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(54) **FOOTWEAR SOLE CONSTRUCTION**

SCHUHSOHLENAUFBAU

SEMELLE POUR CHAUSSURE

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EP-A- 0 042 138 **EP-A- 0 182 245**
SE-B- 424 951 **US-A- 4 658 515**

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Description

[0001] The present invention relates to a footwear sole construction as presented in the preamble of the accompanying claim 1.

[0002] In the soles of the footwear, air-containing porous plastic has been used as heat-insulating material, which plastic has poor thermal conductivity and which therefore serves as an insulator. The construction of the insulator is so dense that the convection, i.e., in this case the air flow through the insulator, is prevented. A material of this type is most commonly of foamed polyurethane, EVA (ethylene-vinylacetate) foam or latex foam. Another generally used solution is to "lighten" the somewhat thick sole construction by shaping projections on the sole surface which is against the foot, between which projections there is left material and weight saving air pocket which, at the same time, is a heat-insulating construction.

[0003] Due to the cellular construction of the plastic used, the proportion of the heat radiation in the heat transfer increases, because the heat radiation penetrates easily the gas pore or the air pocket, although conductivity and convection are insignificant. To prevent the heat loss caused by heat radiation, a reflective layer can have been glued on the surface of the insulating layer, which reflective layer is most commonly a thin metal film, e.g. a lustrous aluminium foil. A lustrous metal surface well reflects the heat radiation coming via the insulating layer and it should thus prevent heat loss by radiation.

[0004] In prior art solutions, the reflective layer is attached to the insulating layer by gluing. Although the glue layer is thin (0.02-0.03 mm) and e.g. visually seen it is transparent, it can affect the heat-insulating properties. Many materials used as a glue absorb well heat radiation in the wavelength area of 8 to 15 μm , and the quantity that is absorbed can well exceed even 80 %. Also the radiation reflecting back from the reflecting surface of the reflective layer is absorbed when returning to the glue layer, so that over 95 % of the heat radiation can be absorbed even to a thin glue layer. The quantity of the heat radiation returning to the insulating layer can thus be very small. Hence, the problem is that the materials of the reflective layer also conduct well heat, wherein when the heat is transferred by conducting from the glue layer to the reflective layer, heat is transferred out exactly due to the good heat conductivity of the reflective layer, e.g. to the glue layer on the opposite side of the reflective layer.

[0005] These problems are present both in situations in which it is desired to protect the foot in the footwear against cold or against heat surrounding the sole from below. In the former case, the heat should be prevented from transferring out from the interior of the footwear, and in the latter case from outside into the footwear. A metal foil glued to the insulating layer does not operate, i.e., reflect heat radiation, as planned.

[0006] British Patent application GB-A-2137866 dis-

closes a separate insole in which a surface which is facing the inner sole is made of polyester coated with a metal film, and between the outermost metal surface and the inner sole there is an additional intermediate layer, having a thickness of 1 mm, attached to the metal surface, perforated and made of polyethylene. The polyester layer (PET) on the side of the foot behaves in the same manner as the glue layer; it conducts well heat, and the openness of the intermediate layer facing the inner sole subjects the metal layer to mechanical damages and the heat is capable of transferring partially by convection through holes, particularly in the case of a separate Insole, which will move during the use.

[0007] Document EP-A-0 042 138 shows an insole where a film of aluminized polymeric material is placed on the underside of a central layer of elastomeric material.

[0008] Document EP-A-0 182 245 describes a shoe having a heat reflecting layer made of Aluminium.

[0009] The object of the invention is to eliminate the above mentioned disadvantages and to present a sole construction with improved heat insulation properties, the sole construction being most commonly an insole used between the inner lining and the wear sole. To attain this object the sole construction is mainly characterized in what is presented in the characterizing portion of the accompanying claim 1. The reflective surface of the reflective layer is attached directly to material of an insulating layer without an intermediate absorbent glue layer. The significance of this construction has until now remained undiscovered, but it can be proved that the advantage achieved by means of it is distinctly to be noticed in connection with insulating layers permeable to heat radiation. The construction has two such reflective surfaces facing opposite directions so that they can act in both directions.

[0010] In the following, the invention will be described in more detail with reference to the accompanying drawings, wherein

Fig. 1 illustrates a cross section of a conventional construction and phenomena taking place therein,

Fig. 2 illustrates a cross section of a construction in accordance with the invention and phenomena taking place therein,

Fig. 3 shows how the construction in accordance with the invention is located in the footwear, and

Fig. 4 shows a second alternative of the sole construction.

[0011] In Fig. 1 the reference numeral 1 refers generally to an insulating layer having the predominant task of preventing heat transfer from taking place by conduc-

tion. The insulating layers employed advantageously in the construction of the invention are discussed later. To this layer there is attached, by using a glue layer 2, a reflective layer 3 made of such material that its surface reflects more than 90 %, preferably more than 95 % of the heat radiation coming thereto in the wave-length area of 8 to 15 μm . Such materials include metals, and the most employed material is aluminium. The reflective layer 3 can be further attached to its other side to another construction by means of a glue layer 2. The above described heat transfer phenomena are further illustrated schematically by arrows, of which an arrow 6 refers to incoming heat radiation, an arrow 7 to reflected heat radiation, arrows 8 to absorbed heat radiation and arrows 9 to heat transfer taking place between the layers by means of conduction.

[0012] Fig. 2 illustrates a construction according to the invention, in which, as in Fig. 1, the thickness of the layers has been exaggerated for the sake of clarity. The insulating layer 1 is generally of plastic material with good heat-radiation permeability but poor heat conductivity being characterized in the employed layer thickness by a heat-radiation permeability of 40 to 90 % taken as average in a wavelength area of 8 to 15 μm , particularly in the wavelength range between 9 and 10 μm , which corresponds to foot temperature. Furthermore, a material of this type is characterized by the fact that, particularly compared to an ordinary polyethylene-terephthalate (polyester) of the same thickness, it is in the employed layer thickness characterized by at least twice, preferably at least three times, higher heat-radiation permeability in the wavelength range of 9 to 10 μm . The material is advantageously of some expanded polyolefin having a cellular construction brought about by orientation. Most advantageously suitable are such films which have a thickness not exceeding 0.1 mm, and most commonly in an area between 0.025 and 0.06 mm and having a closed-cell cellular construction brought about by cavitation technique. One suitable film material is polypropylene, and applicable for this purpose is e.g. a commercial OPP-film, which is known from other contexts. A reflective layer 4 is attached directly on the surface of the insulating layer 1, wherein a reflective surface 4a crucial to the heat-insulation has a direct contact with the material of the insulating layer 1. It is important that the interface is sharp so that the material having the above mentioned properties of the insulating layer 1 changes at the interface layer to the material of the reflective layer 4 without an intermediate layer having distinctly different properties from those of the insulating layer. Non-glue attachment of this kind to the insulating layer can be obtained e.g. by vacuum evaporating the material of the reflective layer 4 onto the surface of the insulating layer 1, and this can be obtained by a known vacuum evaporation technique of metals, by which technique plastic materials are metallized. Also other methods can be considered for attaching the film directly onto the surface of the insulating layer, e.g. a closed cellular

construction could be formed directly on top of the metal film.

[0013] Due to this construction the heat radiation (arrow 6) is reflected almost entirely (arrow 7) from the reflective surface 4a, because there exists no heat-absorbing material between the insulating layer 1 and the reflective layer 4, and only the portion (arrow 8) determined by the properties of the material of the reflective layer 4 is absorbed and is transferred away by conducting. E.g. the emission coefficient of a vacuum-evaporated aluminium film is 0.04 at temperature of 20°C, which corresponds to a reflectivity of 96 %.

[0014] The thickness of the reflective layer 4 is most advantageously not more than 50 nm, which is a relatively thick layer in vacuum-evaporation technique, corresponding to a basis weight of 0.15 g/m² for aluminium.

[0015] Further, the insulating layer 1 is characterized by the fact that it is a film having a uniform macroscopic construction and covering the reflective layer 4, i.e., it is closed having no holes in the middle through which the heat could pass through the film by convection, the air operating as the medium, and through which the reflective layer would be subject to damages.

[0016] The above mentioned layers constitute the minimum conditions for the invention to be functional. Provided that it is desired to maintain heat in the interior of the footwear, the insulating layer 1 is in the insole on the side of the inner lining and the reflective layer 4a faces consequently the inner linings. In case it is desired to protect the foot from hot surroundings, e.g. the footwear being intended for walking on hot grounds, the insulating layer 1 is positioned in the insole on the side of the wear sole and the reflective surface 4a of the reflective layer faces consequently the wear sole. However, Fig. 2 shows at the same time a two-sided construction according to the invention which construction can be used for preventing the heat from transferring from both sides. In this case the construction has a second insulating layer 1 and a reflective layer 4 attached directly thereon, the layers being situated in a mirror symmetrical manner in relation to the first layered construction in a manner that the reflective layers 4 are situated in the middle of the construction and their reflective surfaces 4a reflecting heat radiation are facing to the opposite directions towards their own insulating layers 1. These layered constructions comprising an insulating layer 1 and a reflective layer 4 can be attached together by attaching the reflective layers 4 at their free surfaces together, e.g. by means of an intermediate glue layer 2, which has no disadvantageous effect in this position. Also in case of the two-sided construction only a small proportion of the heat radiation coming through one insulation layer 1 is transferred by conducting away through the reflective layers 4 and the glue layer 2 and is radiated to a second insulating layer (arrow 10). Fig. 2 further shows how the insulating layers 1 are joined at their outer surfaces to the rest of the sole construction 5, e.g. to an ordinary insole material, and at this point a glue line

also can be used for joining. The inner lining can serve as the layer 5 above, and beneath there can be the uppermost blank piece of the insole, having the size of the shoe sole. As for the use and manufacturing, the two-layer construction includes the advantage that the inner thin reflective layers 4 are well protected and the outermost insulating layers 1 function as attachment surfaces with the other layers. Particularly in the insole, but also elsewhere in the shoe sole, the thin layer 4 is not subject to bending to the degree that it would be damaged.

[0017] The insulating layer 1 can be used for separating the reflective layer 4a from such layers of the sole construction which have a distinctly poorer heat-radiation permeability than the insulating layer 1 or which are practically non-permeable to heat radiation.

[0018] The above-mentioned two-sided protection can also be obtained by means of a construction having the reflective layer 4 attached on both sides of the insulating layer 1 in accordance with the invention, wherein on both sides of the insulating layer there is a reflective surface 4a directly against it, which reflective surface is capable of receiving the heat radiation coming through the insulating layer 1 without intermediate absorbent material. The glue line is also in this situation elsewhere than between the reflecting surface and the insulating layer. On the other hand, the heat radiation in this construction is low as such, because the reflective layer 4 has a poor emissivity and it does not radiate much when warmed up.

[0019] Fig. 3 shows a cross section of a footwear in which the sole construction is situated. The construction is most advantageously a layered construction situated close to the interior of the footwear, in the example of Fig. 3 a fixed insole 11, to which the vamp or upper 12 is attached by using methods generally known in footwear industry. An outsole to which the ready-made vamp part is connected by means of a soling method is denoted by reference numeral 13, and the filling which is left between the insole 11 and the outsole 13 is denoted by reference numeral 14. The entity constituted of one or several insulating layers 1 and reflective layers 4 is placed to a correct position in relation to the direction of the incoming heat radiation, preferably in the middle of the insole, wherein they are supported and protected by its layers.

[0020] Fig. 4 shows yet another sole construction, i. e., a separate insole 15 or insert positioned on top of the inner sole (interior bottom) of the footwear. Also here the layered construction composed of the insulating layer 1 and the reflective layer 2, most advantageously the two-sided construction of Fig. 2, is situated preferably in the middle, wherein on its other side there is a layer having the suitable properties and placed against the foot sole, and on the other side there is a layer placed against the inner sole.

[0021] The invention is further illustrated with the following two Examples, which are not to restrict the scope of protection.

Example 1.

[0022] The effect of the glue layer on heat reflection was measured by means of a long-wave camera. The test included three samples, the order of the samples from the top to the bottom being:

Sample 1: OPP-film - vacuum-evaporated aluminium layer - glue layer - OPP-film.

Sample 2: OPP-film - glue layer - vacuum-evaporated aluminium layer - OPP-film.

Sample 3: OPP-film - glue layer - OPP-film.

[0023] The OPP-film is a biaxially oriented polypropylene film. The samples were placed side by side on a surface of room temperature (23°C). On the other side of the samples a vessel of warm water (36°C) was placed to serve as the heat source and on the other side a heat camera was placed by which the temperatures of the heat source and the sample surfaces were measured. The surface of the sample 1 showed a temperature of 27°C and the surfaces of the samples 2 and 3 both showed a temperature of 25°C and the surface below showed a temperature of 23°C. According to the measurement, the glue layer between the OPP-film and the aluminium surface prevented the heat-reflecting effect of the aluminium and the reflectivity showed the same value as the sample without the aluminium layer.

Example 2.

[0024] Various insoles were manufactured for tests. The basic materials were common commercial insole materials. An element according to the invention was laminated to a part of the samples. The warmth of the different solutions were measured by employing a device in which the sample to be measured was pressed against an aluminium surface in a cold weather room (-10°C) by means of a heating element constructed for this purpose. The heating element was heated at a constant power and the temperature was measured on the surface of the sample after the stabilization time of two hours. The better the insulation was, the higher the temperature that was measured. In the test, the insole provided with the element of the invention was 2°C warmer than a corresponding construction without the element (8.9°C versus 10.8°C). When a construction corresponding to the element and having the same thickness but having no reflective layer was laminated to a corresponding insole construction, the insulation properties were improved but distinctively less than when the construction was provided with a reflective layer.

Claims

1. A footwear sole construction having:

- an insulating layer (1) permeable to heat radiation; 5
- a reflective layer (4) attached directly on a surface of said insulating layer (1);

the insulating layer (1) and the reflective layer (4) attached thereto being placed between the inner lining and the wear sole, 10

characterized in that the sole construction further comprises:

- a second reflective layer (4) directly attached on said insulating layer or on a second insulating layer (1), wherein each reflective surface (4a) of each reflective layer (4) faces opposite directions and each forms a sharp interface with the material of the respective insulating layer (1) without an intermediate absorbent glue layer, 15 20

such a construction reflecting heat radiation incoming from opposite directions of the sole. 25

2. A sole construction as set forth in claim 1, **characterized in that** said two reflective layers (4) are attached against each other, wherein the insulating layers (1) directly attached to them are outermost and serve as attaching surfaces to the rest of the construction. 30

3. A sole construction as set forth in claim 1 or 2, **characterized in that** the reflective layer (4) is a metal foil attached to the insulating layer (1) by vacuum evaporation. 35

4. A sole construction as set forth in any of claims 1 to 3, **characterized in that** it is a fixed insole (11). 40

5. A sole construction as set forth in any of claims 1 to 3, **characterized in that** it is a separate insole (15). 45

6. A sole construction as set forth in any of claims 1 to 5, **characterized in that** the insulating layer (1) is a uniform plastic film having a thickness not exceeding 0.1 mm. 50

7. A sole construction as set forth in claim 6, **characterized in that** the insulating layer (1) is an oriented closed-cell cellular film. 55

Patentansprüche

1. Ein Sohlenaufbau für Schuhwaren, umfassend:

- eine Isolationsschicht (1), welche für Wärmestrahlung durchlässig ist;
- eine Reflexionsschicht (4), welche direkt auf einer Oberfläche der Isolationsschicht (1) angebracht ist;

wobei sich die Isolationsschicht (1) und die daran angebrachte Reflexionsschicht (4) zwischen dem Innenfutter und der Laufsohle befinden, **dadurch gekennzeichnet, dass** der Sohlenaufbau ferner beinhaltet:

- eine zweite Reflexionsschicht (4), welche direkt auf der Isolationsschicht oder auf einer zweiten Isolationsschicht (1) angebracht ist,

wobei jede reflektierende Oberfläche (4a) einer jeden Reflexionsschicht (4) in entgegengesetzte Richtungen gerichtet ist und jeweils eine scharfe Grenzfläche zum Material der jeweiligen Isolationsschicht (1) ohne dazwischenliegende absorbierende Klebeschicht bildet, so dass ein derartiger Aufbau Wärmestrahlung, welche von entgegengesetzten Richtungen der Sohle einfällt, reflektiert.

2. Ein Sohlenaufbau nach Anspruch 1, **dadurch gekennzeichnet, dass** die beiden Reflexionsschichten (4) aneinander angebracht sind, wobei die direkt an ihnen angebrachten Isolationsschichten (1) zuäusserst sind und als Oberflächen zur Befestigung des verbleibenden Aufbaus dienen.

3. Ein Sohlenaufbau nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Reflexionsschicht (4) ein Metallbelag ist, welcher auf der Reflexionsschicht durch Aufdampfen im Vakuum aufgebracht ist.

4. Ein Sohlenaufbau nach irgendeinem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** er eine Brandsohle (11) ist.

5. Ein Sohlenaufbau nach irgendeinem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** er eine Einlegesohle (15) ist.

6. Ein Sohlenaufbau nach irgendeinem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** die Isolationsschicht (1) eine gleichförmige Kunststoffschicht mit einer Dicke von nicht mehr als 0.1 mm ist.

7. Ein Sohlenaufbau nach Anspruch 6, **dadurch gekennzeichnet, dass** die Isolationsschicht (1) ein ausgerichteter geschlossenzelliger Schaumstoff ist.

Revendications

ractérisé en ce que la couche isolante (1) est un film cellulaire orienté à cellules fermées.

1. Ensemble de semelle pour chaussures comportant :

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- une couche isolante (1) perméable à un rayonnement thermique,
- une couche réfléchissante (4) fixée directement sur une surface de ladite couche isolante (1),

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la couche isolante (1) et la couche réfléchissante (4) fixée à celle-ci étant placées entre le revêtement intérieur et la semelle d'usure,

caractérisé en ce que l'ensemble de semelle comprend en outre :

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- une seconde couche réfléchissante (4) directement fixée sur ladite couche isolante ou sur une seconde couche isolante (1), où chaque surface réfléchissante (4a) de chaque couche réfléchissante (4) est orientée dans des directions opposées et chacune forme une interface marquée avec le matériau de la couche isolante respective (1) sans couche de colle absorbante intermédiaire,

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un tel ensemble réfléchissant un rayonnement thermique provenant de directions opposées de la semelle.

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2. Ensemble de semelle selon la revendication 1, **caractérisé en ce que** lesdites deux couches réfléchissantes (4) sont fixées l'une contre l'autre, dans lequel les couches isolantes (1) qui leur sont directement fixées sont les plus à l'extérieur et servent de surface de fixation au reste de l'ensemble.

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3. Ensemble de semelle selon la revendication 1 ou 2, **caractérisé en ce que** la couche réfléchissante (4) est une feuille métallique fixée à la couche isolante (1) par évaporation sous vide.

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4. Ensemble de semelle selon l'une quelconque des revendications 1 à 3, **caractérisé en ce qu'il** s'agit d'une semelle intérieure fixe (11).

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5. Ensemble de semelle selon l'une quelconque des revendications 1 à 3, **caractérisé en ce qu'il** s'agit d'une semelle intérieure séparée (15).

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6. Ensemble de semelle selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** la couche isolante (1) est un film de matière plastique uni-forme ayant une épaisseur ne dépassant pas 0,1 mm.

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7. Ensemble de semelle selon la revendication 6, **ca-**

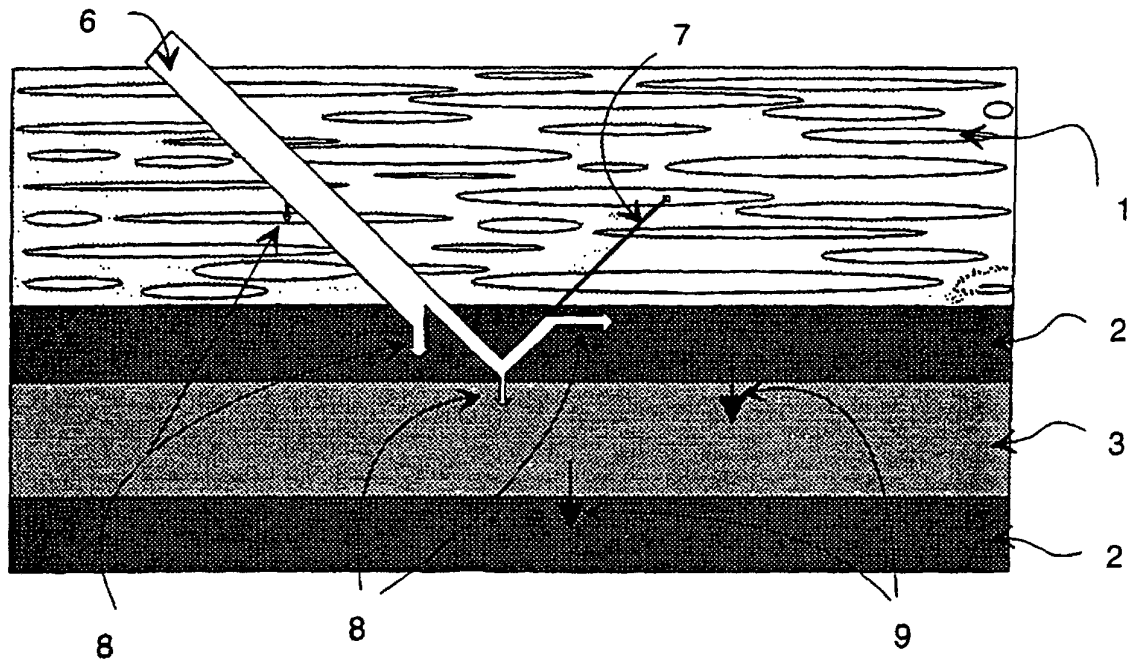


Fig. 1

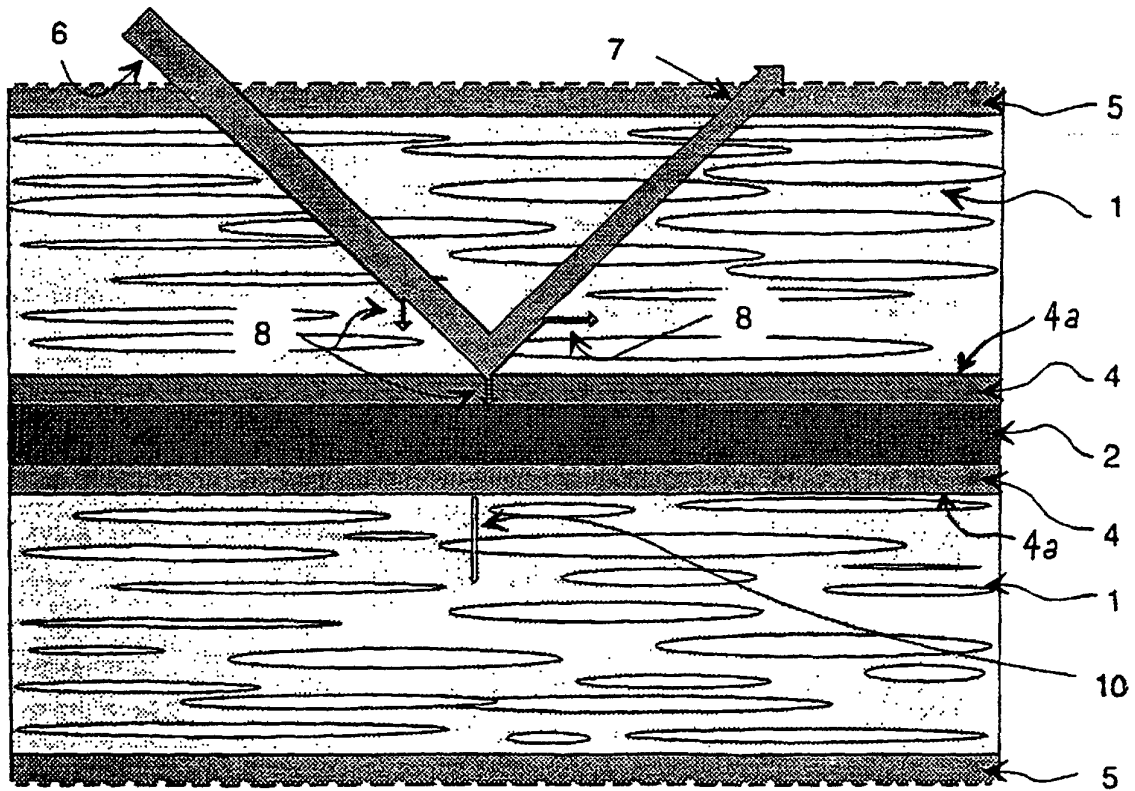


Fig. 2

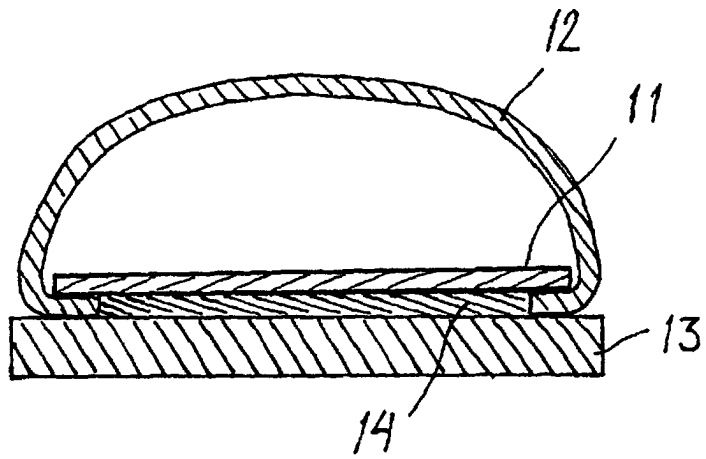


Fig. 3

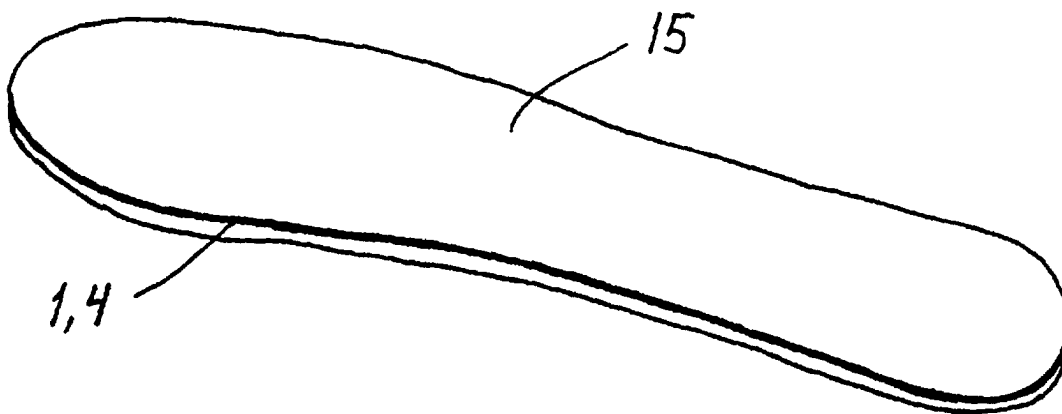


Fig. 4