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(54) **Roofing material and roofing structure and method for manufacturing a roofing structure**

(57) The invention relates to a roofing material, which is arranged as strips (10) longer than they are wide. The various layers of the roofing material include a support layer (11) and an insulating layer (12, 13) on both sides of it. In addition, on the surface of the first insulating layer (12) opposite to the support layer (11) is a surface layer (14), which covers part of the surface area of the strip (10) starting from one longitudinal side of the strip (10). There is a protective layer (15) on the opposite surface of the support layer (11) to the second insulating layer (13). The surface layer (14) covers 40 - 60 %, preferably 45 - 55 %, of the width of the strip (10). The invention also relates to a roofing structure and a method for manufacturing a roofing structure.

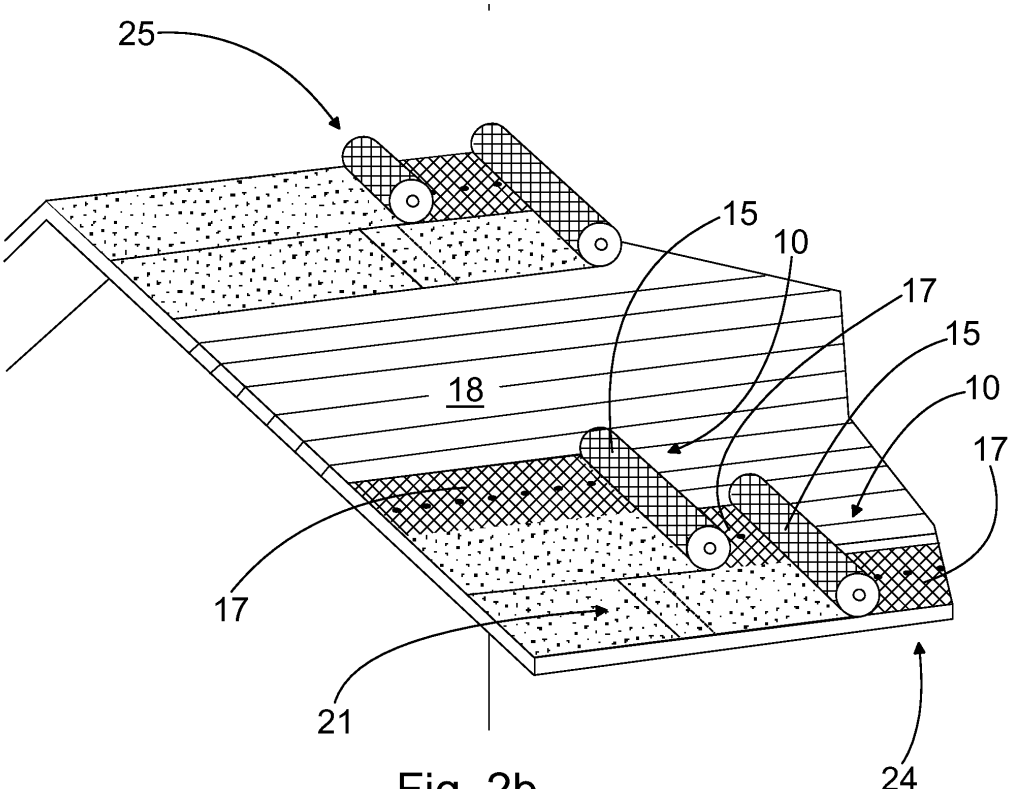

Fig. 2b

EP 2 060 695 A1

Description

[0001] The present invention relates to a roofing material, which is arranged as strips longer than they are wide, the various layers of which include

- a support layer,
- an insulating layer on both sides of the support layer
- a surface layer, which covers part of the surface area of the strip starting from one longitudinal side of the strip, on the opposite side of the support layer to the first insulating layer, and
- a protective layer on the opposite surface of the support layer to the second insulating layer.

[0002] The invention also relates to a roofing structure and a method for manufacturing a roofing structure.

[0003] In the prior art, particularly when roofing low-pitch and flat roofs, a base membrane is first installed from a roll on top of the base structure, followed by a surface membrane, in which there is the desired surface layer. In other words, there are at least two layers in the finished roofing structure. If necessary, one or more additional layers are installed, depending on the building regulations. Usually, the base layers are attached to their base and to each other by both gluing or welding and by mechanical attachments. The surface membranes are generally attached entirely by gluing. In the gluing of the seams, the parallel membrane strips are overlapped and rolled open at the same time to remove the protective structure, which protects a narrow bitumen layer at the edge of the membrane strip in self-adhesive products. Generally, the bitumen layer is on the surface-layer side of the membrane. There can also be a second bitumen layer at the other edge of the membrane, at the side opposite to the first bitumen layer. The overlap of the membranes is about 100 mm at the side seams and 150 mm at the end seams.

[0004] The known roofing manner is difficult. Each layer of the roofing structure is made separately, so that the roofing materials and tools must be moved backwards and forwards on the roof. This takes time, while the movement on the roof can break the layer that has already been made. In addition, the gluing and mechanical attachment is slow and, despite the tools, is largely manual work. The gluing also demands a lot of space to work, while the membrane rolls to take up space on the roof. In addition, if the surface of the base membrane is damp due to rain or dew, it must be dried before the surface membrane can be installed. This further increases the time taken by roofing. The known roofing structure is also uneven, as it is mainly doubled, but is even quadrupled at the overlaps. The end seams also remain almost entirely visible. In addition, the roofing materials are difficult to handle.

[0005] The invention is intended to create a new type of roofing material, which will be easier to handle and which will not have the drawbacks of the prior art. In addition, the invention is intended to create a new type of roofing structure, which will be more even and watertight than previously. The invention is also intended to create a new type of method for manufacturing a roofing structure, which is simpler and faster than previously and cheaper in cost. The characteristic features of the roofing material according to the invention are stated in the accompanying Claim 1. Correspondingly, the characterizing features of the roofing structure according to the invention are stated in the accompanying Claim 8. In addition, the characterizing features of the method according to the invention are stated in the accompanying Claim 11. In the roofing material according to the invention, new and surprising types of layers are used, the mutual dimensioning of which is, in addition, ingenious. Thus, the roofing material is more user-friendly and considerably lighter than previously. The new type of roofing material permits the creation of a new type of roofing structure. The finished roofing structure is watertight and durable. The method also brings a significant saving in time, in both the actual roofing and the other operations relating to the manufacture of the roofing structure. At the same time, savings are also possible in material and handling costs.

[0006] In the following, the invention is examined in detail with reference to the accompanying drawings showing some embodiments of the invention, in which

- Figure 1a shows a schematic cross-section of a first embodiment of the roofing material according to the invention,
- Figure 1b shows a schematic drawing of a cross-section of the roofing structure according to the invention,
- Figure 2a shows a schematic drawing of a roof being roofed according to the prior art,
- Figure 2b shows a schematic drawing of a roof being roofed according to the invention,
- Figure 3a shows a schematic cross-section of a second embodiment of the roofing material according to the invention, and
- Figure 3b shows a schematic cross-section of a third embodiment of the roofing material according to the invention.

[0007] Figure 1a shows a cross-section of a first embodiment of the roofing material according to the invention. In reality, the roofing material is arranged as a strip 10, which is longer than it is wide, which is stored and transported as a roll (Figure 2b). The roofing material, which is also referred to as a membrane, includes layers attached to each other, which are shown here substantially enlarged, for reasons of clarity. In reality, the roofing material is a few millimetres thick. Firstly, a support layer 11 gives the roofing material its strength. The support layer 11 is, for example, a glass-fibre or polyester mat. Next are insulating layers 12 and 13 on both sides of the support layer 11. Usually, the insulating layer is bitumen

or rubberized bitumen. A roofing material of this kind is strong, but sufficiently flexible to be rolled up. This is followed by a surface layer 14, on the opposite surface of the support layer 11 to the first insulating layer 12, which determines the appearance of the finished roofing structure. Usually, the surface layer is of a mineral material, such as slate or mineral chips. Unlike a roof tile, the surface part only covers part of the surface area of the strip 10, starting from one longitudinal edge of the strip 10 (Figures 2a and 2b). This is due to the roofing-structure manufacturing method, which differs from that of a roofing tile, and which will be described in greater detail hereinafter.

[0008] On the other side of the support layer is a protective layer 15, which is on the opposite side of the support layer 11 to the insulating layer 13. The protective layer usually covers the entire area of the roofing material and prevents the strips from unintentionally adhering to their base, or to each other during transport and storage. The protective layers also prevent adhesion during manufacture. According to the invention, the surface layer 14 surprisingly covers 40 - 60 %, preferably 45 - 55 % of the width of the strip 10. A roofing material of this kind can be used in a new way, which will be described in greater detail hereinafter. In addition, the roofing material is also cheaper than previously to manufacture, because two separate products are replaced with a single product. Large batches of the single product can be manufactured at one time, which reduces production costs. This also reduces the need for storage.

[0009] Figures 1a, 3a, and 3b show embodiments of the roofing material according to the invention. Figure 1a shows a so-called weldable roofing material. Thus, Figure 1a shows an adhesive layer 23 between the second insulating layer 13 and the protective layer 15 and between the first insulating layer 12 and the second protective layer 17. In a product for welding, the adhesive layer is of welding bitumen, which is heated, for example, using a gas torch. In addition to what is described above, it is also possible for only the second adhesive layer to be of welding bitumen, in which case the other side is attached in some other manner, for example, by gluing. In this case, the protective layer 15 is formed of a film 16, which is arranged to be removed during installing by heating. In other words, the film burns off when the welding bitumen is heated.

[0010] In the roofing material shown in Figure 3a, there are also adhesive layers 23 on both sides, but in this case they are of a self-adhesive mass. Thus, the strip can be attached without heating. In this case too, the protective layer 15 is formed of a film 16, which is arranged to be removed during installing by detaching. In practice, the membrane is detached by tearing or rolling, after which the adhesive layer is pressed onto its base. In addition to what is described, it is also possible for only one adhesive layer to be of a self-adhesive mass, in which case the other side is attached in some other manner, for example, by welding. In that case, one surface of the strip is attached by welding, the other surface being self-adhesive. The various cross-sections of the adhesive layers 23 and the film 16 in Figures 1a and 3a show primarily various grades of bitumen. The adhesive layer 23 in Figure 1 is of welding bitumen, whereas in Figure 3a it is of self-adhesive mass. Secondly, the film burns off when the welding bitumen is heated, whereas the film or fibre woven fabric protecting the self-adhesive mass is removed prior to installation.

[0011] Figure 3b shows a third embodiment, in which both protective layers 15 and 17 are formed of sand 22. A roofing material of this kind is attached by gluing. Heated, liquid bitumen is used in the gluing. In addition to what is described, it is also possible for only one protective layer to be of sand, in which case the other side is attached in some other manner, for example, welding or gluing. In that case, there would be welding bitumen or a self-adhesive mass and a film in the surface without the sand. The same reference numbers are used for components that are used functionally in the same way.

[0012] The film covers essentially the entire surface of the adhesive layer. Thanks to the plastic film of the upper surface, the weight of a roll is reduced by several kilograms, compared to the prior art. If necessary, it is then possible to make the strip in a single roll even longer. Known rolls weigh from fully thirty to fifty kilograms, their coverage correspondingly ranging from eight to twenty square metres. In known membranes, the protective layer is formed of sand and the membrane is attached by gluing or by means of detachable plastic placed on top of welding bitumen, in which case attachment is by welding. On the other hand, the roofing material according to the invention too can be made to be glued, which, however, will add to the weight. The width of a roll is usually about 1000 mm while the length of a strip varies according to the properties of the roofing material. In principle, the heavier the square mass of the roofing material, the fewer square metres of it can be fitted into a single roll.

[0013] The film can be made from different materials. The film is preferably formed of a plastic film, which is light and thin. The plastic film can be, for example, of polyethylene. However, in welded roofing materials, the film is preferably of plastic. A rollable film is preferably used. It will then be easy to situate the film roll in the production process and the attachment of the plastic can be automated. The main function of the film is to act as a protective layer, so that even very thin films can be used. In practice, the thickness of the film is 0,005 - 0,3 mm, preferably 0,005 - 0,2 mm. Generally, the plastic film is thinner than the woven fabric. The film prevents the bitumen of the insulating layer from adhering accidentally. Even a thin film will work well, as long as the film is essentially impenetrable by the material of the second insulating layer. However, the film will adhere to the bitumen in the manufacturing process and remain in place at least until installation. In welding, the film burns off the surface of the welding bitumen, but in self-adhesive products the protective layer is removed prior to in-

stallation.

[0014] In addition, the roofing material includes the second protective layer 17 described above, which covers the rest of the surface area of the strip 10, which remains after the surface layer 14. In other words, the second protective layer is on the upper surface of the roofing material, which also lacks the bitumen edge according to the prior art. Lacking bitumen edges, the strips are attached to their base and to each other by welding or gluing, or by using self-adhesive strips. During welding, the welding bitumen is heated as the roll is rolled open. Correspondingly, in gluing hot, molten bitumen is spread between the strips.

[0015] Figure 1b shows part of the roofing structure according to the invention, which is formed from roofing material arranged as a strip 10 that is longer than it is wide. In the roofing structure, at least two layers of roofing material are arranged on top of a base structure 18. The base structure is, for example, boarding, sheeting, or rockwool. The strips 10 are arranged to overlap both transversely and longitudinally. Here, only two layers are shown in the strip and are shown separated from each other, for reasons of clarity. In reality, the strips are, for example, according to Figure 1a and, in the finished roofing structure, the various layers and strips lie tightly against each other. Thus, Figure 1b shows both the strip's surface layer 14 and its base material, which consists of a support layer 11, insulating layers 12 and 13, and a protective layer 15. According to the invention, the surface layer 14 covers 40 - 60 %, preferably 45 - 55 % of the width of the strip 10. Thus, the roofing structure, comprising two layers, is made quickly and in a single operation. In addition, the strips 10 are attached to both the base structure 18 and to the other strips 10 by welding or gluing, as well as by mechanical attachment. In addition, it should be noted that all the strips 10 in the roofing structure are mutually similar. This ensures good durability and watertightness. In addition, in the roofing structure according to the invention, there are fewer seams than previously, so that the square mass of the finished roofing structure is as much as ten percent less than previously.

Figure 1b also shows the starting strip 24 and the ending strip 25, which are described in greater detail hereinafter.

[0016] Figure 2a shows one way to manufacture a roof, according to the prior art. The spreading of the strip starts from the eaves of the roof. The strip 10 includes the previously described bitumen edges 19 and 20, as well as the wide protective layer 15, formed of sand, on the undersurface. The same reference numbers are used for functionally similar components. In this case, the strip 10 is both glued and attached mechanically to the base structure 18, at bitumen layer. Welding can also be used, if the material being used permits this. However, the attachments always remain hidden under the next strip. Figure 2a shows in principle the manner of installing both the base membrane and the surface membrane. Of course, the base membranes are first installed over the entire area of the base structure, according to Figure 2a. After this, the installation of the surface membrane is commenced, again starting from the eaves. The surface membranes, of course, are attached solely by gluing or welding, depending on the material used.

[0017] Figure 2b shows the method according to the invention for manufacturing a roofing structure. In the method, the roofing material, which is arranged as a strip longer than it is wide, is installed on top of the base structure 18, in such a way that two layers are formed. In addition, the strips 10 are arranged to overlap both transversely and longitudinally, as in the prior art. In addition, the outer layer of the roofing structure is manufactured of strips 10, on the outer surface of which is a surface layer 14. The surface layer 14 covers part of the surface area of the strip 10, starting from one of the strip's 10 longitudinal edges. In addition, the surface layers 14 of the adjacent strips 10 are set next each other, so that the finished roofing structure becomes watertight and of good appearance. In the method according to the invention, a strip 10 is used, in which the surface layer 14 covers 40 - 60 %, preferably 45 - 55 % of the width of the strip 10. Thus, in practice the roofing structure is completed in a single stage. In other words, the roofing structure is finished at one time, which considerably accelerates roofing and brings clear savings in material and handling costs. In addition, considerably less of the overlapping 21 of the strips than previously remains visible (Figure 2b).

[0018] The outer surfaces, i.e. the surface layer 14 and both protective layers 15 and 17, of the strip can also be seen in Figure 2b. In other words, the bitumen edges are totally lacking. They are unnecessary, as according to the invention the strips 10 are welded and/or glued to other strips. Here the term gluing refers to the use both of liquid bitumen and of a self-adhesive mass. In addition, the layer of the surface layer 14 closest to the base structure 18 is attached mechanically. Thanks to the new kind of roofing material, the mechanical attachment can, for example, be made closer to the centre line than the edge of the strip (Figure 2b). This facilitates the attachment and makes it more reliable than previously, thus accelerating the manufacture of the roofing structure. Correspondingly, the handling and spreading of the strips is facilitated and accelerated, by using mutually similar strips in the manufacture. In other words, both layers of the roof are made using the same kind of strip.

[0019] In fact, Figure 2b shows two different stages in the same figure. The starting stage of the roofing is shown at the eaves while correspondingly the final stage of the roofing is shown at the ridge. According to the invention, roofing is started with a narrow starting strip 24, which is about half the width of a full-width strip according to the invention. The rolled starting strip entirely lacks a surface layer. Instead, the outer layer is formed of welding bitumen and the film according to the invention, or of a self-adhesive mass and a protective layer, or only of sand. Correspondingly, the undersurface of the starting roll is

that shown in any of Figures 1a, 3a, or 3b.

[0020] The manufacture of the roof is ended with a narrow ending strip 25, in which there is a surface layer throughout. The protective layer of the preceding full-width strip is covered with the rolled ending strip. Thus, the roofing becomes entirely two-layer, with a faultless appearance. The undersurface too of the ending strip can be that shown in any of Figures 1a, 3a, or 3b. The strips used and the starting and ending strips are selected for each job, in such a way that they suit each other. The starting and ending strips are preferably manufactured in production to form separate rolls. Of course, if necessary a full-width strip according to the invention can be cut in half, even on site, to form starting and ending strips. Generally, the manufacture of the roofing structure is thus started using a starting strip 24 without a surface layer and is ended using an ending strip 25 with a surface layer over its entire area.

[0021] The new type of roofing material facilitates and clearly accelerates the manufacture of a roofing structure. Savings are also made in material and handling costs. The finished roofing structure is a truly watertightly seamed roof. The strips are attached to each other over their entire attachment area, instead of the previous ten centimetres. Also, the end seams of the strips are more reliable than previously. In addition, the number of end seams is reduced from the previous number and their visible length is halved from the known length. There is also a significant simplification in working, as the entire roofing structure can be manufactured from one and the same product. In other words, the widely popular two-layer roof structure can be made using one kind of roofing material. The roofing structure will then also be faster to manufacture than before to make and the site arrangements are clearly simplified. Particularly the possible drying stage of the first layer, i.e. the under membrane is entirely eliminated, which further accelerates the manufacture of the roofing structure. As the installation of an under membrane is entirely eliminated, the roof is made in one stage. At the same time, site arrangements are facilitated and simplified, as only a small area is needed for installation and the tools are only used once in one place. In other words, the previously required backwards and forwards movements of tools, etc. can be entirely avoided. Roofing can be started from the eaves and proceed while finishing the roofing structure at the same time. The application of the invention also achieves a 10-% savings in materials, compared to the traditional two-layer solution.

[0022] Usually, the insulating material in the roofing materials is bitumen, nowadays mostly rubberized bitumen, to which an SBS elastomer is often added. Reference is then made to polymer-modified rubberized bitumen, the stretching and flexing properties of which at low temperatures are better than those of pure bitumen. Fatigue-resistance and adhesion also improve, as do low-temperature properties. In other words, the durability of the roofing improves. The surface layer of the roofing material is highly resistant to mechanical strain and creates the desired appearance for the roofing structure. The film described above can also be applied, for example, to roofing tiles. In addition, differing from the embodiment examples, there can also be several layers in the roofing material or other bitumen-membrane products.

Claims

1. Roofing material, which is arranged as strips (10) longer than they are wide, the various layers of which include

   - a support layer (11),
   - an insulating layer (12, 13) on both sides of the support layer (11),
   - a surface layer (14), which covers part of the surface area of the strip (10) starting from one longitudinal side of the strip (10), on the opposite side of the support layer (11) to the first insulating layer (12), and
   - a protective layer (15) on the opposite surface of the support layer (11) to the second insulating layer (13),

   characterized in that the surface layer (14) covers 40 - 60 %, preferably 45 - 55 %, of the width of the strip (10).

2. Roofing material according to Claim 1, **characterized in that** the roofing material includes a second protective layer (17), which covers the rest of the surface area of the strip (10) remaining after the surface layer (14).

3. Roofing material according to Claim 1 or 2, **characterized in that** either or both of the protective layers (15, 17) are formed from sand (22).

4. Roofing material according to Claim 1 or 2, **characterized in that** there is an adhesive layer (23) between the second insulating layer (13) and the protective layer (15) and/or the first insulating layer (12) and the second protective layer (17).

5. Roofing material according to Claim 1 or 2, **characterized in that** the protective layer (15) is formed of a film (16), which is removed by heating, in connection with the installation.

6. Roofing material according to Claim 6, **characterized in that** the film (16) is formed of plastic film or woven fabric.

7. Roofing material according to Claim 5 or 6, **characterized in that** the thickness of the film (16) is 0,005 - 0,3 mm, preferably 0,005 - 0,2 mm.

8. Roofing structure, which is formed from roofing material arranged in strips (10) that are longer than they are wide, in such a way that at least two layers of roofing material are arranged on top of a base structure (18), by arranging the strips (10) to overlap in both the transverse and longitudinal directions, and, in the outermost layer of which layers, on the outer surface of the strips (10) there is a surface layer (14), which covers part of the surface area of the strip (10), starting from one longitudinal edge, and in the roofing structure the surface layer (14) of the adjacent strips (10) are next to each other, **characterized in that** the surface layer (14) covers 40 - 60 %, preferably 45 - 55 %, of the width of the strip (10).

9. Roofing structure according to Claim 8, **characterized in that** all the strips (10) in the roofing structure are mutually similar.

10. Roofing structure according to Claim 8 or 9, **characterized in that** the strips (10) are attached to the other strips (10) by welding, gluing, and/or self-adhesion, and in addition the layer of the surface layer (14) closest to the base structure (18) is attached mechanically closer to the centre line of the strip (10) than to its edge.

11. Method for manufacturing a roofing structure, in which method at least two layers of a roofing material arranged in strips (10) longer than they are wide are installed on top of a base structure (18), and which strips (10) are arranged to overlap in both the transverse and longitudinal directions, and the outer layer is manufactured from strips (10), on the outer surface of which is a surface layer (14), which covers part of the surface area of the strip (10) starting from one longitudinal edge of the strip (10), and the surface layers (14) of the adjacent strips (10) are set next to each other, **characterized in that** in the method a strip (10) is used, in which the surface layer (14) covers 40 - 60 %, preferably 45 - 55 %, of the width of the strip (10).

12. Method according to Claim 11, **characterized in that** the strips (10) are welded and/or glued to the other strips (10) and/or self-adhesive strips (10) are used, while in addition the layer of the surface layer (14) closest to the base structure (18) is attached mechanically, closer to the centre line of the strip (10) than to its edge.

13. Method according to Claim 11 or 12, **characterized in that** the layers of the roof are manufactured using one type of strip (10).

14. Method according to any of Claims 11 - 13, **characterized in that** the roofing structure is completed in a single stage.

15. Method according to any of Claims 11 - 14, **characterized in that** the manufacture of the roofing structure is started using a starting strip (24) without a surface layer, and is finished using a ending strip (25) that has a surface layer over its entire surface area.

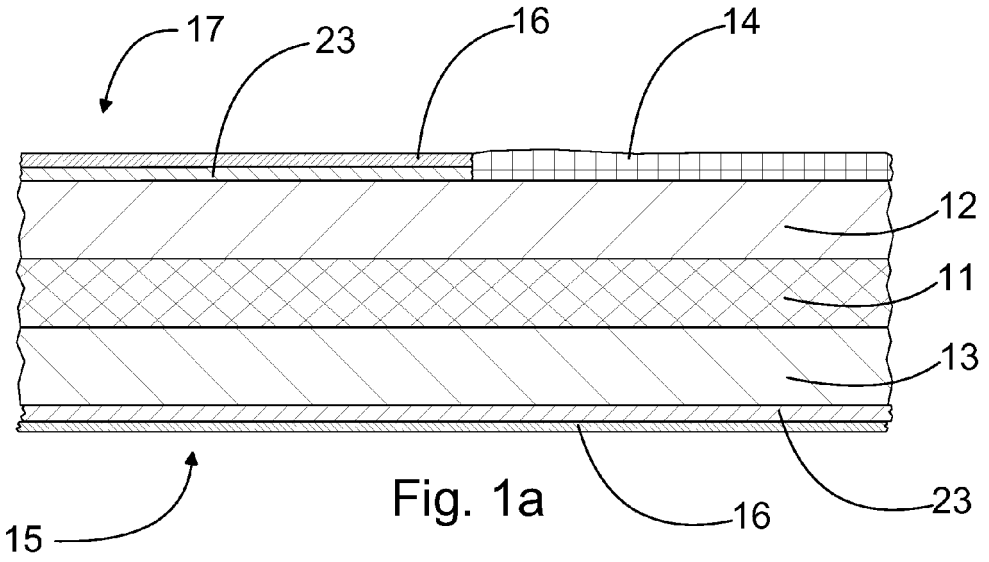
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Fig. 1a

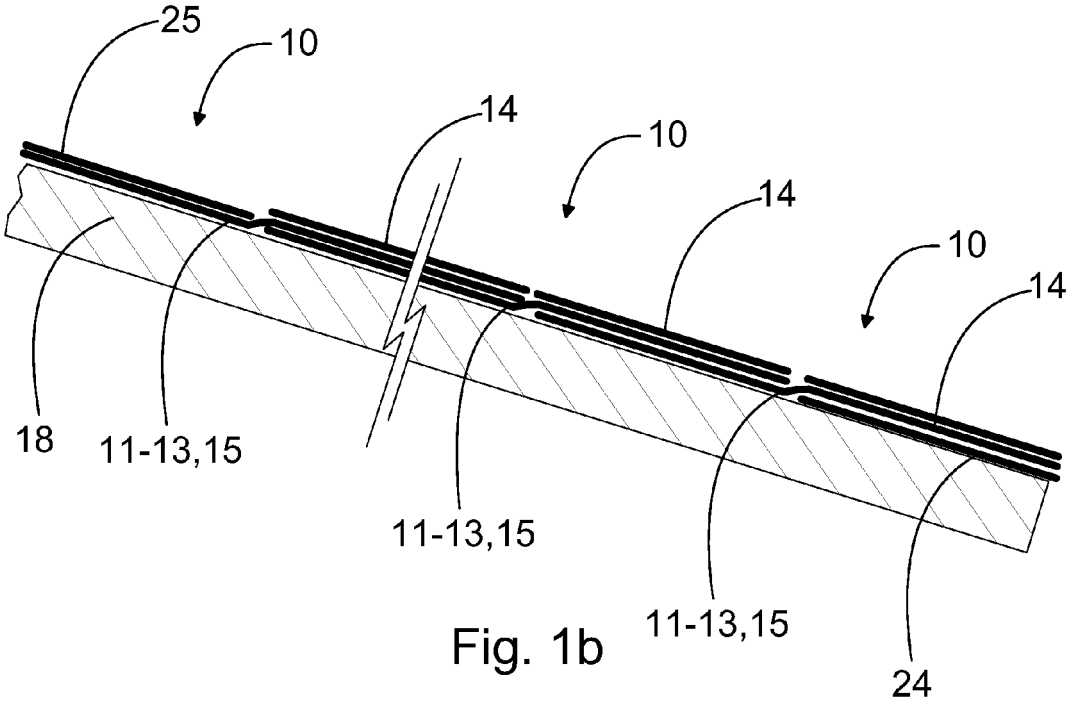
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Fig. 1b

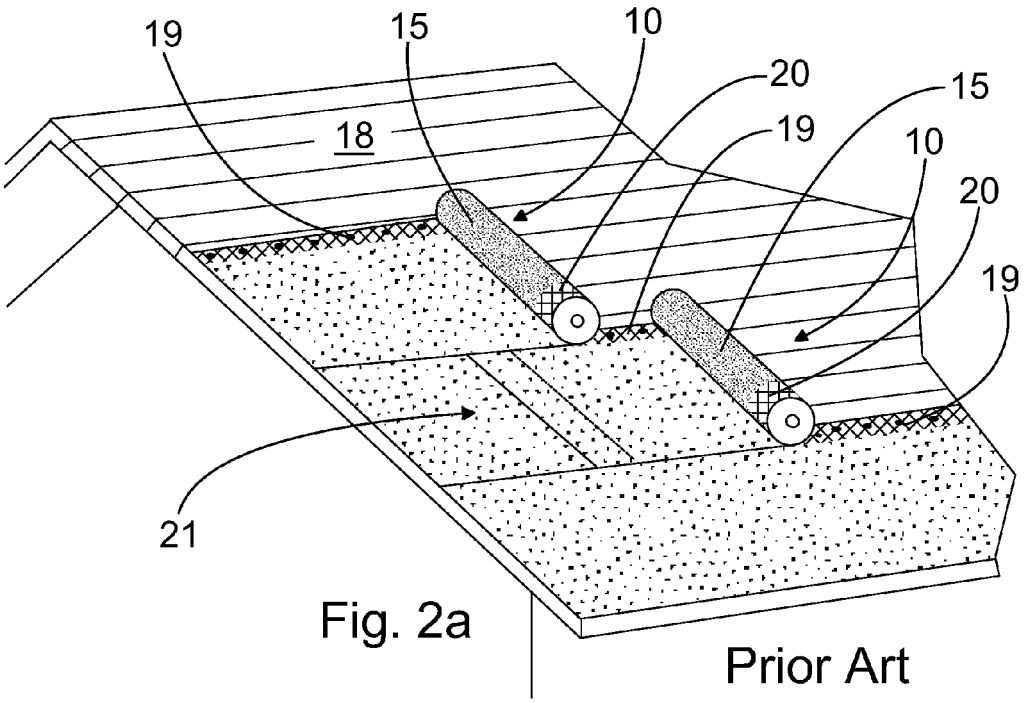

Fig. 2a Prior Art

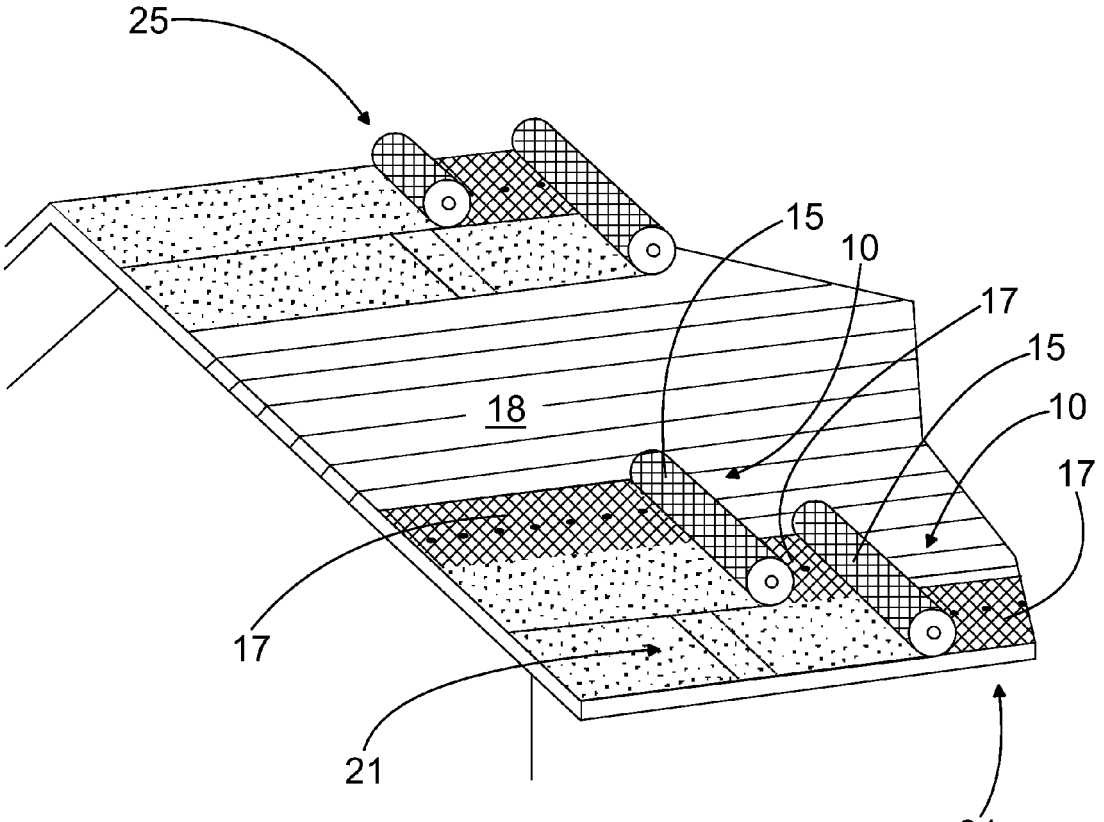

Fig. 2b

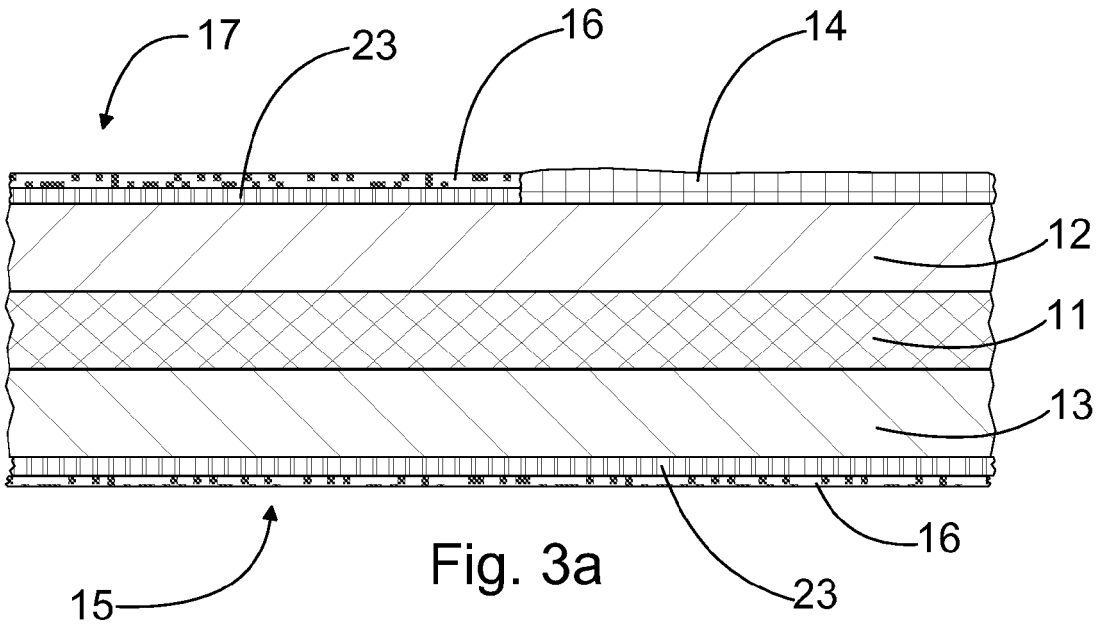

Fig. 3a

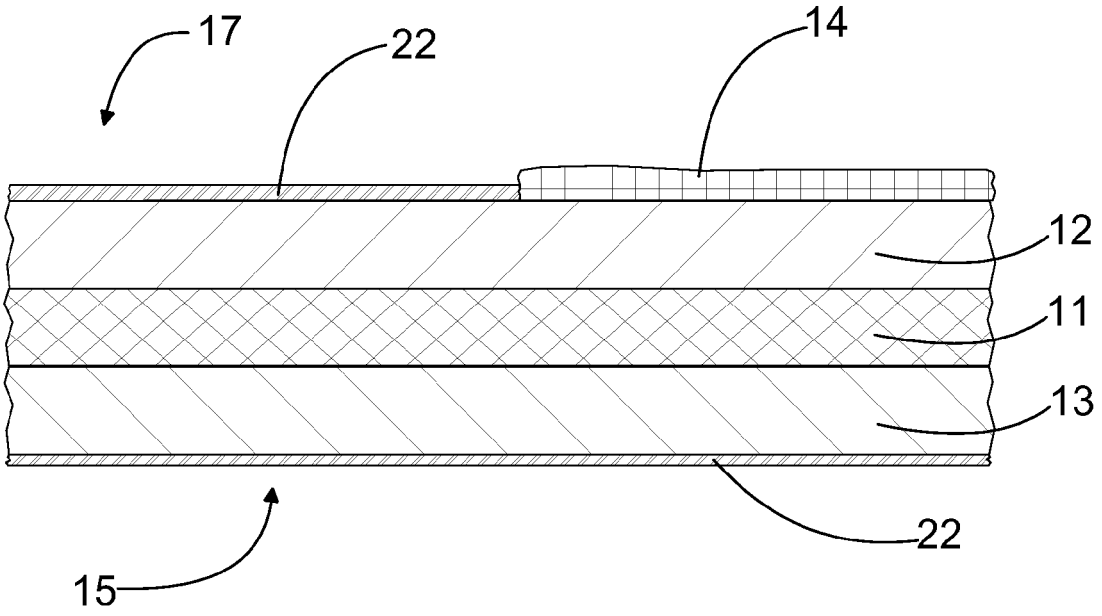

Fig. 3b

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EUROPEAN SEARCH REPORT

Application Number
EP 08 16 9240

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2005/126102 A1 (SWANN RAYMOND C [US]) 16 June 2005 (2005-06-16) * figures 1,4,5 * * paragraph [0028] * -----	1,2,4,8, 9,11,13, 14	INV. E04D1/26 E04D5/10 E04D5/12
A	US 2003/230040 A1 (SHIROTA MUNEYASU [JP]) 18 December 2003 (2003-12-18) * figures 1B,1D * -----	1-15	
A	US 3 624 975 A (MORGAN ALBERT R ET AL) 7 December 1971 (1971-12-07) * figure 5 * -----	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

E04D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	10 February 2009	Bauer, Josef

CATEGORY OF CITED DOCUMENTS

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