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(54) **WATERPROOF FOOTWEAR AND METHOD FOR ITS PRODUCTION**

(76) Inventor: **Franz Haimerl**, Starnberg (DE)

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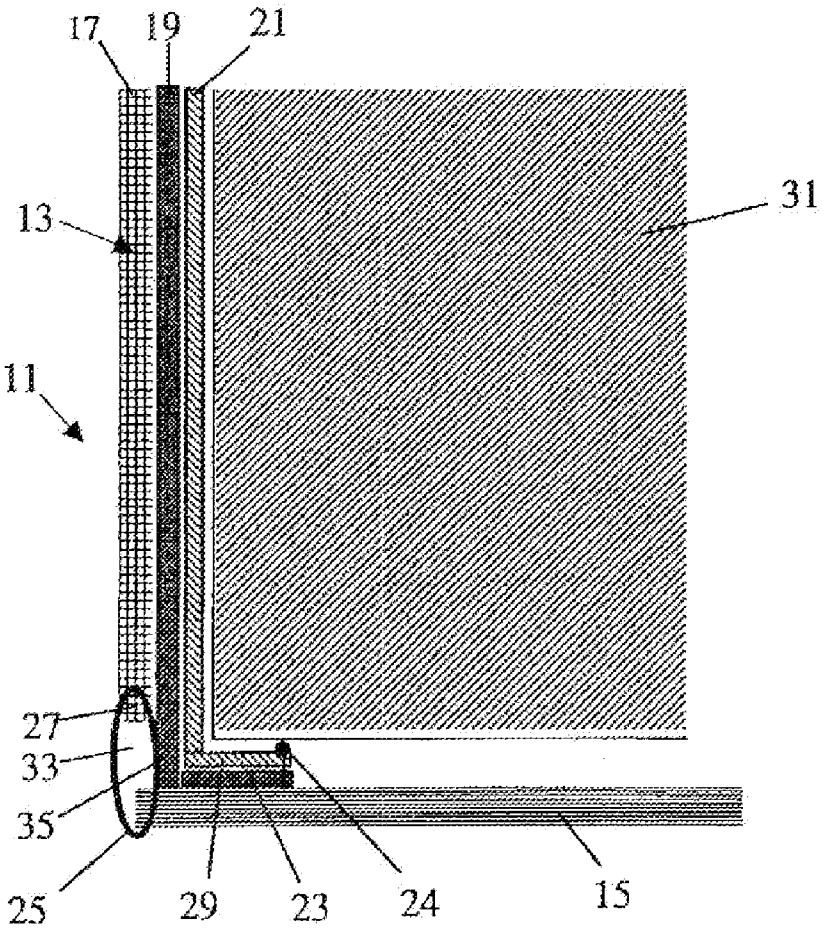
(57) **ABSTRACT**

A shoe-reinforcement material having a fiber combination with a first fiber component and a second fiber portion having a second fiber component, whereby the first fiber component has a first melting point and a first softening-temperature range lying below it, and a first fiber portion of the second fiber component has a second melting point and a second softening-temperature range lying below it; the first melting point and the first softening-temperature range are higher than the second melting point and the second softening-temperature range, the second fiber portion of the second fiber component has a higher melting point and a higher softening temperature lying above it than the first fiber portion, and the fiber combination.



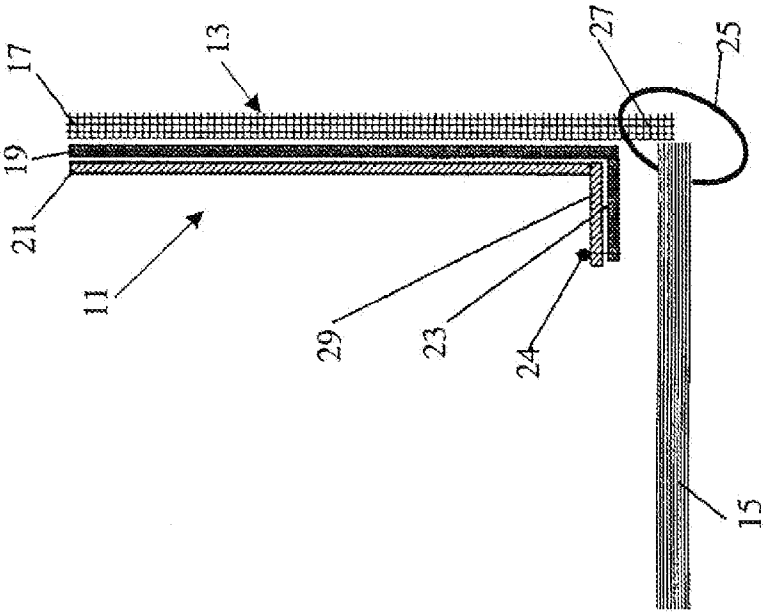

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FIG. 1

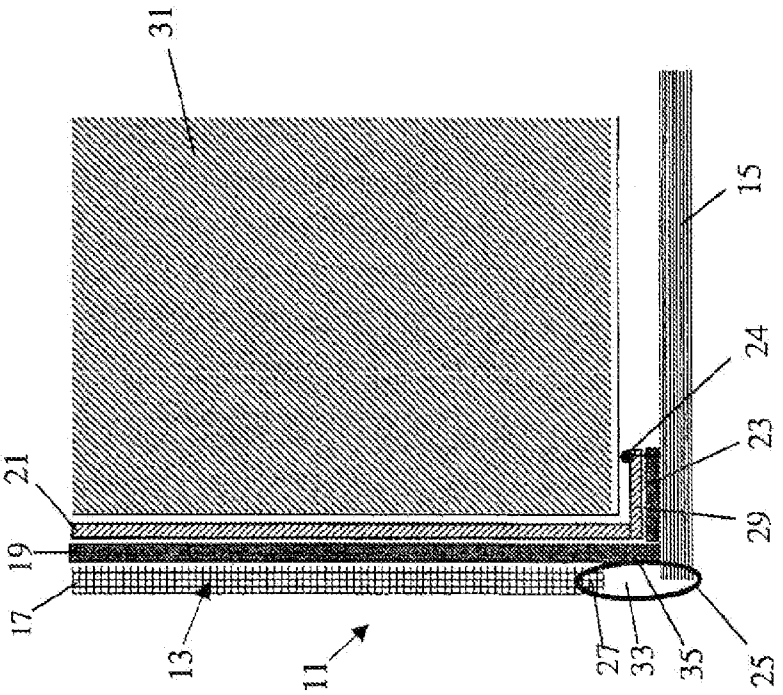
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FIG. 2

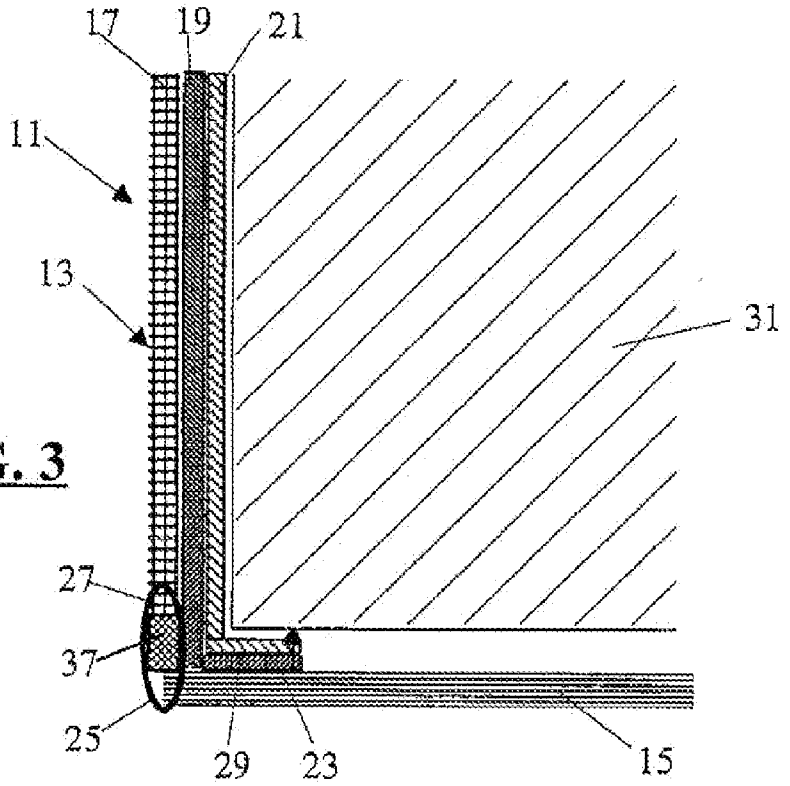
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FIG. 3

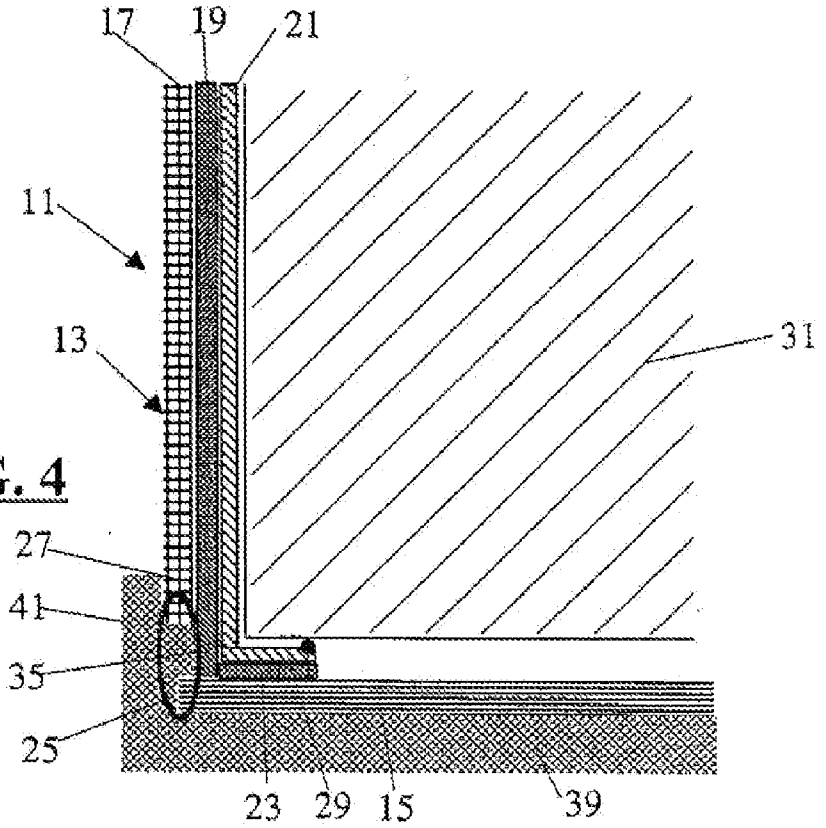
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FIG. 4

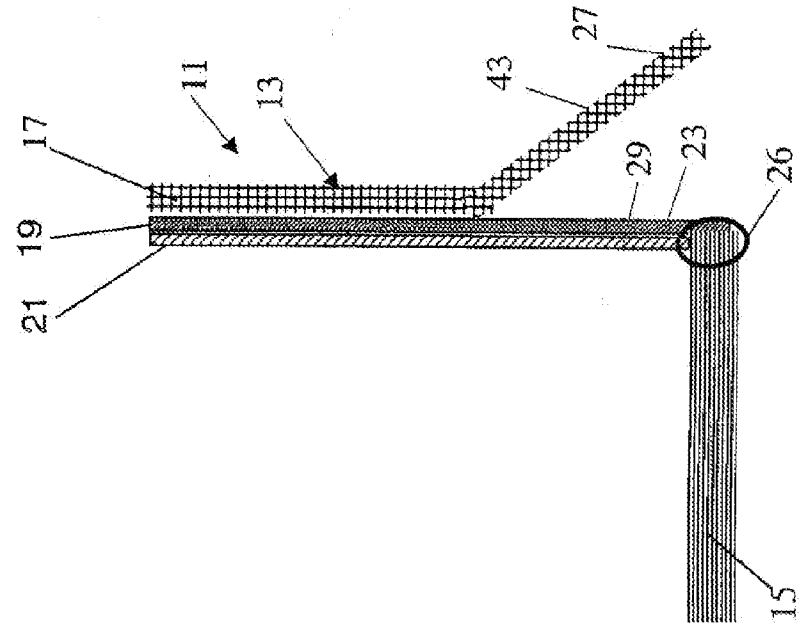


FIG. 5

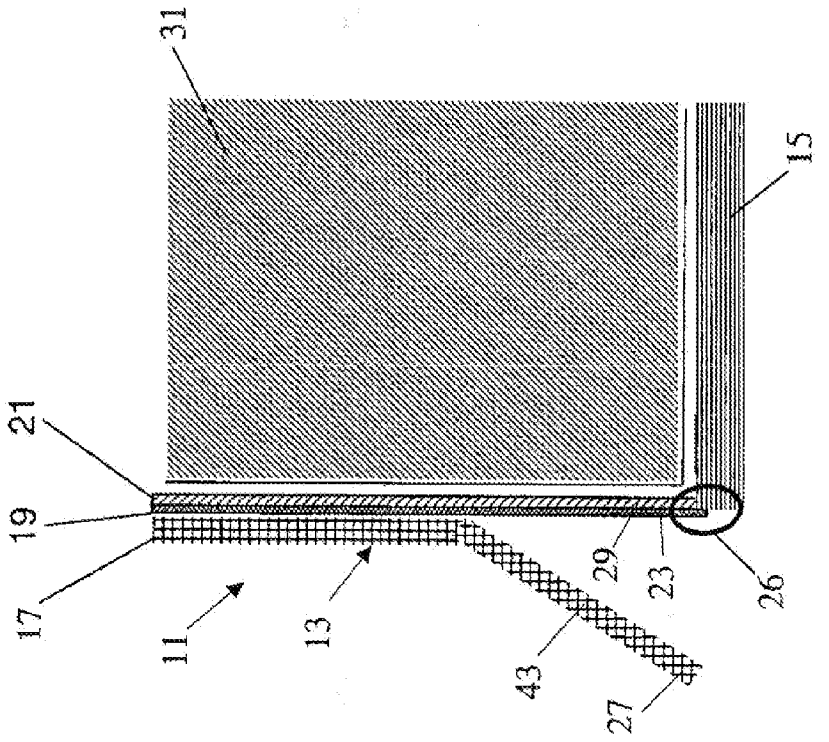


FIG. 6

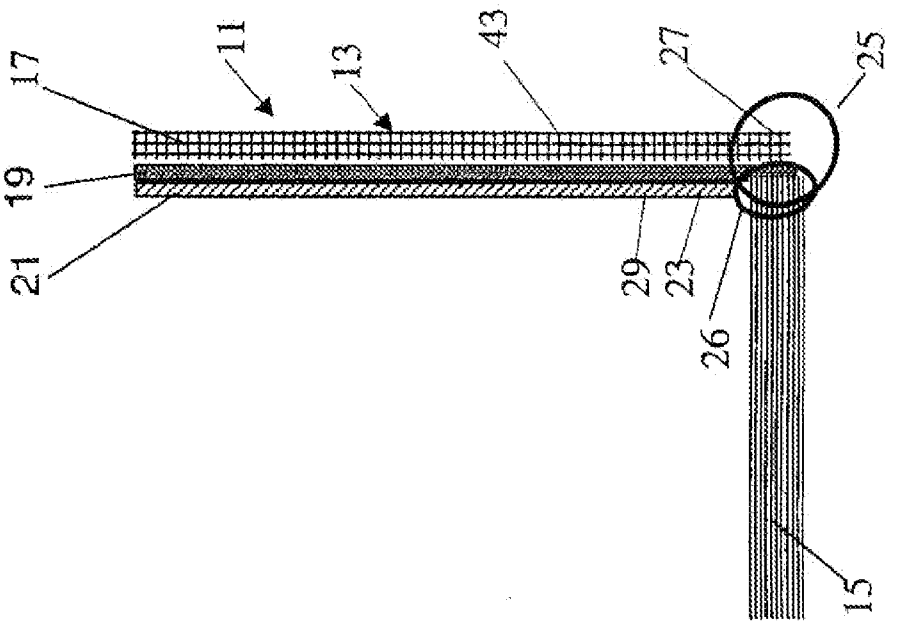
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FIG. 7

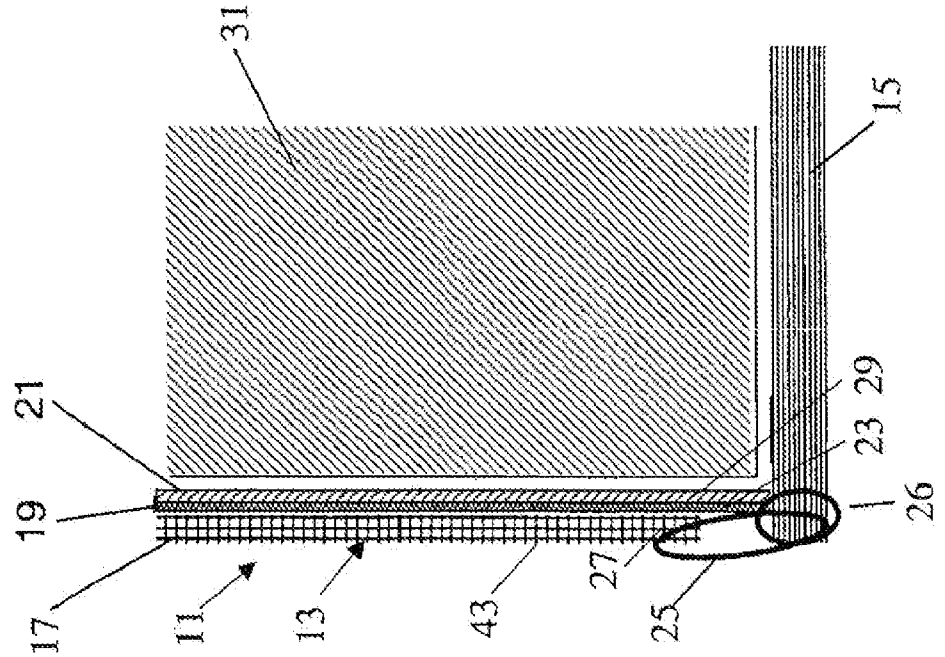
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FIG. 8

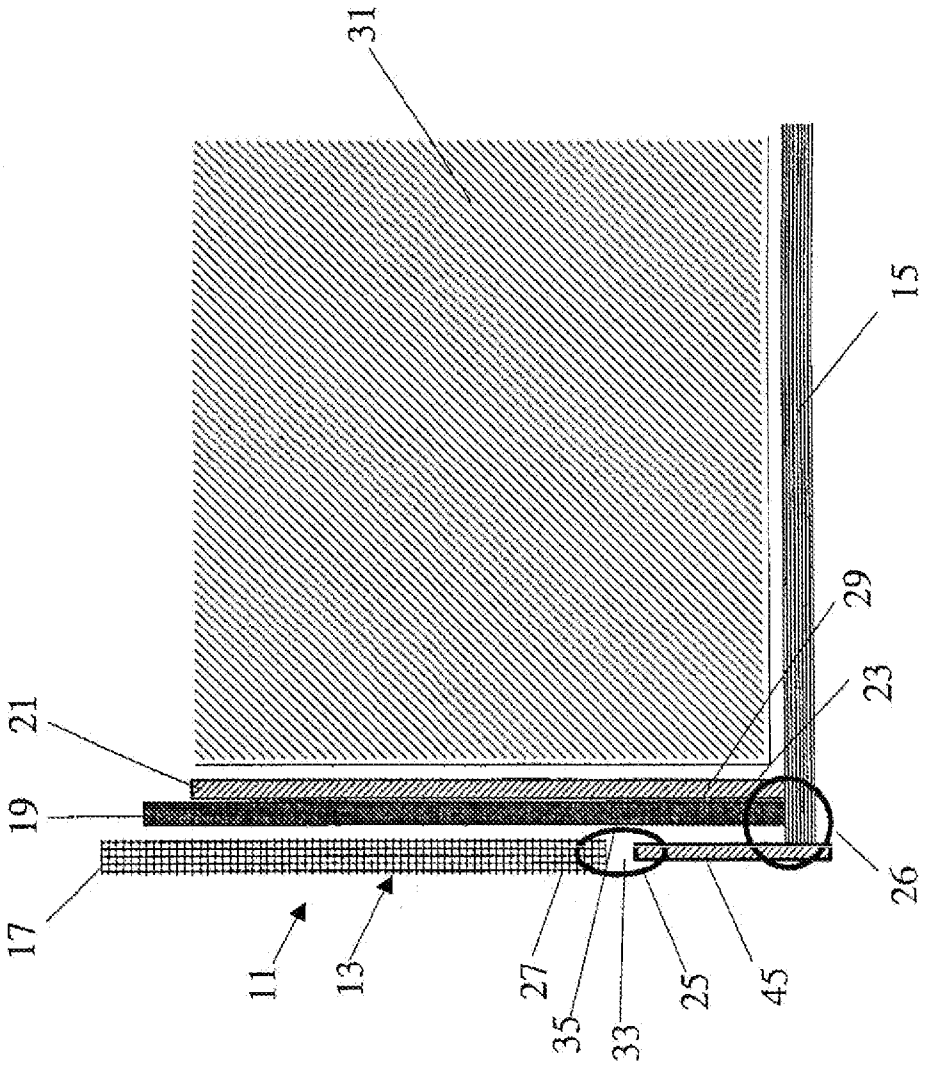


FIG. 9

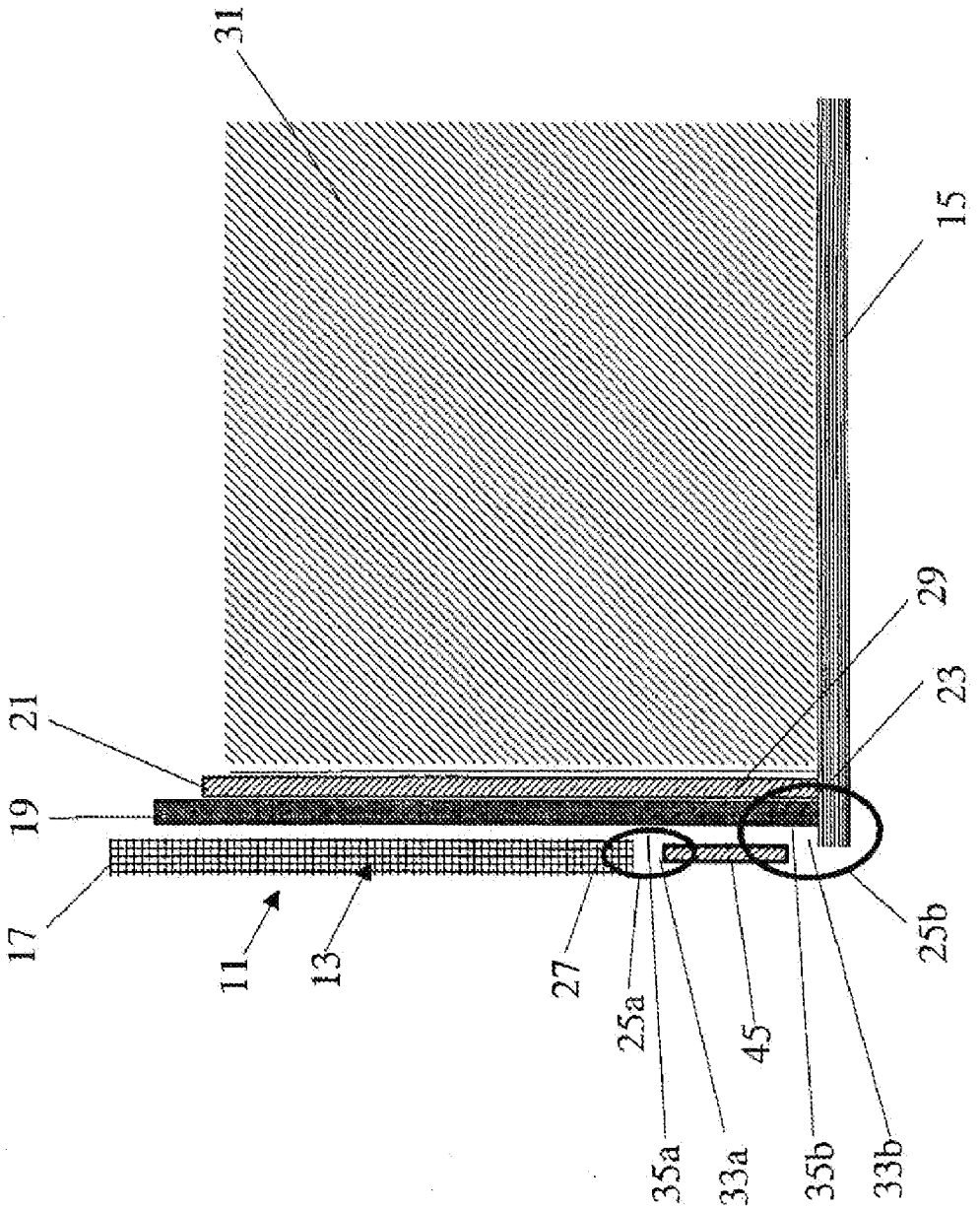


FIG. 10

# WATERPROOF FOOTWEAR AND METHOD FOR ITS PRODUCTION

## RELATED APPLICATION

**[0001]** The present application is a divisional application of pending U.S. patent application Ser. No. 10/555,146 filed Oct. 31, 2005.

## BACKGROUND OF THE INVENTION

**[0002]** The invention relates to footwear with an upper, which is constructed with an outer material and a waterproof functional layer arranged on the inner side of the outer material, an outer-material end region on the sole side being joined to an inner sole and a functional-layer end region on the sole side being sealed by a sealing material leading to waterproofness. An example of footwear of this type is known from the applicant's EP 0 298 360 B1.

**[0003]** The invention also relates to a method for producing footwear of this type.

**[0004]** In the case of the footwear according to EP 0 298 360 B1, the outer-material end region ends at a predetermined distance from an inner sole serving as an insole, this distance being bridged by a gauze strip through which liquid material can flow, one longitudinal side of which is sewn to the outer-material end region and the other longitudinal side of which is sewn to the insole. One end of the functional layer on the sole side reaches down as far as the insole and is likewise sewn to the latter. This known footwear has a moulded-on outsole. When the outsole is being moulded on, the gauze strip is penetrated by liquid outsole material, whereby such outsole material flows against the outer side of the functional layer and, after curing, brings about waterproof sealing of the functional layer in the functional-layer and region.

**[0005]** With this so-called gauze-strip solution, which has proven to be very successful, particularly good and reliable waterproofness of breathable shoes has been accomplished.

**[0006]** The sewing of the gauze strip on its two longitudinal sides requires a certain effort, with corresponding consequent costs. What is more at points at which the insole has a small radius of curvature, in particular in the case of children's shoes, it is not always that easy to sew the gauze strip without any folds.

## SUMMARY OF THE INVENTION

**[0007]** The present invention provides footwear with which such problems can be overcome, which is inexpensive, can be handled more easily during production, including at points with small radius of curvature, and leads to good waterproofness.

**[0008]** The invention provides footwear according to Claim **1** which can be produced in a way corresponding to Claim **19**. Embodiments of the footwear according to the invention and of the method according to the invention are provided in the dependent claims.

**[0009]** Footwear according to the invention comprises an upper, which is constructed with an outer material having an outer-material end region on the sole side and with a waterproof functional layer which is arranged on the inner side of the outer material and has a functional-layer end region on the sole side. What is more, such footwear has an inner sole and a joining device which joins the outer-material end region to the inner sole, which runs around at least part of the periphery of the upper, and which allows for a space to be left between the outer-material end region and the inner sole in such a manner, that it can be flowed through by sealing material that is liquid during application. The functional-layer end region extends at least into the region of the joining device and is sealed in a waterproof manner by sealing material which has passed through the joining device during production of the footwear.

**[0010]** In the case of the method according to the invention, footwear of the stated type is produced by the outer-material end region being joined to the inner sole by means of a joining device running around at least part of the periphery of the upper, in such a way that a space through which liquid can flow can be established between the outer-material end region and the inner sole, that the functional-layer end region is designed in such a way that it extends at least into the region of the joining device, and that, while the outer-material end region and the inner sole are kept at a distance from each other by means of the joining device, which can be flowed through by liquid, a sealing material which is in the liquid state and leads to waterproofness is applied to the outer side of the joining device in such a way that it flows through the liquid-permeable joining device against the functional-layer end region.

**[0011]** The functional-layer end region is formed in such a way that the sealing material flows against a surface-area region of the functional layer, just a cut edge of the functional layer or both.

**[0012]** In the case of one embodiment of the invention, a lining is arranged on the inner side of the functional layer, the lining being either a separate lining layer or a lining layer joined to the functional layer to form a laminate.

**[0013]** In embodiments of the invention, the inner sole is an insole or some other material which closes off the upper at its end on the sole side, for example an intermediate sole or a sealing sheet (gasket).

**[0014]** In one embodiment of the invention, the joining device is formed by a joining device which is like or similar to a seam.

**[0015]** In one embodiment of the invention, the joining device is formed by an expandable seam, which is either loosely sewn, so that it can be flowed through by liquid sealing material at least in a stretched or extended state, or which is sewn with an extensible yarn, so that the outer-material end region on the sole side and the inner sole can be brought to such a distance from each other during the production of the footwear by extending the yarn that liquid sealing material can flow through the extended seam. The extensible yarn may be elastically extensible yarn or non-elastically extensible yarn.

**[0016]** In one embodiment of the invention, the joining device is formed by a Strobel seam, which is either loosely sewn or sewn with extensible yarn. However, other types of seams, for example a quilted seam or a cross seam, which are loosely sewn or sewn with extensible yarn, are also suitable.

**[0017]** However, a joining device according to the invention does not have to be formed by a sewn seam. Other types of joining devices are also suitable, as long as they only form a connection between the outer material and the inner sole through which liquid material can flow. Examples of joining devices which are not sewn but are suitable for the invention are adhesive filaments or adhesive strips, which are adhesively attached to the outer material and to the inner sole, loops or individual rings, which are joined to the outer mate-

rial and to the inner sole, or staple like joining elements, which are joined to the outer material and to the inner sole.

**[0018]** In the case of footwear with a joining device according to the invention, in the form of a seam, only a single joining seam is required in the region of the connection between the outer material and the inner sole, said joining seam also being entirely unproblematical even at those points at which the inner sole has a small radius of curvature. All that is required in comparison with footwear with a conventional seam, as shown for example in FIG. 1 of the already cited EP 0 298 360 B1, is to design the seam in such a way that it can be flowed through by liquid material, i.e. has or allows (for example by extending) a distance between the outer material and the inner sole through which liquid sealing material can flow against a zone of the functional layer located in the region of the joining device and, as a result, the said zone can be sealed by the sealing material.

**[0019]** In the case of a joining device according to the invention in the form of a sewn seam, this means that the sewing machine used for producing the seam merely needs to be set in such a way that it creates a seam which can be flowed through by liquid material, or that extensible yarn is sewn with a conventional sewing machine St at a conventional setting and this yarn is extended by liquid sealing material being applied, in such a way that the liquid sealing material can flow against the said zone of the functional layer through the extended seam.

**[0020]** A seam according to the invention accordingly does not entail any greater effort than that which is required for a conventional seam, for example for the prior-art footwear shown in FIG. 1 of the cited EP 0 298 360 B1. The labour costs for the production of a seam according to the invention are consequently no higher than in the case of producing the seam of footwear of the cited prior art.

**[0021]** In the case of one embodiment of the invention, the functional-layer end region on the sole side is adhesively bonded to the inner sole.

**[0022]** In the case of one embodiment of the invention, a substantially nonexpandable fixed seam, by means of which the functional-layer end region on the sole side is joined to the inner sole, but not to the outer-material end region on the sole side, is provided in addition to the joining device.

**[0023]** In the case of one embodiment of the invention, the fixed seam is formed by a Strobel seam.

**[0024]** In the case of one embodiment of the invention, the outer material ends at a predetermined distance above the inner sole, the distance between the outer material and the inner sole is bridged by a strip of material impermeable to sealing material or liquid sole material, the strip of material is joined to the outer material by means of a top seam and to the functional layer and/or to the inner sole by means of a bottom seam and at least the top one of the two seams forms a joining device which can be flowed through, in the form of a seam which can expand as a result of loose sewing or sewing with an extensible yarn.

**[0025]** The sealing material may be either sole material, in particular outsole material of a moulded-on outsole, or a sealing adhesive which is liquid during application or can be liquefied after application by being activated. In one embodiment of the invention, a reactive hot-melt adhesive which in the fully reacted state leads to particularly high and permanent waterproofness of the sealed spot is used as the sealing adhesive.

**[0026]** Reactive hot-melt adhesive has, on the one hand, particularly great creepability in the liquid state before fully reacting and, on the other hand, brings about particularly high and permanent waterproofness in the fully reacted state. The reactive hot-melt adhesive can be applied with very simple means, for example be brushed on, sprayed on or applied in the form of a strip of adhesive or a bead of adhesive, the reactive hot-melt adhesive being made tacky by heating and, as a result, allowing itself to be attached to the region to be sealed before the full reacting process and accompanying permanent adhesive bonding to the functional layer begins.

**[0027]** The adhesive bonding of the reactive hot-melt adhesive or other sealing material to the functional layer is particularly intimate if the reactive hot-melt adhesive or other sealing material is mechanically pressed against the functional layer after being applied to the joining strip. Preferably suitable for this purpose is a pressing device, for example in the form of a pressing pad, with a smooth material surface which cannot be wetted by the reactive hot-melt adhesive or other sealing material and therefore cannot bond with the reactive hot-melt adhesive or the other sealing material, for example made of non-porous polytetrafluoroethylene (also known by the trade name Teflon), silicone or PE (polyethylene). Preferably used for this purpose is a pressing pad, for example in the form of a rubber pad or air cushion, the pressing surface of which is covered with a film of one of the said materials, for example non-porous polytetrafluoroethylene, or such a film is arranged between the sole construction provided with the reactive hot-melt adhesive or the other sealing material and the pressing pad before the pressing operation.

**[0028]** Preferably, a reactive hot-melt adhesive which can be cured by means of moisture is used which adhesive is applied to the region to be adhesively bonded and exposed to moisture to make it fully react. In one embodiment of the invention, a reactive hot-melt adhesive which can be thermally activated and can be cured by means of moisture is used, which adhesive is thermally activated, applied to the region to be adhesively bonded and exposed to moisture to make it fully react.

**[0029]** Reactive hot-melt adhesives refer to adhesives which, before their activation, comprise relatively short molecular chains with an average molecular weight in the range from approximately 3000 to approximately 5000 g/mol, are non-adhesive and, possibly by thermal activation, are brought into a state of reaction in which the relatively short molecular chains are crosslinked to form long molecular chains and thereby cure, doing so predominantly in moist atmosphere. During the reaction or curing time, they are capable of adhesive bonding. After the crosslinking curing, they cannot be re-activated. When they fully react, three-dimensional crosslinking of molecular chains occurs. The three-dimensional crosslinking leads to particularly high protection against water ingress into the adhesive.

**[0030]** Suitable for example for the purpose according to the invention are polyurethane reactive hot-melt adhesives, resins, aromatic hydrocarbon resins, aliphatic hydrocarbon resins and condensation resins, for example in the form of epoxy resin.

**[0031]** Particularly preferred are polyurethane reactive hot-melt adhesives, referred to hereafter as PU reactive hot-melt adhesives.

**[0032]** In one practical embodiment of footwear according to the invention, a PU reactive hot-melt adhesive which is

obtainable under the name IPATHERM S 14/242 from the company H, P. Fuller of Wells, Austria, is used. In another embodiment of the invention, a PU reactive hot-melt adhesive which is obtainable under the name Macroplast QR 6202 from the company Henkel AG, Dusseldorf, Germany, is used.

**[0033]** In one embodiment, in which the joining device according to the invention is formed by a sewn seam, monofilament sewing yarn is used, which yarn has a comparatively small yarn diameter in comparison with multi-filament sewing yarn, so that liquid sealing material flows against a greater surface area of the functional-layer zone located in the region of the joining device than in the case of multi-filament sewing yarn with a larger yarn diameter. What is more, in the case of mono-filament sewing yarn, there is no longer the risk that exists in the case of multi-filament sewing yarn of water being conducted along the sewing yarn as a consequence of capillary action.

**[0034]** Sewing machines by means of which a joining seam according to the invention can be produced by loose sewing are obtainable under the name Strobel machines from the company Strobel of Munich, Germany.

**[0035]** Monofilament sewing yarn, which is well suited for the production of a joining device according to the invention, is obtainable under the name Transfil from the company Amann & Sohne GmbH & Co. KG, D-74357 Bonnigheim, Germany. Extensible yarn which is suitable for a joining device according to the invention is a thread which is obtainable from the stated company Amann under the name Serafil 40/3 and has a non-destructive extensibility of 25%.

**[0036]** In one embodiment of the invention, a functional layer which is not only water-impermeable but also water-vapour-permeable is used. This makes it possible to produce waterproof shoes which remain breathable in spite of the waterproofness.

**[0037]** Suitable materials for the waterproof, water-vapour-permeable functional layer are, in particular, polyurethane, polypropylene and polyester, including polyether esters and their laminates, as described in the publications U.S. Pat. No. 4,725,481 and U.S. Pat. No. 4,493,870. Particularly preferred, however, is expanded microporous polytetrafluoroethylene (ePTFE), as described for example in the publications U.S. Pat. No. 3,953,566 and U.S. Pat. No. 4,187,390, and expanded polytetrafluoroethylene which is provided with hydrophilic impregnating agents and/or hydrophilic layers; see for example the publication U.S. Pat. No. 4,194,041. A microporous functional layer is understood to mean a functional layer of which the average pore size lies between approximately 0.2 microns and approximately 0.3 microns.

**[0038]** The pore size can be measured with the Coulter Porometer (trade name), which is produced by Coulter Electronics, Inc,, Hialeath, Fla., USA.

**[0039]** A functional layer is regarded as "waterproof", if appropriate including the seams provided at the functional layer, if it ensures a water ingress pressure of at least $1\times10^4$ Pa, The material of the functional layer preferably ensures a water ingress pressure of over $1\times10^5$ Pa. The water ingress pressure is measured by a test method in which distilled water at 20±2° C. is applied with increasing pressure to a sample of the functional layer of 100 $cm^2$. The pressure increase of the water is 60±3 cm of water column per minute. The water ingress pressure then corresponds to the pressure at which water appears on the other side of the sample for the first time. Details of the procedure are described in ISO standard 0811 from the year 1981.

**[0040]** A functional layer is regarded as "water-vapour-permeable" if it has a water-vapour permeability coefficient Ret of less than 150 $m^2\times Pa\times W^{-1}$. The water-vapour permeability is tested by the Hohenstein skin model. This test method is described in DIN EN 31092 (02/94) or ISO 11092 (1993).

**[0041]** Whether a shoe is waterproof can be tested for example by a centrifuge arrangement of the type described in U.S. Pat. No. 5,329,807.

**[0042]** If ePTFE is used as the functional layer, the reactive hot-melt adhesive can penetrate into the pores of this functional layer during the cementing operation, which leads to a mechanical anchoring of the reactive hot-melt adhesive in this functional layer.

**[0043]** The functional layer consisting of ePTFE may be provided with a thin polyurethane layer on the side with which it comes into contact with the reactive hot-melt adhesive during the cementing operation. If PU reactive hot-melt adhesive is used in conjunction with such a functional layer, there occurs not only the mechanical bond but also a chemical bond between the PU reactive hot-melt adhesive and the PU layer on the functional layer, This leads to a particularly intimate adhesive bonding between the functional layer and the reactive hot-melt adhesive, so that particularly durable waterproofness is ensured.

**[0044]** The extension of the end of the functional layer on the sole side in relation to the end of the outer material on the sole side and/or the inner sole can be adapted to the requirements of the respective specific footwear. For the functioning of the invention, it is merely required that the end of the functional layer on the sole side extends at least into the region of the joining device, so that sealing material flowing through the joining device can impinge on the functional layer and seal it.

**[0045]** The minimum length which the joining device is to have or the minimum space which the joining device has to allow for during the application of liquid sealing material depends on the viscosity of the liquid sealing material and on the pressure at which the liquid sealing material is applied. The lower the viscosity and the higher the pressure, the smaller this length/space can be. In embodiments of the invention, the distance between the end of the outer material and the inner sole which the joining device has or allows lies in the range from approximately 1/10 mm to approximately 12 mm. in practical embodiments, the distance between the end of the outer material and the inner sole lies in the range from 1 mm to 6 mm, in a more narrowly specified case between 1 mm and 4 mm. In the case of sealing material which has a particularly low viscosity in the liquid state and which is sprayed on with relatively high pressure, a length of the joining unit which lies below 2 mm, and is for example in the range from 0.1 mm to 1 mm, may be adequate. Since it is adequate for the flow to take place against a relatively small surface area of the functional layer in order to seal it with the sealing material, in many practical embodiments the length which the joining device has or the space to be allowed for need not be very much more than 2 mm. A much greater length/space, for example in the range from 4 to 5 mm or higher, is only desirable, if at all, if sealing material which has a comparatively high viscosity in the liquid state is applied with low pressure.

**[0046]** Leather or textile fabrics are suitable for example as the outer material of the upper. The textile fabrics may be, for example, woven or knitted fabrics, non-wovens or felt. These

textile fabrics may be produced from natural fibres, for example from cotton or viscose, from synthetic fibres, for example from polyesters, polyamides, polypropylenes or polyolefins, or from blends of at least two such materials.

**[0047]** When a functional layer is used, a lining material is normally arranged on the inner side. The same materials as are specified above for the textile outer material of the upper are suitable as lining material, which is often combined with the functional layer to form a functional-layer laminate. The functional-layer laminate may also have more than two layers, it being possible for a textile backing to be located on the side of the functional layer remote from the lining layer.

**[0048]** The outsole of footwear according to the invention may consist of waterproof material, such as for example rubber or plastic, for example polyurethane, or of non-waterproof, but breathable material, such as in particular leather, leather provided with rubber or plastic inlays or rubber or plastic provided with leather inlays. In the case of non-waterproof outsole material, the outsole can be made waterproof, while maintaining breathability, by being provided with a waterproof, water-vapour-permeable functional layer at least at points at which the sole construction has not already been made waterproof by other measures.

**[0049]** In the case of a moulded-on sole, for example an outsole, being also used as sealing material, it may consist for example of polyurethane (PU).

**[0050]** The insole of footwear according to the invention may consist of viscose, a nonwoven, for example polyester nonwoven, to which fusible fibres may be added, leather or adhesively bonded leather fibres. An insole is obtainable under the name Texon Brandsohle from Texon Mockmuhl GmbH of Mockmuhl, Germany. Insoles of such materials are water-permeable. An insole of such material or other material can be made waterproof by arranging a layer of waterproof material on one of its surfaces or inside it. For this purpose, for example, a film with Kappenstoff V25 from the company Rhenoflex of Ludwigshafen, Germany, may be ironed on, If the insole is to be not only waterproof but also water-vapour-permeable, it is provided with a waterproof, water-vapour-permeable functional layer, which is preferably constructed with ePTFE (expanded, microporous polytetrafluoroethylene). Suitable for this for example is a laminate which contains a waterproof, water-vapour-permeable functional layer and is obtainable under the trade name TOP DRY from W.L. Gore & Associates GmbH, Putzbrunn, Germany,

**[0051]** A further possibility is to adhesively attach such a laminate (TOP DRY) onto the insole, whereby the upper is already made waterproof before an outsole is applied.

**[0052]** The invention is now explained in more detail on the basis of embodiments. In the drawings, in which part of a shoe, for example in the region of the front foot of the shoe, is depicted as highly schematized representations which are not true to scale:

## DESCRIPTION OF THE DRAWINGS

**[0053]** FIG. **1** shows a sectional representation of a first embodiment of a shoe designed according to the invention, before it is stretched onto a last;

**[0054]** FIG. **2** shows a sectional representation as in FIG. **1**, but after the shoe has been stretched onto a last;

**[0055]** FIG. **3** shows a representation corresponding to FIG. **2**, but after sealing material in the form of an adhesive has been applied;

**[0056]** FIG. **4** shows a representation corresponding to FIG. **2**, but after a sole has been moulded on as sealing material;

**[0057]** FIG. **5** shows a sectional representation of a second embodiment of a shoe designed according to the invention, once a first seam has being created and before this shoe is stretched onto a last;

**[0058]** FIG. **6** shows a sectional representation as in FIG. **5**, but after the shoe has been stretched onto a last for a first time;

**[0059]** FIG. **7** shows a sectional representation as in FIG. **5**, but after the shoe has been removed from the last and a second seam has been created;

**[0060]** FIG. **8** shows a sectional representation as in FIG. **6**, but after the shoe has being stretched onto a last for a second time;

**[0061]** FIG. **9** shows a sectional representation of a third embodiment of a shoe designed according to the invention, after it has been stretched onto a last; and

**[0062]** FIG. **10** shows a sectional representation of a fourth embodiment of a shoe designed according to the invention, after it has been stretched onto a last.

## DETAILED DESCRIPTION OF THE INVENTION

**[0063]** All the figures show a greatly schematized sectional view, in each case of part of a not yet completed shoe in a cross section in the forefoot region, For all of the embodiments production phases before the shoe has been stretched onto a last and production phases after the shoe has been stretched onto a last are shown in the figures. The word shoe is used here, although this shoe has not yet been fully completed, since, with the exception of the representation in FIG. **4**, at least the outsole is still missing. If the inner sole shown in the figures is an insole, the outsole will be attached to it, either by adhesively attaching or moulding on an outsole.

**[0064]** FIGS. **1** to **4** show a first embodiment of the invention, in which a single seam is involved in the joining device. FIGS. **3** and **4** of these embodiments show two different variants of this embodiment, in the case of FIG. **3** the sealing of the functional layer being performed by means of a sealing material, while in the case of FIG. **4** the sealing is performed by means of material of a moulded-on sole. FIGS. **5** to **10** show three further embodiments of the invention, in which two seams are used in the region of the joining device. In the case of the embodiment of FIGS. **7** and **8**, as in the case of all the previous embodiments, the lower end of the outer material is joined to an inner sole by means of one loosely sewn or expandable seam of the two seams. In the case of the embodiments shown in FIGS. **9** and **10**, between the two seams there is a strip of material which is fastened by means of one of the two seams to the lower end of the outer material and by means of the other of the two seams to the inner sole. In the case of the embodiment of FIG. **9**, the bottom seam is fixedly sewn and the top seam is loosely sewn or sewn in such a way that it can expand. In the case of the embodiment of FIG. **10**, both seams are loosely or sewn in such a way that they can expand.

**[0065]** FIGS. **1** to **4** show sectional views of a shoe **11** according to a first embodiment of the invention with an upper **13** and an inner sole **15**, which is for example an insole **15**. The upper **13** comprises an outer material **17**, a waterproof functional layer **19** and a textile layer **21**, which is, for example, a lining textile. The functional layer **19** is located between the outer material **17** and the textile layer **21**. In the embodiment shown in the figures, the functional layer **19** and the textile layer **21** are joined to each other at an end **23** of the

functional layer on the sole side by means of a stretch seam **24**. In another embodiment (not shown) of such a shoe **11**, the functional layer **19** and the textile layer **21** form parts of a functional-layer laminate, it being possible to dispense with the stretch seam **24**. In the embodiment represented, the joining device according to the invention is formed by a loosely sewn Strobel seam **25**, which joins an end **27** of the outer material on the sole side to the insole **15**. In the embodiment represented, the end **27** of the outer material on the sole side runs perpendicularly in relation to the insole **15**, while the end **23** of the functional layer on the sole side and a lower end **29** of the textile layer on the sole side are angled away in such a way that they extend parallel to the insole **15**. However, this is not a precondition for the invention. In another embodiment (not represented), the end **29** of the textile layer on the sole side and the end **23** of the functional layer extend perpendicularly in relation to the insole **15**.

**[0066]** Shown in FIG. **1** is a production phase before the upper **13**, closed off by the insole **15**, is stretched over a last **31**. FIG. **2** shows a production phase after the upper **13** has been stretched over the last **31**. A comparison of the two FIGS. **1** and **2** shows that the loosely sewn Strobel seam **23** is so compliant that, when the upper **13** is stretched over the last **31**, a distance or gap **33** can be produced between the end **27** of the outer material on the sole side and the insole **15**. As a comparison of the two FIGS. **1** and **2** also shows, the lower ends **23** and **29** of the functional layer **19** and textile layer **21** are designed in such a way that they allow themselves to be forced down onto the insole **15** when the upper **13** is stretched over the last **31**, so that a functional-layer free zone **35** is produced in the region of the gap **33** on the outer side of the functional layer **19**, in which liquid sealing material **37** can flow against the functional layer **19** through the gap **33**, which leads to sealing of the functional layer **19** in the functional-layer free zone **35**.

**[0067]** Shown in FIGS. **3** and **4** are production phases of this embodiment which follow on from the production phase shown in FIG. **2** and differ from the latter in that sealing material has been applied in the region of the functional-layer free zone **35**.

**[0068]** FIG. **3** shows a variation of this embodiment in which sealing material in the form of liquid plastic or adhesive **37** has been applied in the region of the Strobel seam **25**, which has been extended and consequently allows liquid to pass through it, with such a viscosity and at such a pressure that the adhesive **37** can flow against the functional-layer free zone **35** and seal it. In one embodiment of the invention, the adhesive **37** is formed by a reactive hot-melt adhesive which leads to waterproofness in the fully reacted state.

**[0069]** The sealing material, applied only in the region of the gap **33** in the case of FIG. **3**, may also be a sheet-like sealing material, which is cut out in strip form from a sheet-like adhesive material, and which is placed from the outside onto the gap **33** and brought into a liquid and tacky state by activation energy, for example thermal energy. For better wetting of the functional-layer free zone **35** with the liquefied adhesive, a pressing device, which preferably consists of or is coated with a material which cannot be wetted by the liquid adhesive, may be used in the way already mentioned, in order to ensure that the liquefied adhesive **37** comes into adequately intimate contact with the functional layer **19**.

**[0070]** FIG. **4** shows a variation of this embodiment in which the sealing material is formed by sole cement of a moulded-on sole **39**, the sole **39** being a moulded-on outsole or a moulded-on sole which does not itself serve as an outsole but serves as a carrier for an outsole, which is fastened to the sole **39**, for example by cementing on or sewing on. In this case, the sole **39** is formed like a dish and is moulded on with such a high side wall **41** that both the Strobel seam **25** and the functional-layer free zone **35** are covered by sole material. The sole material, which is liquid when it is moulded on, is moulded on at such pressure that the liquid sole material flows against at least part of the functional-layer free zone **35** and the latter is consequently sealed in a waterproof manner.

**[0071]** In order to obtain sealing of the functional layer **19** in the end region **23** on the sole side, it is neither necessary for the functional-layer free zone **35** to extend over the entire gap **33** nor necessary for the end **23** of the functional layer on the sole side to extend beyond the gap **33**. To achieve adequate sealing of the functional layer **19**, it is adequate for the end **23** of the functional layer to extend into the gap **33**. It is already adequate if the lower end **23** of the functional layer extends into the gap **33** only so far that a cut edge of the lower end **23** of the functional layer is located within the gap **33**, so that sealing material can flow against and around this cut edge.

**[0072]** A second embodiment of the invention is now considered on the basis of FIGS. **5** to **8**. To the extent that components coincide with the embodiment shown in FIGS. **1** to **4**, the same reference numerals are used and reference can be made to the previous explanations in connection with the first embodiment.

**[0073]** The second embodiment according to FIGS. **5** to **8** differs from the first embodiment essentially in that two seams are used in the transitional region between the upper **13** and the inner sole **15**, that is a fixed seam **26**, by means of which the ends of the functional layer **19** and of the textile layer **21** on the sole side are joined to the border of the inner sole **15**, which is for example an insole. The fixed seam **26** is not expandable, or only insignificantly. It is, for example, a Strobel seam.

**[0074]** FIG. **5** shows a production phase after the fixed seam **26** has been formed. An end region **43** of the outer material **17** on the sole side has been swung away from the functional layer **19** and the inner sole **15**, to gain access for sewing the fixed seam **26**.

**[0075]** FIG. **6** shows a representation in which the shoe completed up to the production stage shown has been stretched onto a last **31** or lasted. A comparison of FIGS. **5** and **6** shows that the fixed seam **26** has yielded only insignificantly. The representation of FIG. **6** is merely of a demonstrative nature. In this production stage of the shoe, the last **31** itself is not yet required. Rather, directly following the production stage shown in FIG. **5**, according to FIG. **7**, the end region **43** of the outer material **17** on the sole side can be swung down again, so that it bears against the outer side of the functional layer **19**. After that, in the same way as in the case of the first embodiment of FIGS. **1** to **4**, a loose seam is created in the form of a loosely sewn and/or expandable Strobel seam **25**, by means of which the end of the outer material **17** on the sole side is sewn to the functional layer **19** and the inner sole **15**. In the production stage reached in this way, the shoe according to FIG. **8** is stretched onto a last **31**, causing expansion of the Strobel seam **25**, but not of the fixed seam **26**. In just the same way as already explained in connection with FIG. **2** for the first embodiment, this creates a gap **33** between the lower end of the outer material **17** and the inner sole **15**, which exposes a functional-layer free zone **35**. The further steps are then explained in just the same way as in connection

with FIGS. **3** and **4**. Either a sealing material **37** is applied to the functional-layer free zone **35** through the gap **33** or, when a sole is moulded on, liquid sole material penetrates through the gap **33** as far as the functional-layer free zone **35**, so that the functional layer is sealed there.

**[0076]** Footwear exists in which the lower end of the outer material **17** on the sole side ends at a distance above the inner sole and this distance is bridged by a strip of impermeable material. In FIGS. **9** and **10**, two embodiments with a joining device according to the invention are shown for such footwear.

**[0077]** FIG. **9** shows such an embodiment with a strip of material **45**, the upper end of which is sewn by means of a loose seam **25** to the lower end of the outer material **17** on the sole side and the lower end of which is sewn by means of a fixed seam **26** to the lower end of the functional layer **19** on the sole side, the textile layer **21** and to the border of the inner sole **15**. The loose seam **25** is again a seam, in the case of the embodiment represented a Strobel seam, which is loosely sewn and/or sewn with extensible yarn, so that it yields to tensile loading. The fixed seam **26** is again a seam, which does not yield, or only insignificantly, under tensile loading, and is a Strobel seam in the case of this represented embodiment.

**[0078]** FIG. **9** shows a production stage after both seams **25** and **26** have been produced and the shoe in the production stage then reached has been stretched onto a last **31**. The fixed seam **26** essentially does not yield, while the loose seam **25** yields on account of the tensile force exerted by the lasting, to the extent that there is a gap **33** created between the lower end of the outer material **17** and the upper end of the strip of material **45**, in the region of which gap a functional-layer free zone **35** is created. in the same way as explained in connection with FIGS. **3** and **4**, sealing material can then pass through the gap **33** to the functional-layer free zone **35**, in order to seal the latter, it again being possible for this to be pure sealing material or sole material acting in a sealing manner.

**[0079]** FIG. **10** shows a fourth embodiment, which differs very much from the embodiment shown in FIG. **5** and differs from the embodiment shown in FIG. **9** only in that not only the seam **25***a* joined to the upper border of the strip of material **45** but also the seam **25***b* joined to the lower border of the strip of material **45** is formed as a loose seam, in that it is loosely sewn and/or sewn with extensible yarn. After the lasting of the shoe in the production stage shown, the two seams **25***a* and **25***b* expand, so that two gaps **33***a* and **33***b* are created, in the regions of which there are two functional-layer free zones **35***a* and **35***b* formed, which can be sealed by sealing material being applied or by liquid sole material penetrating, as already explained in connection with FIGS. **3** and **4**.

**[0080]** In one embodiment of the invention, the joining device, in the embodiments represented in the figures the Strobel seam **25** or the Strobel seams **25**, **25***a*, **25***b*, **26**, runs around the entire lower periphery of the upper. In other embodiments of the invention, the joining device runs only around part of the periphery of the upper, while a different technology is used for the remaining part of the lower periphery of the upper. For example, the joining device according to the invention is provided only at those points of the periphery of the upper at which the periphery of the upper has a particularly small radius of curvature, as is the case in particular in the region of the toes and heels of shoes, most particularly in the case of children's shoes. As an example of another technology which can be used in the remaining region of the periphery of the upper, bootie technology may be mentioned. A bootie is the name given to a sock-like insert which includes a waterproof and water-vapour-permeable functional layer and is arranged as a lining on the inner side of the upper and of the sole construction. When bootie technology is applied in the case of a shoe in which a joining device according to the invention is used in a subregion of the periphery of the upper, only the remaining region of the periphery of the upper is provided with a bootie-like formation. In the embodiments represented in the figures, the Strobel seam **25** or the Strobel seams **25***a*, **25***b* are made flow-through by the said seam or seams being loosely sewn. As already mentioned, in other embodiments of the invention flowing through of the seam or seams is accomplished by the said seam or seams being sewn with extensible yarn. The same effects are obtained when using, for example, a lockstitch seam or zigzag seam sewn loosely or with extensible yarn.

We claim:

**1**. Method for producing footwear with an upper which is constructed with an outer material having an outer-material end region on the sole side and with a waterproof functional layer which is arranged on the inner side of the outer material and has a functional-layer end region on the sole side, and with an inner sole, comprising the steps of:

a) the outer-material end region is joined to the inner sole by means of a joining device running around at least part of the periphery of the upper, in such a way that a space through which liquid can flow can be established between the outer-material end region and the inner sole,

b) the functional-layer end region is designed in such a way that it extends at least into the region of the joining device;

c) while the outer-material end region and the inner sole are kept at a distance from each other by means of the joining device, a sealing material which is in the liquid state and leads to waterproofness is applied to the outer side of the joining device in such a way that it flows through the liquid-permeable joining device against the functional-layer end region.

**2**. Method according to claim **1**, in which the joining device is produced in such a way that it runs around the entire periphery of the upper.

**3**. Method according to claim **1**, in which the joining device is produced in such a way that it runs around only part of the periphery of the upper.

**4**. Method according to claim **1**, in which the joining device is formed as a joining device which is like or similar to a seam.

**5**. Method according to claim **1**, in which the joining device is formed by an expandable seam.

**6**. Method according to claim **5**, in which the joining device is formed by a loosely sewn seam.

**7**. Method according to claim **5**, in which the joining device is formed by a seam sewn with extensible yarn,

**8**. Method according to claim **5**, in which the seam is formed by a Strobel seam, a quilted seam, a cross seam or a zig-zag seam.

**9**. Method according to claim **1**, in which a sealing layer to be moulded on, consisting of a sealing material which is liquid when it is moulded on and can penetrate through the joining device, is formed as the sealing material.

**10**. Method according to claim **1**, for producing footwear with a moulded-on sole, in which the sealing material is formed by sole material which is liquid when it is moulded on and penetrates through the joining device.

**11**. Method according to claim **10**, for producing footwear with a moulded-on outsole, in which the sealing material is formed by outsole material which is liquid when it is moulded on.

**12**. Method according to claim **1**, in which a plastic is used as the sealing material.

**13**. Method according to claim **1**, in which an adhesive is used as the sealing material.

**14**. Method according to claim **1**, in which the functional-layer end region on the sole side is adhesively bonded to the inner sole.

**15**. Method according to claim **1**, in which a substantially nonexpandable fixed seam, by means of which the functional-layer end region on the sole side is joined to the inner sole, but not to the outer-material end region on the sole side, is created in addition to the joining device.

**16**. Method according to claim **1**, in which the outer material is made to end at a predetermined distance above the inner sole, the distance between the outer material and the inner sole is bridged by a strip of material impermeable to sealing material or liquid sole material, the strip of material is joined to the outer material by means of a top seam and to the functional layer and/or to the inner sole by means of a bottom seam and at least the top one of the two seams is formed by a joining device, which can be flowed through and which is in the form of a seam which can expand as a result of loose sewing or sewing with an extensible yarn.

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