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(54) A footwear component, such as a sole, insole or insert, a method for designing and/or manufacturing a footwear component and a shoe

(57) A footwear component, for example insert or insole. The component has a grid with a plurality of cells, which reduces the impact and/or pressure on at least a part of a foot supported directly or indirectly by the footwear component. The grid of cells further includes a coupling between the plurality of cells. The coupling transfers a part of a force, due to at least a part of the impact or the pressure, exerted on a first cell by a first part of the foot supported directly or indirectly by the first cell, via a second cell, to a second part of the foot supported directly or indirectly by the second cell, or vice versa, depending on the force on the first part.

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Description

FIELD AND BACKGROUND OF THE INVENTION

[0001] The invention relates to a footwear component, such as an insole or insert. The invention further relates to a method for designing and/or manufacturing a footwear component, and to use of a footwear component. The invention also relates to a shoe.

[0002] From sports research it is known, that shoes are able to reduce the load exerted on a human foot by providing cushion or padding between the foot and the ground. Shock absorbing materials deform upon the collision between the foot and the ground and absorb a part of the impact on the foot during running.

[0003] A disadvantage of the existing shoe sole materials, is that only the load due to collision during heel strike is reduced. During roll-off, when walking or running, the foot initially is subjected to a dynamic load. The dynamic load in mainly exerted on the heel area of the foot. During push-off, the forefoot experiences a static or semi-static load. Because the weight-bearing area during push-off is fairly small compared to the force that is exerted on the forefoot, the respective pressures or stress during push-off are relatively high.

[0004] Most common sports shoes have a sole which is made of materials with homogenous characteristics over the whole sole, e.g. made of foamed plastics. Some shoes have differences in construction between the forefoot and the heel part, e.g.: a reduced thickness of the cushioning material at the forefoot part or an air cushion at lower pressure compared to the pressure of the cushion in the heel part. However, currently used materials only accommodate for dynamic load, which is appropriate for the heel part of the shoe, but not for the forefoot, because during push-off there is no noticeable dynamic force due to collision. Hence, currently used shoe concepts do not accommodate sufficiently for the variety of loads during roll-off, for the different parts of the foot.

[0005] In orthopaedic medicine, excessive plantar pressure is reduced through forming a suitably shaped insole. These insoles are made with depressions and elevations. In order to reduce the pressure on protrusions and shift pressure to less vulnerable foot areas, the depressions of the insole can accommodate protrusions (off-loading) of the foot, while the elevations can exert a pressure on adjacent areas (support). A general disadvantage of such an orthopaedic insole is that the device has to be custom made and is consequently expensive.

[0006] Also, a commonly used orthopaedic treatment concept to reduce peak pressures is to increase the contact area between the foot and the insole. These insoles are appropriate for (semi-) rigid constructions, such as a total contact plaster cast or an inflexible orthopaedic shoes where the foot is immobilized. In a more or less mobile foot, this concept is not effective since the contact area varies during roll-off and does not correspond to the change in force: the contact area decreases rapidly already after approximately 70% of the roll-off cycle, whereas the peak pressure reaches a maximum at about 80% of the roll-off.

[0007] Because the whole forefoot area is already loaded during the push-off, there is no increase of the supporting area possible. Although it is commonly thought that filling the space under the medial foot arch can create a larger supporting area during push-off, it is found by the applicant that, this does not create a larger supporting area of a mobile foot during push-off.

[0008] Accordingly, although some reduction of the pressure can be obtained through a flexible insole, the current insole concepts for sport and orthopaedic devices do not adequately prevent locally high semi-static pressures on the forefoot.

SUMMARY OF THE INVENTION

[0009] An object of the invention is to provide a footwear component, which enables an improved reduction of pressure on the foot. Therefore, according to a first aspect of the invention, a footwear component according to claim 1 is provided.

[0010] Such a footwear component enables an improved reduction of a semi-static plantar load because a local exerting force on a particular part of the foot is transferred and dissipated to an other, e.g. larger, part of the foot. Also the transfer of load will accommodate to the rate of impact. Accordingly, locally high loads on the plantar area are prevented and the reduction of the pressure is improved.

[0011] A further advantage that may be obtained, is that the footwear element will adapt to a specific individual, because the pressure is transferred depending on the distribution of the pressure. Accordingly, the need to provide a custom-made footwear element, e.g. an insert, is obviated. Further, as at least a part of the force exerted on the first cell is transferred to the second cell by the coupling between the plurality of cells, the grid with the plurality of cells is less susceptible to strain and wear. Thus, reliability and durability of the footwear component may be increased.

[0012] According to a second aspect of the invention, a method for designing a footwear component according to claim 23 is provided. Such a method enables to design a footwear component, which exhibits an improved reduction of pressure on the foot.

[0013] According to a third aspect of the invention, a method for manufacturing a footwear component according to claim 24 is provided. Such a method enables to manufacture a footwear component, which exhibits an improved reduction of pressure on the foot.

[0014] According to a fourth aspect of the invention, a use according to claim 25 is provided. Such a footwear use allows a more effective alleviation of food dysfunctions, because the footwear component will exhibit an improved reduction of pressure on the foot.

[0015] According to a fifth aspect of the invention, a

shoe according to claim 26 is provided. Such a shoe has an improved comfort, because the footwear component exhibits an improved reduction of pressure on the foot.

[0016] Specific embodiments of the invention as set forth in the dependent claims.

[0017] These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Further details, aspects and embodiments of the invention will be described, by way of example only, with reference to the drawings.

[0019] FIG. 1 schematically shows a perspective, partial sectional view of a footwear component according to the invention.

[0020] FIG. 2-3 schematically show a detailed sectional side view of a part of the example of FIG. 1, in different stages of the functional mechanism according to the invention.

[0021] FIG. 4 schematically shows a perspective view of another footwear component according to the invention.

[0022] FIG. 5 schematically shows an example of an embodiment of a shoe in which a footwear component according to the invention is used.

DETAILED DESCRIPTION

[0023] The example of a footwear component shown in FIG. 1 is a separate padding 1 which can be inserted in a shoe to provide direct support to the sole of the foot, i.e.: the foot sole is in direct contact with the footwear component. As shown in FIG. 5, the component is positioned in the lower part A of the inside space of the shoe 10 and rests upon the outsole 11 of the shoe. The sole 1 is therefore supported by the bottom of the inside of a shoe, more in particular by the sole 11 of the shoe 10, but not attached to the bottom portion. However, it is also possible to attach the sole 1 to the bottom portion, for example by gluing, stitching, welding or otherwise.

[0024] It should be noted that in the art, a *sole* generally refers to the entire bottom of a shoe, which acts to protect the foot against, for example, sharp objects, as well as to support the foot. The sole typically includes a protective outer layer which is relatively hard and performs the protective function. The sole may also include an inner layer which supports the foot (or at least a part of the foot) and one more intermediate layers which, for instance, perform shock absorption. The inner layer may be attached to the outer layer or to an intermediate layer. The inner layer may for example be softer than the outer layer and have a foot side surface which follows the general contour of a foot. An *insole* generally refers to a separate padding that can be inserted after the shoe is manufactured, and supports substantially the whole foot. The insole may for example be placed in a shoe, to adapt the sole of to the individual shape of an individual, for example to alleviate or correct a foot dysfunction of the concerned individual. An *insert* generally refers to a separate padding which supports a part of the foot only, such as a fore-foot support.

[0025] In the examples, the footwear component 1 is an insole. However, the footwear component may alternatively be an insert. The footwear component may also be implemented as a shoe sole or one or more layers of a sole, for example an inner layer of a sole, i.e. a cushioning or padding attached to the outer sole of the shoe during manufacturing of the shoe. The footwear component 1 may also include a part of a shoe, which provides indirect support to the foot, i.e. in which the foot sole is indirectly in contact with the respective part. For example, the footwear component may include a intermediate sole, i.e. a layer of cushioning or padding provided between an insole or insert which directly supports the foot and/or an outer sole which protects the other layers of the sole or may include the outer sole of a shoe.

[0026] As shown in FIG. 1, the footwear component 1 has a foot side 3 and a bottom side 2. The footwear component 1 further includes a grid 4 with a number of cells 40. In this example, at the foot side 3, the grid is covered by a cover layer 30, which may for example absorb moisture from the foot. At the bottom side 2, the grid is covered by a protective layer 20, which protects the grid 4, for example against rubbing against the sole of a shoe.

[0027] The separate cells 40 may have damping and/or elastic characteristics for reducing the impact of load (dynamic) or static pressure on at least a part of a foot supported directly or indirectly by the respective, separate cell. The impact can for instance be reduced by an elastic cell or other resilient cell, which upon impact absorbs a part of the energy by deforming elastically and releases the absorbed energy after impact by returning to the non-deformed state.

[0028] The grid 4 includes a coupling between cells 40. The coupling transfers a force exerted on a discrete cell 40 by the part of the foot above the cell 40 to another part of the foot via another cell depending on the force on the cell 40, as is explained below in more detail. Thus, the amount of impact or pressure exerted on that part is reduced, and foot dysfunctions, such as bone deformation or wounds caused by excessive impact or pressure, can be alleviated. For example, when walking or running, forces are exerted on the foot with a significant component in the direction from the bottom 2 to the foot side 3, e.g. when walking or running, the rear part of the foot is typically subject to a higher impulse or impact than the forefoot: the force and related pressure exerted on the forefoot increases gradually during push-off. Typical values for the loading rate or impulse of local plantar pressure is approximately 0.9 kPa/ms under the metatarsals and 1.5 kPa/ms under the big toe region, whereas typical impact of the rear part of the foot may be 30-40 kPa/ms. It will be appreciated that other loading rates of local plantar pressures are possible, e.g. within a bandwidth

of plus and minus 30% of the above mentioned loading rates. By transferring the force from a particular part of the sole to adjacent areas, proportionally to the amount of force and impulse, the local pressure can be reduced in an adaptive manner and a more even distribution of the pressure over the surface of the foot. This concept is effective during the different phases of walking or running and the pressure distribution will adapt to the changes in force, such as shifts in pressure over the contact area between the foot and the footwear element 1.

[0029] In the example of FIG. 1, the grid extends over at least the forefoot part of the insole. Thereby, dysfunctions of the forefoot caused by excess pressure or impact, for example during push-off, can be reduced. This is particularly advantageous, because as explained above, during push-off almost the entire forefoot is loaded and it is found by the applicant that, contrary to common believe, increasing the contact area to the medial foot arch is not effective.

[0030] FIGs. 2 and 3 show a sectional view of a part of the grid 4 shown in FIG. 1. In this example, the cells of the grid may act as a primary unity of cells 40 which is directly loaded by the foot or a secondary unity of cells which react to the load transfer through the coupled cells 41. In FIGs 2 and 3, a force indicated with arrow A is exerted on the primary unity of cells 40. The primary unity of cells 40 is coupled to the secondary unity of cells 41 and the force on the primary unity of cells is partially transferred to the secondary unity of cells. According to the Law of Pascal, the coupling effectuate an interactive control of the pressure between the primary and secondary unity of cells The pressure may for example be linearly or non-linearly dependent on the force exerted on the primary unity of cells.

[0031] The interactive coupling may transfer the force in any suitable manner. The coupling may for example, as indicated with arrows B1-B3 in FIG. 3, reverse the direction of the force. That is, the first cell 40 and the second cell 41 may be coupled such that upon exerting a force A on the first cell 40 in a direction towards or away from the first part of the foot, the second cell 41 exerts a force B1-B3 on the second part of the foot opposite to the first force. The second force may be controlled to have a magnitude, which is depended on the magnitude of the first force.

[0032] The first cell 40 may be connected via the coupling to second cells 41 directly adjacent to the first cell 40. However, it is also possible that the first cell 40 is coupled to second cells 41 which are separated from the first cell 40 by other cells 40. For instance, in the example of FIG. 2 the right most cell 41 is coupled to the first cell 40 and, as illustrated in FIG. 3, the force will at least partially be transferred to this right most cell 41 and the right most cell 41 exerts a force B2 on the foot in response. Hence, the first cell 40 may be regarded as the centre of a web to which second cells 41 are coupled. The second cells 41 may in turn be coupled to other cells. Thereby, the force on the first cell 40 can be transferred to a relatively large number of second cells 41, and the amount of additional force that will be exerted by the second cells 41 is relatively small with respect to the force already exerted by the second cells 41 due to the pressure. In this example, the right most cell 41 is coupled to the first cell 40 via another second cell 41. Accordingly, the amount of force transferred to the right most second cell 41 is only a part of the amount of force transferred to the second cell 41 directly adjacent to the first cell 40 with couplings having a transfer coefficient (i.e. the amount of force transferred to a second cell 41 relative to the amount of force exerted by the foot on the first cell 40 which decreases with increasing distance from the first cell 40.

[0033] The force exerted on the foot by the cells 40,41 may be controlled in any suitable manner. In the example of FIGs 2 and 3, for instance, the cells have a foot side 42 which can move towards and away from the foot. By moving the foot side 42 of a cell 40,41 relative to the foot sides 42 of the other cells, the force exerted by the respective cell can be controlled. As illustrated in FIGs. 2 and 3, the first cell 40 may for example have a foot side which is at least partially moved away from the foot by the force, e.g. relative to a common level of the foot sides 42 indicated in FIGs. 2 and 3 with dashed line L. Thereby, the force or pressure exerted on the respective part of the foot by the first cell 40 is lowered. In response to the movement of the first cell 40, the coupling may control a movement of the foot side 42 of the second cell(s) 41, for example to move the foot side 42 towards the foot, as shown in FIG. 3 and indicated with arrows B. Thereby, the force or pressure exerted on the respective part of the foot by the second cell 41 is increased. Accordingly, the pressure on the foot can be distributed and excessively high (local) pressure levels be prevented.

[0034] The movement of the foot side 42 of the cells 40,41 may be any suitable movement. As shown in FIGs. 2 and 3, the food side 42 of the cells 40,41 may for example be flexible and flex in the direction of the force, e.g. towards or away from the food. However, the food side 42 may alternatively be rigid and displace in a direction towards or away from the food as a whole without substantial bending or be semi-flexible make a combined flexing and displacing movement.

[0035] The coupling may be any coupling suitable to obtain a desired transfer of the force and to obtain a desired relationship between the force exerted on the first cell 40 and the amount of transferred force. The first cell 40 may for example, as shown in FIG. 2 and 3, include a compressible space 400, which reduces in volume under the force and the second cell 41 may include an expandable space 410. The coupling, may in response to a compression of the compressible space 400, control an expansion of the expandable space 410, for example by transferring a fluid from the compressible space 400 to the expandable space 410. As shown in FIGs. 2-3, the first cell 40 and the second cell 41 may for example be coupled by a fluid connection 420, which allows a fluid

to flow between the first cell and the second cell in response to the force. The fluid may for example be propelled out of the first cell 40 by compressing the compressible space 400, into the second cell 41 expand the expandable space 410. The first cell 40 and the second cell 41 coupled to the first cell 40 thus act as fluid vessels in fluid communication and by transferring the fluid from the first cell 40 to second cell 41, the force on the first cell can be transferred effectively and an accurate distribution of the pressure can be obtained.

[0036] The fluid may be any suitable type of fluid. The fluid may for example be a gas, a liquid, a visco-elastic fluid, a non-Newtonian fluid or any other suitable type of fluid. The fluid may for example be a dilatants fluid, of which viscosity increases with the speed of deformation of the body of fluid. Preferably, the fluid acts as a (nearly) elastic body at high flow velocity of the fluid, whereas at low flow velocity the fluid acts as a fluid. Thereby, the impact, e.g. during strike or landing phase, can be absorbed by the grid 4 whereas, e.g. during push-off, the pressure can be distributed effectively to prevent local high pressures on the foot. The fluid may for instance be a polymer fluid. For example, low molecular weight poly-alpha-olefins are found to be suitable as a synthetic liquid. A suitable fluid has been found to be a low- molecular weight ethylene propylene (EP) rubber.

[0037] The grid 4 may have different couplings between cells 40,41, for distributing the impact or pressure differently from the first cell to the second cells. For instance in the example of FIGs. 2 and 3, the fluid connections 420 may have different fluid resistances. For example, the fluid connections may include, as shown in FIG 3, include valves 45-47. The valves 45-47 restrict the fluid flow between the chambers 400. As shown in FIG. 3, the valves 45-47 have different diameters and hence different fluid resistances. Accordingly, the fluid pressed out of the first cell 40 will distributed to the second cells 41 to a different extent, and therefore, the second cells 41 will act upon the foot differently.

[0038] In the example of FIG. 2 and 3, the movement of the top side 42 is an elastic movement. That is, when the force on the first cell 40 is removed, the first cell 40 will return from the compressed state to a natural state, and the second cells 41 will return from the expanded state to their natural state. Thereby, the cells 40, and hence the grid 4, exhibits an elastic behaviour and accordingly are able to absorb at least a part of the energy due to impact.

[0039] In the example of FIGs. 2 and 3, the compressible space 400 and the expandable space 410 are shaped as a chamber defined by one or more side walls 43 extending between a bottom side of the chamber and a foot side of the chamber. The chamber is filled with the fluid and is in fluid communication with at least one compartment in another cell, via the respective fluid connection 420 between directly adjacent cells. The chamber may be implemented in any manner suitable for the specific implementation. The chamber may for example be defined by one or more elastically deformable walls. In the example of FIGs. 2 and 3, the chamber for example includes an elastically deformable side wall 43 which separates a cell from an adjacent cell. The side wall 43 will be compressed elastically due to the force exerted by the foot, and hence absorb impact energy. In case a cell (more in particular: the space 400) is compressed, the fluid pressure increases and will exert a deforming force on the side walls 43 of the respective chamber. Consequently, the side walls 43 will also deform elastically, more in particular bend as indicated in FIG. 3 with the dashed lines. Preferably, the side walls 43 are sufficiently elastic to allow an effective absorption of the impact energy, while being sufficiently rigid to provide stability during e.g. walking or running.

[0040] The sides walls 43 are an example of an elastic connection, between a bottom side of the compartment and a foot side 42 of the compartment. The elastic connection, for absorbing at least a part of the impact or pressure in a direction from the bottom to the food side surface or vice versa. The elastic connection may differ in resilience for at least two of the cells. For instance in the example of FIGs. 2 and 3, the thickness of the walls 43 may vary between the cells 40,41 and in the example of FIG. 4 the pillars may have a differing thickness and/or height. Thereby, the impact absorbing may differ over the grid 4, and differences in the impact forces acting on the foot can be taken into account.

[0041] In the example of FIGs. 2 and 3, the chamber further has, an elastically deformable foot side wall which defines a foot side of the chamber. The elastically deformable foot side wall flexes when the foot exerts a force on the respective cell 40,41 and accordingly enables compressing or expanding the space 400,410 defined by the chamber while automatically returning the space 400,410 to its original volume (and shape) when the force is absent. Furthermore, the deformable walls allow the shape of the cell 40,41 to adjust to the deforming of the footwear element 1, e.g. during roll-off.

[0042] The footwear component may include a single grid or a plurality of grids. The footwear component may for instance, as shown in FIG. 4, include two or more grids. The example of FIG. 4 includes a forefoot grid 4B extending over a forefoot part of the footwear component. The footwear element 1 may in addition, or alternatively, include a rear foot grid 4A extending over a rear foot part of the footwear component. In the example of FIG. 4, the cells located at a forefoot part of the footwear element have a smaller height that cells located at a rear foot part of the footwear element, and/or the height of the cells 40,41 follows a general foot contour.

[0043] The rear foot grid may, as shown in FIG. 4, be separated from the forefoot grid by a buffer, for example made of a foamed polymer, which at least partially inhibits a transfer of the impact or pressure from the rear foot part to the forefoot part or vice versa. Thereby, stability of the foot during displacement is increased. As shown in FIG. 4 with the dash-dotted line, the footwear may fur-

ther include a grid in the mid-part of the foot, which may be an extension of the forefoot grid 4B in order to use the mid-foot, i.e. the foot arch, to distribute pressure acting on the forefoot grid 4B.

[0044] A footwear element according to the invention may for example be designed by determining a part or parts of a foot exposed to pressure or impact above a threshold, determining a part or parts of the foot to which the pressure or impact can be transferred and determining suitable transfer characteristics of the transfer of pressure or impact. Thereafter, a grid of cells may be determined and a coupling between the cells suitable to obtain the determined transfer characteristics. Subsequently, a tangible footwear element may be manufactured corresponding to the design.

[0045] A footwear component according to the invention may be used to alleviate foot dysfunctions. The footwear element may for example be used to alleviate foot dysfunctions such as pressure sores, caused by prolonged excess static pressure, for example foot ulcers. In particular, the insole may be provided in order to alleviate foot dysfunctions such as, at least partially, caused by diabetes and rheumatoid arthritis, sports injury, aging, muscle fatigue, Hanssen disease (leprosy), peripheral vascular disease, osteoarthritis, other disorders of the musculoskeletal system, asymptomatic foot pain, low back pain, hip pain, knee pain or other dysfunctions.

[0046] In the foregoing specification, the invention has been described with reference to specific examples of embodiments of the invention. It will, however, be evident that various modifications and changes may be made therein without departing from the broader spirit and scope of the invention as set forth in the appended claims. For example, footwear element 1 may be used by humans and be shaped to suit a human foot. Furthermore, the footwear element 1 may for example be designed to a generalized foot contour or be custom made for a specific individual. Also, the grid 4 may be exposed or be enclosed at the foot side 2 and/or the bottom side 3 by any suitable layer of material, such as for example resilient layers, moisture absorbing layers or any other suitable layer.

[0047] Also, the grid 4 may have any suitable pitch and the cells 40,41 may have a foot side area per cell of less than 5 cm^2, such as less than 1 cm^2, such as less than 5 mm^2, and preferably 4 mm^2. Also, the cells have any volume suitable for the specific implementation. A volume per cell of less than 2 cm^3, such as less than 1 cm^3, and/or a height of less 25 mm are found to be suitable to provide stability during walking or running. The height of the cells 40,41 may be at least 1 mm or more, in order to obtain a sufficient damping of the impact and/or redistribution of the pressure.

[0048] Furthermore, the grid 4 may include two or more sub-grids and one or more of the sub-grids may be separated from the other sub-grids, i.e. not transfer the force to the other sub-grids. Also, the grid 4 may include cells 40 which are not coupled to other cells.

[0049] Also, the cells 40,41 may have any suitable shape, for example cubic, honeycomb or shaped otherwise. Furthermore, for example the topside 42, (and hence the height of the cells 40,41), may follow the general contour of a foot.

[0050] However, other modifications, variations and alternatives are also possible. The specifications and drawings are, accordingly, to be regarded in an illustrative rather than in a restrictive sense.

[0051] In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. The word 'comprising' does not exclude the presence of other cells or steps then those listed in a claim. Furthermore, the words 'a' and 'an' shall not be construed as limited to 'only one', but instead are used to mean 'at least one', and do not exclude a plurality. The mere fact that certain measures are recited in mutually different claims does not indicate that a combination of these measures cannot be used to advantage.

Claims

1. A footwear component, such as an insert or insole, including:

   a grid with a plurality of cells, for reducing the impact and/or pressure on, at least, a part of a foot supported directly or indirectly by the footwear component, said grid of cells further including:

   a coupling between said plurality of cells, for transferring, at least, a part of a force due to at least a part of the impact or the pressure, exerted on a first cell by a first part of the foot supported directly or indirectly by said first cell, via a second cell, to a second part of the foot supported directly or indirectly by said second cell, or vice versa, depending on the force on the first part.

2. A footwear component according to claim 1, wherein said first cell and said second cell are coupled such that upon impact or pressure on the first part of the foot, the second cell increases the pressure on the second part of the foot.

3. A footwear component according to claim 2, wherein said first cell and said second cell are coupled such that upon exerting a force on said first cell, said force having a first force component in a direction towards or away from the first part of the foot, said second cell exerts a force on the second part of the foot with a second force component opposite to the first force component, said second force component having a magnitude which is depended on the magnitude of the first force component.

4. A footwear component according to claim 2 or 3, wherein said first cell has a foot side which upon said force at least partially moves away from the foot and said second cell has a foot side which is controlled by said coupling to move towards said foot in response to the force.

5. A footwear component according to any one of the preceding claims, wherein said first cell includes a compressible space which under said force reduces in volume and said second cell includes an expandable space and wherein said coupling, in response to a compression of the compressible space, controls an expansion of the expandable space.

6. A footwear component according to any one of the preceding claim, wherein said first cell and said second cell are coupled by a fluid connection, which allows a fluid to flow between said first cell and said second cell in response to said force.

7. A footwear component according to claim 6, wherein said fluid is at least one of the group consisting of: gas, liquid, visco-elastic fluid, non-Newtonian fluid.

8. A footwear component according to claim 7, wherein said fluid is a non-Newtonian fluid, such as a polymer fluid, for example a low- molecular weight ethylene propylene rubber.

9. A footwear component according to any one of the preceding claims, including different couplings between cells, for distributing the impact or pressure differently from said first cell to said second cells.

10. A footwear component according to claim 9 and any one of claims 6-8, including fluid connections with different fluid resistances.

11. A footwear component according to claim 10, wherein at least one of said fluid connections includes a valve for restricting the fluid flow.

12. A footwear component according to any one of claims 6-8, wherein said cells include a chamber defined by at least one wall extending between a bottom side of the chamber and a foot side of the chamber, said chamber being filled with said fluid and in fluid communication with at least one chamber in another cell.

13. A footwear component according to claim 12, wherein said chamber is defined at least partially by at least one elastically deformable wall, such as an elastically deformable side wall separating a cell from an adjacent cell and/or an elastically deformable foot side wall defining the chamber at a foot side thereof.

14. A footwear component according to any one of the preceding claims, wherein said first cell and said second cell each include at least one elastic connection between a bottom side of the cell and a foot side of the cell, for absorbing at least a part of the impact or pressure in a direction from the bottom to the food side surface or vice versa.

15. A footwear component according to claim 14, wherein said elastic connection differs instantaneously in resilience for at least two of said cells.

16. A footwear component according to any one of the preceding claims, wherein said cells have a foot side, said foot side having an surface area per cell of less than 5 cm^2, such as less than 1 cm^2, such as less than 5 mm^2, and preferably 4 mm^2.

17. A footwear component according to any one of the preceding claims, wherein said cells have a volume per cell of less than 2 cm^3, such as less than 1 cm^3, and/or a height between 1 mm and 25 mm.

18. A footwear component according to any one of the preceding claims, wherein cells located at a forefoot part of the footwear element have a smaller height that cells located at a rear foot part of the footwear element, and/or wherein the height of the cells follows a general foot contour.

19. A footwear component according to any one of the preceding claims, including a forefoot grid extending over a forefoot part of the footwear component.

20. A footwear component according to any one of the preceding claims, including a rear foot grid extending over a rear foot part of the footwear component.

21. A footwear component according to claims 19 and 20, wherein said rear foot grid is separated from the forefoot grid by a buffer, for at least partially inhibiting a transfer of said impact or pressure from the rear foot part to the forefoot part or vice versa.

22. A footwear component according to any one of the preceding claims, said footwear component being a sole or an insert having a support area of the sole or insert which directly or indirectly supports the foot.

23. A method for designing a footwear component, including:

determining at least one first part of a foot exposed to pressure or impact above a threshold;
determining at least one second parts of said foot to which said pressure or impact can be transferred;
determining suitable transfer characteristics of

said transfer of pressure or impact; and
determining a suitable grid of cells, said grid being suitable for reducing the impact and/or pressure on at least a part of a foot supported directly or indirectly by the footwear component, said grid of cells including: a plurality of cells for reducing the impact or pressure on a part of a foot supported directly or indirectly by a respective one of said cells; and
determining a coupling between said cells suitable to suitable obtain the determined transfer characteristics, said coupling transferring at least a part of a force, due to at least a part of the impact or the pressure, exerted on a first cell by a first part of the foot supported directly or indirectly by said first cell, via a second cell, to a second part of the foot supported directly or indirectly by said second cell, or vice versa, depending on the force on the first part.

24. A method for manufacturing a footwear component according to any one of the preceding claims, including:

a method according to claim 23; and
manufacturing a tangible footwear component with the determined grid of cells.

25. Use of a footwear component according to any one of claims, to alleviate foot dysfunctions.

26. A shoe, including a footwear component according to any one of claims 1-22.

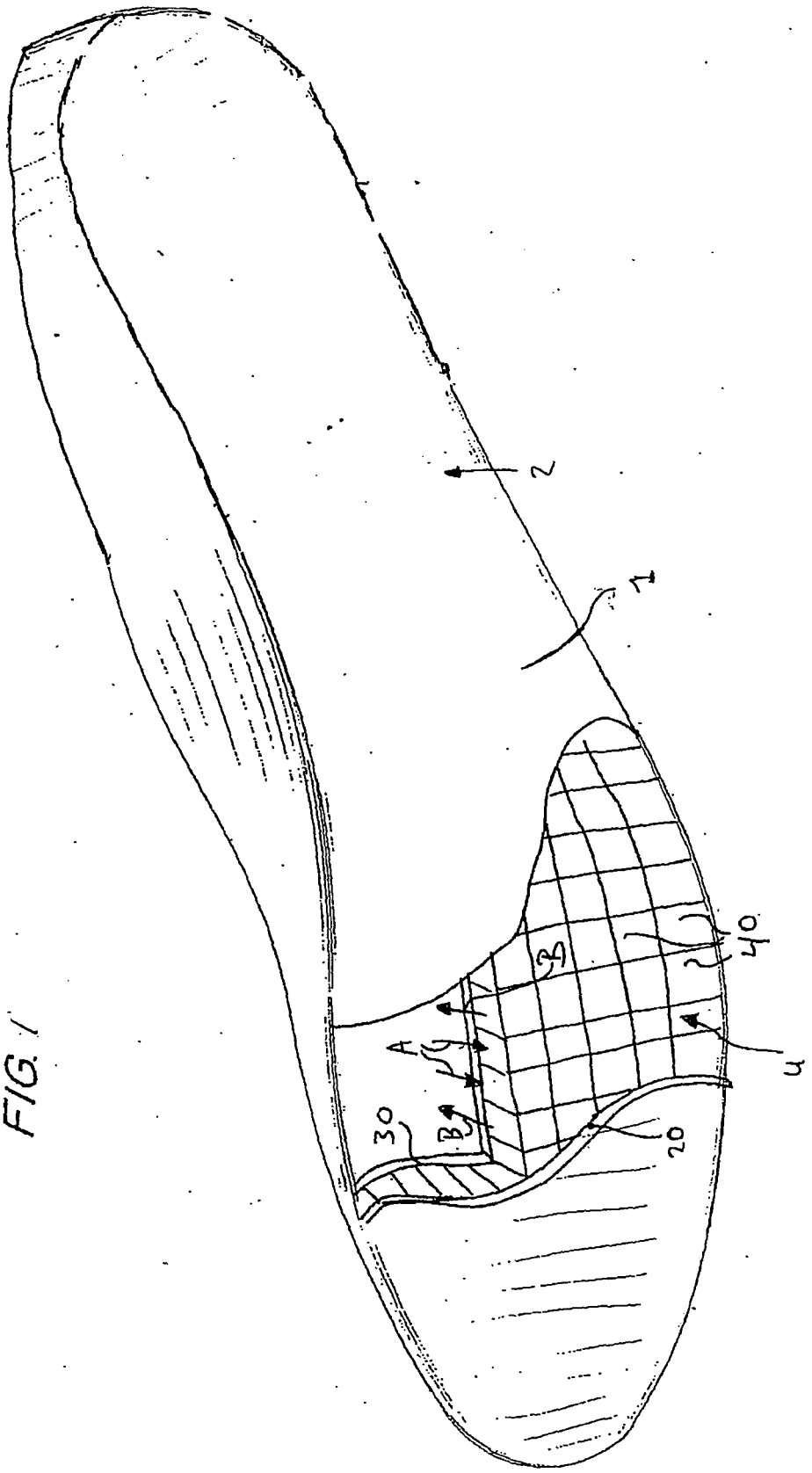
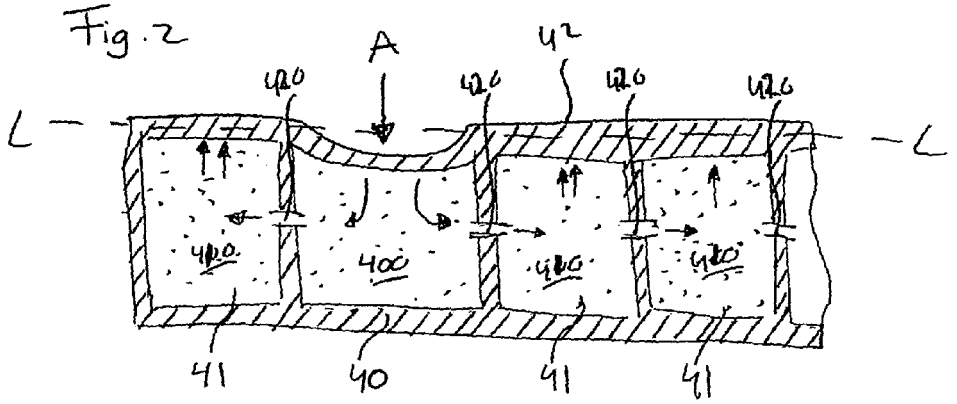


FIG. 1

Fig. 2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400
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40
41
41

Fig. 3

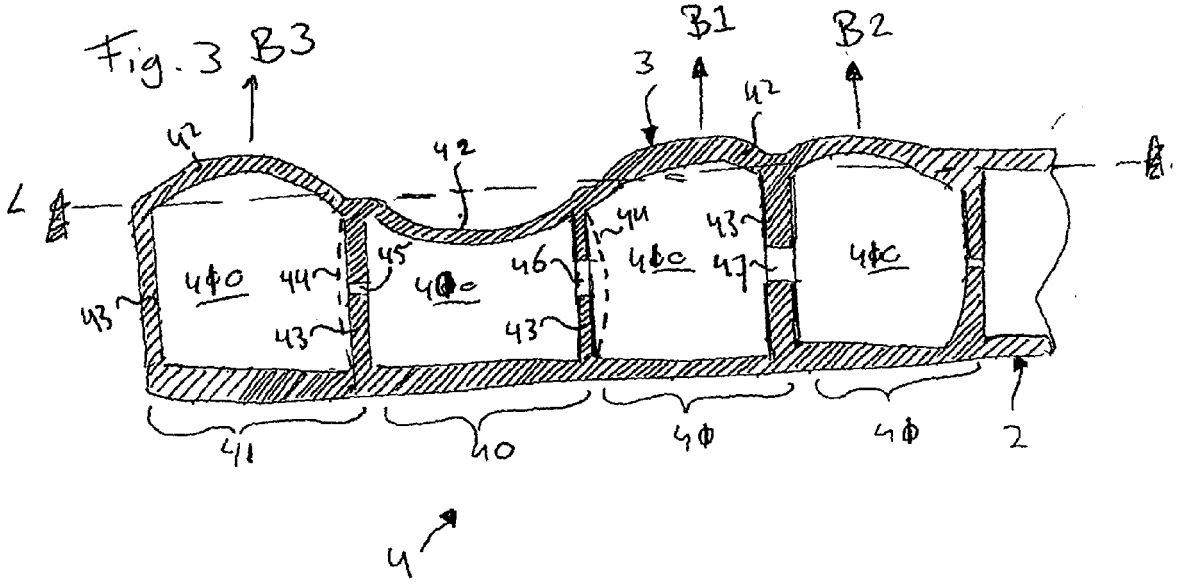
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Fig. 4

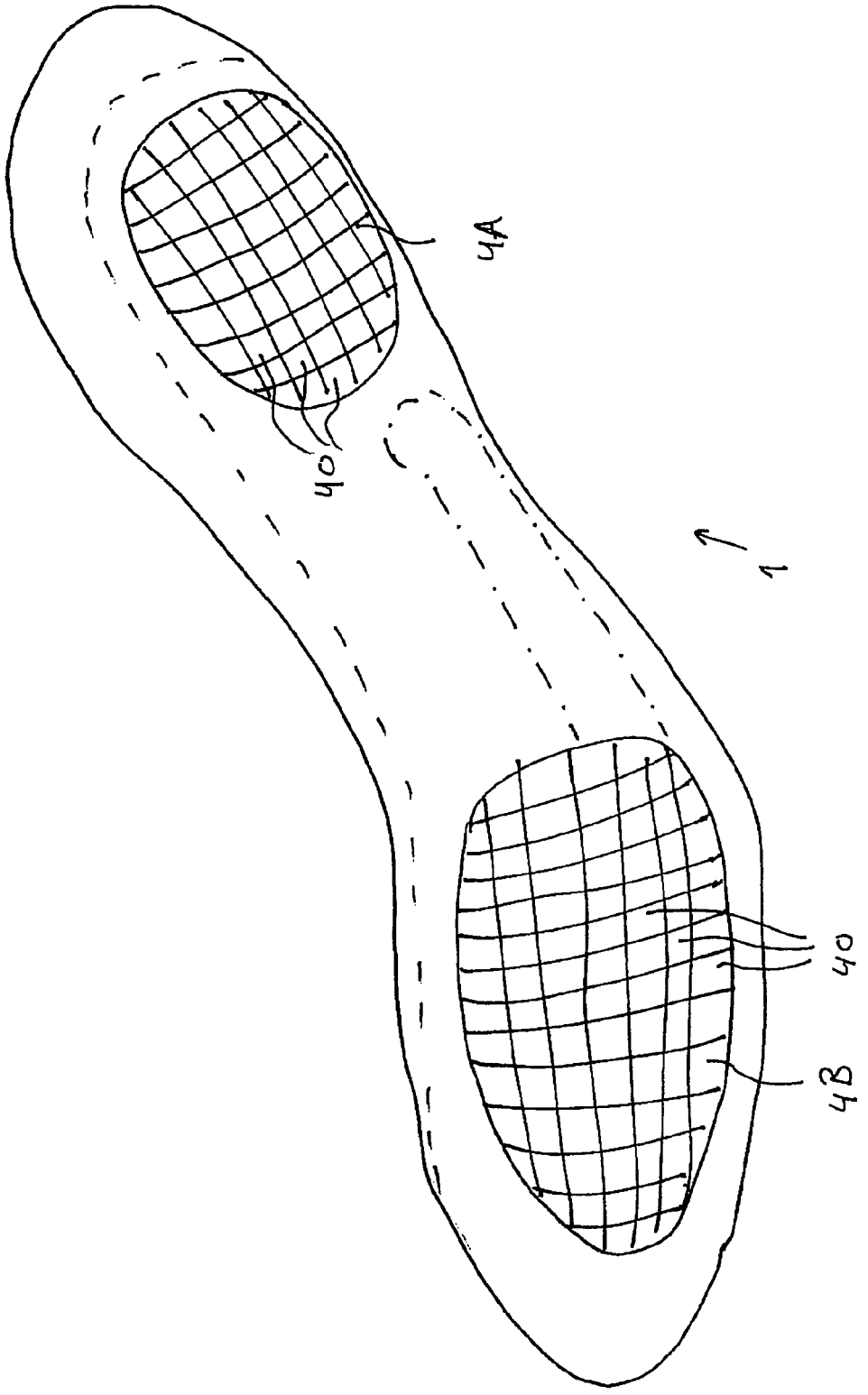
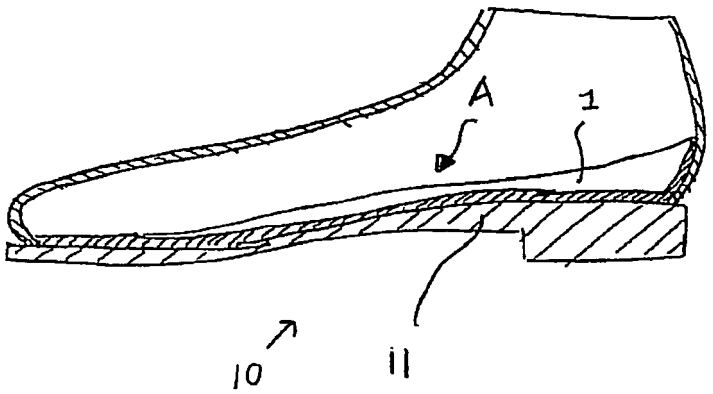


Fig 5



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 07 6763

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 784 807 A (PAGEL TODD A [US]) 28 July 1998 (1998-07-28) * column 6, lines 36-60; claim 1; figures *	1-22,25, 26	INV. A43B17/03 A43B17/02
X	US 5 134 790 A (WOITSCHAETZKE HANS [DE] ET AL) 4 August 1992 (1992-08-04) * claims; figures *	1-22,25, 26	
X	US 5 220 737 A (EDINGTON CHRISTOPHER J [US]) 22 June 1993 (1993-06-22) * claims; figures *	1-22,25, 26	
A	US 4 777 739 A (HILES MAURICE [US]) 18 October 1988 (1988-10-18) * the whole document *	8	

TECHNICAL FIELDS SEARCHED (IPC)

A43B

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	20 February 2007	Claudel, Benoît

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

4

European Patent Office

Application Number
EP 06 07 6763

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1 - 22, 25, 26

European Patent Office

LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 06 07 6763

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-22,25,26

   multi cells foot component with non newton fluid
   ---

2. claims: 23,24

   method for designing a foot component adapted to the morphology of a foot
   ---

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 07 6763

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

20-02-2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5784807 A	28-07-1998	NONE	
US 5134790 A	04-08-1992	NONE	
US 5220737 A	22-06-1993	JP 2651433 B2	10-09-1997
		JP 5253006 A	05-10-1993
US 4777739 A	18-10-1988	NONE	

EPO FORM P0459

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