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(54) **INCLINING INSULATION STRUCTURE AND METHOD FOR INSTALLING THE SAME**

(57) The present invention relates to an insulation structure (111) adapted to be positioned on a supporting base layer (20) wherein the insulation structure comprises: An insulation lamella structure (11) including two or more insulation lamellas (1) wherein each of said two or more insulation lamellas has a length, a base side and an opposing top side, wherein the base side is adapted to be positioned substantially parallel to the base plane (BP(x,y)), and the length of each of the two or more insulation lamellas is positioned substantially in parallel. Each insulation lamella (1) has two outermost edges (17a, 17b) wherein both outermost edges extend along the length and along the top side of each of the two or

more insulation lamellas (1). The insulation structure (111) has a base surface (18) and an opposing top surface (19), wherein the opposing surface is constituted by the opposing top sides of the two or more insulation lamellas and constitutes an inclining surface (19) wherein a difference in distance (23) between the base surface (18) and the first outermost edge (17a) and between the base surface (18) and the second outermost edge (17b) defines the inclination, and wherein the insulation structure furthermore comprises a separate pressure distributing layer (7) provided on the top surface (19) of the insulation lamella structure (11).

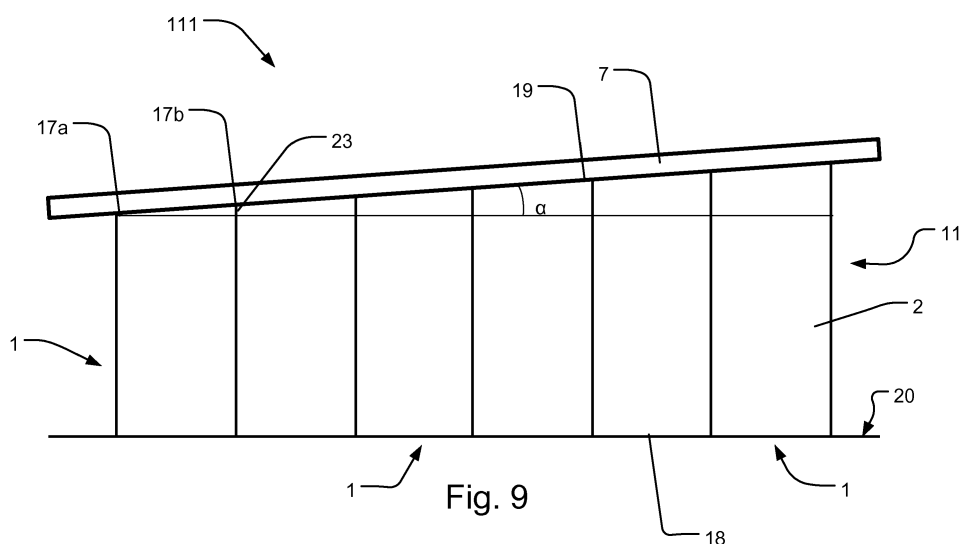


Fig. 9

Description

Technical Field

[0001] The present invention relates to an insulation structure according to the preamble of claim 1. The invention furthermore relates to a method of laying an insulation structure on a supporting base layer, and to a lamella.

Background Art

[0002] When the roof structure of a warm roof, i.e. a roof where the insulation is positioned above the supporting roof layer, such as a low slope roof, is to be constructed, usually a layer of insulation is provided on a supporting layer of e.g. concrete, lightweight concrete or profiled steel plates. On top of the insulation roof covering means such as roofing felt or foil is positioned, forming the exterior of the roof.

[0003] A problem with the current insulation lamellas is that when you have an inclined roof, where the insulation lamellas are wedge shaped, such that the insulation lamella has an inclining upper surface extending in the length direction of the insulation lamella, the lamellas are laid in columns extending across the inclination. However, when for example you have to make an opening for a skylight or a chimney or another roof-penetrating structure, a lot of excess insulation has to be removed. This cannot be used on the other side of the opening and often has to be thrown out.

[0004] It is known to provide a wedged shaped insulation plate, where the inclination extends along the length of the insulation plate as can be seen in DE 10 2008 004 018 A1. Further examples of prior art include DE 31 18 495 A1 and EP 2 126 243 B1. DE 31 18 495 A1 shows several small wedge-shaped lamellas being held together by a thin roof covering layer assembled and distributed to the roof in rolls and laid out in columns. This makes it hard to secure a fully insulated roof when the roof mounting personnel cannot see if the insulation fits well together. Furthermore, walking on the insulated roof will cause damage to the roof covering and also, it is hard to make proper cuts in both materials when there are openings in the roof, and the cut away excess material will be waste that has to be disposed of. EP 2 126 243 B1 is a similar type where the lamellas are glued together with a cement board on a production site and when delivered to the installation site is heavy and hard to cut, as insulation and cement plate have to be cut off when there is an opening in the roof. The excess material is waste in this case as well. So, there is still room for improvement as regards the cost efficiency in the manufacture and mounting of the prior art insulation structures.

Summary of Invention

[0005] It is the object of this invention to provide an

insulation structure which makes it possible to reduce the amount of waste generated when making openings in the roof and which is easy to handle both during production and during laying of the insulation structure.

[0006] According to a first aspect this object is met by an insulation structure of the kind mentioned in the introduction and which is furthermore characterized in that a difference in distance between the base surface and the first outermost edge and between the base surface and the second outermost edge of the at least two insulation lamellas defines the inclination of the top surface of the insulation lamella structure, and that the insulation structure furthermore comprises a separate pressure distributing layer provided on the top surface of the insulation lamella structure.

[0007] The length of each of the two or more insulation lamellas is positioned substantially in parallel in the mounted condition of the insulation structure, and thus said two or more insulation lamellas are positioned in adjacent rows of lamellas. Each insulation lamella of the two or more insulation lamellas having a first outermost edge and a second outermost edge wherein both the first and the second outermost edges extend along the length and along the top side, and thus the first outermost edge and the second outermost edge are parallel. Further, the first outermost edge and the second outermost edge are parallel to the base side.

[0008] By forming the inclination of the top surface of the insulation lamella structure by the configuration of the lamellas themselves, i.e. the difference in distance between the base surface and the first and second outermost edges, respectively, and then provide a separate pressure distributing layer (comprising one or more boards) on top of the insulation lamella structure, an arrangement which is easy to manufacture and handle has been obtained. During installation, it is possible to first arrange the insulation lamella structure in a suitable pattern and if necessary cut only single lamellas in order to provide an opening in the overall structure to accommodate roof-penetrating structures such as chimneys, skylights etc. As the pressure distributing layer (board) is separate from the insulation lamella structure, that is, not fixated to the insulation lamella structure, any necessary adaptations of the pressure distributing board may take place independently of the cutting of the insulation lamella structure.

[0009] In a further embodiment a cross-section of the insulation structure along the inclination of the top surface of the insulation structure may exhibit a continuous inclining top surface, a stepwise inclining top surface or a combination thereof. The general impression of the surface is that it is sloping, however, the sloping surface may be reached through lamellas with a top side being parallel to the base plane, but the distance between the top side of the individual lamellas and the base plane increases, creating a stepwise inclining surface. The insulation lamellas may also have an inclining top side, creating a continuous inclining top surface of the insulation struc-

ture.

[0010] In an embodiment the at least one of the at least two insulation lamellas is in an unfolded state and, where said insulation lamella is in a folded state, it may be provided with at least one split along the length, providing at least two lamella parts each having a first and a second side extending along a length of the lamella part, the first side facing the at least one first split in a folded state, the second side opposing the first side and the at least two lamella parts in a folded state are attached to each other along the length by a thin neck. The neck acts as a rotation axis allowing folding and unfolding the lamella without separation of the lamella parts. To that extent, mineral fibrous insulation with the fibres oriented substantially parallel to the plane of the neck, like glass wool, provides excellent flexibility and is beneficial.

[0011] In an embodiment the at least one of the at least two insulation lamellas is in an unfolded state and said insulation lamella in a folded state may be provided with at least one first split along the length, providing at least two lamella parts each having a first and a second side extending along a length of the lamella part, the first side facing the at least one first split in a folded state, the second side opposing the first side and the second side being arranged with an inclination in relation to the first side wherein the at least two lamella parts in a folded state are attached to each other along the length by a thin neck, the at least two lamella parts each being adapted to be turned substantially 180 degrees in relation to the at least one adjacent lamella part, the centre of rotation being the thin neck, such that at least one first side of at least one lamella part, or its opposing second side on the same lamella part, is positioned substantially parallel to the base plane in an unfolded state. Thereby a continuously inclining surface of the insulation structure may be reached through two or more joined unfolded insulation lamellas. This gives the benefit of having at least half as many pallets on site and on stock as would have been the case without this embodiment. Each pallet able to be withholding only identical lamellas in order to ensure a simple logistic with easy identification of the lamellas. Because the insulation lamella parts are connected by the thin neck in a folded state the lamellas are easy to collect from a pallet and unfold when the insulation structure is to be installed. The same result may in some case be achieved by rotating every lamella part 90 degrees in relation to the nape side of the thin neck. The lamella parts can stay connected by the thin neck when built in or they can get disconnected by the rotating motion. If the lamella parts stay connected the lamella is easy to move to another position in the insulation structure.

[0012] In another embodiment of the insulation structure wherein at least one of the at least two insulation lamellas is in an unfolded state and wherein said insulation lamella in a folded state, may be provided with a split along the length, providing two lamella parts each having a first side and a second side extending along a length

of the lamella part, the first side facing the split in a folded state, the second side opposing the first side and the second side being arranged substantially parallel and with a distance in relation to the first side, said distance being different for the two lamella parts in the insulation lamella, wherein the at least two lamella parts in a folded state are attached to each other along the length by a thin neck, the at least two lamella parts each being adapted to be turned substantially 180 degrees in relation to the adjacent lamella part, the centre of rotation being the thin neck, such that the first sides of each of the two lamella parts, is positioned substantially parallel to the base plane in an unfolded state. Thereby a stepwise inclining surface of the insulation structure may be reached through two or more joined unfolded insulation lamellas successively forming steps of a decreasing or increasing height of the insulation lamella parts.

[0013] The thin neck may be constituted by the material of the insulation lamella. This makes it easier to produce the lamella. Alternatively, the thin neck may be provided by a secondary layer of another material, for instance a laminated layer in the insulation lamella, or hinges or joints of a separate material.

[0014] The insulation lamellas may be of a fibrous material, wherein fibres of the two or more insulation lamellas may be adapted to extend substantially perpendicularly to the base plane when positioned on the base layer. This may apply both to the insulation lamellas and/or the lamella parts. The fibrous material may be mineral wool such as glass wool or stone wool. A fibre structure like this will make it very easy to cut the lamella along the fibres as this is often needed when installing.

[0015] The compressive strength of said insulation lamella in a direction perpendicular to said base plane may be above 30 kPa, preferably between 45-70 kPa. It is understood that compressive strength is measured at 10% deformation according to the standard EN13162 Thermal Insulation products for buildings - Factory made mineral wool (MW) products. This compressive strength makes it possible to walk on the lamella, and thereby easy to work with. Additionally, using lamellas with a high compressive strength as seen in a direction perpendicularly to the base plane will also increase the insulation's ability to carry a snow load.

[0016] The insulation lamellas are in an embodiment cut from a slab of fibrous mineral material with slab top surface and slab bottom surface whereby the insulation lamellas have opposite production surfaces constituted by slab top surface and slab bottom surface and wherein the insulation lamellas are adapted for the production surfaces to extend vertically in the mounted position of the insulation lamellas.

[0017] The slab may be produced by a known method, e.g. as disclosed in EP0133083B1 and the corresponding DK157309B, US4632685, and US4964978 cf. below, between conveyors forming the slab top surface and slab bottom surface which accordingly may be designated "production surfaces".

[0018] The insulation lamellas have said length, said width and a height and in an embodiment the ratio between the length and at least one of the width and the height is more than 3, preferably more than 5, and more preferably more than 10. Thus the length is designated "length" because it represents the major dimension of the insulation lamella.

[0019] In a further embodiment the insulation lamella in a folded state may be provided with at least one second split in addition to said at least one first split from the respective opposite side of where said at least one first split is provided, such that fanfolds and at least three lamella parts are created. The fanfold of three or more lamella parts can make it easier to keep track on installing the many lamella parts correctly. One or both lamella parts at the end of the fanfold may also have an inclining second side or first side when in a folded state.

[0020] In a further embodiment, the at least one edge of at least one insulation lamella, which edge extending along the length of said insulation lamella, may be cut, such as by chamfering or filleting. The cut can also be rectangular as opposed to the triangular shape of chamfering or rounded inwards as opposed to the outwards rounded edge of filleting. When an edge is cut off from the lamella part or insulation lamella, a ventilation channel is created. The insulation lamella or lamella part is adapted to be positioned such that the chamfered edge is positioned in the top surface of the insulation structure. The air channel can be used for passively or actively ventilating the roof in order to dry out any moist that may need to vacate the roof.

[0021] In an additional embodiment, the insulation lamella may be provided with at least one air channel recess in each lamella part, extending substantially perpendicularly in relation to the length of the insulation lamella and placed substantially directly opposite each other, such that when the insulation lamella is in an unfolded state an air channel is extending across the lamella parts. This air channel recess will connect the air channels that extends along the length of the insulation lamella.

[0022] The insulation structure may be interrupted by an opening or reservation for an element, such as a sky light or a chimney. The previously described embodiments will in any combination be easy to install in such interrupted insulation structure.

[0023] Where the insulation lamella has been cut off, this may create a cut off lamella piece, and this cut off insulation lamella piece or piece of lamella part may be used on the opposite side of the opening for the element. Thereby less waste is created, and the installation time for insulating the roof around the element is reduced as the construction worker only have to measure and perform one precise cut making the interrupted lamella fit the element, and then proceed with installing in a staggered pattern at the other side of the element.

[0024] In a further embodiment, the insulation structure may provide a grid of connected air channels in the opposing top surface of the insulation structure. Usually

when air channels only extend in one direction, it is best to position the air channels running from east/west instead of north/south. Thereby the roof is better ventilated because the wind often comes from west, at least in northern Europe. When the channels extend in both directions there is no need to plan the orientation of the air channels as any position is as good as another. The grid of connected air channels makes it very likely that a vent placed in one side of the roof will be in air channel connection with another vent placed at the opposite side of the roof. This makes it possible to passively ventilate the whole roof using the pressure difference created by the wind.

[0025] In a still further embodiment, the insulation lamella structure is constituted by rows of lamellas with successively increasing height, preferably 2 to 10 rows, more preferably 3 to 6 rows, to form a section of lamella rows. In a preferred development of this embodiment, the lamellas of a first section of rows are adapted to be positioned directly on the supporting base layer in the mounted condition of the insulation structure, wherein the lamellas of a second section of rows are adapted to be positioned on a plane layer of insulation, and wherein lamellas of optional further sections rows are preferably adapted to be positioned on said first plane layer of insulation and a second, third, fourth etc. plane layer of insulation. This provides for a manageable production and handling of the insulation lamella structure, and provides reliable support to the insulation lamella structure and the separate pressure distributing layer (board) in the mounted condition of the insulation structure.

[0026] The invention also relates to a method of laying an insulation structure on a supporting base layer, comprising the steps of:

positioning an insulation lamella structure on a supporting base layer, such as a roof,
whereby a plurality of lamellas are placed on the supporting base layer to extend substantially perpendicularly to the base plane, the top sides of the lamellas being adapted to define a top surface of the insulation lamella structure, which is inclined in relation to the base surface in a direction transversal to the length of the lamellas, and
positioning a pressure distributing layer on the top surface.

[0027] The unfolding may involve placing a laying device, such as a fork, in the split of the insulation lamella, and rotate one part of the lamella 180 degrees in relation to the adjacent part of the lamella.

[0028] A further object of the invention is a lamella of the type described above, which is able to assume a folded state and an unfolded state, wherein in the folded state the lamella is provided with at least one split along the length, providing at least two lamella parts each having a first and a second side extending along a length of the lamella part, the first side facing the at least one first

split in a folded state, the second side opposing the first side and the at least two lamella parts in a folded state are attached to each other along the length by a thin neck. The neck acts as a rotation axis allowing folding and unfolding the lamella without separation of the lamella parts.

Brief Description of Drawings

[0029] In the following, the invention will be described in further detail with reference to the drawings in which:

Fig. 1A-C is a schematic drawing of a first embodiment of an insulation lamella in three different states, Figs. 2A-C is a schematic drawing of a second embodiment of an insulation lamella in three different states, Fig. 3 shows the structure of an insulation lamella, Fig. 4 shows an embodiment of a slab of insulation for use for an insulation lamella, Fig. 5 shows an embodiment of a part of the production process, Figs. 6A-C show a schematic drawing of a first embodiment of a tapered lamella, Figs. 7A-C show a schematic drawing of a second embodiment of a tapered lamella, Figs. 8A-D show a schematic drawing of a third embodiment of a tapered lamella, Fig. 9 is a schematic drawing of an embodiment of an insulation structure, using insulation lamellas with tapered lamella parts or tapered insulation lamellas, Fig. 10 shows a schematic drawing of an embodiment of an insulation lamella, Figs. 11A-C show a schematic drawing of an embodiment of an insulation structure, providing a step-wise inclining surface of the lamella structure, Fig. 12 shows a schematic drawing of an embodiment of an insulation structure, Figs. 13A-D show drawings in perspective of an embodiment of an insulation lamella having ventilation channels, Figs. 14A-B show schematic drawing of an embodiment of an insulation structure provided with ventilation channels as seen from the front and from the side, respectively, and Figs. 15A-B show schematic drawings of an embodiment of an insulation structure that forms a staggered pattern, provided with ventilation channels, seen in perspective and from above, respectively.

Description of Embodiments

[0030] Referring first to Figs. 9 and 11C, it is shown how the general configuration of an insulation structure 111 according to the invention comprises an insulation lamella structure 11 and a separate pressure distributing layer, in the following referred to as pressure distributing board 7. One or more boards may be present in the pres-

sure distributing layer. In turn, the insulation lamella structure 11 is constituted by a number of lamellas 1 arranged in suitable patterns in the mounted condition of the insulation structure 111 as will be described in further detail in the following. Examples of advantageous configurations of the insulation lamella structure 11 are shown in Fig. 12, Figs. 14A-B and Figs. 15A-B.

[0031] First, the manufacturing and handling of various embodiments of an insulation lamella 1 will be described in some detail.

[0032] In Fig. 1A an embodiment of an insulation lamella 1 is shown in a folded state, as it looks when it has been cut from a slab 6 (cf. Fig. 5) and divided into two lamella parts 2a, 2b only connected by a thin neck 3 of material. In this folded state, first sides 4a and 4b of the respective lamella parts 2a and 2b face each other on either side of a split 9. Second sides 5a and 5b are opposing first sides 4a and 4b of the respective lamella parts 2a and 2b. In Fig. 1B the lamella parts 2a and 2b are in a process of being rotated 180 degrees in relation to each other and thereby being rotated 90 degrees each in relation to the upper surface of a base layer 20 and a base plane, BP(x,y) (to be described in further detail with reference to Figs 13A-D). In Fig. 1C the insulation lamella 1 has been tipped into an unfolded state, and the sides 4a, 4b of the lamella part sides that faced each other in the folded state and that were created by the cutting of a split 9 (cf. Fig. 1A) are now constituting a base side 15 of the unfolded insulation lamella 1. The base side 15 is thus positioned parallel to the base plane BP(x,y) and facing the base layer 20. The sides 5a, 5b of the lamella parts opposing the sides 4a, 4b is in the unfolded state facing upwards and constituting the top side 16 of the unfolded insulation lamella 1. In this embodiment, a cleft 10 is positioned perpendicularly to the base plane BP(x,y) facing upwards in the unfolded state. It can be seen that in the unfolded state, the fibres in the insulation lamella parts 2a and 2b are extending substantially perpendicularly to the upper surface of the base layer 20. The insulation lamella 1 has a first outermost edge 17a and a second outermost edge 17b wherein both the first and the second outermost edges extend along the length and along the top side 16 of the insulation lamella 1.

[0033] In Figs. 2A-2C one lamella part 2b is rotated 180 degrees in relation to the base plane BP(x,y) and instead the lamella part sides 4a, 4b that faced each other and that were created by the split 9 are now positioned parallel to the upper surface of the base layer 20 facing away from the base layer 20. In this embodiment, the cleft 10 is now separating the lamella parts as the thin neck 3 was torn by the rotating motion, and the cleft 10 is now positioned perpendicularly to the upper surface of the base layer 20. The cleft 10 would have been facing only downwards in the unfolded state had the thin neck 3 not been torn. The sides 5a, 5b of the lamella parts opposing the sides 4a, 4b are in the unfolded state facing downwards and constituting the base side 15 of the unfolded insulation lamella 1.

[0034] In Fig. 3 an insulation lamella 1 having an isotropic structure is shown. The insulation lamella 1 has a length 14 extending in a generally longitudinal direction and a width 12, the width extending in a direction transverse to the longitudinal direction. The insulation lamella 1 also has a thickness or height as will be described in further detail below. Typically, the length is larger than the width and larger than the height. Thus the ratio between the length and at least one of the width and the height may be more than 3, preferably more than 5, and even more than 10. Such a lamella may be produced of fibres by means of the process described in EP0133083B1 and the corresponding DK157309B, US4632685, and US4964978. The insulation lamella 1 may be produced by means of other processes and materials. As can be seen in the figure, it is mainly the core that has an isotropic structure of the fibres, while in the top and bottom of the lamella 1, the fibres are generally parallel to the top and bottom surface of the lamella 1. The isotropic structure contributes to a higher compressive strength of the lamella 1. The lamella 1 is preferably produced in this way and has a substantially isotropic structure.

[0035] According to EP0133083B1 and the corresponding DK157309B, US4632685, and US4964978 an apparatus and a process for producing felt of mineral wool, such as glass wool and stone wool, are disclosed by which the orientation of fibres in a felt of fibrous material is, if not isotropic, then at least more random compared to prior art. Thus, fibres initially deposited on a conveyor in layers substantially parallel with the faces of the felt become located according to random directions within the felt while the fibres in contact with the conveyors remain substantially parallel with the faces. In other words, loops which form in the product remain relatively small in size in relation to the thickness of the felt and do not affect the faces. Thus, the loops are small and well dispersed through the mass or core of the product whereas the fibres on the faces of the product constitute layers which are virtually free from loops. Though compared to prior art relative to EP0133083B1 and the corresponding DK157309B, US4632685, and US4964978, the felt thus produced is far more isotropic and has a larger resistance to compression, the felt does provide different compressive strength in different directions as it will be well known to the person skilled in the art. By the formation of loops in accordance with EP0133083B1 and the corresponding DK157309B, US4632685, and US4964978 the fibres in the core of the felt product show an overall layer structure with a majority of fibres extending generally vertical relative to the orientation of the felt during production. Thus the compressive strength is larger in the horizontal direction perpendicular to the direction of production than in the vertical direction perpendicular to the conveyors by means of which the felt is formed. After production as disclosed in EP0133083B1 and the corresponding DK157309B, US4632685, and US4964978 the felt thus produced is cut into slabs, like the slab 6 shown herein,

by cutting the felt perpendicular to the direction of production.

[0036] The slabs thus produced will have opposing surfaces namely a slab top surface and a slab bottom surface at which the structure of the material of the slab is different from the structure of the material at the core of the slab, since, as explained above, the fibres of the slab top surface and the slab bottom surface during production were in contact with the conveyors. Accordingly, the slab top surface and the slab bottom surface, and parts thereof, are herein designated "production surfaces".

[0037] Although fibrous material is presently preferred for use in the insulation structure, alternative materials are of course conceivable and include foam, vacuum boards, silicate boards or the like. In case glass wool or stone wool are among the choices for insulating material, an insulation lamella of glass wool will provide for better cohesion of the two or more lamella parts joined together by a thin neck as described in the above, since the longer fibres of glass wool will tend to keep the thin neck intact after unfolding the lamella, thus avoiding the more brittle properties of stone wool. That is, rather than having torn the thin neck 3 as described in connection with Figs 2A to 2C in the above, the two lamella parts 2a and 2b will remain together as a single unit which is an advantage in case the insulation lamella 1 needs to be moved during installation. In the embodiments described herein, the thin neck 3 is made from the same material as the remaining parts of the insulation lamella 1. However, alternative embodiments include providing the thin neck by a secondary layer of another material, for instance a laminated layer in the insulation lamella, or hinges or joints of a separate material

[0038] Fig. 4 shows an embodiment of a slab of insulation 6 that has been cut into a number of lamellas 1, and each of the lamellas 1 has furthermore been divided into two lamella parts 2 by cutting a split 9, almost all the way through the slab 6, leaving a thin neck 3. The lamellas 1 have production surfaces 28. Thus, cutting the slab 6 into lamellas 1, the lamellas 1 obtain as top and bottom, part of the slab top surface and a slab bottom surface and the thin neck 3 provided by the cutting indicated in Fig. 4 will be provided by the material of one of the slab top surface and a slab bottom surface depending on whether the slab has been turned upside-down or not prior to cutting. The part of the slab 6 where the thin neck is located can be of another material than the rest of the slab 6 or be with another structure of the same kind of material to provide any one of the configurations of the thin neck 3 described in the above.

[0039] In Fig. 5 it is shown how the slab of insulation 6 can be cut into lamellas 1 and how the lamellas 1 are divided into lamella parts 2 by using a circular saw 30 making a partial cut in the form of a split 9. Other means of cutting may be used as well. The slab 6 has an overall layer structure as indicated by curved lines in Fig. 5, the curved lines indicating the layers 29. Figs 6A-C shows a first embodiment of a tapered lamella. The lamella 1 is

not tapered in its folded state as can be seen in Fig. 6A. Instead the insulation lamella 1 is provided with a split 9 along the length 14 of the insulation lamella 1 at an angle to a base layer 20 where in this embodiment the lamella has been placed in its folded state. The lamella parts 2a and 2b has two first sides 4a and 4b opposing the second sides 5a and 5b. At side 4b and the opposing side 5b it is indicated how the two opposite sides of the lamella part 2b is arranged with an inclination α . In Fig. 6B the lamella parts 2a and 2b are each turned 90 degrees with the centre of rotation being the thin neck 3 that connects the two lamella parts. Also shown are the two first sides 4a and 4b and the opposing the second sides 5a and 5b.

[0040] In its unfolded state in Fig. 6C this results in a tapered lamella 1, having sloping top side 16, with the inclination α in relation to the base side 15 of the lamella 1 that may be used for creating a sloping opposing top surface 19 of the insulation lamella structure 11 (cf. Fig 9). As is also apparent from Figs 6A to 6C, a first outermost edge 17a and a second outermost edge 17b are present on each insulation lamella 1. Each outermost edge 17a, 17b extends in the longitudinal direction of each insulation lamella 1, i.e. along the length 14. For the general configuration of a tapered insulation lamella 1, reference is made to Fig. 10 showing an alternative embodiment.

[0041] In the embodiment of Figs 6A to 6C, reference numeral 8 indicates that the two outermost edges 17a, 17b are adapted to be cut along the length of the lamella to provide a chamfered or filleted edge, in the following referred to as chamfered edge 8. With particular reference to Figs 15A and 15B, this results in air channels 24 in the side of the lamella facing upwards in its unfolded state either combined with an adjacent lamella 1 or a protruding roof part. The air channel 24 extends across the sloping top surface 19 created by the chamfered and tapered lamella 1 (cf. Figs 15A and 15B).

[0042] Figs 7A-C show a second embodiment of a lamella 1 being tapered in its unfolded state. One lamella part 2b is rotated 180 degrees in relation to the base plane BP(x,y) on the base layer 20, where in this embodiment the lamella 1 has been placed in its folded state. The lamella part sides 4a, 4b that faced each other and that were created by the cutting of split 9 are now positioned with an inclination to the base plane facing away from the base layer 20. In this embodiment, the cleft 10 is positioned perpendicularly to the upper surface of the base layer 20 facing downwards in the unfolded state. As in the first embodiment of a tapered lamella, the insulation lamella 1 of the second embodiment comprises top side 16 and base side 15.

[0043] Compared to the embodiment of Figs. 6A-C the outermost edges 17a and 17b, here adapted to form the chamfered edges 8, were in the folded state situated along the split 9 in that the outermost edges 17a, 17b were created by the partial inclined cut, which created the inclined split 9.

[0044] In both the first and the second embodiment of

the tapered lamella the chamfered edges 8 are positioned at the upper edges along the length of the lamella 1 in the unfolded state resulting in an air channel 24 (cf. Figs 15A and 15B), cf. in this regard Figs 6C and 7C.

[0045] Figs 8A-D show a third embodiment of an insulation lamella 1 being tapered in its unfolded state. Fig. 8A shows the lamella 1 in a folded state, the lamella standing upright on a supporting base layer 20 with the side 5a facing the base layer and the opposing side 4a facing an inclined cut constituting a first split 9a. Thereby the side 4a is provided with an inclination in relation to side 5a. Here the lamella 1 is in addition to the inclined first split 9a, provided with a second split 9b parallel to the side 5a. The split 9b is cut from the opposite side 21 b than where the inclined cut creating split 9a opens on to, i.e. side 21a, and thus splitting the lamellas into three lamella parts 2a, 2b, 2c of successive greater size. In Fig. 8B it can be seen how the first lamella part 2a remains at the same position, lamella part 2b rotates 180 degrees with the centre of rotation being the thin neck 3a between lamella part 2a and lamella part 2b, and the third lamella part 2c is not rotated but merely positioned on the supporting base layer as lamella part 2b rotates 180 degrees in relation to lamella part 2c, around the thin neck 3b. The lamella part 2c is furthermore provided with a tapered face positioned parallel to or substantially parallel to the partial cut at the first split 9a. This results in a sloping top side 16 of the insulation lamella 1 in an unfolded state. Like in the previous two embodiments the lamella 1 is provided with first and second outermost edges 17a and 17b, in the embodiment shown adapted to be filleted or chamfered as indicated by reference numeral 8 to provide chamfered edges 8. However, in this embodiment, one chamfered edge 8 positioned along the length of the lamella 1 is provided at the outermost edge 17a of the lamella 1 at the surface 16 facing upwards in the unfolded state, while the other two chamfered edges 8 are facing each other in the cleft 10 creating an air channel 24 (cf. Figs. 15A and 15B).

[0046] Fig. 9 shows the insulation lamella 1 shown in Figs. 7A-C used in an insulation lamella structure 11, where an inclined opposing top surface 19 is created. To maintain the inclined opposing top surface 19 over several lamellas 1, the second, or middle, and third, or right-hand, lamellas 1 as compared to the first, or left-hand, lamella 1 in Fig. 7A have been made successively taller. Likewise, lamella parts designated 2 are made successively taller in the height direction, or wider as the case is in the embodiment in Figs. 6A-C merely because of its orientation in relation to the base plane BP(x,y) or supporting base layer 20 when placed on said layer 20 in a folded state. This results in a difference in distance 23 between the base surface 18 and the first outermost edge 17a and between the base surface 18 and the second outermost edge 17b, and said distance 23 defines the inclination α of the top surface 19 in relation to the base surface 18.

[0047] Fig. 10 shows an alternative embodiment of an

insulation lamella 1 having an inclining top side 16. Also the base side 15, the length 14, the width 12 and first and second outermost edges 17a and 17b are shown in order to indicate the general configuration of a tapered lamella 1.

[0048] In Fig. 11A-C the partial cut to form split 9 in the lamella 1 has been made either perpendicular to or parallel to the base plane BP(x,y) here placed on the upper surface of the base layer 20, depending on the orientation of the lamella 1 on the base layer 20, however the cut 9 has been positioned slightly off the middle on the lamella 1, resulting in lamella parts 2a and 2b of different sizes in the width direction, shown by distance 12a and 12b being unequal. In this way, a stepwise inclining top side 16 and top surface 19 of the insulation lamella structure 11 is attained through a difference in distance 23 formed by the difference in height between the base side 15 and second outermost edge 17b on one hand, and the base side 15 and an outermost edge 17c protruding at the middle of the lamella 1 and constituting the first outermost edge in terms of defining the inclination, on the other. The outermost edge 17c is here located in the same distance from the base side 15 as the outermost edge 17a. A separate top plate or pressure distributing board 7 is supported by the edges 17b and 17c such that the insulation lamella structure 11 and the pressure distributing board 7 together form the insulation structure 111. It is noted that the pressure distributing board 7 is provided separately from the insulation lamella structure 11 and is positioned on top of the lamellas 1 to cover them substantially completely. Hence, the pressure distributing board 7 acts as a loose cover of the insulation lamella structure 11 and has an inclination corresponding to the top surface 19 of the insulation lamella structure 11, although displaying the inclination α in relation to the base plane BP(x,y). The hollow space between the stepwise inclining top surface 19 and the top plate in the form of pressure distributing board 7, forms a series of air channels 24. The edges 17b and 17c can be cut for example by chamfering in an angle corresponding the inclination α , hence supporting the pressure distributing board 7 with a larger area of the top side 16 and having air channels with a lesser cross-sectional area.

[0049] The height of the insulation lamellas forming the lamella structure may be 200-500 mm, preferably between 300-400 mm to achieve a U-value below 0.12 W/m²K of the roof construction.

[0050] The properties, dimensions and choice of material of the pressure distributing board 7 are chosen according to the specific needs and requirements of the intended field of application of the insulation structure. Preferably, the pressure distributing board 7 is of a fibrous material such as stone wool or glass wool, preferably glass wool as this is easier to cut. The fibres in the board can be stretched and in a substantially laminated structure or it could more preferably be crimped with a wave-formed structure adding compressive strength to the plate for better walkability. The thickness may for in-

stance lie between 10-200 mm, preferably 15-50 mm, more preferably 20-30 mm. The compressive strength typically lies in the range of 30-70kPa, preferably 40-70 kPa. As mentioned in the above, the pressure distributing board 7 should cover all of the insulation lamella structure 11 in the finished insulation structure 111.

[0051] Fig. 12 shows an embodiment of an insulation structure according to the invention, in which the separate pressure distributing board 7 is removed for reasons of clearness in reading the drawings, typically representing a situation in which the pressure distributing board 7 has not yet been mounted. A number of lamellas 1 have been arranged in rows 25. Viewing the drawing from left to right, the first six rows 25 of lamellas 1 form a first section positioned on the base plane BP(x,y), i.e. directly on the supporting base layer 20. The next six rows 25 of lamellas 1 forming the second section are positioned on top of a plane layer 26a of insulation, and the further next six rows 25 forming the third section of lamellas 1 are positioned on top of two plane layers 26a and 26b of insulation of equal thickness. The six last rows 25 of lamellas 1 forming a fourth section of rows 25 are positioned on top of two plane layers 26a and 26c of insulation of unequal thickness. This provides a continuously inclining opposing surface 19 across several lamellas 1. The plane layers 26a, 26b, 26c of insulation may be made of other materials than insulation, as long as the different in height and the support is provided to the lamellas 1. A further feature apparent from this Figure is the configuration of the insulation lamella structure 11 in that the lamellas 1 form a staggered pattern, where every second row 25 of lamella 1 is offset lengthwise in relation the adjacent row 25. The staggered pattern can be obtained by only two lamellas being of different length, being of same length and offset lengthwise or being of different length with a lengthwise offset displacement. The lamellas 1 are lengthwise running across the inclination α created by the lamellas that have been cut at an angle in relation to the base plane and base layer 20 and are typically provided as in the embodiments shown in Figs 6, 7 or 8. The first and the second outermost edges extends along the length of the insulation lamella. As in the above embodiments, the length of the insulation lamella is preferably longer than it is wide and longer than it is high. The staggered pattern is preferably provided by having insulation lamellas offset in relation to each other along the length of the insulation lamellas or by having a difference in the length of the insulation lamellas. This provides better production tolerances on the length of the lamella. Length tolerances for installing in a staggered pattern can be very coarse, making the lamellas easier to produce, with length cutting techniques fit for mass production, and with less unplanned interruptions of production.

[0052] By providing an underlying step structure of plane layers 26a, 26b, 26c the number of different lamellas 1 may be limited, and the size of the lamellas 1 will not get difficult to handle.

[0053] Furthermore, the insulation lamella structure 11 is here provided with an opening 13, for example for a skylight or a chimney. Because the insulation lamella structure 11 forms a staggered pattern across the inclination α there is less waste as the pieces 27 of lamellas 1 that have been cut off to make room for the opening 13, can be used on the other and opposing side of the opening 13.

[0054] When for example the known lamellas provided with a lengthwise inclination are placed side-by-side in columns extending across the inclination α , the cut off pieces of those lamellas cannot be used elsewhere in the insulation structure and is considered to be waste.

[0055] Figs 13A-D show an embodiment of an insulation lamella 1 provided with ventilation channels 24. In Figs 13A and 13B the lamella is seen from two different sides. In Fig. 13A the split 9 is facing upwards and in Fig. 13B the split 9 is facing downwards. Both figures show the lamella 1 in a folded state. Both lamella parts 2 are provided with chamfered edges 8 extending along the edge of the lamella 1, and two air channel recesses 22 positioned substantially opposite each other, substantially perpendicularly to the length 14 and the base plane BP(x,y). Although the two air channel recesses 22 are shown as located more or less accurately opposite each other, slight variations in the positions do not hinder the air channel from functioning, even if the recess placing should drift a bit.

[0056] When each of the lamella parts 2 are rotated 90 degrees in relation to the base plane BP(x,y), the centre of rotation being the thin neck 3 that connects the two lamella parts 2, the air channel recesses 22 are positioned in extension of each other, connecting the chamfered edges 8 along each top side of the unfolded lamella 1, forming a grid of air channels 24. This can be seen in Fig. 13D.

[0057] Figs. 14A-B shows an embodiment of an insulation structure 111 provided with ventilation channels 24 as seen from the front and from the side, respectively. The air channels 24 are formed by either the chamfered edges 8 of two lamellas 1 placed side-by-side (Fig. 14A) or by the recess 22 in the lamella part 2. The recesses 22 can be formed by other geometry of the cross-sectional area and there can be more recesses 22 per lamella 1. Here insulation lamellas 1 with tapered lamella parts 2 have been used. The lamellas have been covered with a pressure distributing board 7. The lamella parts 2 are positioned on a substantially horizontal base layer 20, where the inclining side 16 of the lamella 1 is facing upwards, creating a sloping opposing surface 19, such as a roof surface. On top of the lamella parts 2 the separate pressure distributing board 7 has been placed. The lamella parts 2 are being made successively taller or wider depending on the lamella's 1 orientation in relation to the base plane BP(x,y) on the supporting base layer 20. Because of the inclined partial cut in relation to the base plane or supporting base layer 20 the sloping or inclining opposing top surface 19 is continuous.

[0058] Fig. 15A shows an embodiment of an insulation lamella structure 11 provided with ventilation channels 24 as seen from above. Here the air channels 24 are extending both along the inclination, established by air channel recesses 22, and across the inclination, constituted by chamfered edges 8, of the insulation lamella structure 11. The insulation lamella structure 11 forms a staggered pattern, and the grid of air channels 24 can be seen as the punctured lines.

[0059] Fig. 15B shows an embodiment of a similar insulation structure 111 as in Fig. 15A, as seen from above. However, here the insulation structure 111 has been provided with openings 13, such as protruding elements in the form of chimneys, ventilation hoods, skylights or the like. The insulation lamellas 1 that have been cut off, may be used on the other side of the interrupting element 13 due to the staggered pattern of the insulation structure 111.

[0060] The term insulation lamella and lamella are both used for the same element. The same applies to supporting base layer and base layer.

[0061] The same reference numbers apply to the same features throughout the application.

[0062] The different embodiments and the different features described throughout the application may be combined with each other as seen fit.

List of Reference Numerals

[0063]

1	insulation lamella
2a	lamella part
2b	lamella part
2c	lamella part
3	neck
3a,3b	neck
4a	first side facing split
4b	first side facing split
5a	second side opposing first side
5b	second side opposing first side
6	slab of insulation
7	pressure distributing board
8	chamfered edges
9	split
9a	first split
9b	second split
10	clef
11	insulation lamella structure
12	width
12a	distance
12b	distance
13	opening
14	length
15	base side of unfolded insulation lamella
16	top side of unfolded insulation lamella
17a	first outermost edge
17b	second outermost edge

17c	first uppermost edge	
18	base surface	
19	sloping opposing top surface	
20	base layer	
21a	side (of first split 9a)	5
21b	opposing side (of second split 9b)	
22	air channel recesses	
23	distance	
24	air channel	
25	row	10
26a	plane layer of insulation	
26b	plane layer of insulation	
26c	plane layer of insulation	
27	cut-off piece	
28	production surface	15
29	layers	
30	circular saw	
111	insulation structure	
BP(x,y)	base plane	
α	inclination	20

Claims

1. An insulation structure (111) adapted to be positioned above a supporting base layer (20) in a mounted condition, the insulation structure (111) defining a base plane (BP(x,y)) which is substantially parallel to an upper surface of the supporting base layer (20) in said mounted condition, in which the insulation structure (111) comprises:

an insulation lamella structure (11) including two or more insulation lamellas (1), wherein each of said two or more insulation lamellas has a length (14) and a width (12) the length being larger than the width, a base side (15) and an opposing top side (16), wherein the base side (15) is adapted to be positioned substantially parallel to the base plane (BP(x,y)), and the length of each of the two or more insulation lamellas (1) is positioned substantially in parallel in the mounted condition of the insulation structure (111), each insulation lamella (1) of the two or more insulation lamellas having a first outermost edge (17a; 17c) and a second outermost edge (17b) wherein both the first and the second outermost edges (17a; 17b; 17c) extend along the length and along the top side (16) of each of the two or more insulation lamellas (1), wherein

the insulation lamella structure (11) has a base surface (18) and an opposing top surface (19), wherein the base surface (18) is adapted to be positioned substantially parallel to the base plane (BP(x,y)), and the opposing top surface (19) is constituted by the top sides (16) of the two or more insulation lamellas (1) and defines an inclining surface having an inclination in re-

lation to the base surface (18),

characterized in that

a difference in distance (23) between the base surface (18) and the first outermost edge (17a; 17c) and between the base surface (18) and the second outermost edge (17b) of the at least two insulation lamellas (1) defines the inclination of the top surface (19) of the insulation lamella structure (11), and that the insulation structure (111) furthermore comprises a separate pressure distributing layer (7) provided on the top surface (19) of the insulation lamella structure (11).

2. The insulation structure according to claim 1, wherein a cross-section of the insulation lamella structure (11) along the inclination of the top surface (19) of the insulation lamella structure (11) exhibits a continuous inclining top surface, a stepwise inclining top surface or a combination thereof.

3. The insulation structure according to claim 1 or 2, wherein each of the at least two insulation lamellas (1) is able to assume a folded state and an unfolded state, wherein at least one of the at least two insulation lamellas (1) is in an unfolded state in said mounted condition,

and wherein said insulation lamella (1) in a folded state is provided with at least one first split (9; 9a, 9b) along the length providing at least two lamella parts (2; 2a, 2b, 2c),

each lamella part (2; 2a, 2b; 2c) having a first and second side (4a, 4b, 5a, 5b) extending along a length of the lamella part, the first side (4a, 4b) facing the at least one first split (9; 9a, 9b) in a folded state, the second side (5a, 5b) opposing the first side (4a, 4b) and the second side (5a, 5b) being arranged with an inclination in relation to the first side (4a, 4b) wherein the at least two lamella parts (2; 2a, 2b; 2c) in a folded state are attached to each other along the length by a thin neck (3; 3a, 3b),

the at least two lamella parts (2; 2a, 2b; 2c) each being adapted to be turned substantially 180 degrees in relation to the at least one adjacent lamella part,

the centre of rotation being the thin neck (3; 3a, 3b), such that at least one first side (4a, 4b) of at least one lamella part, or its opposing second side (5a, 5b) on the same lamella part, is positioned substantially parallel to the base plane (BP(x,y)) in the unfolded state.

4. The insulation structure according to claim 1 or 2, wherein each of the at least two insulation lamellas (1) is able to assume a folded state and an unfolded state, wherein at least one of the at least two insulation lamellas is in an unfolded state in said mounted condition,

- and wherein said insulation lamella (1) in a folded state is provided with a split (9) along the length, providing two lamella parts (2; 2a, 2b), each lamella part (2; 2a, 2b) having a first side (4a, 4b) and a second side (5a, 5b) extending along a length of the lamella part (2; 2a, 2b), the first side (4a, 4b) facing the split (9) in a folded state, the second side (5a, 5b) opposing the first side (4a, 4b) and the second side (5a, 5b) being arranged substantially parallel and with a distance (12a, 12b) in relation to the first side (4a, 4b), said distance (12a, 12b) being different for the two lamella parts (2; 2a, 2b) in the insulation lamella (1), wherein the at least two lamella parts (2; 2a, 2b) in a folded state are attached to each other along the length by a thin neck (3), the at least two lamella parts (2; 2a, 2b) each being adapted to be turned substantially 180 degrees in relation to the adjacent lamella part, the centre of rotation being the thin neck (3), such that the first sides (4a, 4b) of each of the two lamella parts (2; 2a, 2b) is positioned substantially parallel to the base plane (BP(x,y)) in the unfolded state.
5. The insulation structure according to claim 3 or 4, wherein the thin neck (3) is constituted by the material of the insulation lamella (1).
 6. The insulation structure according to any one of the preceding claims, wherein the insulation lamellas (1) are of a fibrous material, and wherein fibres of the two or more insulation lamellas are adapted to extend substantially perpendicularly to the base plane (BP(x,y)) when positioned on the base layer.
 7. The insulation structure according to any one of the preceding claims, wherein the insulation lamellas are cut from a slab of fibrous mineral material with slab top surface and slab bottom surface whereby the insulation lamellas have opposite production surfaces constituted by slab top surface and slab bottom surface and wherein the insulation lamellas are adapted for the production surfaces to extend vertically in the mounted position of the insulation lamellas.
 8. The insulation structure according to any one of the preceding claims, wherein the insulation lamellas have said length, said width and a height and wherein the ratio between the length and at least one of the width and the height is more than 3, preferably more than 5, and more preferably more than 10.
 9. The insulation structure according to any one of the preceding claims, wherein the compressive strength of said insulation lamella in a direction perpendicular to said base plane (BP(x,y)) is above 30 kPa, preferably between 45-70 kPa.
 10. The insulation structure according to any one of claims 3 or 5 to 9, wherein the insulation lamella (1) in a folded state is provided with at least one second split (9b) in addition to said at least one first split (9a) from the respective opposite side of where said at least one first split (9a) is provided, such that fanfolds and at least three lamella parts (2a, 2b, 2c) are created.
 11. The insulation structure according to any one of the preceding claims, wherein at least one edge (8) of at least one insulation lamella (1), which edge extending along the length (14) of said insulation lamella is cut, such as by chamfering or filleting.
 12. The insulation structure according to any one of claims 3 to 11, wherein the insulation lamella (1) is provided with at least one air channel recess (22) in each lamella part (2; 2a, 2b, 2c), extending substantially perpendicularly in relation to the length of the insulation lamella and placed substantially directly opposite each other, such that when the insulation lamella is in an unfolded state an air channel (24) is extending across the lamella parts.
 13. The insulation structure according to any one of the preceding claims, wherein the insulation structure is interrupted by an opening or reservation for an element, such as a skylight or a chimney.
 14. The insulation structure according to claim 13, wherein an insulation lamella (1) has been cut off creating a cut off lamella piece (27), and this cut off lamella piece is used on the opposite side of the opening for the element.
 15. The insulation structure according to any one of the preceding claims, wherein the insulation structure provides a grid of connected air channels (24) in the opposing top surface (19) of the insulation structure.
 16. The insulation structure according to any one of the preceding claims, wherein the insulation lamella structure (11) is constituted by rows (25) of lamellas (1) with successively increasing height, preferably 2 to 10 rows, more preferably 3 to 6 rows, to form a section of lamella rows (25).
 17. The insulation structure according to claim 16, wherein the lamellas (1) of a first section of rows (25) are adapted to be positioned directly on the supporting base layer (20) in the mounted condition of the insulation structure (111), wherein the lamellas (1) of a second section of rows (25) are adapted to be positioned on a plane layer (26a) of insulation, and wherein lamellas (1) of optional further sections rows

(25) are preferably adapted to be positioned on said first plane layer (26a) of insulation and a second, third, fourth etc. plane layer (26b, 26c) of insulation.

- 18.** A method of laying an insulation structure on a supporting base layer, comprising the steps of: 5

positioning an insulation lamella structure on a supporting base layer, such as a roof, whereby a plurality of lamellas are placed on the supporting base layer to extend substantially perpendicularly to the base plane, the top sides of the lamellas being adapted to define a top surface of the insulation lamella structure, which is inclined in relation to the base surface in a direction transversal to the length of the lamellas, and positioning a pressure distributing layer on the top surface. 10 15 20

- 19.** The method according to claim 18, wherein the lamellas are provided in a folded state, with a split along their length, and the mounting includes unfolding the lamellas, such that the sides of the split now form a side surface of the lamellas, and positioning said side surface substantially parallel to the base plane. 25

- 20.** A lamella which is able to assume a folded state and an unfolded state, wherein in the folded state the lamella is provided with at least one split along the length, providing at least two lamella parts each having a first and a second side extending along a length of the lamella part, the first side facing the at least one first split in a folded state, the second side opposing the first side and the at least two lamella parts in a folded state are attached to each other along the length by a thin neck. 30 35

- 21.** The lamella according to claim 20, wherein the split is inclined with respect to the sides of the lamella, such that in the unfolded state, the top surface of the lamella is inclined with respect to the base surface. 40 45 50 55

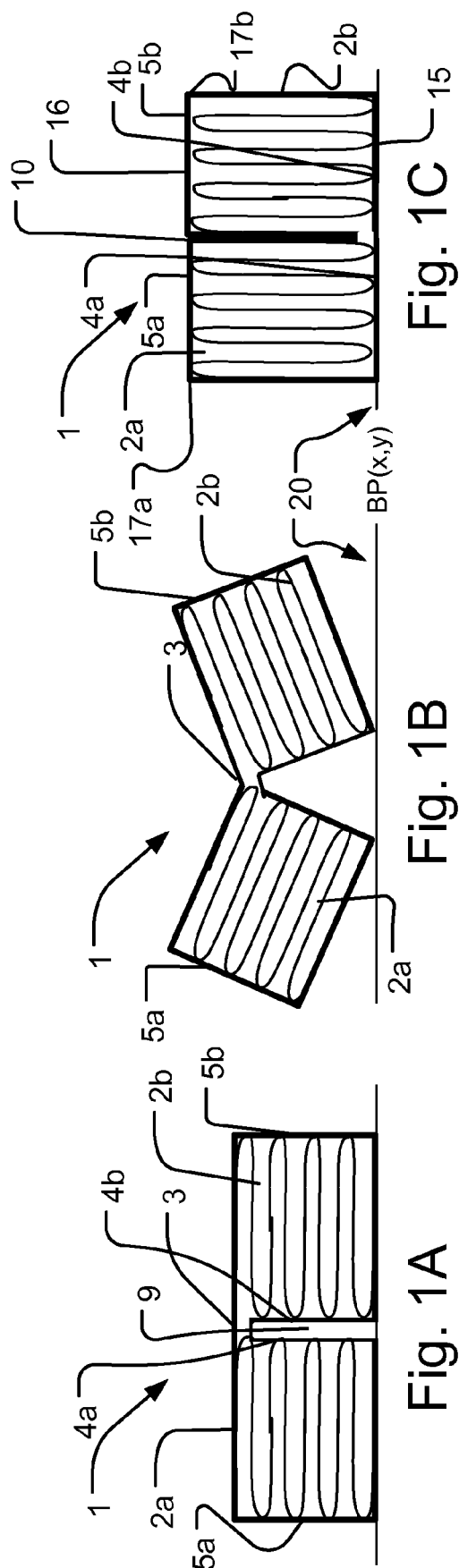


Fig. 1A

Fig. 1B

Fig. 1C

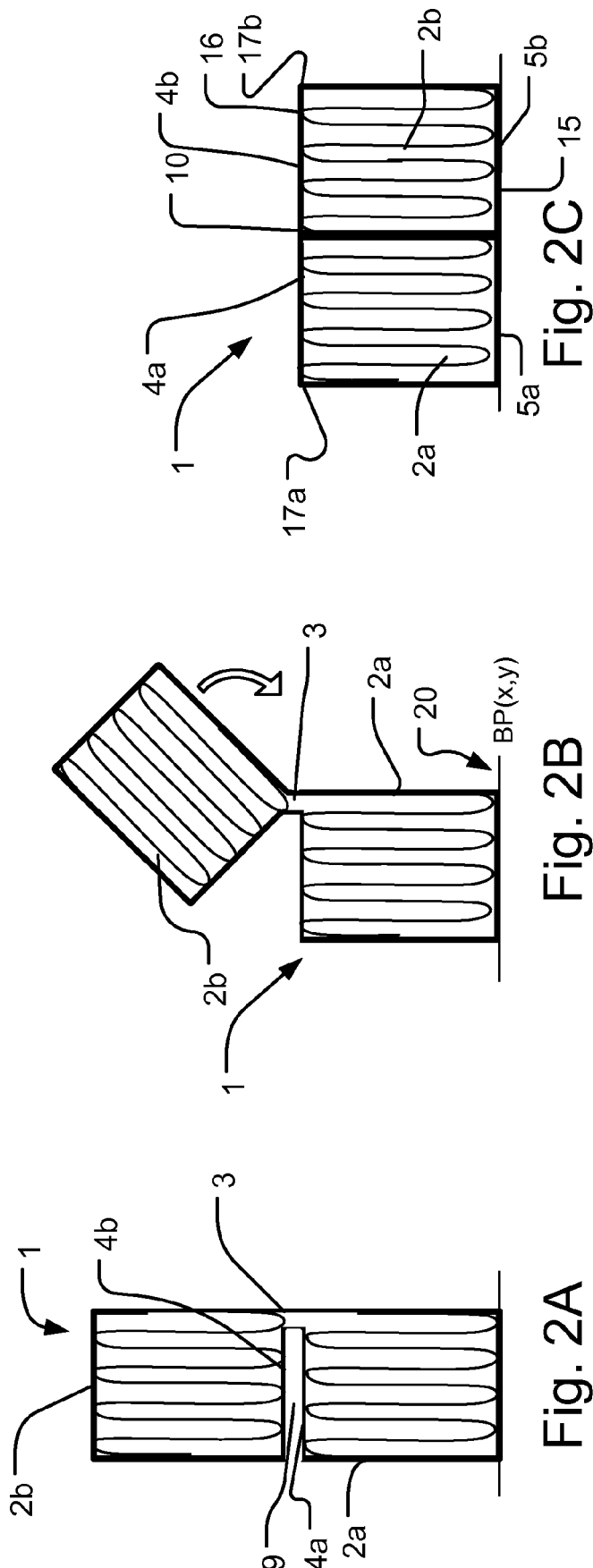


Fig. 2A

Fig. 2B

Fig. 2C

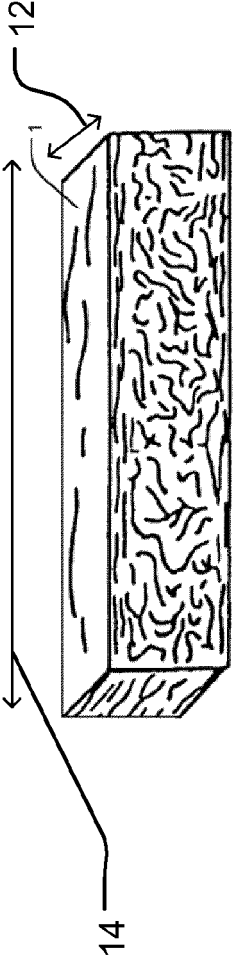


Fig. 3

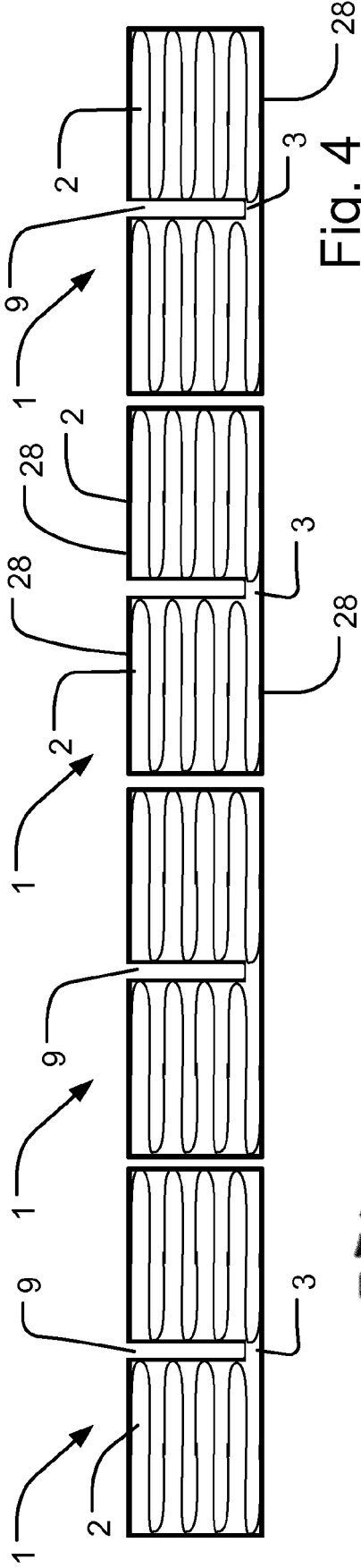


Fig. 4

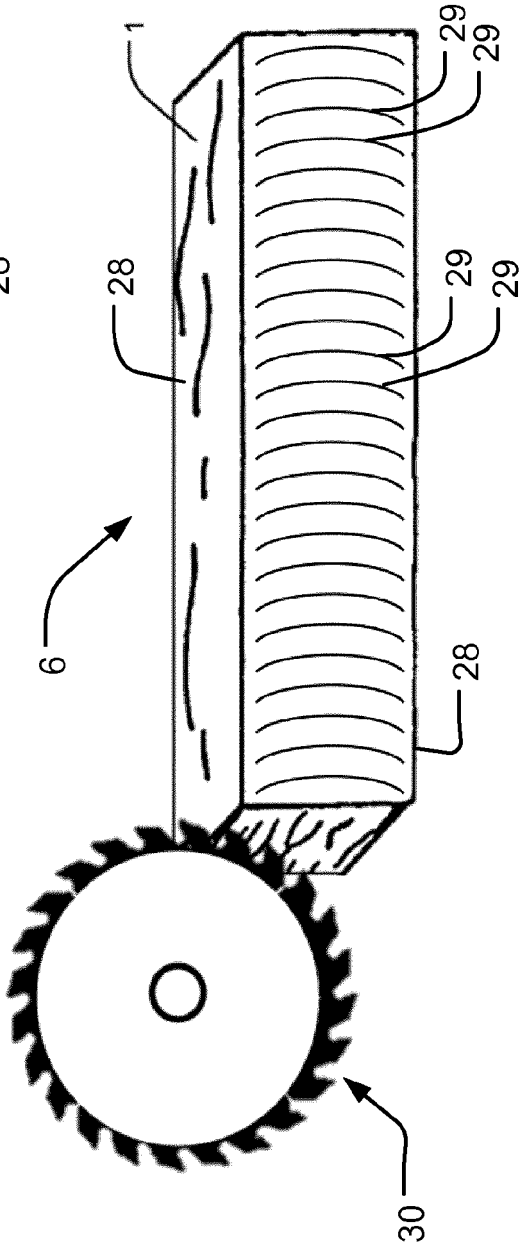
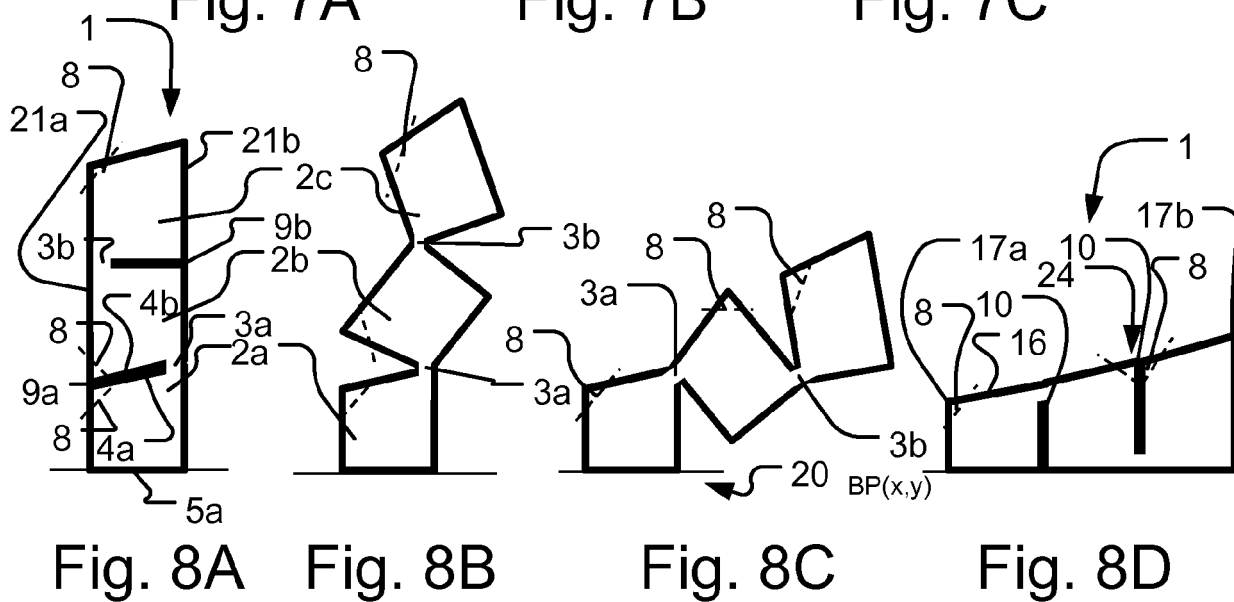
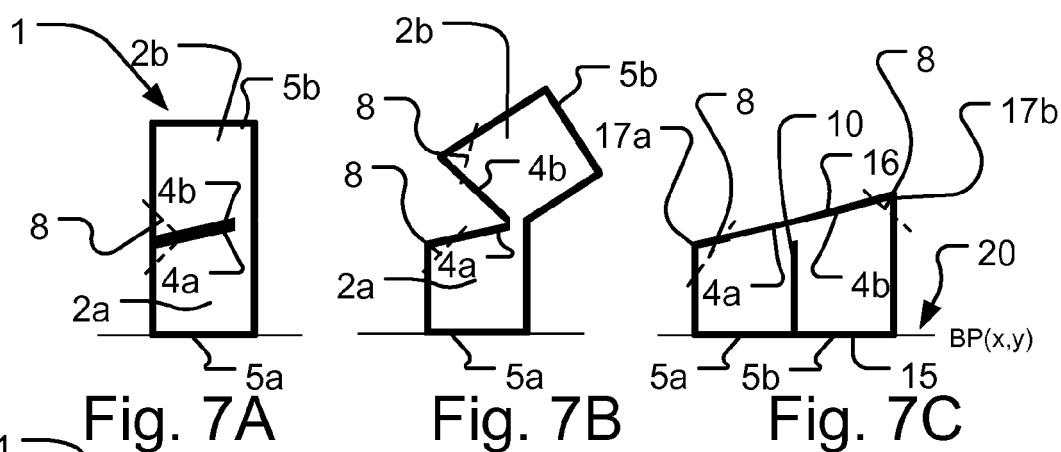
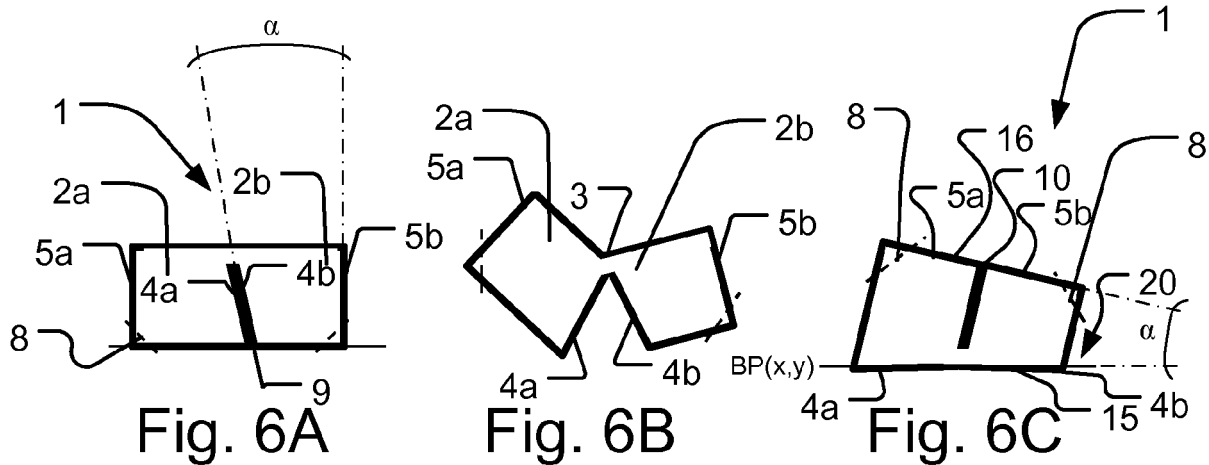


Fig. 5



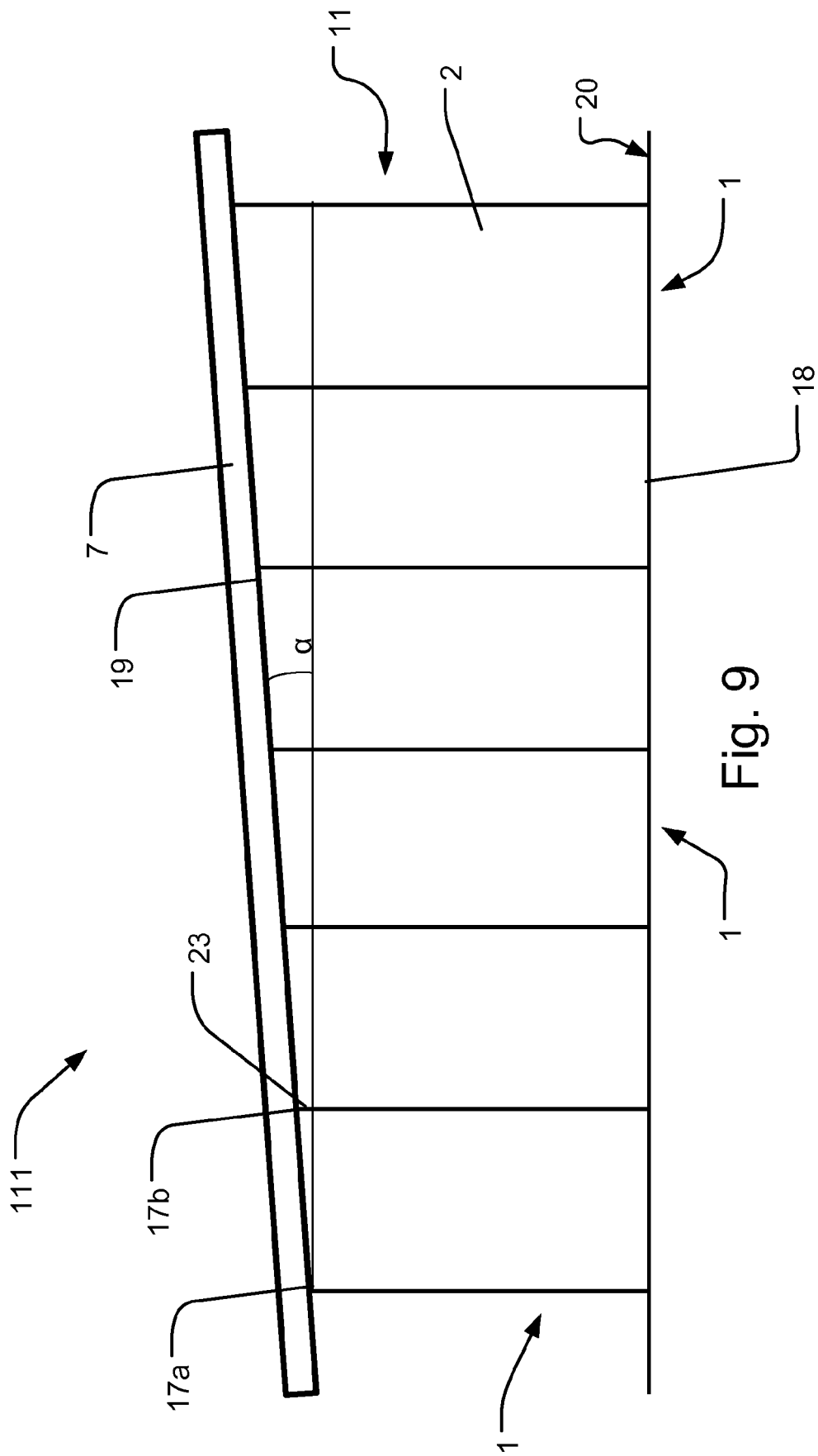
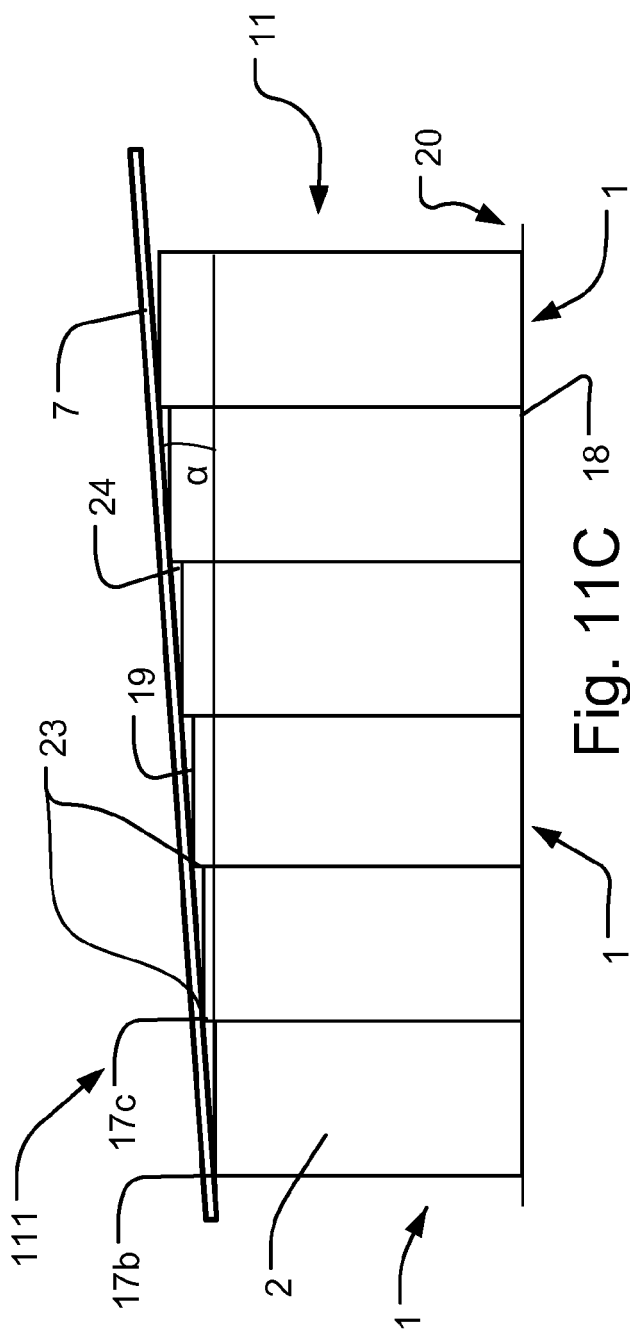
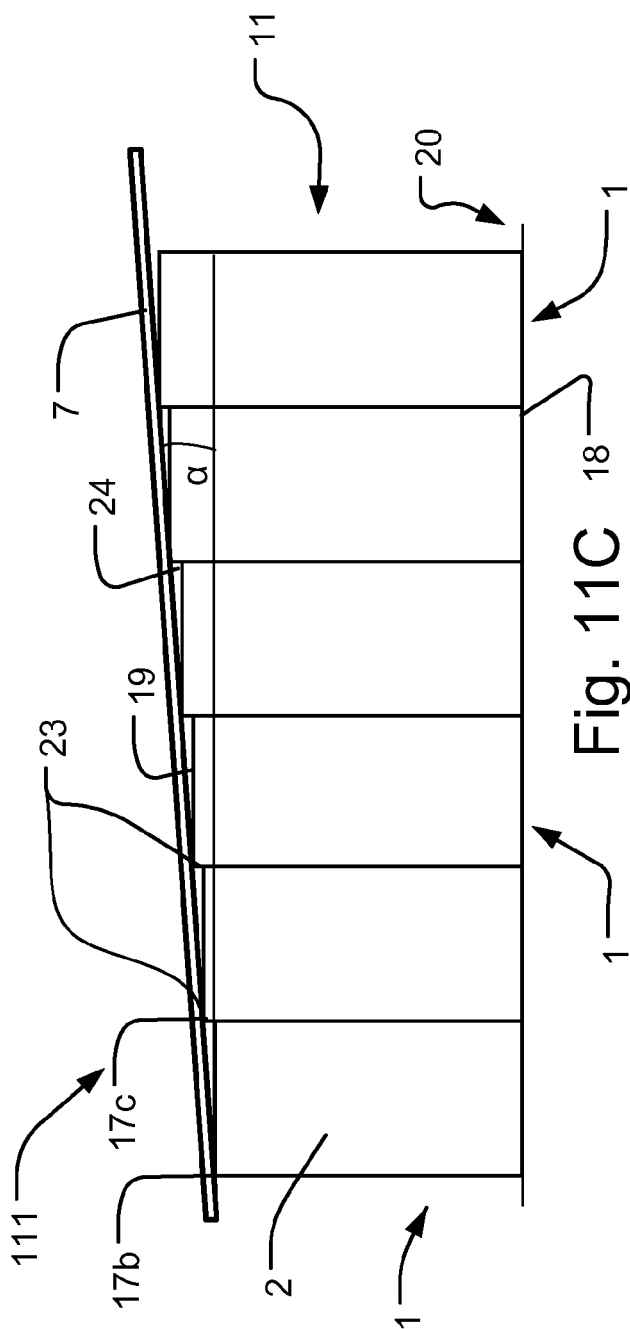
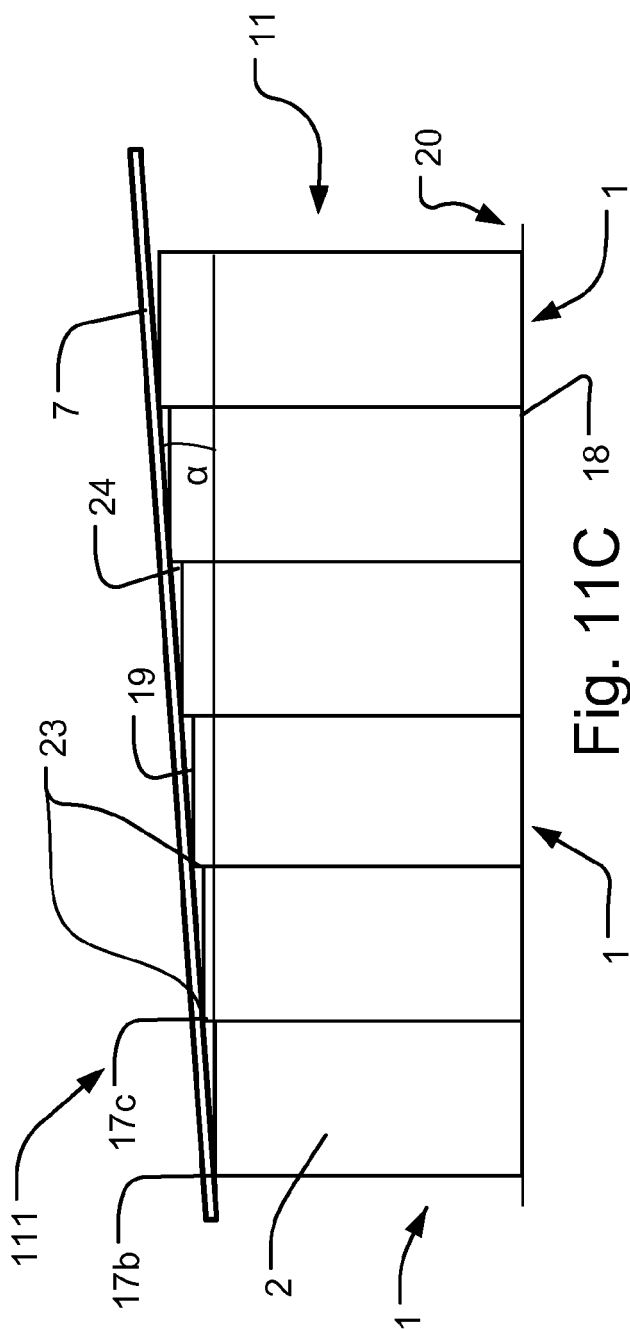
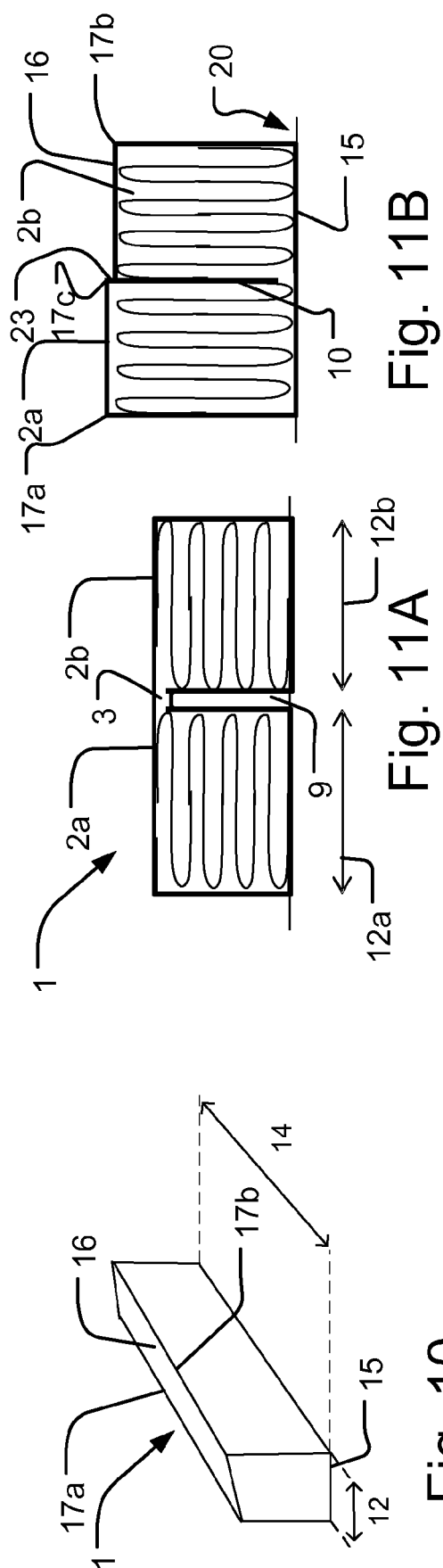


Fig. 9



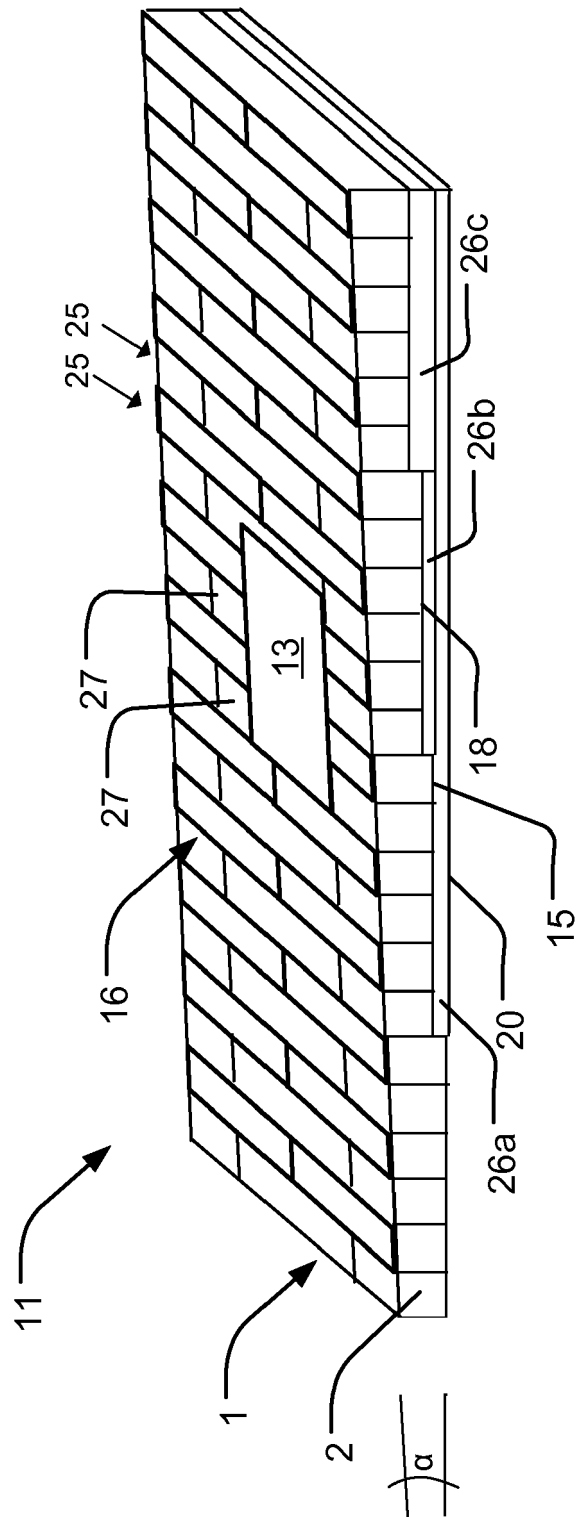


Fig. 12

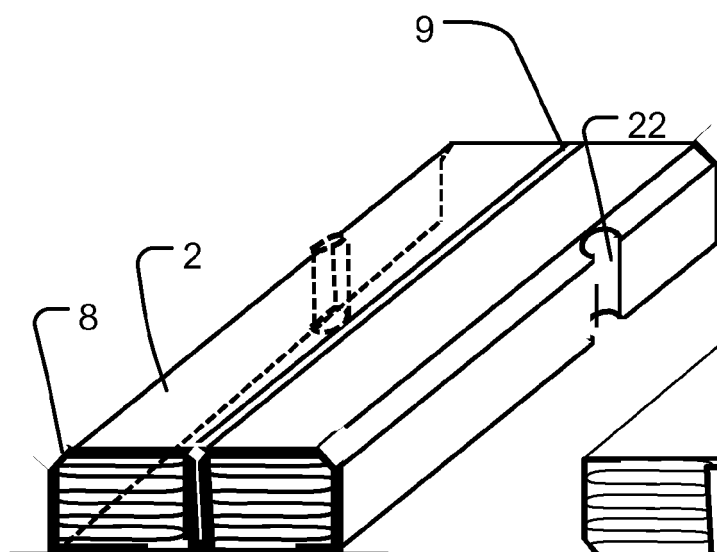


Fig. 13A

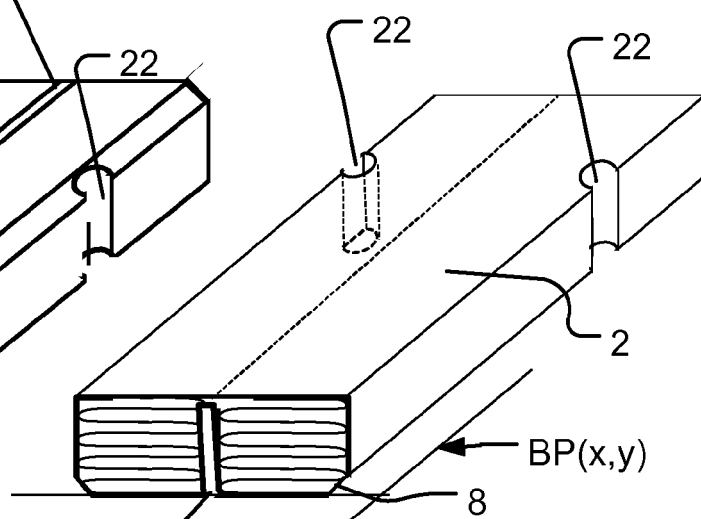


Fig. 13B

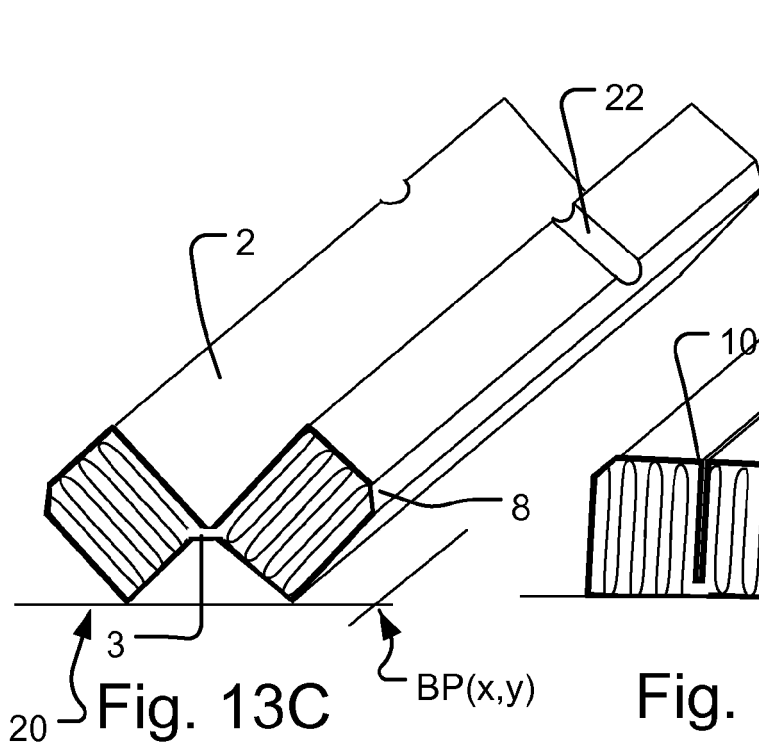


Fig. 13C

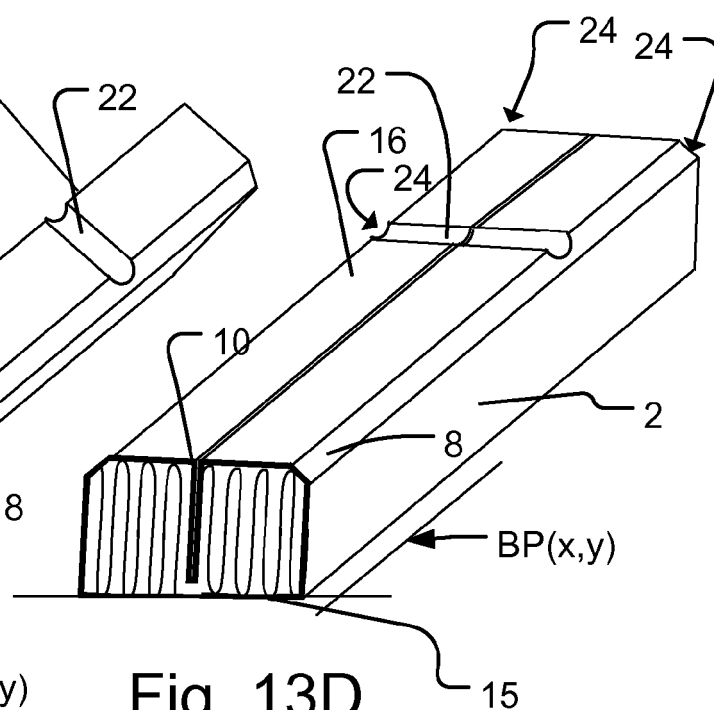


Fig. 13D

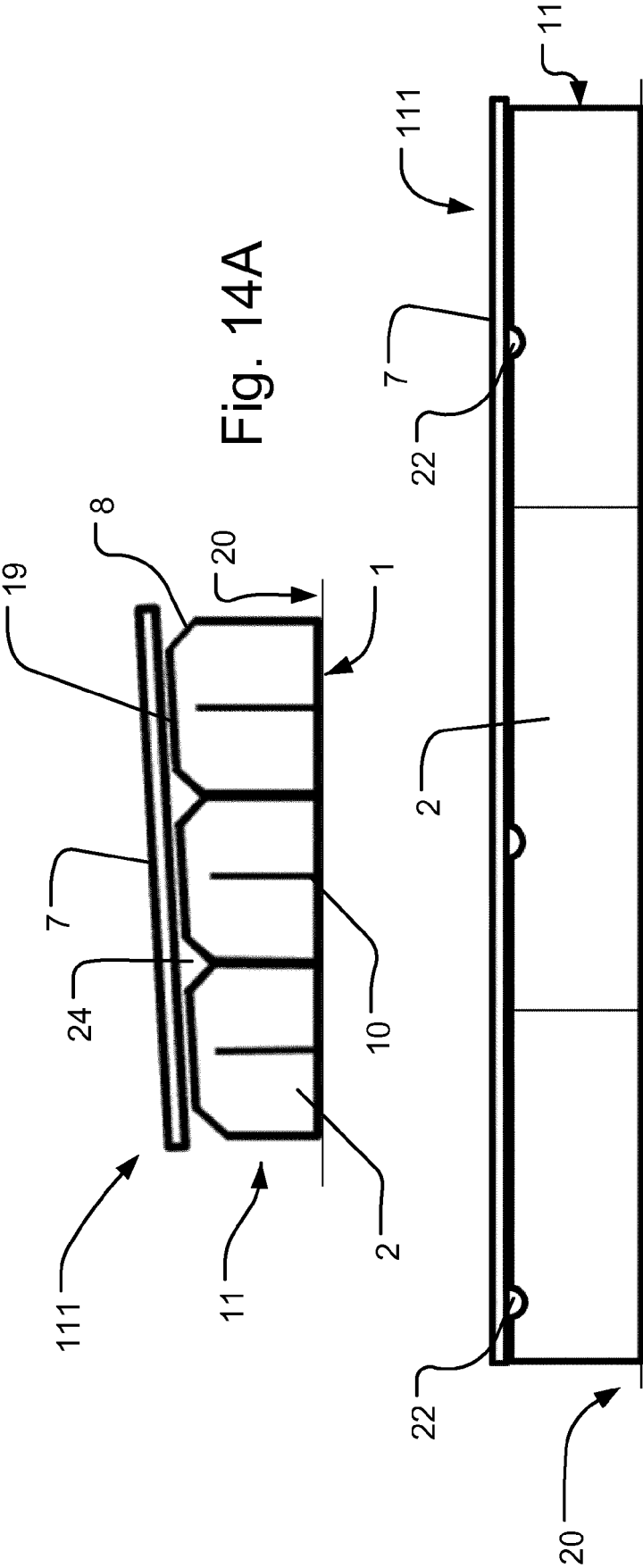
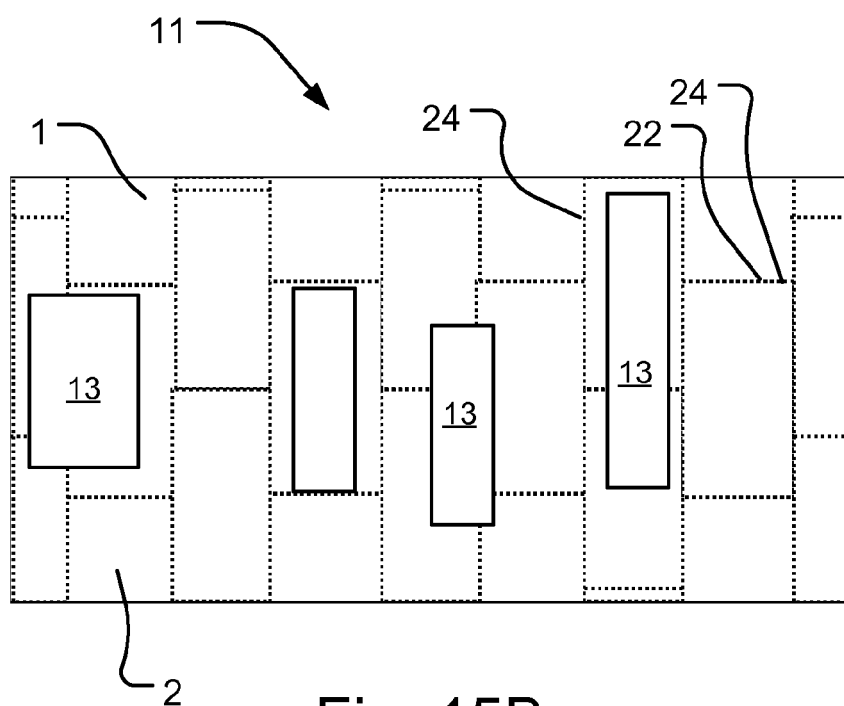
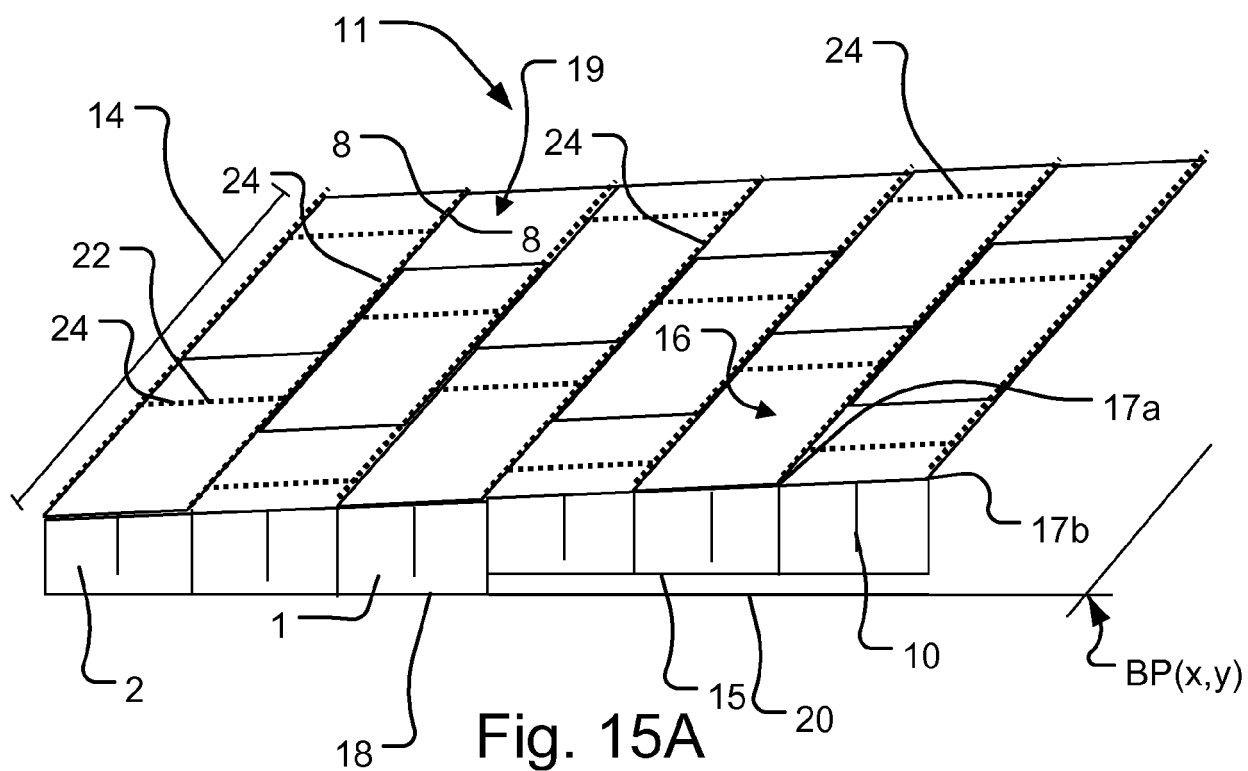


Fig. 14B

Fig. 14A





EUROPEAN SEARCH REPORT

Application Number
EP 18 18 5483

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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