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(54) A ROOF ASSEMBLY AND A METHOD FOR PRODUCING SUCH ROOF ASSEMBLY

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EP-A- 0 269 989
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Description

[0001] The invention relates to a roof assembly comprising a structural support, a waterproof membrane comprising sheets of bituminous membrane material arranged on said support with overlay; wherein the lower layer of the overlay is, exclusively in the peripheral portion of the sheet, in permanent connection with the support; and wherein the upper layer of the overlay is in permanent connection with the lower layer of the overlay.

[0002] Roof constructions with a roofing of a bituminous roofing material are well known. For the formation of such, a structural support is provided which is usually made of a sheet material that can be secured on a rafter construction or the like structural support. The support may also be a supporting sheet material and eg an overlaying heat-insulating layer. This support serves as support for a bituminous roofing layer which is permanently connected thereto, eg by welding. In that context, it may be a full-surface connection, as described eg in DK 136 374 and SE 460 982; or eg elongate connecting strips or the like positioned at intervals transversally to a roofing sheet so as to establish a connection to the support. The roofing layer can consist of a single- or multi-layered bituminous roofing material and is typically coated on its top surface with crushed slate, but it may also have another surface. Often, a need subsequently arises for covering this roofing layer with a waterproof membrane which is usually, like the roofing material proper, made of a bituminous material. Such subsequent coverings with a waterproof membrane can be made eg in accordance with the prior art, wherein membrane sheets are mounted with an overlay and secured to the support. In this context it is known to use two different principles for the attachment of the membrane sheets relative to the roof construction, viz a peripheral connection or full-surface welding/strip welding of the membrane sheets.

[0003] The peripheral attachment is generally considerably more expediently established than a full-surface/strip welding. Furthermore, compared to the principle of full-surface/strip welding, the principle of peripheral attachment involves the considerable advantage that a subsequent dismounting of the membrane sheets is considerably less difficult. This is significant in connection with the increasing re-use of such membrane material. For the peripheral attachment, the membrane sheets must generally be dimensioned with more strength. The drawback associated with this in the form of an increased material consumption, however, is amply balanced by the advantage of more expedient mounting and the convenient properties in connection with dismounting. An example of peripheral attachment is shown in SE 460 982.

[0004] The prior art within the field of peripheral attachment of the membrane sheets teaches that that a lower part of the overlay, ie the lower moisture-barrier membrane sheet, is secured to the support by means of attachment meanss, such as nails, which - in case an intermediate roofing layer is present - must be mounted through the roofing layer. It is necessary in such construction that the lower membrane layer in the overlay is, with regard to surface impacts, dimensioned in accordance with the attachment means used and the spacing there between. Thus, any pull in the membrane will have to be absorbed in the area covered by the attachment means in the lower layer of the overlay. Obviously, due to the usually small expanse of an attachment means and the usually sharp edge area of such, either a small mutual spacing between such attachment means or else a high strength of the membrane material is required to resist pulling-through of the attachment meanss by influences, eg by wind. The required insertion of the attachment means through a roofing layer, if any, involves an increased risk of moisture penetration below such roofing layer. Despite the fact that the use of separate mechanical attachment meanss is considerably more expedient than the full-surface welding or strip welding otherwise employed, a significant amount of time, however, is consumed in this attachment process in the establishment of the membrane covering.

[0005] It is therefore an object of the present invention to form a roof covering of the type described above which will, while maintaining the properties of a peripheral connection that are advantageous with a view to dismounting and re-use, yield improved strength of the connection between support and membrane thereby reducing the risk of moisture penetration below a roofing layer, and which is substantially more expedient to accomplish.

[0006] In accordance with the invention this is accomplished by the permanent connection between the lower membrane layer in the overlay and the lower layer consisting of a permanent, mutual welded or adhesive connection between support and a peripheral area of the lower membrane layer in the overlay.

[0007] Since this is a case of a welded or adhesive connection, power influences that may occur on the membrane layer relative to the support are not associated with large, local concentrations of tension as is the case around the edge of the mechanical attachment means used so far. Furthermore, it is possible in a simple manner to distribute power influences across a larger area without hereby substantially influencing the time consumed in the mounting. Thus, it is hereby obtained that corresponding material dimensions yield improved strength of the membrane layer compared to the prior art peripheral attachment, or else a corresponding strength is obtained with smaller material dimensions. In the roof construction in accordance with the invention, no holes occur in a roofing layer, if any, when the membrane material is connected to the support, and thus no passage for moisture to the area below the roofing layer is created as a consequence of the mounting of the membrane. Permanent connection between the support and the lower part of the overlay can be established sub-

stantially more expediently by an adhesive or welded connection than by permanent connection by means of attachment means. Hereby a considerable rationalisation of the roof construction is obtained from a manufacturing point of view, and considerably improved strength conditions are also obtained therefor while maintaining the advantageous properties of the peripheral attachment as regards dismounting. When re-using membrane material or roofing material with a membrane mounted there across it is no longer required to separate the attachment means, which may be eg metallic, from the remaining material. This entails a considerable rationalisation of the re-use.

[0008] Preferably the roofing layer comprises a bituminous top layer coated with crushed slate or other surface coating, and the side of lower portion of the overlay that faces the bituminous top layer preferably comprises a heat-activatable adhesive layer which will, by the welding connection, establish the permanent connection between the lower membrane layer in the overlay and the roofing layer and hence the permanent connection with the remaining support.

[0009] As also mentioned, a substantial amount of the time it takes to establish the membrane layer covering is consumed by the use of separate mechanical attachment means as is commonly known in the prior art for peripheral attachment. It is therefore a further object of the invention to accomplish a method of connecting a waterproof membrane by peripheral attachment to a support, which method is considerably more expediently exercised that the prior art.

[0010] Therefore, the invention also relates to a method for use in the construction of a roof as described above by connecting a lower layer of a membrane material in an overlay with a lower layer. The method is characterised in that the lower layer in the overlay is in the overlay area connected to the support in a heating process; and in a subsequent depression of the membrane layer towards the roofing layer.

[0011] This heating process is conveniently effected by heat being supplied to the underside of an outer periphery of the membrane layer which forms the lower portion of the overlay, following deposition of the membrane portion on the support, and to the top surface of the lower layer while the heat source is moved in the longitudinal direction of the sheet, and in that, successively, in the same direction and at essentially the same velocity, a depression of the membrane layer towards the lower layer is carried out.

[0012] Particularly conveniently the method can be exercised in that the heat supply can be effected by use of a hot-air generator with a mouthpiece introduced between the membrane layer and the support, said hot air being blown in at a high velocity. In case the support comprises a roofing layer with a bituminous top layer coated with crushed slate or a similar coating material and the side of the lower portion of the top layer that faces towards the bituminous top layer preferably comprises a heat-activatable adhesive layer, this is particularly convenient since it has surprisingly been found that the blowing-in and subsequent depression causes the coating material to be shifted from the central area of the zone of peripheral welding, whereby a substantially improved connection is obtained between the bituminous material in the roofing layer and the heat-activatable adhesive layer than was otherwise known by welding of membrane sheets with a coated surface.

[0013] Use of a hot-air generator, preferably an electrical hot-air generator, allows for substantial energy savings compared to eg use of a gas burner. Use of an electric hot-air generator also results in a considerable reduction of the risk of fires erupting compared to the use of gas burners.

[0014] Depression of the membrane layer towards the roofing layer is preferably effected by means of a roll which is conveyed either by hand or in a rack that also carries the heat source. In this context, the pressure force constitutes 0.4-4.0 N/mm, preferably 0.8-3.0 N/mm. The rate of advancement for the heat supplier is preferably such that, at the side of the membrane edge, a bead of heat-activatable adhesive substance will emerge, having a magnitude of 2-20 mm. Hereby a surprisingly high strength of the connection is obtained in a simple manner. The width of the welding area at the edge corresponds approximately to the width of the overlay, ie it is within the range of 5-15 cm.

[0015] The invention will now be explained in further detail with reference to the drawings which illustrate partly the prior art, partly a preferred embodiment of the roof construction according to the invention, and wherein

Figure 1 is a sectional view of an exemplary membrane material for mounting on top of an existing roofing;

Figure 2 is a sectional view through a roof construction wherein the lower membrane layer in an overlay, cf the prior art known before the invention, is attached to a lower layer by means of attachment meanss;

Figure 3 is a sectional view through a roof construction according to the invention;

Figure 4 illustrates a roof construction according to the invention, seen from above, by connection of the membrane material to the roofing layer and thus to the support;

Figure 5 is a sectional view along line 5-5 in Figure 4;

Figure 6 illustrates use of an alternative tool for a roof construction in accordance with the invention, seen from above, for the connection of the mem-

brane material to the roofing layer and thus the support;

Figure 7 is a sectional view along line 7-7 in Figure 6.

[0016] Figure 1 illustrates combining of a membrane layer 3 for mounting on an existing roofing 2 (Figures 2 and 3). The membrane layer comprises a reinforcing layer 11 which has been impregnated and coated with a mixture 12 of bitumen, filler and thermoplastic elastomer; and wherein a layer of crushed slate 13 is arranged on top of this. On the underside of the reinforcing layer 11, a heat-activatable adhesive substance 14 is provided consisting of bitumen, filler and thermoplastic elastomer. On its underside the membrane layer is provided with a readily meltable plastics film 15.

[0017] Figure 2 shows an example of prior art wherein an existing roofing layer 2 mounted on a support 1 of sheet material is coated with a membrane 3,4. The roofing material 2 is permanently attached to the support 1 by full-surface welding. However, it may be discrete welding areas, such as elongate connecting strips or peripheral attachment. The lower layer of the membrane material 3 is connected to the support 1 by means of an attachment means 21. The upper layer of the membrane material 4 is subsequently arranged in overlay relative to the lower membrane material layer 3, and is herein welded thereto by peripheral welding 5. Obviously the head of such attachment means covers a limited area and therefore, with a view to the power influences exerted thereon, the membrane layer 3 must be dimensioned in accordance with the size of the head of the attachment means or the number thereof. Equally obviously, this known method of attachment involves penetration of the existing roofing material 2 which creates access for moisture below the roofing material.

[0018] Figure 3 illustrates an example of the roof construction according to the invention wherein a support 1 has a roofing material 2 mounted thereon by full welding; and wherein the attachment of membrane material 3 relative to the support 1 has been accomplished by peripheral welding relative to the existing roofing material 2, thus producing an indirect connection. The superjacent membrane sheet 4 is, like in the prior art, connected by welding to the lower membrane sheet 3 in an overlay.

[0019] Figure 4 shows a section of a roof construction while exercising the method for forming the roof construction illustrated in Figure 3. Herein the membrane layer 3 has been rolled onto the roofing material 2 and the mouthpiece 8 of a heat supplier 7 has been inserted into the peripheral area below the membrane layer 3 where it is conveyed to the left in Figures 4 and 5 during the welding process. Following activation of the adhesive substance on the underside of the membrane material 3, a roll 9 is conveyed manually across the welding area and the welding area is compressed.

[0020] This will appear more clearly from Figure 5 which illustrates the support 1, the existing roofing material 2 and the membrane material 3. It also appears that the mouthpiece 8 of the hot-air supplier 7 blows the hot air in a direction towards the welding site, ie to the right in Figures 4 and 5.

[0021] Correspondingly, Figure 6 illustrates an alternative embodiment of the method according to the invention wherein the subsequent compression of the welding place is effected by means of a more heavy roll 10 mounted on a not shown rack which also carries the hot-air supplier 7. Owing to the mounting on a rack which is advanced to the left in the drawing, there is a need for a heavier roll, since it is not possible to exert a manual pressure on the welding site. The same will appear from Figure 7 which is a sectional view through the construction shown in Figure 6.

[0022] The roofing layer preferably comprises a bituminous top layer coated with crushed slate or the like coated material, and the side of the lower portion of the overlay which faces towards the bituminous top layer preferably comprises a heat-activatable adhesive layer. This coated coating presents particularly difficult conditions in a welding connection. In the method according to the invention and as shown in Figures 4-7, the blowing-in of hot air and the subsequent depression effects a shifting of the coating material in the welding area, and this enables a tear strength in the connecting area which substantially exceeds the tear strengths otherwise obtainable between roofing and membrane.

Claims

1. A roof construction comprising a support (1) and a waterproof membrane (3,4) comprising sheets of bituminous membrane material arranged on the support with overlay, wherein the lower layer (3) of the overlay is exclusively at the outer periphery of said sheet in permanent connection with the support; and wherein the upper layer of the overlay is in permanent connection (5) with the lower layer (3) of the overlay, **characterized in that** the permanent connection between the lower membrane layer (3) in the overlay and the lower layer (1) consists in a permanent, mutual welded or adhesive connection (6) at the periphery of the lower membrane layer (3).

2. A roof construction according to claim 1, **characterized in that** the structural support (1) is composed of a lower structural part and a heat-insulating upper part.

3. A roof construction according to claim 1 or 2, **characterized in that** the support (1) comprises a bituminous roofing layer (2) arranged on the lower structural portion or on an insulating layer in direct or indirect permanent connection with the structural portion of the support; wherein the permanent pe-

ripheral connection between the support and the bituminous membrane is formed between the roofing layer (2) and the membrane layer (3).

4. A roof construction according to claim 3, **characterized in that** the roofing layer (2) comprises a bituminous top layer coated with slate or other surface coating; and **in that** the side of the lower portion (3) of the overlay that faces towards the support comprises a heat-activatable adhesive layer.

5. A roof construction according to any one of claims 1-4, **characterized in that** transversally to the permanent peripheral connection (6) between support (1) and the lower membrane layer (3) of the overlay is provided with passages so as to establish flow-connection through the peripheral connection (6) for pressure equalisation between the spaces between membrane and support that are covered by the membrane sheets (3,4).

6. A method for use in the formation of a roof construction according to claims 1-5, wherein a lower membrane sheet (3) in an overlay is to be connected to a support (1) exclusively at a peripheral area, **characterized in that** the connection of the lower membrane sheet in the overlay to the support is effected by the lower membrane sheet in a peripheral area being permanently connected to the support by a heating process; and a subsequent depression of the membrane sheet (3).

7. A method according to claim 6, **characterized in that** the membrane sheet (3) of which an outer peripheral area forms the lower part of the overlay is laid onto the support; and **in that** heat is supplied to the underside of this outer periphery and to the top surface of the support, the heat source being moved in the longitudinal direction of the sheet; and **in that**, successively and in the same direction and with substantially the same rate, a depression of the membrane sheet (3) is performed.

8. A method according to claim 7, **characterized in that** the heat supply is effected by use of a hot-air generator with a mouthpiece introduced between membrane layer (3) and support (2), wherein the hot air is blown out at a high rate.

9. A method according to claim 7, **characterized in that** the depression is carried out by means of a roll which is conveyed either by hand or in a rack which also carries the heat supplier.

10. A method according to claims 6-9, **characterized in that** the depression is effected by a linear pressure within the range of 0.4-4.0 N/mm, preferably within the range of 0.8-3.0 N/mm.

11. A method according to any one of claims 6-10, **characterized in that**, at discrete locations in the permanent peripheral connection between lower layer (2) and the lower membrane sheet (3), passages are provided over the entire width of the permanent peripheral connection, wherein the passage-forming material is eg a felt material.

Patentansprüche

1. Dachkonstruktion, welche ein Trägermaterial (1) und eine wasserdichte Membran (3, 4) beinhaltet, welche Bahnen aus bituminösem Membranmaterial beinhaltet, die auf dem Trägermaterial mit Überlappung angeordnet sind, wobei sich die untere Schicht (3) der Überlappung ausschließlich in der äußeren Randzone der Bahn in dauerhafter Verbindung mit dem Trägermaterial befindet; und wobei sich die obere Schicht der Überlappung in dauerhafter Verbindung (5) mit der unteren Schicht (3) der Überlappung befindet, **dadurch gekennzeichnet, dass** die dauerhafte Verbindung zwischen unterer Membranschicht (3) der Überlappung und unterer Schicht (1) aus einer in der Randzone der unteren Membranschicht (3) vorhandenen dauerhaft miteinander verschweißten oder verklebten Verbindung (6) besteht.

2. Dachkonstruktion nach Anspruch 1, **dadurch gekennzeichnet, dass** das Strukturträgermaterial (1) aus einem unteren Strukturteil und einem wärmeisolierenden oberen Teil besteht.

3. Dachkonstruktion nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Trägermaterial (1) eine bituminöse Dachbelagschicht (2) aufweist, die auf dem unteren Strukturabschnitt oder auf einer Isolierschicht in direkter oder indirekter dauerhafter Verbindung mit dem Strukturabschnitt des Trägermaterials angeordnet ist; wobei die in der Randzone befindliche dauerhafte Verbindung von Trägermaterial und bituminöser Membran zwischen der Dachbelagschicht (2) und der Membranschicht (3) hergestellt ist.

4. Dachkonstruktion nach Anspruch 3, **dadurch gekennzeichnet, dass** die Dachbelagschicht (2) eine bituminöse obere Schicht aufweist, die mit Schiefer oder einem anderen Oberflächenbelag bedeckt ist; und dass die Seite des unteren Abschnitts (3) der Überlappung, die dem Trägermaterial zugewandt ist, eine wärmeaktivierbare Klebstoffschicht aufweist.

5. Dachkonstruktion nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** in Querrichtung zu der in der Randzone befindlichen dauerhaften

Verbindung (6) zwischen Trägermaterial (1) und unterer Membranschicht (3) der Überlappung Durchlässe vorgesehen sind, um so eine Strömungsverbindung, die durch die in der Randzone befindliche Verbindung (6) hindurch verläuft, herzustellen, um für einen Druckausgleich zwischen den zwischen Membran und Trägermaterial befindlichen Räumen zu sorgen, die von den Membranbahnen (3, 4) überzogen sind.

6. Verfahren, das bei der Erzeugung einer Dachkonstruktion nach den Ansprüchen 1 bis 5 Anwendung findet, bei welchem eine untere Membranbahn (3) einer Überlappung ausschließlich bei einer Randzone mit einem Trägermaterial (1) zu verbinden ist, **dadurch gekennzeichnet, dass** das Verbinden mit der Trägermaterial der unteren Membranbahn der Überlappung dadurch erfolgt, dass die untere Membranbahn in einer Randzone durch einen Heizprozess mit dem Trägermaterial dauerhaft verbunden wird; und dass ein anschließendes Herunterdrükken der Membranbahn (3) erfolgt.

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** die Membranbahn (3), deren äußere Randzone den unteren Teil der Überlappung bildet, auf das Trägermaterial aufgelegt wird; und dass der Unterseite dieser äußeren Randzone und der Oberseite des Trägermaterials Wärme zugeführt wird, wobei die Wärmequelle in Längsrichtung der Bahn bewegt wird; und dass, sukzessive und in gleicher Richtung, und mit im Wesentlichen gleicher Geschwindigkeit ein Herunterdrücken der Membranbahn (3) durchgeführt wird.

8. Verfahren nach Anspruch 7, **dadurch gekennzeichnet, dass** die Wärmezufuhr unter Verwendung eines Heißluftgenerators erfolgt, wobei ein Mundstück zwischen Membranschicht (3) und Trägermaterial (2) eingeführt wird und die heiße Luft mit hoher Geschwindigkeit ausgeblasen wird.

9. Verfahren nach Anspruch 7, **dadurch gekennzeichnet, dass** das Herunterdrücken mittels einer Walze erfolgt, die entweder von Hand oder in einem Gestell vorwärts transportiert wird, das auch die Wärmezufuhreinrichtung trägt.

10. Verfahren nach einem der Ansprüche 6 bis 9, **dadurch gekennzeichnet, dass** das Herunterdrükken mit einem Lineardruck zwischen 0,4 und 4,0 N/mm und vorzugsweise zwischen 0,8 und 3,0 N/mm erfolgt.

11. Verfahren nach einem der Ansprüche 6 bis 10, **dadurch gekennzeichnet, dass** an voneinander getrennten Stellen der dauerhaften Randzonenverbindung zwischen unterer Schicht (2) und unterer Membranbahn (3) über die gesamte Breite der dauerhaften Randzonenverbindung Durchlässe vorgesehen sind, wobei es sich bei dem den Durchlass bildenden Material z. B. um ein Filzmaterial handelt.

Revendications

1. Construction de toit comprenant un support (1) et une membrane étanche à l'eau (3,4) comprenant des feuilles d'un matériau de membrane bitumineux disposées sur le support avec un chevauchement, où la couche inférieure (3) du chevauchement se situe exclusivement à la périphérie extérieure de ladite feuille en une connexion permanente avec le support ; et où la couche supérieure du chevauchement est en connexion permanente (5) avec la couche inférieure (3) du chevauchement, **caractérisée en ce que** la connexion permanente entre la couche de membrane inférieure (3) dans le chevauchement et la couche inférieure (1) consiste en une connexion permanente, mutuellement soudée ou adhésive (6) à la périphérie de la couche de membrane inférieure (3).

2. Construction de toit selon la revendication 1, **caractérisée en ce que** le support structurel (1) est constitué d'une partie structurelle inférieure et d'une partie supérieure calorifuge.

3. Construction de toit selon la revendication 1 ou 2, **caractérisée en ce que** le support (1) comprend une couche de toit bitumineuse (2) disposée sur la portion structurelle inférieure ou sur une couche isolante en une connexion permanente directe ou indirecte avec la portion structurelle du support ; où la connexion périphérique permanente entre le support et la membrane bitumineuse est formée entre la couche de toit (2) et la couche de membrane (3).

4. Construction de toit selon la revendication 3, **caractérisée en ce que** la couche de toit (2) comprend une couche supérieure bitumineuse revêtue d'ardoise ou d'un autre revêtement de surface ; et **en ce que** le côté de la portion inférieure (3) du chevauchement qui est orienté vers le support comprend une couche adhésive activable par la chaleur.

5. Construction de toit selon l'une des revendications 1 à 4, **caractérisée en ce que** sont prévus transversalement à la connexion périphérique permanente (6) entre le support (1) et la couche de membrane inférieure (3) du chevauchement des passages de manière à établir une connexion d'écoulement à travers la connexion périphérique (6) en vue d'une égalisation de la pression entre les espaces entre la membrane et le support qui sont recouverts

par les feuilles de membrane (3,4).

6. Procédé pour utilisation dans la formation d'une construction de toit selon les revendications 1 à 5, où une feuille de membrane inférieure (3) dans un chevauchement doit être reliée à un support (1) exclusivement à une zone périphérique, **caractérisé en ce que** la connexion de la feuille de membrane inférieure dans le chevauchement au support est effectuée par la feuille de membrane inférieure dans une zone périphérique reliée en permanence au support par un processus de chauffage ; et un enfoncement suivant de la feuille de membrane (3).

7. Procédé selon la revendication 6, **caractérisé en ce que** la feuille de membrane (3) dont une zone périphérique extérieure forme la partie inférieure du chevauchement est placée sur le support ; et **en ce que** de la chaleur est amenée au côté inférieur de cette périphérie extérieure et à la surface supérieure du support, la source de chaleur étant déplacée dans la direction longitudinale de la feuille ; et **en ce que**, successivement et dans la même direction et sensiblement à la même vitesse, un enfoncement de la feuille de membrane (3) est effectué.

8. Procédé selon la revendication 7, **caractérisé en ce que** l'amenée de chaleur est effectuée en utilisant un générateur d'air chaud avec une embouchure introduite entre la couche de membrane (3) et le support (2), où l'air chaud est expulsé selon un débit élevé.

9. Procédé selon la revendication 7, **caractérisé en ce que** l'enfoncement est exécuté au moyen d'un rouleau qui est déplacé soit à la main soit dans une crémaillère qui porte également l'organe fournissant la chaleur.

10. Procédé selon les revendications 6 à 9, **caractérisé en ce que** l'enfoncement est effectué par une pression linéaire dans la plage de 0,4-4,0 N/mm, de préférence dans la plage de 0,8-3,0 N/mm.

11. Procédé selon l'une des revendications 6 à 10, **caractérisé en ce que**, à des emplacements discrets dans la connexion périphérique permanente entre la couche inférieure (2) et la feuille de membrane inférieure (3), des passages sont prévus sur toute la largeur de la connexion périphérique permanente, où le matériau de formation des passages est par exemple un matériau de feutre.

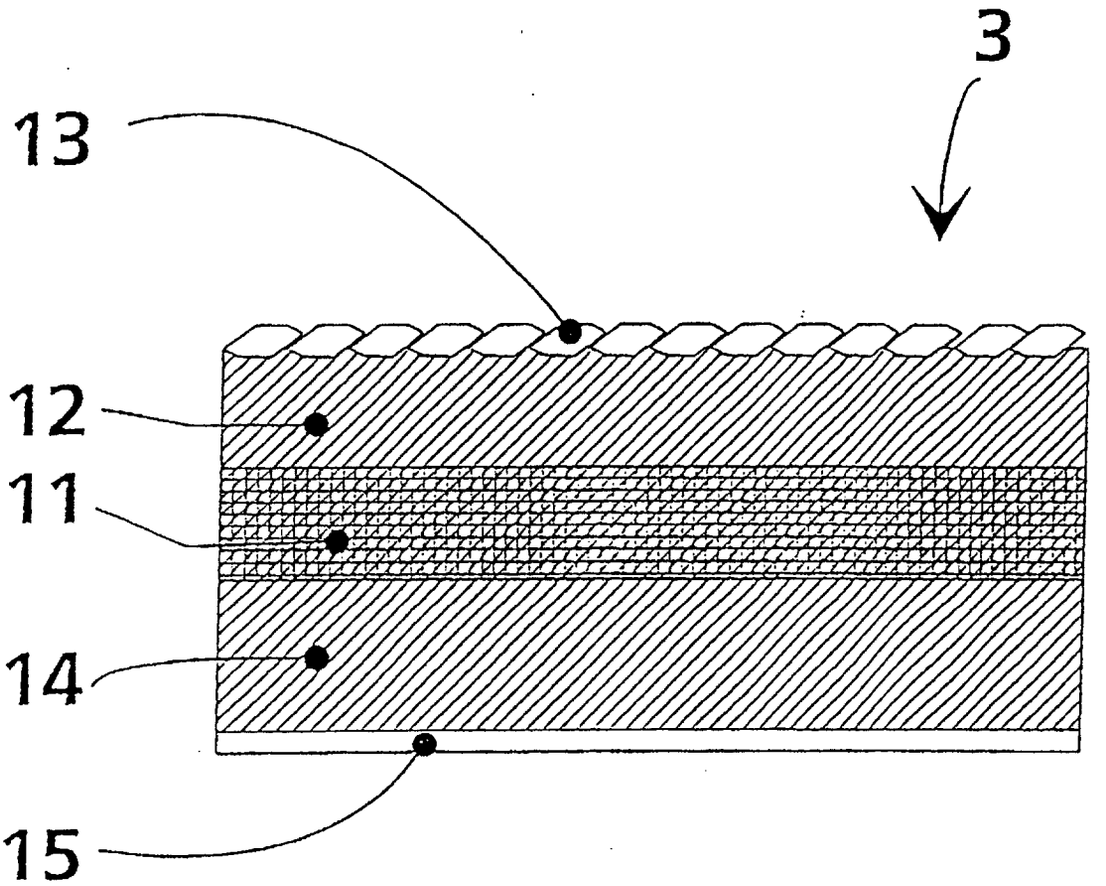

Fig. 1

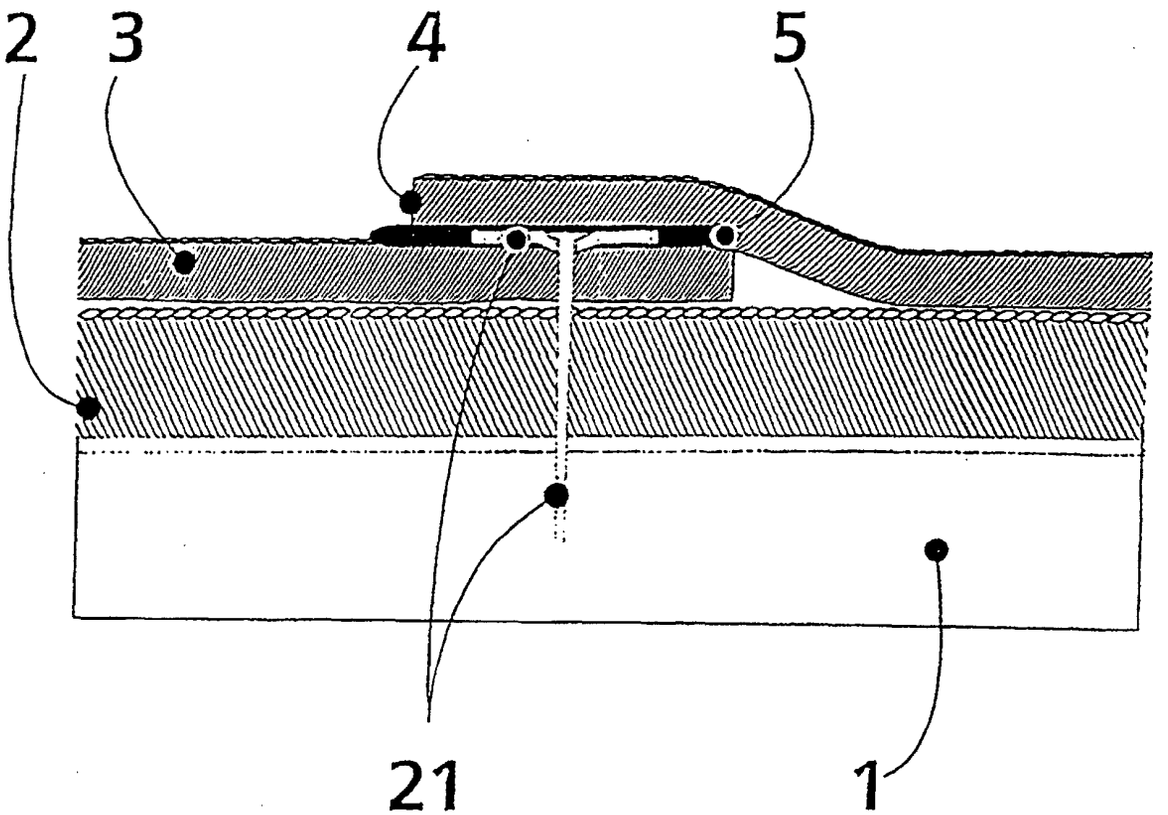

Fig. 2

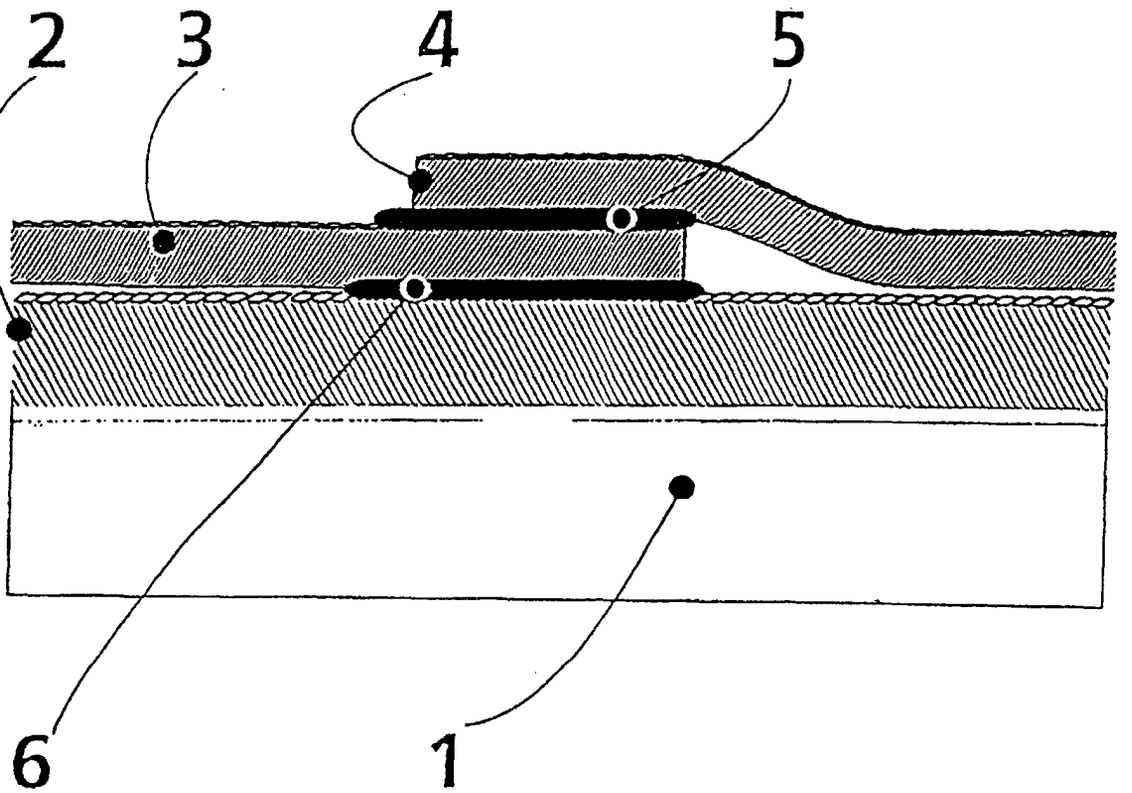

Fig. 3

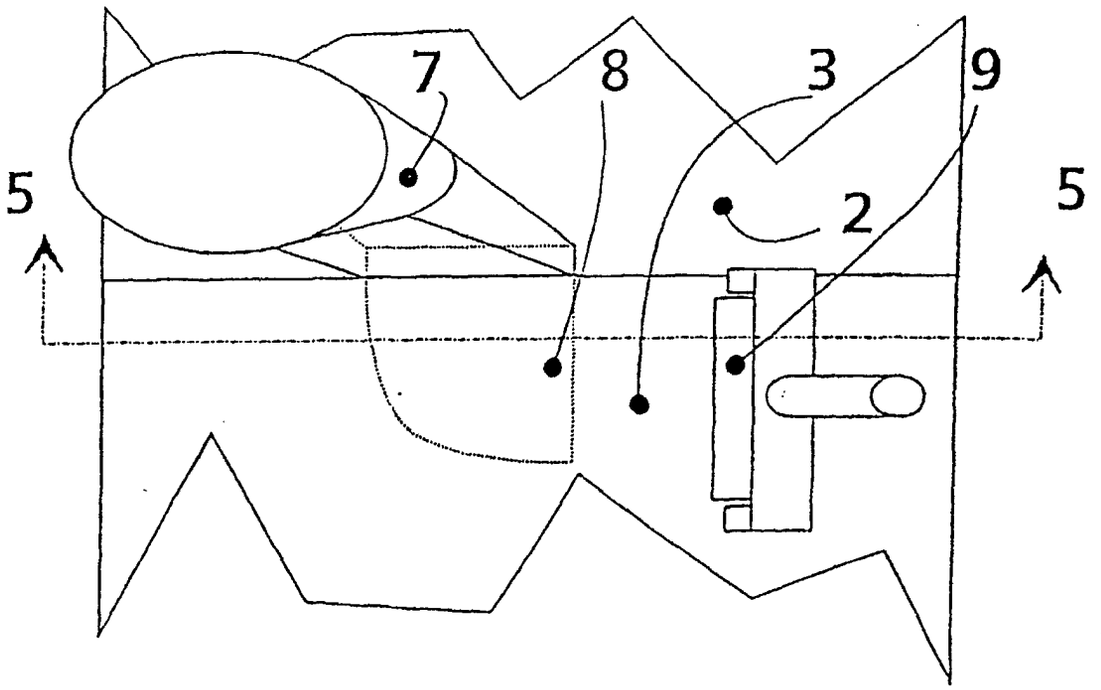

Fig. 4

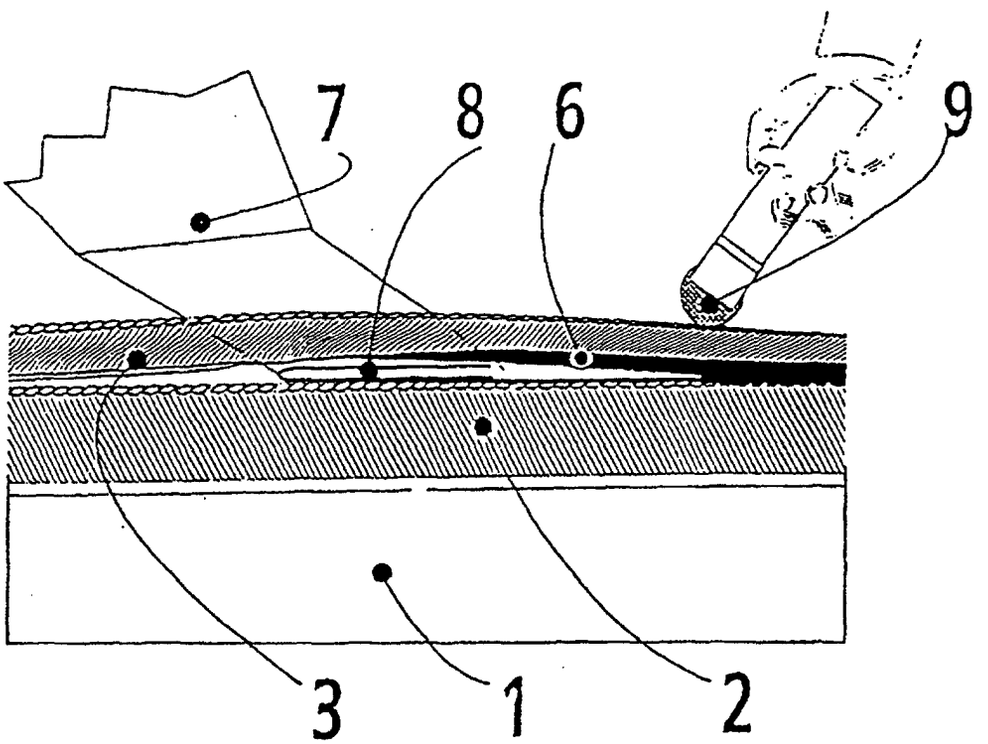

Fig. 5

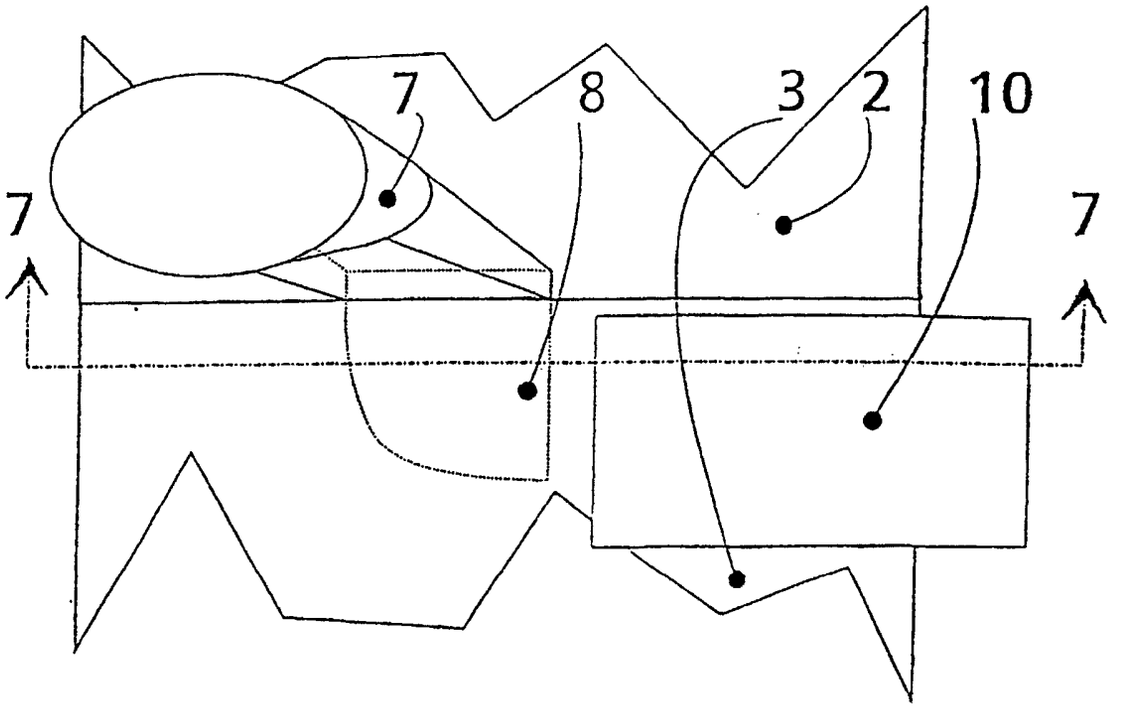

Fig. 6

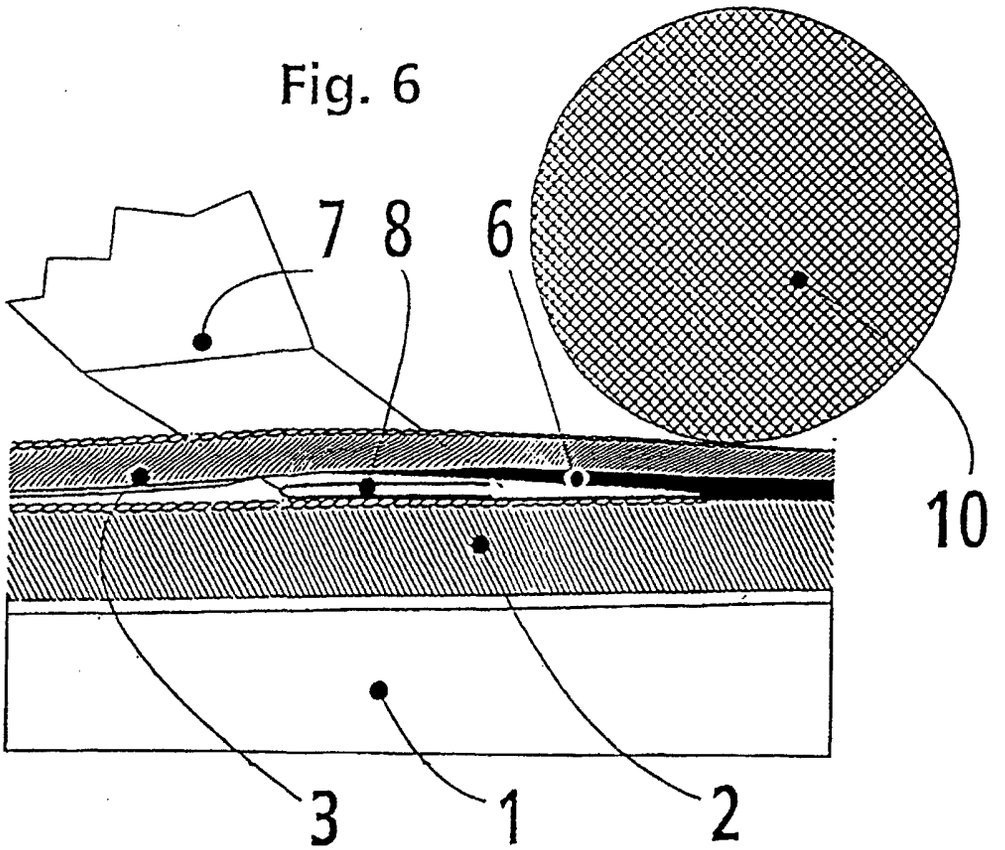

Fig. 7