(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 438 369 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.02.2019 Bulletin 2019/06

(51) Int Cl.:
***E04D 13/16** (2006.01)* *E04D 13/04 (2006.01)*
E04D 13/17 (2006.01)

(21) Application number: **18185477.9**

(22) Date of filing: **25.07.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **31.07.2017 EP 17184086**

(71) Applicant: **Saint-Gobain Denmark A/S**
2300 Copenhagen S (DK)

(72) Inventors:
- **RASMUSSEN, Mona Ammitzbøll**
6600 Vejen (DK)
- **JESSEN, Erling**
6100 Haderslev (DK)

(74) Representative: **AWA Denmark A/S**
Strandgade 56
1401 Copenhagen K (DK)

(54) INSULATION LAMELLA STRUCTURE WITH SPLIT LAMELLAS AND METHOD FOR INSTALLING THE SAME

(57) In an insulation lamella structure (11) adapted to be positioned above a supporting base layer (20) in a mounted condition, each of one or more insulation lamellas (1) is able to assume a folded state and an unfolded state, wherein each of the one or more insulation lamellas (1) is in an unfolded state in the mounted condition. The insulation lamella (1) is in a folded state provided with a split (9) along the length providing at least two lamella parts (2a, 2b). Each lamella part (2a, 2b) has a first side (4a, 4b) and a second side (5a, 5b) extending along a length of the lamella part. The first side (4a, 4b) faces the split (9) in a folded state, the second side (5a, 5b) opposing the first side (4a, 4b). The lamella parts (2a, 2b are in a folded state attached to each other along the length by a thin neck (3). The lamella parts (2a, 2b) are 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 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.

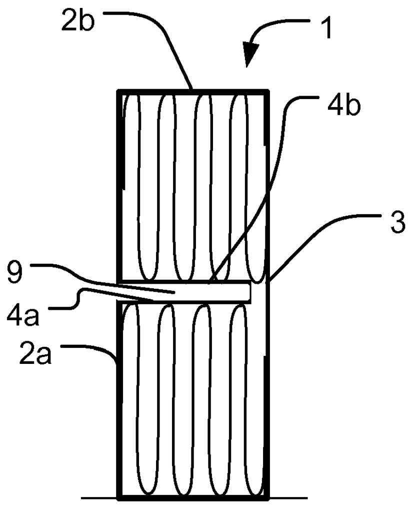

Fig. 2A

EP 3 438 369 A1

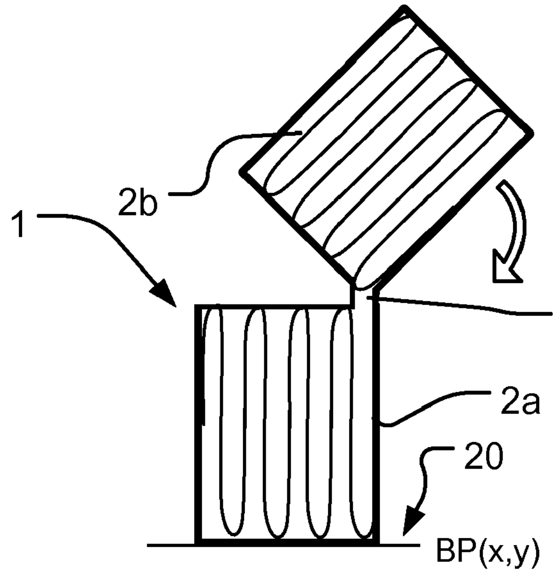

Fig. 2B

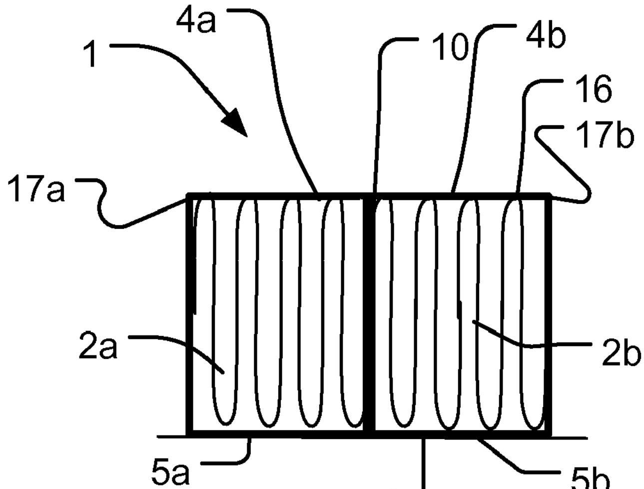

Fig. 2C

Description

Technical Field

[0001] The present invention relates to an insulation lamella structure according to the preamble of claim 1. The invention furthermore relates to a method of laying an insulation lamella 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] Transportation and handling of the lamellas during installation can be cumbersome and costly.

[0004] It is known to provide insulation lamellas that are pre-cut which is made in order to make the product fit for a production with longitudinal conveyer belts transportation on the production site. One example of a prior art lamella is shown in EP 2 757 208 A1, where a mat with splits is shown. The text however describes that the singular lamella pieces has to be torn apart before installation. This gives an extra amount of labour needed to install the roof because the manual tearing apart is time consuming and hard work for the personnel. So, there is still room for improvement as regards the cost efficiency of the prior art insulation structures.

Summary of Invention

[0005] With this background, it is the object of the invention to provide an insulation lamella structure by which it is possible to reduce the overall costs for manufacture, transportation and mounting.

[0006] This and further objects are achieved in that each of the one or more insulation lamellas is able to assume a folded state and an unfolded state, wherein each of the one or more insulation lamellas is in an unfolded state in said mounted condition, and wherein said insulation lamella in a folded state is provided with at least one first split along the length providing at least two lamella parts, each lamella part having a first side 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 substantially parallel and with a distance to the first side, said distance being substantially equal for the at least two lamella parts, 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 at least one first side of at least one lamella part, or its opposing second side on the same lamella part, is positioned substantially in parallel to the base plane in the unfolded state.

[0007] In this manner, the increased cost-efficiency aimed at is attained in that the insulation lamella(s) of the insulation lamella structure can be transported and handled, for instance carried onto the roof structure, while in the unfolded state. Once the folded insulation lamella has been brought to its intended position, it is unfolded to reach the mounted condition. Depending on the number of lamella parts provided in each insulation lamella, only half or less of the number of lamellas need to be handled as compared to the prior art. Furthermore, installing an insulation lamella structure of low thickness is facilitated compared to prior art structures having precut lamellas requiring cutting-through before installation.

[0008] The thin neck is made from the same material as the rest of the insulation lamella. This makes it easier to produce the lamella.

[0009] 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.

[0010] 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.

[0011] 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 by slab top surface and slab bottom surface which accordingly may be designated "production surfaces".

[0012] 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.

[0013] 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.

[0014] 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.

[0015] 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.

[0016] 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.

[0017] The insulation structure may be interrupted by an opening or a 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.

[0018] Where the insulation lamella has been cut off, this may create a cut off lamella piece, and this cut off insulation lamella or 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.

[0019] In a further embodiment, the insulation structure may be provided with 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.

[0020] The invention also relates to a method of laying an insulation lamella structure on a supporting base layer, comprising the steps of:

positioning an insulation lamella structure on the supporting base layer such as a roof,
whereby a plurality of lamellas is 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.

[0021] 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.

[0022] A further object of the invention is a lamella of the type described above, which is able to assume a folded state and un 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

[0023] 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 produc-

tion 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 stepwise 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,

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,

Figs 16a and 16b illustrates benefits of a neck portion, and

Figs. 17 and 18 illustrates unfolding of a lamella

Description of Embodiments

[0024] Referring first to Fig. 12, Figs. 14A-B and Figs. 15A-B, it is shown how the general configuration of an insulation lamella structure 11 is composed. The insulation lamella structure 11 may form part of an insulation structure 111 together with a separate pressure distributing layer, in the following referred to as pressure distributing board 7, as shown in for instance Figs. 9 and 11C. One or more boards may be present in the pressure distributing layer. In turn, the insulation lamella structure 11 is constituted by a number of lamellas 1, and first, the manufacturing and handling of various embodiments of an insulation lamella 1 will be described in some detail.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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".

[0030] 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.

[0031] 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 (which are production surfaces), 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 the 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 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.

[0032] 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.

[0033] A slab of insulation 6 as seen in Fig. 5 can, as indicated, be produced as described in EP0133083B1 and the corresponding DK157309B, US4632685, and US4964978 or by other processes. As can be seen in the figure, it is mainly the core that has an isotropic structure of the fibres and where many fibres are layered in a generally perpendicular direction in relation to the top and bottom surface (production surfaces 28) of the slab 6, whilst in the top and bottom of the slab 6, the fibres are layered in a generally parallel direction in relation to the top and bottom surface of the slab 6.

[0034] Fig. 5 shows the principle of the fibre layers along the lamella as an indefinite number of layers 29 and Figs. 16a and 16b shows the principle of one fibre layer being unfolded and its relation to the neck 3. This is only a principle drawings of the layers as the isotropic fibre structure also has many fibres going in all other directions and binding the layered structure together.

[0035] When a split 9 and lamella 1 is cut from the slab 6 as shown in fig. 4 the neck 3 is placed in the area (production surface 28) of the slab where fibre layers are generally parallel to the surface (see principle fig. 16a). Testing of the use of the split lamellas has shown the effect that this prolongs the durability of the hinge provided by the neck 3 significantly, as opposed to a hinge placed in the core area of the slab where the isotropic fibre structure consists more of perpendicularly layered fibres (see principle fig. 16b).

[0036] When the hinge is made of fibres and fibre layers that are more parallel to slab surface, the fibres and fibre layers are bending 180 degrees when opening the split and unfolding the lamella (as shown in fig. 16a).

[0037] If the hinge or neck 3 is placed in the structure where the fibres and fibre layers are more perpendicular the fibres tend to break more easily (as shown in fig. 16b).

[0038] A typical lamella with a hinge constituted by fibres and fibre layers parallel to the slab surface has durability for several repeated cycles of unfolding and folding the lamella. This can be very useful in a mounting situation until the lamella is finally fixed in a construction. Even at demolishment of the construction the intact hinge can provide a faster pace of collecting the insulation for re-use or upcycling.

[0039] 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 21b 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 displacing 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/m^{2}K 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 instance lie between 10-200 mm, preferably 15-50 mm, more preferably 20-30 mm. The compressive strength typically lies in the range of 30-70 kPa, 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 making use of the insulation lamella structure 11 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 lamella structure 11 in 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 in an insulation structure 111 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] Referring to Fig. 17 (a) through (d) and Fig. 18 (a) and (b), which illustrate unfolding of a lamella 1 positioned opposite to the lamella shown in Fig. 1A-1C in the sense that the lamella is placed with the neck downwards, a lamella 1 with a split 9 and a hinge or neck 3 can be placed on any supporting surface (preferably a mainly horizontal surface) and when in folded state the person mounting the lamella can initiate unfolding, by pressing at one of the outermost edges, cf. fat arrow in Fig. 17 (a) and (b) and Fig. 18 (a), (preferably by pressing with one's foot at one end of the lamella).

[0061] The weight and geometry of the lamella pieces constitutes how easy it is to unfold the lamella, as the center of gravity, cf. slender arrows in Fig. 18(a) and (b), will move in relation to the supporting edge and the hinge. Also the weight and the center of gravity of the lamella piece which is not pressed by foot constitutes how easy it is to break some of the isotropic part of the fibres in the hinge so that lamella pieces can turn in relation to the hinge, and the lamella unfold.

[0062] The term insulation lamella and lamella are both used for the same element. The same applies to supporting base layer and base layer.

[0063] The same reference numbers apply to the same features throughout the application.

[0064] The different embodiments and the different features described throughout the application may be combined with each other as seen fit.

List of Reference Numerals

[0065]

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	cleft
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)
21b	opposing side (of second split 9b)
22	air channel recesses
23	distance
24	air channel
25	row
26a	plane layer of insulation
26b	plane layer of insulation
26c	plane layer of insulation
27	cut-off piece
28	production surface
29	layers
30	circular saw
111	insulation structure
BP(x,y)	base plane
α	inclination

Claims

1. An insulation lamella structure (11) adapted to be positioned above a supporting base layer (20) in a mounted condition, the insulation lamella structure (11) 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 lamella structure (11) comprises:

   one or more insulation lamellas (1), wherein each of said one 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)),
   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 one or more insulation lamellas (1),
   characterized in that
   each of the one or more insulation lamellas (1) is able to assume a folded state and an unfolded state, wherein each of the one or more 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 side (4a, 4b) and a second side (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 substantially parallel and with a distance to the first side (4a, 4b), said distance being substantially equal for the at least two lamella parts (2; 2a, 2b, 2c),
   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 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, and wherein the thin neck (3) is made from the same material as the rest of the insulation lamella (1).

2. The insulation lamella structure according to claim 1, wherein the insulation lamellas (1) are of a fibrous material, preferably glass fibres, 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.

3. The insulation lamella structure according to claim 1 or 2, 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.

4. The insulation lamella 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.

5. The insulation lamella 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.

6. The insulation lamella structure according to any one of the preceding claims, 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.

7. The insulation lamella 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.

8. The insulation lamella structure according to any one of the preceding claims, 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.

9. The insulation lamella 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.

10. The insulation lamella structure according to claim 8, 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.

11. The insulation lamella 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.

12. A method of laying an insulation lamella structure on a supporting base layer, comprising the steps of:

positioning an insulation lamella structure on the supporting base layer, such as a roof,
whereby a plurality of lamellas is 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 substantially parallel in relation to the base surface.

13. The method according to claim 12, 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.

14. 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.

15. The lamella according to claim 14, 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.

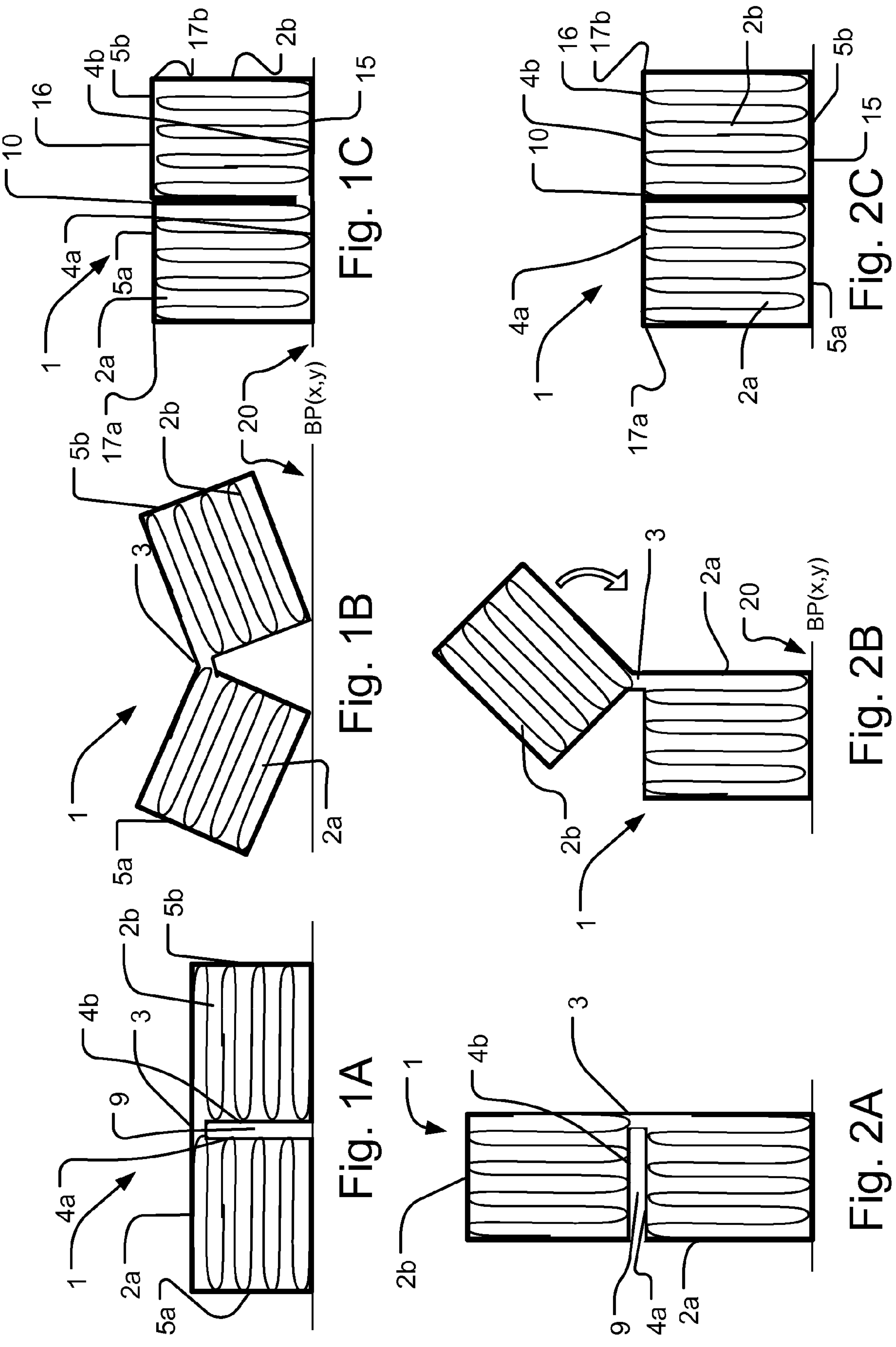

Fig. 1A

Fig. 1B

Fig. 1C

Fig. 2A

Fig. 2B

Fig. 2C

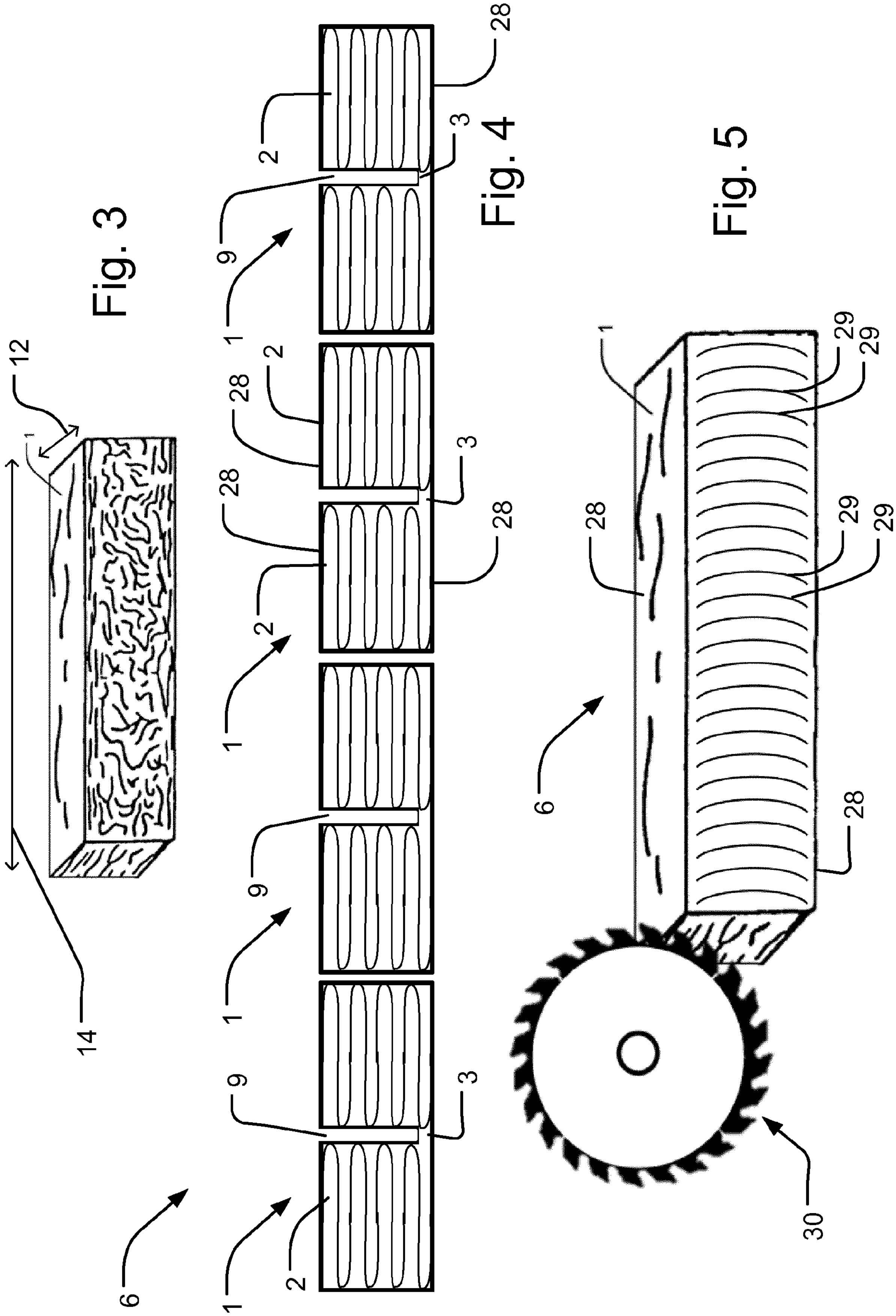

Fig. 3

Fig. 4

Fig. 5

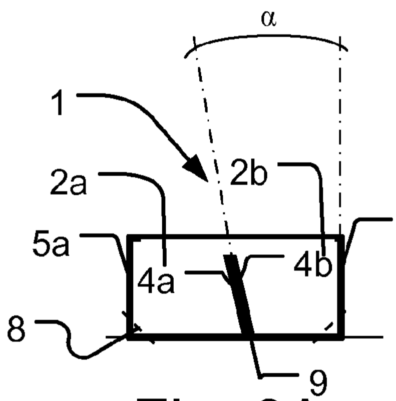

Fig. 6A

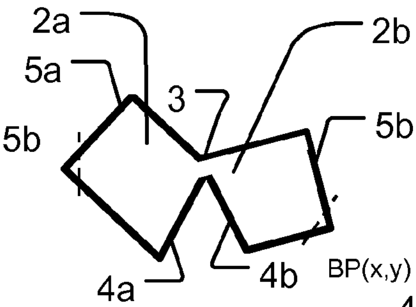

Fig. 6B

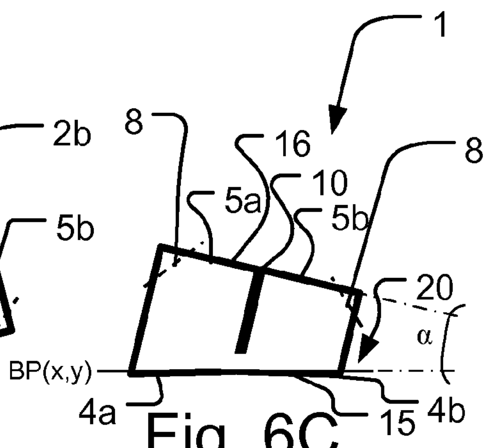

Fig. 6C

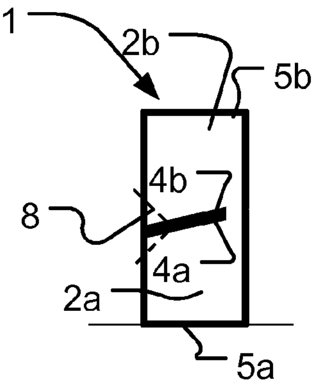

Fig. 7A

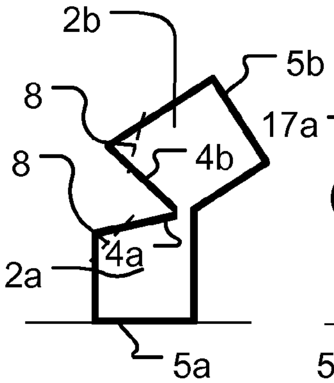

Fig. 7B

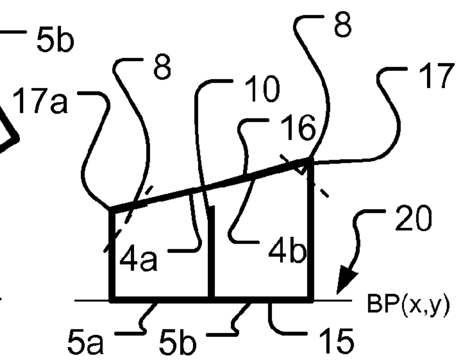

Fig. 7C

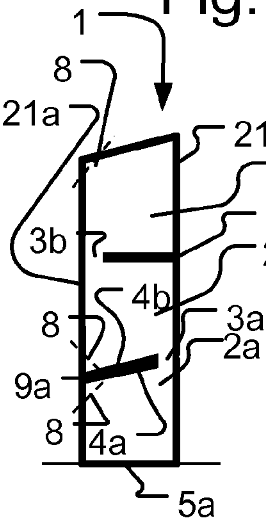

Fig. 8A

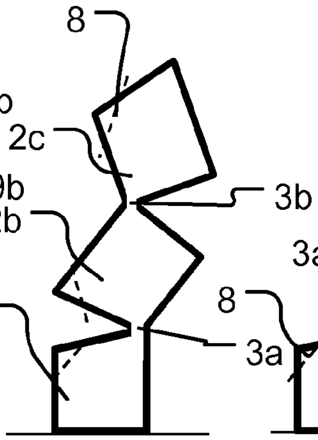

Fig. 8B

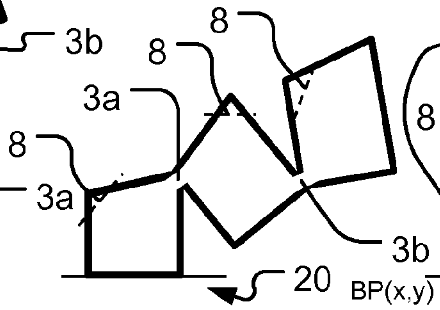

Fig. 8C

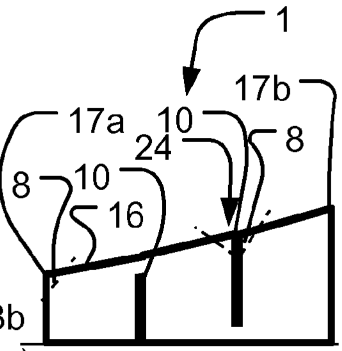

Fig. 8D

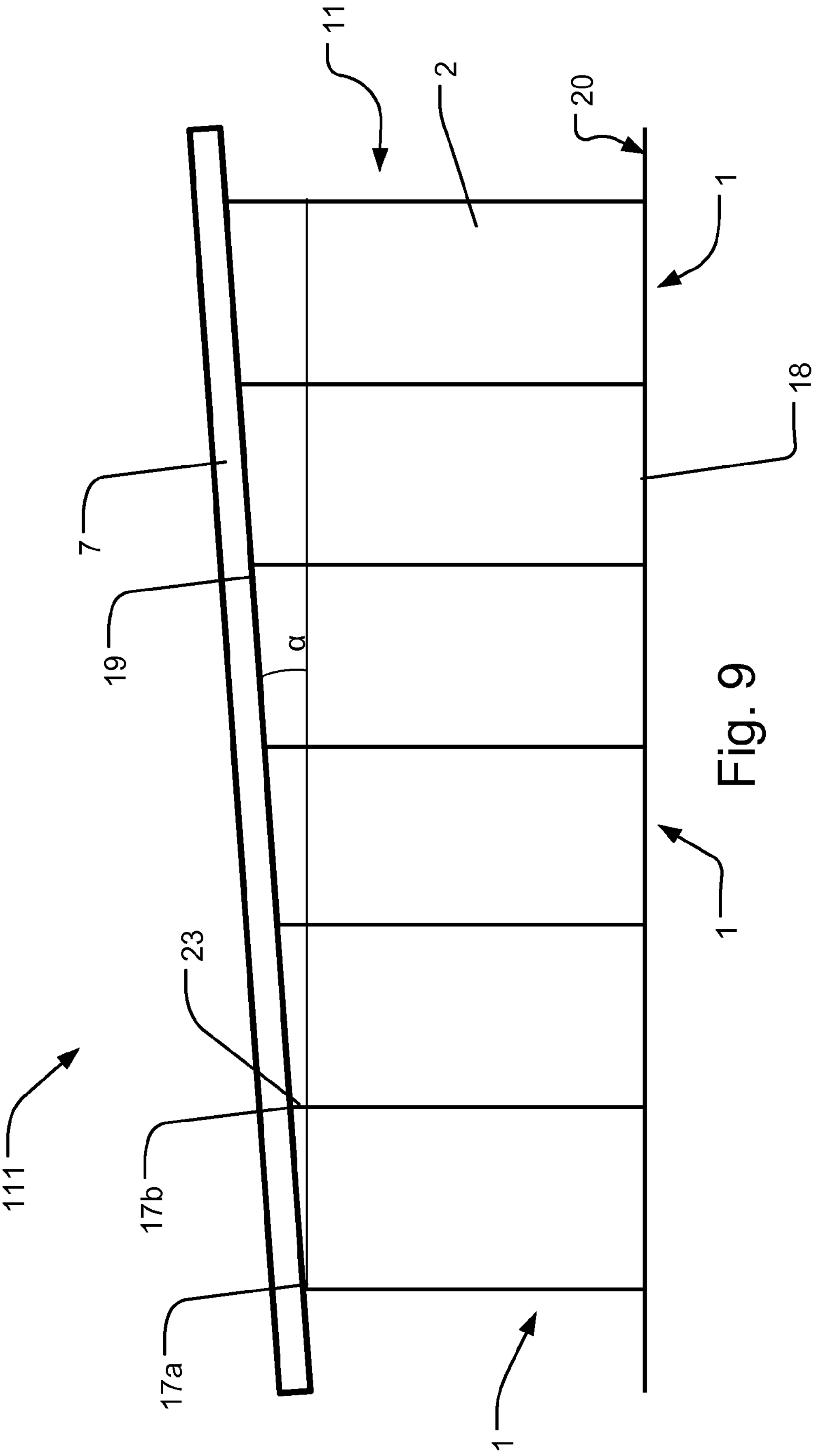

Fig. 9

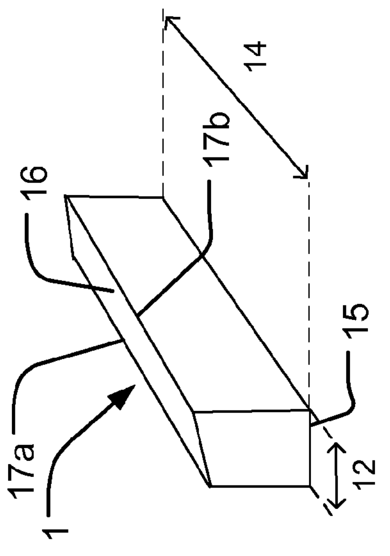

Fig. 10

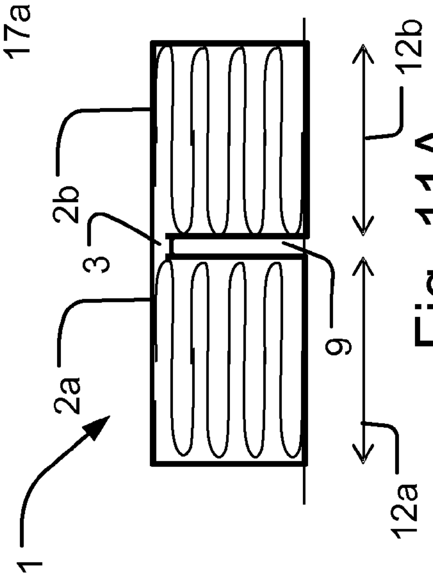

Fig. 11A

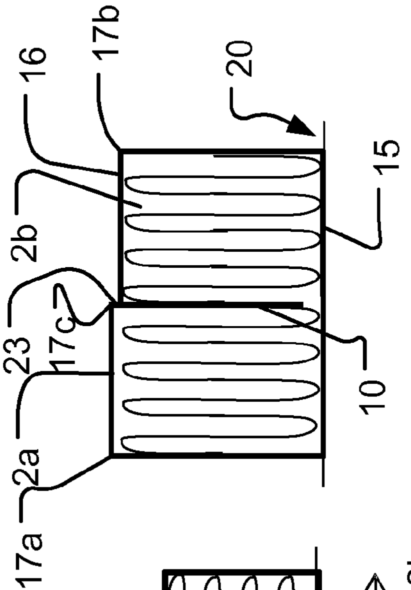

Fig. 11B

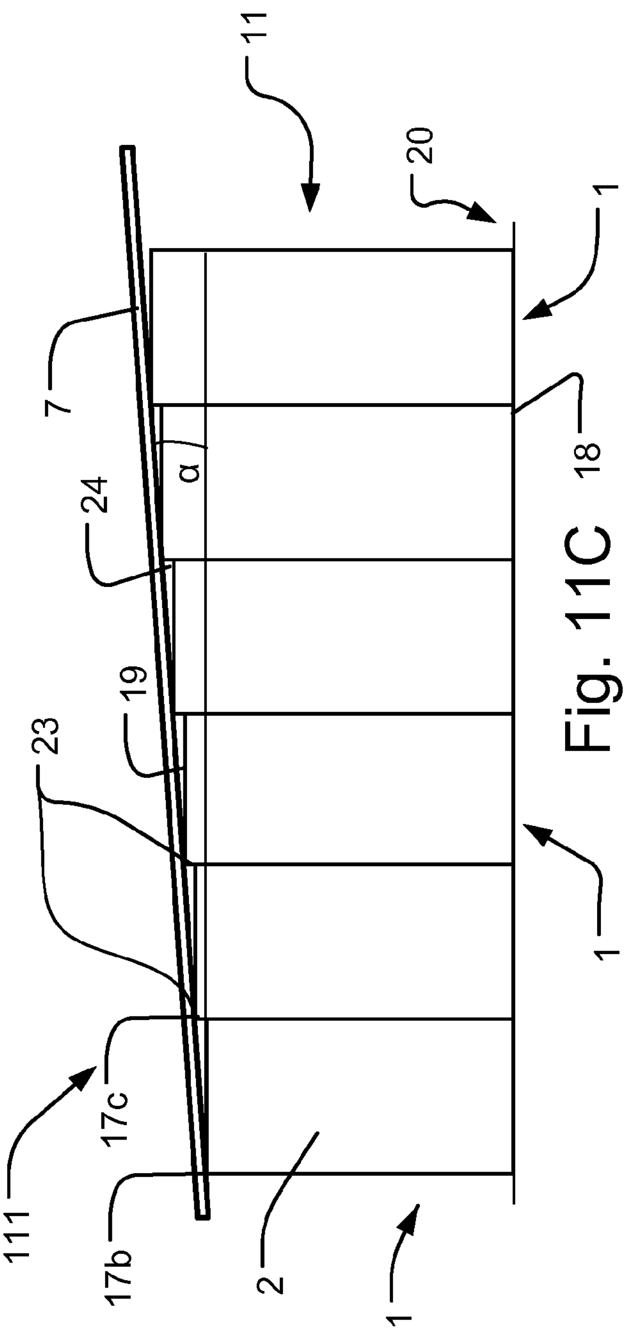

Fig. 11C

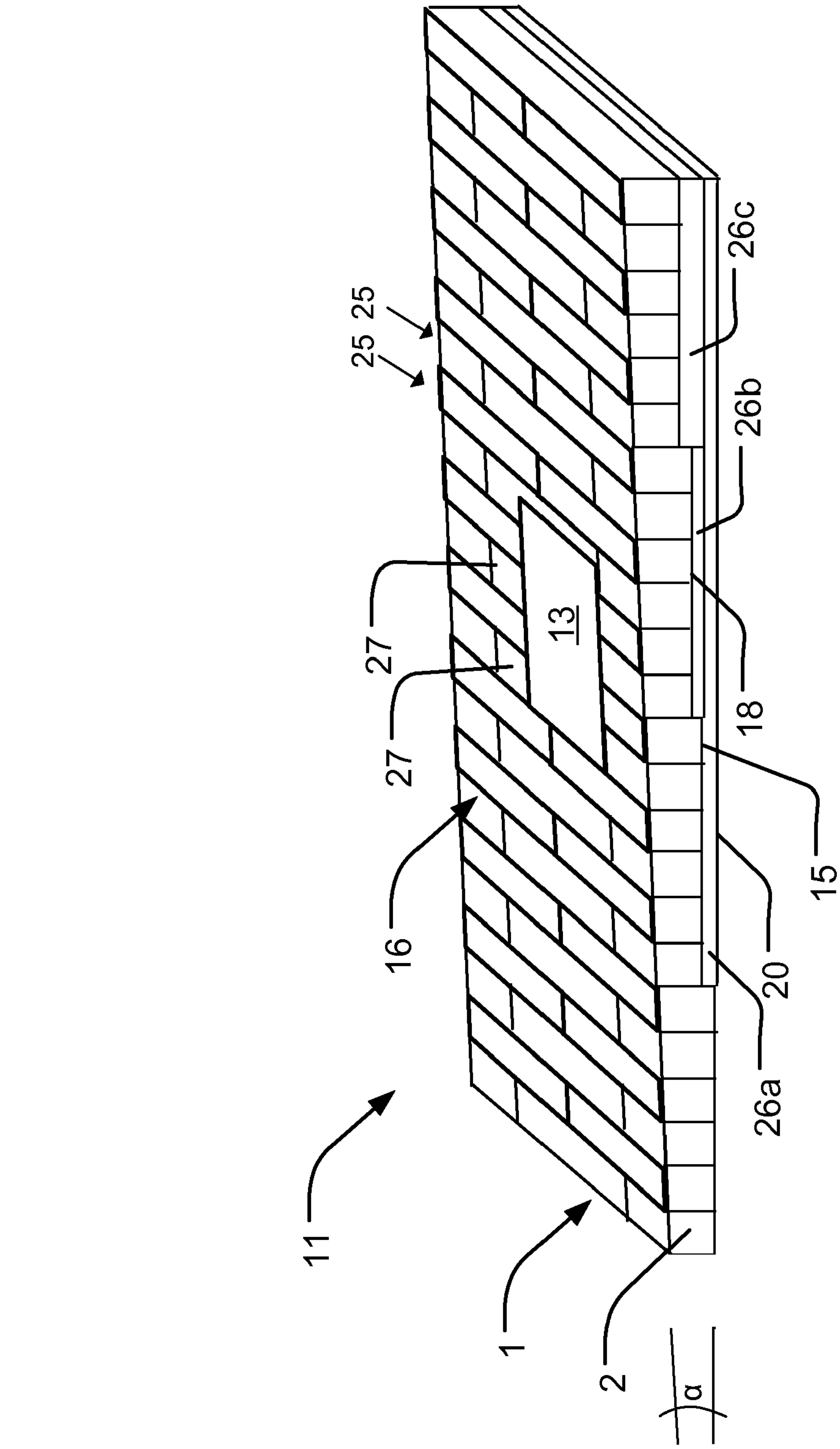

Fig. 12

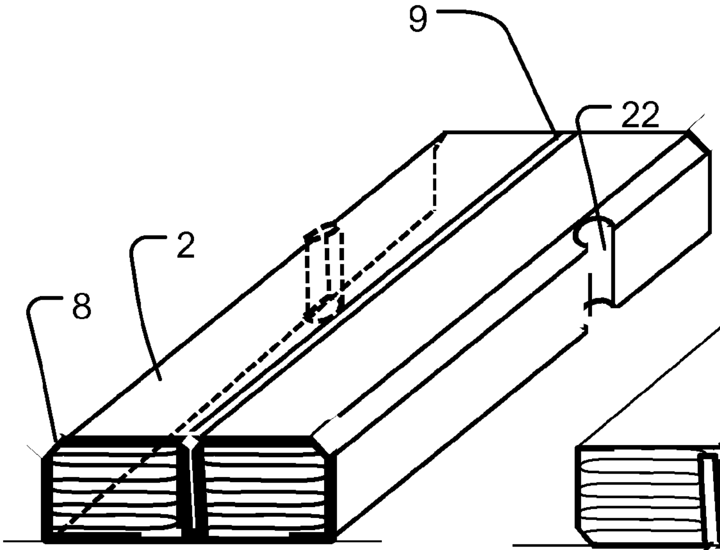

Fig. 13A

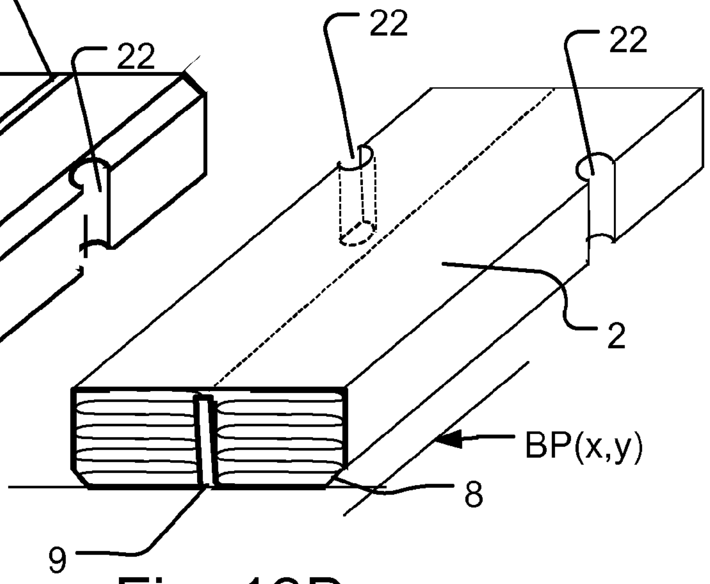

Fig. 13B

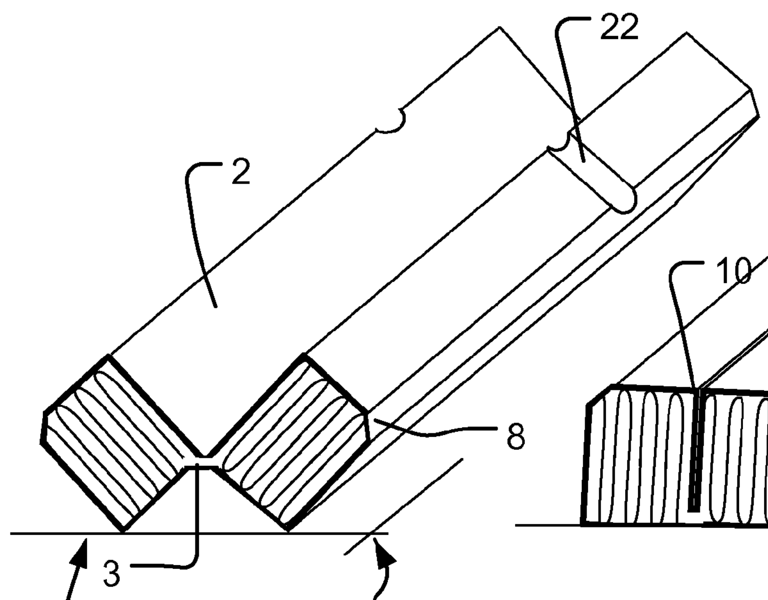

Fig. 13C

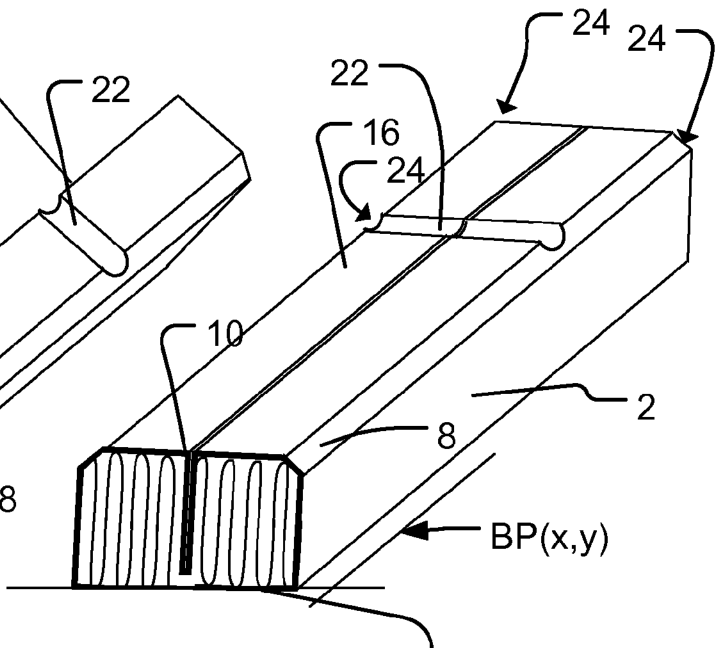

Fig. 13D

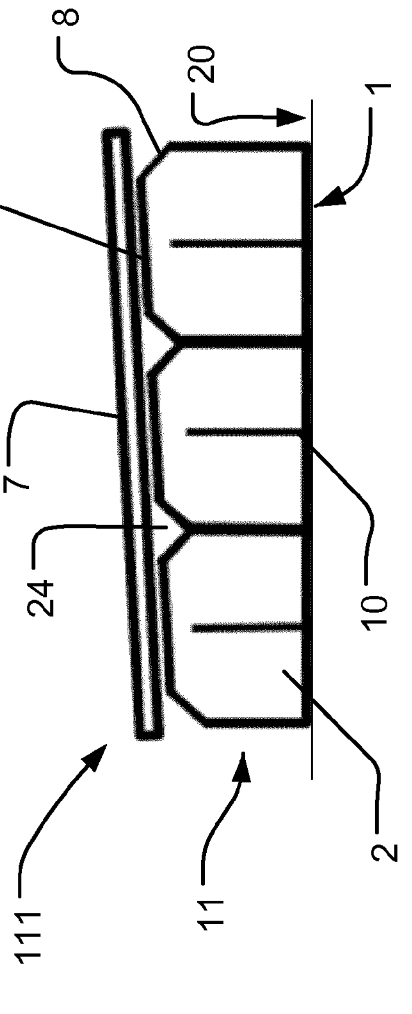

Fig. 14A

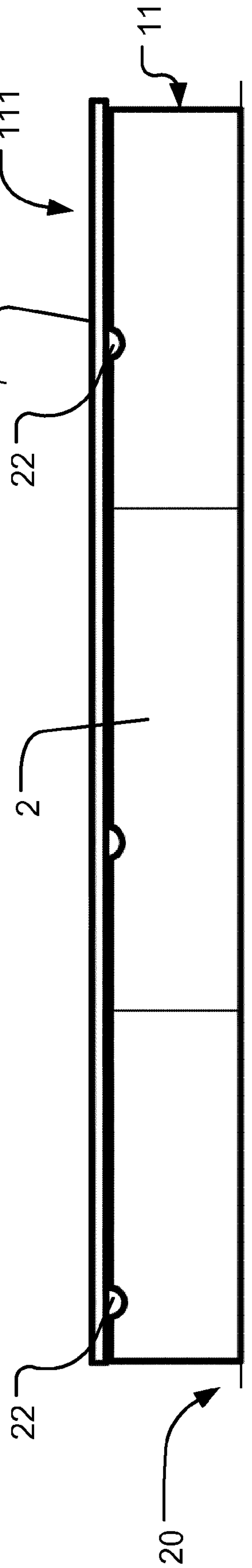

Fig. 14B

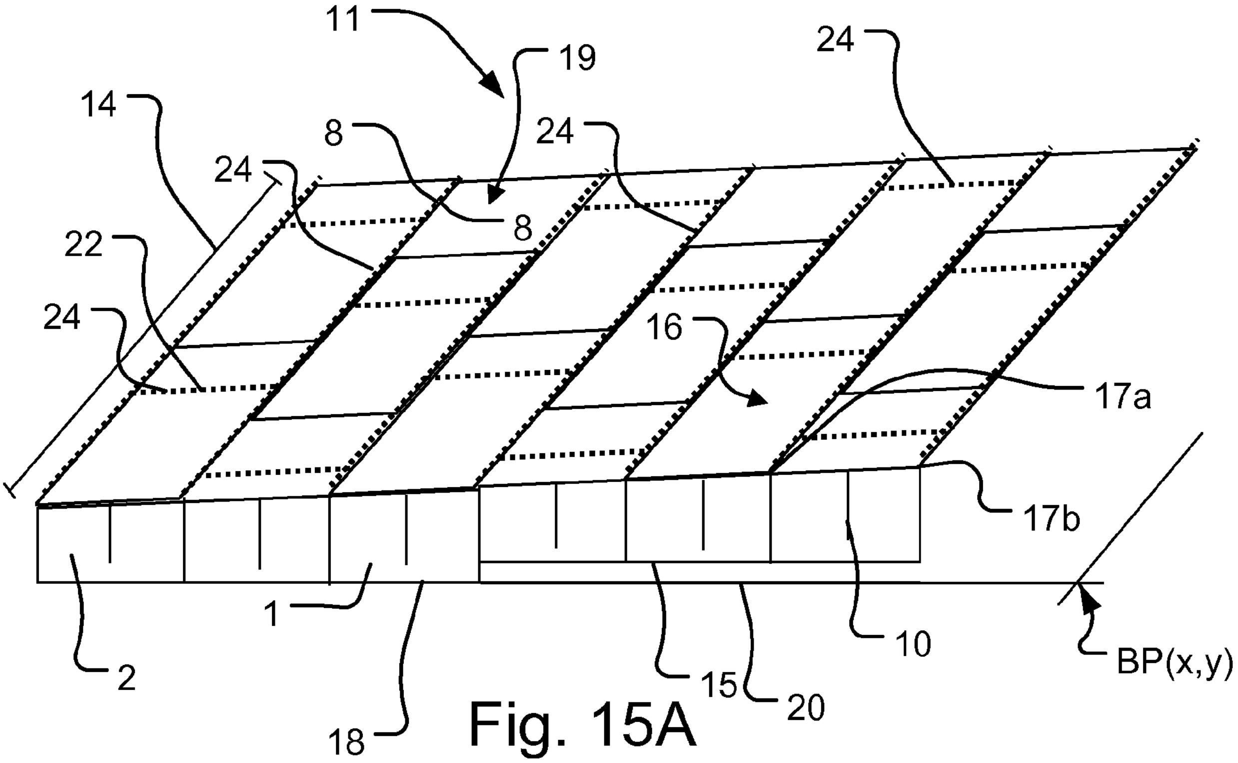

Fig. 15A

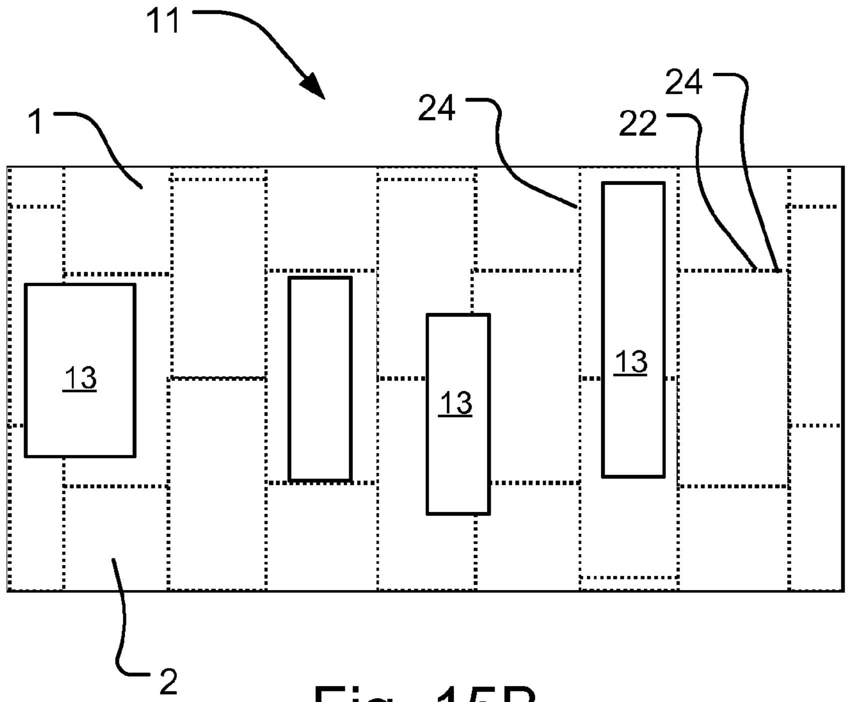

Fig. 15B

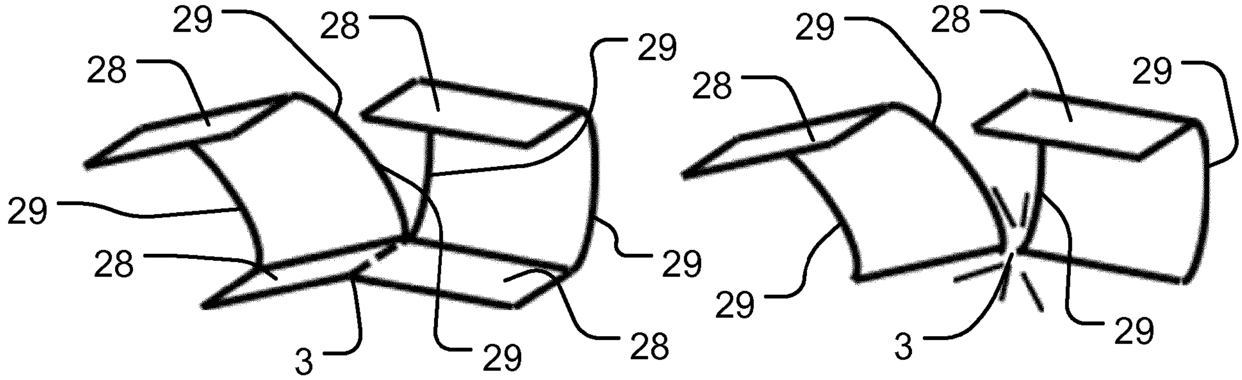

Fig. 16a

Fig. 16b

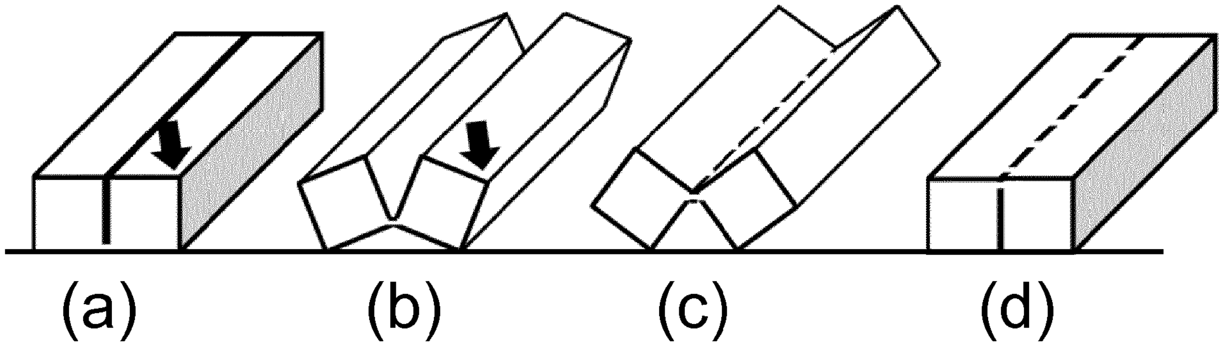

Fig. 17

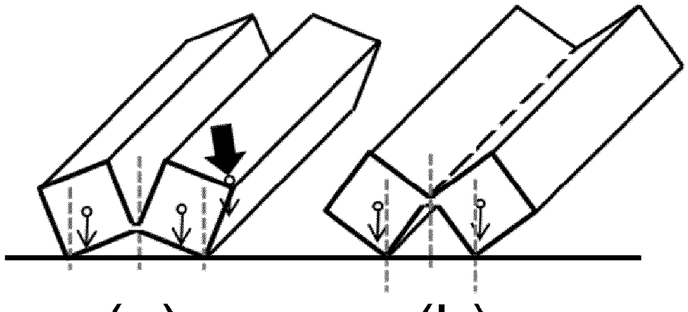

Fig. 18

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 18 5477

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 Y	US 6 105 324 A (KRUSEC EDWARD R [US] ET AL) 22 August 2000 (2000-08-22) * figures 2,3,6c,6d,6e,7,10,11a * * column 6, line 61 - line 67 * * column 5, line 32 - line 37 * * column 8, line 17 - line 51 * -----	12-15 1-11	INV. E04D13/16 ADD. E04D13/04 E04D13/17
X Y	DE 92 13 220 U1 (J.U.OTTO KREBBER) 21 January 1993 (1993-01-21) * figures 1,4,5,6 * -----	12-15 1-5,7-9	
X Y	US 9 249 571 B1 (WHITE ARTHUR PAUL [US]) 2 February 2016 (2016-02-02) * figures 1,2,3,6,7,8,22,23,24,25,26 * -----	12-14 1-7,9-11	
Y	DE 101 01 929 A1 (PFLEIDERER DAEMMSTOFFTECHNIK [DE]) 19 September 2002 (2002-09-19) * figures 1,5 * * paragraph [0028] * -----	1-11	TECHNICAL FIELDS SEARCHED (IPC)
Y	US 4 379 381 A (HOLCOMBE J L) 12 April 1983 (1983-04-12) * figures 1,2,3,5 * -----	1-11	E04D
Y	DE 20 2005 016852 U1 (MAYER HELMUT [DE]) 9 February 2006 (2006-02-09) * figure 4 * -----	8,9,11	

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	20 November 2018	Petrinja, Etiel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 18 5477

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

20-11-2018

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 6105324	A	22-08-2000	CA	2275880 A1	29-04-1999
			EP	1032738 A1	06-09-2000
			US	5966883 A	19-10-1999
			US	6105324 A	22-08-2000
			WO	9920855 A1	29-04-1999
DE 9213220	U1	21-01-1993	NONE		
US 9249571	B1	02-02-2016	NONE		
DE 10101929	A1	19-09-2002	NONE		
US 4379381	A	12-04-1983	NONE		
DE 202005016852	U1	09-02-2006	NONE		

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 2757208 A1 **[0004]**
- EP 0133083 B1 **[0011] [0027] [0028] [0033]**
- DK 157309 B **[0011] [0027] [0028] [0033]**
- US 4632685 A **[0011] [0027] [0028] [0033]**
- US 4964978 A **[0011] [0027] [0028] [0033]**