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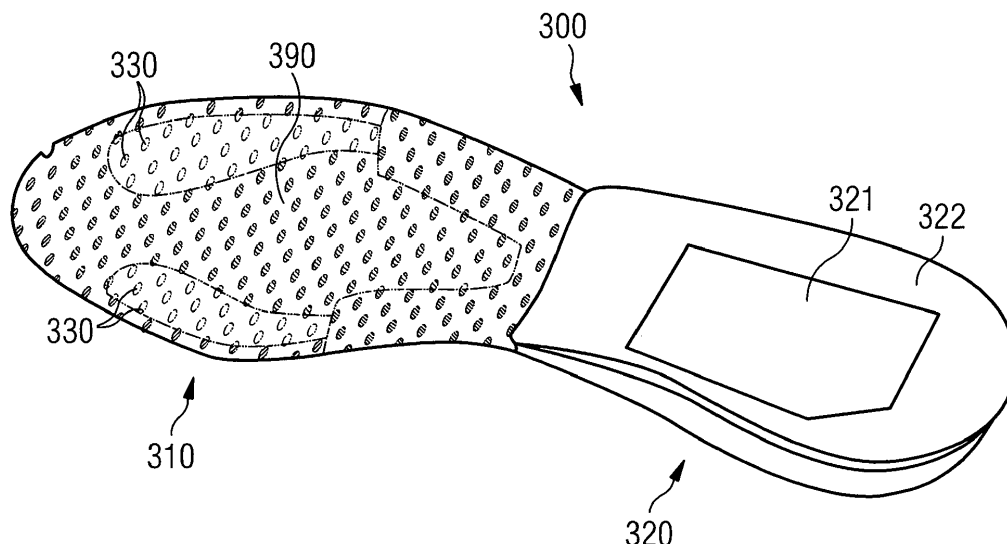
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(54) **SOLE ELEMENTS AND SHOES**

(57) The present invention relates to a sole element, such as an insole, for a shoe, in particular for a sports shoe, as well as to a shoe, in particular a sports shoe. A sole element for a shoe comprises a first portion (110; 210; 310) and a second portion (120; 220; 320), wherein the second portion comprises a deformable material

(121; 221; 321), which is adapted to generate heat by being deformed. The sole element moreover comprises a transport element (130; 230; 330) adapted for selectively directing the generated heat from the second portion to the first portion.

FIG 3



Description

1. Technical Field:

[0001] The present invention relates to a sole element, such as an insole, for a shoe, in particular for a sports shoe, as well as to a shoe, in particular a sports shoe.

2. Prior art:

[0002] Shoes may provide their wearer with various functionalities such as traction, cushioning, protection from sharp objects, heat management, etc. Therein, different regions of a shoe may be provided with varying properties according to the different needs in these regions.

[0003] For example, from document US 6,528,140 it is known that an article of footwear may provide a dual energy management system. For example, a first area in a forefoot portion may comprise an elastic material, whereas a second area in a rearfoot portion comprises a viscous material. Such a design may take into account the passive and active force peak values arising during the natural course of motion. In general, optimization of the force distribution within a shoe or, more generally, the cushioning properties of a shoe have been a field in which a multitude of research endeavors have been made.

[0004] A different important aspect of shoes is to optimize their heat management. For example, a shoe may be required to keep the wearer's foot warm. In the prior art various approaches are known to insulate the inside of a shoe, such that the feet remain warm even in a cold environment.

[0005] For example, US 4,055,699 describes a multi-layer insole for disposition in an article of footwear to insulate the foot from the cold developed in the sole from walking on a cold surface. The insole comprises four superimposed layers, namely a thin soft fabric layer, an open cell foam layer, a dense cross-linked polyolefin layer, and a moisture barrier layer of polymeric material having an aluminum coating at its bottom.

[0006] Document US 4,887,368 discloses insoles for providing heat insulation and for storing and distributing heat on the areas of the outer skin. The insoles are formed of a foam layer and another foam layer, wherein a flexible heat conductive metal layer is placed between the foam layers.

[0007] However, a mere insulation of a shoe from its environment may not be sufficient to keep certain regions of a foot warm, such as the toe region, especially when the shoe is used in a cold environment for a longer period of time.

[0008] Document US 2011/0247235 A1 discloses an insole comprising a seventh ring which forms a chamber for holding a reactive chemical compound that is chargeable of exothermic heat development. The container is contacted by a heat conducting element. A chemical re-

action may be activated within the chemical compound or a phase change material may be used.

[0009] However, creating heat by chemical reactions or phase change may require the need of toxic substances. Moreover, such an approach is a one-time process, such that the chemical compound needs to be frequently replaced which may be costly and cumbersome.

[0010] Another approach disclosed by US 2012/0192452 A1 is to use a fabric for an insole, which can absorb and store excess heat from the feet, and then can release the heat when needed to warm the feet. A phase change material may be incorporated in the fabric. However, also with this approach, the amount of energy that can be used to warm the foot remains limited. When using the shoes in a cold environment, the stored heat may be used up quickly such that the feet may get cold over time.

[0011] DE 10 2005 024 919 A1 discloses a device for converting kinetic energy into heat. The heat is generated by two forms parts, which are arranged one after another in the main direction of movement, at least one of which consisting of a polymer plastic material and being elastically moveable. The form parts are structured in such a way at respective opposing surfaces that, when the form parts move towards each other, surface friction occurs, which generates frictional heat.

[0012] US 3 493 986 A discloses a sealed casing that can be employed in shoes. Flat top and bottom members of the casing serve to define a closed cavity which is filled with tightly packed particles of at least one piezoelectric or magnetostrictive material. When the top or bottom member of the filled casing is repeatedly subjected to force, useful amounts of heat are produced.

[0013] Therefore, there is a need for shoes and/or elements of shoes that provide better ways of keeping a wearer's feet warm. It is an object of the present invention to provide such shoes and/or elements of shoes.

3. Summary of the invention:

[0014] According to an aspect of the present invention, this object is at least partly solved by a sole element, in particular an insole, for a shoe, in particular a sports shoe. The sole element may comprise a first portion and a second portion, wherein the second portion may comprise a deformable material, which may be adapted to generate heat by being deformed. The sole element may further comprise a transport element adapted for selectively directing the generated heat from the second portion to the first portion.

[0015] An underlying concept of the present invention may be considered to make use of the impact energy at every step of the wearer by means of the deformable material that is adapted to generate heat repeatedly each time it is deformed. In particular, the deformable material may be adapted to generate heat by being repeatedly deformed. Every time the wearer's foot touches the ground, the corresponding impact energy is at least partly

transformed into heat by the deformable material. In addition, the transport element (heat transport element) is adapted to selectively direct the generated heat to the first portion such that the temperature of the first portion may be increased. Hence, heat can be generated in the second portion and delivered to the first portion at every step taken by the wearer. The sole element can thus repeatedly deliver heat such that the feet are prevented from getting cold as long the wearer keeps on walking or running. Rather than relying on heat diffusion or other inefficient mechanisms, by using a dedicated transport element adapted to selectively direct the generated heat to the first portion, an efficient transport to the first portion, where the heat is actually needed, may be ensured.

[0016] In some examples, a resilience of the deformable material is below 80%, preferably below 65%, more preferably below 50%, particularly preferably below 35%, for example below 15%, or even below 10%. For deformable materials with such low resilience, a large fraction of the impact energy is transformed into heat, leading to a particularly effective heating of the sole element, in particular when it is repeatedly deformed. In some examples, a deformable material with a resilience equal or below 5 % may be used, for example a material known under the trade name Elastopan®, e.g. Elastopan® CS 9850, from the company BASF®. For example, a resilience between 1% to 5 %, for example of about 2% may be provided.

[0017] A resilience of a material can for example be measured based on ISO 8307. According to this norm, a pendulum with a ball is released from a height h_0 and made to rebound on a sample of the material. The corresponding resilience value is given by the ratio hR/h_0 , wherein hR is the maximum height reached by the ball after a first rebound on the material.

[0018] It is noted that the term "comprise" as used herein, also encompasses the term "consists of". Moreover, the terms "one or more" or "at least one" encompass any number, e.g. 1, 2, 3, 4, 5, ..., as well as the terms "two or more", "three or more", etc., and "multitude of". Finally, the terms "at least in part" or "at least partially" or "at least partly" as used herein, also encompass the notion of "fully".

[0019] In some examples, the first portion comprises a resilient material having a resilience that is higher than a resilience of the deformable material, preferably higher by at least 15%, more preferably by at least 25%, particularly preferably by at least 40% or 41 %, or by at least 50%, or by at least 70% and in some embodiments by about 80%. For example, the deformable material may have a resilience of approximately 10%, wherein a resilience of the resilient material is higher by at least 50%, e.g. the resilience of the resilient material is approximately 60% or higher. The first portion may thus contribute to the energy return of the sole element. Despite a relatively low resilience of the deformable material of the second portion, by means of the high resilience of the resilient material of the first portion, the impact energy upon touching ground may be returned relatively elastically to the

wearer. This trade-off may facilitate a more efficient walking or running owing to the resilient material of the first portion such that the wearer gets tired less quickly, whereas at the same time the heat generated by the lower resilience deformable material of the second portion keeps the wearer's feet warm.

[0020] In some examples, a resilience of the resilient material may be higher than a resilience of the deformable material by a particular factor. For example, a resilience of the resilient material may be at least two times, at least five times, or at least ten times higher than a resilience of the deformable material. For example, a resilience of the deformable material may be approximately 5%, and a resilience of the resilient material may be at least ten times higher, i.e. at least approximately 50%.

[0021] The resilience of the resilient material may be at least 20%, preferably at least 35%, particularly preferably at least 50%, in particular at least 60%, at least 65%, or even at least 76%, and in some embodiments about 85%. A high degree of resilience may allow for a higher energy return of the sole element such that a high degree of energy return is facilitated. For example, expanded polymer materials, e.g. in pellet form, may be used for the resilient material. Specifically, for example, expanded thermoplastic polyurethane (eTPU), in particular in foamed pellet form, may be used, which can provide a resilience of 50 % to 90 %, or 55 % to 65 %, e.g. approximately 60 %. Additionally or alternatively, ethylene-vinyl-acetate (EVA) may be used, for example with a resilience of between 30% and 60%, e.g., of about 40%.

[0022] In some example, the resilient material may comprise a thermal conductivity below 100 mW/(K.m), preferably below 75 mW/(K.m), particularly preferably below 60 mW/(K.m). Hence, the resilient material may contribute to insulate the first portion from the ground. Heat may be selectively transported to the first portion, and by means of the resilient material, the first portion may be insulated from the ground such that the heat is released to the foot of a wearer instead of leaking out of the sole element. Specifically, EVA may be used as resilient material with a thermal conductivity of 65 mW/(K.m) to 75 mW/(K.m), e.g. approximately 70 mW/(K.m). Additionally or alternatively, expanded polymer materials, e.g. in pellet form, may be used, for example, eTPU, in particular in pellet form, which may have a thermal conductivity of 40 mW/(K.m) to 60 mW/(K.m), e.g. approximately 54 mW/(K.m). The values for thermal conductivity refer to values at a mean temperature of approximately 25°C. The values for thermal conductivity may for example be obtained according to GB/T 10295-2008 or any other suitable method.

[0023] The deformable material may comprise a foam material, in particular a (poly-)urethane foam material. This material class may allow a large amount of heat generation and at the same time provide cushioning to the foot. For example, the aforementioned material known under the trade name Elastopan®, e.g. Elastopan® CS 9850, from the company BASF® may be used.

Additionally or alternatively, also foamed EVA may be used.

[0024] The sole element may for example be provided as an insole or as a part of an insole. An insole may be removably inserted into a shoe, in particular a sports shoe. Providing the sole element as an insole may therefore allow an easy exchange of the heating properties of a shoe. Depending on the season or the present weather conditions, for example, a shoe may then be combined with a corresponding insole having suitable heating characteristics. As a further example, the first and second portions may be arranged as needed in an insole for a specific wearer and/or a specific type of use of the shoe such that the shoes may be customized as desired. Moreover, by providing the second portion and its deformable material in an insole, the deformation of the deformable material required for heat generation takes place close to the foot. This may help to minimize the shear forces associated with the deformation.

[0025] The second portion may have a thickness that is a larger than a thickness of the first portion. A relatively large thickness of the second portion may allow an increase in the volume of the deformable material such that the amount of energy absorbed when the foot hits the ground is higher and thereby the heat generated by the deformable material in the second portion may be increased. Moreover, the larger thickness of the second portion relatively to the first portion may contribute to ensuring that the impact forces during running/walking are maximized on the second portion.

[0026] In some examples, in at least a part of the second portion, the deformable material is arranged such that it extends through at least 40% of a thickness of the sole element, preferably through between 50% and 95% of the thickness of the sole element, particularly preferably between 75% and 90%, or approximately 85%, of the thickness of the sole element. Therein, the deformable material may be arranged as a continuous portion. Alternatively, the deformable material may also be arranged as several separated portions, wherein possibly other portions with different characteristics may be arranged in between. Each separate portion of the deformable material may be continuous, e.g. provided in one piece without holes. Generally, arranging the deformable material through a large fraction of a thickness of the sole element, e.g. an insole, may increase the amount of heat generated by the deformable material. At the same time, using a small fraction of the thickness of the sole element for other materials may optimize the functionality of the sole element. For example, a lining may be provided on a top surface of the second portion, a coating may be provided on a top and/or bottom surface of the second portion etc. Moreover, an insulating element may be provided on a top and/or bottom surface of the second portion etc. Such other materials may provide the second portion with other functionalities, e.g. a nice feel, insulation etc., in addition to the heat generating functionality.

[0027] In at least a part of the second portion, the de-

formable material may be arranged such that it comprises a vertical extension that is larger than an average thickness of the sole element. This aspect may help maximizing the amount of heat that can be generated by the deformable material during a single impact. The deformable material may be provided with a relatively large vertical extension such that it has a large volume that may be deformed to generate heat. At the same time, the relatively large vertical extension of the deformable material compared to an average thickness of the sole element may ensure that the impact forces acting on the deformable material are large compared to other parts of the sole element.

[0028] In some examples, the second portion forms at least one protrusion on an upper surface of the sole element. This may help to ensure that the second portion and its deformable material are actually deformed during walking or running. For example, when touching ground, the foot of a wearer may tend to flatten the at least one protrusion, such that a deformation of the deformable material may be increased. Additionally or alternatively, the deformable material may form at least one protrusion on an upper surface of the sole element.

[0029] In some examples, the second portion may be adapted to extend at least partially in a rear half of a foot, e.g. in a rearfoot area, preferably in a heel area of the foot, e.g. in an area underneath the calcaneus of the foot. The area underneath the calcaneus of the foot mostly touches ground first, such that typically a large amount of impact energy is deposited in this half of the foot. Hence, locating the heat generating second portion with its deformable material in this area, or generally in a rearfoot area, of the foot may help to maximize the heat that is created at each step, and may thus provide a particularly high heating effect. At the same time, providing a large amount of energy return is not so critical in this area of the foot. In some embodiments, the second portion may be adapted to extend entirely in a rear half of a foot, e.g. in a rearfoot area, preferably in a heel area of the foot, e.g. in an area underneath the calcaneus of the foot

[0030] Additionally or alternatively, the second portion may also be arranged in a toe area, e.g. in an area under the metatarsal heads. These areas tend to get cold most quickly. Providing the second portion in these areas may thus be particularly effective. A sole according to the invention may therefore comprise a plurality of second portions with deformable material in different locations of the sole. For example, at least two second portions may be provided, such as for example one in the heel area and one in the forefoot area.

[0031] The first portion may be adapted to extend at least partially in a midfoot and/or a forefoot area and/or a toe area of a foot. Arranging the first portion in the mentioned areas of the foot provides a larger energy return, which may be beneficial. A high elasticity material, which is less suitable to generate heat when being deformed, may be arranged in these areas.

[0032] In some examples, the transport element may,

e.g. only partly or fully, overlap with an upper and/or lower surface of the second portion, preferably at least throughout 50% of the upper and/or lower surface of the second portion, particularly preferably at least throughout 80% of the upper and/or lower surface of the second portion, and/or up to 100% of the upper and/or lower surface of the second portion. Having such an overlap between the second portion and the transport element adapted to selectively transport heat from the second portion may allow an improved heat transfer from the second portion to the transport element such that the transport element can effectively transport the heat generated by the second portion. Additionally or alternatively, the transport element may overlap with an upper and/or lower surface of the deformable material to the mentioned extent. For example, the transport element may have a heat absorption portion overlapping with the second portion to the mentioned extent. It is also possible that, additionally or alternatively, the transport element may comprise one or more sections that extend in the second portion and/or the deformable material. For example, such a section of the transport element may be arranged between two or more parts of the second portion or the deformable material of two or more such parts of the second portion.

[0033] The transport element may comprise a heat conductive element. This may allow an efficient and fast transport of the heat generated in the second portion to the first portion.

[0034] In some examples, the transport element comprises a heat conductivity of at least 150 mW/(K.m), preferably of at least 200 mW/(K.m), particularly preferably of at least 220 mW/(K.m) or approximately 250 mW/(K.m). With these values, a particularly good heat transport may be ensured.

[0035] The transport element may for example comprise metal, in particular copper and/or aluminum. For example, the transport element may comprise a metal that is provided as a sheet, which may possibly be thin and/or lightweight. Such a transport element may not adversely affect the mechanical properties of the sole element but still provide excellent heat transport properties. For example, a transport element with a thickness of below 100 μ m and with a heat conductivity of approximately 250 mW/(m.K) may be provided. The transport element may comprise a printed metal. It may be provided by printing or otherwise applying an ink, or generally a liquid, containing metal or other heat conductive material, for example in the form of particles.

[0036] The transport element may have a thickness below 1 mm, preferably below 0.3 mm, particularly preferably below 0.2 mm. For example, a transport element with a thickness of approximately 0.08 mm may be provided. The specified thickness may apply to the transport element throughout its lateral extension. Alternatively, it may apply to a majority of its lateral extension, e.g. more than 50 %, more than 75 %, or more than 95 % of its lateral extension, or be an average of its thickness.

[0037] In some examples, the transport element com-

prises at least one air channel. By means of an air channel, a convective heat transport may be enabled.

[0038] The transport element may be arranged at least partly above the first portion. Hence, the transport element may be able to release the heat towards the feet above the first portion. At the same time, the first portion may serve as an insulating means for preventing the heat transported by the transport element from being released towards the ground. In particular, the transport element may be arranged so as to be at the upper surface of a sole according to the invention. The heat may thus be delivered directly to the foot. In particular, in some embodiments, the transport element is arranged so as to be at least partially in contact with a foot.

[0039] In some examples, the sole element comprises a first insulating element extending at least partially below the second portion and/or at least partially below the transport element. In particular, the sole element may comprise a first insulating element extending below the entire second portion and/or below the entire transport element. By providing such a first insulating element, a release of the heat generated in the second portion towards the ground in the area of the second portion may be prevented. Additionally or alternatively, a release of the generated heat that is transported through the transport element towards the ground may be prevented along the transport element. The first insulating element may be provided for example as an insulating layer. A layer is understood as a relatively thin element with relatively large lateral extensions. A layer may extend approximately parallel to the ground. A layer may extend throughout the sole or sole element (full layer) or it may only extend in one or more areas of the sole or sole element (partial layer).

[0040] The first insulating element and the first portion may comprise the same material. Hence, the insulating element and the first portion may for example be integrally fabricated, for example such that the first portion extends at least partly below the second portions and/or the transport element. Moreover, gaps between the insulating element and the first portion through which the generated heat may partly be released, e.g. due to seams or layers of glue, etc., may thus be avoided such that a more efficient insulation of the sole element may be provided.

[0041] The sole element may comprise a second insulating element extending at least partially above the transport element and/or at least partially above the second portion. The second insulating element may help to avoid that generated heat is released by the transport element and/or the second portion towards the foot in areas where this is not desired. The transport element may for example be insulated from above in areas outside the first portion. Generated heat may then only be released by the transport element in an area of the first portion. For example, the first portion may be located in a front area of the foot (e.g., comprising a midfoot and a forefoot area of the foot), a forefoot area, and/or a toe

area of the foot. The second insulating element may in such cases, for example, extend in a rearfoot area, a midfoot area, and/or a forefoot area, respectively, but for example not in a toe area of the foot. The second insulating element may generally comprise the same properties as the first insulating element, e.g. the same material. However, first and second insulating elements may also be provided with different properties, e.g. different materials, different thicknesses, different coatings, etc.

[0042] The transport element may comprise a forefoot portion above which no or only one or more weakly insulating element is arranged. This may ensure that heat can be effectively released towards the foot of the wearer in a forefoot area of the foot. In some examples, the transport element may comprise a toe portion above which no insulating element is arranged. In further examples, the transport element may comprise a front portion (i.e. a midfoot portion and/or a forefoot portion) above which no insulating element is arranged. A weakly insulating element may be a liner placed for comfort. It may have a very low heat conductivity. Such liner may for example have holes such that at least a portion of the transport element is bare.

[0043] The first insulating element and/or the second insulating element may comprise an aerogel. Aerogels have turned out to provide good insulating values and although in many cases these materials can be rigid, softer grades of aerogels are available, such softer aerogels may contain one or more additives, e.g. a polymer additive (e.g. rubber). In particular, such softer aerogels have turned out to be suitable also for a provision in close proximity to a foot, since they may provide good cushioning properties and may be flexible enough to adapt to the shape of a wearer's foot without tending to create pressure marks or blisters.

[0044] In some examples, the first insulating element and/or the second insulating element may have a thickness below 1 mm, preferably below 0.5 mm, e.g. approximately 0.2 mm. Such thin elements may contribute to provide a lightweight, low profile sole element. The first and/or the second insulating element may for example be provided as one or more coating, one or more layers, one or more foils etc.

[0045] The first insulating element and/or the second insulating element may comprise a thermal conductivity below 50 mW/(K.m). Such low values of thermal conductivity may provide a particularly good insulation of the sole element from the ground and may facilitate the transport of the generated heat from the second portion to the first portion. In some examples, the first insulating element and/or the second insulating element may comprise a thermal conductivity of approximately 30 mW/(K.m). In case of anisotropic insulating elements, the values of thermal conductivity may be understood as values characterizing the minimum of a thermal conductivity of the respective insulating element between the parts to be insulated by that insulating element (e.g. between, on the one side, the transport element and/or the second

portion, and, on the other side, the ground and/or to the foot of the wearer). In some examples, the first insulating element may comprise a first insulating material and the second insulating element may comprise a second insulating material, wherein the first insulating material and/or the second insulating material comprise a thermal conductivity below 50 mW/(K.m) or of approximately 30 mW/(K.m).

[0046] In some embodiments, the deformable material acts as a second insulating element between a foot and the transport element.

[0047] In some embodiments, the second portion is arranged in an insole, and a midsole and/or an outsole ensure the function of a first insulating element. For example, such midsole may comprise a polymer such as EVA, polyurethane (e.g. TPU), or a foamed polymer, such as eTPU.

[0048] In some examples, a shoe, in particular a sports shoe, may be provided which comprises a sole element according to any of the examples described herein.

[0049] According to another aspect of the present invention, a shoe may be provided, in particular a sports shoe, which additionally or alternatively may comprise a first portion and a second portion. The second portion may be arranged at a sole of the shoe and may comprise a deformable material, which may be adapted to generate heat by being deformed. The shoe may further comprise a transport element adapted for selectively directing the generated heat from the second portion to the first portion.

[0050] As mentioned, the deformable material adapted to generate heat can make use of the impact energy at every step of the wearer. In particular, the deformable material may be adapted to generate heat by being repeatedly deformed. Every time the wearer's foot touches the ground, the corresponding impact energy may at least partly transformed into heat by the deformable material. In addition, the transport element may be adapted to selectively direct the generated heat to the first portion such that the temperature of the first portion may be increased. Hence, heat can be generated in the second portion and delivered to the first portion at every step taken by the wearer. The shoe can repeatedly deliver heat such that the feet of the wearer are prevented from getting cold as long the wearer keeps on walking or running. Such shoe does not need any external source of power to be heated, apart from the mechanical energy input by the wearer of the shoes.

[0051] The shoe may be combined with one or more sole elements as described further above, and the first and second portions of the shoe, the deformable material of the second portion of the shoe, as well as the transport element of the shoe may be provided with the same aspects as explained herein in relation to a sole element.

[0052] In some examples, the transport element of the shoe may at least partly be arranged in an upper of the shoe. This may allow heat transport also to or via the upper of the shoe. For example, the transport element

may at least partially be arranged in a midfoot area, a forefoot area and/or a toe area of the upper. Hence, heat may be transported to these areas of the shoe not only from below via the sole but additionally or alternatively also via the upper. For example, heat may be transported to and released at two or more elevation levels of the foot or from (e.g. from the sole and from the upper), and/or from two or more opposing sides or even from all sides. For example, a transport element may at least partly encompass a certain area such that heat may be released all around that area. For example, a transport element may be provided that comprises one or more loops around a forefoot portion of the foot.

[0053] The shoe may comprise an insulating layer that is at least partly arranged in an outsole and/or a midsole of the shoe. The insulating layer may contribute to insulating the shoe such that the generated heat is not inadvertently released towards the ground.

[0054] In some examples, the insulating layer may at least partially be arranged in at least one recess of the outsole. By arranging the insulating layer in a recess, a low profile sole may be provided since no or only very little extra space may be required for the insulating layer. A majority of the volume of the insulating layer may be arranged in the at least one recess of the outsole.

[0055] The shoe may comprise at least one profile element formed on the outsole opposite to the at least one recess. Profile elements, such as studs, cleats etc., may help to increase traction provided by the shoe. By using a recess typically formed in the outsole opposite to such profile elements, particularly low profile shoes may be provided. Also the heat loss due to the cleats, studs, etc. in the ground, in particular in a wet and/or cold ground, is further limited by placing an insulating material in the recess of these structures.

[0056] The shoe may comprise at least one profile element, wherein the at least one recess is arranged in the profile element.

[0057] The insulating layer may comprise a foam material, in particular a (poly-)urethane foam material. The insulating layer may generally be provided with the same properties as the first and second insulating elements explained further above. Such material is generally lightweight such that their addition does not change significantly the weight of the shoe, or may even lower the shoe's weight compared to integral cleats, studs, etc.. The aspects described herein may be applicable to a wide range of sports shoes, e.g. soccer shoes, rugby shoes, running shoes, etc. It is noted that the sole elements and shoes described herein may also be provided without a transport element. For example, a second portion may be provided in the shoe and/or sole element, respectively, wherein the second portion comprises a deformable material that comprises a relatively high viscosity and/or a relatively low resilience, as described herein, such that excess heat may be generated by repeatedly deforming the deformable material. Such a second portion may be located, e.g. below an area of a foot, which

needs to be heated, e.g. a toe area and/or a forefoot area. Additionally or alternatively, the excess heat may be selectively directed to a first portion of the shoe and/or sole element, respectively, without a dedicated transport element, e.g. by arranging the first portion such that it contacts the second portion.

[0058] The invention also extends to a sole element comprising a first portion and a second portion. The second portion comprises a deformable material having a resilience lower than 35%.

[0059] Said deformable material may have a resilience lower than 35%, in particular lower than 20%, more particularly lower than 10%, for example between 1% and 5%. Such resilience values may be understood to be measured according to ISO 8307, at a temperature of 23 +/-2 degrees Celsius.

[0060] Such sole element may comprise one or more of the characteristics described herein in relation to a sole element or a shoe. In particular, such sole element may be devoid of a transport element, or may comprise one or more transport elements.

[0061] The invention also extends to an insole comprising a first portion and a second portion. The second portion comprises a deformable material having a resilience lower than 80%.

[0062] Said deformable material may have resilience lower than 80%, more particularly lower than 65%, in particular lower than 50 % or lower than 35%, and in some embodiments lower than 20%. Such resilience values may be understood to be measured according to ISO 8307, at a temperature of 23 +/-2 degrees Celsius.

[0063] Such insole may comprise one or more of the characteristics described herein in relation to a sole element or a shoe. In particular, such insole may be devoid of a transport element, or may comprise one or more transport elements.

4. Brief description of the Figures:

[0064] Possible embodiments of the present invention will be further described in the following detailed description with reference to the following Figures:

Fig. 1A-B: Top view and view of individual parts of an exemplary sole element;

Fig. 2A-B: View of individual parts and various perspective and sectional views of another exemplary sole element;

Fig. 3: Further exemplary sole element.

5. Detailed description:

[0065] It is noted that in the following, only some possible embodiments of the present invention can be described in detail. The person skilled in the art readily recognizes that the specific details described with reference

to these embodiments may be altered, developed further, combined in a different manner and that certain aspects of the specific embodiments described in the following may also be omitted. Moreover, it is noted that the aspects described in the subsequent detailed description may be combined with aspects described in the above summary section.

[0066] Various aspects in the detailed description are described with reference to sole elements that may be provided as insoles. It is noted however that various parts and elements of the described sole elements may be altered in shape and/or size and/or may be omitted such that sole elements, which do not form an insole may be provided. On the other hand, further parts and elements may be added to or exchanged in the described sole elements such that these form a midsole and/or an outsole. In addition, an upper may be added to the described sole elements such that these may form an entire shoe, in particular sports shoe.

[0067] Fig. 1A shows a first example for a sole element 100 according to the present invention. The sole element 100 may be provided as an insole.

[0068] In the example of Fig. 1A, the sole element 100 comprises several areas adapted to be arranged at least partly underneath corresponding areas of a foot of a wearer. In the example of Fig. 1A, the sole element 100 specifically comprises a rearfoot area, which comprises a heel area. Moreover, sole element 100 comprises a midfoot area. Sole element 100 further comprises a forefoot area, which comprises a toe area.

[0069] In other examples, sole element 100 may more generally comprise one or more areas adapted to be arranged at least partly underneath corresponding areas of a foot of a wearer. For example, a sole element 100 may generally comprise a rearfoot area, which may comprise a heel area. Sole element 100 may comprise a midfoot area. Sole element 100 may alternatively or additionally comprise a forefoot area, which may comprise a toe area. The forefoot and midfoot areas may form a front area.

[0070] A sole element 100 may generally comprise one or more first portions 110. In the example of Fig. 1A, the sole element 100 comprises a single first portion 110.

[0071] The first portion 110 of sole element 100 extends in a forefoot area of sole element 100 including a toe area of sole element 100. In other examples, the first portion 110 may at least partially extend in a front area of sole element 100. The first portion 110 may extend at least partially in a midfoot area and/or a forefoot area of the sole element 100 and/or a toe area of the sole element 100. The first portion 110 may also extend at least partially in a rearfoot area of the sole element 100. The first portion 110 may be adapted to extend essentially throughout one or more of said areas of the sole element 100.

[0072] In examples in which a plurality of first portions 110 are provided, one or more different first portions 110 may e.g. extend at least partially in one or more different

areas of the sole element 100. Additionally or alternatively, one or more different first portions 110 may also extend at least partially in one or more same areas of the sole element 100, e.g. at different heights.

[0073] A portion may generally be understood as a region of space. It may also be understood as comprising one or more elements of the sole element located in that region of space, e.g. in a forefoot area and/or a midfoot area of a sole element. As will be explained below, the first portion 110 of the sole element may comprise, at least in part, a lining element 190, a transport element 130 or one or more heat release portions 132 of the transport element 130, and, e.g. an insulating element 160, possibly having a covering element 150, e.g. as far as these are arranged in a forefoot area and/or a midfoot area of the sole element.

[0074] Sole element 100 may also comprise one or more second portions 120. In the example of Fig. 1A, the sole element comprises a single second portion 120. The single second portion 120 extends in a rearfoot area of the sole element 100 including a heel area of the sole element 100.

[0075] In other examples, the second portion 120 may at least partially extend in a rearfoot area of the sole element 100. The second portion 120 may also extend at least partially in a midfoot area and/or a rearfoot area of the sole element 100 and/or a heel area of the sole element 100. The second portion 120 may also extend at least partially in a forefoot area of the sole element 100. The second portion 120 may be adapted to extend essentially throughout one or more of said areas of the sole element 100.

[0076] In examples in which a plurality of second portions 120 are provided, one or more different second portions 120 may, e.g., extend at least partially in one or more different areas of the sole element 100. Additionally or alternatively, one or more different second portions 120 may also extend at least partially in one or more same areas of the sole element 100, e.g. at different heights.

[0077] A second portion 120 may comprise a deformable material, which is adapted to generate heat by being repeatedly deformed. In the example of Fig. 1A, the second portion 120 of the sole element 100 comprises heating element 121 in which the deformable material is arranged at least partly. In the example of Fig. 1A, the heating element 121 extends in a rearfoot area including a heel area of the sole element 100. The heating element 121 also extends partially in a midfoot area of the sole element 100. The heating element 121 may essentially consist of the deformable material such that the terms heating element and deformable material may be used interchangeably. It is also possible that the deformable material is arranged only in one or more selected areas of the second portion 120. For example, it may be located in a heel area of the second portion 120, e.g. in an area arranged to be located underneath the calcaneus of the foot of a wearer. The deformable material may be ar-

ranged in one or more areas of the second portion 120 such that it extends through the entire second portion 120 from top to bottom in these areas. Alternatively or additionally, the deformable material may be arranged in one or more areas of the second portion 120 such that it does not extend throughout the entire thickness of the second portion 120 in these areas.

[0078] In other examples, the heating element 121 can be arranged differently. The heating element 121 can be adapted to the specific geometry and/or location of the corresponding second portion 120. In some examples, two or more heating elements may be provided.

[0079] In other examples, the deformable material may be arranged differently within a sole element. For example, no separate heating elements 121 may be geometrically discernable. For example, the deformable material may be integrated into other elements of the second portion 120 of a sole element 100. All aspects set forth herein with respect to one or more heating elements are therefore applicable to one or more second portions 120 in general.

[0080] The deformable material of the second portion 120 of the sole element 110 may be arranged such that it is deformed whenever a wearer of the sole element 110 takes a step: For every step, the corresponding impact forces deform the deformable material of the second portion 120 of the sole element. For example, when the foot of the wearer touches the ground, the deformable material is compressed. During each deformation, a part of the impact energy is dissipated into heat by the deformable material. Hence, heat is generated, at every step, by the deformable material being repeatedly deformed.

[0081] The deformable material may generally comprise a low resilience. Specifically, the deformable material may for example be provided with properties as explained in the section "summary of the invention". The deformable material may comprise a viscous material.

[0082] Sole element 100 may generally comprise one or more transport elements 130 adapted for selectively directing the generated heat from the second portion 120 to the first portion 110. In the example of Fig. 1A, a single transport element 130 is provided. The single transport element 130 extends from the second portion 120 to the first portion 110. In other examples, two or more transport elements 130 may be provided.

[0083] A transport element 130 may generally comprise one or more heat release portions 132 adapted to release heat to one or more first portions 110 of the sole element 100, e.g. via direct contact. A transport element 130 may moreover comprise one or more heat absorption portions 131 adapted to absorb, e.g. via direct contact, heat from one or more second portions 120 of sole element 100, e.g. with the deformable material of one or more second portions 120 of the sole element 100.

[0084] Transport element 130 may generally be provided with materials and properties as explained in the section "summary of the invention".

[0085] In the example of Fig. 1A, the transport element 130 comprises a heat absorption portion 131 that is adapted to provide heat contact with the second portion 120 of sole element 100, and in particular with the heating element 121, e.g. the deformable material of the heating element 121. The heat absorption portion 131 of the transport element 130 extends in the rearfoot area including the heel area of the sole element 100. Moreover, the heat absorption portion 131 of transport element 130 extends partially in the midfoot area of the sole element 100. Generally, the heat absorption portion 131 of the transport element 130 may be adapted to be located above or below but e.g. in contact with the second portion 120 of the sole element 100 and/or the deformable material of the second portion 120 and/or the heating element 121 of the second portion 120. A surface of a heat absorption portion 131 of the transport element 130 may generally be adapted such that heat transfer between the second portion 120 of the sole element 100 and the heat absorption portion 131 is maximized. For example, the surface of a heat absorption portion 131 may at least partly be adapted to directly contact the second portion 120 and/or a heating element 121 of the second portion 120 and/or the deformable material of the second portion 120. In the example of Fig. 1A, the heat absorption portion 131 of the transport element 130 is in one piece without holes.

[0086] In the example of Fig. 1A, the transport element 130, comprises two heat release portions 132, namely a lateral heat release portion and a medial heat release portion. It is noted that the transport element 130 may be integrally fabricated, for example the heat release portions 132 and the heat absorption portion 131 may be integrally fabricated from the same material. In particular, the heat transport element may be arranged to provide continuous heat transport from the heat absorption portion 131 to the heat release portions 132. As shown in the example of Fig. 1A, the lateral and/or medial heat release portions 132 may originate from a lateral and/or medial side of the midfoot area of the heat absorption portion 131 of the transport element 130. The lateral and/or medial heat release portions 132 may extend along the lateral and/or medial sides of the forefoot area of the sole element 100. The lateral and/or medial heat release portions 132 may terminate in a toe area of the sole element 100. A width of the lateral and/or medial heat release portions may be relatively constant, e.g. throughout the forefoot area of the sole element 100. A width of the lateral and/or medial heat release portions 132 may be increased in a toe area of the sole element 100 compared to a width in the remaining forefoot area of the sole element 100. The increased width of one or more of the heat release portions 132 may help to maximize the amount of heat that can be released in the first portion 110 of the sole element 100, in particular in the toe area of the sole element 100. The width of one or more heat release elements 132 may generally be increased in the first portion 110, or in a sub-portion or

specific area thereof in which an increased heat release is desired. In some examples, the medial and lateral heat release portions 132 may partly meet or merge, e.g. in a toe area of the sole element 100.

[0087] In other examples, the one or more heat absorption portions and the one or more heat release portions may be provided differently from the examples shown in Fig. 1A. For example, a different number of these portions may be provided and/or they may be arranged differently with respect to each other and/or with respect to the remaining parts of the sole element 100. For example, besides the approximate U-shape as shown in Fig. 1A, heat release portions may be provided to form a T-shape (a first elongate heat release portion is terminated by a second elongate heat release portion arranged approximately perpendicular to the first, e.g. arranged along the toe area), a V-shape (two non-parallel elongate heat release portions emerging from approximately the same area). Also in these examples, a width of one or more of the heat release portions may be increased in specific areas, e.g. in a toe area, e.g. a width of the ends of the "T" and/or the "V" may be increased. In other examples, a single heat release portion may be provided, e.g. extending in the forefoot area and/or the toe area of the sole element 100. Additionally or alternatively, two or more heat absorption portions may be provided. For example, two heat absorption portions may be provided, e.g. arranged along a medial side and a lateral side, respectively, of the rearfoot area and/or of the heel area of the sole element 100.

[0088] Properties as explained in the section "summary of the invention" with respect to an overlap of a transport element and a second portion as well as possible extension of a transport element into a second portion may, more generally, be applied to one or more transport elements 130, one or more heat absorption portions 131 and/or one or more heat release portions 132. The latter transport elements 130 and/or its heat absorption portions 131 and/or its heat release portions may overlap with or extend into one or more second portions 120 and/or one or more first portions 110, respectively, as described.

[0089] The sole element 100 may comprise one or more insulating elements 140. The one or more insulating elements 140 may extend at least partially above and/or below the second portion 120 and/or the transport element 130.

[0090] In the example of Fig. 1A, the sole element 100 comprises a single insulating element 140. The insulating element 140 of Fig. 1A extends partially in a rearfoot area of the sole element 100 and in particular extends in a heel area of the sole element 100. The insulating element 140 may be arranged at least partially above the second portion 120 and/or the transport element 130. Thus, a transfer of the generated heat towards the foot may be prevented above the second portion 120 and/or at least partially above the transport element 130 by the insulating element 140. This may increase the amount of heat

that is selectively directed to the first portion 110 by the transport element 130. Alternatively or additionally, the insulating element 140 may be arranged at least partially below the second portion 120 and/or at least partially below the transport element 130. An insulating element 140 arranged to extend at least partially below the second portion 120 and/or the transport element 130 may help to avoid that the heat generated in the second portion 120 is released towards the ground. Again, this increases the amount of heat that is selectively directed to the first portion 110 by the transport element 130. Seen from a different perspective, an insulating element 140 arranged to extend at least partially below the second portion 120 and/or the transport element 130 may help to avoid that cold from the ground enters the sole element 100.

[0091] In other examples, a plurality of insulating elements 140 may be provided. For example, one or more insulating elements 140 may additionally or alternatively be provided such as to extend at least partially below the first portion 110. Such insulating elements may insulate the sole element from the ground also in areas where the first portion 110 is arranged. Additionally or alternatively, one or more insulating elements 140 may be provided that extend at least partially above the first portion 110. Thus, heat may only be released to the foot in selected areas of the first portion 110.

[0092] Generally, one or more insulating elements 140 may be provided as layers, coatings, foils etc. with materials, geometries and further properties as explained in the section "summary of the invention".

[0093] The sole element 100 may further comprise one or more lining elements 190. In the example of Fig. 1A, a single lining element 190 is provided. The lining element 190 extends in a front area of the sole element 100. In particular, the lining element 190 extends in a forefoot area including a toe area of the sole element 100. Moreover, the lining element 190 extends at least partially in a midfoot area of the sole element 100. The lining element 190 may be adapted to be arranged above the transport element 130. The lining element 190 may be adapted to be heat-permeable. It may be adapted such that heat generated in the second portion 120 and selectively directed to the first portion 110 by the transport element 130 may be released towards the foot of the wearer in the first portion 110 through the lining element 190. For example, the lining element 190 may be provided with one or more openings and/or holes, and/or the lining element 190 may comprise a lattice structure and/or a web-structure etc. letting the transport element 130 bare in some portions so as to allow a good transmission of heat between said transport element 130 - in particular the heat release portions 132 - and the foot of the wearer. Alternatively or in combination, the lining element 190 may have a low thermal conductivity. Generally, the lining element 190 may be adapted to contact a foot of the wearer. The lining element 190 may be adapted to provide a nice feel and/or wearing comfort with materials known in the art.

In other examples, no lining element 190 may be provided or one or more lining elements 190 may be provided differently. For example, one or more lining elements may be adapted to extend throughout the sole element 100. One or more lining elements 190 may be adapted to be at least partially heat insulating. For example, a lining element or a part of a lining element adapted to be arranged at least partially above a second portion 120 of the sole element 100 and/or at least partially above a transport element 130 may be adapted as an insulating element.

[0094] While the heating element 121, the transport element 130, the insulating element 140 are shown as contiguous elements in the example of Fig. 1A, in other examples, one or more of these elements may be provided having one or more openings and/or holes. Moreover, one or more of these elements may comprise a lattice structure and/or a web-structure etc.

[0095] Fig. 1B shows an exploded view of the sole element 100 as shown in Fig. 1A with its individual exemplary components in an exemplary order from top to bottom of the sole element 100.

[0096] According to the example shown in Fig. 1B, the heating element 121 and the lining element 190 may be arranged above the transport element 130. Therein, the heating element 121 may be at least partially arranged above the lining element 190. Specifically, in a midfoot area, the heating element 121 may be arranged above the lining element 190. In other examples, the heating element may be arranged below the lining element 190 in this area and/or in other areas. Alternatively, the lining element 190 and the heating element 121 may be arranged adjacent to each other.

[0097] Further, according to the example shown in Fig. 1B, the insulating element 140 is arranged below the transport element 130. In between the transport element 130 and the insulating element 140, possibly a further insulating element 160 and/or a covering element 150 of the insulating element may be provided. In the example of Fig. 1B, the further insulating element 160 and the covering element 150 are arranged to extend throughout the entire sole element 100. In other examples, the insulating element 160 and/or the covering element 150 may only extend in one or more selected areas of the sole element 100. The covering element 150 may be arranged above the insulating element 160, as shown in the example of Fig. 1B.

[0098] The insulating element 160 may comprise a foam material, e.g. a TPU foam, and/or an aerogel, with properties and dimensions as generally explained for first and second insulating elements in the section "summary of the invention". The insulating element 160 may be adapted to provide insulation between the ground and those parts of the sole element 100 located above the insulating element 160. This way, cold may be prevented from entering the sole element 100 from the ground. Moreover, heat generated by the deformable material may be prevented from being released by the sole ele-

ment 100 towards the ground. When the sole element is provided as an insole, such insulating element may impede heat from the foot and created in the insole to leak toward the midsole, thereby limiting the amount of heat leaking toward the ground and the environment around the midsole's sides. Besides providing insulation, the insulating element 160 may be adapted to provide cushioning. A similar insulating element may alternatively or additionally be provided above the transport element 130 and/or above the second portion 120, wherein the similar insulating element may, e.g., extend in a rearfoot area and/or a midfoot area, such that heat release towards the foot is prevented in these areas.

[0099] A covering element 150 may optionally be provided above (or, in other examples, below) the insulating element 160. The covering element may be provided as a coating and/or a layer comprising insulating material. It may increase the insulation provided by the insulating element 160. Additionally or alternatively, the covering element 150 may be provided as being water-resistant or water-repellent. Hence, humidity may be prevented from entering the sole element 100 from the ground.

[0100] It is noted that, while the various parts of sole element 100 are depicted in Figs. 1A and 1B as being homogenous, the various parts may comprise further elements and substructures that are not depicted in Figs. 1A and 1B for simplicity. For example, individual parts may comprise several layers and/or several areas in which different materials and/or different properties are provided. Moreover, the aspects as explained with reference to the examples in Figs. 1A and 1B may also be replaced by or combined with further aspects explained herein.

[0101] Fig. 2A shows an exploded view of another example for a sole element 200. Fig. 2B shows a bottom view and various side and sectional views of sole element 200. In the example of Figs. 2A-B, the sole element 200 comprises a heating element 221, a transport element 230, a first insulating element 260, a second insulating element 270, and a lining element 290. Sole element 200 may be adapted to be provided as an insole.

[0102] The heating element 221, the transport element 230, the first insulating element 260, and the lining element 290 of exemplary sole element 200 may generally be provided as explained above with respect to the heating element 121, the transport element 130, the first insulating element 160 and the lining element 190, respectively, of exemplary sole element 100. For example, the first insulating element 160 may comprise a covering element. Moreover, it is noted that sole element 200 may generally comprise one or more of said heating element 221, transport element 230, first insulating element 260, and/or lining element 290.

[0103] Transport element 230 of sole element 200 may generally be provided similarly as transport element 130 of sole element 100, e.g. with similar materials, geometries, and other properties. For example, similarly to transport element 130 of sole element 100, transport el-

ement 230 of sole element 200 may be arranged at least partly above or at least partly below the heating element 221 and/or the second portion 220 of the sole element (cf. Fig. 2B for reference sign 220). Additionally, transport element 230 may comprise one or more openings 233, e.g. as shown in Fig. 2A. The one or more openings 233 may be arranged in a heat absorption portion 231 of transport element 230 and/or in a rearfoot area of transport element 230. For example, the openings may allow a better attachment of the heat transport element 130 to the first insulating element 260 and the second insulating element 270, e.g. an adhesive may be applied between the surfaces of the first and second insulating elements 260, 270.

[0104] The one or more openings 233 may be arranged symmetrically around a longitudinal axis of sole element 200 and/or of transport element 230. For example, as shown in Fig. 2A, two openings 233 may be arranged at a lateral side of the rearfoot area and two further openings 233 may be provided at a medial side of the rearfoot area of the sole element 200. The openings 233 may be elongate and/or they may extend along the lateral and medial sides, respectively. In other examples, only one opening 233 or more than two openings 233 may be provided at the lateral and medial sides, respectively, of the sole element 200. Additionally or alternatively, an opening 233 may for example be provided at a rear side of sole element 200, as shown in Fig. 2A. Such an opening 233 at a rear side may also be elongate and/or be arranged along the rear side. It may be provided as a section of a circle or approximately in a U-shape such that it may extend along an approximately circular rear side of the sole element 200. In other examples, one or more of the described openings may be omitted such that the openings may not be arranged symmetrically.

[0105] The one or more openings 233 may facilitate an improved connection of the respective part of the sole since they may allow a direct connection, e.g. by bonding, between the first insulating element 260 and the one or more second insulating elements 270 through openings 233. Transport element 230, in particular when comprising a metal, may exhibit a relatively weak bonding with the first insulating element 260 and the one or more second insulating elements 270, in particular when the latter elements comprise a polymer. By means of a direct connection between the first insulating element 260 and the one or more second insulating elements 270 through openings 233 in transport element 230, e.g. by gluing and/or heat-pressing, transport element 230 may be secured within the sole more safely.

[0106] At the same time, openings 233 may be optimized to still allow sufficient transfer of the heat generated by the heating element 221 of the second portion 220 to the heat absorption portion 231 of the transport element 230, such that the generated heat can be selectively directed to the first portion 210 of sole element 200 by means of the transport element 230 (cf. Fig. 2B for reference signs 210 and 220).

[0107] The sole element 200 may, as mentioned, also comprise one or more second insulating elements 270. The one or more second insulating elements 270 may generally be provided similarly as the first insulating element 260. However, the one or more second insulating elements 270 may generally be adapted to be at least partially arranged above the transport element 230, i.e. between the transport element 230 and the foot of the wearer.

[0108] Moreover, the one or more second insulating elements 270 may not extend through the entire area of the sole element 200. For example, the one or more second insulating elements 270 may be provided such that no insulating element is arranged above a first portion 210 of the sole element 200. For example, a toe area and/or a forefoot area of the sole element 200 may not have any insulating element arranged above it, e.g. between the toe area and/or the forefoot area of the sole element 200 and the foot of the wearer. Hence, heat release towards the foot may be promoted in such areas where the transport element 230 is not covered by second insulating elements 270 and/or other insulating elements, thereby making these portions of the transport element heat release portions.

[0109] In other examples, however, the one or more second insulating elements 270 may in fact extend essentially through the entire area of the sole element. This may for example be the case if the sole element 200 is intended for a shoe with one or more transport elements arranged in an upper of the shoe. For example in such cases, the one or more second insulating elements 270 may be provided to form an essentially continuous layer, which may however be penetrated by one or more transport elements 230 extending from the second portion 220 of the sole element to a first portion 210 which may, e.g., be located in the upper of the shoe.

[0110] Coming back to Fig. 2A, the second insulating element 270 may generally extend in an area of the second portion 220 of the sole element 200. In the example of Fig. 2A, the second insulating element 270 extends in a rearfoot area including a heel area and it also extends at least partially also in a midfoot area. The part of the second insulating element 270 extending in the rearfoot area may form a rearfoot portion of the insulating element 270. In other examples, the second insulating element 270 may additionally or alternatively extend in one or more other areas.

[0111] The second insulating element 270 may be adapted to be arranged at least partly above the heating element 221, or more generally above the second portion 220 of sole element 200. In other words, the second insulating element 270 may be arranged at least partly between the second portion 220 of sole element 200 and the foot of a wearer. The insulating element 270 may thus provide insulation between the second portion 220 of the sole element 200, including heating element 221, and the foot of the wearer. Hence, the second insulating element 270 may help to avoid that heat generated by the

second material of the heating element 221 is released from the second portion 220 towards the foot in the area of the second portion 220. For example, in realizations in which the transport element 230, in particular the heat absorption portion 231 of the transport element 230 is arranged above the heating element 221 of the second portion 220, one or more second insulating elements 270 may for example be arranged at least partially directly above the transport element 230. On the other hand, for example, if the heat absorption portion 231 of the transport element 230 is arranged below the heating element 221, one or more insulating elements 270 may be arranged at least partly directly above the second portion 220 and/or the heating element 221 and/or the deformable material of the second portion 220.

[0112] One or more second insulating elements 270 may, however, also be adapted to be arranged below the heating element 221. Generally, one or more second insulating elements 270 may be arranged above the transport element 230, e.g. at least partly directly above the transport element 230. One or more second insulating elements 270 may be arranged between the transport element 230 and a foot of a wearer.

[0113] Specifically, the second insulating element 270 may also be arranged between the transport element 230 and the heating element 221. This may help to maximize the deformation in the second portion 220, e.g. of the heating element 221, at each step. The second insulating element 270 may comprise one or more openings and/or holes 273. The one or more openings and/or holes 273 may be adapted to be arranged in an area of the sole element 200, where the deformable material, e.g. the deformable material of the heating element 221, is provided. The one or more openings and/or holes 273 may be adapted to be elongate. The one or more openings and/or holes 273 may be provided to ensure that the heat generated by the deformable material of the heating element 221 can be transferred to the heat absorption portion 231 of the transfer element 230.

[0114] In the example of Fig. 2A, the second insulating element 270 comprises an opening 273, which extends from a center of a midfoot area of the sole element 200 to a center of a heel area of the sole element 200. The opening 273 is elongate. A width of the opening 273 may increase from the midfoot area to the heel area. The opening 273 may be adapted to allow heat generated in the second portion 220, e.g. in the heating element 221, to be absorbed by the heat absorption portion 231 of the transport element 230. In particular, the transport element 230 may be in mechanical contact with the heating element 221 in at least part of the surface of the opening 273 through the second insulating element 270.

[0115] The one or more second insulating elements 270 may generally extend in areas in which the second portion 220 is arranged and/or in areas in which the transport element 230 is arranged. A second insulating element 270 may generally be provided in order to provide insulation for a second portion 220 and/or for a transport

element 230. In the example of Fig. 2A, the rearfoot portion of the second insulating element 270 may provide insulation for a corresponding rearfoot portion of transport element 230 and/or for the second portion 220 arranged in a rearfoot area.

[0116] The one or more second insulating elements 270 may extend, as mentioned, at least partially in a forefoot area. In the example of Fig. 2A, the second portion 220, e.g. the heating element 221, is not arranged in a forefoot area of the sole element 200 but the transport element 230 at least partially extends in the forefoot area. Hence, the second insulating element 270 extending in the forefoot area in the example of Fig. 2A may be provided in order to insulate the transport element 230 in that area. As shown in Fig. 2A, the second insulating element 270 may comprise a lateral and a medial forefoot portion 272, each of which extends at the lateral and medial sides of the sole element 200 in a rear part of the forefoot area. The lateral and medial forefoot portions 272 of the second insulating element 270 may be adapted to be arranged at least partially above corresponding lateral and medial heat release portions 232 of the transport element 230. For example, the lateral and medial forefoot portions 272 may be arranged directly above the transport element 230 in a forefoot area. Generally, one or more second insulating elements 270 may be arranged at least partly above, e.g. directly above, the transport element 230 in an area, where the second portion 220, or more specifically the heating element 221, does not extend. This may for example be in a forefoot area of the sole element 200, as in the example of Figs. 2A-B.

[0117] Generally, one or more second insulating elements 270 may be adapted such that heat can be directed to the foot only in a certain area of the sole element 200, e.g. in a toe area or in a forefoot area. For example, one or more second insulating elements 270 may be adapted to be arranged at least partly above a transport element 230, wherein no insulating element is arranged above a front area of the transport element 230.

[0118] As can best be seen from the medial, lateral and cross-sectional view along section A-A of Fig. 2B, the heating element 221 may be arranged above a first insulating element 260. The transport element 230, the second insulating element 270 and the lining element 290 are not indicated in these views for ease of representation. These elements may be arranged above the first insulating element 260 as explained above, e.g. with respect to Figs. 1A-B and 2A. These elements may moreover be arranged above or below the heating element 221 or, more generally, above or below the second portion 220 of the sole element 200, as also explained above.

[0119] As can be seen from the example shown in Fig. 2B, the heating element 221 (which in the example of Figs. 2A-B may consist of the heating element 221) extends in a rearfoot area, including a heel area and, in particular, an area below the calcaneus. It also extends partially in a midfoot area of the sole element 200. The first insulating element 260 may extend throughout the

entire area of the sole element 200. The first insulating element 260 may have a constant thickness. Its thickness may be in the range of 1 mm to 5 mm, e.g. 2 mm to 4 mm, or approximately 3 mm. An average thickness of the heating element 221 may be larger than an average thickness of the first insulating element 260, e.g. by a factor of 1.5 to 5 or of 2 to 4. An average thickness of the heating element 221 may be larger than an average thickness of the sole element 200, e.g. by a factor of 1.5 to 5 or of 2 to 4.

[0120] An average thickness of the transport element 230 and/or of the second insulating element 270 may be lower than an average thickness of the heating element 221, e.g. by a factor of more than 10, or more than 50, or more than 100, or more than 200. An average thickness of the heating element 221 may be 4 mm to 20 mm, 6 mm to 16 mm or 8 mm to 13 mm.

[0121] The heating element 221 may, in at least an area, e.g. an area below the calcaneus, have a thickness, which amounts to 40% to 100%, or 50% to 95%, or 75% to 90%, or approximately 85 % of the sole element.

[0122] The heating element 221 may comprise a profile with varying thickness. A thickness of the heating element 221 in a center (between lateral and medial sides) of the heating element 221 may increase from the midfoot area towards the heel area (cf. sectional view A-A in Fig. 2B). For example, a thickness of the heating element 221 may increase by approximately 30% to 70%, e.g. 50 %, from a front part of the rearfoot area (section B-B) towards a central part of the rearfoot area (section C-C). The thickness in a center (between lateral and medial sides) of the heating element 221 in a central part of the rearfoot area (section C-C) may be approximately 6 mm to 14 mm, or 8 mm to 10 mm, or 9 mm. The thickness of the heating element 221 may then remain relatively constant in a central part (e.g. when moving further towards the rear part) of the rearfoot area. However, the thickness of the heating element 221 may then again increase at a rear rim of the sole element 200 and/or of the heating element 221, e.g. to provide support for the foot. For example, within a range of approximately 0.2 cm to 4 cm, or approximately 0.5 cm to 2 cm, to the rear rim, the thickness of the heating element 221 may increase to a value of approximately 10 mm to 20 mm, or 12 mm to 18 mm, or 16 mm to 17 mm.

[0123] Additionally or alternatively, a thickness of the heating element 221 may be relatively in the center of lateral-medial cross sections (cf. sections B-B and C-C) of the heating element 221. For example, a thickness of approximately 6 mm to 14 mm, or 8 mm to 10 mm, or 9 mm may be provided in a central part of the rearfoot area. The thickness may however increase at lateral and/or medial rims of the heating element 221, e.g. to provide support for the foot. For example, within a range of approximately 0.2 cm to 4 cm, or approximately 0.5 cm to 2 cm, to the lateral and/or medial rim, the thickness of the heating element 221 may increase to a value of approximately 10 mm to 20 mm, or 12 mm to 18 mm, or 16

mm to 17 mm. Generally, a thickness profile of the heating element 221 may be adapted to follow the shape of a wearer's heel.

[0124] Fig. 3 shows a further example of a sole element 300, which is adapted to be provided as an insole. The exemplary sole element 300 comprises a first portion 310. Generally, the first portion 310 may be provided with aspects as described herein, e.g. with reference to Figs. 1A-B and 2A-B. Specifically, the first portion 310 may be adapted to extend in a forefoot area including a toe area of the sole element 300 and/or to extend at least partly in a midfoot area of the sole element 300. The exemplary sole element 300 may moreover comprise a second portion 320. Generally, the second portion 320 may be provided with aspects as described herein, e.g. with reference to Figs. 1A-B and 2A-B. In particular, the second portion 320 may be adapted to extend in a rearfoot area including a heel area (e.g. including an area below the calcaneus) and/or to extend at least partly in a midfoot area of the sole element 300. The second portion 320 may be adapted to be arranged at least partly above the first portion 310, e.g. in the midfoot area of sole element 320.

[0125] The second portion 320 may comprise a deformable material, which is adapted to generate heat by being repeatedly deformed. The deformable material may be arranged in a heating element 321 of the second portion 320. The heating element 321 may be arranged to be located in an area underneath a calcaneus of the foot of a wearer. Frequently, the largest impact forces arise in this area during walking or running. Hence, locating the heating element 321 in this area may maximizes the amount of heat that can be generated by means of the deformable material of the second portion 320. The heating element 321 may not be arranged at a rim of the sole element 300 or of the sole provided by sole element 300, so as to minimize heat leaks toward the sides of the sole.

[0126] The second portion 320 may further comprise one or more stabilizing element 322, which may generally be arranged at least partly adjacent to the heating element 321. In the example of Fig. 3, the stabilizing element 322 is arranged around the heating element 321. Additionally or alternatively, the stabilizing element 322 may also be arranged at least partly below the heating element 321. For example, the stabilizing element 322 may comprise one or more recesses in which the heating element 321 is inserted. In some examples, the heating element 321 may form at least one protrusion extending above the stabilizing element 322. In some examples, two or more heating elements 321 may be provided in the second portion 320 in the manner described. The heating element 321 may also be given a shape so as to have the structure and/or the function of the stabilizing element 322.

[0127] Similarly, two or more stabilizing elements 322 may be provided in the second portion 320. In other examples, the stabilizing element 322 and the heating el-

element 321 may be integrally formed from the same material. In particular, the second portion 320 may consist of heating element 321.

[0128] The one or more stabilizing elements 322 may generally be provided to increase the stability of the deformable material in the sole element 300. Additionally or alternatively, the stabilizing elements 322 may be provided such as to include an insulating material, e.g. as described with reference to the first portions or any of the insulating elements further above, e.g. with reference to Figs. 1A-B, 2A-B, 3. The main function of the stabilizing elements 322 may thus also be to insulate the heating element 321, for example to insulate it from an upper of a shoe, and more generally from the lateral sides of a shoe, e.g. a heel counter. In such a case, a stabilizing element 322 may also simply be implemented by an insulating element as described herein without providing additional stability functionality.

[0129] The first portion 310, and possibly also the second portion 320, may comprise a lining element 390. The lining element 390 may be provided with aspects similar as described with reference to lining elements 190 and 290 of sole elements 100 and 200, respectively. Specifically, lining element 390 may be the topmost element of the first portion 310. It may be provided in the first portion 310 only, or it may at least partially also extend in the area of the second portion 320. In the latter case, the lining element 390 may e.g. also be arranged above the second portion 320.

[0130] The lining 390 may generally be provided to be heat permeable. In the example of Fig. 3, the lining 390 comprises a plurality of openings. In other examples, only a single opening or no opening may be provided in the lining 390. The openings 390 of the lining may contribute to the heat permeability of the lining element 390. The openings may be regularly arranged over the lining element 390 in the area of the first portion 310, as e.g. shown in Fig. 3. The lining 390 may comprise a material with a high thermal conductivity.

[0131] In the example of Fig. 3, one or more transport elements 330 may be arranged below the second portion 320 in the rearfoot area or below the heating element 321 of the second portion 320, e.g. extending in the area below the calcaneus of the foot. The one or more transport elements 330 may be adapted to at least partially extend in the area of the first portion 310. The one or more transport elements 330 may be adapted for selectively directing the generated heat from the second portion 320 to the first portion 310. For example, one or more transport elements similar to those as described with reference to transport elements 130 and 230 of sole element 100 and 200, respectively, may be provided. Suitable insulating elements may additionally be provided, e.g. similarly as described above, e.g. with reference to Figs. 1A-B and 2A-B. As explained, these may help to avoid that heat generated in the second portion 320 is released towards to ground and/or towards the foot in areas in which this is not desired, e.g. in areas in which the first

portion 310 is not arranged.

[0132] The sole element 300 may in addition comprise one or more further parts as described herein, e.g. with reference to Figs. 1A-B and 2A-B.

[0133] An aspect of the present invention may also relate to manufacturing a sole element and/or a shoe as described herein. The various constituents of the sole elements and shoes described herein may be attached to each other by means of applying a hot melt adhesive and applying heat and pressure (heat pressing). For example, TPU may be used as a hot melt adhesive. Additionally or alternatively, other adhesives and/or primer may be used. Specifically regarding the deformable material of the second portion, this material may be attached to the other constituents of the sole element or shoe, respectively, by using an adhesive, which does not require heat pressing. These adhesives can be non-reactive adhesives such as pressure- or contact-adhesives; or reactive adhesives such as single- or multi-component adhesives. These adhesives can be for example polyurethanes (thermoplastic or thermosetting), epoxies, polyimides, etc. For example, the deformable material, e.g. when provided as a foam material, may be molded onto, e.g. directly molded onto, the sole element or the shoe, respectively. The sole element, e.g. when provided as an insole may be stitched to a shoe or attached to the using adhesive.

[0134] In the following, further embodiments are described to facilitate the understanding of the invention:

1. Sole element for a shoe, wherein the sole element comprises:

- a. a first portion (110; 210; 310) and a second portion (120; 220; 320);
- b. wherein the second portion comprises a deformable material (121; 221; 321) which is adapted to generate heat by being deformed;
- c. a transport element (130; 230; 330) adapted for selectively directing the generated heat from the second portion to the first portion.

2. Sole element according to embodiment 1, wherein a resilience of the deformable material is below 80%, preferably below 50%, particularly preferably below 15%.

3. Sole element according to embodiment 1 or embodiment 2, wherein the first portion comprises a resilient material (150, 160; 260) having a resilience that is higher than a resilience of the deformable material (121; 221; 321), preferably higher by at least 15%, particularly preferably by at least 25%, and/or having a resilience that is at least 20%, preferably at least 35%, particularly preferably at least 50%.

4. Sole element according to embodiment 3, wherein the resilient material (150, 160; 260) comprises a

thermal conductivity below 100 mW/(K.m), preferably below 75 mW/(K.m), particularly preferably below 60 mW/(K.m).

5. Sole element according to any of embodiments 1-4, wherein the deformable material (121; 221; 321) comprises a foam material, in particular a (poly-)urethane foam material. 5

6. Sole element according to any of embodiments 1-5, wherein the sole element is provided as an insole (100; 200; 300). 10

7. Sole element according to any of embodiments 1-6, wherein the second portion (120; 220; 320) has a thickness that is larger than a thickness of the first portion (110; 210; 310). 15

8. Sole element according to any of embodiments 1-7, wherein in at least a part of the second portion (120; 220; 320), the deformable material (121; 221; 321) is arranged such that it extends through at least 40% of a thickness of the sole element, preferably through between 50% and 95% of the thickness of the sole element, particularly preferably between 75% and 90% of the thickness of the sole element. 20 25

9. Sole element according to any of embodiments 1-8, wherein in at least a part of the second portion (120; 220; 320), the deformable material (121; 221; 321) is arranged such that it comprises a vertical extension that is larger than an average thickness of the sole element. 30

10. Sole element according to any of embodiments 1-9, wherein the second portion (120; 230; 320) forms at least one protrusion on an upper surface of the sole element. 35

11. Sole element according to any of embodiments 1-10, wherein the second portion (120; 220; 320) is adapted to extend at least partially in a rear half of a foot, preferably in a heel area of the foot. 40

12. Sole element according to any of embodiments 1-11, wherein the first portion (110; 210; 310) is adapted to extend at least partially in a midfoot and/or a forefoot area of a foot. 45

13. Sole element according to any embodiments 1-12, wherein the transport element (130; 230; 330) overlaps with an upper and/or lower surface of the second portion (120; 220; 320), preferably at least throughout 50% of the upper and/or lower surface of the second portion, particularly preferably at least throughout 80% of the upper and/or lower surface of the second portion. 50 55

14. Sole element according to any of embodiments 1-13, wherein the transport element (130; 230; 330) comprises a heat conductive element.

15. Sole element according to any of embodiments 1-14, wherein the transport element (130; 230; 330) comprises a heat conductivity of at least 150 mW/(K.m), preferably of at least 200 mW/(K.m).

16. Sole element according to any of embodiments 1-15, wherein the transport element (130; 230; 330) comprises metal, in particular copper and/or aluminum.

17. Sole element according to any of embodiments 1-16, wherein the transport element (130; 230; 330) has a thickness below 1 mm, preferably below 0.3 mm, particularly preferably below 0.2 mm.

18. Sole element according to any of embodiments 1-17, wherein the transport element (130; 230; 330) comprises at least one air channel.

19. Sole element according to any of embodiments 1-18, wherein the transport element (130; 230; 330) is arranged at least partly above the first portion.

20. Sole element according to any embodiments 1-19, wherein the sole element comprises a first insulating element (140; 150; 260) extending at least partially below the second portion (120; 220) and/or at least partially below the transport element (130; 230). 230).

21. Sole element according to embodiment 20, wherein the first insulating element (140; 150; 260) and the first portion comprise the same material.

22. Sole element according to any of embodiments 1-21, wherein the sole element comprises a second insulating element (270) extending at least partially above the transport element (230) and/or at least partially above the second portion (220).

23. Sole element according to embodiment 22, wherein the transport element (130; 230; 330) comprises a forefoot portion above which no insulating element is arranged.

24. Sole element according to any of embodiments 20 to 23, wherein the first insulating element (140; 150; 260) and/or the second insulating element (270) comprises an aerogel.

25. Sole element according to any of embodiments 20 to 24, wherein the first insulating element (140; 150; 260) and/or the second insulating element (270) comprises a thickness below 1 mm, preferably below

0.5 mm.

26. Sole element according to any of embodiments 20 to 25, wherein the first insulating element (140, 150; 260) and/or the second insulating element (270) comprise a thermal conductivity below 50 mW/(K.m).

27. Shoe, in particular sports shoe, comprising a sole element according to any of embodiments 1-26.

28. Shoe,

- a. comprising a first portion and a second portion;
- b. wherein the second portion is arranged at a sole of the shoe and comprises a deformable material which is adapted to generate heat by being deformed;
- c. the shoe further comprising a transport element adapted for selectively directing the generated heat from the second portion to the first portion.

29. Shoe according to embodiment 27 or 28, wherein the transport element is at least partly arranged in an upper of the shoe.

30. Shoe according to any of embodiments 27-29, wherein the shoe comprises an insulating layer, at least partly arranged in an outsole and/or a midsole of the shoe.

31. Shoe according to embodiment 30, wherein the insulating layer is at least partially arranged in at least one recess of the outsole.

32. Shoe according to embodiment 31, further comprising at least one profile element formed on the outsole opposite to the at least one recess.

33. Shoe according to any of embodiments 30 to 32, wherein the insulating layer comprises a foam material, in particular a (poly-)urethane foam material.

Claims

1. Sole element for a shoe, wherein the sole element comprises:

- a. a first portion (110; 210; 310) and a second portion (120; 220; 320);
- b. wherein the second portion comprises a deformable material (121; 221; 321) which is adapted to generate heat by being deformed;
- c. a transport element (130; 230; 330) adapted for selectively directing the generated heat from the second portion to the first portion.

2. Sole element according to claim 1, wherein a resilience of the deformable material is below 80%, preferably below 50%, particularly preferably below 15%.

3. Sole element according to claim 1 or claim 2, wherein the first portion comprises a resilient material (150, 160; 260) having a resilience that is higher than a resilience of the deformable material (121; 221; 321), preferably higher by at least 15%, particularly preferably by at least 25%, and/or having a resilience that is at least 20%, preferably at least 35%, particularly preferably at least 50%.

4. Sole element according to any of claims 1-3, wherein the deformable material (121; 221; 321) comprises a foam material.

5. Sole element according to claim 4, wherein the foam material comprises a (poly-)urethane foam material.

6. Sole element according to any of claims 1-5, wherein the sole element is provided as an insole (100; 200; 300).

7. Sole element according to any of claims 1-6, wherein the transport element (130; 230; 330) comprises a heat conductivity of at least 150 mW/(K.m), preferably of at least 200 mW/(K.m).

8. Sole element according to any of claims 1-7, wherein the sole element comprises a first insulating element (140, 150; 260) extending at least partially below the second portion (120; 220) and/or at least partially below the transport element (130; 230).

9. Sole element according to any of claims 1-8, wherein the sole element comprises a second insulating element (270) extending at least partially above the transport element (230) and/or at least partially above the second portion (220).

10. Sole element according to claim 9, wherein the transport element (130; 230; 330) comprises a forefoot portion above which no insulating element is arranged.

11. Shoe, in particular sports shoe, comprising a sole element according to any of claims 1-10.

12. Shoe,

- a. comprising a first portion and a second portion;
- b. wherein the second portion is arranged at a sole of the shoe and comprises a deformable material which is adapted to generate heat by being deformed;

c. the shoe further comprising a transport element adapted for selectively directing the generated heat from the second portion to the first portion.

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13. Shoe according to claim 11 or 12, wherein the transport element is at least partly arranged in an upper of the shoe.

14. Shoe according to any of claims 11-13, wherein the shoe comprises an insulating layer, at least partly arranged in an outsole and/or a midsole of the shoe. 10

15. Shoe according to claim 14, wherein the insulating layer is at least partially arranged in at least one recess of the outsole. 15

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FIG 1A

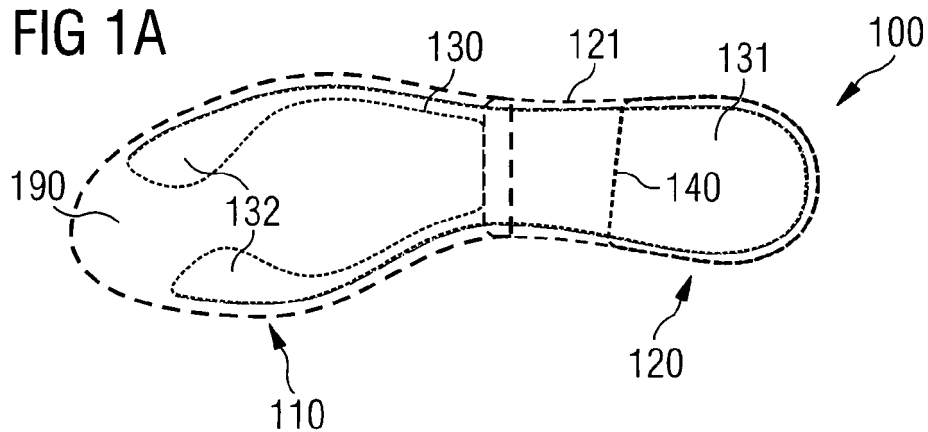


FIG 1B

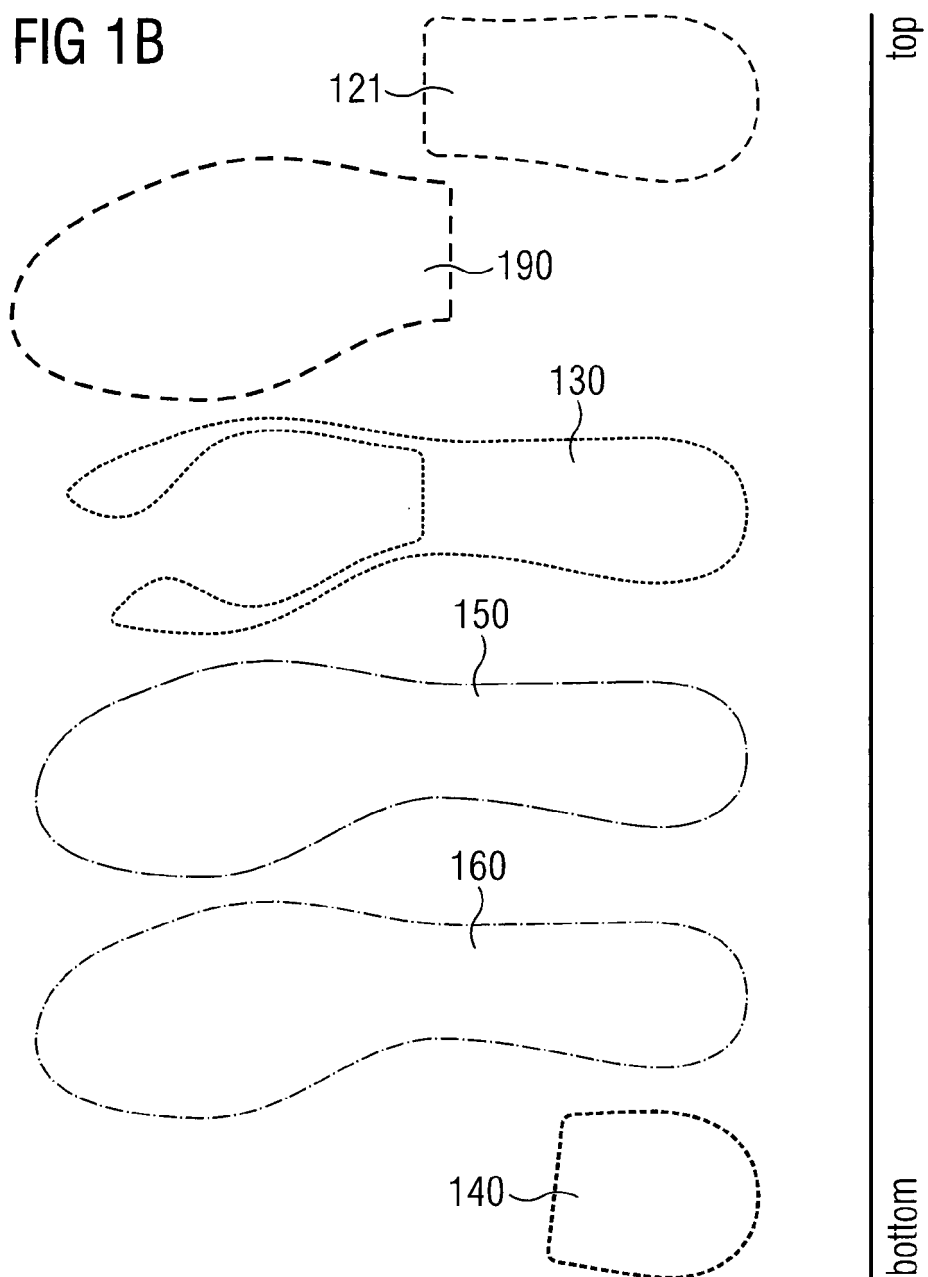


FIG 2A

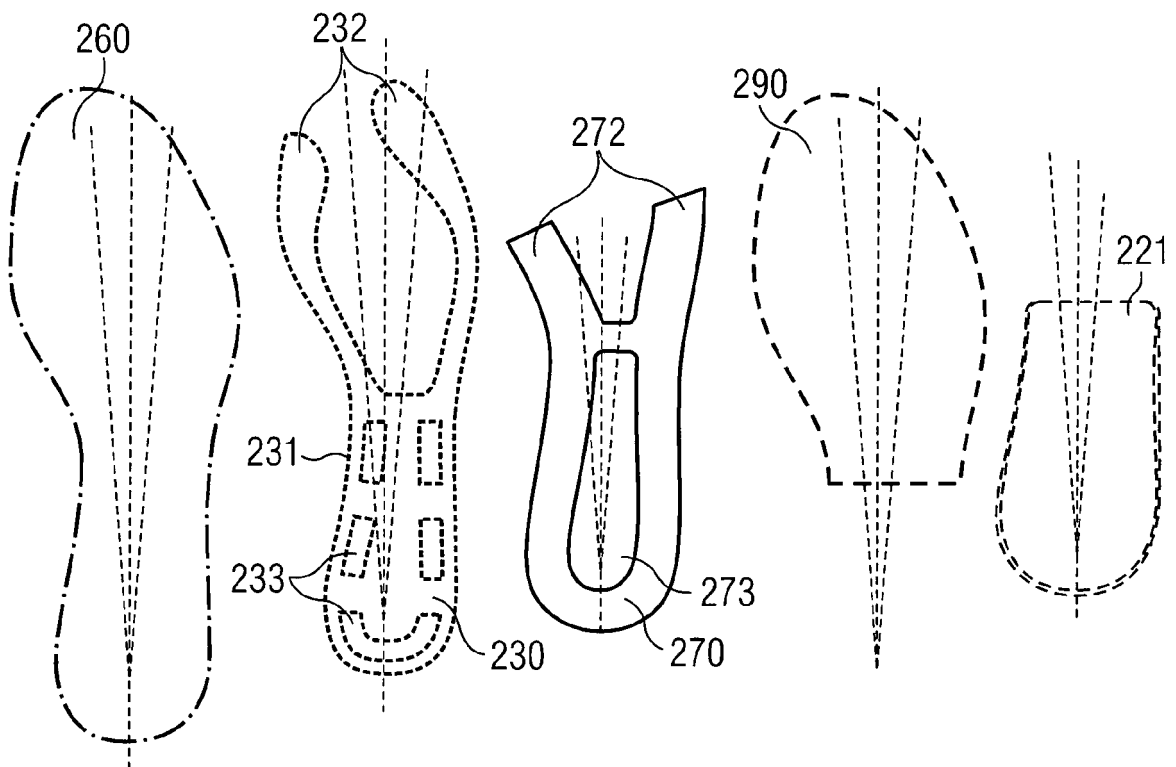


FIG 2B

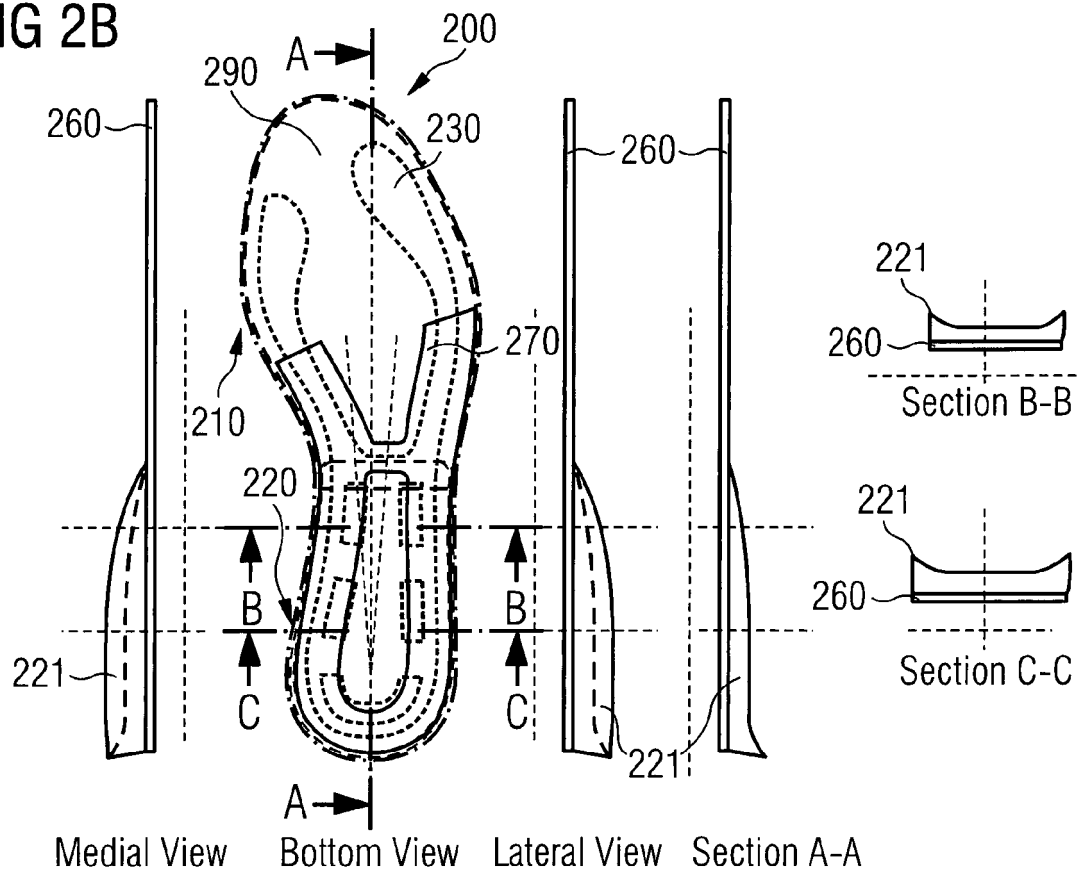
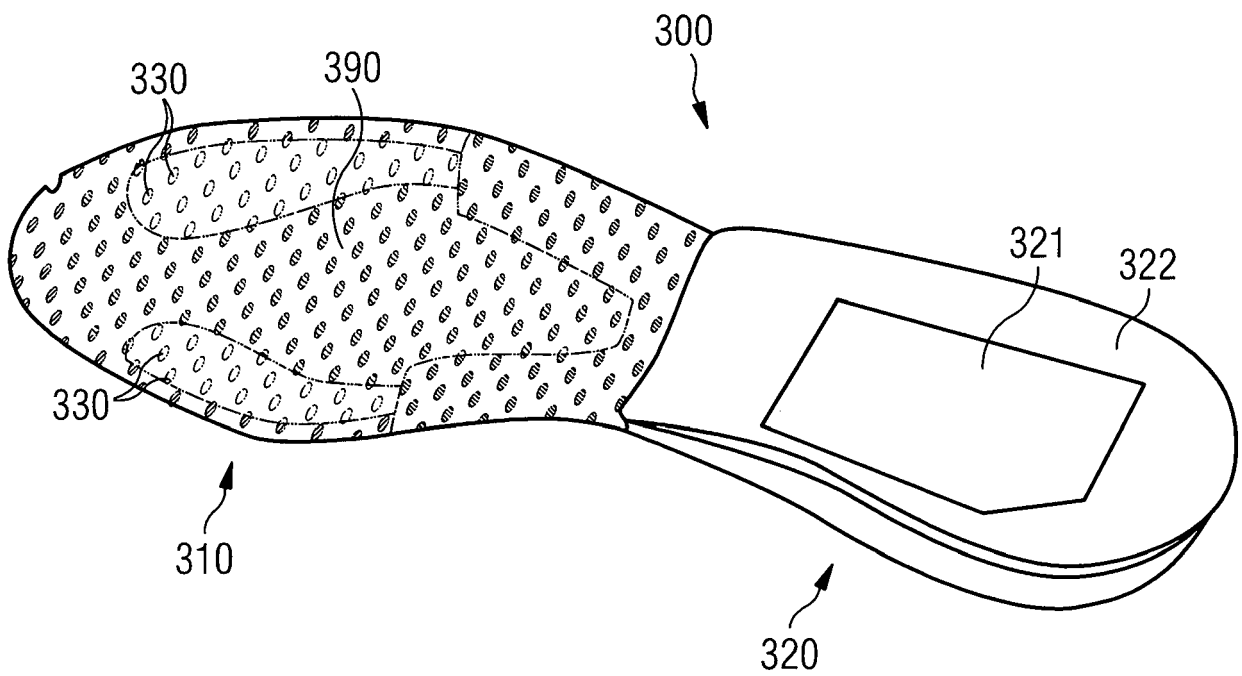


FIG 3





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