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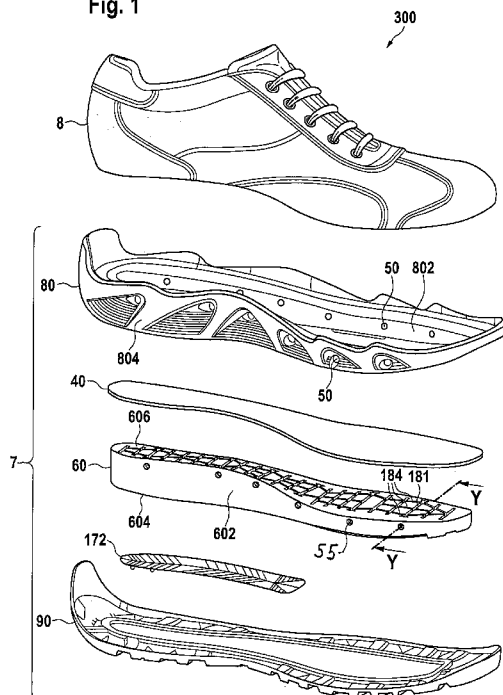
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(54) Title: METHOD FOR MANUFACTURING A SOLE ASSEMBLY AND FOR MANUFACTURING A SHOE

Fig. 1



(57) Abstract: The invention relates to 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; providing a ventilating sole element (161) having a structure or material allowing for air flow through it; placing the ventilating sole element in a mould (220), said mould having pins (221) projecting in a lateral direction; positioning the ventilating sole element and the upper assembly such that an upper part of the ventilating sole element contacts the bottom portion of the upper assembly; closing the mould such that the pins contact a side wall of the ventilating sole element, and injection moulding so as to form a surrounding sole element (195) being fixed to the upper assembly and to the ventilating sole element, said surrounding sole element comprising lateral passages (50) from the outside of the surrounding sole element to the side wall of the ventilating sole element formed by the pins; and after injection moulding, connecting the lateral passages of the surrounding sole element to the structure or material of the ventilating sole element. The invention is also related to a method for manufacturing a corresponding sole assembly.

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Method for manufacturing a sole assembly and for manufacturing a shoe

5 The present invention is related to a method for manufacturing a breathable sole assembly and a method for manufacturing a breathable shoe.

It is known in the art to equip shoes with breathable soles. An example of such a breathable sole is known from EP 1 033 924 B1. Therein, a safety shoe is described, whose outsole comprises horizontal air vents at the sides of the sole for ventilation. The shoe is also provided with a honeycomb structure lying within the outsole and a perforated insole, such that water vapour is discharged from the inside of the shoe through these vapour permeable layers and the horizontal air vents to the outside atmosphere. The honeycomb may be made of an air-permeable material such as a fibre structure. Alternatively, the honeycomb may be made of a mouldable material such as polyurethane (PU) into which a set of canals has been formed. If the shoe is not worn in totally dry conditions, such as a paper mill, then a waterproof breathable membrane may be provided below the insole.

EP 1 033 924 B1 also discloses a method for manufacturing a sole assembly and a shoe. To manufacture the shoe the honeycomb is attached to the insole of the upper structure or assembly which is lasted. An injection mould is provided with pins on both sides extending parallel to the plane of the sole member. The last closes the mould from above. Then sole material is injected into the mould forming a sole with horizontal air vents and at the same time attaching it to the upper structure or assembly. In case the honeycomb has a duct structure and is surrounded by an intact edge, the pins penetrate through the edge of the honeycomb forming canals or openings between the air vents and the duct structure. If no intact edge exists then the pins extend into close contact with the sides of the honeycomb to form air vents between the honeycomb and the outside atmosphere.

30 Alternatively, a sole structure or assembly is manufactured separately by inserting a body the size of the honeycomb into the mould to form a cavity for the honeycomb and injecting the sole material. The honeycomb is then fitted into the cavity and the sole structure or assembly together with the honeycomb is attached to the insole of the upper structure or assembly preferably by gluing.

35 Particularly with a honeycomb which has a duct or channel structure, the pins of the mould need to be aligned and correspond very precisely with this duct or channel structure to en-

sure that the canals or openings are in the right place and to achieve a smooth transition from the ducts or channels to the air vents. In case of the use of a membrane in the shoe the pins must furthermore be placed such that they will not damage the delicate membrane, which makes alignment even more difficult.

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It is an object of the invention to provide a method for manufacturing a sole assembly and a method for manufacturing a shoe which are suitable for manufacturing the sole assembly and shoe, respectively, for a wide variety of usage scenarios overcoming the disadvantages of the prior art solution.

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According to an aspect of the invention, there is provided a method for manufacturing a sole assembly according to the features of claim 1 and a method for manufacturing a shoe according to the features of claim 2.

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In particular, in an aspect of the invention there is provided a method for manufacturing a sole assembly, comprising the steps of providing a ventilating sole element having a structure or material allowing for air flow through it, placing the ventilating sole element in a mould, said mould having pins projecting in a lateral direction, closing the mould such that the pins contact a side wall of the ventilating sole element, and injection moulding so as to form a surrounding sole element being fixed 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, and after injection moulding, connecting the lateral passages of the surrounding sole element to the structure or material allowing for air flow through it of the ventilating sole element.

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In another aspect of the invention there is provided 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 water vapour permeable bottom portion, providing a ventilating sole element having a structure or material allowing for air flow through it, placing the ventilating sole element in a mould, said mould having pins projecting in a lateral direction, positioning the ventilating sole element and the upper assembly such that an upper part of the ventilating sole element contacts the bottom portion of the upper assembly, closing the mould such that the pins contact a side wall of the ventilating sole element, and 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, and after injection moulding, connecting the lateral

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passages of the surrounding sole element to the structure or material allowing for air flow through it of the ventilating sole element.

5 According to the invention, a method for manufacturing a sole assembly and a method for manufacturing a shoe are provided which are suitable for manufacturing the sole assembly and shoe, respectively, for a wide variety of usage scenarios. The different components such as upper assembly, ventilating sole element, surrounding sole element, outsole, etc., may be manufactured for a wide variety of usage scenarios in a way that they fulfil the particular demands. The interconnection between the structure or material allowing for air
10 flow through it of the ventilating sole element and the lateral passages in the surrounding sole element is made in a manufacturing step in which openings or apertures are made in side wall of the ventilating sole element through the lateral passages to interconnect the structure or material of the ventilating sole element with the lateral passages. In other words the lateral passages in the surrounding sole element are formed at the time of forming the surrounding sole element. The openings or apertures are made in later step, at a
15 time in which the passages already exist. In this way, air and water vapour may effectively be transferred out of the shoe via the ventilating sole element and the lateral passages. The open parts of the structure or material of the ventilating sole element and the lateral passages in the surrounding sole element formed by the pins are interconnected by making
20 apertures or openings in the ventilating sole element through the lateral passages, which have already been formed previously. In that way there is a reliable path for air to communicate between the structure or material and an outside of the surrounding sole element regardless of the exact position of the moulding pins.

25 The method is beneficial since it is not necessary that the pins of the mould are exactly aligned with any channels or open parts in the structure or material of the ventilating sole element prior to injection moulding. Further, no injected material can enter into the channels or open part of the structure or material of the ventilating sole element. According to the invention, the pins for forming the lateral passages can have any geometric shape. They
30 do not need to correspond exactly to the position or shape or size of the channels or open parts of the ventilating sole element .

According to an embodiment of the invention, the lateral passages of the surrounding sole element are connected to the structure or material of the ventilating sole element by drill-
35 ing, puncturing or lasering into a portion of the side wall of the ventilating sole element or otherwise removing some of the material of the side wall, through the lateral passages of the surrounding sole element.

According to an embodiment of the invention, the upper assembly comprises a breathable outer material and a waterproof, breathable functional layer arrangement extending over said upper portion and said bottom portion. For example, according to a further embodiment, a side end area of a bottom functional layer of said functional layer arrangement and a lower end area of an upper functional layer of said functional layer arrangement are connected to one another with a waterproof seal being provided at the connection. In this way, a shoe may be provided which allows for an excellent protection against water entering the inner part of the shoe containing the foot, while ensuring high breathability through the upper as well as the sole of the shoe. The waterproof upper assembly, comprising the functional layer arrangement, e.g. in the form of a bootie or a three dimensional sock or in the form of the upper functional layer and the bottom functional layer, whose connection is sealed in a waterproof manner, ensures that no water enters the shoe from the outside, such that the wearer will not get wet feet in any wet conditions, e.g. rainy, muddy or snowy environments. The functional layer arrangement extends over substantial parts of the upper portion and the bottom portion of the upper assembly, particularly it extends over substantially the entire inner extension of the upper assembly. In this way, the upper assembly forms a waterproof bag around the wearer's foot, which allows for a 360° water protection for the wearer's foot, i.e. it completely surrounds the wearer's foot (with the exception of the shoe opening for receiving the wearer's foot, of course). The functional layer arrangement may be arranged towards the inner space of the upper assembly, in particular it may form at least substantial parts of the inner surface of the upper assembly. For example, the functional layer arrangement may be comprised of one or more functional layer pieces or of one or more functional layer laminate pieces. These pieces may be sealed with respect to each other in any suitable way, e.g. via the application of sealing tapes, via injection-moulding of sealing material, via welding them together, via heating the pieces in an overlap region and pressing them with sufficient force against each other that a waterproof seal is formed, etc..

The functional layer arrangement, particularly, the waterproof, breathable upper functional layer laminate ensures that no water enters the shoe from the outside through the outer material. At the same time, it is ensured that the upper portion is breathable and therefore helps in transporting water vapour from the inside of the shoe to the outside. Water vapour can be effectively transferred out of the shoe both via the upper portion of the upper assembly as well as the bottom portion of the upper assembly, the structure or material of the ventilating sole element and the lateral passage. Accordingly, a high level of water vapour discharge is achieved, particularly because air flow can take place in the lateral passage

and the ventilating sole element in a static environment, e.g. when sitting or standing. This flow may be enhanced by the movement of the shoe when the wearer is walking or running. Two favourable effects take place during a walking or running motion, each of which is predominantly associated with one of the two phases of the gait cycle, namely the actual stance phase and the shoe swinging phase in between the actual steps. During the shoe swinging phase, an air flow in and out of the ventilating sole element through the at least one lateral passage is generated, with the lateral passages being very suitable to develop such air flow therein. This is particularly the case, because the outside end of the lateral passage is in air connection with the environment during all phases of the walking motion, allowing for water vapour discharge along with the air discharge at all times. The bending of the shoe sole during the walking or running motion and additionally the application of the wearer's weight on the ventilating sole element during the stance phase also forces air flow within the ventilating sole element and the at least one lateral passage. The air pushed out of the ventilating sole element takes water vapour from the inside of the shoe with it. The ambient air coming back into the ventilating sole element can then be recharged with water vapour.

Any water, dirt, soil etc., that may enter through the passages will be discharged through those passages over time by gravity and movement of the shoe. Therefore, there will be no build-up of these undesirable materials over time. The functional layer lying above the ventilating sole element will therefore also not be affected e.g. by such dirt particles.

The term breathable material refers to materials that are water vapour permeable. They may also be air permeable. In a particular embodiment, the functional layer arrangement, in particular the upper functional layer laminate and the bottom functional layer laminate are waterproof and breathable, but not air permeable. The term breathable shoe refers to a shoe through which water vapour in the form of sweat may pass from the inside of the shoe to the outside.

The term ventilating sole element is not intended to imply that the ventilating sole element comprises an active, self-propelled mechanism for ventilating the sole. Instead, the structure of the ventilating sole element allows for an airing or ventilating of the ventilating sole element in a static environment and also particularly due to the wearer's motion during use of the shoe. Accordingly, the ventilating sole element may also be referred to as ventilated sole element or ventilation sole element. It is explicitly pointed out, however, that the invention does not rule out that an active mechanism, such as a self-propelled pump or the like, is present in addition to the particular inventive structure.

A shoe according to the invention always features a sole or sole assembly which comprises at least the ventilating sole element and a surrounding sole element, but may also comprise further elements such as a separate outsole. The bottom or lower surface of the sole or sole assembly may contain a tread, i.e. a profile or contour or pattern in a vertical and/or horizontal direction but does not have to. The sole or sole assembly may be attached to the upper assembly of the shoe in a number of ways, including but not limited to moulding or injection moulding the sole or parts of the sole assembly on to the upper assembly and gluing parts or all of the sole on to the upper assembly.

According to a further embodiment, the ventilating sole element comprises a plurality of openings.

According to a further embodiment, at least one opening connected to at least one lateral passage extends from the structure or material of the ventilating sole element, allowing for air flow through it, through a side wall of the ventilating sole element. The at least one lateral passage extends from the opening through said surrounding sole element, said opening and lateral passage allowing for communication of air between said structure or material of said ventilating sole element and an outside of said surrounding sole element. Describing the path the other way around, the passage passes from the outer lateral surface of the surrounding sole element through the surrounding sole element and the opening passes through the side wall of the ventilating sole element to the structure or material of the ventilating sole element allowing for air flow through it. The passage in the surrounding sole element forms the last piece in the water vapour discharge chain. The water vapour, generated by the wearer's foot perspiration, reaches the lateral outside of the sole of the shoe, that is the ambient air, via the bottom functional layer laminate, the ventilating sole element and the at least one opening and lateral passage. A path for water vapour to be discharged effectively via airflow and gradient driven diffusive forces is established.

The lateral passages may be placed anywhere in the surrounding sole element. Particularly, they may be situated in the back (heel region) of the surrounding sole element and/or in the front (toe area). This allows the air with the water vapour to be more easily pushed through the ventilating sole element and out of the lateral passages due to the rolling motion of the sole assembly during walking.

According to a further embodiment, the surrounding sole element and ventilating sole element may comprise at least one lateral passage and opening connected thereto extending straight through the surrounding sole element and the ventilating sole element from the outside on one side to the outside of the other side. Such opening(s) may e.g. be created by using a laser or a drill to pass right through the ventilating sole element.

According to a further embodiment, the ventilating sole element does not comprise vertical passages extending through the ventilating sole element from the bottom side thereof to an upper side thereof. Not having vertical passages allows for a high flexibility of the sole design, particularly for the provision of stable, waterproof and non water vapour permeable sole layers across the complete extension of the underside of the foot. This may provide high comfort to the wearer, because the load bearing of the sole may be distributed over the whole area of the sole, such that less stiff materials may be used. The sole may feel more uniform and therefore more comfortable for the user than soles with vertical holes. An additional advantage is that a dirt/soil/mud/sand build-up on the underside of the sole does not compromise the water vapour discharge capability of the shoe. The lateral openings and passages ensure breathability of the shoe in a wide variety of usage scenarios, in particular also in highly adverse usage environments.

In a further embodiment however, the ventilating sole element comprises at least one vertical passage in addition to the at least one opening allowing for additional air flow. This also allows for additional drainage of liquids and/or dirt from the ventilating sole element.

According to a further embodiment, said ventilating sole element has a channel structure. This channel structure forms said structure allowing for air flow through it, which is provided in the ventilating sole element. Such a ventilating sole element comprising a channel structure provides for an effective collection and transport of air and moisture resulting from the water vapour being discharged via diffusion through the breathable bottom portion of the upper assembly which is positioned above the ventilating sole element, when the completed shoe comprising the ventilation sole element is worn.

According to a further embodiment, said ventilating sole element comprises a side wall, a channel structure is formed in the ventilating sole element, and said channel structure comprises a plurality of channels. These channels may be either transverse or longitudinal channels. At least some of the channels comprise air and moisture discharging ports. At least one of the channels is a peripheral channel, i.e. a channel that lies on the periphery or circumference of the ventilating sole element, but inside the side wall. This peripheral

channel intersects with a plurality of the other channels. The channels and the side wall form functional pillars. The ratio of the top surface area of the functional pillars (A_p) to the top surface area of the channels (A_c) of the channel structure is between 0.5 and 5.0.

5 The peripheral channel does not have to be closed or run along the entire circumference of the ventilating sole element. The first kind of functional pillars is surrounded completely by channels, e.g. by two transverse channels and the left and right portions of a peripheral channel or by two transverse channels, one longitudinal channel and one peripheral channel or by two transverse channels and two longitudinal channels. The second kind of functional pillars is formed by respective upper portions of the ventilating sole element surrounded by the inner end of the side wall and by the channel portions that are located closest to said inner end of the side wall. Such second kind of functional pillars can for example extend in longitudinal direction of the shoe between two adjacent transverse channels and in a transverse direction between the inner end of the side wall and the adjacent portion of the peripheral channel. The side wall extends between the outer surface of the side wall and an imaginary line drawn between those channel walls or channel ends or channel ports which are located closest to the outer surface of the side wall. The side wall does not have to be thick or load-bearing. It provides a boundary of the ventilating sole element to the outside of the sole.

20 The channel structure may be formed in the top or upper part of the ventilating sole element, i.e. starting at the upper surface facing towards the upper assembly and extending some way down into the ventilating sole element. The channel structure may also be formed throughout the ventilating sole element or in any other part thereof.

25 All or a subset of the air and moisture discharging ports are connected to the outside of the ventilating sole element by openings and lateral passages passing through the side wall of the ventilating sole element and through the surrounding sole element, such that air can pass from the channel structure of the ventilating sole element to the outside of the shoe and vice versa.

35 The functional pillars that are formed by the channel structure and the side wall of the ventilating sole element serve the first purpose of a good distribution of the pressure as imposed on the ventilating sole element structure by the underside of the foot, and the second purpose of providing an efficient air and moisture collecting and transferring channel structure formed around the functional pillars to allow for good ventilation.

Moreover, the ventilating sole element having a channel structure, as described above, has good flexing properties and is wear resistant. It can easily be manufactured, particularly in one moulding step, wherein the outer shape of the ventilating sole element including the channel structure in the ventilating sole element is formed by the moulds. The ventilating sole element can be cast, injected or vulcanized.

By the relationship of the top surface area of the pillars to the top surface area of the channels being between 0.8 and 5.0 a good compromise between comfort, durability, supporting and pressure distribution properties on the one hand and the ventilation effect on the other is attained.

The inventors have discovered that a particularly good compromise between supporting and pressure distribution properties, leading to a high degree of comfort for a wearer, and ventilation is attained when the top surface area formed by the pillars is equal to or greater than the top surface area defined by the channels. A particularly good compromise is attained when this ratio is between 1.0 and 3.0 and more particularly between 1.4 and 2.2.

This relationship can better be understood by having a look at the extremes: From a comfort point of view no channels in the ventilating sole element at all are desired. From a ventilation point of view the open space in the ventilating sole element that is created by the channel structure, should be as large as possible.

On the other hand the width of the channels is not arbitrary. Channels which are too narrow are not suitable, since they do not allow for enough collection and transport of air and moisture. Channels that are too wide do not feel comfortable because the wearer will feel the edges of the pillars. The wider the channels are, the more their edges will imprint on the above layers, in particular the functional layer at the bottom.

Taking all these points into account, the inventors of the present application have discovered that the relationship as described above is particularly advantageous.

According to a further embodiment of the invention, the functional pillars have a minimum upper edge length of 4 millimetres. All edges should be at least 4mm long, both in the longitudinal and in the transverse direction.

According to a further embodiment of the invention, at least some of the lateral ends of said channels are formed as air and moisture discharging ports.

The channels may follow the shape of the ventilating sole element. At least the bottom surface of the transverse channels may be substantially horizontal, when seen in the main direction of the transverse channels. In this case the channel depth varies throughout the ventilating sole element. In another embodiment the bottom surface of the transverse channels is inclined downwards towards the centre of the ventilating sole element. The channels may also be inclined downwards towards the outside of the ventilating sole element.

According to a further embodiment of the invention, the width of the channels at the upper side of the ventilating sole element lies between 2 and 5 millimetres, particularly between 2 and 3.5 millimetres.

According to a further embodiment of the invention, the channel structure has a first portion with a first channel width, and a second portion with a second channel width. By providing such portions with different channel widths different flexing and bending conditions occurring in such portions can be matched.

In a further embodiment of the invention such portions having a different channel width can be positioned under a heel portion of the foot and/or a forefoot portion of the foot, particularly a ball portion of the forefoot.

According to an embodiment of the invention, the channel width in such special portions can be smaller than the channel width in the other portions of the channel structure.

According to a further embodiment of the invention, the distances between adjacent transverse channels in the forefoot portion can be smaller than in the heel portion, in order to increase the effect of actively moving air and moisture to the outside. In the forefoot portion of the ventilating sole element the flexing that occurs is greater than in the heel portion. Furthermore, the foot produces more sweat in this region than e.g. in the heel region. By such flexing the cross section of the channel is reduced and widened again which forces the air out of such channels. By providing a higher transverse channel density in the forefoot portion, such active effects can be increased which leads to a further improved ventilation effect.

The shape of the channels can be of different kinds. According to a further embodiment of the invention, the channels comprise channel walls and a channel bottom, wherein the dis-

tance between the walls of a channel, when seen in the sectional view, increases in an upwards direction. Such channel form provides for a good air and moisture collecting and transport function.

5 According to a further embodiment of the invention the channel bottom is formed as a substantially horizontal plane. By the provision of this feature, the channels, when seen in a sectional view, have an essentially isosceles trapezoid shape and, more particularly the form of an isosceles trapezoid.

10 According to a further embodiment of the invention, oblique bottom transition faces are provided between the substantially horizontal channel bottom and the channel walls.

In an alternative embodiment of the present invention, the channel bottom has a rounded, concave form, giving the channels a U-like shape, when seen in a sectional view.

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The channels may be formed in a way that they do not have sharp corners and/or edges, such as corners or edges having acute angles. Due to the lack of 90° angles in the embodiments of the channel bottom, air and moisture cannot be trapped in any corners where no air/moisture movement can take place, as may be the case in rectangular shaped channels.

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None of the above described channel forms are prone to mechanical failure, e.g. in the form of breakage as is the case for example with a plane V-shaped channel. Furthermore, due to the width of the channel bottoms in comparison to a simple V-shape the channels can take up far more air and moisture.

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Any sharp edges reduce airflow due to friction and turbulence created and induce cracks and failure of the sole. This is particularly the case at the intersections of the channels. In a preferred embodiment at least the vertical edges of the channels are rounded, preferably having a radius of between 0.25 and 5mm.

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The horizontal edges of the channel/pillar tops may be rounded in a further embodiment, preferably having a radius between 0.5 and 5mm. This leads to less imprinting on the layers in the shoe above the ventilating sole element and a more comfortable feeling for the wearer.

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According to a further embodiment of the invention, one continuous peripheral channel is provided extending from a front portion to a rear portion of the ventilating sole element.

By such single continuous peripheral channel, a good collection and transport of air and moisture can be attained.

5 According to an alternative embodiment, at least two peripheral channels are provided extending over different portions of the ventilating sole element. Such peripheral channels can intersect with each other or they can be formed separately from each other. By the provision of at least two peripheral channels, a good air and moisture collecting and transporting function can be attained as well.

10 According to a further embodiment of the invention, the peripheral channel runs in a zigzag line, seen from a front section to a rear section of the ventilating sole element. By using such a zigzag shaped peripheral channel, a particularly efficient transport of air and moisture to the air and moisture discharging ports can be achieved.

15 The zigzag form of the peripheral channel can be such that the outer points of such zigzag peripheral channel intersect with those transverse channels the ends of which are formed as air and moisture discharging ports, at a position just inside of those air and moisture discharging ports.

20 The channel structure as a whole, that is the arrangement of the various channels to each other is such that in a preferred embodiment, the maximum length that a water molecule has to travel from the inside of the ventilating sole element to the nearest air and moisture discharging port is 60mm.

25 According to a further embodiment of the invention, the air and moisture discharging ports have a greater depth, and in addition or instead they can be broadened as compared to the other channel portions. Thus, enough air and moisture can be received and transported further outwards by the air and moisture discharging ports.

30 As described above, the openings of the ventilating sole element may be connected to the air and moisture discharging ports of the ventilating sole element. Such openings can be drilled or lasered or punctured and/or melted, e.g. with a hot needle into the ventilating sole element in a subsequent manufacturing step. During this step an increased depth or broadness of the ports allows for a much more reliable, safer and easier connection process
35 of the passages to the channel system of the ventilating sole element.

According to a further embodiment of the invention the upper surface of the ventilating sole element has a curved form with a lower front region and a higher rear portion, so as to accommodate the underside of the foot to be supported. The shape of the ventilating sole element follows the shape of the anatomical last, which is ergonomically customized to the feet to be supported by the ventilating sole element.

In order to make the sole assembly light weight it is preferred to use low density polyurethane (PU) e.g. having a density of 0.35 g/cm³ for the ventilating sole element.

Such a polyurethane ventilating sole element has high stability to support/transfer at least a portion of the weight of the user during use, such as during walking, while having some flexibility in order to enhance the wearer's comfort during walking. Depending on the preferred use of the shoe, a suitable material can be chosen. Examples of such material are Elastollan from the company Elastogran GmbH, Germany. This material is preferred due to its low density. Alternatively for injection moulding the ventilating sole element, TPU (Thermoplastic Polyurethane), EVA (Ethylene Vinyl Acetate), PVC (Polyvinyl Chloride) or TR (Thermoplastic Rubber), etc. may be used.

It is further preferred to use PU on a polyethylene (PE) basis for the ventilating sole element.

It is further preferred to use a material that is not too hard for the ventilating sole element for shock absorption reasons. Thus, a polyurethane material with a shore A hardness between 38 and 45 is preferred for the ventilating sole element. Shore hardness is measured by the durometer test. A force is applied onto a spot of the polyurethane, whereby the force creates an indentation. The time taken for the indentation to disappear is then measured.

According to another embodiment of the invention the material of the ventilating sole element is porous, such that it has a high rate of water vapour diffusion through it. This enhances the ventilating effect of the ventilating sole element.

In a further embodiment of the invention the depth of the channels is less than 20mm, preferably between 2 and 10 mm. This avoids the wearer of the shoe experiencing a rolling movement when walking which would badly influence the comfort sensed by the wearer and which would effect a tilting torque on the functional pillars which over time may cause breakage of the functional pillars.

The functional pillars formed by the channel structure can have different sizes, especially length, depth and surface area, that can vary across the surface of the ventilating sole element.

- 5 The functional pillars can also have different shapes, when seen in a plan view, for example a rectangular shape, a triangular shape or a rounded shape.

10 The inventors have found out that there is a relationship between the depth of the channels and the surface area of the functional pillars facing the upper assembly above. The less deep the channels are the smaller the surface area can be. A typical value of a functional pillar surface is 0.6 to 1 cm².

15 According to a further embodiment, said ventilating sole element comprises a container element having a bottom part and a side wall so as to form an inner space of said container element, wherein said inner space is filled with a filler material allowing for air flow through it. Instead of a filler material allowing for air flow through it, there may also be provided a filler structure allowing for air flow through it, such as a channel structure. The container element forms a tub for receiving the filler material or filler structure allowing for air flow through it.

20 According to a further embodiment, the filler structure or material is a three-dimensional spacer. The three-dimensional spacer may be configured so that the structure or material maintains a spacing between layers situated beneath it and above it, in particular between the lower portion of the upper assembly and the bottom part of the container element. In this way, the air flow through the structure or material is retained. Particularly, such a spacer structure or material may allow for a very low air flow resistance, while ensuring high stability of the combination of the container element and the spacer structure or material. In another embodiment, the spacer structure or material is made to be at least partially elastic. Because of this, the walking comfort of the shoe is increased, as the spacer structure or material allows for cushioning and an easier rolling process during the stance phase of the gait cycle. In another embodiment, the spacer structure or material is designed so that during maximal stress with the maximum weight of the shoe user to be expected corresponding to the shoe size in the corresponding shoe, it yields elastically at most to the extent that, even during such maximum stress, a significant part of the air flow of the spacer structure or material is still retained. The spacer may be made of materials such as e.g. polyester, polyolefins or polyamides.

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In another embodiment, the air permeable spacer has a flat structure forming a first support surface and a number of spacer elements extending away from the flat structure at right angles and/or at an angle between 0 and 90°. The ends of the spacer elements lying away from the flat structure then together define a surface by means of which a second support surface, facing away from the flat structure, can be formed. In another embodiment, the spacer elements of the spacer are designed as knobs, the free knob ends together forming the second support surface mentioned. In another embodiment, the spacer has two flat structures arranged parallel to each other, the two flat structures being joined to each other via the spacer elements in a manner allowing for air flow through and between them and holding them spaced apart from each other. Each of the flat structures then forms one of the two support surfaces of the spacer. All the spacer elements need not have the same length in order to make the two support surfaces equidistant over the entire surface extent of the spacer structure. For special applications, it can be advantageous to make the spacer have different thickness in different zones or at different locations along its surface extent, in order to form a surface anatomically compatible with the foot. The spacer elements can be formed separately, i.e., not joined to each other between the two support surfaces. However, there is also the possibility of allowing the spacer elements to touch between the two support surfaces and the possibility of joining them at at least some of the contact sites, for example, with an adhesive or by the fact that the spacer elements consist of materials that can be welded to each other, such as a material that becomes adhesive from heating. The spacer elements can be rod- or thread-shaped individual elements or sections of a more complex structure, for example, a truss or lattice. The spacer elements can also be connected to each other in a zigzag or in the form of a cross-grating. In another embodiment, the spacer structure or material is formed by two air-permeable flat structures arranged substantially parallel to each other, which are joined to each other and spaced apart by means of mono- or multifilaments in a manner allowing for air flow through and between them.

In another embodiment the filler material or structure is porous.

The filler structure or material may also be discontinuous in an additional embodiment. According to a further embodiment, the filler comprises a number of filler elements, which are spherical in shape, e.g. filler balls. These filler elements are received by the container element. The filler elements themselves may be made of a material which does not allow for an air flow or water vapour to pass through it. However, with the filler elements having voids therebetween, an overall structure may be formed which does allow for air flow and thus water vapour transport through it. The filler elements may be selected based on their

stability and comfort characteristics. The air flow through the filler structure may be adjusted by adjusting the size of the filler elements.

5 According to a further embodiment, the filler structure is at least partly comprised of channels. The channel structure allows for a distributed air connection between the under-
side of the lower portion of the upper assembly and at least portions of the side wall and/or
bottom part of the container element. Water vapour can pass from the inside of the shoe to
the channel structure provided inside the container element through the bottom functional
layer laminate.

10 Air communication between the filler structure or material and the outside of the container
element is established through the at least one opening, which extends through the side
wall of the container element, such that water vapour can pass to the outside of the con-
tainer element together with the air flow out of the container element. The at least one
15 opening may also extend through the filler structure or material insofar that air flow from
the filler structure or material to the outside of the container element is established. The
container element may also be provided with openings in its bottom part.

20 It is pointed out that the side wall and/or bottom part of the container element does not
have to be load bearing and/or be a structurally crucial part, but can also merely serve as a
border structure between the inside and the outside of the container element in order to
help a functional separation of the individual components and the manufacturing of the
shoe.

25 The ventilating sole element may be the container element filled with the air flow permit-
ting material or structure. In this case, the side wall of the ventilating sole element may be
formed by the side wall of the container element and the surrounding sole element sur-
rounding the ventilating sole element.

30 In a separate embodiment the structure or material allowing for air flow through it may be
inherently stable, such that no container element may be necessary to support this structure
or material. It may be directly attached to the bottom of the upper assembly. It may also be
wrapped at least on its lateral surface with a tape, which may be attached to the upper as-
sembly, e.g. by sewing or gluing. The tape may serve the purpose of preventing surround-
35 ing sole material or outer sole material from entering the open structure during injection or
else may prevent other fluid material from entering which is used to connect the structure
or material to the upper assembly.

According to a further embodiment, said side end area of said bottom functional layer laminate is attached by a sewn seam to said lower end area of said upper functional layer laminate. Said seam may be sealed by sealing adhesive, the application of a waterproof
5 seam tape or by fluid material of the surrounding sole element having penetrated into and around said sewn seam during injection moulding of the surrounding sole. The penetrated surrounding sole material, i.e. the penetrated material of the surrounding sole element, allows for a tight sealing between the two laminates and for the provision of a waterproof upper assembly.

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In a further embodiment, said ventilating sole element is positioned below said bottom portion of the upper assembly, such that an upper perimeter of said ventilating sole element is located within said bond, in particular within said sewn seam. In other words the ventilating sole element is placed some distance away from the bond towards the middle of the
15 shoe. In particular, said upper perimeter may have a minimum distance from said sewn seam, particularly 1mm to 4mm, more particularly 2mm to 3mm. In this way, the surrounding sole material may penetrate freely into and around the sewn seam. The injected or moulded on surrounding sole material reaches the bond between the functional layer laminates and seals it. The ventilating sole element may be attached to the bottom portion of
20 the upper assembly before said surrounding sole material is applied.

According to a further embodiment, a lower portion of said breathable outer material allows for penetration of surrounding sole material therethrough, said waterproof seal being formed at least partially by surrounding sole material having penetrated through said lower
25 portion of said breathable outer material to said upper functional layer laminate, said bottom functional layer laminate and said sewn seam. The surrounding sole element seals the upper assembly. It accounts for a waterproof seal between the upper portion and the bottom portion of the upper assembly.

According to a further embodiment, said lower portion of said breathable outer material comprises a netband, with the side end area of said bottom functional layer laminate being attached by said sewn seam to said netband, particularly to a lower end area of said netband, and to said lower end area of said upper functional layer laminate, with said surrounding sole material having penetrated through said seam. The netband provides a
35 highly efficient way of ensuring a high level of sole material penetration to the sewn seam. The netband may be positioned substantially only horizontally at the underside of the upper assembly or substantially only vertically at the side portions of the upper assembly. It

may also be positioned partly horizontally and partly vertically, wrapping around the corner region of the upper assembly between the underside and the side portions. The netband and the remaining end of the breathable outer material may be positioned end-to-end or may have an overlap or may both be folded over at the connection point. Accordingly, the netband may also in part be positioned laterally to the remainder of the breathable outer material.

According to a further embodiment, said surrounding sole element is formed by a material moulded or injected on at least parts of a lower portion of said upper assembly and onto said lateral surface of said ventilating sole element. In this way, the upper assembly and the ventilating sole element are permanently fixed with respect to each other. In exemplary embodiments, the provision of the surrounding sole element may be achieved in one of the following two manners. In the first alternative, a first injection-moulding step provides for a localized application of surrounding sole material onto the upper assembly and the ventilating sole element resulting in an attachment of the two components. This first injection-moulding step may also provide for the sealing between the upper functional layer laminate and the bottom functional layer laminate, as described above. The surrounding sole element may be completed in a second injection-moulding step, which also provides for the sealing if the sealing has not been achieved in the first injection-moulding step. In the second alternative, only one injection-moulding step is performed, through which the attachment between the upper assembly and the ventilating sole element, the sealing between the upper functional layer laminate and the bottom functional layer laminate and the forming of the entire surrounding sole element is achieved. The surrounding sole element may therefore perform three functions, namely attaching the ventilating sole element to the upper assembly, ensuring airflow through the provision of the at least one lateral passage, and sealing the connection region between the upper portion and the bottom portion of the upper assembly.

According to a further embodiment, said ventilating sole element is glued to said upper assembly in a breathable way.

According to a further embodiment, said bottom functional layer laminate is a two layer laminate comprising an upper supporting textile layer and a lower breathable and waterproof functional layer, also referred to as bottom membrane or lower membrane. This embodiment is preferable for use in shoes with injected soles. The injected material may penetrate directly onto the lower membrane.

According to a further embodiment, said bottom functional layer laminate is a two layer laminate comprising an upper breathable and waterproof functional layer, and a lower supporting textile layer. This embodiment is preferable for use in shoes with cemented/glued soles.

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According to a further embodiment, said ventilating sole element comprises a circular lip protruding from said ventilating sole element. According to a further embodiment, said ventilating sole element comprises a circular lip arranged in the vicinity of an upper circumferential edge of said ventilating sole element, said circular lip protruding in a direction between and including upwards, that is vertical, and laterally outwards, that is horizontal, from said ventilating sole element. The circular lip provides a means for attaching the (inner) ventilating sole element to the upper assembly. Such attachment gives advantages during manufacturing of the shoe because the upper assembly and the (inner) ventilating sole element can be handled as a unit which is easily transported from one manufacturing station to the next inside the factory. Additionally/alternatively, the circular lip provides a barrier against surrounding sole material, such that said surrounding sole material may be kept to the desired locations, for example during injection-moulding of the surrounding sole element.

20 In a further embodiment, said ventilating sole element comprises lip sections. These lip sections may be provided for a portion-wise attachment and/or sealing. The lip sections may be positioned on the ventilating sole element as discussed above with regard to the circular lip. In a particular embodiment, said ventilating sole element comprises a first lip section in the vicinity of an upper circumferential edge in a heel area and a second lip section in the vicinity of an upper circumferential edge in a forefoot area. Said first and second lip sections may extend vertically upwards from an upper surface of said ventilating sole element.

30 In a particular embodiment, the circular lip / the lip sections may be provided on the upper surface of the ventilating sole element, in particular in a position spaced from the lateral edge of the ventilating sole element. This spacing between lateral edge and the circular lip / lip portions allows for a penetration of surrounding sole material around the upper lateral edge of the ventilating sole element. In embodiments where the upper lateral edge is aligned with the bond between the upper functional layer laminate and the bottom functional layer laminate, the surrounding sole material may still penetrate around said bond and provide for an effective seal covering respective portions of both laminates. The spacing may be in the range of 1 to 5 mm, more particularly in the range of 2 to 3 mm. The

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height of the circular lip / lip sections may be between 0.5 and 3 mm, particularly around 1 mm.

5 In a further embodiment, the circular lip may be stitched to a lower portion of said upper assembly, particularly in a strobeled or zig-zag fashion. The circular lip may also be glued or attached via an injection-moulded material to a lower portion of said upper assembly.

10 In an exemplary embodiment where the ventilating sole element comprises a circular lip, the circular lip may be attached to the upper assembly in a first injection-moulding step, with the first injection-moulding step also sealing the connection between the upper functional layer laminate and the bottom functional layer laminate. The surrounding sole element having at least one lateral passage may then be formed in a second injection-moulding step.

15 According to a further embodiment, said bottom functional layer laminate is provided with supporting members, particularly dots or knobs, at its underside. The dots ensure that the functional layer of the bottom functional layer laminate does not come to lie directly on top of the sole or a sole element, in particular the ventilating sole element, which is arranged below the bottom functional layer laminate. The dots lie on top of the sole element and ensure maintaining a distance between the sole element and the bottom functional layer laminate. The dots enhance the grip between the bottom functional layer laminate and the sole element underneath. The dots may be arranged in a particular pattern or grid that is matched to the sole element and prevents the bottom functional layer laminate from being displaced during use. The dots may also be shaped and distributed over the under-
20 side of the bottom functional layer laminate in an arbitrary fashion. Moreover, the dots may compensate for a potentially uneven surface of the sole element. They may prevent edges/recesses in the sole element from pushing through the bottom functional layer laminate, such that the wearer's comfort is enhanced. In embodiments where the sole element, i.e. the (inner) ventilating sole element, comprises a channel structure, a suitable arrangement of the dots prevents a forcing of the bottom functional layer laminate into the channels of the channel structure during use. Moreover, the dots and the channel structure may form a functional unit in such a way that the dots assist in the air exchange in the channel structure below the dots. In a particular embodiment, the pattern of the dots may at least partially correspond to the channel system of the (inner) ventilating sole element, such that
30 water vapour discharge from the inside of the shoe to the channel system is maximized.

Particularly, there may be provided a plurality of discrete abrasion-resisting polymeric dots forming a discontinuous lining-forming pattern on the surface of said bottom functional layer laminate. In a particular embodiment, the polymeric dots have a smooth, rounded, non-angular external surface. They may be substantially circular in plan view and part-
5 spherical in cross-section. This contributes to providing a smooth and comfortable feel of the shoe to the wearer. The dots may be arranged in a repeat regular pattern, such as in a plurality of parallel rows, or in a random pattern. In a particular embodiment, the polymeric dots cover 20-80% of the area of the bottom functional layer laminate, more particularly 30-70% and even more particularly 40-60%.

10 In a particular embodiment, each dot is preferably of a maximum cross-dimension or width in the plane of the substrate which is less than 5000 microns, for example in the range of 100 to 1000 microns, preferably 200-800, particularly 400-600 microns. The dots may be spaced apart centre-to-centre by 200-2000 microns, particularly 300-1500, especially 400-
15 900 microns. Each dot may have a height in the range of 10-200 microns, preferably 70-140, particularly 80-100 microns.

According to a further embodiment, a water vapour permeable comfort layer is provided on top of at least parts of said ventilating sole element. Particularly, the comfort layer may
20 be provided on top of the ventilating sole element. The comfort layer may have a larger lateral extension than the ventilating sole element, particularly projecting between 0.5mm and 2mm over the ventilating sole element, more particularly projecting approximately 1mm over the ventilating sole element. It is also possible that the comfort layer is provided only on top of the filler structure or material described above. The comfort layer may be
25 provided to compensate for an uneven upper surface of the ventilating sole element. As a structure or material allowing for air flow through it, the ventilating sole element may have a heterogeneous or jagged structure. In particular, a channel system or channel grid may cause alternating portions of voids and sole material of the ventilating sole element. The comfort layer allows for the discomfort potentially caused to the wearer of the shoe by
30 these inhomogeneous portions to be greatly reduced or prevented. The water vapour permeable comfort layer may be of any suitable material that provides a highly comfortable feel to the wearer and that is able to withstand the loads and forces applied thereto during use. Exemplary materials are open cell polyurethanes. For example, the material may be POLISPORT (trademark) from company Jin Cheng Plastic, China. According to an em-
35 bodiment, before assembling the comfort layer on the ventilating sole element, mechanical pressure is applied to the material of the comfort layer, which is pressed, e.g., from 2 mm to 1 mm in thickness. This may be done to make the material more compact and hence to

lower the amount of water absorbed. This advantageously prevents the material to act as sponge which nurtures growth of fungus and the like.

5 The water vapour permeable comfort layer may be attached to the top of said ventilating sole element, in particular by spotwise or circumferential gluing or by gluing across the entire surface with a breathable glue. Enhanced air flow characteristics in the (inner) ventilating sole element may be achieved by spotwise gluing or gluing across the entire surface, as channels enclosed at their upper side may be formed.

10 According to a further embodiment, said comfort layer has an upper side and a lower side, where the upper side is facing the bottom portion of the upper assembly, and the lower side is facing the ventilating sole element, the lower side being flexurally rigid or stiff and the upper side being soft. The lower stiff side can be made of a woven or non woven fabric and the upper side of any smooth and soft material, for example a non-woven or a foamed
15 polyurethane. The comfort layer may consist of two discrete layers. With the lower layer being comparably stiff or hard, the comfort layer may be prevented from being pressed into the channel structure of the ventilating sole element more than 1mm. Stiffness or flexural rigidity is defined e.g. in German DIN Norm 53864 with respect to textiles. In this way, the comfort layer characteristics are preserved as desired, with the comfort layer being
20 very durable during use of the shoe. The soft upper layer may provide for a very comfortable feel of the sole for the wearer's foot. In an embodiment of the invention the soft upper layer has a smooth surface with the difference between peaks and valleys of no more than 0.1 mm.

25 In a particular embodiment, both the upper layer and the lower layer of the comfort layer are made of polyester. The upper and lower layers may be joined via a hot melt adhesive. In a particular embodiment, the material properties of the upper layer and the lower layer are as follows. The stiff lower layer has the following properties: a tensile strength in the lengthwise direction between 400 N/5cm and 700 N/5cm (UNI EN 29073/3), particularly
30 between 500 N/5cm and 600 N/5cm; and a tensile strength in the crosswise direction between 500 N/5cm and 800 N/5cm (UNI EN 29073/3), particularly between 600 N/5cm and 700 N/5cm. The soft upper layer has the following properties: a tensile strength in the lengthwise and the crosswise direction between 50 N/5cm and 200 N/5cm (UNI EN 29073/3), particularly between 100 N/5cm and 150 N/5cm.

35 In a further embodiment the comfort layer has a thickness of less than or equal to 2,0mm, a water absorption of < 45% by weight and an MVTR (Moisture Vapour Transmission

Rate) of $> 5000 \text{ g/m}^2/24\text{h}$, preferably about $8000 \text{ g/m}^2/24\text{h}$. In an embodiment a functional layer or membrane may be attached to the ventilating sole element above the comfort layer. The combination of comfort layer and membrane has an MVTR $> 2000 \text{ g/m}^2/24\text{h}$, preferably about $4500 \text{ g/m}^2/24\text{h}$. MVTR was measured according to the potassium acetate test described in DIN EN ISO 15496.

A comfort layer as described in the paragraphs above may be used in any kind of sole or shoe construction, not limited to the constructions described herein. In particular, the invention also generally proposes the provision of such a comfort layer in a shoe or shoe sole construction. This aspect is to be seen and may be applied independently from the other aspects as described herein. Accordingly, this aspect and its embodiments may form a separate part of the invention claimed independently from other aspects described herein.

According to a further embodiment, the underside of said ventilating sole element forms at least a part of an outer sole. Particularly, the undersides of said surrounding sole element and said ventilating sole element may form at least a part of an outer sole. This outer sole may or may not have a tread. The underside of said ventilating sole element may be arranged at a higher position as compared to the underside of said surrounding sole element. So in this case, although both the ventilating sole element and the surrounding sole element form a part of the outer sole, only the surrounding sole element part of this outer sole touches the ground.

According to a further embodiment, the surrounding sole element consists of a first polyurethane and the ventilating sole element consists of a second polyurethane, the second polyurethane being softer than the first polyurethane. Particularly, said second polyurethane may have a Shore A value of 35-45. In this way, the ventilating sole element may not be too hard and provides good shock absorption properties. It is also possible that the surrounding sole element and the ventilating sole element consist of the same polyurethane, but that they are produced in separate manufacturing steps. Shore hardness is measured by the durometer test. A force is applied onto a spot of the polyurethane, whereby the force creates an indentation. The time taken for the indentation to disappear is then measured.

According to a further embodiment, an additional sole element is provided forming at least a part of an outer sole, said additional sole element being arranged below said ventilating sole element. Portions of said additional sole element may also be arranged laterally outside of the container element. The additional sole element is not necessarily arranged directly adjacent to the ventilating sole element.

According to a further embodiment, supporting members are formed in portions of said additional sole element below said ventilating sole element, said supporting members extending substantially vertically through said additional sole element.

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According to a further embodiment, a sole comfort layer is provided. In particular, the sole comfort layer may be provided in the form of an additional sole layer arranged above the outer sole. More particularly, the sole comfort layer may be arranged between the ventilating sole element and the additional sole element forming at least a part of an outer sole.

10 The sole comfort layer does not necessarily extend over the whole lateral extension of the sole.

According to a further embodiment, said surrounding sole element extends below said ventilating sole element. Particularly, said surrounding sole element may form at least a part
15 of an outer sole. It is possible that an additional sole element is arranged under said surrounding sole element, thus forming an outer sole element. The additional sole element is not necessarily arranged directly adjacent to the surrounding sole element. For example, a further layer, such as an additional sole comfort layer, may be positioned in between.

20 According to a further embodiment, supporting members are formed in portions of said surrounding sole element below said ventilating sole element, said supporting members extending substantially vertically through said surrounding sole element. Supporting members may also be formed in any other element or layer arranged below said ventilating sole element.

25

According to a further embodiment, at least one hollow insert is provided in the at least one lateral passage. The at least one hollow insert may be removable. It may have a covering with an opening in it, such as an insert head with a hole in its centre. It is also possible that at least one removable solid insert is provided in the at least one lateral passage. Al-
30 ternatively, a partially hollow insert may have a solid covering/head.

According to a further embodiment, a breathable inner sole or footbed is removably provided above the bottom functional layer laminate, i.e. between the wearer's foot and the top of the bottom functional layer laminate during use of the shoe or between the wearer's foot
35 and an insole. The inner sole may account for a better adaptation of the shoe to the wearer's foot and may therefore increase the wearer's comfort. Such an inner sole may be made of leather, fibre, polyurethane, etc.. Perforations in these materials may ensure the

necessary breathability. However, the inner sole may also be made of a material which is breathable per se.

5 According to a further embodiment, the ventilating sole element may be glued to the upper assembly. It is also possible that the ventilating sole element is attached to the upper assembly through injection-moulding, in particular through the application of an injection-moulded surrounding connection element.

10 According to a further embodiment, the step of providing the upper assembly comprises providing said upper portion of said upper assembly with a waterproof, breathable upper functional layer laminate having a lower end area, providing said bottom portion of said upper assembly with a waterproof, breathable bottom functional layer laminate having a side end area, joining said side end area of said bottom functional layer laminate to said lower end area of said upper functional layer laminate, and providing a waterproof seal
15 between said bottom functional layer laminate and said upper functional layer laminate.

According to a further embodiment, the opening(s) in the ventilating sole element is at least partly created by lasering or drilling or puncturing or otherwise thermally removing (melting away) some material so as to form a passage. The at least one lateral passage is
20 formed during injection-moulding by providing the mould with respective pins for forming the at least one lateral passage. Lasering provides for extremely accurate results, while drilling and puncturing can be performed more cheaply.

The methods for manufacturing a breathable shoe or sole assembly may be modified corresponding to the modifications discussed above with respect to the breathable shoe. In other words, manufacturing steps corresponding to additional shoe elements/features may be included in the methods for manufacturing a breathable shoe or sole assembly. It is explicitly pointed out that the steps of attaching, given for the methods in accordance with above aspects of the invention, may be the only steps of attachment. It is, however, also possible
25 that additional attachments between the given elements are present.
30

According to another aspect, the invention also generally proposes the use of a laser for creating openings in an element of a shoe, particularly a shoe sole or removing shoe sole material. This aspect is to be seen and may be applied independently from the other aspects as described herein before, particularly independently from a method for manufacturing a shoe or sole assembly using a ventilating sole element as described herein before.
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Accordingly, this aspect in connection with the following embodiments may form a separate part of the invention claimed independently from other aspects described herein.

Particularly, according to an embodiment there is provided a method for making openings
5 in an element of a shoe, particularly a shoe sole, characterized in that a robot is adapted to hold the element, such as the sole or part thereof, in front of a laser apparatus and that the laser apparatus through a series of repetitive shots at the element (e.g., sole or part thereof) burns away material of the element for making at least one opening or a design in the element. The at least one opening may have a length of between approx. 0.5 to 50 mm. The
10 opening may be formed as an air channel or guide for supporting an air flow therein from one end of the opening to the other.

For such use, different types of lasers can be used as, e.g., diode lasers, infrared lasers and CO₂ lasers. In the following an embodiment of the invention will be described which
15 makes use of a CO₂ laser. CO₂ lasers work with a wave length in the range of 9.4 – 10.6 micrometers. Usually, a laser is controlled by way of three parameters, such as speed (of the beam), quantity of energy and wavelength.

Making openings or patterns with a laser, particularly a CO₂ laser, is possible in elastomeric, i.e. meltable materials such as polyurethane (PU), thermoplastic polyurethane (TPU), ethylene vinyl chloride (EVA), polyvinyl chloride (PVC) or rubber. In these materials the laser will, using a sufficient amount of energy, burn away the targeted sole material which will disappear without leaving debris.

25 Use of a laser for roughening of a shoe upper is described in DE 10 2009 049 776 A1.

When roughing shoe uppers of leather, techniques exist according to which the laser beam is swept across the surface of the upper in a predetermined time and with a predetermined amount of energy. The beam is swept by a mirror in the laser apparatus that deflect the
30 laser beam in order to reach the surface of the shoe to be roughened while the robot holds the shoe upper in a fixed position during sweeping of the beam. The robot places the shoe in front of the laser and then the mirrors move the beam through the leather. During this process the robot is stopped. If the curvature of the shoe upper becomes too great, i.e. if the focus point of the laser beam is removed too much from the targeted spot, the shoe upper
35 is repositioned anew by the robot. After repositioning, the new target spot is again in focus, and the laser sweeps across one or more spots.

A problem occurs, however, when deep openings in a (elastomeric) sole or element thereof shall be made. Such openings have a depth which is by far larger than the relatively shallow roughing made on leather uppers by the laser. For example, a lasered channel in a leather upper has a depth of 0.5 mm, whereas an opening in the sole may extend from the medial side of the sole to the lateral side, i.e. has a length of 50 mm. If the mirror-solution, which is used for roughing of the upper, with deflecting the laser beam is used for making openings in an element of a shoe, a problem may occur in opening any borders, such as the side wall of the ventilating sole element which may need to be provided with deep and narrow channels.

10

When using the mirror-solution the deflection of the beam may create an acute angle between the beam itself and the surface of the element. When applied for connecting narrow and elongated channels of the lateral passages of the surrounding sole element to the structure or material of the ventilating sole element, such acute angle drives the beam sideways into the channel side wall of the lateral passages and it does not reach the bottom thereof facing the ventilating sole element.

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On the other hand, according to the invention, the opening is made in the element of the shoe or sole, such as in the side wall of the ventilating sole element, by keeping the beam of the laser in a fixed direction (i.e. no sweeping of the laser beam) and letting the robot position the target spot of the element aligned with the center of the laser lens. This means that the laser beam will not be swept as when roughening a shoe upper. Instead we only move the robot arm holding the sole. However, there may be applications in which a mirror may be used when making openings in an element of a sole.

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This method is thus especially useful if the laser beam shall be shot through a cylindrical passage already present in the sole as is the case if e.g. the end of a passage in a sole, such as in the surrounding sole element, has to be opened.

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According to an example a number of openings shall be made in a polyurethane sole. The sole material is Elastollan™ from manufacturer Elastogran GmbH. Elastollan has a relatively low density (0.35 g/cm³) and is often used for shoe midsoles. The following steps may be applied in various ways, in combination or individually depending on the particular implementation and needs. The terms “first, second ...” are used only for designation purposes and shall not impose any limitations as to sequence or numbers of steps.

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(1) In a first step a sole is placed in front of the laser by a robot. (2) In a second step the target spot on the sole or element thereof is placed orthogonally to the laser beam by the robot. (3) In a third step the laser beam hits the sole material at an angle to the sole (element) surface of approximately 90 degrees. (4) In a fourth step the focus of the laser is kept constant, i.e. unchanged. (5) In a fifth step a series of laser shots towards the target spot is performed (e.g., multiple shots in the same place). The number of shots may be between 1 and 10 depending on the power of the laser and material and depth of entry. Duration per shot may be approx. 1 ms.

When applied for connecting the lateral passages of the surrounding sole element to the structure or material of the ventilating sole element, the laser shots may result in a diameter of the openings in the side wall of the ventilating sole element which equals the diameter of the passages made by the pins in the surrounding sole element during injection. In order to get the desired diameter the number of shots can be varied as can the relative position of the shots. During a shot cycle the target can be moved a few millimeters (e.g., the robot moves), and the diameter will increase. In a further step, the robot moves the sole to the next target spot, i.e. the process goes to the second step (2) above.

In relation to the ventilating sole element, the opening of the side wall of the ventilating sole element with laser leaves no debris. Everything is burned away. Hereby any clogging of the air channels caused during manufacturing of the openings is prevented. The method further has the advantage that it is very fast compared to drilling out the openings.

In the following, particular embodiments and/or variations of the process making use of a laser for creating openings in a shoe sole are described:

In order to get a cylindrical opening with a clean edge the amount of energy per shot may be increased. The focus point may be kept constant. The first laser shots start with a low energy for making a first opening with a diameter of say 2 mm. The next series of shots has an energy increase of 50% per shot. The opening now has a diameter of 4 mm. The third series of shots has again an increase of energy by 50%, increasing the diameter at the beginning of the opening to 6 mm.

Alternatively, or simultaneously, the point of focus of the laser beam can be amended per shot or per series of shots. After a first series of shots the depth of the opening may be 3 mm. Now the focus has to be changed and moved 3 mm further inwards in the sole.

Change of focus is made via software which controls the movement of the lenses in the laser apparatus.

Further, in order to ensure a well defined opening with a well defined edge, the laser beam
5 can be moved in a spiral shape. Such spiral shape can be elliptical or circular. This functions the following way:

- A first series of shots in the centre of the target spot.
- The next series of shots in a neighbouring spot.
- 10 - And continuing in a spiral shape until an opening with the desired shape is achieved.

Ideally, in order to create a clean cut in a polyurethane sole, the diameter of the point of focus (spot size) may be between 0.5 mm and 2mm and the power between 150 watt and 250 watt. It should be noted that these values are to be understood as pure examples without imposing any limitations in connection with the invention.
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The combination of a robot and laser is considered part of this aspect of the invention because something is needed to position precisely the channels in front of a laser. The robot is one of the preferred solutions because the openings are always in different positions –
20 for instance, the position of a shoe with size 40 is different of the same shoe in size 41. A shoe sole is characterized by 3D-curvatures. It is not only a 2D surface, and therefore the focus point of the laser beam is changed along the 3D surface of the sole.

Aspects of the invention and further embodiments thereof are disclosed in the following description with reference to the drawings, in which:
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Fig. 1 is an exploded three-dimensional view of the main components of a shoe in accordance with a first embodiment of the invention.

30 Fig. 2a is a schematic cross-sectional view of a shoe in accordance with a second embodiment of the invention.

Fig. 2b is a schematic cross-sectional view of a shoe in accordance with a third embodiment of the invention.

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Fig. 2c is a schematic cross-sectional view of a shoe in accordance with a fourth embodiment of the invention.

Fig. 2d is a schematic cross-sectional view of a shoe in accordance with a fifth embodiment of the invention.

- 5 Fig. 3a is a schematic cross-sectional view of a shoe in accordance with a sixth embodiment of the invention.

Fig. 3b is a schematic cross-sectional view of a shoe in accordance with a seventh embodiment of the invention.

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Fig. 3c is a schematic cross-sectional view of a shoe in accordance with an eighth embodiment of the invention.

- 15 Fig. 3d is a schematic cross-sectional view of a shoe in accordance with a ninth embodiment of the invention.

Fig. 3e is a schematic cross-sectional view of a shoe in accordance with a tenth embodiment of the invention.

- 20 Fig. 3f is a schematic cross-sectional view of a sole in accordance with the eighth embodiment of the invention.

Fig. 4a is a schematic cross-sectional view of a shoe in accordance with an eleventh embodiment of the invention.

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Fig. 4b is a schematic cross-sectional view of a shoe in accordance with a twelfth embodiment of the invention.

- 30 Fig. 5 is a schematic cross-sectional view of a shoe in accordance with a thirteenth embodiment of the invention.

Fig. 6a is a schematic cross-sectional view of a shoe in accordance with a fourteenth embodiment of the invention.

- 35 Fig. 6b is a schematic cross-sectional view of a shoe in accordance with a fifteenth embodiment of the invention.

Fig. 6c is a schematic cross-sectional view of a shoe in accordance with a sixteenth embodiment of the invention.

Fig. 7 is a schematic cross-sectional view of a shoe in accordance with a seventeenth embodiment of the invention.

Fig. 8 is a schematic cross-sectional view of a shoe in accordance with a twentieth embodiment of the invention.

Fig. 9a-c show an embodiment of a mould and of a semimanufactured product formed in the process of manufacturing a shoe in accordance with aspects of the present invention, the semimanufactured product comprising an exemplary outsole and ventilating sole element attached to the outsole,

Fig. 10 shows a semimanufactured product of Fig. 9 in a process step with a comfort layer disposed on the ventilating sole element,

Fig. 11 shows the semimanufactured product of Fig. 10 placed in a mould for injection moulding prior to the moulding step,

Fig. 12 shows a process step in which the upper portion of the shoe placed on a last is positioned to contact the ventilating sole element in the mould prior to the moulding step,

Fig. 13 shows an example of a drilling apparatus, which may be used to interconnect the lateral passages in the surrounding sole element and the ventilating sole element,

Fig. 14 shows an example of a finished shoe with lateral passages formed in the surrounding sole element

In the following, exemplary embodiments of a shoe in accordance with principles of the invention will be described. The skilled person will be aware that various changes or adaptations may be made as far as appropriate and depending on the particular needs of the respective shoe construction.

Fig. 1 shows an exploded three-dimensional view of the main components of a shoe 300 according to an embodiment of the invention. The shoe 300 comprises a sole assembly 7 and an upper assembly 8. The sole assembly 7 in turn comprises, from bottom to top in the

exploded view, an outsole 90, a shank 172, a ventilating sole element 60, a comfort layer 40, and a surrounding sole element 80.

The primary purpose of Fig. 1 is to provide context for the following Figures. The position of a vertical plane including horizontal line Y-Y corresponds to the positions of the cross-sectional planes depicted in the following Figures. It is pointed out that the embodiments of the following Figures are different from the shoe 300, but that the position and viewing direction of the respectively depicted vertical cross-sectional planes can be inferred from the line Y-Y and the associated arrows, which represent the viewing direction.

The outsole 90 comprises a tread or corrugated structure on its lower surface for improving the grip characteristics of the shoe during walking. The shank 172 is provided in the shoe 300 to give it additional stability. The shank 172 may be made of metal or any other suitable material. Due to the illustrative nature of Fig. 1, the shank 172 is shown as a separate element. However, in most embodiments, the shank 172 is positioned within the ventilating sole element 60. It is pointed out that the shank 172 is an optional component, which is not shown in most embodiments.

The ventilating sole element 60 comprises a channel structure, in particular a channel grid, at its upper side. The channel structure comprises transverse channels, generally designated with reference numeral 181. Channels 184 cross the transverse channels 181.

A distinction is made between at least one peripheral channel being formed in a peripheral region of the channel structure and longitudinal channels. For the sake of simplicity in describing different shoe constructions by presenting cross-sectional views in Figures 2 to 10, the channels 184 are generally referred to as longitudinal channels, although one or more of the channel cross-sections shown may belong to one or more peripheral channels.

The ventilating sole element 60 has an upper surface 606, a lower surface 604 and a lateral surface 602. In an assembled state of the shoe 300, the lower surface 604 of the ventilating sole element 60 is partly adjacent the shank 172 and partly adjacent the outsole 90, the upper surface 606 of the ventilating sole element 60 is adjacent the comfort layer 40, and the lateral surface 602 of the ventilating sole element 60 is adjacent a lateral inner surface 802 of the surrounding sole element 80. Regarding the engagement/connection of the individual components, more details are given below.

The channel structure, in particular the transverse channels 181, is in air communication with a plurality of openings 55. The openings 55 extend through a side wall of the ventilating sole element 60, particularly they extend from the channel structure of the ventilating sole element 60 to lateral passages 50 of the surrounding sole element 80..

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The surrounding sole element 80 has a varying height across its circumference, with the lateral passages being arranged at different heights. In this way, the positions of the lateral passages account for the uneven surface structure of the ventilating sole element 60, which takes into account the wearer's foot and its positioning during walking. Exemplary embodiments of the components are described in greater detail below.

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Fig. 2a is a schematic cross-sectional view of a shoe 301a in accordance with an embodiment of the invention. Figures 2 to 8 are in particular schematic in that they show a u-shaped shoe portion. It is apparent to a person skilled in the art that the shoe is closed on top, in particular in a forefoot region.

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The shoe 301a comprises an upper assembly 8 and a sole assembly 7. The upper assembly 8 has an upper portion 10 and a bottom portion 20. The upper portion 10 comprises, from outside to inside, a breathable outer material 11, also referred to as upper material, a mesh 12, an upper membrane 13, and a textile lining 14. The mesh 12, the upper membrane 13 and the textile lining 14 are provided as a laminate, also referred to as upper functional layer laminate 17. The upper membrane 13 is breathable and waterproof. With all of the upper material 11, the mesh 12 and the textile lining 14 being breathable, i.e. water vapour permeable, the upper portion 10 as a whole is breathable and waterproof.

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The upper material 11 may be any breathable material suitable for forming the outside of a shoe, such as leather, suede, textile or man made fabrics, etc.

The upper functional layer laminate (i.e. mesh 12, upper membrane 13 and textile lining 14) may be any suitable waterproof and breathable laminate, such as commercially available GORE-TEX® laminate from W.L. Gore & Associates.

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A lower portion of the outer material 11 is comprised of a netband 15. The netband 15 may be attached to the remainder of the outer material 11 through any suitable way of connection, for example stitching or gluing. In the exemplary embodiment of Fig. 2a, the netband 15 is attached to the remainder of the outer material 11 via stitching 16, as illustrated by a connecting line. As the term netband suggests, this portion of the outer material is not a

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continuous material, but comprises voids in the material that allow for the penetration of fluid sole material therethrough, as will be explained later. Instead of providing a netband, the lower portion may also be comprised of the same material as the remainder of the outer material, with the voids being generated by puncturing or perforating the outer material in the lower portion.

The bottom portion 20 comprises, from bottom to top, a lower membrane 21 and a supporting textile 22. The textile may be a woven, non-woven or knitted textile, for example Cambrelle®. The lower membrane 21 and the supporting textile 22 are provided as a laminate, also referred to as bottom functional layer laminate 24. The lower membrane 21 is waterproof and breathable. With the supporting textile 22 being breathable, an overall breathable and waterproof bottom functional layer laminate 24 is provided. The bottom functional layer laminate 24 may be any suitable laminate, for example commercially available GORE-TEX® laminate from W.L. Gore & Associates.

The upper portion 10 and the bottom portion 20 are connected to each other at their respective end areas. Particularly, a lower end area of the upper functional layer laminate 17 is connected to a side end area of the bottom functional layer laminate 24. In the embodiment of Fig. 2a, this connection also connects an end area of the netband 15 to the upper functional layer laminate 17 and the bottom functional layer laminate 24. The bottom functional layer laminate 24, the upper functional layer laminate 17 and the netband are stitched together, for example by a strobel stitch or a zigzag stitch. Accordingly, a connection 30, also referred to as bond 30, in the form of a sewn or stitched seam is formed connecting the bottom functional layer laminate 24, the outer material 11 (via the netband 15) and the upper functional layer laminate 17. This seam 30 is sealed in a waterproof manner by sole material, as will be explained later, such that a waterproof structure is formed by the upper portion 10 and the bottom portion 20.

The upper functional layer laminate 17 and the bottom functional layer laminate 24 may be positioned end-to-end before being connected and sealed together, as shown in Fig. 2a. Both laminates may also be bent downwards, such that respective portions of the upper sides of the laminates are positioned adjacent each other. In these different positions, the laminates may be connected, for example through stitching as shown, and the connection region may be sealed. The netband 15 of the outer material 11 may be positioned corresponding to the upper functional layer laminate 17, i.e. in an end-to-end or overlap or bent relation with respect to the bottom functional layer laminate 24, such that the connection 30 also connects the netband 15 to the bottom functional layer laminate 24 and the upper

functional layer laminate 17. The netband 15 may also extend through the connection 30, which is uncritical due to its porous structure. These different options for forming the connection 30 may be applied to all embodiments described herein.

- 5 In the embodiment of Fig. 2a, the connection 30 between the upper functional layer laminate 17 and the bottom functional layer laminate 24 is located at the substantially horizontal portion of the inside of the shoe 301a, which is intended to support the underside of the wearer's foot. In the cross-sectional plane of Fig. 2a, the connection 30 is close to the lateral end of said substantially horizontal portion, i.e. close to the point where the portion for supporting the weight of the foot transitions into the side wall of the shoe. Due to the nature of the shoe 301a, the bottom functional layer laminate 24 is a substantially foot-shaped structure, with the upper functional layer laminate 17 being connected thereto perimetrically. It is pointed out that the terms horizontal and vertical refer to the horizontal and vertical directions present when the shoe is placed with the sole on an even ground.
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- 15 For an easier understanding, the shoes are depicted in that orientation throughout the Figures.

- The sole or sole assembly 7 of the shoe 301a, i.e. the portion of the shoe 301a below the upper assembly 8, which consists of the upper portion 10 and the bottom portion 20, is comprised of a ventilating sole element 61, a comfort layer 40 and a surrounding sole element 81.
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- The ventilating sole element 61 comprises a channel structure 160 that allows for air communication between the upper side of the ventilating sole element 61 and openings 55.
- 25 Lateral passages 50 extend through a side wall 702 of the surrounding sole element 81 and the openings 55 extend through a side wall 608 of the ventilating sole element 61. For an easier reading of the Figures 2 to 8, the reference numerals 608 and 702 are provided with brackets illustrating lateral extensions of the side wall of the ventilating sole element and side wall of the surrounding sole element, respectively. It is, however, understood that the reference numerals 608 and 702 are meant to denote the side wall of the ventilating sole element and the side wall of the surrounding sole element themselves. The channel system 160 of the embodiment of Fig. 2a comprises a plurality of longitudinal channels 184, arranged in the longitudinal direction of the shoe 301a, and a plurality of transverse channels 181, arranged in the transverse direction of the shoe 301a, i.e. in the direction orthogonal to the longitudinal direction of the shoe.
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The cross-sectional view of Fig. 2a cuts through a transverse channel 181 of the channel structure 160 along the horizontal line Y-Y of Fig. 1. Therefore, the transverse channel 181 of the ventilating sole element 61 is not shown in a shaded manner, as the cross-sectional cut reaches through the open channel. In contrast thereto, the portions of the ventilating sole element 61 surrounding the channel structure 160 and the surrounding sole element 81 are shown in a shaded manner illustrating that the cross-section of Fig. 2a slices through these shoe elements in the depicted cross-sectional plane. Correspondingly, the upper assembly 8 and the comfort layer 40 are shown in a shaded manner.

In the cross-sectional view of Fig. 2a, the longitudinal channels 184 are seen in their cross-sectional shape, which is a u-shape reaching from the upper surface 606 of the ventilating sole element 61 some distance towards the lower surface 604 of the ventilating sole element 61. The transverse channel 181 cut in the cross-section of Fig. 2a is confined by a surface made of the portions between the longitudinal channels lying behind the cross-sectional plane. Accordingly, the transverse channel 181 depicted extends longitudinally behind the cross-sectional plane of Fig. 2a, with the non-shaded portions of the ventilating sole element 61, which surround the u-shaped longitudinal channels 184, forming a transverse boundary surface. Only the u-shaped longitudinal channels 184 form a longitudinal air flow permitting connection to further transverse channels behind and in front of the cross-sectional plane of Fig. 2a.

The u-shape of the longitudinal and transverse channels allows for a good compromise between providing sufficient channel volume for fluid communication and providing a strong ventilating sole element structure for supporting the wearer's foot and transferring the wearer's weight to the ground and/or the surrounding sole element 81. Also, the u-shaped channels can be manufactured easily and quickly, particularly in the case of an injection-moulded ventilating sole element 61, because the rounded channel side walls allow for an easy parting of the ventilating sole element 61 and the mould after the moulding operation.

It is pointed out that the channels of the ventilating sole element 61 may have any suitable cross-section that allows for an efficient transfer of water vapour from the upper side of the ventilating sole element 61 to the lateral passages 50 in the surrounding sole element 81. At the same time, the ventilating sole element 61 should provide a stable structure for the sole of the shoe. It is also pointed out that the channels may have varying cross-sections along their length in order to form a channel system having desired properties.

The exemplary embodiment of Fig. 2a comprises five longitudinal channels 184, which are distributed across the width of the ventilating sole element 61 in a uniform manner. It is also possible that the longitudinal channels have varying widths and/or are distributed non-uniformly across the width of the ventilating sole element 61. Further, it is possible that
5 these channels are at an angle with respect to the longitudinal direction of the shoe 301a, such that any suitable channel structure 160 may be formed.

The transverse channel 181 connects the longitudinal channels 184 to each other and to the openings 55 and lateral passages 50 in the surrounding sole element 81. At its lateral ends,
10 the transverse channel is equipped with air and moisture discharging ports 182. The air and moisture discharging ports 182 are arranged laterally outside from the laterally outmost longitudinal channel. In particular, the air and moisture discharging ports 182 are arranged directly adjacent the side wall 608 of the ventilating sole element 61. The air and moisture discharging ports 182 are formed by recesses in the floor of the transverse channels 181. In
15 other words, the floor of the transverse channels 181 extends deeper down into the ventilating sole element 61 in the region of the air and moisture discharging ports 182 than throughout the remainder of the transverse channels 181. The air and moisture discharging ports 182 allow for an efficient collection of moisture/water vapour from the inside of the shoe, from where the water vapour can be carried away effectively through the openings
20 55 and lateral passages 50. All or only a subset of the transverse channels may 181 have air and moisture discharging ports.

All or only a subset of the transverse channels 181 may provide for the connection with openings 55 and lateral passages 50. There may also be transverse channels 181 that are
25 not in air communication with openings 55 and lateral passages 50, but end in dead ends. The transverse channels of the ventilating sole element 61, one of which is being shown in Fig. 2a, allow for air communication between the channel system 160 of the ventilating sole element 61 and the openings 55 and lateral passages 50 extending through the side walls 608 and 702, respectively. With the bottom functional layer laminate 24 being
30 breathable, water vapour transport from the inside of the shoe to the lateral outside of the sole 7 is ensured through the ventilating sole element structure, which allows the water vapour containing air to pass through it.

It is pointed out that the transverse channels 181 may have the same, a smaller or greater
35 height than the longitudinal channels 184. They may be channels that reach from the top of the ventilating sole element towards the inside of the ventilating sole element, such that they can also be seen as grooves or tranches. It is also possible that the transverse channels

lie below a portion of the ventilating sole element 61 and are therefore not readily visible from the top of the ventilating sole element 61. Also, the longitudinal channels may be grooves, as shown, or channels concealed from the upper surface of the ventilating sole element 61.

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In the present embodiment, the channel system 160 of the ventilating sole element 61 is a channel grid. The channels of the channel grid extend from the top of the ventilating sole element 61 to the inside thereof. The channels may be longitudinal channels 184 and transverse channels 181, which intersect for allowing air communication therebetween.

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The channels may also be diagonal channels, when seen from the top of the ventilating sole element. In general, such a channel grid may have any combination of longitudinal, transverse and diagonal channels.

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It is pointed out that any channel structure may be embodied in all other constructions of the remainder of the shoe, in particular in combination with all other upper assembly constructions and all other constructions relating to the remainder of the sole 7.

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The lateral passages 50 extend through the side wall 702 of the surrounding sole element 81 and the openings 55 extend through a side wall 608 of the ventilating sole element 61 of the shoe 301a, allowing for air communication between the channel structure of the ventilating sole element 61 and the lateral outside of the shoe 301a. In the exemplary embodiment of Fig. 2a, the lateral passages 50 and openings 55 are depicted as transverse passages and openings being horizontal. However, the terms lateral passage and openings may not be understood in such a restricting manner. A lateral passage or opening may be any passage or opening, respectively, that allows for an air communication between the inside of the ventilating sole element and a lateral outside of the surrounding sole element, i.e. the outside of the surrounding sole element that is not the underside of the shoe 301. In particular, the lateral passages 50 and/or openings 55 may be inclined with respect to the horizontal direction, in particular with the outer end lower than the inner end of the ventilation passage. This inclination has the advantage that water can drain out more easily from the ventilating sole element and surrounding sole element. However, horizontal lateral passages and openings have the advantage of providing a favourable path for air or water vapour flow, particularly if a continuous passage from the right side of the ventilating sole element to the left side of the ventilating sole element or vice versa is present. The lateral passages 50 and/or openings 55 may also be inclined with the outer end being higher than the inner end of the ventilation passage. This allows for creating the openings, for example through drilling or by laser operation, without any danger of damaging the delicate mem-

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brane 21 of the bottom functional layer laminate 24. Moreover, water vapour, which is warm due to the wearer's body temperature, may effectively exit the ventilating sole element through such inclined lateral passages in a chimney-like manner. When viewed from the top of the ventilating and surrounding sole element, the lateral passages 50 may be in a longitudinal direction of the shoe, in a transverse direction of the shoe, or in any direction therebetween. For example, in the front or the back of the shoe, the ventilation channels may be substantially in a longitudinal direction of the shoe. The orientation options described for the lateral passages 50 may be applied to all embodiments described.

The ventilating sole element 61 of the shoe 301a also comprises a circular lip 101. The circular lip 101 is arranged at the upper lateral edge of the ventilating sole element 61. As the ventilating sole element 61 is a three-dimensional structure, the circular lip 101 surrounds the perimetric upper edge of the remainder of the ventilating sole element 61. In other words, the circular lip 101 is arranged at the periphery of the upper lateral portion of the ventilating sole element 61. Accordingly, the term circular is not intended to be understood as referring to the shape of a circle. Instead, it is understood as referring to a structure surrounding an inner space or as referring to a loop structure. However, the term is also not intended to require a closed lip or collar structure. The lip may be continuous around the perimeter of the ventilating sole element 61, but is may also be made of a plurality of spaced apart lip sections distributed around the perimeter of the ventilating sole element 61. The lip also does not need to be arranged right at the upper lateral edge of the ventilating sole element 61. It may also be attached to the lateral surface 602 or the upper surface 606 thereof. However, a positioning in the vicinity of an upper circumferential edge of the ventilating sole element may be beneficial, as will be discussed below.

The circular lip 101 may perform one or more of the functions described as follows. As shown in Fig. 2a, the circular lip 101 extends to the position of the connection 30. The connection 30 includes the circular lip 101, such that it connects the upper portion 10, the bottom portion 20 as well as the ventilating sole element 61. In particular, the strobil stitch 30 connects the upper functional layer laminate 17, the netband 15 of the upper material 11, the bottom functional layer laminate 24 and the circular lip 101 of the ventilating sole element 61. Hence, the circular lip 101 allows for an attachment of the ventilating sole element 61 to the upper assembly 8. This attachment is independent from the attachment of the ventilating sole element 61 to the upper assembly 8 via the surrounding sole element 81. During the manufacture of the shoe 301a, the ventilating sole element 61 may be attached to the upper assembly 8 in a fixed position through the connection 30 along the circular lip 101, which may also leave the comfort layer 40 in a fixed position. This allows

for a more accurate production of the shoe 301a, as the fixed position of the ventilating sole element 61 ensures that the surrounding sole element 81 surrounds the ventilating sole element 61 in the desired manner and location.

5 The ventilating sole element 61 and the circular lip 101 may be made of one piece or more pieces. In other words, the circular lip 101 may be an integral part of the ventilating sole element 61 or it may be a part attached in a separate manufacturing step to the remainder of the ventilating sole element 61. Particularly, the ventilating sole element 61 - including the circular lip 101 - may be produced in one manufacturing step, for example through in-
10 jection moulding. In this way, a strong connection between the circular lip 101 and the remainder of the ventilating sole element 61 is ensured, which results in a strong attachment of the whole ventilating sole element 61 to the upper assembly 8. For example, the lip extends 2 millimetres horizontally from the ventilating sole element; extensions will typically be between 1 and 5 millimetres.

15 It is also possible that the ventilating sole element 61, comprising the circular lip 101, is attached to the upper assembly by gluing the circular lip 101 onto the upper assembly 8 or by effecting an attachment between the circular lip 101 and the upper assembly 8 through a local injection-moulding operation in the region of the circular lip 101, particularly only in
20 the region of the circular lip 101.

The circular lip 101 may additionally/alternatively have the function of providing a barrier for the sole material of the surrounding sole element 81 during its injection-moulding onto the ventilating sole element 61 and the upper assembly 8. The circular lip may be posi-
25 tioned such that the sole material of the surrounding sole element 81 does not penetrate through to the comfort layer 40 and/or the upper side of the ventilating sole element 61. The circular lip 101 may also be designed and positioned in such a way that some sole material of the surrounding sole element 81 may penetrate onto the bottom functional layer laminate 24, particularly onto the bottom membrane 21. The sealing between the bottom
30 functional layer laminate 24 and the upper functional layer laminate 17 may be effected via the surrounding sole element material. However, the circular lip may prevent excess sole material from penetrating into the area between the ventilating sole element and the bottom functional layer laminate. In this way, the water vapour permeability of a large area of the bottom functional layer laminate 24 is ensured.

35 The ventilating sole element 61 may be placed in a mould with a suitable pressure / fixation, such that the circular lip 101 can fulfil this function during injection-moulding of the

surrounding sole element 81. In particular, a piston may exert pressure on the ventilating sole element 61, through which it is pressed against the upper assembly 8. The circular lip may be pressed against the upper assembly 8, in the process of which a deformation of the protruding lip may occur, such that a tight barrier for the subsequent injection-moulding step is formed. The circular lip 101 may in this way help to keep a large portion of the lower surface of the bottom functional layer laminate 24 from getting into contact with the sole material of the surrounding sole element 81, such that a large area with breathable characteristics is maintained. The circular lip 101 may also be positioned at any position on the upper surface 606 of the ventilating sole element 61, such that a barrier for the injection-moulding is established at a desired location. Also, the circular lip 101 may be attached to the lateral surface 602 of the ventilating sole element 61, with the barrier effect being achieved through an attachment of the far end of the circular lip 101 to the upper assembly 8, for example through the strobil stitch 30.

The circular lip 101 may extend from the ventilating sole element in any direction between a lateral direction towards the outside of the ventilating sole element and a vertical direction upwards from the ventilating sole element.

It is explicitly pointed out that, albeit the circular lip 101 is only shown for the embodiments of Fig. 2a, the ventilating sole elements of the other embodiments of the invention may also comprise a lip or collar structure, in particular a circular lip or a plurality of lip sections as described above.

The upper portion of the surrounding sole element 81 is located above the circular lip 101 of the ventilating sole element 61, i.e. below a part of the bottom functional layer laminate 24, as well as underneath the circular lip 101 and underneath a part of the upper portion 10 of the upper assembly 8 as well as adjacent a part of the upper portion 10 of the upper assembly 8 that is arranged in a substantially vertical direction. In other words, the surrounding sole element 81 wraps around the corner of the upper assembly 8 where the inside of the shoe is patterned to match a wearer's foot. In yet other words, the surrounding sole element 81 covers a part of the underside of the upper assembly 8 as well as parts of the lower lateral sides of the upper assembly 8. Sole material of the surrounding sole element 81 is penetrated through the netband 15, through the strobil stitch 30, through the mesh 12, onto the upper material 11, onto the upper membrane 13, around at least a portion of the circular lip 101 and onto the bottom membrane 21. This penetrated sole material seals the strobil stitch 30 in a waterproof manner on the one hand and attaches the ventilating sole element to the upper assembly 8 on the other hand. The sealing provides a completely wa-

terproof upper assembly 8 made up of the upper functional layer laminate 17 and the lower functional layer laminate 24 surrounding the interior of the shoe and being sealed in a waterproof manner to each other. The sealed upper functional layer laminate 17 and bottom functional layer laminate 24 form a waterproof, breathable functional layer arrangement.

5 Thus the upper assembly 8 is waterproof, which allows the sole assembly to be non-waterproof. The surrounding sole material also penetrates through the connection 30 to the upper sides of the bottom functional layer laminate 24 and the upper functional layer laminate 17, which is illustrated by the circle sector covering the upper side of the strobil stitch 30 and extending onto the bottom functional layer laminate 24 and the upper functional

10 layer laminate 17 in Fig. 2a. In particular, the surrounding sole material penetrates through the space between the two laminates upwards. The surrounding sole material also penetrates somewhat in between the circular lip 101 and the bottom functional layer laminate 24. In this way, the whole region of the strobil stitch 30 is penetrated with surrounding sole material, such that all holes generated in the upper membrane 13 and the bottom

15 membrane 21 through the strobil stitching operation are reliably sealed by surrounding sole material. However, the penetrating surrounding sole material is kept to such a low volume that the comfort for the wearer as well as the breathability of the upper assembly 8 is essentially unimpeded.

20 Above the ventilating sole element 61, the comfort layer 40 is provided in the shoe 301a. The comfort layer 40 is positioned on top of the ventilating sole element 61. The comfort layer 40 may be loosely positioned there or may be attached before further manufacturing of the shoe. Such attachment may be achieved by a spot-gluing or circumferential gluing or by gluing making use of breathable glue, such that the flow of water-vapour from the in-

25 side of the shoe to the ventilating sole element 61 is not prevented. Also, the full surface of the ventilating sole element 61 can be glued, and in order to prevent glue to enter the channels a highly thixotropic glue should be used. The comfort layer 40 is inserted for increasing the soft walking feel for the wearer, particularly for ensuring that the wearer does not feel bothered by the channel system 160 of the ventilating sole element 61. In the ex-

30 emplary embodiment of the shoe 301a, the comfort layer 40 has a greater lateral extension than the channel system 160 of the ventilating sole element 61 and extends somewhat above the region of the circular lip 101. However, the comfort layer does not extend to the lateral edges of the circular lip 101 where it is attached to the upper assembly 8. In general, the comfort layer may have the same or smaller or larger lateral dimensions as/than the

35 ventilating sole element.

The comfort layer 40 is provided directly on top of the ventilating sole element 61. However, it could also be spaced apart somewhat from the ventilating sole element 61. Such a spacing may be the result of using a gluing layer for attaching the comfort layer 40 to the ventilating sole element 61 that has a sizeable vertical extension. The comfort layer may still provide the beneficial properties discussed, when not provided directly on top of the ventilating sole element.

The ventilating and surrounding sole elements are produced and attached to the upper assembly 8 in a several stage process. As a first step, the ventilating sole element 61 is produced, for example through injection-moulding of a polyurethane (PU) into an accordingly shaped mould. Polyurethane is one of a plurality of suitable materials that can be used in order to form a ventilating sole element 61 that has high stability to support at least a portion of the weight of the wearer during use, such as during walking, while having some flexibility in order to enhance the wearer's comfort during walking. Depending on the preferred use of the shoe, a suitable material can be chosen. Examples of such materials besides polyurethane is EVA (Ethylene Vinyl Acetate). etc.

As a next step, the comfort layer 40 is placed on top of the ventilating sole element 61 and attached to it using an adhesive. The ventilating sole element 61 and the comfort layer 40 are then placed in the desired position with respect to the upper assembly 8 in a mould, wherein the surrounding sole element material is injection-moulded onto the upper assembly 8 and the ventilating sole element 61. In this way, the surrounding sole element 81 adheres to the upper assembly 8 as well as to the sole ventilating element 61, such that a lasting, integral joint of these elements is achieved through the sole material of the surrounding sole element 81. Suitable materials for the surrounding sole element are polyurethane, EVA, PVC or rubber, etc..

In the embodiment of Fig. 2a, the netband 15 wraps around the corner of the upper portion 10, i.e. the part of the upper portion 10 where the upper functional layer laminate 17 and the netband 15 of the upper material 11 are bent from a substantially horizontal orientation to a substantially vertical orientation. The part having a substantially vertical orientation forms the side walls for the wearer's foot. Accordingly, the sole material of the surrounding sole element 81 may penetrate through the netband 15 and onto the upper membrane from the underside and from the lateral sides of the upper assembly 8. In this way, a strong, multi-directional attachment between the surrounding sole element 81 and the upper functional layer laminate 17 is achieved, as well as a good seal provided between the laminates 17, 24.

In the exemplary embodiment of Fig. 2a, the surrounding sole element 81 reaches further down than the ventilating sole element 61, which leads to a supporting of the wearer's weight by only the surrounding sole element 81 on a plane surface. This may be desired, as only a portion of the sole needs to be designed for continuous load bearing of the wearer, whereas the material used for the ventilating sole element 61 may be chosen based on the manufacturing characteristics for producing the channel system 160 and/or based on a minimisation of weight of the ventilating sole element 61 and therefore of the centre portion of the sole 7 of the shoe 301a in which the ventilating sole element 61 is situated.

Even though, according to the exemplary embodiment of Fig. 2a, the sole 7 of the shoe 301a is not shown to have an outer sole, it is pointed out that such an additional sole element could be provided therewith as well as with all other embodiments described. Also, the undersides of the ventilating sole element 61 and the surrounding sole element 81 are not provided with a tread structure for improving the grip of the sole assembly 7 on the ground during use of the shoe. It is, however, pointed out that tread elements may be provided at the underside of the sole in all embodiments described. Exemplary tread structures/elements will be described below.

Fig. 2b shows a cross-section through a shoe 301b according to another embodiment. Many elements of the shoe 301b are identical to the corresponding elements of the shoe 301a shown in Fig. 2a. Like or similar elements are denoted with like reference numerals, and a description thereof is omitted for brevity.

The channel structure 160 of the ventilating sole element 61 of the shoe 301b is shown to have a plurality of longitudinal channels 184, which are rectangular in cross-section. The longitudinal channels 184 are connected to each other and to the openings 55 and lateral passages 50 by a plurality of transverse channels 181, one of which being positioned and shown in the cross-sectional plane of Fig. 2b. Each of the lateral ends of the transverse channel 181 coincides with a longitudinal channel 184, and no air and moisture discharging ports are provided in the transverse channels 181. The positioning of these lateral ends is adapted to the positioning of the openings 55 and lateral passages 50, which extend through the side wall 608 of the ventilating sole element 61 and through the surrounding sole element 81, such that the openings 55, lateral passages 50 and the transverse channel 181 allow for air flow therethrough. The small cross-sectional area of the openings 55 and lateral passages 50 through the side walls 702 and 608 as compared to the cross-sectional area of the transverse channel 181 at its lateral ends has the advantage that a large connec-

tion area between the lateral surface 602 of the ventilating sole element 61 and the inner lateral surface 802 of the surrounding sole element 81 is provided, such that a strong attachment can be achieved.

5 The longitudinal channels 184 of the channel structure 160 of the shoe 301b extend deeper into the ventilating sole element 61 than the transverse channels 181. The provision of channels with different heights is one measure of achieving a desired compromise between channel volume and ventilating sole material volume, i.e. a desired compromise between air flow volume and sole stability. Accordingly, different height channels may also be used
10 in the other embodiments described.

In addition to the differences in the channel structure 160, a number of further differences between the embodiment of Fig. 2a and the embodiment of Fig. 2b exist.

15 The ventilating sole element 61 of the shoe 301b does not comprise a circular lip. The surrounding sole element 81 is arranged below a portion of the upper functional layer laminate 17 as well as below a portion of the bottom functional layer laminate 24. In this way, the surrounding sole element 81 allows for a strong attachment and sealing of these laminates to each other. Moreover, the comfort layer 40 is extended over the full width of the
20 ventilating sole element 61, such that the wearer benefits from the comfortable feel thereof over a large portion of the underside of the foot.

In the exemplary embodiment of Fig. 2b, the ventilating sole element 61 and the surrounding sole element 81 are provided with tread elements, in particular with a pattern of protruding and receding portions, for improving the walking characteristics of the shoe 301b.
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It is pointed out that it is possible that the upper material 11, the mesh 12, the upper membrane 13 and the textile lining 14 are formed as a four-layer laminate in the embodiment of Fig. 2b as well as in the other embodiments described.

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Fig. 2c shows a cross-section through a shoe 301c according to another embodiment. Many elements of the shoe 301c are identical to the corresponding elements of the shoe 301b shown in Fig. 2b and shoe 301a shown in Fig. 2a, with a description thereof omitted for brevity. However, the ventilating sole element 61 of the shoe 301c is different from the
35 ventilating sole element 61 of the shoe 301b. The ventilating sole element 61 of the shoe 301c comprises longitudinal channels 184 and transverse channels 181 that extend from the upper surface 606 of the ventilating sole element 61 to the lower surface 604 of the

ventilating sole element 61. In other words, the channels in the ventilating sole element 61 extend along the whole height of the ventilating sole element 61. In this way, water vapour is communicated from the underside of the bottom functional layer laminate 24 to the underside of the shoe 301c through the channels in addition to being communicated to the lateral sides of the shoe 301c through the openings 55 and lateral passages 50. Accordingly, water vapour can be discharged from the inside of the shoe into all directions.

The cross-sectional view of Fig. 2c cuts through a transverse channel 181 of the channel system 160 of the ventilating sole element 61 of the shoe 301c. The water vapour entering the ventilating sole element 61 from the inside of the shoe 301c partially exits the shoe at its underside via the longitudinal channels 184 and the transverse channels 181 of the channel structure 160 and partially through the openings 55 and lateral passages 50, wherein the transverse channels 181 allow for the air communication between the channel system 160 of the ventilating sole element 61 and the lateral passages 50. The transverse channels 181 extend across the full width of the ventilating sole element 61. When seen from the bottom, the ventilating sole element 61 of the shoe 301c is comprised of a plurality of individual inner ventilating sole element blocks separated by the longitudinal and transverse channels.

Again, the transverse channels 181 and/or the longitudinal channels 184 may extend over any portion of the height of the ventilating sole element 61, particularly over the whole height, as shown, or over a portion of the height extending from the top of the ventilating sole element 61 to the inside thereof. Also, the channels in the ventilating sole element 61 may have any direction between the longitudinal direction of the shoe 301c and the transverse direction of the shoe 301c, when seen from its top or bottom. In other words, the channels may be oriented in any direction in the ventilating sole element 61, when looking at a horizontal cross-section through the sole of the shoe.

It is pointed out that the individual components of the ventilating sole element may be injection-moulded onto the upper assembly 8 in separate injection-moulding steps.

The comfort layer 40 of the shoe 301c extends across the entire lateral extension of the ventilating sole element 61 and an adjacent portion of the surrounding sole element 81. In this way, any discontinuities between the ventilating sole element 61 and the surrounding sole element 81, which may be present due to a particular design, such as a lip or collar at the lateral edges of the ventilating sole element 61, or due to manufacturing process imperfections, may be covered with the comfort layer 40, such that these discontinuities are not

detrimental to the wearer's comfort or to the bottom membrane 21. It is pointed out that the comfort layer 40 may also extend beyond the ventilating sole element 61 in other embodiments shown.

- 5 Fig. 2d shows a cross-section through another embodiment of a shoe 301d in accordance with the invention. Again, all elements of the shoe 301d are identical to the corresponding elements of the shoe 301a shown in Fig. 2a, with the exception of the ventilating sole element 61. The ventilating sole element 61 of the shoe 301d comprises channels 184 that extend through the whole height of the ventilating sole element 61. The channels are diagonal,
10 agonal, meaning that their open ends at the upper surface 606 of the ventilating sole element 61 are offset from their open ends at the lower surface 604 of the ventilating sole element 61. This has the advantage that sharp objects that might enter into these diagonal channels, e.g. tacks or nails lying on the ground will normally not pass up the channel, but get stuck in the material of the ventilating sole element 61 and therefore will not damage
15 the functional layer lying above the channels. In the embodiment of Fig. 2d, the diagonal channels 184 are longitudinal channels, with their open ends at the upper surface 606 of the ventilating sole element 61 being offset in a transverse direction from their open ends at the lower surface 604 of the ventilating sole element 61. The diagonal longitudinal channels are connected by horizontal channels 181 in the transverse direction of the shoe
20 301d, i.e. by transverse channels 181. The transverse channels 181 allow for fluid communication between the diagonal channels 184 and the lateral passages 50. Again, the transverse channels 181 may have any vertical extension. They may extend the whole height of the ventilating sole element 61 as well as only portions of it. They may be covered by sole material of the ventilating sole element 61 when viewed from the top of the ventilating
25 sole element 61, as shown, but they may also extend from the top of the ventilating sole element 61 to the inside thereof. It is also possible that the transverse channels are diagonal channels and that the longitudinal channels have a vertical orientation, as for example shown in Fig. 2b. Also, both the longitudinal and the transverse channels may be diagonal, intersecting and forming a particular fluid communication channel structure. In the em-
30 bodiment of Fig. 2d again, water vapour is communicated from the inside of the shoe to the underside of the upper assembly 8 and from there together with the air through the channels and passages out of the sole, allowing for a water vapour discharge from the foot in all directions.
- 35 Again, the comfort layer 40 is shown to be provided directly on top of the ventilating sole element 61.

Fig. 3a shows a cross-section through a shoe 302a according to another embodiment. Many components of the shoe 302a are similar or identical to the corresponding elements of the shoe 301b depicted in Fig. 2b. A description thereof is therefore omitted for brevity. However, the shoe 302a comprises a ventilating sole element 62 and a surrounding sole element 82 that are different from the corresponding elements of the shoe 301b. The ventilating sole element 62 has a varying lateral extension from the upper surface 606 to the lower surface 604. On the upper surface 606 and for approximately the upper two thirds of the ventilating sole element 62, the lateral extension is constant and corresponds to the extension of the ventilating sole element 61 of the shoe 301b. Throughout a lower portion of the ventilating sole element 62, the ventilating sole element 62 extends over the complete lateral extension of the sole assembly 7. The ventilating sole element 62 comprises the entire contact area between the sole assembly 7 and the ground. The ventilating sole element 62 extends underneath the surrounding sole element 82, such that the surrounding sole element 82 does not touch the ground when the shoe is positioned on its sole. The surrounding sole element 82 fills the lateral pocket between the ventilating sole element 62 and the upper assembly 8. It also covers a lower part of the side walls of the upper assembly 8, i.e. it is also adjacent a part of the upper portion 10 of the upper assembly 8 that is arranged in a substantially vertical direction. The ventilating sole element 62 comprises five longitudinal channels 184 in the depicted cross-sectional plane, the longitudinal channels 184 extending approximately one third into the ventilating sole element 62 from the upper surface 606 thereof. The longitudinal channels 184 of the shoe 302a are connected by transverse channels 181 to each other and to the openings 55 and lateral passages 50, with the cross-section of Fig. 3a cutting through one of the transverse channels 181. The transverse channels 181 have the same height extension as the longitudinal channels 184 and also extend from the upper surface 606 of the ventilating sole element 62 thereinto. The longitudinal channels 184 and the transverse channels 181 may be seen as grooves extending into the ventilating sole element 62 from its upper surface 606. Again, many other channel structures are also possible to effect fluid communication between the top of the ventilating sole element 62 and the lateral passages 50, as described with respect to the other Figures.

The design of the shoe 302a allows for a small amount of sole material being needed for the surrounding sole element 82. The ventilating sole element 62, which takes up most of the volume of the sole assembly 7, may be produced separately, and the surrounding sole element 82 may be produced in a quick, well-controlled injection-moulding step. This step may be the last step in finishing the shoe manufacturing.

Fig. 3b shows a cross-section through a shoe 302b according to another embodiment. The shoe 302b is identical to the shoe 302a of Fig. 3a, with the exception of the sole assembly 7. The shoe 302b comprises a ventilating sole element 62 and a surrounding sole element 82. An outsole 92 is provided below the ventilating sole element 62 and the surrounding sole element 82. The surrounding sole element 82 of the shoe 302b is identical to the surrounding sole element 82 of the shoe 302a, shown in Fig. 3a. The ventilating sole element 62 of the shoe 302b extends between the inner lateral surface 802 of the surrounding sole element 82. The outsole 92 extends across the entire width of the sole assembly 7 of the shoe 302b. It covers both the undersides of the ventilating sole element 62 and the surrounding sole element 82. The outsole 92 is the only element of the shoe 302b coming into contact with the ground during normal use of the shoe 302b on an even surface. This design has the advantage that a particularly suitable material for the outsole 92 can be chosen independently from any requirements for the ventilating sole element 62 and the surrounding sole element 82. For example, a thermoplastic polyurethane (TPU) or rubber or leather can be used. Also, the materials of the ventilating sole element 62 and the surrounding sole elements 82 may be chosen purely based on factors such as comfort for the wearer, stability of the sole, bonding properties during the manufacture of the shoe 302b, without having to worry about the wear and tear of the sole through the continuous contact of the sole to the ground during use.

The channel structure 160 of the ventilating sole element 62 has four longitudinal channels 184 in the cross-sectional plane of Fig. 3b. The channel structure also comprises transverse channels 181, one of which being shown in the cross-sectional plane of Fig. 3b. The laterally outermost longitudinal channels 184 are not positioned at the lateral ends of the transverse channel 181. At the lateral ends of the transverse channels 181, air and moisture discharging ports 182 are provided. The air and moisture discharging ports comprise recesses in the floor of the transverse channel 181, with the floor having an inclined shape in the exemplary embodiment of Fig. 3b. The lateral ends of the transverse channel 181 are in air communication with the openings 55 and lateral passages 50, which extend through the side walls 608 and 702 of the ventilating sole element 62 and the surrounding sole element 82, respectively. It is apparent that the channel structure 160 may be modified in various different ways as described above.

Fig. 3c shows a cross-section through a shoe 302c according to another embodiment. Many elements of the shoe 302c are identical to the corresponding elements of the shoes 302a and 302b shown in Figs. 3a and 3b, with a description thereof omitted for brevity.

The bottom functional layer laminate 24 of the bottom portion 20 of the upper assembly 8 of the shoe 302c is a three-layer laminate, which comprises – from bottom to top – a mesh 23, a bottom waterproof and breathable membrane 21 and a supporting textile 22. The mesh 23 may give the bottom functional layer laminate 24 enhanced stability. It is pointed out that the bottom functional layer laminate 24 of the other embodiments may also be the three-layer laminate, as comprised in the shoe 302c.

Fig. 3d shows a cross-section through a shoe 302d according to another embodiment. Many elements of the shoe 302d are identical to the corresponding elements of the shoe 302b shown in Fig. 3b, with a description thereof being omitted for brevity. The ventilating sole element 62 of the shoe 302d extends in between the surrounding sole element 82 in an upper portion of the vertical extension of the surrounding sole element 82. The height extension of the ventilating sole element 62 is approximately half the height extension of the surrounding sole element 82 underneath the upper assembly 8. The channel system 160 of the ventilating sole element 62 is similar to the channel system 160 of the ventilating sole element 62 of the shoe 302a, shown in Fig. 3a. Below the ventilating sole element 62, there is provided a sole comfort layer 122, also referred to as midsole 122. The sole comfort layer 122 is co-extensive with the ventilating sole element 62 in the lateral dimension. The sole comfort layer 122 does not comprise air communication channels in the embodiment shown in Fig. 3d, but may also comprise air communication channels in other embodiments. The three-layered design over a large portion of the lateral extension of the sole assembly 7, i.e. the arrangement of ventilating sole element 62, the sole comfort layer 122 and the outsole 92 on top of each other, allows for selecting a plurality of materials highly suitable for certain tasks. In particular, the material for the outsole 92 may be selected based on its grip and abrasion properties, the material for the sole comfort layer 122 may be selected based on its comfort and cushioning capabilities, and the material for the ventilating sole element 62 may be selected based on its ability to provide stability while having a channel structure therein. These elements may be attached to each other through gluing, injection-moulding or other suitable techniques.

Fig. 3e shows a cross-section through a shoe 302e according to another embodiment. Many elements of the shoe 302e are identical to the corresponding elements of the shoe 302d shown in Fig. 3d, with a description thereof being omitted for brevity.

In contrast to the shoe 302d, the shoe 302e does not comprise a comfort layer and a channeled ventilating sole element. It is, however, pointed out that a comfort layer, as discussed

above, may also be present in the embodiment of the shoe 302e. It is also pointed out that the comfort layer may be dispensed with in the other embodiments described.

5 The shoe 302e comprises a container element 113. The container element 113 is filled with a structure or material 112 allowing for air flow through it. The structure or material 112 extends through the whole volume of the container element 113, which is confined by a bottom part 113a and a side wall 113b. The structure or material 112 allows for air communication between the underside of the bottom functional layer laminate 24 and the openings 55 and lateral passages 50. The openings 55 extend through the side wall 113b of the
10 container element 113 and the lateral passages 50 extend through the side wall 702 of the surrounding sole element 82. It is also possible that the material of the side wall 113b of the container element 113 is made of a material which allows for air flow through it, e.g. a porous material.

15 The container element 113 comprises a circular lip 113c at its upper lateral edge. The circular lip 113c is attached to the upper assembly 8 via the strobil stitch 30, such that at least the container element 113, including the structure or material 112, is fixed with respect to the upper assembly 8, before the surrounding sole element 82 is injection-moulded. It is also possible that the container element 113, the sole comfort layer 122, also referred to as
20 midsole 122, and the outsole 92 are attached to each other, before this composite sole structure is attached to the upper assembly 8 via strobil stitch 30.

The container element 113 forms the ventilating sole element of the shoe 302e. Its placement underneath the bottom functional layer laminate 24 of the upper assembly 8 establishes an air communication between the inside of the shoe, the container element 113 and the openings 55 and lateral passages 50 provided in the side wall of the container element
25 113 and the surrounding sole element 82.

The structure or material 112 may be any such structure or material suitable for allowing
30 air communication and for supporting a desired portion of the wearer's weight during use of the shoe. The structure or material 112 may be comprised of a number of filler elements placed in the container element 113, such that air flow can occur through the voids in between the filler elements. Examples for such a structure or material are man made fabrics with open cell structure or other suitable materials, as described above.

The structure or material 112 allowing for air flow through it may be continuous, three-dimensionally formed such as a spacer or else a porous structure or material, having inherent air flow permitting properties.

5 It is pointed out that the ventilating sole element of other embodiments may also be substituted by the structure or material 112 allowing for air flow through and, if necessary, the container element 113. It is also possible that the whole ventilating sole element is made from an air flow permitting material, such as a porous material, which allows the water vapour discharge from the underside of the upper assembly 8 through lateral passages in
10 the material.

Fig. 3f shows a cross-section through a sole 202b in accordance with another embodiment. The sole 202b corresponds substantially to the sole of the shoe 302c, shown in Fig. 3c, with the exception of a slightly different channel structure 160. Accordingly, a detailed
15 description is omitted for brevity. The sole 202b may be manufactured as a separate element and may be attached to the upper assembly 8 of the shoe 302c or any other upper assembly described herein. The attachment may be achieved by gluing, injection-moulding or any other suitable attachment technique.

20 Fig. 4a shows a cross-section through a shoe 303a according to another embodiment. The upper assembly 8, comprising the upper portion 10, the lower portion 20 and the connection 30 thereof, and the comfort layer 40 of the sole assembly 7 are identical to the upper assembly 8 and the comfort layer 40 of the shoe 302d, shown in Fig. 3d. Also, regarding its outer dimensions, the ventilating sole element 63 of the shoe 303a is identical to the ventilating sole element 62 of the shoe 302d. Regarding the channel structure 160, the ventilating sole element 63 of the shoe 303a is fairly similar to the ventilating sole element 62 of the shoe 302a. However, the channel structure of the ventilating sole element 63 is less
25 wide, and the side wall 608 of the ventilating sole element 63 has a greater lateral extension. A detailed description of these elements is omitted for brevity. The shoe 303a comprises the ventilating sole element 63 and the surrounding sole element 83. Again, openings 55 and lateral passages 50 are provided, which extend through the side wall 608 of the ventilating sole element and side wall 702 of the surrounding sole element for effecting air communication between the channel structure of the ventilating sole element 63 and the lateral outside of the sole assembly 7 of the shoe 303a.

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The surrounding sole element 83 not only surrounds the ventilating sole element 63 laterally, but also passes underneath or is arranged below it in the exemplary embodiment of

shoe 303a. The surrounding sole element 83 comprises supporting members 133. The supporting members 133 extend vertically through the surrounding sole element 83. They are positioned below the ventilating sole element 63. In the present embodiment, the surrounding sole element 83 comprises four supporting members 133 equally spaced below the ventilating sole element 63. Depending on their extension in the longitudinal direction of the shoe 303a, the supporting members 133 may be ribs or stilts. In other words, the supporting members 133 may have longitudinal extensions substantially equal to their transverse extensions, shown in Fig. 4a, or may have longitudinal extensions substantially larger than their transverse extensions. In another embodiment, the supporting members may be formed as transverse ribs.

The supporting members 133 may be manufactured as follows. The supporting members 133 may be made from the same material as the ventilating sole element 63. In this case the ventilating sole element 63 and the supporting members 133 may be injection-moulded integrally in one injection-moulding step. Accordingly, the surrounding sole element 83 may then be injection-moulded around the ventilating sole element 63, parts of the upper assembly 8 and the supporting members 133 in a subsequent injection-moulding step. It is also possible that the supporting members 133 are manufactured separately. In this case, they may either be attached to the ventilating sole element 63 or may be kept in a fixed position with respect to the ventilating sole element 63 in a mould, before the surrounding sole element 83 is injection-moulded.

The supporting members 133 contribute to the stability of the sole, in particular of the ventilating sole element of the shoe 303a. Their positioning underneath the ventilating sole element 63 may offset stability disadvantages that may arise from the channeled structure of the ventilating sole element 63. Moreover, the supporting members 133 allow for a less restricted selection of the material for the surrounding sole element 83, because sole stability is less of a concern. The supporting members 133 also keep the ventilating sole element 63 elevated to allow the surrounding sole element material 83 to flow underneath the ventilating sole element 63 during injection moulding.

Fig. 4b shows a cross-section through a shoe 303b according to another embodiment. Many elements of the shoe 303b are identical to the corresponding elements of the shoe 303a, shown in Fig. 4a, such that a description thereof is omitted for brevity. The ventilating sole element 63 of the shoe 303b comprises the channels given in the ventilating sole element 63 of the shoe 303a. Also, the openings 55 and lateral passages 50, extending through the side walls 608 and 702 of the ventilating sole element 63 and the surrounding

sole element 83, are identical to the openings 55 and lateral passages 50 of the shoe 303b. Additionally, vertical passages 52 are provided, which extend vertically from the channel structure of the ventilating sole element 63 through the ventilating sole element 63 to its lower surface 604 and further through the surrounding sole element 83. The vertical channels 52 allow for air flow between the channel structure of the ventilating sole element 63 and the underside of the sole assembly 7. In this way, vertical water vapour and air discharge channels are provided in the shoe 303b, such that a higher breathability is achieved. The supporting members 133 of the surrounding sole element 83 are arranged around the vertical channels 52 in the surrounding sole element 83. In other words, the supporting members 133 of the surrounding sole element 83 of the shoe 303a are hollow structures, through which the vertical channels 52 extend. It is pointed out that the surrounding sole element 83 may also be provided without hollow supporting members 133, but may still have vertical channels. In general words, vertical channels may extend through the surrounding sole element 83 in its portion below the ventilating sole element 63. Such vertical channels can be made by having vertical pins fixated in a bottom piston of the mould.

The shoe 303b additionally comprises inserts 51 arranged in at least a portion of the lateral passages 50 of the surrounding sole element 83. The inserts 51 are pin-shaped. They comprise pin-heads with the pin-head extension being greater than the diameter of the lateral passages 50. The inserts 51 have a hollow structure, such that air and water vapour discharge from the ventilating sole element 63 through the lateral passages 50 is effected through the inside of the inserts 51. The diameter of the lateral passages 50 may be enlarged so as to accommodate the inserts and ensure an adequate air flow through them.

Without the inserts 51, the walls of the lateral passages 50 may be rough or uneven from the manufacturing process, giving rise to turbulences in the air flow therethrough and diminished air and water vapour discharge capabilities. The hollow inserts 51 ensure that the air flow through the lateral passages 50 flows along smooth surfaces and is highly efficient in transporting air and water vapour from the ventilating sole element 63 to the outside of the sole of the shoe 303b. An unimpeded air and water vapour flow through the lateral passages may be achieved by the inserts 51 in a cheaper way than by optimizing manufacturing processes, such as injection-moulding processes for the surrounding sole element 83.

The inserts 51 may be removable inserts, allowing the wearer to insert them as desired to account for different usage scenarios. Being removable, the inserts 51 are also a way of making the appearance of the shoe adjustable by the wearer.

The inserts 51 may also be solid, i.e. not hollow, and removable. In this case, the wearer may insert the inserts 51 in extremely adverse usage environments, such as during heavy rainfalls or hiking through puddles or muddy terrain. In this way, an entering of water, mud, etc. into the sole may be completely prevented, such that the lateral passages 50 and the ventilating sole element 63 may not be clogged up or made impermeable to air flow in any other way for later use. Also, these solid inserts may be used in low temperature conditions, such that no flow of cold air through the lateral passages 50 and the ventilating sole element 63 causes discomfort to the wearer. In order to save material and weight, it is also possible to only make the heads of the pins solid, with the portions of the pins received by the lateral passages being hollow. Another measure against the discomfort of cold air flow is to provide an insulating comfort layer 40 or an insulating bottom functional layer laminate 24.

The inserts 51 may be made of metal or plastic or any other suitable material.

It is pointed out that the provision of the inserts 51 and the provision of the hollow supporting members 133 are independent. While they both may enhance the water vapour characteristics of the shoe 303b, one feature may also be provided without the other. Also, both features may be provided in the other embodiments discussed, separately or in combination.

Fig. 5 shows a cross-section through a shoe 304 according to another embodiment. Many elements of the shoe 304, particularly the whole upper assembly 8, are identical to the shoe 303a, as shown in Fig. 4a. Also, the ventilating sole element 64 of the shoe 304 is similar to the ventilating sole element 63 of the shoe 303a. The surrounding sole element 84 of the shoe 304 is modified as compared to the surrounding sole element 83 of the shoe 303a. The surrounding sole element 84 of the shoe 304 does not extend to the bottom of the shoe 304, i.e. to the surface area of the shoe 304 that gets into contact with the ground during normal use. The vertical extension of the surrounding sole element 84 of the shoe 304 is smaller than the vertical extension of the surrounding sole element 83 of the shoe 303a.

An outsole 94 is arranged underneath the surrounding sole element 84 of the shoe 304. The outsole extends over substantially the whole lateral extension of the surrounding sole element 84. In the cross-sectional view of Fig. 5, the outsole 94 extends over the whole width of the surrounding sole element 84. The outsole 94 is provided with a tread in order to increase traction for the wearer on a variety of surfaces. The outsole 94 does not comprise supporting members. Supporting members 134 are present in the surrounding sole element

84. Providing a separate outsole 94 for the shoe 304 has the same advantages as providing the outsole 92 for the shoe 302b, as discussed in connection with Fig. 3b.

Fig. 6a shows a cross-section through a shoe 305a according to another embodiment. The
5 upper assembly 8 and the comfort layer 40 of the shoe 305a correspond to the upper assembly 8 and the comfort layer of the shoe 304, as described with reference to Fig. 5. The shoe 305a comprises a ventilating sole element 65 and a surrounding sole element 85. The ventilating sole element 65 has a channel structure 160 identical to the channel structure 160 of the ventilating sole element 64 of the shoe 304 of Fig. 5. The surrounding sole element 85 has lateral passages 50, which are in fluid communication with openings 55 and
10 the channel system 160 of the ventilating sole element 65.

The lateral extension of the ventilating sole element 65 changes somewhat below the height of the lower end of the lateral passages 50. Approximately half way from the upper
15 surface 606 of the ventilating sole element 65 to its lower surface 604, the ventilating sole element 65 extends across almost the entire width of the transverse extension of the ventilating sole element. The surrounding sole element 85 forms a sole element surrounding the lateral surface 602 of the wider portion of the ventilating sole element 65. It also covers the lower surface 604 of the ventilating sole element 65, thereby forming the contact surface of the shoe 305a with the ground. The surrounding sole element 85 also fills the
20 pocket between the ventilating sole element 65 and the upper assembly 8, thereby effecting an attachment between these two components and a waterproof seal between the upper portion 10 and the lower portion 20.

25 The surrounding sole element 85 comprises supporting members 135 arranged below the ventilating sole element 65. The design of the ventilating sole element of the shoe 305a ensures that the cushioning and comfort capacities of the ventilating sole element 65 are taken advantage of over a large volume of the ventilating sole element, while the complete surrounding of the ventilating sole element 65 by the surrounding sole element 85 allows
30 for a uniform optical appearance of the shoe and for the provision of a durable outer material across all outer walls of the sole assembly 7. The surrounding sole element 85 is provided with a tread structure.

Fig. 6b shows a cross-section through a shoe 305b according to another embodiment. As
35 compared to Fig. 6a, the surrounding sole element 85 is modified in that it does not comprise a portion that gets into contact with the ground during regular use of the shoe 305b. In other words, the surrounding sole element 85 surrounds the ventilating sole element 65

only laterally, not from the bottom side. An outsole 95 is provided below the undersides of the ventilating sole element 65 and the surrounding sole element 85. The outsole 95 comprises supporting members 135. The supporting members 135 are comparable to the supporting members 135 shown in the lower layer of the surrounding sole element 85 of Fig. 6a. Moreover, the outsole 95 comprises a tread structure on its underside. The advantages of having a separate outsole 95 element are the same as described with the outsole 92 of the shoe 302b shown in Fig. 3b.

Fig. 6c shows a cross-section through a shoe 305c according to another embodiment. The upper assembly 8 of the shoe 305c comprises an upper portion 10, comprising an upper material 11 and an upper functional layer laminate 17, and a bottom portion 20, comprising a bottom functional layer laminate 24. The bottom functional layer laminate 24 extends across the entire horizontal portion of the upper assembly 8. It also extends somewhat up the side portions of the upper assembly 8. The upper functional layer laminate 17 does not extend all the way down to the transition from the horizontal portion to the side portions of the upper assembly 8. The upper material 11, including the netband 15, may extend as far down as the upper functional layer laminate 17 or further down than the upper functional layer laminate 17. In the exemplary embodiment of Fig. 6c, the netband 15 extends down to the bottom end of the lateral sides of the upper assembly 8. The upper functional layer laminate 17 and the bottom functional layer laminate 24 are brought close together with the respective edges, with a strobil stitch 30 connecting these components in the exemplary embodiment of Fig. 6c. The strobil stitch 30 also attaches the netband 15 to these components.

A ventilating sole element 65, which is arranged below the bottom functional layer laminate 24 and a comfort layer 40, extend across most of the horizontal portion of the bottom functional layer laminate 24. In fact, the ventilating sole element 65 may extend over the entire horizontal portion of the bottom functional layer laminate 24. This is possible because the seam 30, joining the netband 15 of the upper material 11, the bottom functional layer laminate 24 and the upper functional layer laminate 17, is situated at a lower lateral side of the upper assembly 8 rather than at the underside of the upper assembly 8. The surrounding sole element 84 may thus only be applied outside the horizontal lateral extension of the bottom functional layer laminate 24, rather than also underneath the bottom functional layer laminate 24 (which is the case in Fig. 6c), whilst still being able to seal the seam 30.

The ventilating sole element 65 in Fig. 6c has a constant width along its vertical extension in the cross-sectional plane of Fig. 6c. It may have a constant width in all transverse cross-sections throughout the entire longitudinal direction of the shoe 305c. It is also possible, however, that the width of the ventilating sole element 65 may vary in the vertical dimension in other transverse cross-sections at different longitudinal points throughout the shoe 305c, as shown for example in Fig. 1. The channel structure 160 of the ventilating sole element 65 of the shoe 305c corresponds to the channel structure 160 of the ventilating sole element 65 of the shoe 305b, shown in Fig. 6b.

Providing the ventilating sole element 65 over all or almost the entire lateral dimension of the sole assembly 7 has the advantage that the high water vapour discharge capabilities of the bottom functional layer laminate 24 and the ventilating sole element 65 receiving the water vapour therefrom may be taken advantage of over a large area. This feature may also be applied to all of the other embodiments.

The surrounding sole element 85 surrounds the lateral surface 602 of the ventilating sole element 65. It has a constant width throughout the vertical extension of the ventilating sole element 65. Above that vertical extension, the surrounding sole element 85 laterally surrounds a lower portion of the upper assembly 8. The sole material of the surrounding sole element 85 is penetrated through the netband 15 and through the strobil stitch 30, thereby sealing the connection region between the upper portion 10 and the lower portion 20 of the upper assembly 8. Underneath the ventilating sole element 65 and the surrounding sole element 85, an outsole 95 is provided. Again, the outsole 95 is provided with supporting members 135 and a tread structure on its underside.

Fig. 7 shows a cross-section through a shoe 306 according to another embodiment. The upper assembly 8 of the shoe 306 is identical to the upper assemblies of both the shoe 301b of Fig. 2b and the shoe 302b of Fig. 3b, with the exception of the bottom functional layer laminate 24 used, which will be discussed below. The shoe 306 does not comprise a comfort layer on top of the ventilating sole element 66. The surrounding sole element 86 of the shoe 306 is identical to the surrounding sole element 81 of the shoe 301b. The ventilating sole element 66 of the shoe 306 has a channel structure 160 similar to the channel structure 160 of the ventilating sole element 62 of the shoe 302c, but comprising only 4 longitudinal channels 184. The lateral extension of the ventilating sole element 66 of the shoe 306 is identical to the lateral extension of the ventilating sole element 62 of the shoe 302c. The ventilating sole element 66 extends between the surrounding sole element 86 with a constant width along the vertical dimension. The ventilating sole element 66 ex-

tends all the way down to the bottom of the sole, particularly as far down vertically as the surrounding sole element 86. The ventilating sole element 66 and the surrounding sole element 86 form a flush surface (with the exception of the tread structures) for getting into contact with the ground during use of the shoe 306. Therefore, the weight of the wearer may be evenly distributed between the two components of the ventilating sole element.

The bottom functional layer laminate 24 of the shoe 306 is provided with dots 29, also referred to as knobs, on its lower side. Accordingly, the dots 29 are provided on the lower surface of the bottom membrane 21. The dots 29 are polymeric dots distributed over the lower surface of the bottom functional layer or membrane in a regular pattern, particularly in parallel rows extending in the transverse direction of the shoe, with one such row being shown in the cross-sectional view of Fig. 7. The dots 29 have a cushioning effect, such that the wearer's comfort is ensured despite the non-uniform nature of the top surface of the ventilating sole element 66. The dots 29 have been found to be so efficient that the comfort layer may be dispensed with. A bottom functional layer laminate 24 having polymeric dots 29 may be applied to all other embodiments as well. Due to the spaces present between the discrete dots 29, the water vapour permeability of the bottom functional layer laminate 24 is not compromised. As the bottom functional layer laminate 24 may be readily manufactured including the dots 29, such a laminate may reduce the number of components needed for manufacturing the shoe, such that gains in the manufacturing efficiency may be achieved.

Fig. 8 shows a cross-section through a shoe 308 according to another embodiment. The upper assembly 8 is similar to the upper assembly 8 of the shoe 305c shown in Fig. 6c, and a comfort layer 40 is disposed between the bottom functional layer laminate 24 and a ventilating sole element 68. The shoe 308 comprises the ventilating sole element 68 and a surrounding sole element 88. The ventilating sole element 68 extends vertically from the comfort layer 40 to the lower end of the shoe 308 forming an outer sole of the shoe 308. The ventilating sole element 68 is equipped with a tread structure at its underside. The ventilating sole element 68 extends across the entire lateral dimension of the shoe 308 in its lower portion. In its upper portion, the lateral dimension of the ventilating sole element 68 is reduced as compared to the lower portion. The lateral extension of the upper portion of the ventilating sole element 68 corresponds approximately to the lateral extension of the upper assembly 8. The surrounding sole element 88 surrounds the upper portion of the ventilating sole element 68 and a lower portion of the upper assembly 8, covering the connection region 30 between the upper portion 10 and the lower portion 20 of the upper assembly 8. Openings 55 and lateral passages 50 are provided, which extend through the side wall 608

of the ventilating sole element 68 and the side wall 702 of the surrounding sole element 88, respectively, and which are in air communication with the channel structure 160 of the ventilating sole element 68. The ventilating sole element 68 comprises a channel structure 160 corresponding to the channel structure 160 of the ventilating sole element 65 of the shoe 305c.

The surrounding sole element 88 has a small lateral extension, which allows for a very uniform design of the ventilating sole element 68, as the vast majority of the sole volume is provided by the ventilating sole element 68. Again, the small volume of the surrounding sole element 88 allows for a quick and well-controlled injection-moulding of the surrounding sole element 88, while the attachment between ventilating sole element 68 and upper assembly 8 as well as the sealing of the connection between the upper portion 10 and the lower portion 20 of the upper assembly 8 as well as the water vapour discharge capabilities through the lateral passages 50 can be ensured.

In the embodiments described, a number of modifications may be made, as is apparent to a person skilled in that art. Further, the embodiments can be combined in different ways.

For example, instead of injection-moulding, other techniques can be used for manufacturing the sole elements of the embodiments described above. For example, the ventilating sole element may also be poured into a mould in a casting process. Vulcanizing is another well-known sole production process.

Another exemplary modification relates to the two-layer bottom functional layer laminate described. It is also possible to provide a three-layer bottom functional layer laminate, having a third layer below the lower membrane. The third layer may be a mesh or another suitable material that allows penetration of sole material therethrough during injection-moulding, such that a sealing of the lower membrane to the upper membrane may be effected.

Another exemplary modification is that the at least one lateral passage 50 can be provided with inserts that can be removed before the first use. In particular, the inserts may be connected to the material around the lateral passages, in particular to the surrounding sole element. However, such attachment may be weak, for example only comprising local attachment points, such that a user may remove the inserts by hand. In this way, it is ensured that the lateral passages remain free of dirt during the shipping and selling process, but that the lateral passages can be easily completed by the wearer of the shoe.

In the following, an exemplary method for manufacturing a shoe in accordance with principles of the invention will be described. The skilled person will be aware that various changes or adaptations may be made in manufacturing the shoe as far as appropriate and depending on the particular needs of the respective shoe construction.

The manufacturing method described in the steps below is described by way of polyurethane injection of the ventilating sole element. However, any other suitable material for forming the ventilating sole element may be used, e.g. Ethylene Vinyl Acetate (EVA). Alternatively, the ventilating sole element can be made in a casting process where the ventilating sole element material is poured (i.e. not injected) into a mould where it is formed and cured or in a vulcanization process.

In a process of forming an upper assembly, a bottom portion 20 of the upper assembly is attached to an upper portion 10 thereof. This can be done in any suitable way, for example using commonly known methods such as gluing, stitching etc. For example, the bottom portion may comprise a breathable insole or a waterproof, breathable functional layer laminate with a membrane being waterproof and water vapour permeable. The bottom portion may extend between lower end areas of the upper portion such as shown in the examples of Figs. 1 to 8. Particularly, the bottom portion may be seen as the lower part of the upper assembly extending between the seams 30. Accordingly, it may encompass also parts of the side portions of the upper assembly.

In the examples of Figures 1 - 8 as described above, the bottom portion 20 of the upper assembly comprises a waterproof, breathable bottom functional layer laminate. In an embodiment, a 2-layer bottom functional layer laminate is stitched ("strobeled") to a waterproof, breathable upper functional layer laminate at a stitched seam 30 according to the Strobel method as described above. For example, the laminate may have a textile layer 22 on top towards the foot and a membrane, which is waterproof and breathable, below towards the sole.

In the process of forming a sole assembly, an outsole, e.g. of rubber, is made in a respective manufacturing step as commonly known. The rubber is vulcanized and shaped into an outsole. Afterwards, the outsole may optionally be chemically primed by brushing "TFL Primer" (commercially available from the company Forbo Adhesives) on the surface facing the foot. Priming is carried out on open rubber cells in a well known manner to improve the connection to the polyurethane of the ventilating sole element which is later in-

jected. After such priming, glue (for example, Helmipur® GPU from Forbo Adhesives) is applied to that area of the outsole where the ventilating sole element is to be placed later. The outsole is dried for a particular period of time as necessary, for example half an hour at 25-40°C.

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Thereafter, optionally a shank (not shown in Fig. 9b) as commonly known may be mounted on the outsole on the side facing the foot. The shank may be adhered to the outsole and may be elevated, e.g., by 3-5 millimetre high protrusions which are arranged on the side of the shank facing the outsole. This elevation allows the material of the ventilating sole element to enter between shank and outsole during the injection taking place later.

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In a further step, the outsole is then placed on a piston of a mould, which is in the present embodiment a first injection form or mould and is shaped to mould the ventilating sole element. An exemplary injection mould 210 is shown in Fig. 9a. It comprises side frames 211 which are shown in a closed position surrounding a bottom portion 213 of the mould. The structure visible on top of the bottom portion 213 is arranged to form the channel structure in the ventilating sole element, as can be seen in Fig. 9c with channel structure 162. The outsole may be placed on another part of the mould 210, for example on a top piston as the top part of the mould. For example, as shown in Fig. 9b, an outsole 191 is placed on top of a top piston 212 of the mould 210. In a subsequent step, the side frames 211 of the mould 210 close from an opened state into the state as shown in Fig. 9a, wherein the top piston 212 with the outsole 191 facing the inner space of the mould is lowered and seals the mould 210 from the top (not shown).

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Afterwards, the material forming the ventilating sole element, such as polyurethane, is injected into the mould 210 (e.g., conventional polyurethane of the type such as MS18 from Elastogran GmbH (BASF)). In an embodiment of the invention, this may be the same polyurethane which is used for a surrounding sole element (which may also be seen as a midsole) later on. In another embodiment the polyurethane of the ventilating sole element is softer (Shore A value of e.g. 30-45) than a polyurethane used for the surrounding sole element (Shore A value of e.g. 45-65). This increases comfort for the wearer. During injection the formed ventilating sole element is bonded to the outsole. After completion of the injection process, these two components now form a monolithic entity, as can be seen in Fig. 9c. Subsequently, the edges of the ventilating sole element may be manually treated for superfluous material, if any.

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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 ventilating sole element attached to an outsole. An embodiment of a ventilating sole element 161 attached to an outsole 191 is shown in Fig. 9c. In other embodiments, according to the aspects as described with reference to Figures 1 to 8, a semimanufactured product comprising any type of ventilating sole element with or without an outsole component and/or stilts may be manufactured in a first stage of a manufacturing process, e.g. by a sub-supplier.

As illustrated in Fig. 10, a breathable comfort layer 40 is fixed on the surface of the ventilating sole element, e.g. by glue being manually spread on the edge of the ventilating sole element or over parts of or the full surface of the ventilating sole element. According to an embodiment, before assembling the material on the ventilating sole element, mechanical pressure is applied to the material, which is compressed, e.g., from 2 mm to 1 mm in thickness. This may be done to make the material more compact and hence to lower the amount of water absorbed. This advantageously prevents the material from acting as sponge which nurtures growth of fungus and the like.

The ventilating sole element with the outsole and the comfort layer is then placed in an injection mould, such as a second injection mould 220 (which in this embodiment is different from the first injection mould 210 for forming the ventilating sole element), as shown in Fig. 11. For example, the outsole 191 with the ventilating sole element 161 and the comfort layer 40 is placed on top of a bottom piston 222. The second injection mould 220 incorporates pins 221 in the side frames for making lateral passages in a surrounding sole element which is formed during the following injection process.

At the beginning of the moulding process, the last with the upper portion 10 of the shoe is lowered into the second injection mould 220. The bottom piston 222 is then raised until the ventilating sole element has firm contact with the bottom portion 20 of the shoe upper assembly placed on the last. The contact between ventilating sole element with comfort layer and the bottom portion 20 must be so tight that polyurethane from the upcoming injection does not enter between bottom portion 20 and comfort layer. In order to achieve a tight sealing a lip extends vertically from the surface of the ventilating sole element. The lip could be arranged around the full upper circumferential edge of the sole element, but preferably a U-shaped lip of approx 2 mm height is made in the heel area, and a 1 mm high lip is made in the forefoot area. When raising bottom piston 222 against bottom portion 20

an extra mechanical pressure is exerted on the lip in order to deform it a bit. Due to the force impact the lip will bend outside and away from the ventilating sole element, and with the aid of the comfort layer make a tight seal which prevents entry of polyurethane. After raising the bottom piston the side frames with pins 221 close the mould 220, as shown in
5 Fig. 12. The pins 221 contact the side wall of the ventilating sole element so as to form lateral passages 50 in the surrounding sole element to be injected, but do not penetrate them.

Thereafter, an injection with surrounding sole material, particularly PU, is made, hereby
10 creating a surrounding sole element. After a certain curing time (e.g. 3.5 minutes) the side frames are opened and last with the shoe is lifted. Any remaining sprue is manually removed from the surrounding sole element with a knife.

In a subsequent step, openings 55 are made in the side wall of the ventilating sole element,
15 e.g. with a laser or a drill or puncturing e.g. with a hot needle or other thermal means of removing wall material. In this regard, Fig. 13 shows a drilling apparatus 230 with a drill 231 suitable for entering into the lateral passages 50.

The creation of openings 55 in the side wall of the ventilating sole element connects the
20 lateral passages 50 of the surrounding sole element to the structure or material of the ventilating sole element, so that water vapour can flow and/or diffuse through the bottom portion of the upper assembly and then flow through the structure or material of the ventilating sole element together with the air flowing therethrough and then through the lateral passages in the surrounding sole element to the outside of the shoe, that is the ambient air.
25 It is not necessary that pins of the mould for forming the surrounding sole element are exactly aligned with any channels or open parts in the ventilating sole element prior to injection moulding, to ensure there is a safe connection between the passages and openings with a smooth transition and that no injected material can enter into the channels or openings of the ventilating sole element. Rather, according to the invention, the pins for forming the
30 lateral passages do not penetrate into any channels or open parts of the ventilating sole element. They can have a position in which they are adjacent to or in contact with the side wall of the ventilating sole element. The pins can have a position which is not aligned with any channels or open parts, if any, formed in the ventilating sole element. The structure or material of the ventilating sole element and the lateral passages in the surrounding sole
35 element are interconnected by making apertures or openings in the ventilating sole element through the lateral passages, so that thereafter there is a reliable path for air to communicate between the structure or material of the ventilating sole element and an outside of the

surrounding sole element, that is the ambient air, regardless of the exact position of the moulding pins.

Fig. 14 shows a finished shoe with a surrounding sole element 181 having lateral passages
5 50 formed therein. According to an embodiment, the process of drilling starts with high speed and then switches to a lower speed of the drill.

A functional layer/membrane as described herein is a water vapour-permeable and/or wa-
terproof layer, for example, in the form of a membrane or a correspondingly treated or fin-
10 ished material, for example, a textile with plasma treatment. Both the lower functional layer, also referred to as lower membrane, and the upper functional layer, also referred to as upper membrane, can be parts of a multilayer, generally a two-, three- or four-layer laminate; the lower functional layer and the upper functional layer are sealed so as to be waterproof in the lower area of the shaft arrangement on the sole side; the lower functional
15 layer and the upper functional layer can also be formed from one material.

Appropriate materials for the waterproof, water-vapour-permeable functional layer are es-
pecially polyurethane, polyolefins, and polyesters, including polyether esters and laminates
thereof, as described in documents US-A-4,725,418 and US-A-4,493,870. In one variant.
20 the functional layer is constructed with microporous, expanded polytetrafluoroethylene (ePTFE), as described, for example, in documents US-A-3,953,566 and US-A-4,187,390, and expanded polytetrafluoroethylene provided with hydrophilic impregnation agents and/or hydrophilic layers; see, for example, document US-A-4,194,041. Microporous func-
tional layers are understood to mean functional layers whose average effective pore size is
25 between 0.1 and 2 μm , preferably between 0.2 μm and 0.3 μm .

A laminate as described herein is a composite consisting of several layers permanently joined together, generally by mutual gluing or sealing. In a functional-layer laminate, a waterproof and/or water vapour-permeable functional layer is provided with at least one
30 textile layer. The at least one textile layer mostly serves to protect the functional layer during its processing. Here, we speak of a two-layer laminate. A three-layer laminate consists of a waterproof, water-vapour-permeable functional layer embedded in two textile layers. The connection between the functional layer and the at least one textile layer occurs by means of a discontinuous glue layer or a continuous water-vapour-permeable glue layer. In
35 one variant, a glue can be applied spot-wise between the functional layer and the one or two textile layers. Spot-wise or discontinuous application of glue occurs because a full-

surface layer of a glue that is not water vapour-permeable itself would block the water-vapour permeability of the functional layer.

5 A functional layer / functional-layer laminate is considered "waterproof," optionally including the seams provided on the functional layer / functional-layer laminate, if it guarantees a water-entry pressure of at least 1×10^4 Pa. The functional-layer material preferably withstands a water-entry pressure of more than 1×10^5 Pa. The water-entry pressure is then measured according to a test method in which distilled water at 20 ± 2 °C is applied to a sample of 100 cm^2 of the functional layer with increasing pressure. The pressure increase
10 of the water is $60 \pm 3 \text{ cm H}_2\text{O}$ per minute. The water-entry pressure then corresponds to the pressure at which water first appears on the other side of the sample. Details concerning the procedure are stipulated in ISO standard 0811 from the year 1981.

Whether a shoe is watertight can be tested, for example, with a centrifuge arrangement of
15 the type described in US-A-5,329,807.

A functional layer / functional-layer laminate is considered "water-vapour permeable" or "breathable" if it has a water-vapour-permeability number Ret of less than $150 \text{ m}^2 \times \text{Pa} \times \text{W}^{-1}$. Water-vapour permeability is tested according to Hohenstein skin model. This test
20 method is described in DIN EN 31092 (02/94) and ISO 11092 (1993).

Claims

- 5 1. Method for manufacturing a breathable sole assembly, comprising the steps of:
 providing a ventilating sole element (161) having a structure or material allowing for
 air flow through it,
 placing the ventilating sole element (161) in a mould (220), said mould having pins
 (221) projecting in a lateral direction;
10 closing the mould (220) such that the pins (221) contact a side wall of the ventilating
 sole element (161), and injection moulding so as to form a surrounding sole element (195)
 being fixed to the ventilating sole element, said surrounding sole element comprising lat-
 eral passages (50) from the outside of the surrounding sole element to the side wall of the
 ventilating sole element formed by the pins; and
15 after injection moulding, connecting the lateral passages (50) of the surrounding sole
 element to the structure or material of the ventilating sole element (161).
2. Method for manufacturing a breathable shoe, comprising the steps of:
 providing an upper assembly with an upper portion (10) comprising an outer material
20 (11) and a breathable bottom portion (20);
 providing a ventilating sole element (161) having a structure or material allowing for
 air flow through it;
 placing the ventilating sole element (161) in a mould (220), said mould having pins
 (221) projecting in a lateral direction;
25 positioning the ventilating sole element (161) and the upper assembly (8) such that an
 upper part of the ventilating sole element contacts the bottom portion of the upper assem-
 bly;
 closing the mould (220) such that the pins (221) contact a side wall of the ventilating
 sole element (161), and injection moulding so as to form a surrounding sole element (195)
30 being fixed to the upper assembly and to the ventilating sole element, said surrounding
 sole element comprising lateral passages (50) from the outside of the surrounding sole ele-
 ment to the side wall of the ventilating sole element formed by the pins; and
 after injection moulding, connecting the lateral passages (50) of the surrounding sole
 element (195) to the structure or material of the ventilating sole element.
- 35 3. Method of claim 1 or 2, wherein the lateral passages (50) of the surrounding sole ele-
 ment (195) are connected to the structure or material of the ventilating sole element by

making at least one opening (55) through the side wall of the ventilating sole element (161) through the lateral passages (50) of the surrounding sole element (195), particularly by drilling, puncturing, lasering or other thermal removal.

5 4. The method of one of the preceding claims, wherein the ventilating sole element (161) has a channel structure (162) at least at an upper side thereof allowing for communication of air between the channels and the lateral passages (50) of the surrounding sole element.

10 5. The method of one of the preceding claims, wherein the ventilating sole element (161) is made as a container element having a bottom part and a side wall so as to form an inner space of the container element, wherein in the inner space there is positioned a structure or material allowing for air flow through it.

15 6. The method of one of claims 2 to 5 wherein the ventilating sole element (161) has a functional layer attached to the surface facing the bottom portion (20) of the upper assembly.

20 7. The method of one of claims 2 to 6, wherein the upper assembly (8) comprises a breathable outer material (11) and a waterproof, breathable functional layer arrangement (13, 21) extending over said upper portion (10) and said bottom portion (20) .

25 8. The method of claim 7, wherein a side end area of a bottom functional layer (24) of said functional layer arrangement and a lower end area of an upper functional layer (17) of said functional layer arrangement are connected to one another with a waterproof seal being provided at the connection.

30 9. The method of claim 8, wherein the side end area of said bottom functional layer (24) and the lower end area of said upper functional layer (17) are stitched to one another to form a stitched seam (30).

10. The method of claim 9, wherein said surrounding sole element (195) is moulded so as to penetrate to the upper functional layer (17) so as to form a seal at the stitched seam (30) by material of the surrounding sole element (195) formed by the injection moulding, .

35 11. The method of one of claims 8 to 10, wherein a netband (15) is provided, said netband connecting a lower end area of the breathable outer material (11) with the side end area of

the bottom functional layer (24), and wherein said netband (15) is penetrated by material of the surrounding sole element (195) in the moulding step.

12. The method of one of claims 7 to 11, wherein said bottom functional layer (24) is provided with supporting members (29), particularly knobs, at its lower surface.

13. The method of one of the preceding claims, wherein the ventilating sole element (161) comprises at least one lip (101) protruding from the side wall of the ventilating sole element.

14. The method according to claim 13, wherein positioning of the ventilating sole element (161) is done with a bottom piston (222) pressing and deforming said protruding lip (101) of the ventilating sole element against the bottom portion (20) of the upper assembly.

15. The method of one of claims 1 to 14 wherein the ventilating sole element (161) is attached to the bottom portion (20) of the upper assembly in a first injection-moulding step, and connected to the surrounding sole element (195) formed in a second injection-moulding step.

16. The method of one of claims 1 to 15, wherein a comfort layer (40) is provided on top of said ventilating sole element (161) towards the upper assembly.

17. The method of claim 16, wherein the comfort layer (40) is attached to the top of said ventilating sole element (161), in particular by spotwise or circumferential gluing.

18. The method of one of claims 1 to 17, wherein the underside of said ventilating sole element (161) forms at least a part of an outer sole.

19. The method of one of claims 1 to 17, wherein the undersides of said surrounding sole element (195) and of said ventilating sole element (161) form at least a part of an outer sole.

20. The method of one of claims 1 to 19, wherein the underside of said ventilating sole element (161) is arranged at a higher position as compared to the underside of said surrounding sole element (195).

21. The method of one of claims 1 to 20, wherein an additional sole element (90; 92; 94; 95; 97; 99) is provided forming at least a part of an outer sole, said additional sole element being arranged below said ventilating sole element (161).

5 22. The method of claim 21, wherein said additional sole element (90; 92; 94; 95; 97; 99) is arranged below said surrounding sole element (195) and said ventilating sole element (161).

23. The method of one of claims 1 to 22, wherein said surrounding sole element (195)
10 extends below said ventilating sole element (161).

24. The method of claim 23, wherein said surrounding sole element (195) forms at least a part of an outer sole.

15 25. The method of claim 23, wherein an additional outer sole element (90; 92; 94; 95; 97; 99) forming at least a part of an outer sole is arranged below said surrounding sole element (195).

26. The method of claim 23, wherein supporting members (133; 134; 135) are formed in
20 portions of said surrounding sole element below said ventilating sole element, said supporting members extending substantially vertically through said surrounding sole element.

27. The method of one of claims 2 to 26, wherein a comfort layer (40) is provided on top
25 of said ventilating sole element (161) towards the upper assembly, wherein the comfort layer has an upper side and a lower side, where the upper side is facing the bottom portion (20) of the upper assembly, and the lower side is facing the ventilating sole element (161), wherein the lower side is stiffer than the upper side, particularly the lower side being stiff and the upper side being soft.

30

Fig. 1

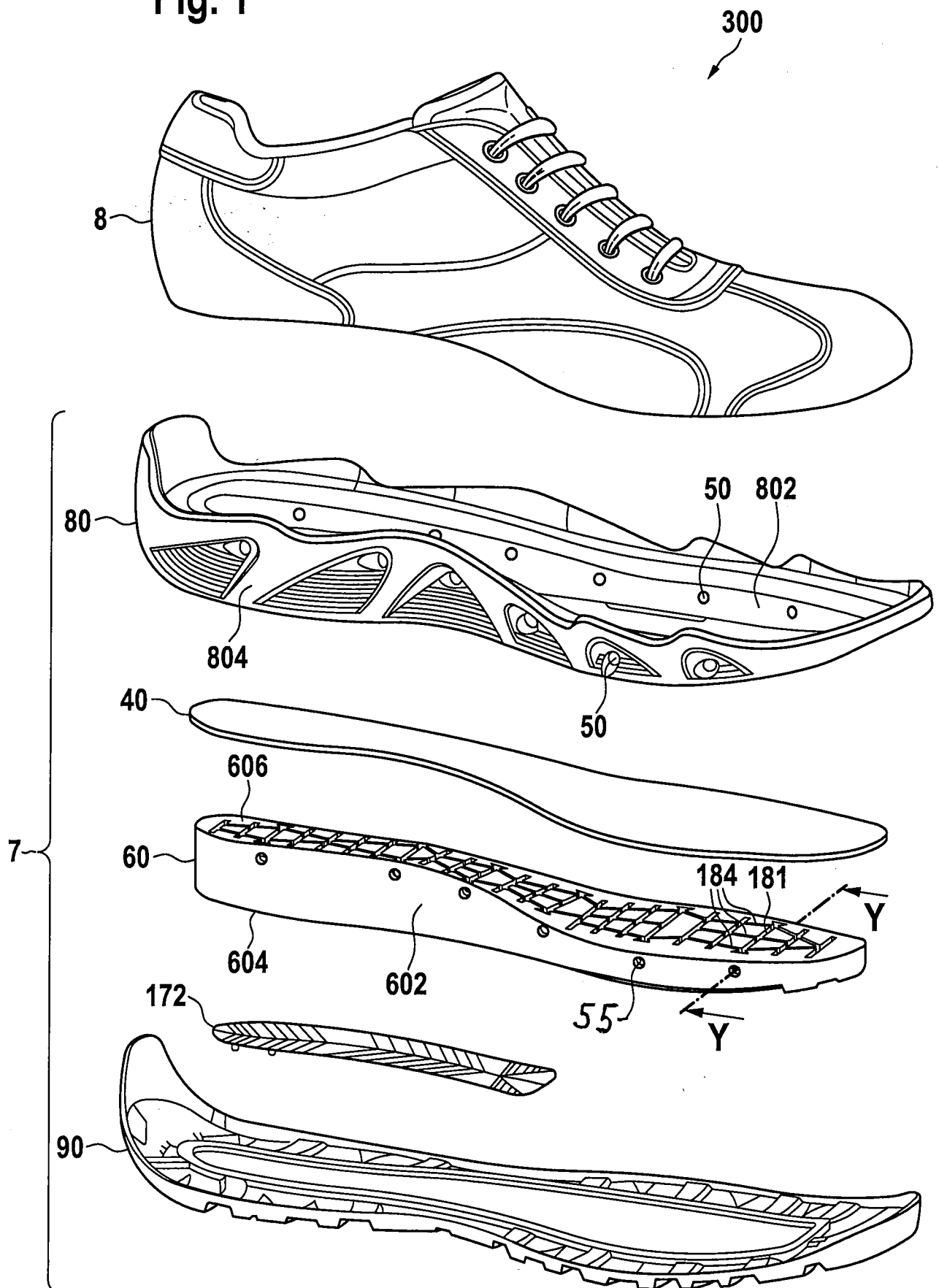


Fig. 2a

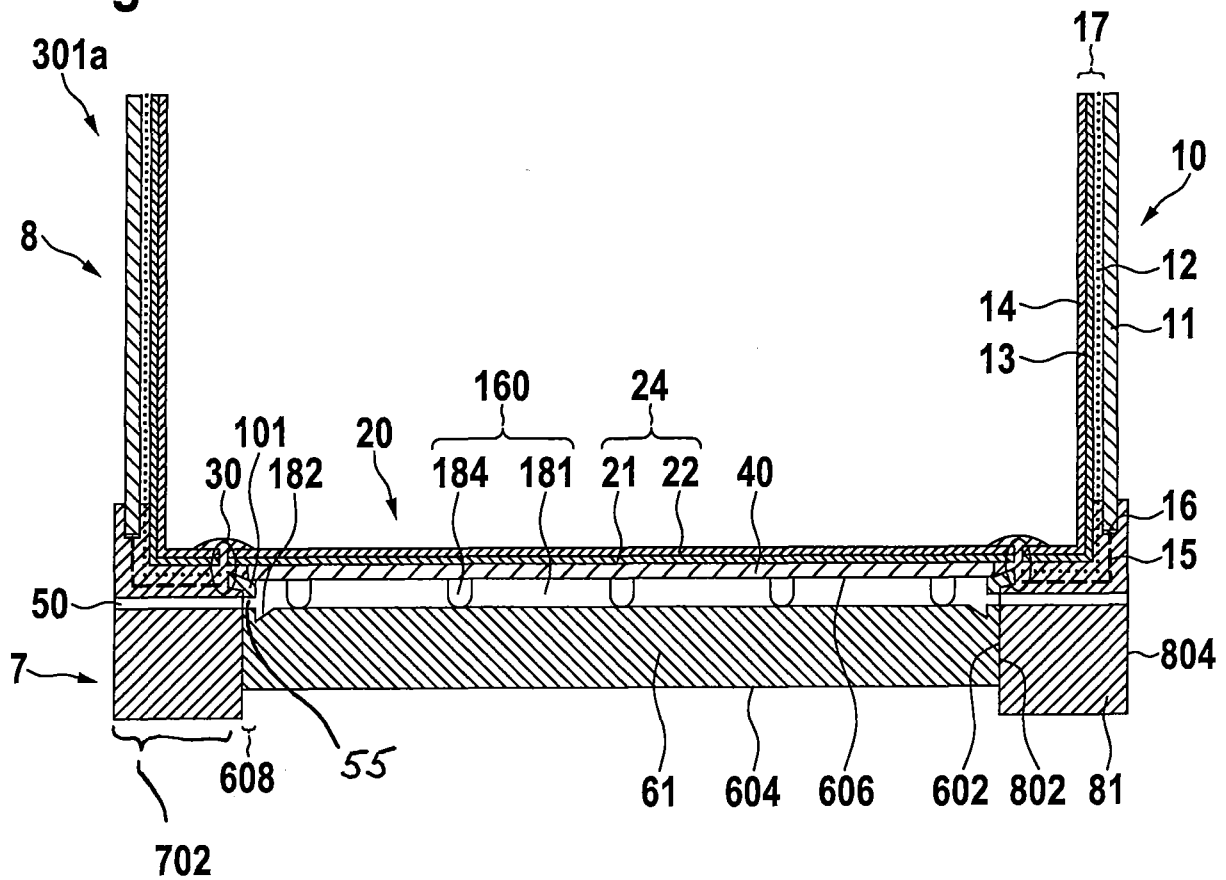


Fig. 2b

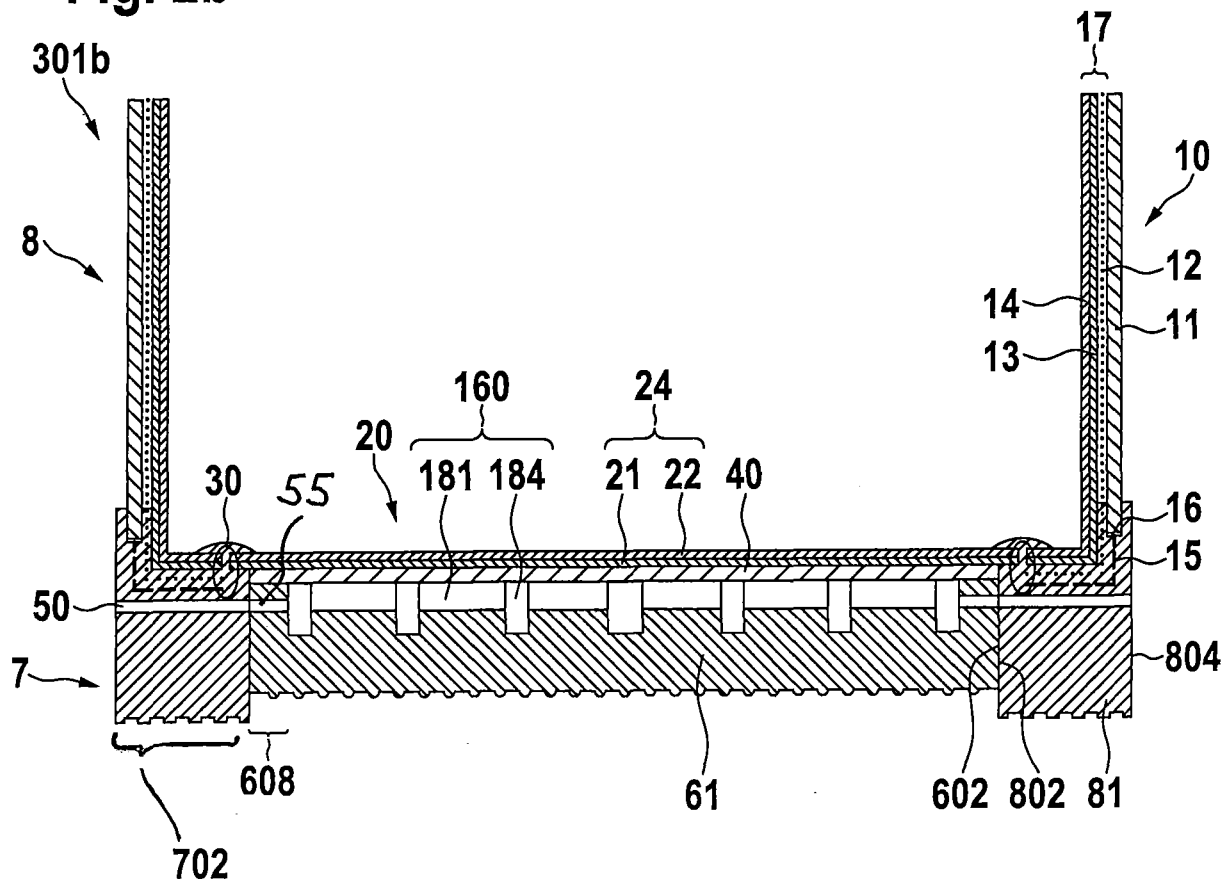


Fig. 2c

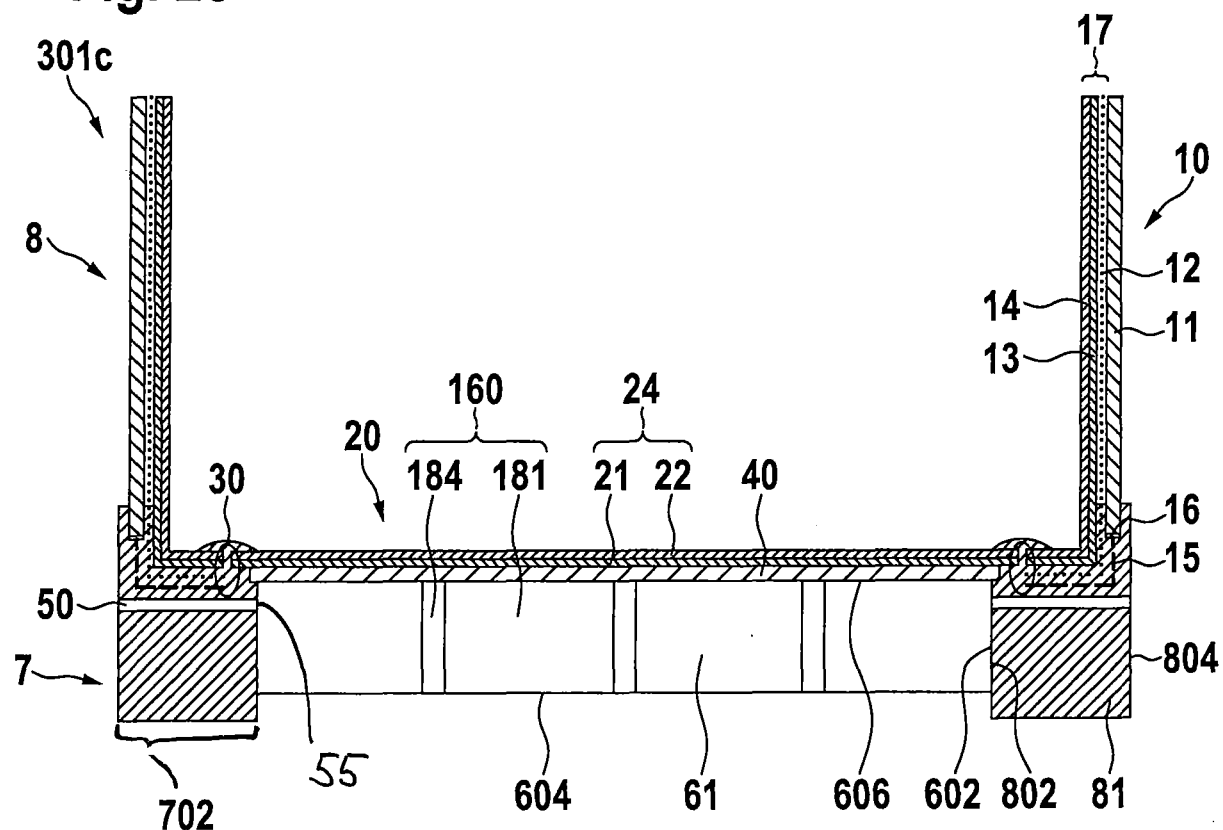


Fig. 2d

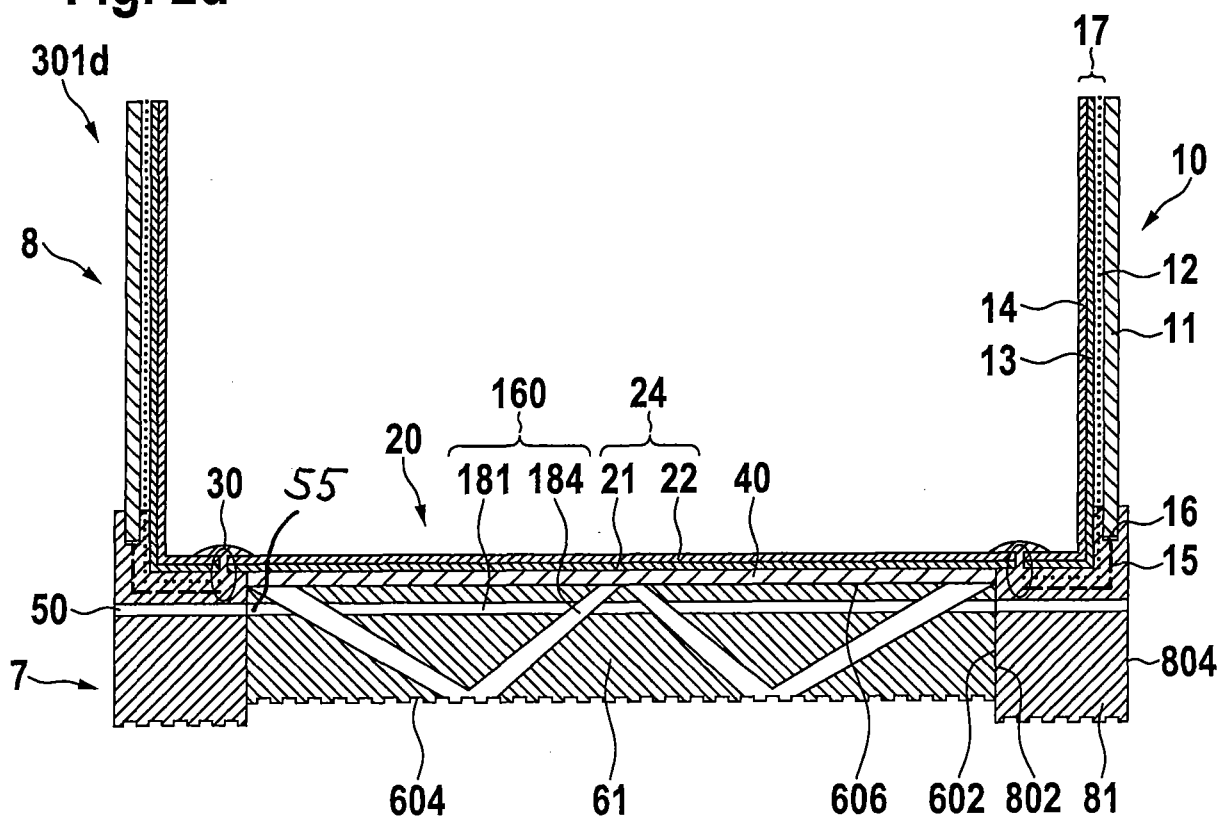


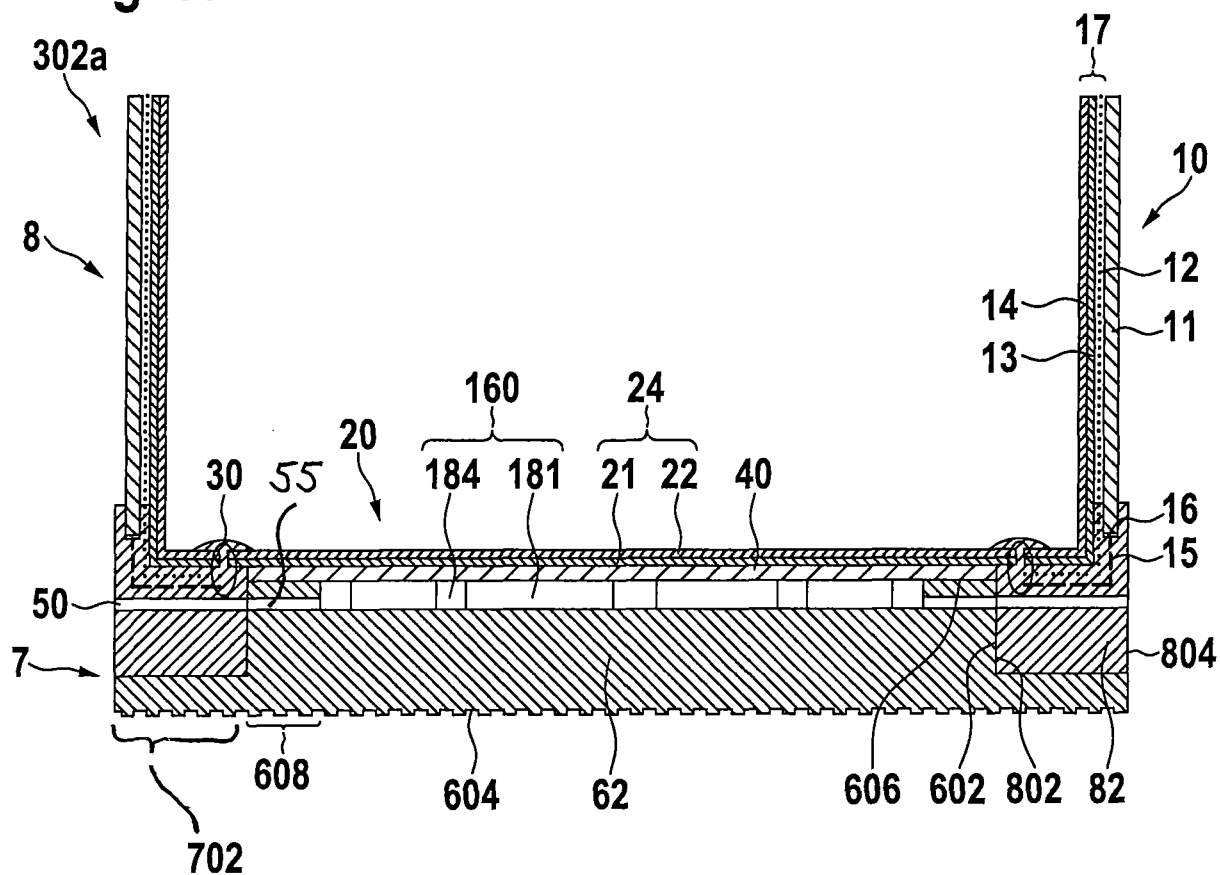
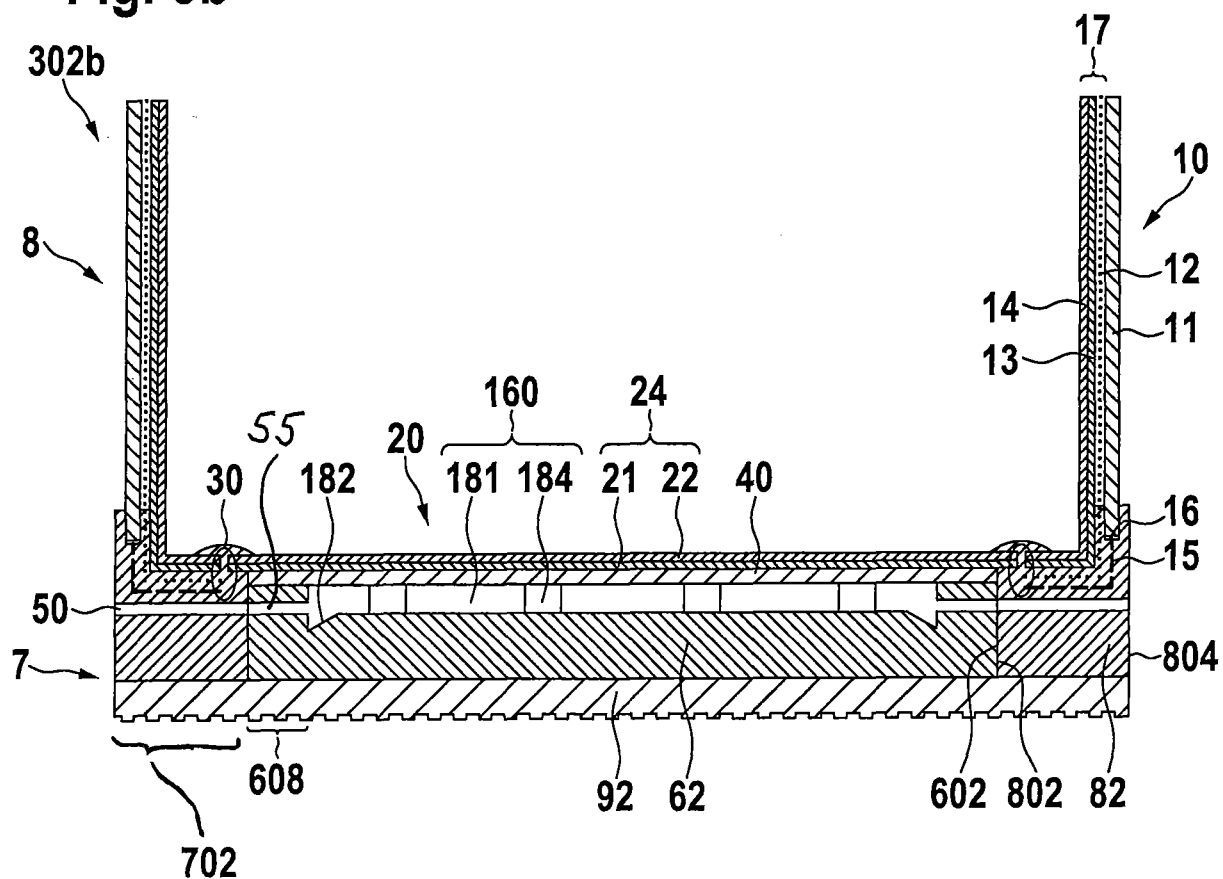
Fig. 3a**Fig. 3b**

Fig. 3c

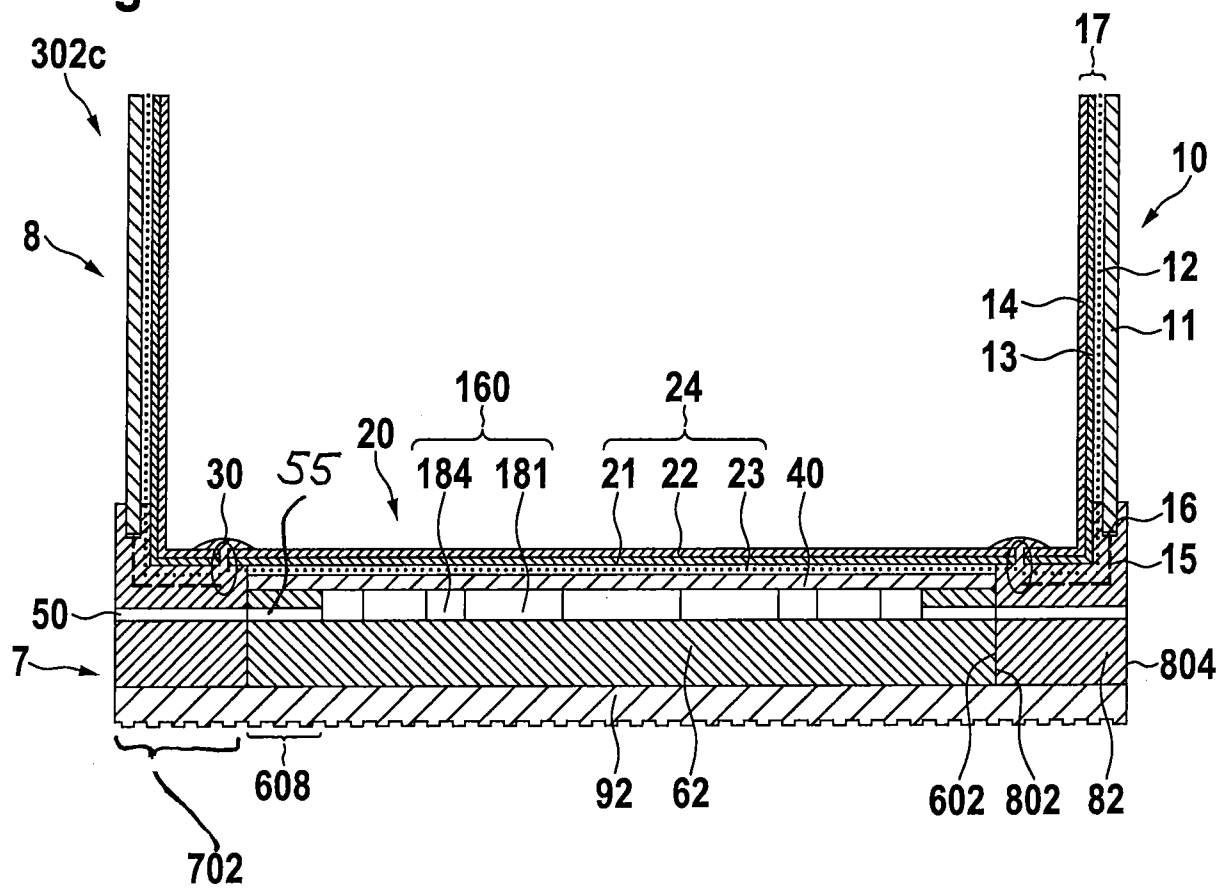


Fig. 3d

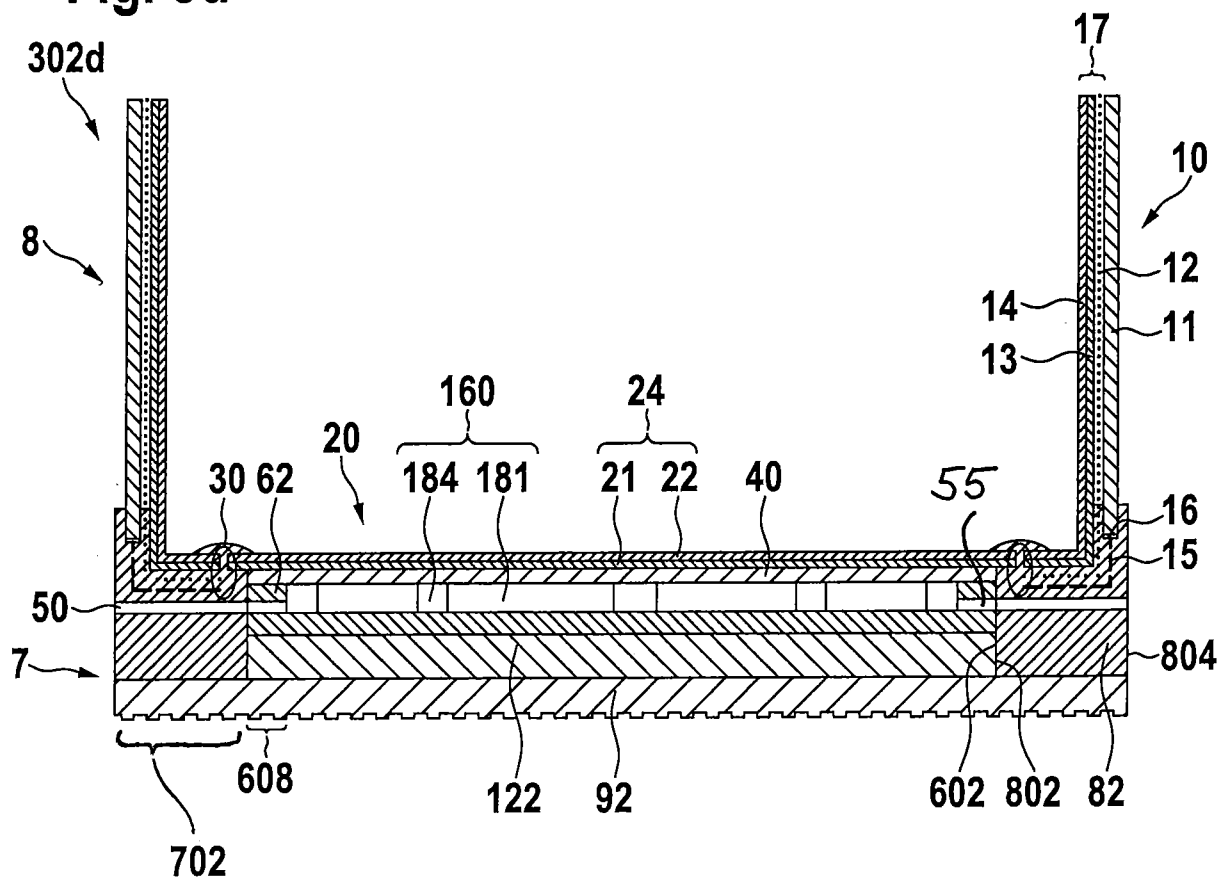


Fig. 3e

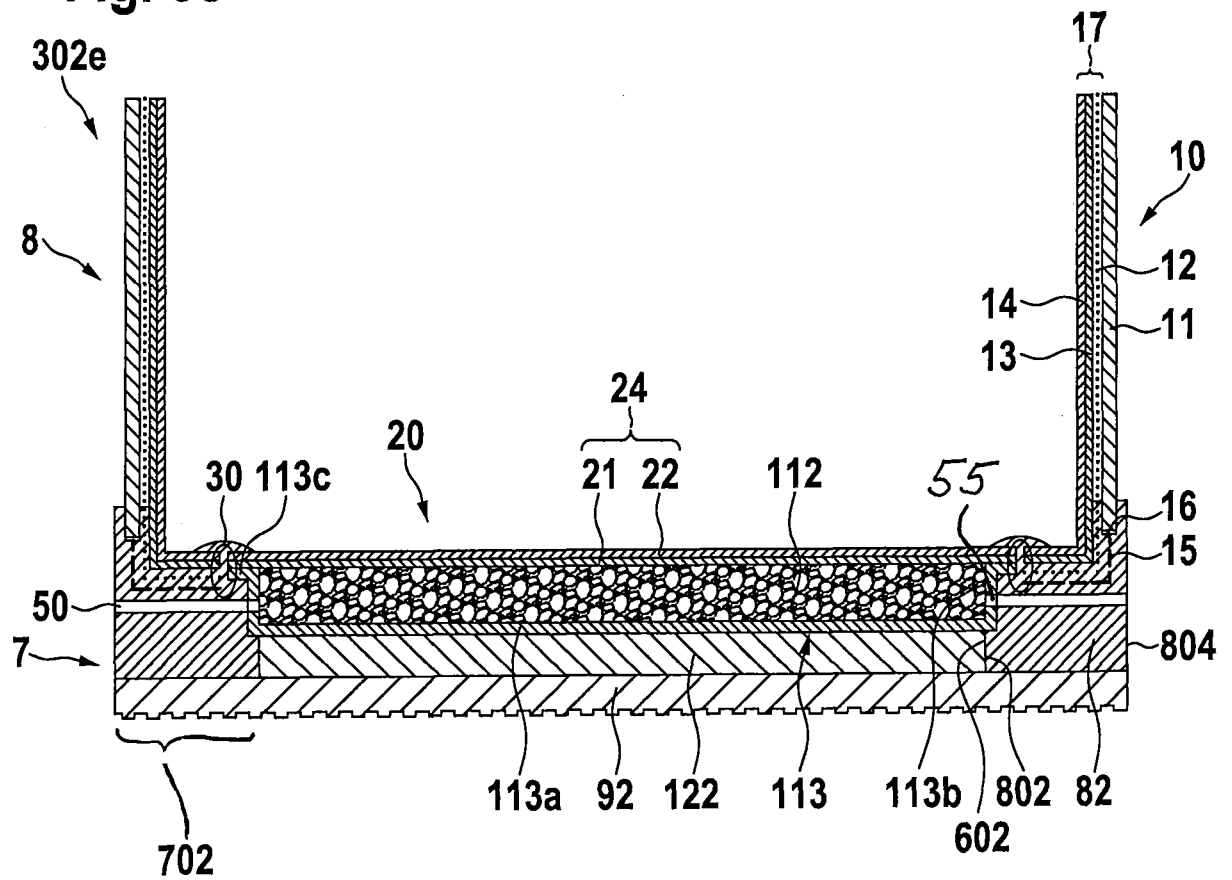


Fig. 3f

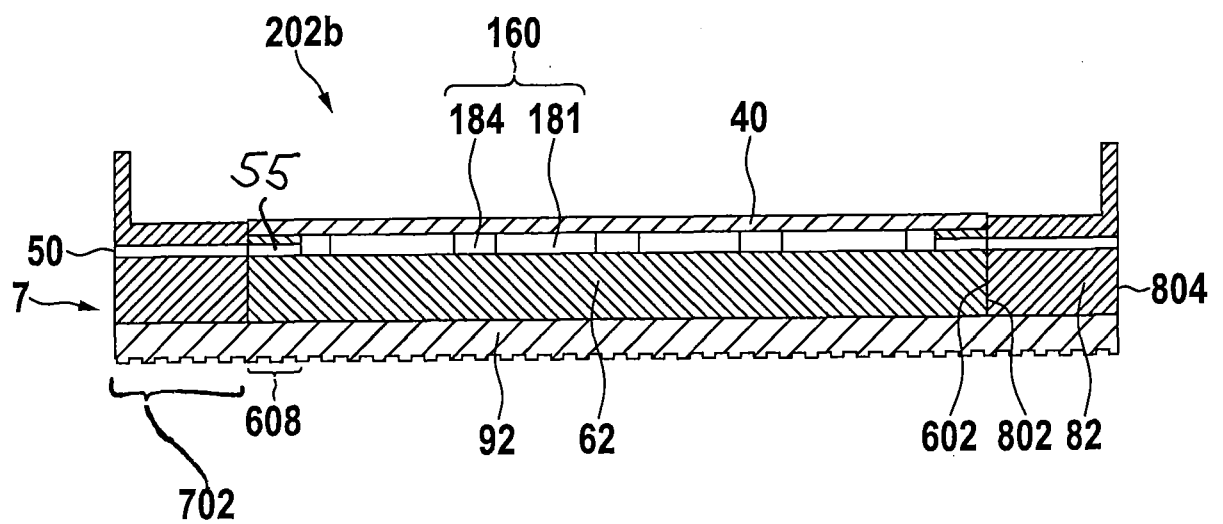


Fig. 4a

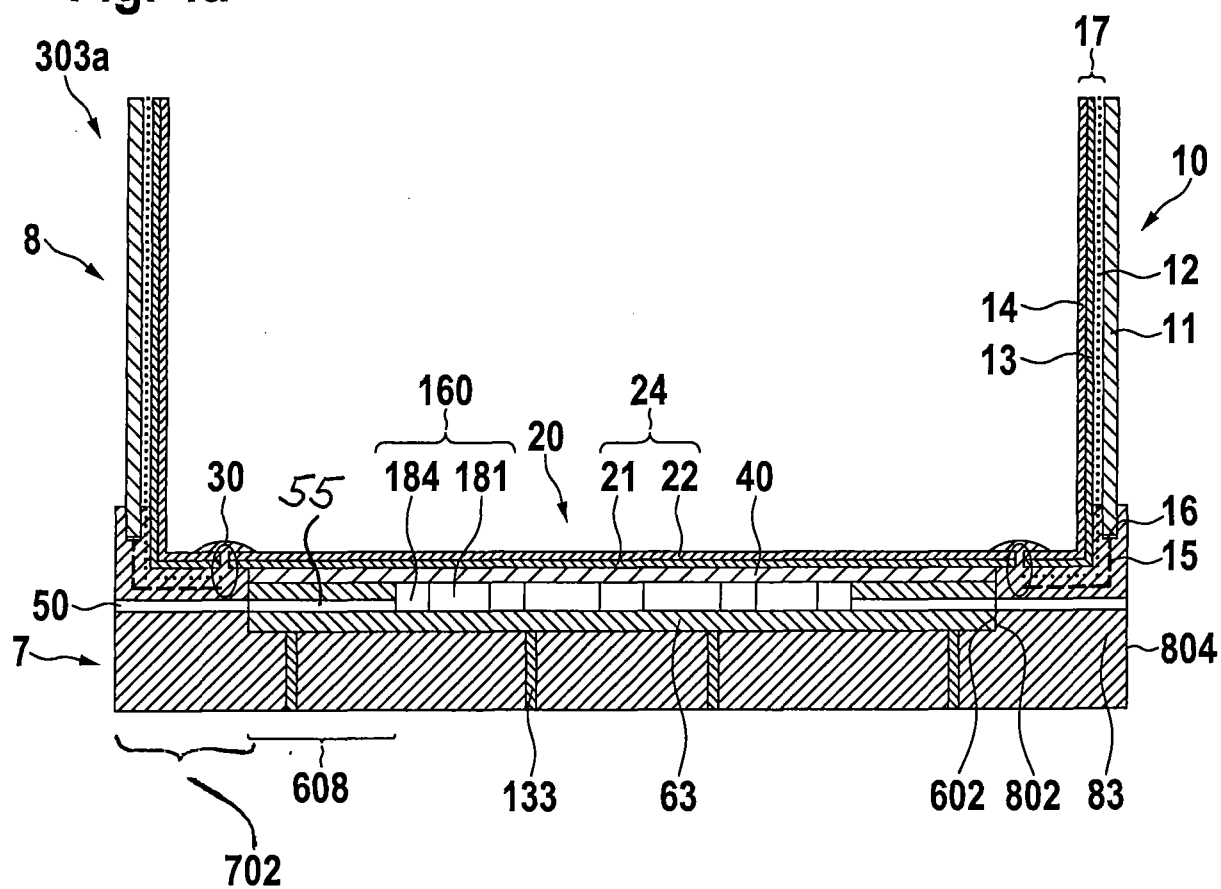


Fig. 4b

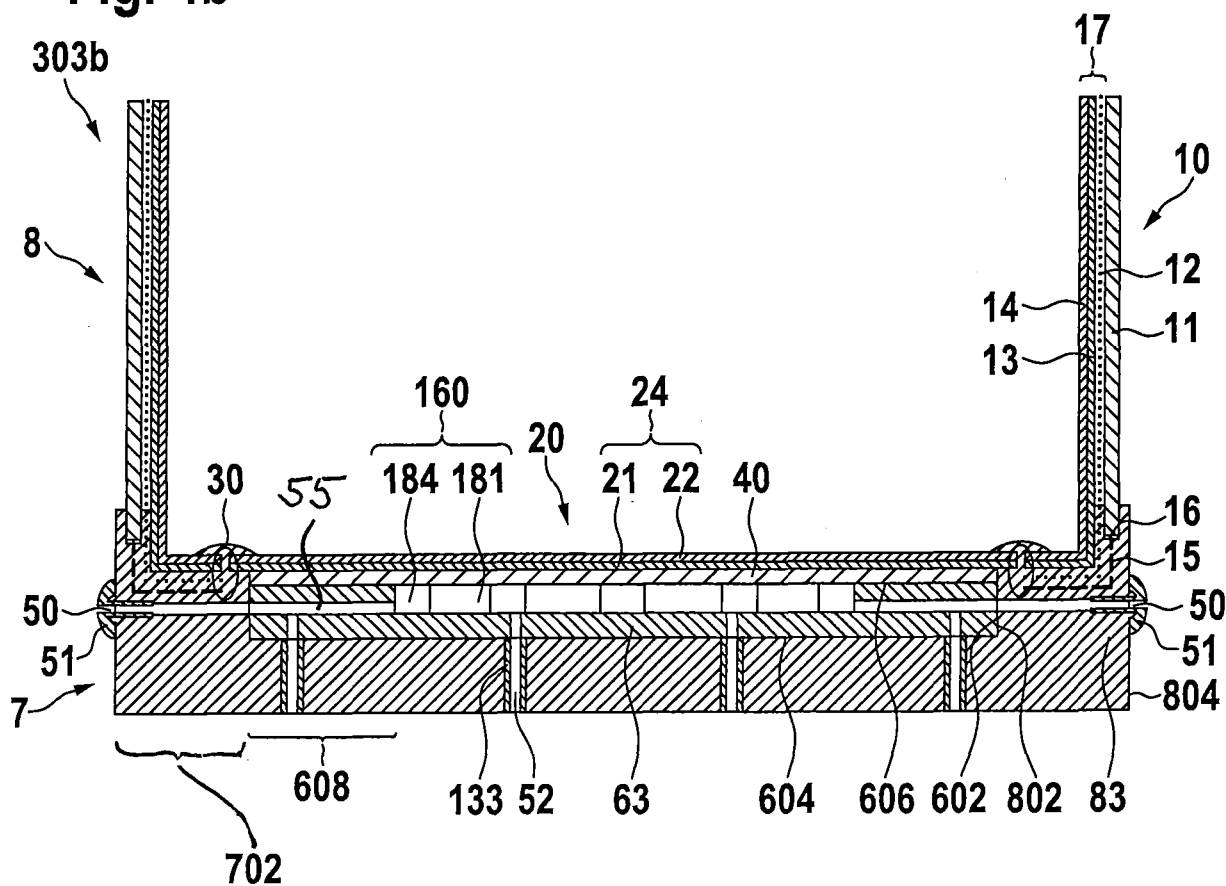


Fig. 5

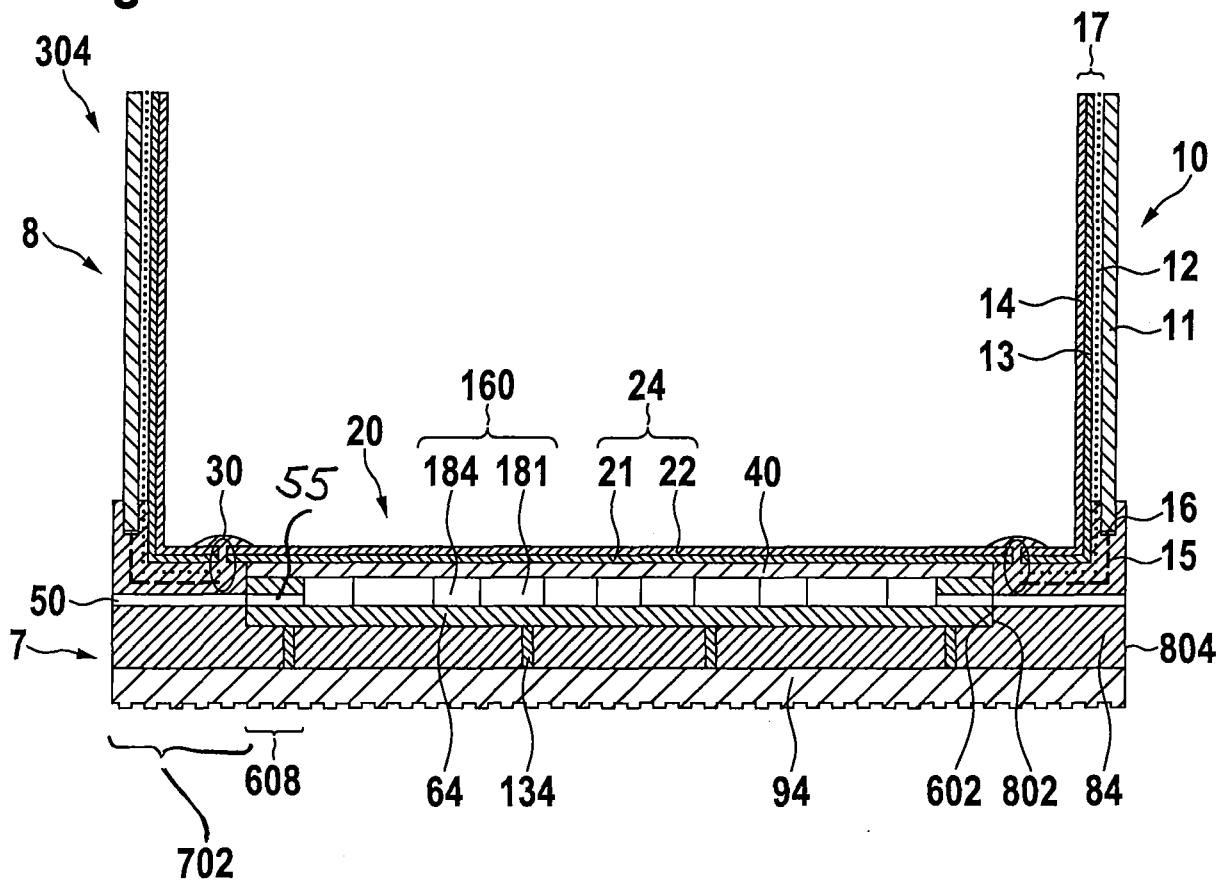


Fig. 6a

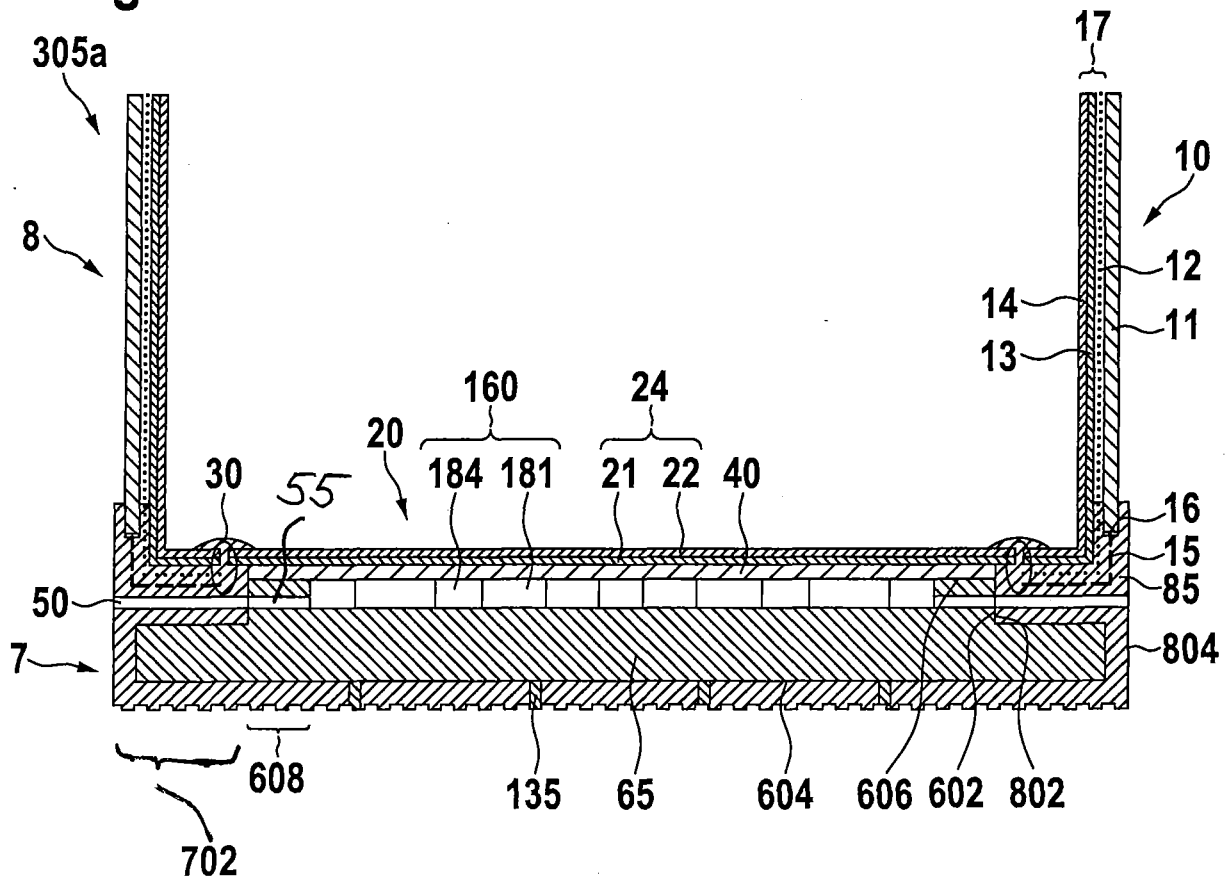


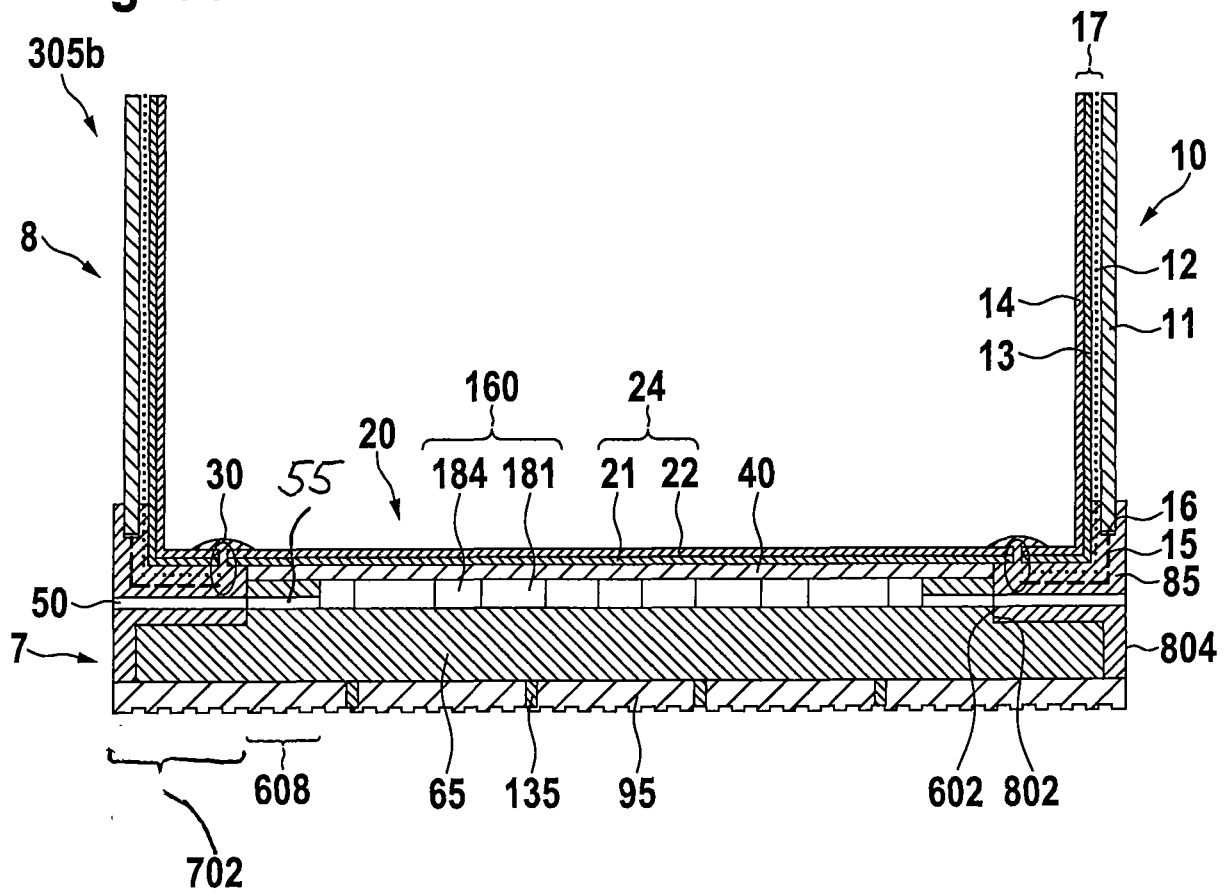
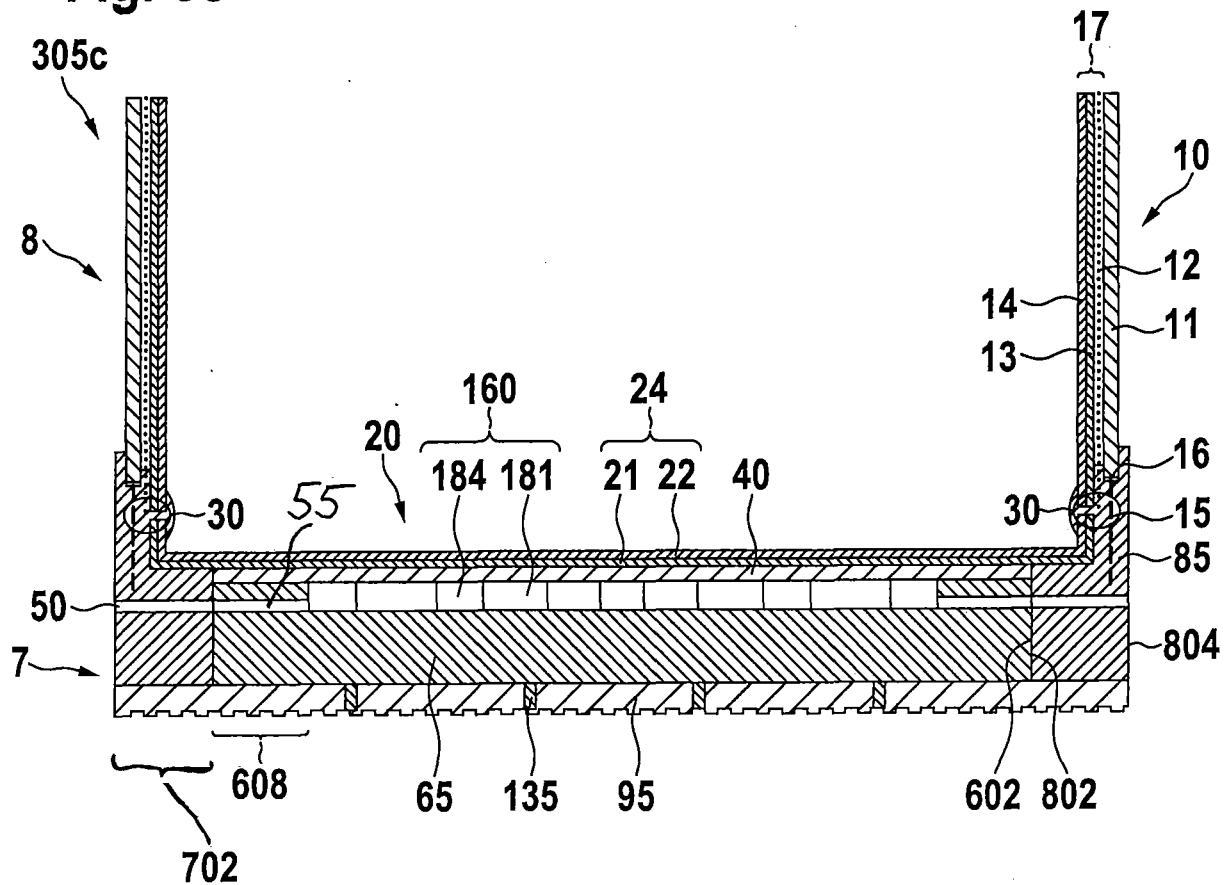
Fig. 6b**Fig. 6c**

Fig. 7

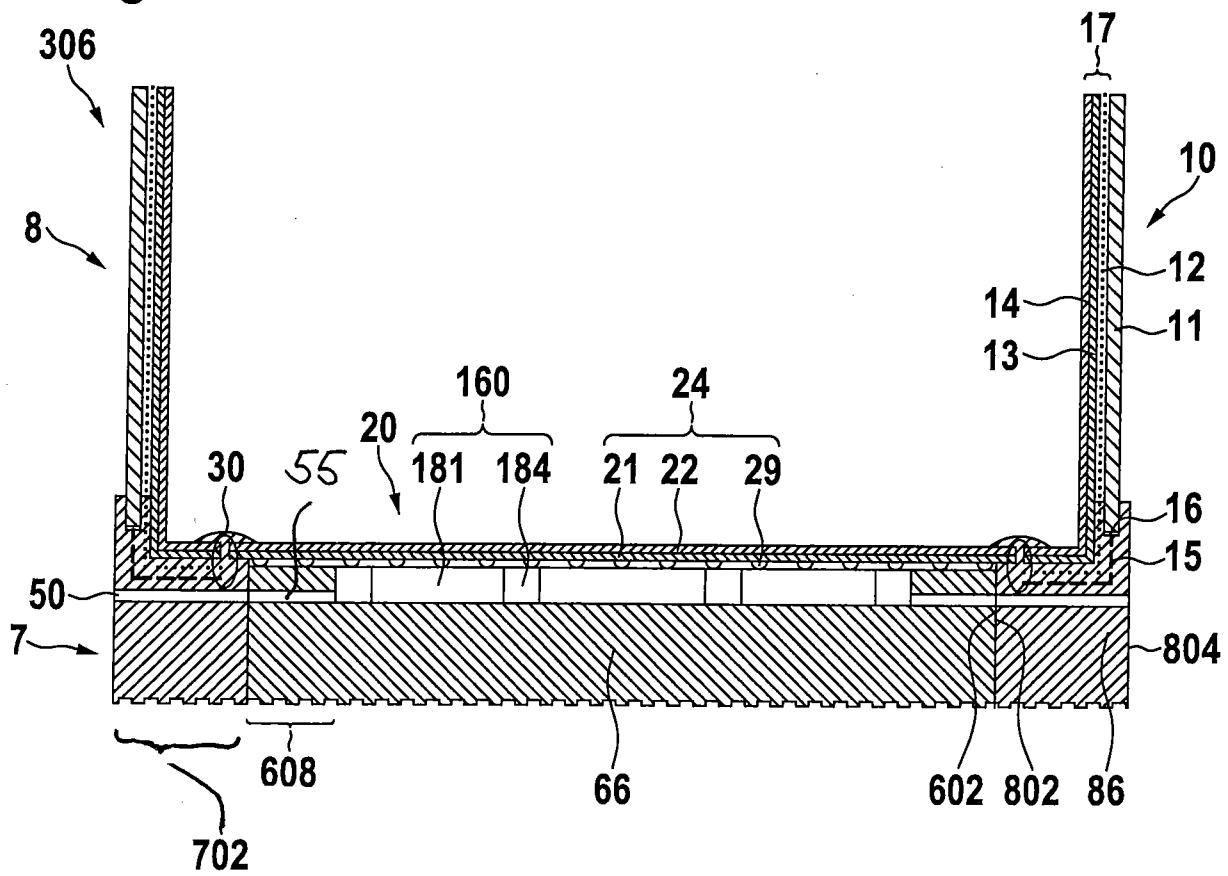


Fig. 8

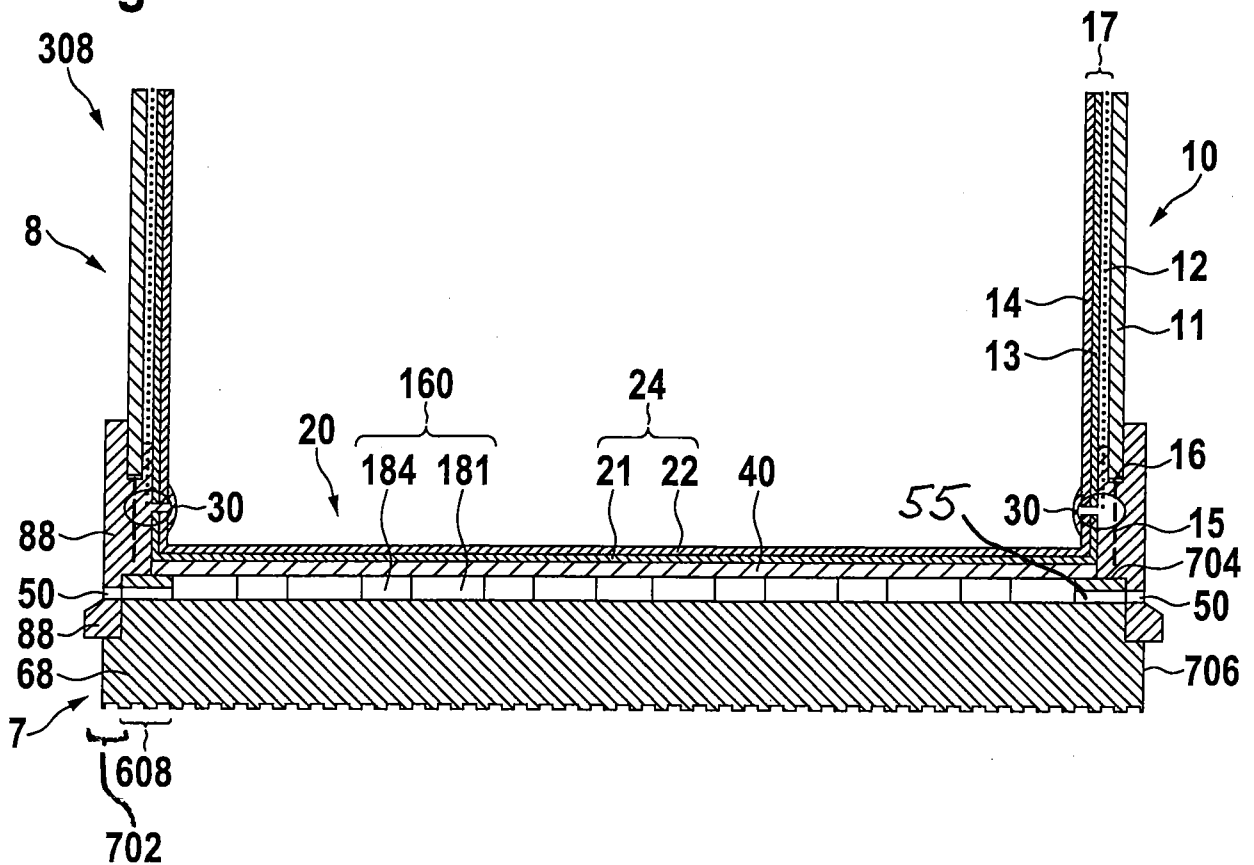


Fig. 9a

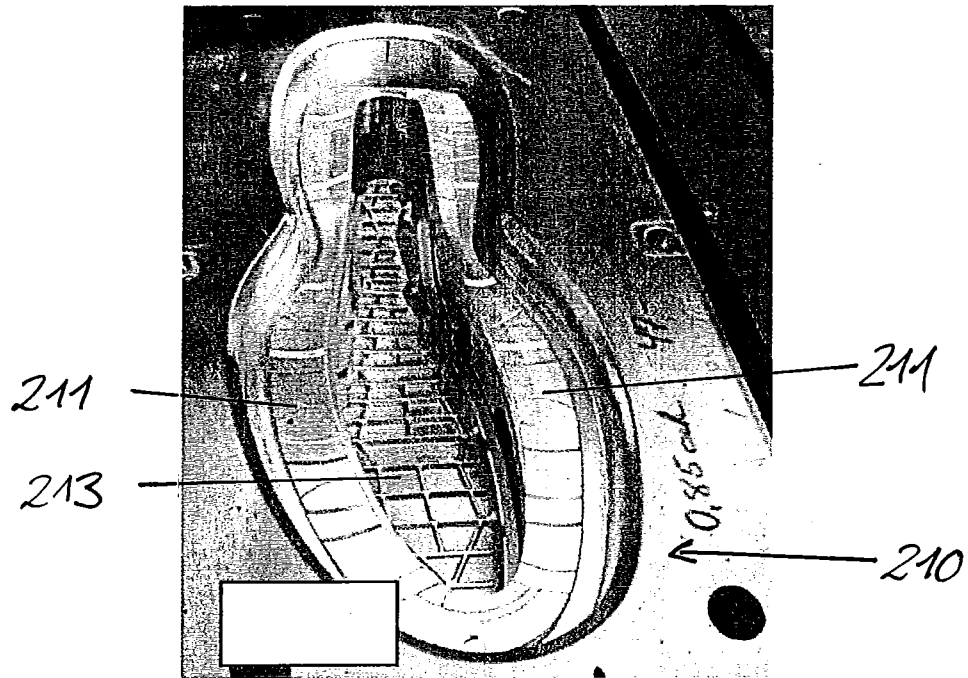


Fig. 9b



Fig. 9c

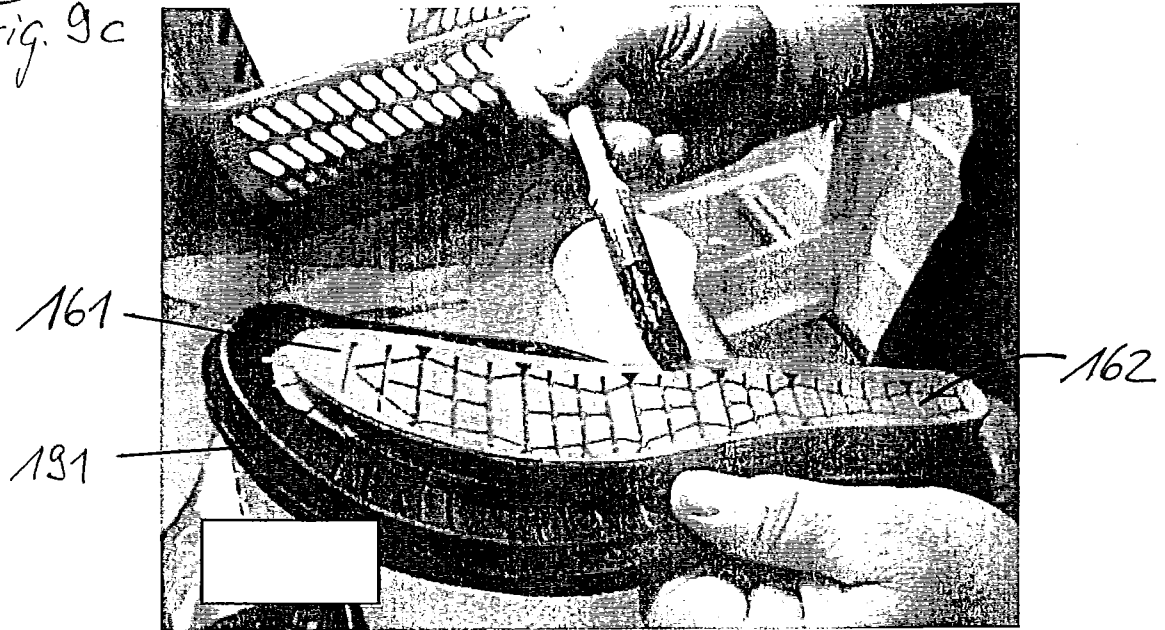


Fig. 10

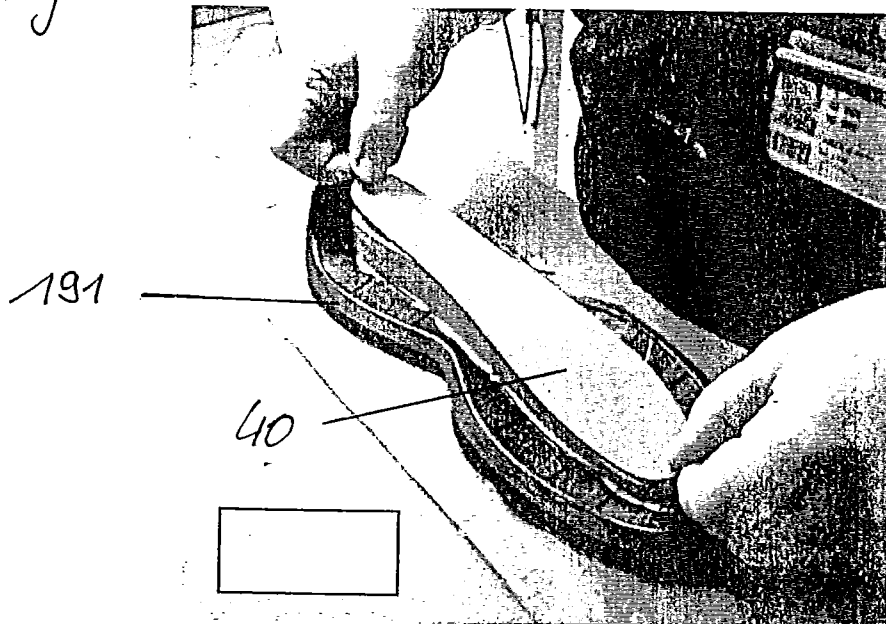


Fig. 11

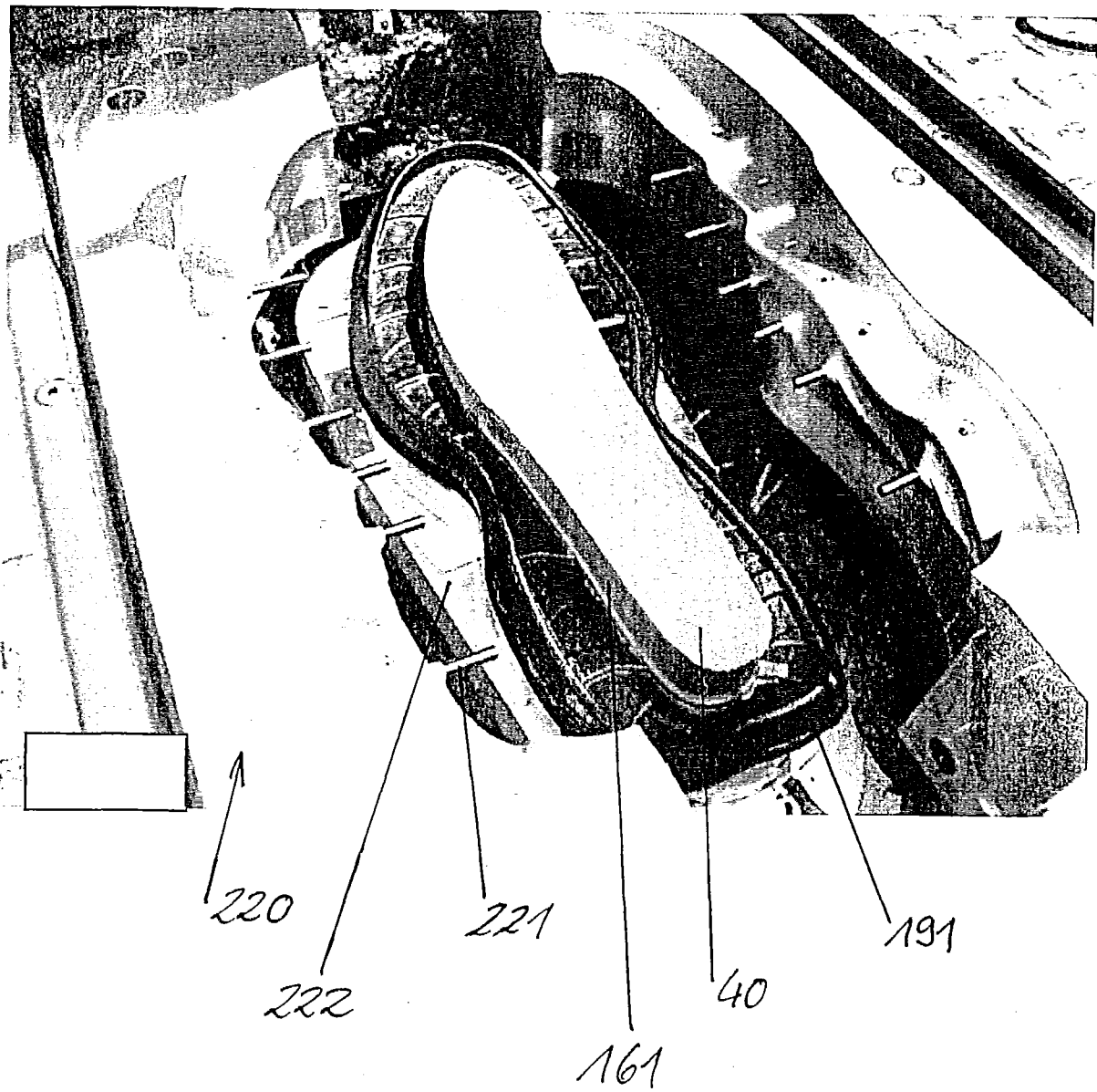


Fig. 12

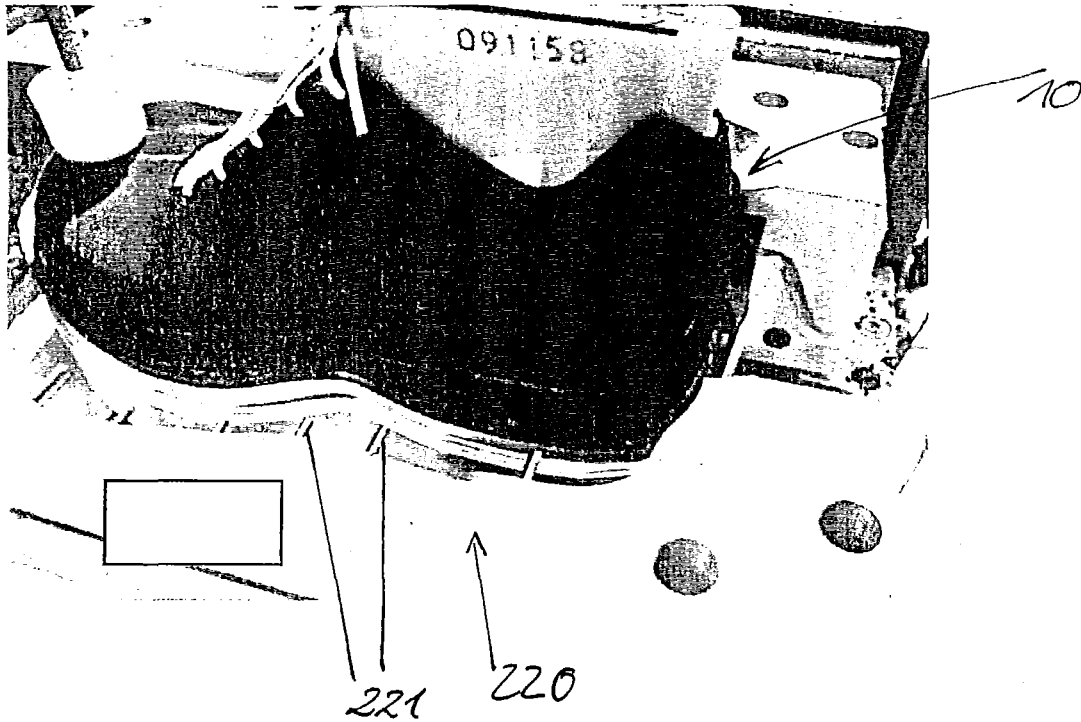


Fig. 13

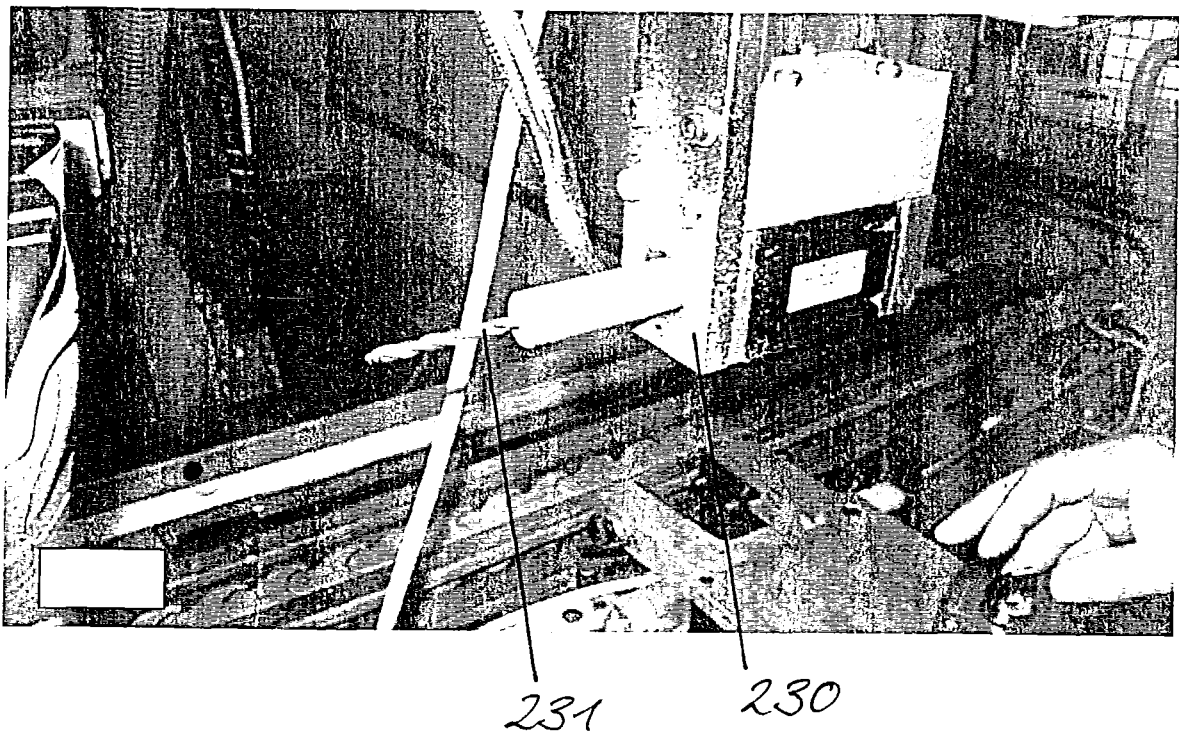


Fig. 14



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/062976

A. CLASSIFICATION OF SUBJECT MATTER INV. A43B7/12 A43B13/12 B29D35/12 A43B7/08 B29D35/06 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 practical, 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 99/26504 A1 (SIEVIN JALKINE OY [FI]; JOKINEN MARKKU OSKARI [FI]) 3 June 1999 (1999-06-03) cited in the application	1-6,16, 17,20, 23,24
Y	page 4 - page 9; figures -----	7-12
Y	WO 2008/003375 A1 (GEOX SPA [IT]; POLEGATO MORETTI MARIO [IT]) 10 January 2008 (2008-01-10) page 9 - page 12; figures 8, 10-11 -----	7-12
A	WO 2004/004502 A1 (CALZATURIFICIO VALLEVERDE S P [IT]; SQUADRONI ONIFARES ELPIDIO [IT]) 15 January 2004 (2004-01-15) the whole document -----	1-27
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family		
Date of the actual completion of the international search 20 May 2011		Date of mailing of the international search report 27/05/2011
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Herry, Manuel

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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欧洲专利申请号： 10771363.8

中文摘要

鞋底组件制造方法和制鞋方法

本发明涉及一种制鞋方法，包括以下步骤：为一鞋帮组件提供一包括一外部材料的上部和一底部；提供一换气鞋底构件(161)，所述换气鞋底构件具有一可使空气从其中流过的结构或材料；将所述换气鞋底构件放置在一模具(220)内，所述模具具有一些沿侧向突伸的销子(221)；将所述换气鞋底构件和所述鞋帮组件定位成使所述换气鞋底构件的一上部与所述鞋帮组件的所述底部相接触；闭合所述模具从而使所述各销子与所述换气鞋底构件的一侧壁相接触，随后注模以形成一固定于所述鞋帮组件和所述换气鞋底构件的围设鞋底构件(195)，所述围设鞋底构件包括由所述各销子形成的、自所述围设鞋底构件的外部至所述换气鞋底构件的所述侧壁的侧向通道(50)；以及在注模之后将所述围设鞋底构件的侧向通道与所述换气鞋底构件的所述结构或材料相连。本发明还涉及一种用来制造一相应的鞋底组件的方法。