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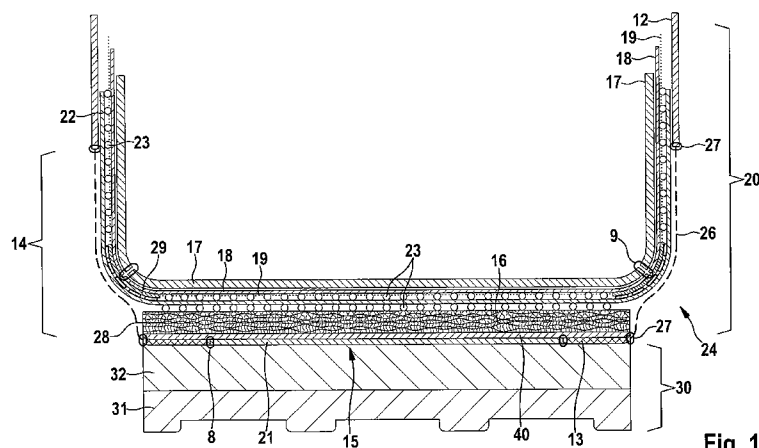


Fig. 1

(57) Abstract: A footwear (10), comprises an upper assembly (20) and a sole (30), in which the upper assembly (20) comprises an upper (12) comprising in a lower peripheral area at least one air permeable portion (14), an air-permeable layer (16) arranged in a lower area of the upper assembly (20) on the sole side above the sole (30), wherein the air-permeable layer (16) has a three-dimensional structure that permits passage of air at least in the horizontal direction and the at least one air permeable portion (14) enables the air-permeable layer (16) to communicate with the outer surroundings such that air (60) is exchanged between the outer surroundings and the air permeable layer (16). An insole (21) is arranged beneath the air-permeable layer (16) and to which a lower end area (13) of the upper (12) is attached, the insole (21) and the lower end area (13) of the upper (12) forming an upper assembly bottom portion (15) to which the sole (30) is attached. At least a part of the sole (30) is formed by sole material injected onto at least part of the upper assembly bottom portion (15) such that the at least one air permeable portion (14) is free of injected sole material, wherein the upper assembly bottom portion (15) is impermeable for liquid sole material injected onto the upper assembly bottom portion (15).

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**Footwear with air permeable layer in a lower peripheral area of the upper assembly
and manufacturing method thereof**

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The present invention is related to footwear comprising an upper assembly and a sole, in which the upper assembly comprises an upper comprising in a lower peripheral area at least one air permeable portion and an air-permeable layer arranged in a lower area of the upper assembly on the sole side above the sole, wherein the air-permeable layer is water vapor permeable and has a three-dimensional structure that permits passage of air at least in the horizontal direction. More specifically, the present invention describes embodiments of footwear and manufacturing methods thereof with ventilation beneath the foot sole and with the removal of water vapor through layers beneath the foot to improve the climate comfort of such footwear.

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Existing shoes have either a certain water vapor permeability in the sole area, also called breathability, as a result of the use of a breathable shoe sole material such as leather, with the drawback of water permeability in the sole area, or shoes are waterproof and water vapour impermeable in the sole area as a result of the use of outsoles made of a waterproof material, such as rubber or a rubber-like plastic, with the drawback that moisture could accumulate in the foot sole area.

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In more recent times, shoes that are waterproof and also water vapor permeable in the sole area have been created by perforating their soles with through-holes and covering the through-holes with a waterproof, water vapor-permeable membrane, so that no water can penetrate into the shoe interior from the outside, but moisture that forms in the foot sole area can escape outward from the shoe interior.

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US 2011/0167677 A1 discloses a shoe which has a ventilation space beneath the foot sole defined by an air-permeable spacer structure, which permits an efficient transport of water vapor to the outside of the shoe. Particularly, an embodiment of the shoe has an upper arrangement and a sole, the upper arrangement having an outer upper material and an air-permeable layer arranged in a lower region of the upper arrangement on the sole side above the sole. The air-permeable layer has a three-dimensional structure that permits air passage in at least the horizontal direction. The outer upper material has at least one air passage opening in a lower peripheral area on the sole side, by means of which a connection can be produced between the air-permeable layer and the outer environment of the

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shoe, such that air exchange between the outer environment and the air-permeable layer can occur. In this way, heat and water vapor can be removed from the area of the upper arrangement situated above the air-permeable layer, for example, by means of convective air exchange through the air-permeable layer. The outsole can be attached to the upper arrangement, for example, by moulding or gluing. With moulding an outsole to the upper arrangement, a robust and safely attached sole can be provided. However, there is the risk of contaminating the air permeable openings in the lower part of the upper and/or of the air permeable layer and its three-dimensional structure by moulded liquid sole material penetrating into these regions. This may compromise the air-permeability and breathability of the footwear. An additional risk to mould an outsole to such a shoe construction is the softness of the air-permeable layer. The softness of the air permeable layer can let the PU material forming the sole escape from the mould rings compromising the aesthetical appearance of the shoe.

WO 2012/028206 A describes a method for manufacturing a shoe comprising the steps of providing an upper assembly with an upper portion comprising an outer material and with a bottom portion and providing a ventilating sole element having a structure or material allowing for air flow through it. The ventilating sole element is placed in a mould, said mould having pins projecting in a lateral direction. The ventilating sole element and the upper assembly are positioned such that an upper part of the ventilating sole element contacts the bottom portion of the upper assembly. The mould is closed such that the pins contact a side wall of the ventilating sole element, followed by the step of injection moulding so as to form a surrounding sole element being fixed to the upper assembly and to the ventilating sole element, said surrounding sole element comprising lateral passages from the outside of the surrounding sole element to the side wall of the ventilating sole element formed by the pins. After injection moulding, the lateral passages of the surrounding sole element are connected to the structure or material of the ventilating sole element.

In EP 1 033 924 A, there is described a method for manufacturing the sole structure of a shoe and for fixing it to the upper structure. A breathable sole structure is made by direct injection moulding and can be fixed permanently and tightly to the upper structure. In this construction, a honeycomb is fixed to an insole of the upper structure and the mould known per se for the sole structure, having pins extending parallel to the sole structure in its side walls, is closed and direct injection moulding is performed. The pins are adapted to extend into close contact with the side walls of the honeycomb in order to provide air vents between the honeycomb and the outside atmosphere. The sole structure is fixed directly to the upper structure.

In WO 2013/087324 A, there is described a waterproof and vapor-permeable shoe comprising an upper assembly, which is composed of at least one upper and a waterproof and vapor-permeable functional layer which is internal thereto, a tread portion made of waterproof material, which is joined to the upper assembly below it, at least one vapor permeation layer provided below the foot insertion space formed inside the shoe to accommodate the foot of the user. At least one opening is provided which is lateral with respect to the shoe proximate to the region of connection of the upper assembly to the tread portion, the at least one opening being open toward the perimetric edge of said at least one vapor permeation layer. The shoe has, interposed between said perimetric edge and the at least one opening selectively at least one waterproof and vapour-permeable functional element so as to prevent the access of water that arrives from the at least one opening to the at least one vapor permeation layer of the at least one functional portion of the functional layer. Moreover, the at least one vapor permeation layer is made of a vapor-permeable material selected among fibrous, porous or microporous materials. The tread portion is joined to the upper assembly advantageously by gluing, according to the working method known as "cemented", or, depending on the contingent requirements, by molding, according to the working method known as "injected". A further functionality of the insole advantageously consists in preserving the breathability of the vapor permeation layer by shielding it from the material that forms the tread portion during the molding thereof.

An object of the present invention is to provide a footwear with at least one air permeable portion in the lower peripheral area of the upper which is capable to be provided with an injected sole or injected part of the sole such that the air permeable portion as well as the air permeable layer which communicates air in the horizontal direction are not penetrated or covered by injected sole material.

According to an aspect, there is provided a footwear, comprising an upper assembly and a sole, in which the upper assembly comprises an upper comprising in a lower peripheral area at least one air permeable portion, an air-permeable layer arranged in a lower area of the upper assembly on the sole side above the sole, wherein the air-permeable layer has a three-dimensional structure that permits passage of air at least in the horizontal direction and the at least one air permeable portion enables the air-permeable layer to communicate with the outer surroundings such that air is exchanged between the outer surroundings and the air permeable layer, an insole arranged beneath the air-permeable layer and to which a lower end area of the upper is attached, the insole and the lower end area of the upper forming an upper assembly bottom portion to which the sole is attached. At least a part of

the sole is formed by sole material injected onto at least part of the upper assembly bottom portion such that the at least one air permeable portion is free of injected sole material, wherein the upper assembly bottom portion is impermeable for liquid sole material injected onto the upper assembly bottom portion.

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According to the invention, the upper assembly bottom portion is impermeable for liquid sole material injected onto the upper assembly bottom portion such that the upper assembly bottom portion is not penetrated by injected sole material from one side to its other side. In this way, the surfaces of the upper assembly bottom portion (particularly the surfaces of the lower end area of the upper and of the insole) which are facing away from the at least one injected part of the sole are not penetrated by the respective injected sole material, i.e. are substantially free of injected sole material. In this way, the three-dimensional structure of the air permeable layer, such as an open spacer structure, which permits passage of air to the outer surroundings in horizontal direction can be kept free of injected sole material, so that the air permeability and breathability of the air permeable layer can be ensured. Further, advantageously the at least one air permeable portion of the upper is free of injected sole material, thus preserving high breathability of the footwear.

In one embodiment the lower end area of the upper is impermeable for liquid sole material injected onto the upper assembly bottom portion. This helps ensuring that the air permeable layer and the air permeable portions are kept free of sole material injected onto the upper assembly bottom portion.

According to an embodiment, the footwear comprises an impermeable layer arranged between the insole and the air-permeable layer and which is impermeable for liquid sole material injected onto the upper assembly bottom portion. Particularly in case of a stitched upper assembly construction (such as a strobelt construction), the insole (such as strobelt insole) is usually thin and flexible to allow the sewing (strobelt) step of the lower end area of the upper to be stitched to the insole. Therefore, the stitching (strobelt) seam may also be protected against penetration of liquid sole injection material. The impermeable layer may be arranged on top of the insole and below the air-permeable layer covering the stitching seam accordingly.

According to an embodiment, the impermeable layer is arranged such that a perimetric edge of the air-permeable layer, through which air is exchanged horizontally to the outer surroundings, is aligned with the at least one air-permeable portion.

In specific embodiments and dependent on the mould form for forming the at least one part of the sole, the impermeable layer can raise up the air-permeable layer in order to place the air-permeable layer accurately with its perimetric edge at substantially the same level as the air-permeable portion.

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In one embodiment said impermeable layer can be chosen from a stiff and/or hard material to ensure a tight closing of the mould rings on the upper. For moulding at least part of a sole onto the upper assembly bottom portion, the shoe last (to stabilize the upper assembly for an accurate attachment of the sole) typically ends above the air-permeable layer. The

10 mould rings for injecting at least a part of a sole end below and/or around the air permeable portions of the upper and, therefore, in the area of or below the air-permeable layer. That could mean that the counter pressure of the last is not available for the mould rings to ensure a tight attachment for the injection process. Therefore, a hard and/or stiff material layer underneath the air-permeable layer can help to overcome that problem.

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For example, the impermeable layer and the insole form a composite layer arrangement, such as a laminate.

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As to the construction of the upper assembly, according to an embodiment, at least parts of the lower end area of the upper and the insole are attached to each other by means of stitching, particularly a Strobel stitching (also called Strobel construction). According to another embodiment, at least parts of the lower end area of the upper are attached by adhesive to an underside of the insole (also called lasted construction).

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In an embodiment, the sole has an upper peripheral edge with a curved form at least in a side part of the sole, and has at least one elevated part which at least partially surrounds the at least one air-permeable portion.

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In one embodiment, the sole has an upper peripheral edge with a curved form for example in a side part of the sole, and has at least one peripheral elevated side part which protrudes between two of the air-permeable portions of the upper so as to at least partially surround the at least two of the air-permeable portions.

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According to another embodiment, the at least one air permeable portion (such as an opening) may be surrounded by sole material. For example, the one or more air permeable portions may be enclosed by an aperture formed by the sole material. This may result in a shoe which has elevated side parts of the sole which protrude in the peripheral regions and

have one or more apertures which enclose one or more air permeable portions. Such elevated side parts of the sole may have further advantages, such as stabilizing the foot in the shoe, provide better support for the foot, particularly in the peripheral regions, and providing increased protection for the shoe against abrasion.

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According to a further embodiment, the footwear further comprises at least one waterproof and water vapor permeable functional layer arranged on an inner side of the upper and above the air-permeable layer. The functional layer may be an upper functional layer and/or an upper bottom functional layer, particularly extending from below the foot to regions upwards to the sides of the upper assembly. As one example, an upper functional layer and upper bottom functional layer may be connected with each other to form a sock-like functional layer arrangement (so-called functional layer bootie). There may be other variations on the process of how the functional layer is made part of the upper assembly.

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According to an embodiment, the footwear further comprises a water vapor permeable first protective layer arranged between said at least one air permeable portion and said functional layer in at least an area of the at least one air permeable portion above the air-permeable layer. The first protective layer is adapted for protecting the functional layer against particles penetrating through the air permeable portion.

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In one embodiment the at least one air permeable portion comprises at least one air passage opening in the upper. In this way, a high air permeability of the upper in the side parts may be achieved. For example, said air passage opening comprises an air permeable second protective layer. In this way, the air passage opening can be protected from external influences and penetrating objects.

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According to another embodiment, the at least one air permeable portion is formed of at least one air permeable material. In a further variant, the at least one air permeable portion may comprise a perforated or microinjected material.

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According to another embodiment, the upper arrangement may comprise at least one particle barrier layer arranged between the at least one air permeable portion and the functional layer at a level above the air-permeable layer. For example, such particle barrier layer, which may be air impermeable, provides additional protection in that it prevents larger or smaller particles such as stones, dirt, etc. to accumulate in a space between the functional layer and the upper material and/or air-permeable layer. The particle barrier layer may be located at a level right above the air permeable layer, but may also be located higher rela-

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tive to the air permeable layer in the direction of the upper material. Thus, the potential risk of damaging the functional layer by such particles is reduced.

For example, the particle barrier layer may have the form of a strip. It may be arranged
5 longitudinally along at least parts of the circumference, particularly where the air permeable portion is arranged, or along substantially the whole circumference of the shoe. It may cover and/or may be arranged in regions above the air permeable layer in a circumferential region of the shoe between the horizontal bottom and the vertical part of the upper arrangement, where the shoe may come into contact with stones or other particles in a vertical
10 movement when stepping onto the ground. The particle barrier layer may be attached to the first protective layer.

For example, the particle barrier layer is arranged so as to contact an inside surface of the air permeable portion. For instance, the air permeable portion presses the particle barrier
15 layer in the direction of the first protective layer. For example, the particle barrier layer is attached to the first protective layer.

According to another aspect, a method of manufacturing a breathable footwear is provided, comprising the steps of: providing an upper assembly with an upper comprising in a lower
20 peripheral area at least one air permeable portion, an air-permeable layer arranged in a lower area of the upper assembly on the sole side, wherein the air-permeable layer has a three-dimensional structure that permits passage of air at least in the horizontal direction and the at least one air permeable portion enables the air permeable layer to communicate with the outer surroundings such that air is exchanged between the outer surroundings and
25 the air permeable layer, and an insole arranged beneath the air-permeable layer and to which a lower end area of the upper is attached, the insole and the lower end area of the upper forming an upper assembly bottom portion for attaching the sole, wherein the upper assembly bottom portion is impermeable for liquid injected sole material. The upper assembly bottom portion is placed in a mould, wherein said mould comprises at least one
30 side frame to enclose at least part of a circumference of the upper assembly bottom portion, the side frame comprising an upper sealing lip. The mould is closed such that the upper sealing lip of the at least one side frame contacts the upper at least in a part which is below the at least one air-permeable portion, followed by the step of injection moulding of sole material into the mould so as to form a sole being fixed to the upper assembly bottom
35 portion and leaving the at least one air-permeable portion free of injected sole material.

For example, the at least one part of the sole may be formed such that it has an upper peripheral edge with a curved form at least in a side area of the sole, and has at least one peripheral elevated side part which protrudes and, following the curved form, at least partially surrounds one or more of the air-permeable portions.

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According to another aspect, there is provided a sole injection mould for manufacturing a footwear according to the invention, comprising a bottom part for forming a sole pattern at the bottom of the sole, and at least one side frame configured to enclose at least part of a circumference of the upper assembly bottom portion. The at least one side frame comprises an upper sealing lip which has a curved form, wherein the upper sealing lip is configured to contact the upper at least below the at least one air-permeable portion and, following its curved form, partially surrounds the at least one air-permeable portion of the upper.

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According to an embodiment, the upper sealing lip has at least one protrusion which is configured to protrude and contact the upper between two of the air-permeable portions.

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Further embodiments and aspects of the invention are evident from the dependent claims and from the description herein below.

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The invention will now be described by means of embodiments and aspects of the invention with reference to the drawings, in which:

Fig. 1 shows a schematic cross-sectional view of footwear according to an embodiment of the invention,

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Fig. 2 shows a schematic cross-sectional view of footwear according to another embodiment of the invention,

Fig. 3, 3a show schematic cross-sectional views of footwear according to further embodiments of the invention,

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Fig. 4 shows respective side views of various embodiments of soles of footwear according to the invention,

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Fig. 5 shows schematic views of a part of a mould used for manufacturing of a footwear according to an embodiment of the invention,

Figs. 6-9 show embodiments of a mould and of a semi-manufactured and finished footwear product in the process of manufacturing a footwear in accordance with aspects of the present invention.

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Fig. 1 shows an exemplary footwear in the form of a shoe according to an embodiment of the invention in a schematic cross-sectional view. The footwear comprises an upper assembly 20 and a sole 30 applied to the lower end area of the upper assembly 20. The upper assembly 20, in the usual manner, has a foot-insertion opening, from which a lace area (not shown) extends in the direction of the forefoot area of the upper assembly. The sole 30, in this embodiment, is substantially flat (i.e., does not extend in vertical direction into the upper regions of the upper assembly) and comprises an outsole or tread 31 and a midsole 32. The sole 30 may be provided as a composite sole, as shown, or may be provided as one material piece. An attachment of the sole 30 to the upper assembly 20 is made by injection moulding, as described in more detail below. The material of the sole 30 is waterproof and typically impermeable to water vapor and may be all appropriate kinds of plastics material including all kinds of rubber, foamed material, cured and thermoplastic materials used for forming injected soles and any layers thereof.

20 In the following, embodiments of the upper assembly 20 are described which are applicable to all embodiments of footwear as shown in the Figures.

The upper assembly 20 has an upper 12, on the inside of which a first layer composite material is situated. For example, as a first layer composite material a laminate is provided (in the following also referred to as "first laminate") which comprises (from inside to outside): an upper lining textile layer 17 which is water vapour permeable but not waterproof, and a functional layer 18 which may have the form of a membrane. In some embodiments, the first laminate further comprises a supporting layer 19 for the functional layer 18, e.g. having a supporting mesh structure (e.g. nylon) that is water vapor permeable and allows penetration of adhesive. The functional layer 18 is preferably waterproof and water vapor permeable, such as an ePTFE (expanded polytetrafluorethylene) membrane or an PU (polyurethane) membrane. The functional layer 18 may have a porous structure and may be a multilayer product, such as a ePTFE layer plus PU coating or ePTFE layer with surface treatment. The first laminate formed by layers 17, 18 and 19 may cover mainly the whole of the top and sides of the foot.

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The functional layer is not limited to the above mentioned execution but can also consist of more or also less layers, other membranes, and also other alternative solutions to membranes achieving the same result for the shoe. This also includes other ways to integrate membranes, as well as treatments like Durable Water Repellent ("DWR") treatments or
5 and other alternative solutions to render the shoe waterproof while being breathable and allowing for air passages as described above.

The upper 12 may be water vapor permeable and may be made, e.g., of leather textile, or other materials, or combinations of these. In one example the upper can be made of poly-
10 amide. It is the visible outer part of the upper assembly. The upper 12 surrounds the first laminate with layers 17, 18, 19, wherein the upper and the first laminate are basically of the same shape to be able to receive a foot. The upper 12 and the first laminate are attached to each other where needed, in a manner that maintains the waterproof and water vapor permeable properties of the combination of upper and first laminate.

15 According to the embodiments of Figs. 1 to 3, there is further provided a second layer composite material in the bottom area of the upper assembly 20. For example, as a second layer composite material a laminate is provided (in the following also referred to as "second laminate") which comprises basically the same layer structure as the first laminate
20 (from the inside to the outside): a bottom lining textile layer 17 which is water vapor permeable but not waterproof, a preferably waterproof and water vapor permeable functional layer 18, such as an ePTFE membrane or composite membrane, and a supporting layer 19 for the functional layer 18, such as a supporting mesh structure (e.g. nylon).

25 The lower end of the first laminate and the circumferential edge of the second laminate are attached to each other by at least one seam 9, such as a Strobel seam or similar. This at least one seam 9 is sealed in a waterproof manner using a seam tape 29 which is applied on the side of the seam facing away from the foot, e.g. by using a special seam sealing machine. The finished lining construction formed by the first laminate and second laminate as
30 part of the upper assembly 20 is a waterproof, water vapor permeable sock-like construction, also known as functional layer bootie.

Such a bootie is usually stitched together from several laminate parts, wherein the stitched seams are glued over with a waterproof seam-sealing strip and made waterproof in this
35 way. The upper assembly 20 is therefore waterproof and water vapor permeable, and after addition of a sole 30, a waterproof and water vapor permeable shoe 10 is provided.

Generally, the upper part and the bottom part of functional layer 18 can be common parts of a functional layer bootie, or they can be separate functional layer parts that are sealed with respect to one another. The upper and bottom parts of functional layer 18 each may be part of a multilayer functional layer laminate, as described above, such as a three-layer
5 functional layer laminate with a functional layer which is embedded between two layers, such as textiles.

In various embodiments, the functional layer may be integrated in any other form or way applicable for such footwear products.

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As further shown in Figs. 1 to 3, an at least air-permeable layer 16 (which may also have other functions) is arranged in a lower area of the upper assembly 20 above the sole 30. The air-permeable layer 16 has a structure that permits air passage at least in the horizontal direction. Particularly, the air-permeable layer 16 is situated beneath the bottom part of
15 functional layer 18. It is preferably water vapor permeable in the direction towards the bottom part of the functional layer 18,

An insole 21 is arranged beneath the air-permeable layer 16. To the insole 21, a lower end area 13 of the upper 12 is attached. In the embodiments of Fig. 1 and 2, at least parts of the
20 lower end area 13 of the upper 12 and the insole 21 are attached to each other by means of stitching. In the present embodiments, the stitching is a Strobel stitching 8. In this way, the upper assembly 20 is closed in the bottom part thereof. The insole 21 and the lower end area 13 of the upper 12 form an upper assembly bottom portion 15 to which the sole 30 is attached, as described in more detail below. The upper assembly bottom portion 15 is im-
25 permeable for liquid sole material injected onto the upper assembly bottom portion 15, such that the upper assembly bottom portion is not penetrated by injected sole material. The lower end area 13 of the upper 12 is configured to be impermeable for liquid sole material injected onto the upper assembly bottom portion 15, as described in more detail below.

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The lower end area 13 of the upper 12 may enclose regions of the upper 12 where the air permeable portions 14 are placed. Particularly, in embodiments in which the sole has at least one elevated part which at least partially surrounds the at least one air permeable portion 14, the lower end area 13 of the upper 12 in the regions of the elevated part(s) of the
35 sole should also be impermeable for liquid sole material injected onto the upper assembly bottom portion 15. Also, in embodiments in which the sole has at least one peripheral elevated side part which protrudes between two of the air-permeable portions 14 of the upper

12 so as to at least partially surround the at least two of the air-permeable portions 14, the lower end area 13 of the upper 12 in regions between two of the air-permeable portions 14 should also be impermeable for liquid sole material.

5 In the embodiments of Fig. 1 and 2, the footwear further comprises an impermeable layer 40 arranged between the insole 21 and the air-permeable layer 16. The impermeable layer 40 is also impermeable for liquid sole material injected onto the upper assembly bottom portion 15, such that liquid sole material cannot penetrate into the air permeable layer 16. The impermeable layer 40 and the insole 21 may be glued to one another. In one embodi-
10 ment, the impermeable layer 40 and the insole 21 may also form a composite layer arrangement.

Generally, the impermeable layer 40 extends over or covers the stitching 8 connecting the lower end area 13 of the upper with the insole 21 in order to make the stitched connection
15 impermeable for injected sole material particularly that injected sole material cannot penetrate up to the air permeable layer 16.

The extension of the impermeable layer 40 from the stitching 8 to the peripheral outside region of the footwear can vary depending on the upper assembly construction and the size
20 of the shoe as long as the stitching 8 is sealed against the injected sole material. In one embodiment the impermeable layer 40 has the same size as the air-permeable layer 16. In another embodiment the impermeable layer 40 extends around 1 mm beyond the peripheral edge of the air-permeable layer 16 towards the outside.

25 In another embodiment, the impermeable layer 40 is a layer which is only positioned in the bottom area of the upper assembly, particularly not in the peripheral and upper regions of the upper 12 above the air permeable portions 14.

Together with the impermeable lower end areas 13 of the upper 12, an impermeable upper
30 assembly bottom portion 15 including the connection between insole 21 and lower end area 13 of the upper 12 is created. In versions where the insole 21 as such is impermeable for injected sole material, the impermeable layer 40 may be omitted. In the context of the present invention, impermeable for injected sole material means that the respective layer or portion is not penetrated by injected sole material from one side of the layer to the
35 other, so that injected sole material cannot penetrate up into the air permeable layer 16 and the air permeable portions 14.

Preferably, the impermeable layer 40 may be used and arranged such that a perimetric edge 28 of the air-permeable layer 16, through which air is exchanged to the outer surroundings of the footwear, is aligned with the at least one air-permeable portion 14. In a method of manufacturing the footwear, impermeable layer 40 is used, and arranged accordingly, for aligning the perimetric edge 28 of the air-permeable layer 16 with the air-permeable portion 14. In specific embodiments and dependent of the mould form used for injecting the sole 30, the impermeable layer 40 can raise up the air-permeable layer 16 in order to place the air-permeable layer 16 (and its perimetric edge 28) accurately at the same level as the air-permeable portion 14 (e.g., its air passage opening 24).

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In the embodiment of Fig. 3, insole 21 is positioned below the air permeable layer 16. At least parts of the lower end area 13 of the upper 12 are attached by adhesive 25 to an underside of the insole 21. In this embodiment, the insole 21 has the constitution of an assembly or lasting insole to which parts of the lower end area 13 of the upper 12 are folded and fixed on its underside for closing the upper assembly 20 when fitted on a last, before a sole is attached to the underside of the closed upper assembly. The insole 21 and the lower surface of the air permeable layer 16 may be fixed to each other by gluing, such as lasting glue, or equivalent.

The insole 21 can be made of various types of materials depending on desired stiffness, hardness or other properties. In an embodiment, the insole is made of 100% Polyamide with a layer of 20 g nonwoven and is non breathable. The insole may have a total thickness of 2.2 mm in the toe area and 4.0 mm in the heel area. The insole can also have other functions like puncture protection for safety shoes. In the stitched embodiments, as in Fig. 1 and 2, the insole may be softer as it is used in common lasted constructions.

In case of a lasted upper construction, the insole material itself is usually harder and/or stiffer as compared to strobel insoles and, therefore, it is difficult for injecting material to penetrate through it. Nevertheless, the lasting edges (lower end area 13) of the upper 12, especially in the area below the air permeable portions 14, should be made impermeable for the liquid injected sole material in order for the connection between insole and upper to be also safely impermeable for injected soled material.

The insole can be made of insole material from the company Texon (so-called "Texon-insole"), leather, non-woven or hard felt material.

35

In one embodiment the lower end area of the upper is impermeable for injected sole material according to the material used for the lower end area like leather, man made leather, TPU, rubber and/or EVA, which can, in one example, be stitched to the remainder of the upper to form the lower end area.

5

In another embodiment the lower end area of the upper is made impermeable for injected sole material by a surface treatment of the upper material. For example, one or more of the following options for the lower end area of the upper may be used:

10 a) attaching a piece (e.g. a foil) of impermeable material to the lower end area of the upper, e.g. by stitching, adhesive or HF (high frequency) welding. In case of HF welding a separate flat mould is typically used to attach e.g. the foil to the upper.

15 b) microinjection: moulding of a layer of material onto the surface of the lower end area of the upper, e.g. forming a plastic frame around the air permeable portions (e.g., openings) and on the lower end area. The process of microinjection typically takes place on a flat piece of upper material before forming the upper assembly. On the flat upper piece an injection mould is tightly placed and injected material is put onto the surface.

20 The lower end area may have a length of at least 3 mm, in one example the length is 4 mm.

In one embodiment, the impermeable layer is waterproof and non breathable. It can be made of material which has no pores and is solvent proof. In one example the impermeable layer comprises a closed cell structure made of copolymers. The impermeable layer may
25 be or may comprise a film of various materials like one or more of the following: TPU, PU, polypropylene, polyethylene, PA, EVA.

In one embodiment the impermeable layer is in the form of a foil made of EVA or PE (polyethylene), preferably with a thickness of 0.5 mm. In another embodiment the impermeable layer is made of EVA, preferably having a thickness of 4 mm. Preferably, the minimum thickness of the impermeable layer is at least 0.5 mm in order to maintain the impermeability during the time the sole material is hot and liquid.

35 The hardness of the impermeable layer may be important to ensure a tight closing of the moulding rings on the upper. Therefore the density of the material for the impermeable layer is in one embodiment at least 100 kg/m³, preferably at least 120 kg/m³ and in another

embodiment at least 200 kg/m³. Depending on the end-use of the shoe the hardness of the impermeable layer can vary.

5 In various embodiments, the dimensions of insole 21 are dependent on shoe size, last shape, and dimensions of impermeable layer 40, or combinations thereof.

The thickness of the impermeable layer 40 depends on the sole design and on the thickness of the air-permeable layer 16. In one embodiment, if a flat sole is used, the impermeable layer 40 could be of a thickness of 0.5 mm or less. In another embodiment, if an air permeable layer 16 of 7 mm thickness is used and a sole is designed to extend over the lower side of the upper, a thickness of the impermeable layer 40 of 4 mm may be used in order to align the air permeable layer 16 to the air permeable portions (e.g., openings). In another embodiment, an air permeable layer 16 of 5 mm may be used, thus the impermeable layer 40 may have a thickness of 6 mm or more.

15 According to an embodiment, the lower end area 13 of the upper 12, especially in the regions below the air permeable portions 14, is an upper material layer which is as such impermeable for injected sole material, and is particularly not provided with any additional layer, such as on the inside, which is impermeable for injected sole material and, thus, in the first place makes the composite impermeable. In this way, the construction of the upper and the lower end area can be facilitated.

In an embodiment, the insole 21 and the air-permeable layer 16 may form a composite. Particularly, the insole 21 may be the bottom layer of the air permeable layer 16, instead of using a separate insole. Thus, it is possible in certain variants to make the bottom or lower support surface of the air-permeable layer 16 correspondingly stable as needed to form an insole layer, so that the lower end area 13 of the upper 12 can be attached to it.

30 In the above embodiments, variants of footwear using lasting and stitching, respectively, to integrate the air permeable layer into the lower region of the upper assembly and for closing the upper assembly have been described. However, other common ways for closing the upper assembly may also be used.

35 As further shown in Figs. 1, 2 and 3, the upper 12 comprises in a lower peripheral area air permeable portions 14, one of which on each side is shown in the depictions of Figs. 1 and 2, and only one in the partial view of Fig. 3. Generally, each of the air permeable portions 14 enables the air permeable layer 16 to communicate with the outer surroundings such

that air 60 (depicted in Fig. 2) is exchanged in both horizontal directions between the outer surroundings and the air permeable layer 16. In embodiments where the air permeable portions 14 are larger and extend in excess of the air permeable layer 16, each of the air permeable portions 14 further enables the water vapor permeable functional layer 18 to communicate with the outer surroundings such that water vapor is transported from an inner side (i.e., the side facing the foot) of the functional layer 18 to the outer surroundings.

According to the embodiment of Figs. 1 and 3, each of the air permeable portions 14 comprises at least one air passage opening 24 formed in the upper 12. The air passage opening 24 preferably comprises an air permeable second protective layer 26 which covers the air passage opening 24. For example, the second protective layer 26 may be connected to the upper 12 by a stitching 27. In the region of the air passage opening 24, the upper 12 may be formed or replaced by the second protective layer 26, or by a lasting net which may be used in addition or alternatively to the second protective layer 26. According to another embodiment, the second protective layer 26 may be formed as a lasting net. For example, such lasting net is connected to the remaining material of the upper 12 by a stitching, such as a Zig Zag stitching.

The second protective layer and/or lasting net is formed, for example, by a gauze or mesh made of a textile material with high air permeability and therefore also high water vapor permeability. The second protective layer 26 can be situated on the outside or inside of the corresponding air passage opening 24. Each air passage opening 24 may have its protective layer 26 applied to it. In other embodiments, the second protective layer 26 may be applied as common protective covering strip to some or all of the air passage openings 24, so that the protective covering strip extends over the corresponding number of air passage openings 26. The protective covering strip can also become at least part of the lasting margin. In a particular implementation, the second protective layer 26 has a net-like structure and is adapted to have protective function against entry of larger particles, like stones. In this way, high water vapor permeability may be combined with suitable protective function against external impacts and stabilizing function.

As further shown in Figs. 1 to 3, a water vapor permeable and preferably water repellent first protective layer 22 is arranged between each of the air permeable portions 14 and the functional layer 18 in at least an area of the respective air permeable portion 14 above the air-permeable layer 16. The first protective layer 22 is adapted for protecting the functional layer 18 against particles, which may penetrate through the air permeable portion 14. Advantageously, the first protective layer 22 is chosen from a group of materials consisting of

woven, nonwoven, felt, knit, porous materials, non porous materials, foam and mesh-like material or combinations thereof. In one embodiment the first protective layer 22 may be made of a non woven felt material which may be treated to become hydrophobic.

5 The first protective layer 22 is optionally associated to the second laminate in a way that breathability is maintained, for example using a discontinuous adhesive application. For example, the first protective layer 22 is optionally associated to the second laminate, i.e. to the upper bottom supporting layer, which may have the form of a mesh, and to the functional layer through the open structure of the layer by means of adhesive dots or particles
10 maintaining breathability of the entire stack of materials.

In the embodiment of Fig. 1, the air permeable layer 16 is attached to the second laminate formed by layers 17, 18 and the sealing tape 29 by adhesive 23, preferably by means of adhesive dots or particles maintaining breathability of the entire stack of materials.

15

In the embodiment of Figs. 1 to 3, the first protective layer 22 also extends horizontally into the bottom area of the upper assembly 20 facing the sole 30 and is situated between the water vapor permeable functional layer 18 and the air-permeable layer 16. Further, the first protective layer 22 may provided with adhesive in discontinuous distribution , such as
20 adhesive dots 23, on an inner and outer surface of the first protective layer 22.

The first protective layer 22 may be arranged such that it covers at least the majority of the lower surface of the upper bottom functional layer 18 facing towards the sole. The first protective layer 22 may also extend at least partially laterally upwards around the edge of
25 the last, at least extending into the area of the openings as shown. The first protective layer 22 may also completely or partially cover the seam tape and even may go beyond it, covering at least parts of the lower end of the first laminate, particularly the upper functional layer 18 in the air permeable portion 14. The first protective layer 22 advantageously protects the upper bottom functional layer 18, which may be in the form of a membrane as set
30 out above, against rubbing with the below arranged air permeable layer 16 as there may be a relative movement between air permeable layer 16 and functional layer 18 during walking, particularly if there are no adhesive dots provided. The first protective layer 22 may also be of a constitution suitable for protecting the functional layer 18 against external impacts acting directly or indirectly through the air permeable portion 14 on the functional
35 layer 18.

Preferably, the first protective layer 22 has a water vapor permeability (MVTR) of at least 4 mg/cm²/h measured according to ISO 14268 (03-2013). In a preferred embodiment, the first protective layer 22 has a MVTR of at least 25 mg/cm²/h. The first protective layer 22 preferably is a durable and water vapor permeable layer that protects the functional layer (more particularly, the bootie laminate(s)) from abrasion and puncture damage. It is preferably also air permeable to increase the overall breathability. Advantageously, it is air permeable at least in the region facing the air permeable layer 16.

The first protective layer 22 can be treated hydrophobic and/or oleophobic. It may be chosen from a group of materials comprising woven materials, nonwoven (felt) material, knits, porous / non porous material, foams, meshlike materials or combinations thereof. The first protective layer 22 may be chosen from a flexible material to adapt to the shape of the sock like bootie.

In one embodiment the first protective layer 22 may be formed by the supporting layer 19 of the laminate.

A primary function of the first protective layer 22 is to protect the functional layer 18 against particles which may penetrate through the air permeable portion 14, particularly against dust and small particles and also against abrasion which may act through the upper material 12 and the second protective layer.

The embodiment according to Fig. 2 is different from the embodiments according to Figs. 1 and 3 in that one or more of the air permeable portions 14 are formed of at least one air permeable material. In the present embodiment, the air permeable portions 14 are formed at least partially by an air permeable material forming the upper 12. For example, such air permeable material has a net-like structure with open interspaces or voids which allow high air permeability. Nevertheless, such material still provides protective function against particles, particularly stones, for the underlying layers, particularly the functional layer 18. For instance, the material of the upper 12 may have an air permeable net-like structure over its whole surface surrounding the foot insertion region above the sole or only over parts of its surface, particularly in the peripheral regions adjacent to and above the air permeable layer 16. In a particular embodiment, the upper 12 may be formed from the same or similar material as the second protective layer 26 according to the embodiment of Figs. 1 and 3. For example, the material forming the air permeable portions 14 preferably has an air permeability of at least 100 l/m²/sec at 100 Pa pressure difference at least in the regions of the air permeable portions.

Alternatively, the air permeable portions 14 comprise a perforated or microinjected material. The latter particularly is made by injecting of a plastic frame around the respective air permeable portion). In Fig. 4a and 4c, such injected frame 140 around the respective air permeable portion 14 is shown.

Further to the components as described above, the upper assembly 20 of the footwear in the embodiment of Fig. 3 comprises a particle barrier layer 45 arranged between the respective air permeable portion 14 and the functional layer 18 at a level above the air permeable layer 16. For example, it is located in the lateral quarter above the air permeable layer 16. For instance, the particle barrier layer 45 is attached to the first protective layer 22, e.g. by adhesive (not shown). On its other side, the particle barrier layer 45 may be arranged so as to contact an inside surface of the air permeable portion 14. For example, the second protective layer 26 or upper 12, respectively, may be arranged such that the particle barrier layer 45 is pressed onto the surface of the first protective layer 22. In this way, the particle barrier layer 45 is held against the upper 12 and/or the second protective layer 26 without any open space or gap in between.

According to an embodiment, the particle barrier layer 45 is impermeable to air. As such, it may be placed advantageously in the region of the seam tape 29 which is also impermeable to air, thus limiting the air impermeable regions only to the angled peripheral areas of the upper assembly 20 directly above the air permeable layer 16.

The particle barrier layer 45 as used herein is preferably a protective boundary layer between the first protective layer 22 and the upper, particularly located in the lateral quarter above the air permeable layer 16. The particle barrier layer 45 according to an embodiment is not permeable to air. It may be permeable to water vapor. The particle barrier layer 45 may be fixed to the lateral extensions of the seam tape 29 or any corresponding facing layer, e.g. by using adhesive, for example an adhesive tape or the same adhesive provided also over the remainder of the facing layer. This may be done in a breathable or non breathable manner. The particle barrier layer 45 may have the form of a strip, and may be arranged longitudinally along at least parts of the circumference of the footwear. It may be formed as a continuous strip or it may comprise multiple strips which are arranged along the peripheral extension of the footwear. It may cover and/or may be arranged in the angled peripheral regions of the upper assembly 20 above the air permeable layer 16. For example, the particle barrier layer is provided with attaching means, such as adhesive or

adhesive tape, on an inner surface of the particle barrier layer, preferably only on the inner surface of the particle barrier layer.

For example, the particle barrier layer is made of a material which has the following properties:

- 5 - Material: closed cell foam (EVA (Ethylene vinyl acetate) and/or PE (polyethylene)
- Provided with self adhesive hot melt on inner side,
- Thickness: 3.0 ± 0.5 mm, according to DIN EN ISO 5084
- Width: 8 ± 2 mm
- 10 - Density: 30 – 80 kg/m³, ISO 845

In one particular example a particle barrier layer may be used in form of a PE adhesive tape with a width of 10 mm, a thickness of 3 mm and a density 40 g/m³.

15 Fig. 3a shows a variant of an embodiment of footwear with a capped sole 30 with side walls which go up and beyond the air-permeable layer 16 while leaving at least the air passage openings 24 open. On the left side the air permeable portion 14 is left fully open whereas on the right side the air permeable portion 14 is left open only partially.

20 As for the air-permeable layer 16 (which also functions and may be designated as a "spacer material"), a material is chosen which provides a durable, highly air permeable region that connects the underfoot functional layer (bottom part of functional layer 18) to the external environment.

25 For example, a hydrophobic water vapor permeable three dimensional textile material may be used for the air permeable layer 16. The air-permeable layer 16 acts as ventilation layer. Preferably, the air-permeable layer 16 is water vapor permeable in a vertical direction and in a horizontal direction. At least in a horizontal direction the air-permeable layer 16 allows a certain airflow due to its structure. The lower surface of the air-permeable layer 16
30 may not be water vapor permeable. In the current embodiment the air-permeable layer 16 is air permeable and water vapor permeable in horizontal and vertical direction. The upper surface of the air-permeable layer 16 may be attached to a layer above, as described above, in a manner that still maintains the breathability of these layers using for example a discontinuous adhesive. The air-permeable layer 16 corresponds in principle to the shape of the
35 insole 21.

In a particular example, the air permeable layer 16 is made of a 100% polyester (PES) material with a thickness of 6.5mm, a weight of 980 g/m² and a width of 110cm available from the company Tylex (article No D0082_03).

- 5 As to the second protective layer 26, according to an embodiment, a net-like structure (also called mesh) is used which provides a durable, highly air permeable, protective layer in the upper arrangement that connects the air permeable layer 16 (spacer material) and functional layer laminate to the external environment.
- 10 Preferably, a material may be used having an air permeability of > 1800 l/m²s (100Pa), according to ISO 9237 and is made of knit preferably a warp knit made of polyamide like polyamide 6.6 (Nylon). Such a knit is advantageously non fraying. The second protective layer 26 is hydrophobic treated.
- 15 In one example the second protective layer 26 is made of 100% polyamide with a double treatment of Melamin Resin (particularly useful for the lasted version; other treatments as used in fabric technology can also be used to obtain a more stiff and resistant textile), and may have a thickness of 1.2 mm, a weight of 390/400 g/m² (+/- 10%) and an air permeability of around 3000l/m² s according to ISO 9237. Such a layer is commercially available for
20 example by company Panatex S.P.A..

Regarding the adhesive as used herein, the following embodiments may be used: The adhesive 23 and any adhesive for attaching the first protective layer 22 is preferably applied discontinuously with a low coverage grid roll and provides a durable bond to the air permeable layer 16 while allowing moisture transport through the uncoated land area. An adhesive material may be used being an atactic polypropylene and/or hot melt resins.

As to the sole 30 of the footwear 10, there are various embodiments for configuring such sole in accordance with the principles of the present invention and which preserve the
30 breathability of the footwear through the air permeable portions 14.

In this regard, Fig. 4 shows respective side views of various embodiments of soles of footwear according to principles of the invention.

- 35 Fig. 4a shows a first embodiment of footwear comprising a substantially flat sole 30-1 with an upper peripheral edge 33 of the sole running below the air permeable portions 14. With the upper peripheral edge 33 of the sole 30-1 running below the air permeable portions 14,

the air-permeable portions 14 are left free of sole material forming the sole 30-1 to preserve breathability of the footwear, particularly of the air permeable portions 14.

Fig. 4b shows a further embodiment of footwear comprising a capped sole 30-2 extended at the sides (i.e. the upper edge of the sole raises at the sides in elevated extensions following a curved form), again with an upper peripheral edge 33 of the sole running below the air permeable portions 14. The upper peripheral edge 33 of the sole has a curved form. With the upper peripheral edge 33 of the sole 30-2 running below the air permeable portions 14, the air-permeable portions 14 are left free of sole material forming the sole 30-2 to preserve breathability of the footwear, particularly of the air permeable portions 14.

Fig. 4c shows a further embodiment of footwear comprising a substantially flat sole 30-3 with extensions upwards in the heel and toe area. The upper peripheral edge 33 of the sole is running below the air permeable portions 14. The air-permeable portions 14 are left free of sole material forming the sole 30-3 to preserve breathability of the footwear, particularly of the air permeable portions 14.

Fig. 4d shows a further embodiment of footwear comprising a capped sole 30-4 extended at the sides partially surrounding the air permeable portions 14, and in the toe and in the heel area. The upper peripheral edge 33 of the sole is running below the air permeable portions 14. The sole 30-4 has an upper peripheral edge 33 with a curved form at least in a side part of the sole, as shown. It has one or more elevated parts or extensions 34, depending on the number of air permeable portions 14, which respectively protrude between two of the air permeable portions 14 so as to at least partially surround the respective two of the air permeable portions 14. Particularly, as shown in the example of Fig. 4d, the elevated part or extension 34 protrudes between the air-permeable portions 14-1 and 14-2 and at least partially surrounds the air permeable portion 14-1 at its bottom and right side and the air permeable portion 14-2 at its left and bottom side. With the upper peripheral edge 33 of the sole 30-4 running below and between the air permeable portions 14, the air-permeable portions 14 are left free of sole material forming the sole 30-4 to preserve breathability of the footwear, particularly of the air permeable portions 14. With the elevated parts 34 of the sole 30-4, the air permeable portions 14 may be better protected against external impacts acting towards the sides of the shoe.

According to another embodiment as shown in Fig. 4e, one or more air permeable portions 14 (such as openings) may be completely surrounded by sole material of the sole 30-5. For example, one or more of the air permeable portions 14 may be enclosed by an aperture

formed by the sole material. This may result in a shoe which has elevated side parts of the sole which protrude in the peripheral regions of the sole 30 and have one or more apertures formed in the sole 30 which enclose the respective air permeable portion 14.

- 5 Turning now to the manufacturing of the footwear as described above, and more particularly to the manufacturing of the sole, reference is made to the Figures 5 to 8, which show embodiments of a mould and of a semimanufactured footwear product in the process of manufacturing a footwear in accordance with aspects of the present invention.
- 10 An exemplary injection mould 50 is shown in Fig. 6. It comprises side frames (or mould rings) 53, 54 which are shown in an open position surrounding a bottom portion 55 of the mould. The structure visible on top of the bottom portion 55 is arranged to form the sole structure in the tread or outsole, appropriately designed for walking on the ground. Each of the side frames 53, 54 is configured to enclose at least part of a circumference of the upper assembly bottom portion 15. According to the present embodiment, in combination the side frames 53, 54 are configured to enclose the circumference of the upper assembly bottom portion 15, as shown in Fig. 8, with the side frames 53, 54 closed around the upper 12 placed on a last 57 to enclose the upper assembly bottom portion 15 (not visible).
- 20 As best shown in Fig. 7A and Fig. 7B, the side frames 53, 54 each comprise an upper sealing lip 52, which is substantially a projection or lug protruding towards the upper 12 and contacts the upper 12 when the mould is closed, as shown in Fig. 8. In this way, the respective upper sealing lip 52 delimits the chamber for the injected sole material in the mould 50 on the upper side of the mould, so that the sole material may not penetrate beyond the upper sealing lip 52 of the mould side frames 53, 54 to enter for example into the air permeable portions 14.

- As shown in Fig. 5, the upper sealing lip 52 has a curved form, wherein the upper sealing lip 52 is configured to contact the upper 12 at least below the at least one air-permeable portion 14 and, following its curved form, partially surrounds the one or more air-permeable portions 14 of the upper 12. In this regard, Fig. 5b schematically shows one of the side frames with its upper sealing lip 52 having a curved form which has one or more protrusions 56 which is configured, when contacting the upper 12 of the footwear, to protrude between two of the air-permeable portions 14. Such state of contacting the upper 12 by the upper sealing lip 52 is shown in Fig. 5a, where the upper sealing lip 52 is pressed against the upper 12 and protrudes between two of the air permeable portions 14. In this way, a sole can be formed which has a structure in the peripheral part as shown in Fig. 4d

with the elevated parts or extensions 34 arranged between two of the air permeable portions, such as air permeable portions 14-1 and 14-2. In Fig. 6 and 7, the respective protrusions 56 are shown to form respective protrusion chambers in order to form the peripheral elevated parts or extensions 34 of the sole.

5

When closing the mould 50 around upper 12, specifically when closing the side frames 53, 54 around the upper 12 to enclose the upper assembly bottom portion 15, liquid sole material for forming at least a part of the sole (such as a midsole, an example of which is shown in Fig. 1 with reference number 31, and/or an outsole, examples of which are shown in Fig. 10 2, 3 and 4), such as polyurethane, is injected into the mould 50 (e.g., conventional polyurethane of the type as commonly used). During or after injection of the sole material, the sole material hardens and bonds to the upper assembly bottom portion 15. After completion of the injection process, the corresponding formed part of the sole forms a monolithic entity. Subsequently, any edges of the formed sole may be manually treated for superfluous material, if any. It is also possible to form at least one part of the sole, such as the midsole, by 15 injection moulding onto the upper assembly bottom portion and subsequently attach another part of the sole, such as the outsole, by gluing it to the previously formed part of the sole. Particularly, it is possible to form the midsole by injection moulding and subsequently attach the outsole to the midsole by gluing or injection moulding.

20

Fig. 9 shows a finished shoe 10 or shoe 10 during the finishing step in which the elevated parts 34 of the upper peripheral edge 33 of the sole 30, which are protruding between two of the air permeable portions 14 (here: air permeable portions 14-1 and 14-2), are visible. The elevated parts 34 may provide better support for the foot and better protection of the 25 shoe against external influences, such as abrasion of the upper.

The manufacturing steps as described above may be performed and finished in a particular manufacturing site independently from other parts of the shoe, for example by a sub-supplier, who will deliver to the shoe manufacturer, for instance, a finished semimanufactured product comprising the upper 12 closed in the region of the upper assembly bottom 30 portion, which may be slipped into a last for injecting moulding.

In the following, a manufacturing process according to an embodiment is described in more detail:

35

a- Cutting:

Each component of the shoe can be cut with all the traditional cutting systems used in the footwear industry, such as: cutting knives, cad cutting machines (water, laser, knife).

b- Stitching and components preparation:

- 5 Each piece of the upper is stitched following any requirements of the final product, e.g. fulfilling any design requirements. Any tread measure can be used. The upper will be laminated with the suitable reinforcements in the toe and heel areas. If required, also the outline of the air permeable portions can be reinforced with a nonwoven or a thermoplastic material. In this regard, the open areas (in net) should be maintained air permeable, particularly free from other material layers and/or adhesive that could compromise the efficiency of the breathability.
- 10

c- Bootie preparation – application of first protective layer, if any:

- After the first and second laminates are connected (i.e. functional layer bootie is formed, e.g. stitched by stitching 9) and the seam is sealed (e.g. by seam tape 29; it is possible to use also other kinds of seam sealing techniques, such as by ultrasound, high frequency, adhesive tapes and/or stripes), the first protective layer 22, if any, is applied. It can be applied during the preparation of the functional layer bootie of the type as described above (so-called "bootie preparation") with the following exemplary steps:
- 15

- 20 – Application of the Atactic Poly-Propylene (APP) hot melt or a thermoplastic resin with sufficient green tack for process. – Sticking the first protective layer over the bootie taking care that the parts concerned are well bonded.
- After glueing, application and pressing of the first protective layer to the bootie by hands and/or with a press machine. A particle barrier layer, as mentioned above, may also be applied.
- 25

d- Upper and bootie assembling

- The bootie, together with the first protective layer, is now ready to be assembled with the upper through a stitch around the top of the collar and the instep.
- 30

e- Preparation of air permeable layer 16 (also called "spacer"):

- An impermeable layer 40 (e.g. a gasket or wedge) is applied on the bottom of the spacer 16. This impermeable layer has a double function: 1- to avoid the penetration of liquid sole material into any mesh of the spacer 16 (protection from spacer contamination); 2- particularly if the sole has a sidewall, the impermeable layer 40 has the functionality to rise up the spacer 16 out of the sole edges guaranteeing the spacer functionality.
- 35

It is possible to apply this material with all kind of adhesive systems: Thermo, PU, Neoprene, hot melt, water and solvent based adhesives, etc.

5 f- Application of air permeable layer 16 (spacer):

On the bottom of the bootie, it is now possible to apply the spacer 16 (together with the impermeable layer 40) using an air permeable adhesive system (such as adhesive 23). There are two potential ways for bonding the spacer to the bootie bottom:

1. Use of a spray machine and applying adhesive drops in the front, middle and back part
10 of the spacer.
2. Use of a hot melt machine to apply a pressure sensitive adhesive based on Atactic Poly-
Propylene (APP) or a thermoplastic resin with sufficient green tack for process.

g- Premolding and strobel stitching:

- 15 The upper is ready to be pre-molded in the heel and in the toe area using common existing premolding machines. The lining is pulled out and the thermoplastic heel counter and the toe cap are activated. The temperature and activation time is dependent on the thermoplastic material and the thickness of the upper material. After these operations, in-
sole 21 is applied by stitching to the lower end area 13 of the upper 12 using a strobel
20 stitch machine.

h- Slip last (injection last):

- The upper is steamed and slipped into the last, and the upper is laced properly (see, e.g., Fig. 8). The lasted upper is then put into a shoe heater. The temperature and drying time
25 are dependent on the upper components (type and thickness of upper material, such as leather).

i- Injection process:

- 1- The lasted upper is inserted into the injection mould. It should be made sure that the
30 setting of the last holder in the shoe fore part is correct (no pressure – just holding in the position).
- 2- Injection of the liquid sole material, such as PU, into the mould.
- 3- De-moulding, i.e. removing the footwear from the mould, for instance after approx. 3.5 min. (depending on the type of PU used).
- 35 4- The process may be completed by any finishing steps, such as removing any edges from the soles, etc.

Preferred specifications of impermeable layer 40 correlated to PU characteristics:

The impermeable layer 40 is non-permeable to the hot and liquid sole material (such as PU) in order to protect the air permeable layer 16 from the contamination of the sole material. Impermeable or non-permeable to the liquid sole material means that the impermeable layer is not penetrated by the sole material from one side of the layer to its other side. It may be or may comprise a film of various materials like one or more of the following: TPU, PU, polypropylene, polyethylene, PA, EVA. It should have enough resistance to the pressure and the temperature of the liquid sole material before the so-called cream time is started (i.e., time period in which the sole material starts the change from liquid state to solid state). Preferably, the minimum thickness of the impermeable layer 40 is at least 0.5 mm in order to maintain the impermeability during the time the sole material is hot and liquid.

The temperature of the liquid sole material (e.g. PU) is preferably between 110° and 200°C depending on the setting of the moulding machine and the quality of the used material compounds. Also the cream time is preferably between 4 to 9 seconds depending on any customer tailoring settings.

In the above described embodiment of Fig. 1 and 2, the upper assembly construction is a stitched construction (Strobel construction) with the upper 12 stitched to an insole 21 (e.g. made of felt). The margin (lower end area 13) of the upper 12 can be varied (longer or shorter) depending on the needs of the particular product.

The upper assembly construction can also be a hybrid construction with an upper 12 stitched to the insole 21, wherein toe and heel area of the upper 12 (i.e. the lower end area 13 thereof) are lasted onto the underside of the insole 21 (such solution helps to hide the strobel stitches in the toe and the heel area in case of a narrow flat sole).

The upper assembly construction can also be a pure lasted technology, see e.g. Fig. 3. In such variant, any type of sole can easily be injected because the lasting margin (lower end area 13) does not have any stitches to be covered.

The air permeable portions, particularly the air passage openings 24, can be created in many different ways. The material of the upper 12 can be perforated or microinjected. Further, as a lasting net or second protective layer 26, a grid or an open compound created and attached with high frequency welding can be used.

In the area where the mould 50 is closing around the upper 12, it is important to provide a lower end area 13 of the upper 12 which is non-permeable to liquid injected sole material. For example, the lower end area 13 of the upper 12 could be made by one or more of the following materials: leather, man made leather, TPU, rubber, EVA. It can be applied by stitching, high frequency, or be microinjected. It is preferable to provide a non permeable lower end area 13 of the upper 12 having a length of 5 mm or longer which is covered on its underside by the sole.

The invention has been described herein above by way of embodiments without limiting the scope of the invention according to the claims. When terms such as top, bottom, above, beneath, vertical, horizontal and so forth are used, this refers to the specific figure and should be understood as related to footwear which is in normal use or placed on the ground.

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Claims

- 5 1. Footwear (10), comprising
- a) an upper assembly (20) and a sole (30), in which:
 - b) the upper assembly (20) comprises
 - b.1) an upper (12) comprising in a lower peripheral area at least one air permeable portion (14),
 - 10 b.2) an air-permeable layer (16) arranged in a lower area of the upper assembly (20) on the sole side above the sole (30), wherein the air-permeable layer (16) has a three-dimensional structure that permits passage of air at least in the horizontal direction and the at least one air permeable portion (14) enables the air-permeable layer (16) to communicate with the outer surroundings such that air (60) is exchanged between the outer surroundings and the air permeable layer (16),
 - 15 b.3) an insole (21) arranged beneath the air-permeable layer (16) and to which a lower end area (13) of the upper (12) is attached, the insole (21) and the lower end area (13) of the upper (12) forming an upper assembly bottom portion (15) to which the sole (30) is attached,
 - 20 c) at least a part of the sole (30) is formed by sole material injected onto at least part of the upper assembly bottom portion (15) such that the at least one air permeable portion (14) is free of injected sole material,
 - d) wherein the upper assembly bottom portion (15) is impermeable for liquid sole material injected onto the upper assembly bottom portion (15).
- 25 2. Footwear according to claim 1, wherein the lower end area (13) of the upper (12) is impermeable for liquid sole material injected onto the upper assembly bottom portion (15).
- 30 3. Footwear according to any one of claims 1 or 2, further comprising an impermeable layer (40) arranged between the insole (21) and the air-permeable layer (16) and which is impermeable for liquid sole material injected onto the upper assembly bottom portion (15).
- 35 4. Footwear according to claim 3, wherein said impermeable layer (40) is arranged such that a perimetric edge (28) of the air-permeable layer (16) through which air is exchanged to the outer surroundings is aligned with the at least one air-permeable portion (14).

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5. Footwear according to any one of claims 1 to 4, wherein the impermeable layer (40) and the insole (21) form a composite layer arrangement.
6. Footwear according to any one of claims 1 to 5, wherein at least parts of the lower end area (13) of the upper (12) and the insole (21) are attached to each other by means of stitching (8), particularly a Strobel stitching.
7. Footwear according to any one of claims 1 to 6, wherein at least parts of the lower end area (13) of the upper (12) are attached by adhesive (25) to an underside of the insole (21).
8. Footwear according to any one of claims 1 to 7, wherein the sole (30) has an upper peripheral edge (33) with a curved form at least in a side part of the sole, and has at least one elevated part (34) which at least partially surrounds the at least one air-permeable portion (14).
9. Footwear according to any one of claims 1 to 8, wherein the sole (30) has an upper peripheral edge (33) with a curved form at least in a side part of the sole, and has at least one elevated part (34) which protrudes between two of the air-permeable portions (14) so as to at least partially surround the at least two of the air-permeable portions (14).
10. Footwear according to any one of claims 1 to 9, further comprising at least one waterproof and water vapor permeable functional layer (18) arranged on an inner side of the upper (12) and above the air-permeable layer (16).
11. Footwear according to claim 10, further comprising a water vapor permeable first protective layer (22) arranged between said at least one air permeable portion (14) and said functional layer (18) in at least an area of the at least one air permeable portion (14) above the air-permeable layer (16), wherein the first protective layer (22) is adapted for protecting the functional layer (18) against particles penetrating through the air permeable portion (14).
12. Footwear according to any one of claims 1 to 11, wherein the at least one air permeable portion (14) comprises at least one air passage opening (24) in the upper (12).
13. Footwear according to claim 12, wherein said air passage opening (24) comprising an air permeable second protective layer (26).

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14. Footwear according to any one of claims 1 to 11, wherein the at least one air permeable portion (14) is formed of at least one air permeable material (12).

15. Footwear according to any one of claims 1 to 11, wherein the at least one air permeable portion (14) comprises a perforated or microinjected material.

16. A method of manufacturing a breathable footwear, comprising the steps of:

a) providing an upper assembly (20) with

- an upper (12) comprising in a lower peripheral area at least one air permeable portion (14),

- an air-permeable layer (16) arranged in a lower area of the upper assembly (20) on the sole side, wherein the air-permeable layer (16) has a three-dimensional structure that permits passage of air at least in the horizontal direction and the at least one air permeable portion (14) enables the air permeable layer (16) to communicate with the outer surroundings such that air (60) is exchanged between the outer surroundings and the air permeable layer (16), and

- an insole (21) arranged beneath the air-permeable layer (16) and to which a lower end area (13) of the upper (12) is attached, the insole (21) and the lower end area (13) of the upper (12) forming an upper assembly bottom portion (15) for attaching the sole (30), wherein the upper assembly bottom portion (15) is impermeable for liquid injected sole material,

b) placing the upper assembly bottom portion (15) in a mould (50), wherein said mould (50) comprises at least one side frame (53, 54) to enclose at least part of a circumference of the upper assembly bottom portion (15), wherein the side frame (53, 54) comprises an upper sealing lip (52),

c) closing the mould (50) such that the upper sealing lip (52) of the at least one side frame (53, 54) contacts the upper (12) at least in a part which is below the at least one air-permeable portion (14), and

d) injection moulding of sole material into the mould (50) so as to form a sole (30) being fixed to the upper assembly (20) and leaving the at least one air-permeable portion (14) free of injected sole material.

17. The method according to claim 16, wherein the lower end area (13) of the upper (12) is impermeable for the injected sole material.

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18. The method according to any one of claims 16 or 17, further arranging an impermeable layer (40), which is impermeable for the injected sole material, between the insole (21) and the air-permeable layer (16).
- 5 19. The method according to claim 18, wherein said impermeable layer (40) is arranged for aligning a perimetric edge (28) of the air-permeable layer (16), through which air is exchanged to the outer surroundings, with the at least one air-permeable portion (14).
20. A sole injection mould for manufacturing a footwear according to any one of claims 1 to 15, comprising:
- 10 - a bottom part (55) for forming a sole pattern at the bottom of the sole,
- at least one side frame (53, 54) configured to enclose at least part of a circumference of the upper assembly bottom portion (15),
- wherein the at least one side frame (53, 54) comprises an upper sealing lip (52) which has
15 a curved form,
- wherein the upper sealing lip (52) is configured to contact the upper (12) at least below the at least one air-permeable portion (14) and, following its curved form, partially surrounds the at least one air-permeable portion (14) of the upper (12).
- 20 21. The sole injection mould according to claim 20, wherein the upper sealing lip (52) has at least one protrusion (56) which is configured to protrude and contact the upper (12) between two of the air-permeable portions (14).

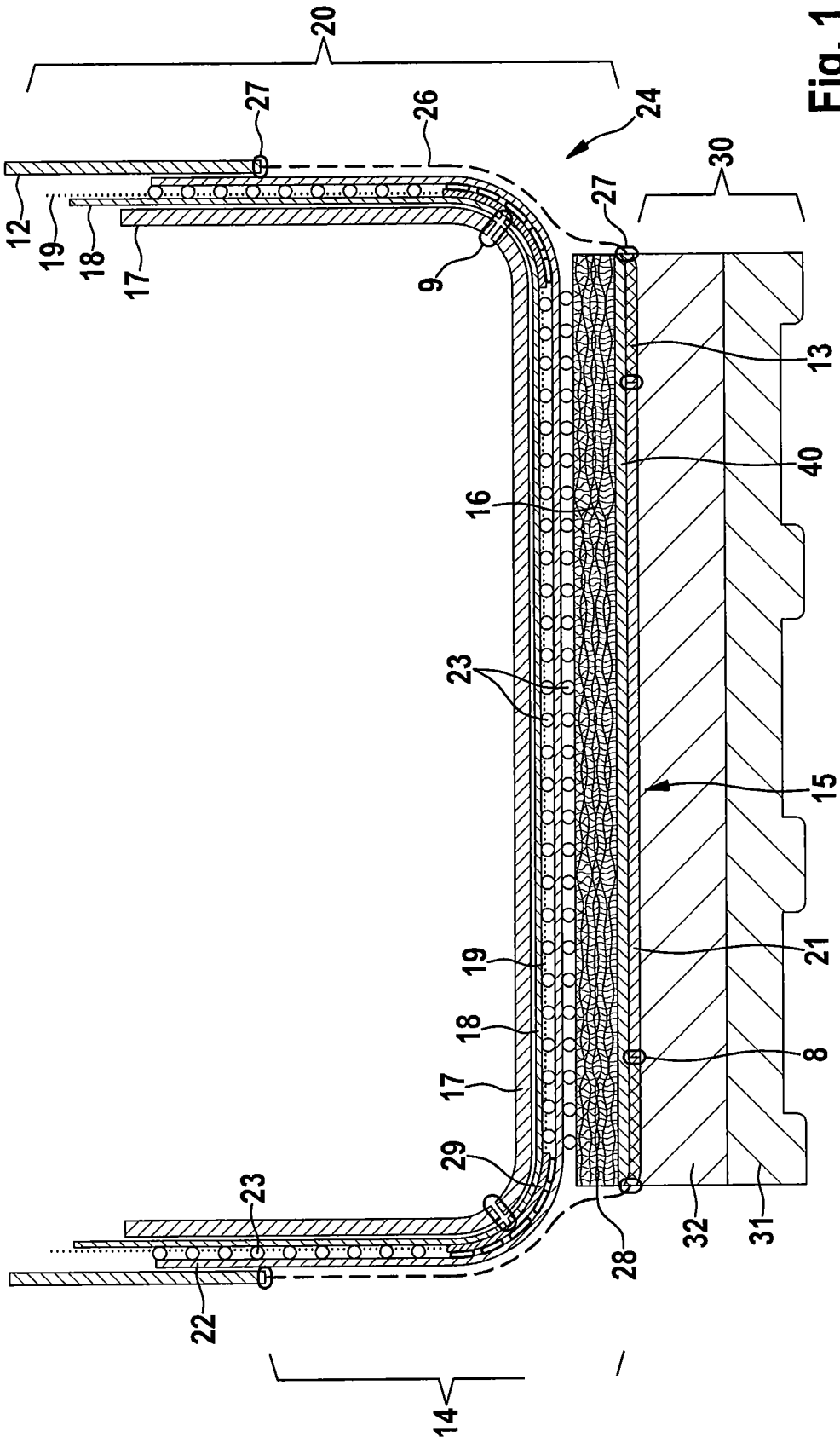


Fig. 1

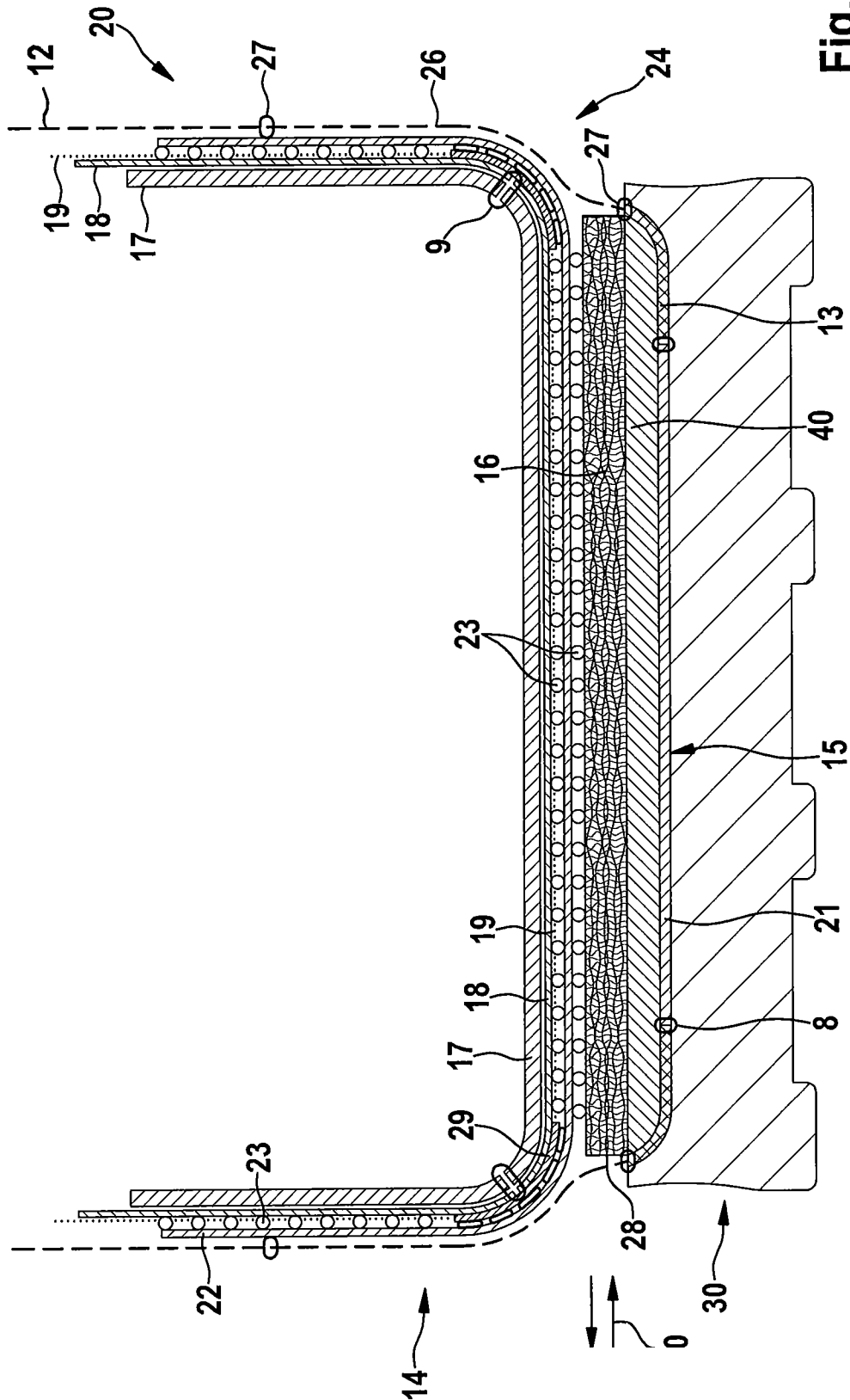


Fig. 2

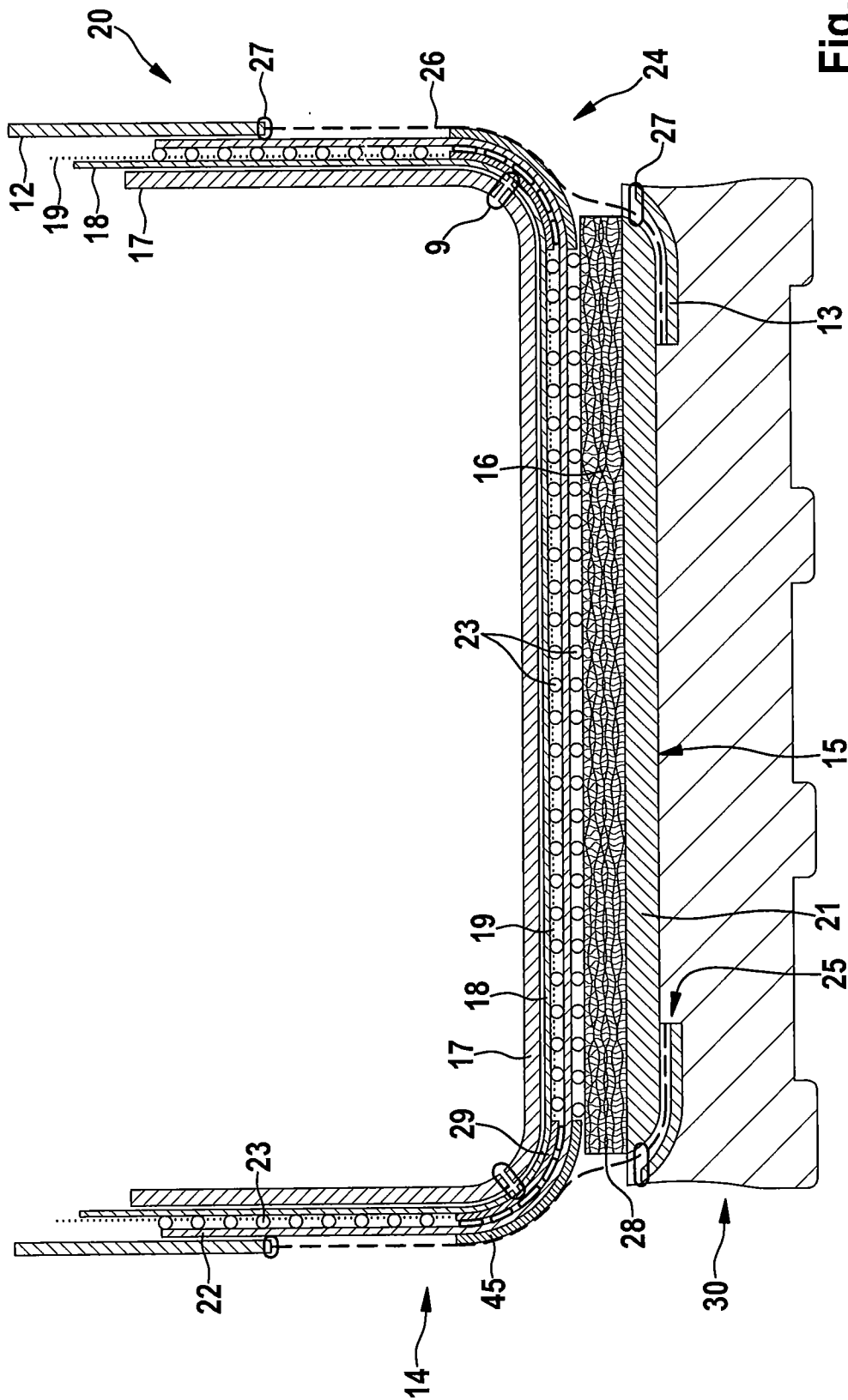


Fig. 3

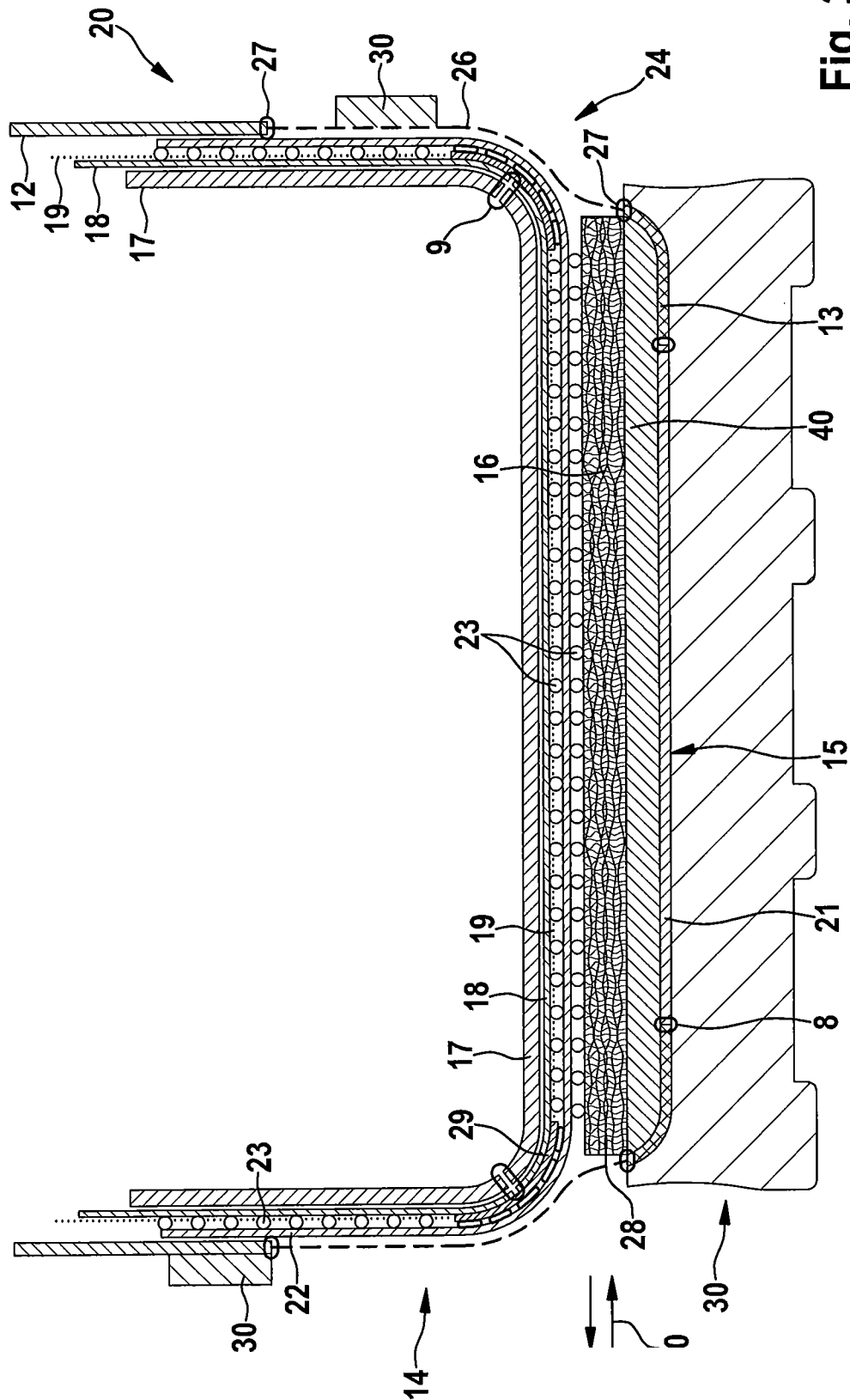
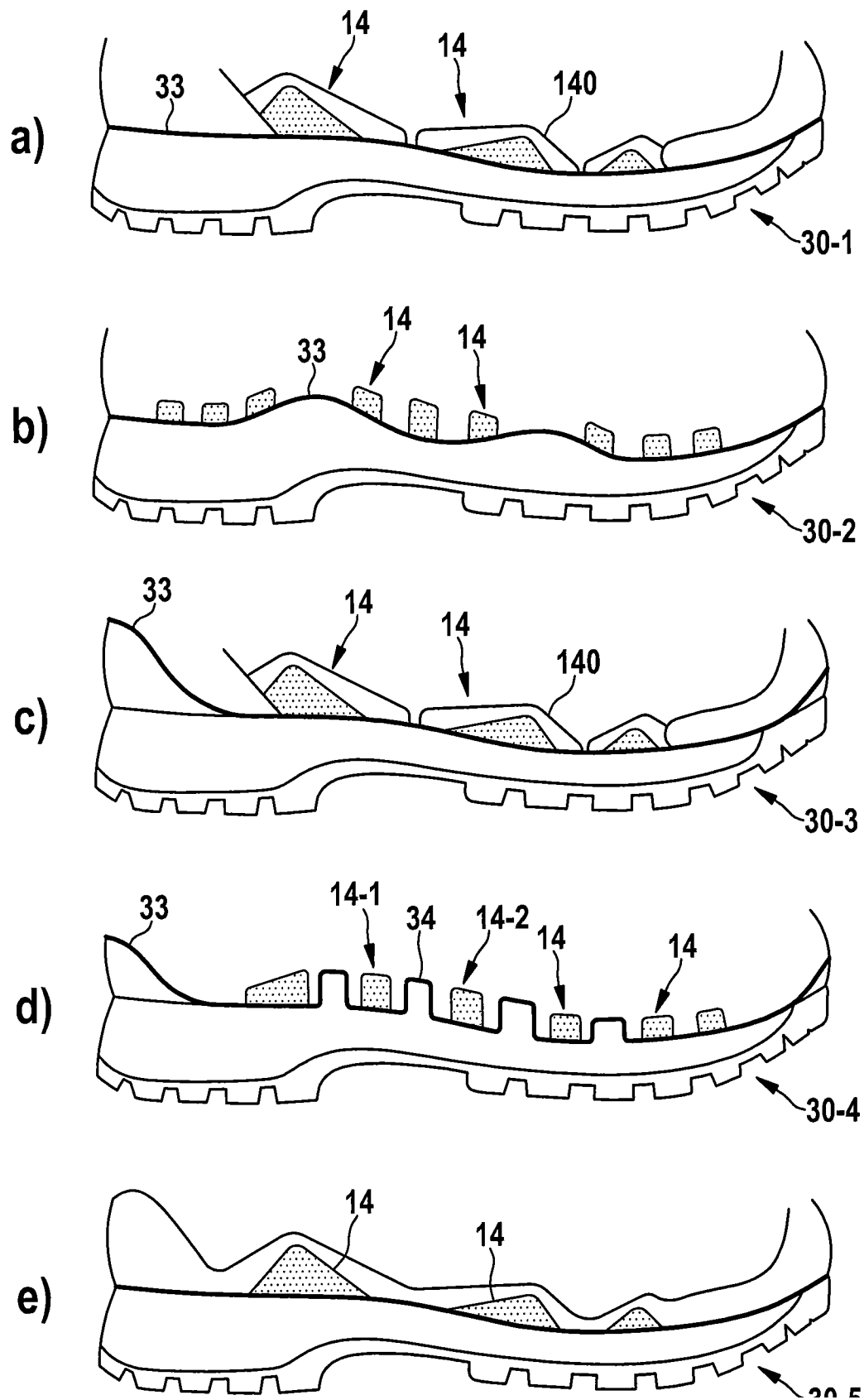


Fig. 3a

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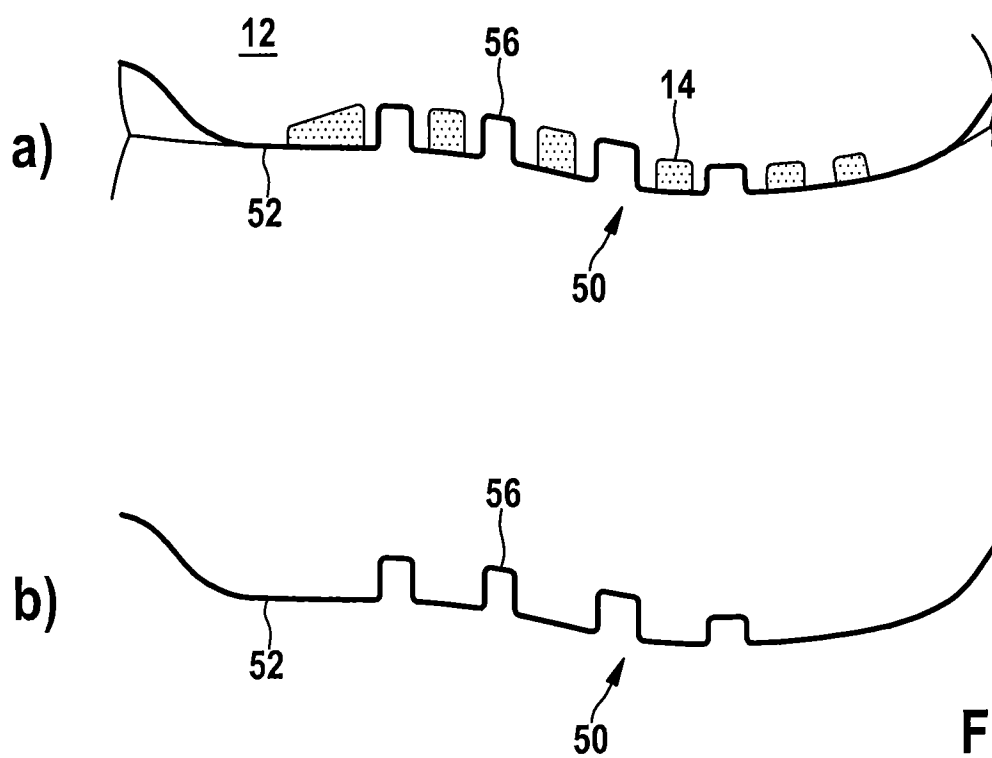


Fig. 5

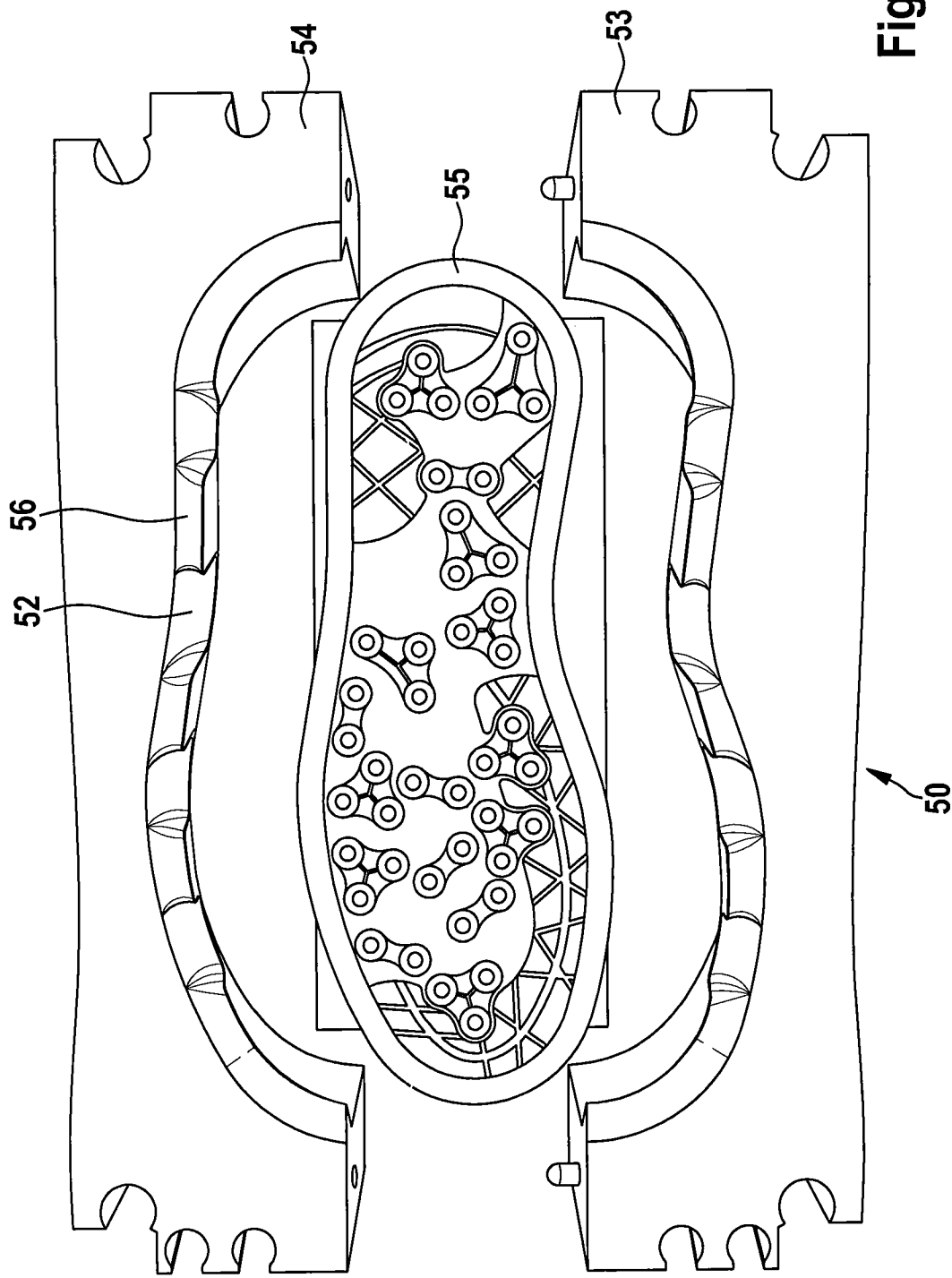
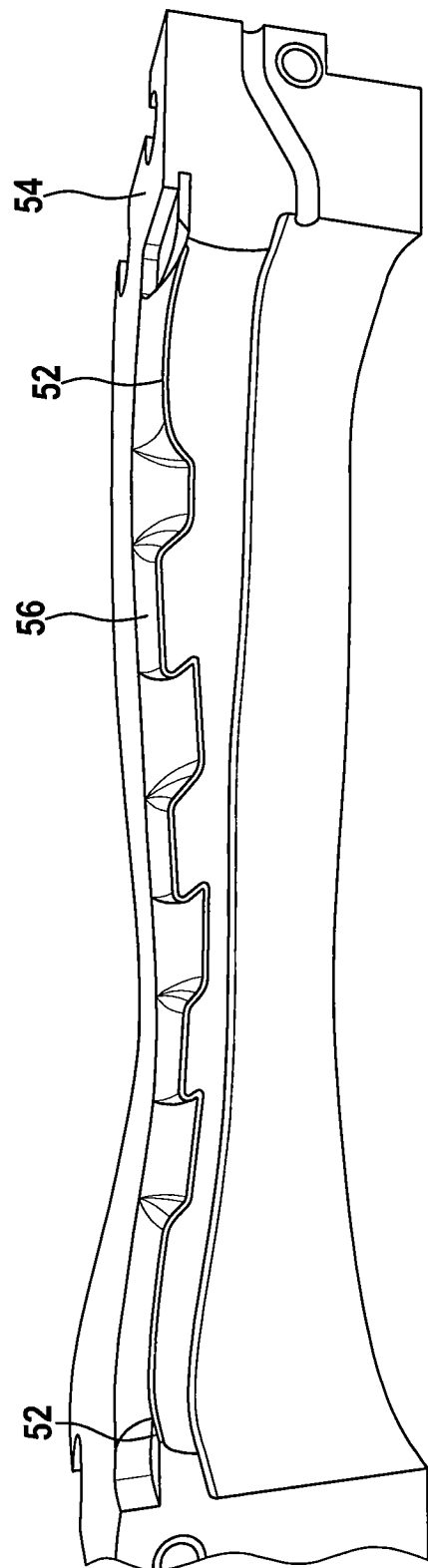


Fig. 6



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Fig. 7A

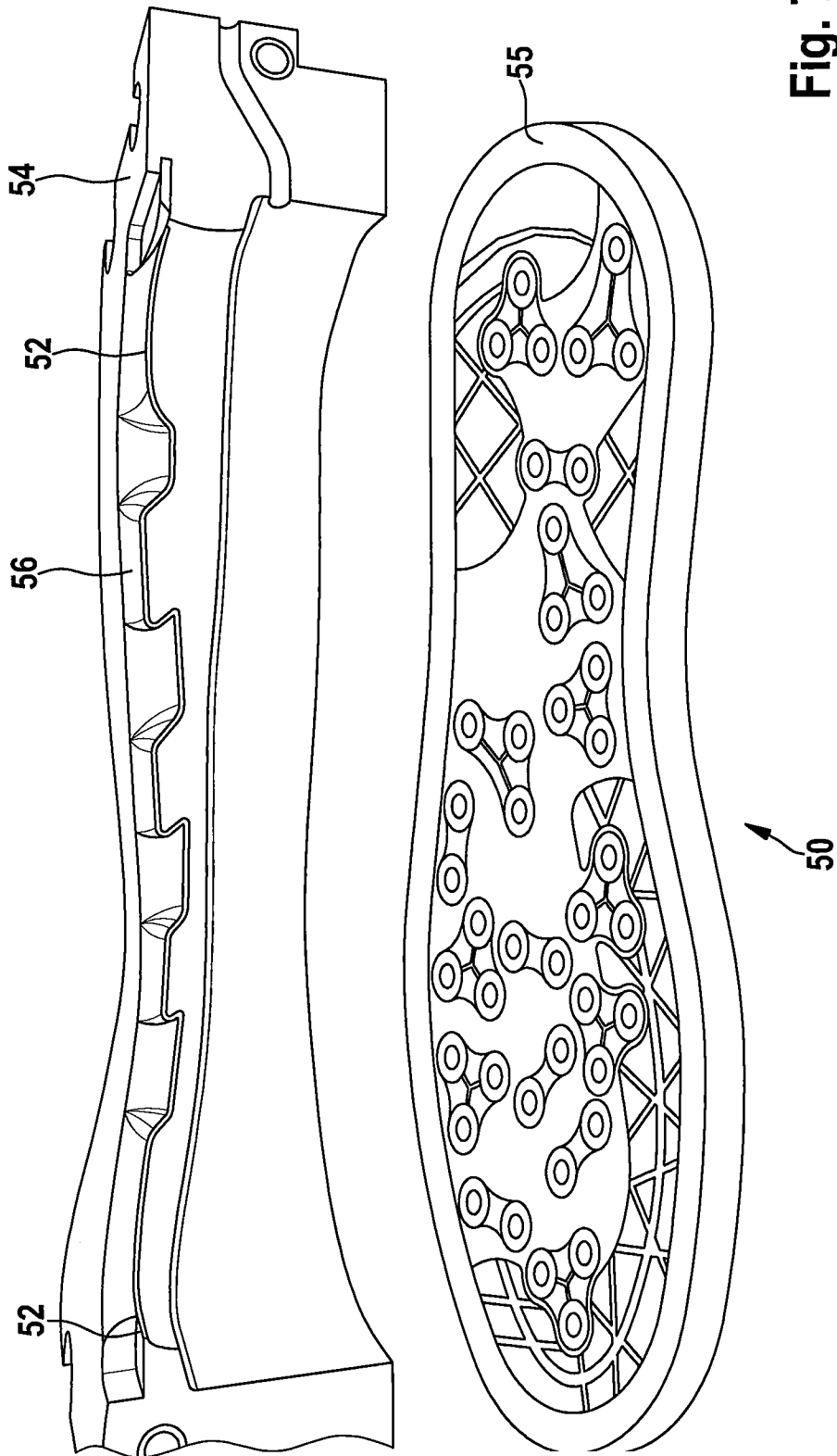


Fig. 7B

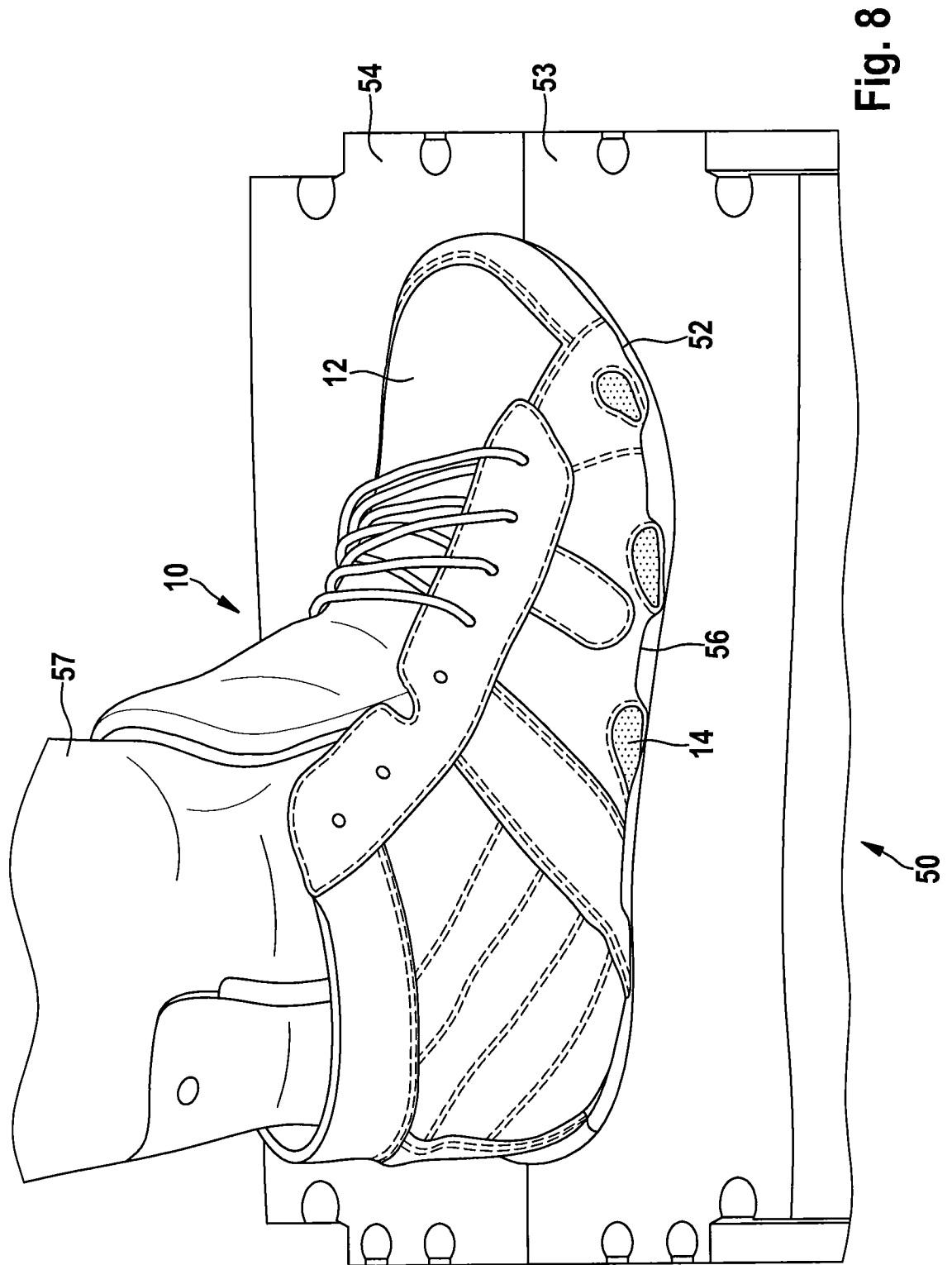


Fig. 8

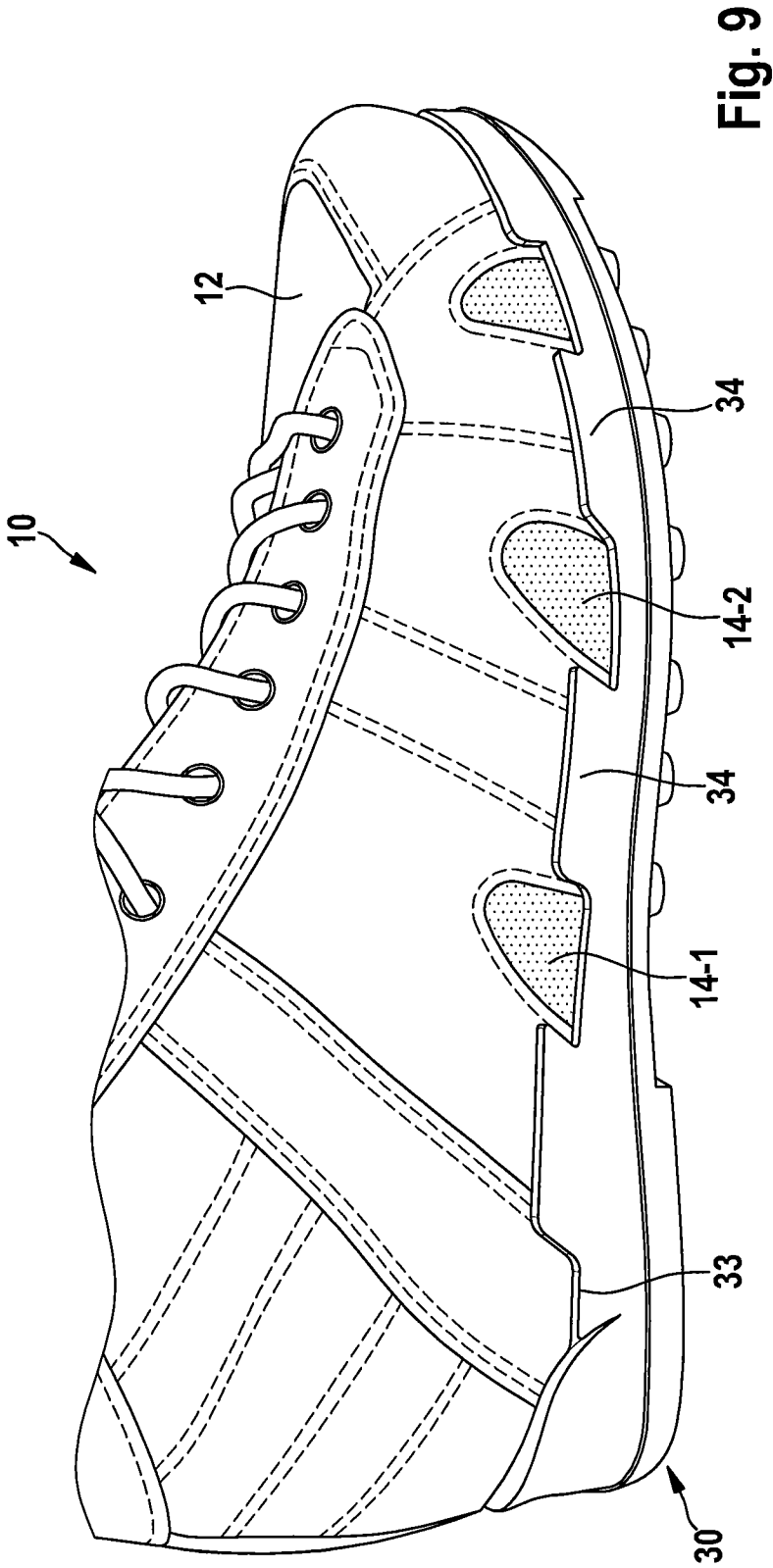


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/067644

A. CLASSIFICATION OF SUBJECT MATTER
INV. A43B7/12 A43B7/08 B29D35/06 B29D35/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A43B B29D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/087324 A1 (GEOX SPA [IT]) 20 June 2013 (2013-06-20) cited in the application	1-7, 10-15
Y	page 7, lines 12-28; figures	16-19
A	page 9, lines 1-4	20
	page 14, lines 19-31	
	page 17, line 28 - page 18, line 4	
	page 19, lines 10-17	

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Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

3 July 2014

Date of mailing of the international search report

10/07/2014

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2013/067644

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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