 846a and the second component 846b may split such from the portion 845 that the first 846a and the second 846b component comprise a C-shaped geometry.

[0104] The first portion 810a splits into two components. In particular, the first portion 810a splits into the component 846a and the component 847a. For example, the component 846a and the component 847a may split from the first portion 810a at essentially the same location. In particular, the component 846a and the component 847a may split from the first portion at a transition from a forefoot part 802a to a midfoot part 802b of the support element 800. A diameter of the component 846a and a diameter of the component 847a may be smaller than a diameter of the first portion 810a. For example, the diameter of the component 846a and the diameter of the component 847a may be such that the sum of the diameters of component 846a and component 847a essentially correspond to the diameter of the first portion 810a.

[0105] Similarly, the second portion 810b splits into two components. In particular, the second portion 810b splits into the component 846b and the component 847b. For example, the component 846b and the component 847b may split from the second portion 810b at essentially the same location. In particular, the component 846b and the component 847b may split from the second portion 810b at a transition from a forefoot part 802a to a midfoot part 802b of the support element 800. A diameter of the component 846b and a diameter of the component 847b may be smaller than a diameter of the second portion 810b. For example, the diameter of the component 846b and the diameter of the component 847b may be such that the sum of the diameters of component 846b and component 847b essentially correspond to the diameter of the second portion 810b.

[0106] The component 847a essentially follows and/or defines a part of a lateral boundary of the support element 800. For example, the component 847a essentially defines the part of the lateral boundary of the support element 800 in the midfoot part 802b and the heel part 8o2c of the support element 800. The component 847a comprises a torsion. In particular, the component 847a comprises the torsion such that an upper surface of the component 847a bends towards the lateral boundary of the support element 800.

[0107] Similarly, the component 847b essentially follows and/or defines a part of a medial boundary of the support element 800. For example, the component 847b essentially defines the part of the medial boundary of the support element 800 in the midfoot part 802b and the heel part 802c of the support element 800. The component 847b comprises a torsion. In particular, the component 847b comprises the torsion such that an upper surface of the component 847b bends towards the medial boundary of the support element 800.

[0108] The support element 800 comprises an aperture 850 in a heel portion 850. For example, the aperture 850 may be at least partially defined by the component 848a and the component 848b. The aperture 850 is open in the heel area 802c, e.g., the aperture 850 is not fully encompassed by the component 848a and the component 848b. In particular, the aperture 850 may be at least partially defined by the component 848a and the component 848b such that the aperture 850 comprises a U-shaped geometry.

[0109] Figure 5 shows an exemplary illustration of a shoe 900 from a lateral side. The shoe 900 comprises a midsole 910 and an upper 920. The midsole 910 comprises a lower portion 910a and an upper portion 910b. The shoe 900 further comprises the support element 800. The support element 800 is arranged in the shoe between the lower portion 910a of the midsole and the upper portion 910b of the midsole. The support element 800 may be arranged such between the lower portion 910a and the upper portion 910b of the midsole such that a least a part of the support element forms a part of an outer surface of the midsole. In particular, the support element 800 may be arranged such that a surface of the component 847a forms a portion of the lateral outer surface of the midsole 910. For example, the torsion of the component 847a may be such that the component 847a essentially follows a torsion of the midsole 910. In addition, the apertures 830a, 830b and the portion 845 may be such that the midsole 910 comprises a gap 930. For example, the gap 930 may extend through the midsole 910, e.g., from the lateral side of the midsole 910 to the medial side of the midsole 910. In other words, the gap 930 of the midsole 910 may be such that one can look through the gap 910 from a lateral side of the midsole to the medial side of the midsole.

Further embodiments of the present invention:

[0110] Embodiment 1: Support element (100, 600) configured to be arranged in a sole structure (410) of a shoe (400), comprising: a first portion (101a) associated with a lateral side of the sole structure (410), comprising a first segment (110a) exhibiting a wave structure; a second portion (101b) associated with a medial side of the sole structure (410), comprising a second segment (110b) exhibiting a uniform structure.

[0111] Embodiment 2: Support element (100, 600) according to embodiment 1, wherein: the wave structure comprises at least one peak and at least one valley, preferably wherein the at least one peak and the at least one valley are smoothly connected to each other; the uniform structure comprises less peaks and/or less valleys than the wave structure, preferably wherein the uniform structure comprises at most one peak or one valley.

[0112] Embodiment 3: The support element according to embodiment 1 or 2, wherein the wave structure comprises peaks and/or valleys which are non-continuously connected, preferably wherein the non-continuous connection is a zigzag connection.

[0113] Embodiment 4: Support element (100, 600) according to embodiment 1, wherein: the wave structure of the first segment (110a) extends in a direction of a longitudinal axis of the sole structure (410), and/or the uniform structure of the second segment (110b) extends in the direction of the longitudinal axis of the sole structure (410).

[0114] Embodiment 5: Support element (100, 600) according to one of the embodiments 1-4, wherein the first segment (110a) and/or the second segment (110b) is configured to be located in a front part (102a) of the sole structure (410), preferably the first half of the sole structure, most preferably the first third of the sole structure.

[0115] Embodiment 6: Support element (100, 600) according to one of embodiments 1-5, wherein: the first portion (101a) exhibits a torsion, and/or the second portion (101b) exhibits a torsion.

[0116] Embodiment 7: Support element (100, 600) according to one of embodiments 1-6, wherein: the first portion (101a) comprises at least one component (110a, 610a-610c) comprising the first segment, wherein the component (110a, 610a-610c) preferably is elongate, most preferably wherein the component forms a finger and/or a rod, and/or the second portion (101b) comprises at least one component (110b, 610d, 610e) comprising the second segment, wherein the component (110b, 610d, 610e) preferably is elongate, most preferably wherein the component forms a finger and/or a rod.

[0117] Embodiment 8: Support element (100, 600) according to embodiment 7, wherein a subset of the components comprises components which are not connected to one another.

[0118] Embodiment 9: Support element (100, 600) according to embodiment 7 comprising a first (110a) and a second (110b) component connected to one another, wherein: the first component (110a) is part of the first portion (101a) and the second component (110b) is part of the second portion (101b), or the first (110a) and the second (110b) component is part of the first portion (101a), or the first (110a) and the second (110b) component is part of the second portion (101b).

[0119] Embodiment 10: Support element (100, 600) according to embodiment 9, wherein the first (110a) and/or the second (110b) component is configured to be arranged in a rim portion of the sole structure (410), preferably wherein: the first component (110a), which is part of the first portion (101a), is configured to be arranged in a lateral rim part of the sole structure (410), and/or the second component (110b), belonging to the second portion (101b), is configured to be arranged in the medial rim part of the sole structure (410).

[0120] Embodiment 11: Support element (100, 600) according to one of embodiments 1-10 wherein: the components (110a, 610a-610c) of the first portion (101a, 601a) are mutually connected, and/or the components (110b, 610d, 610e) of the second portion (101b, 601b) are mutually connected, and/or the components (110a,110b,610a-610e) of the first (101a, 601a) and the second portion (101b, 601b) are mutually connected; preferably wherein the components (110a,110b,610a-610e) are connected in a region associated with a mid portion (102b) of the sole structure (410) and/or wherein the components (110a,110b,610a-610e) are connected in a region associated with a rear part (102c) of the sole structure (410), most preferably wherein the components (110a,110b,610a-610e) are connected in a region associated with a heel part of a foot.

[0121] Embodiment 12: Support element (100, 600) according to one of embodiments 1-11, comprising: a portion associated with a mid portion (102b) of the sole structure (410), preferably associated with a mid foot portion, wherein the portion comprises at least one aperture (130a, 130b), preferably wherein at least one aperture is associated with the first portion (101a) and/or at least one portion is associated with the second portion (101b).

[0122] Embodiment 13: Support element (100, 600) according to embodiment 12, wherein the portion associated with the mid portion comprises: a first aperture (130a) located within the first portion (101a); a second aperture (130b) located within the second portion (101b), preferably wherein the first (130a) and the second (130b) aperture are arranged symmetrical within the support element (100, 600).

[0123] Embodiment 14: Support element (100, 600) according to embodiment 13, wherein the portion associated with the mid portion further comprises: an intermediate section (140) separating the first aperture (130a) from the second aperture (130b), preferably wherein the intermediate section (140) comprises a portion (145), which splits in at least two portions (146a, 146b), most preferably wherein the intermediate section is Y-shaped (145, 146a, 146b).

[0124] Embodiment 15: Support element (100, 600) according to one of embodiments 1-14, comprising: a portion associated with a rear part (102c) of the sole structure (410), preferably associated with a heel part of a foot, wherein the portion comprises at least one aperture (150), preferably wherein the aperture is enclosed.

[0125] Embodiment 16: Support element (100, 600) according to one of the embodiments 1-15, wherein the support element is configured to be arranged in a midsole (410), preferably wherein the support element (100, 600) is arranged in between a top component (410b) of the sole structure and a bottom component (410a) of the sole structure.

[0126] Embodiment 17: Support element according to embodiment16, wherein: the intermediate section (140) is in connection with the bottom component (410a) of the sole structure; a mid part (102b) of the support element is gapped (230) from a top component (410b) of the midsole (410) but in connection with a bottom component (410a) of the midsole (410).

[0127] Embodiment 18: A shoe (400), preferably a sports shoe, comprising a support element (100, 600) according to one of embodiments 1-17.

Claims

1. Support element (100, 600) configured to be arranged in a sole structure (410) of a shoe (400), comprising:

a first portion (101a) associated with a lateral side of the sole structure (410), comprising a first segment (110a) exhibiting a wave structure;
a second portion (101b) associated with a medial side of the sole structure (410), comprising a second segment (110b) exhibiting a uniform structure.

2. Support element (100, 600) according to claim 1, wherein:

the wave structure comprises at least one peak and at least one valley, preferably wherein the at least one peak and the at least one valley are smoothly connected to each other; and/or
the uniform structure comprises less peaks and/or less valleys than the wave structure, preferably wherein the uniform structure comprises at most one peak or one valley.

3. The support element according to claim 1-2, wherein the wave structure comprises peaks and/or valleys which are non-continuously connected, preferably wherein the non-continuous connection is a zigzag connection.

4. The support element according to claim 2 or 3, wherein:

a distance between two consecutive peaks of the wave structure is at least 0.5 cm, preferably at least 0.8 cm, more preferably at least 1.1 cm, even more preferably at least 1.4 cm, most preferably at least 1.7 cm; and/or
a distance between two consecutive peaks of the wave structure is at most 8 cm, preferably at most 7 cm, more preferably at most 6 cm, even more preferably at most 5 cm, most preferably at most 4 cm; and/or
a height of a peak of the wave structure is at least 0.1 cm, preferably at least 0.3 cm, more preferably at least 0.6 cm, even more preferably at least 0.9 cm, most preferably at least 1.2 cm; and/or
a height of a peak of the wave structure is at most 4 cm, preferably at most 3.5 cm, more preferably at most 3 cm, even more preferably at most 2.5 cm, most preferably at most 2 cm; and/or
a depth of a valley of the of the wave structure is at least 0.1 cm, preferably at least 0.3 cm, more preferably at least 0.6 cm, even more preferably at least 0.9 cm, most preferably at least 1.2 cm; and/or
a depth of a valley of the wave structure is at most 4 cm, preferably at most 3.5 cm, more preferably at most 3 cm, even more preferably at most 2.5 cm, most preferably at most 2 cm.

5. Support element (100, 600) according to one of the claims 1 to 4, wherein:

a height of a peak decreases along the wave structure of the first segment (110a) from a mid portion (102b) of the sole structure (410) towards a front part (102a) of the sole structure (410); and/or
a depth of a valley decreases along the wave structure of the first segment (110a) from a mid portion (102b) of the sole structure (410) towards a front part (102a) of the sole structure (410); and/or
a distance between two consecutive peaks decreases along the wave structure of the first segment (110a) from a mid portion (102b) of the sole structure (410) towards a front part (102a) of the sole structure (410); and/or
a distance between two consecutive valleys decreases along the wave structure of the first segment (110a) from a mid portion (102b) of the sole structure (410) towards a front part (102a) of the sole structure (410).

6. Support element (100, 600) according to one of the claims 1 to 5, wherein:

the wave structure of the first segment (110a) extends in a direction of a longitudinal axis of the sole structure (410); and/or
the uniform structure of the second segment (110b) extends in the direction of the longitudinal axis of the sole structure (410); and/or the first segment (110a) and/or the second segment (110b) is configured to be located in a front part (102a) of the sole structure (410);
preferably the first half of the sole structure, most preferably the first third of the sole structure.

7. Support element (100, 600) according to one of claims 1-6, wherein:

the first portion (101a) comprises at least one component (110a, 610a-610c) comprising the first segment, wherein the component (110a, 610a-610c) preferably is elongate, most preferably wherein
the component forms a finger and/or a rod; and/or the second portion (101b) comprises at least one component (110b, 610d, 610e) comprising the second segment, wherein the component (110b, 610d, 610e) preferably is elongate, most preferably wherein
the component forms a finger and/or a rod.

8. Support element (100, 600) according to claim 7 comprising a first (110a) and a second (110b) component connected to one another, wherein:

the first component (110a) is part of the first portion (101a) and the second component (110b) is part of the second portion (101b); or
the first (110a) and the second (110b) component is part of the first portion (101a); or
the first (110a) and the second (110b) component is part of the second portion (101b).

9. Support element (100, 600) according to claim 8, wherein the first (110a) and/or the second (110b) component is configured to be arranged in a rim portion of the sole structure (410), preferably wherein:

the first component (110a), which is part of the first portion (101a), is configured to be arranged in a lateral rim part of the sole structure (410); and/or
the second component (110b), belonging to the second portion (101b), is configured to be arranged in the medial rim part of the sole structure (410).

10. Support element (100, 600) according to one of claims 1-9 wherein:

the components (110a, 610a-610c) of the first portion (101a, 601a) are mutually connected; and/or
the components (110b, 610d, 610e) of the second portion (101b, 601b) are mutually connected; and/or
the components (110a,110b,610a-610e) of the first (101a, 601a) and the second portion (101b, 601b) are mutually connected;
preferably wherein:

the components (110a,110b,610a-610e) are connected in a region associated with a mid portion (102b) of the sole structure (410); and/or
the components (110a,110b,610a-610e) are connected in a region associated with a rear part (102c) of the sole structure (410), most preferably wherein the components (110a,110b,610a-610e) are connected in a region associated with a heel part of a foot.

11. Support element (100, 600) according to one of the claims 1 to 10, further comprising a portion associated with a mid portion (102b) of the sole structure (410), wherein the portion associated with the mid portion (102b) comprises:

a first aperture (130a) located within the first portion (101a); and
a second aperture (130b) located within the second portion (101b); preferably wherein the first (130a) and the second (130b) aperture are arranged symmetrical within the support element (100, 600).

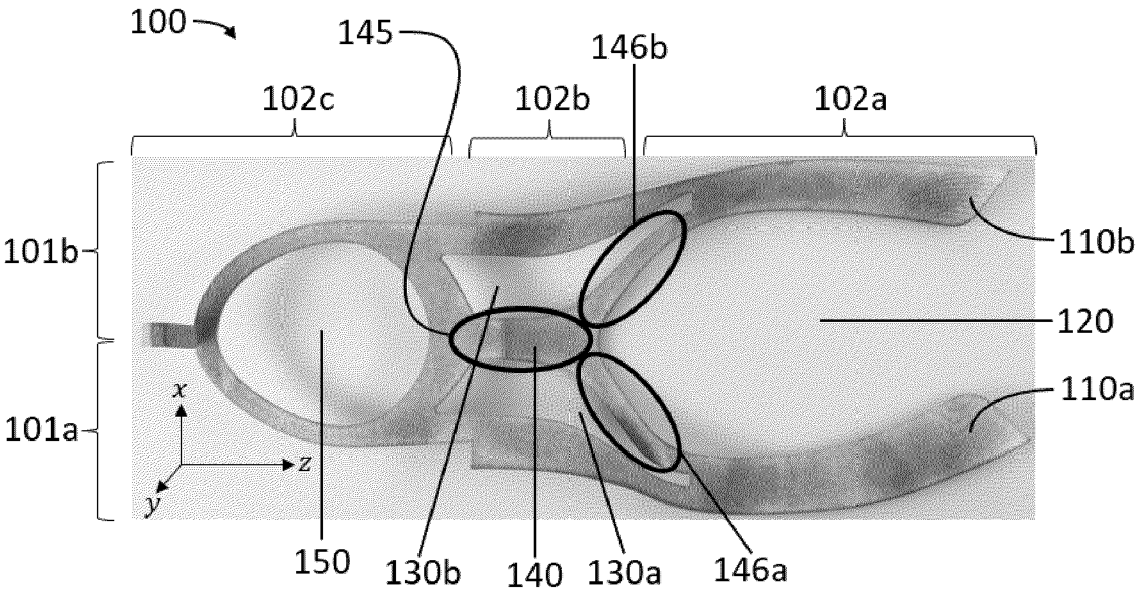
12. Support element (100, 600) according to claim 11, wherein the portion associated with the mid portion further comprises:
an intermediate section (140) separating the first aperture (130a) from the second aperture (130b);
preferably wherein the intermediate section (140) comprises a portion (145), which splits in at least two portions (146a, 146b), most preferably wherein the intermediate section is Y-shaped (145, 146a, 146b).

13. Support element (100, 600) according to one of claims 1-12, comprising:
a portion associated with a rear part (102c) of the sole structure (410), preferably associated with a heel part of a foot, wherein the portion comprises at least one aperture (150).

14. Support element according to claim 12, wherein:

the intermediate section (140) is in connection with a bottom component (410a) of the sole structure; and
a mid part (102b) of the support element is gapped (230) from a top component (410b) of the midsole (410) but in connection with a bottom component (410a) of the midsole (410).

15. A shoe (400), preferably a sports shoe, comprising a support element (100, 600) according to one of claims 1-14.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145
146b
102c
102b
102a
101b
110b
120
110a
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x
z
y
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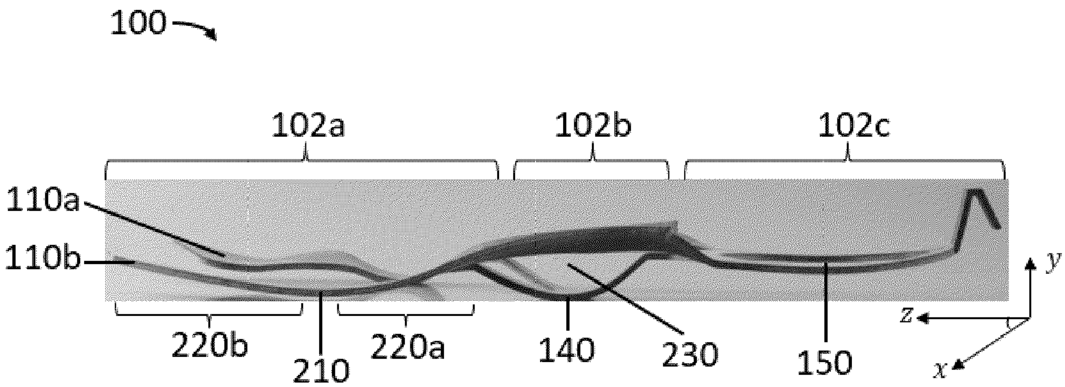
130b
140
130a
146a

Fig. 1A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102b
102c
110a
110b
y
z
x
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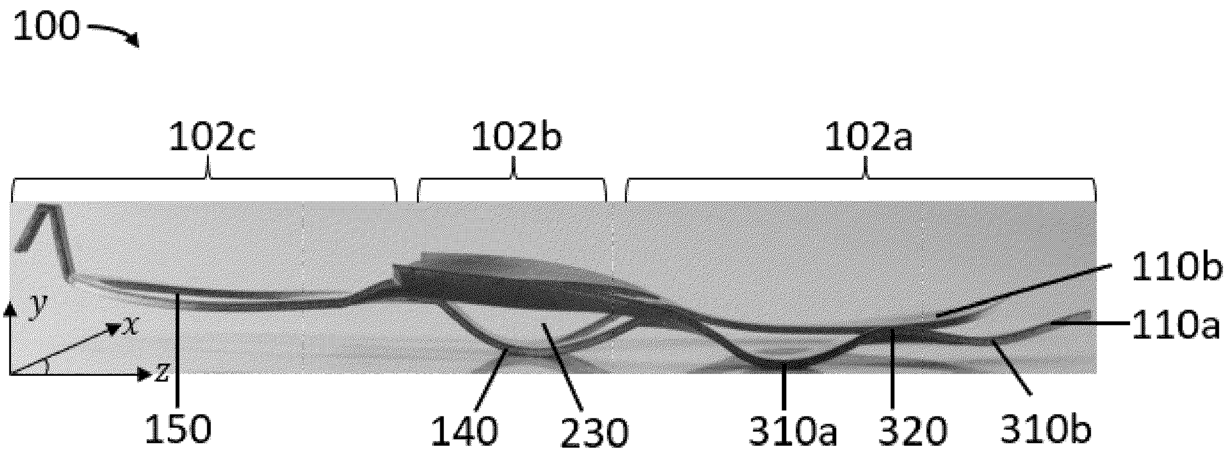
140
230
150

Fig. 1B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102a
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110a
y
x
z
150
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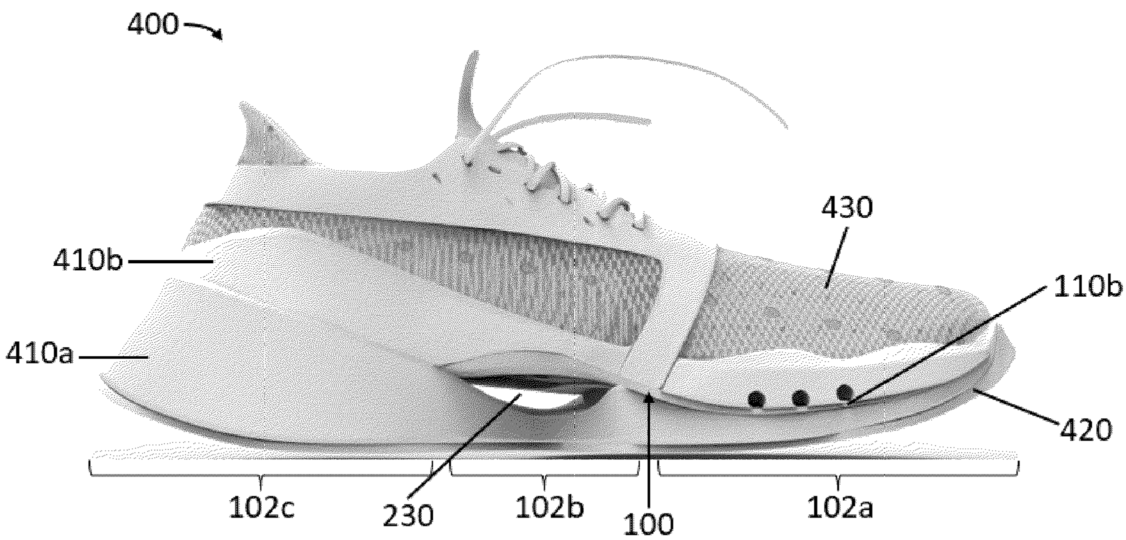
230
310a
320
310b

Fig. 1C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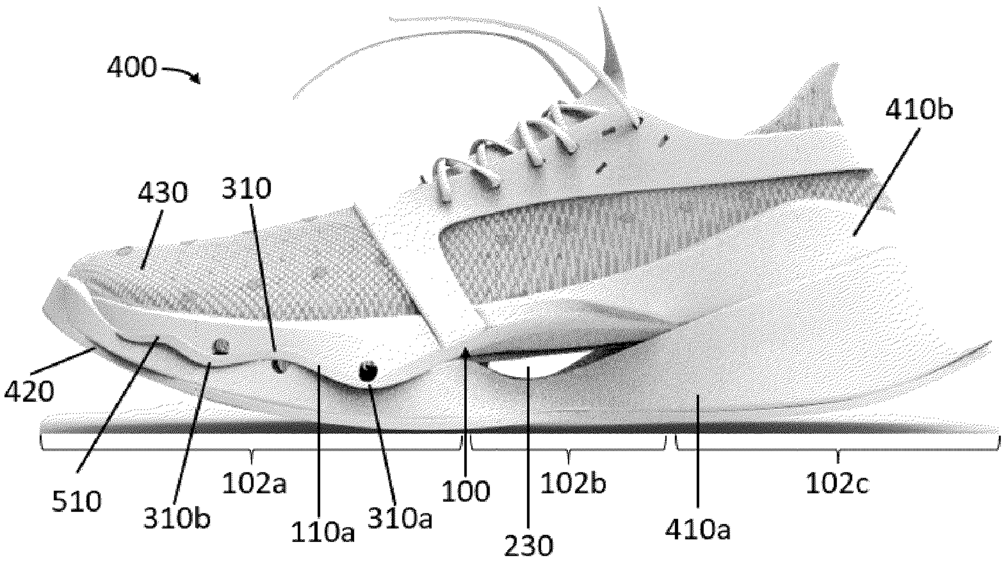
410b
110b
410a
420
102c
230
102b
100
102a

Fig. 2A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110a
310a
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102b
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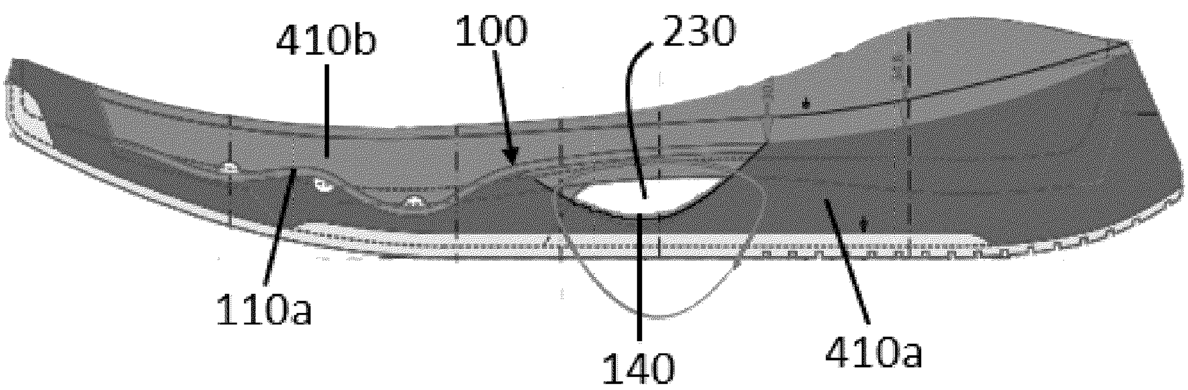
410a
102c

Fig. 2B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230
110a
140
410a

Fig. 2C

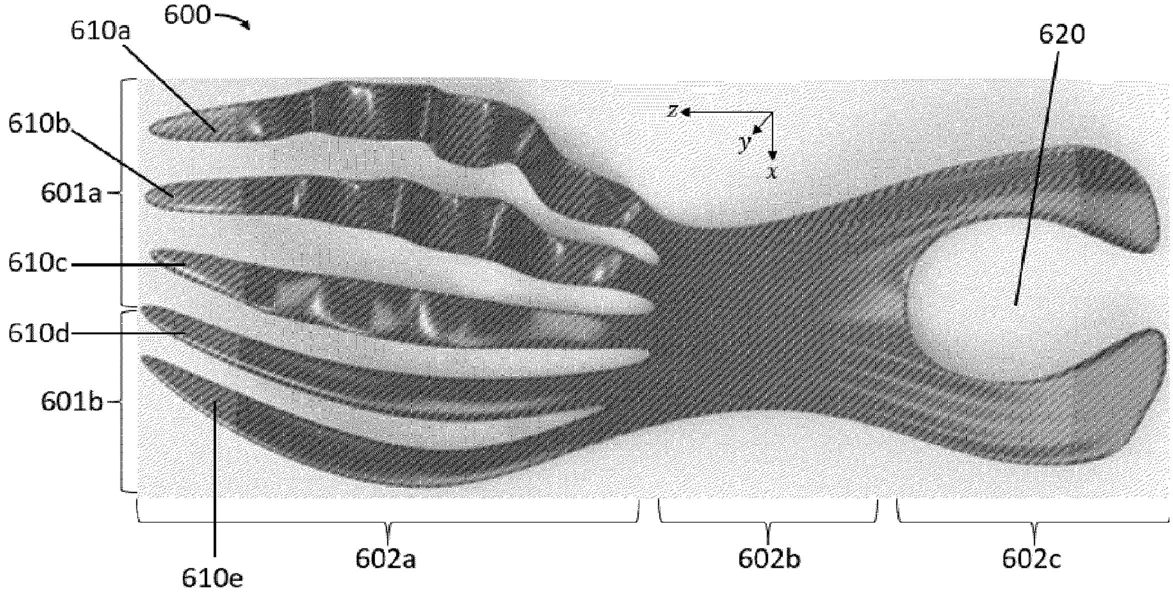
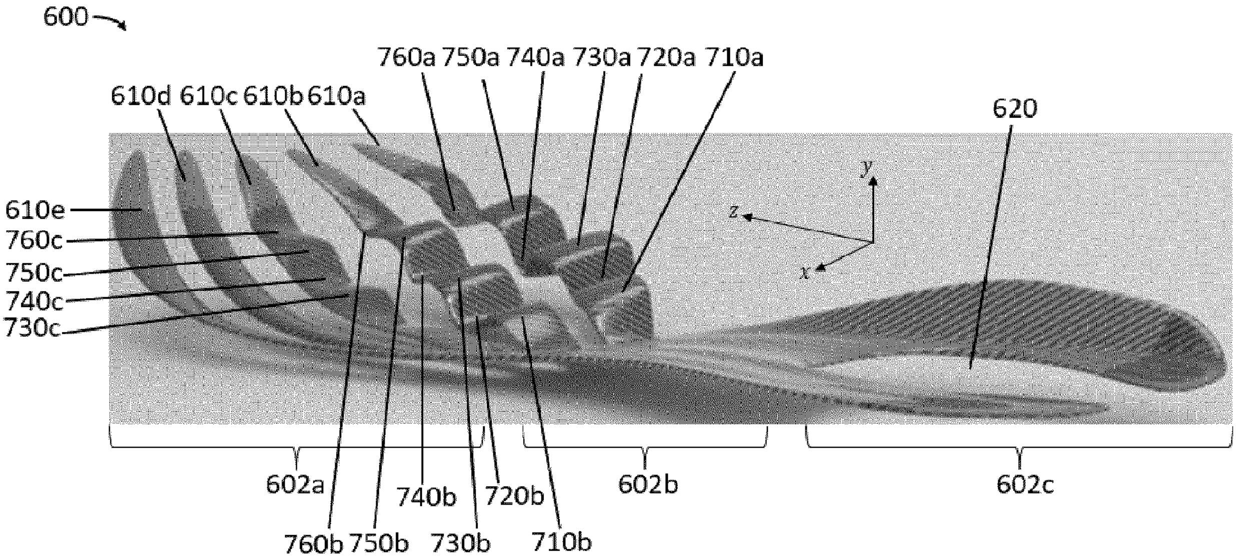

600
610a
610b
601a
610c
610d
601b
610e
620
z
y
x
602a
602b
602c

Fig. 3A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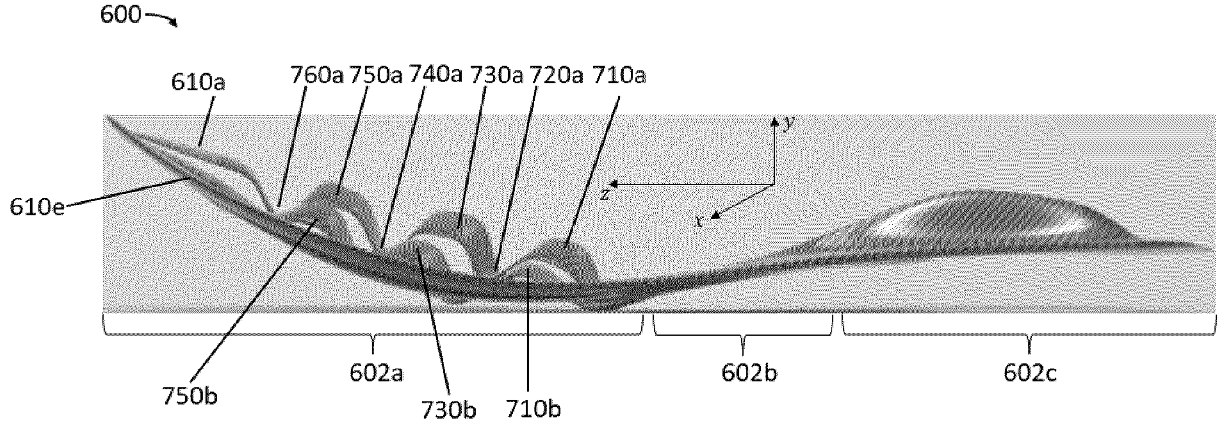
610d 610c 610b 610a
760a 750a 740a 730a 720a 710a
620
610e
760c
750c
740c
730c
y
z
x
602a
740b
720b
602b
602c
760b 750b
730b
710b

Fig. 3B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610a
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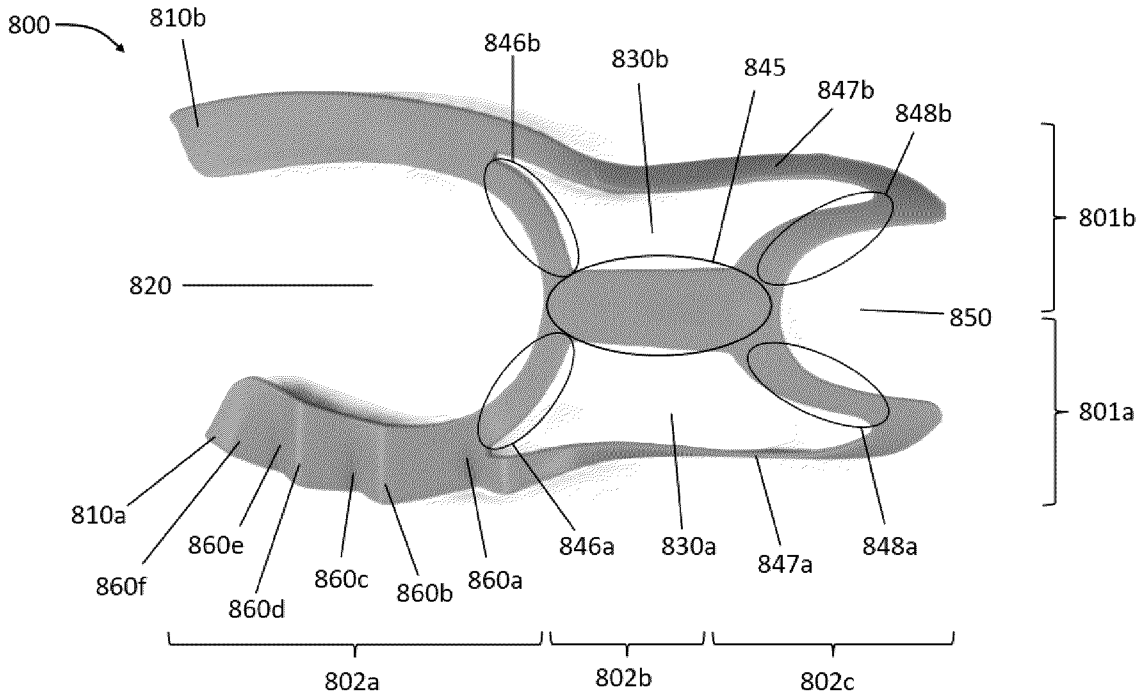
y
z
x
610e
750b
602a
730b
710b
602b
602c

Fig. 3C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830b
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848b
801b
820
850
801a
810a
860e
860f
860d
860c
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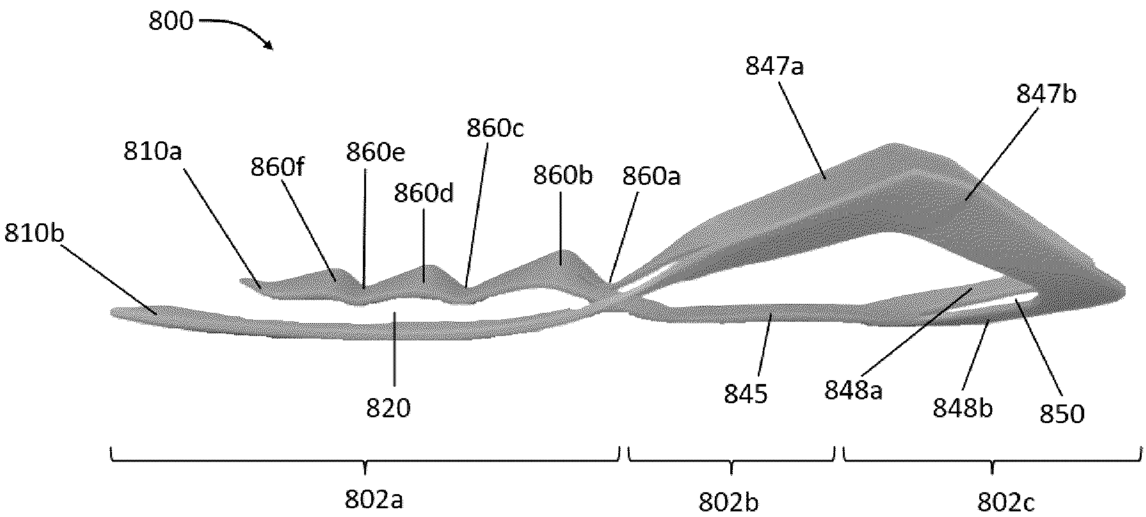
860a
846a
830a
847a
848a
802a
802b
802c

Fig. 4A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845
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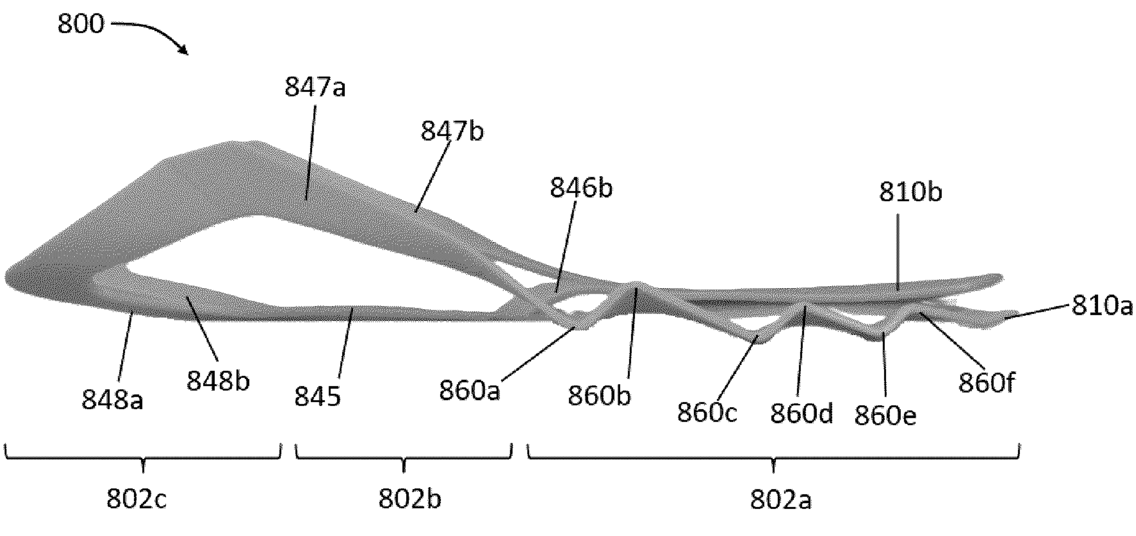
850
802a
802b
802c

Fig. 4B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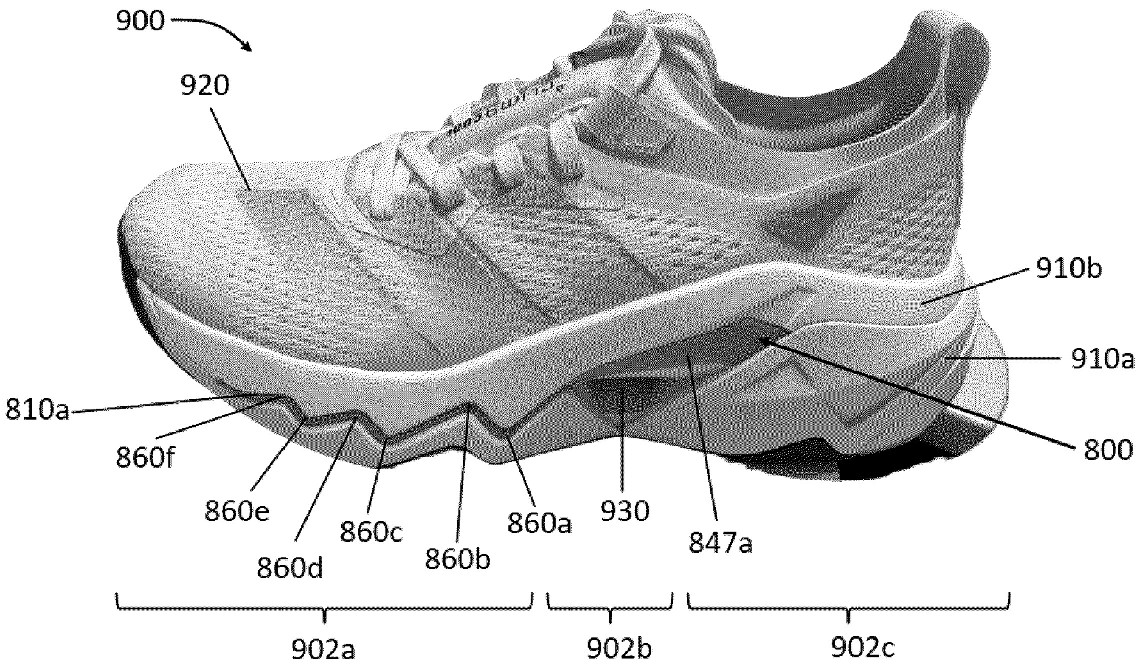
802b
802a

Fig. 4C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920
910b
910a
810a
800
860f
860e
860c
860a
930
847a
860d
860b
902a
902b
902c

Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 24 21 6007

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 10 758 003 B2 (MIZUNO KK [JP]) 1 September 2020 (2020-09-01) * figures *	1-4, 6-10,15 5,11-14	INV. A43B13/14 A43B13/18
A	US 6 389 713 B1 (KITA KENJIRO [JP]) 21 May 2002 (2002-05-21) * figures *	1-15	
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TECHNICAL FIELDS SEARCHED (IPC)

A43B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	13 March 2025	Gkionaki, Angeliki

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- The effect of lateral banking on the kinematics and kinetics of the lower extremity during lateral cutting movements. *Human Movement Science*, 2014, vol. 33, 97-107 **[0003] [0004]**
- The influence of lateral wedged insoles on performance and ankle joint biomechanics of lateral movements. *Footwear Science*, 2023, vol. 15, 146-147 **[0005]**