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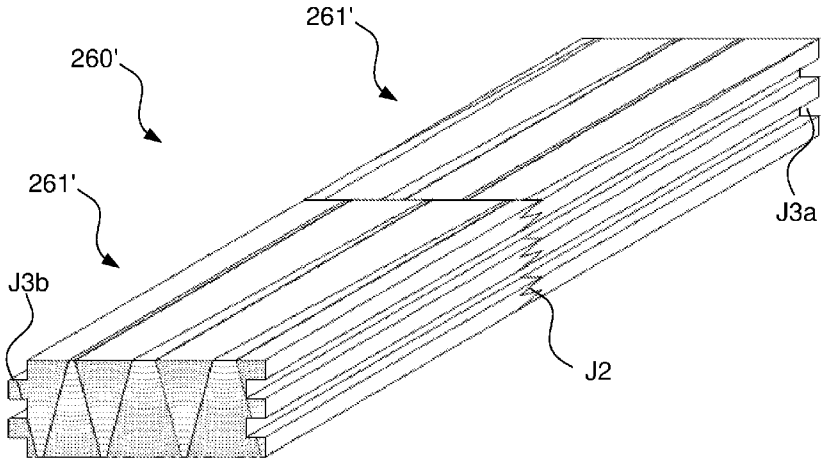

Fig 4c

(57) Abstract: The present disclosure provides a laminated wood product (260, 260', 261 ', 271, 271 ', 280) for use as a construction element. Such a product comprises a plurality of adjacent wood lamellae (20a, 20b), each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2). The lamellae are glued together side surface (ss1) to side surface (ss2), such that major base surfaces (bs1) of immediately adjacent lamellae face opposite directions. The major base surfaces (bs1) define respective major surfaces of the wood product. A thickness of the wood product, as seen in a direction perpendicular to the major surfaces, is about 6-30 cm, preferably 8-26 cm.

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ENGINEERED WOOD PRODUCTS AND METHODS OF THEIR MANUFACTURE

Technical Field

The present disclosure relates to wood-based construction components and methods of their manufacturing. In particular, the disclosure relates to construction components which make better use of the raw material and/or which provide enhanced strength properties as compared to conventional construction components.

The disclosure relates to laminated elements for making ceilings and/or floors.

The disclosure also relates to engineered load bearing components, such as joists, beams and light weight panels.

The disclosure also relates to so called rib slab elements for use as floor elements.

The disclosure also relates to laminated boards, in particular single-ply boards and multi-ply boards.

The disclosure also relates to components for making elongate construction elements intended for receiving a load in a longitudinal direction, such as pillars or columns.

Background

Engineered wood products, i.e. products which are made up of a plurality of wood pieces that are glued together, are known as such.

Examples of engineered wood products include floor and ceiling elements, glulam beams and joists, rib slabs and plywood boards.

Such engineered wood products are typically provided by a process wherein a wood log is sawn according to a cross sectional pattern of mutually orthogonal cuts, after which the thus provided planks are dried, formatted (planed), graded and then glued together.

One disadvantage of such engineered wood products is the waste of material provided by the mismatch between log's natural generally circular cross section and the orthogonal cut-based sawing pattern traditionally used.

Another disadvantage of such engineered products is that the orthogonal cut-based sawing pattern results in wood pieces having different strength and/or warp properties.

There is a general need for engineered wood products which make better use of the raw material, such that less waste of material is provided and wood products having better strength and warp properties can be provided.

Summary

It is a general object of the present disclosure to provide engineered wood products, which make better use of the raw material and which have better strength than comparative (in terms of weight and volume) existing engineered wood products.

The invention is defined by the appended independent claims. Embodiments are set forth in the appended dependent claims, in the following description and in the attached drawings.

According to a first aspect of a first concept, there is provided a laminated wood product for use as a construction element, comprising a plurality of adjacent wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces. The lamellae are glued together side surface to side surface, such that major base surfaces of immediately adjacent lamellae face opposite directions. The major base surfaces define respective major surfaces of the wood product. A thickness of the wood product, as seen in a direction perpendicular to the major surfaces, is about 6-30 cm, preferably 8-26 cm.

A laminated wood product as described above can be used as a wall, roof, floor or ceiling element, making optimum use of the portions of the wood

having the highest strength while at the same time minimizing waste of material.

The lamellae may present year rings, wherein year rings at the major base surface have a greater bending radius than year rings at the minor base surface.

An edge portion of the wood product may present means for mechanically connecting the wood product in at least one direction to another identical wood product.

The edge portion may be the long side edge portion (parallel with the longitudinal direction of the wood lamellae) and/or the short side edge portion, which may be perpendicular to the long side edge portion.

The connecting means may comprise at least one of a tongue and/or a groove extending substantially parallel with the base surfaces for providing a mechanical connection in a direction perpendicular to the base surfaces, and locking member extending substantially perpendicular to the base surfaces for providing a mechanical connection in a direction parallel with the base surfaces and perpendicular to the longitudinal direction.

Hence, mechanical locking may be provided for preventing adjacent laminated wood products from separating in an out-of-plane direction (typically vertically, when used as floor or ceiling element) and/or in an in-plane direction (typically horizontally).

Major and minor base surfaces, which may be provided by a pair of immediately adjacent lamellae, and which face the same direction, may be situated in a common plane.

Such a laminated wood product may present smooth, planar principal surfaces.

At least some major and minor base surfaces, which are provided by a pair of immediately adjacent lamellae, and which face the same direction, may be situated in spaced apart planes.

Such laminated wood products may present an enhanced ratio of height and/or stiffness to weight.

The base surfaces may taper along said longitudinal direction.

Such lamellae provide optimal use of the raw material.

Alternatively, the base surfaces may present a substantially constant width along the longitudinal direction.

Such lamellae may be easier to produce, especially from a population of logs with varying diameter.

The wood lamellae may be glued together by means of a glue that is suitable for wet gluing, i.e. gluing at a moisture content of the wood lamellae greater than 25 % by dry mass, preferably greater than 30 % by dry mass.

After gluing the formed wood product may be dried. Thereby reducing the moisture content of the billet to 8-18 % by dry mass.

Wet gluing, e.g. using a urethane or polyurethane based glue, has proven to be an effective way of gluing together wood that has not been subjected to drying. While the drying process often causes some warping, which means that formatting of the dried wood pieces may be necessary prior to gluing, wet gluing will reduce the waste of material by making use of the format achieved in the sawing of the log when producing the billet.

The lamellae which are glued together may be surface dried lamellae. Prior to gluing the lamellae may be surface dried to remove free water from the wood surface. Such surface drying basically has no effect except for on the very surface of the wood lamellae, and may be performed e.g. by means of a fan.

According to a second aspect, there may be provided an elongate laminated wood product, comprising at least two laminated wood products as described above, which are joined together in an end-to-end manner, preferably by means of a finger joint.

The elongate laminated wood product may comprise at least two pairs of laminated wood products, which are joined together in an end-to-end manner by a respective joint, wherein said joints may be offset from each other in the longitudinal direction, preferably by 10-50 % of a length of the laminated wood products.

According to a third aspect, there is provided a method of making a laminated wood product for use as a ceiling or floor element having major

surfaces and a thickness as seen in a direction perpendicular to the major surfaces, of about 6-30 cm, preferably 8-26 cm. The method comprises providing a plurality of wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces, applying glue to the side surfaces, arranging the wood lamellae side surface to side surface (ss2), such that major base surfaces of immediately adjacent lamellae face opposite directions and the base surfaces define the respective major surfaces of the wood product, pressing the side surfaces towards each other for a sufficient time to bond the wood lamellae to each other to form a billet, and cutting the thus formed billet along a plane parallel with the longitudinal direction and perpendicular to the major surfaces to form a plank.

The step of applying glue may comprise applying glue suitable for wet gluing to the side surfaces of the wood lamellae while a moisture content of the wood lamellae being greater than 25 % by dry mass, preferably greater than 30 % by dry mass.

The method may further comprise subjecting the wood lamellae to a drying step prior to the application of glue.

The method may optionally comprise subjecting the wood lamellae to a surface drying step prior to the application of glue. Such surface drying removes free water from the wood surface and basically has no effect except for on the very surface of the wood lamellae, and may be performed e.g. by means of a fan.

The method may further comprise subjecting the billet to a drying step subsequent to the bonding. Thereby the moisture content of the billet may be reduced to 8-18 % by dry mass.

The method may further comprise forming locking means along at least one long side edge of the plank.

According to a fourth aspect, there is provided use of a laminated wood product as described above as a wall, roof, floor or ceiling element.

Such a wall, roof, floor or ceiling element may be a load bearing element.

According to a first aspect of a second concept, there is provided a beam, which is at least partially formed of wood-based material and which presents a longitudinal direction and a principal transverse load direction, perpendicular to the longitudinal direction.

A flange portion of the beam comprises a wood lamella, having a longitudinal direction which is substantially parallel with a principal fiber direction of the wood lamella, and a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces. As seen in the transverse load direction, the wood lamella is arranged such that its major base surface is closer to an outermost part of the beam than the minor base surface.

The “principal transverse load direction” may be defined as a direction in which the beam is intended to receive its main load. That is, a direction which is perpendicular to a longitudinal direction of the beam and typically also perpendicular to an upper surface of the beam. In the case when the beam has an elongate cross section, the principal load direction will typically be parallel with a major side of this cross section. For a beam that is positioned horizontally, the principal transverse load direction will be a vertical direction.

The terms “flange” and “web” are used herein in their ordinary senses in the field of load-bearing beams.

Such a beam will make optimum use of the natural strength of the wood, while reducing waste of material.

The beam may comprise a pair of wood lamellae, which form part of a respective flange and major base surfaces of which face opposite directions.

Hence, the beam may be designed to achieve maximum strength in both bending directions.

The wood lamellae may be connected to each other minor base surface to minor base surface.

Such a beam can be made from only two lamellae or extended lamellae and be formed to make maximum use of the strength of the wood in both bending directions.

The wood lamellae may be spaced apart by a generally planar web member, a major plane of which being parallel with the transverse load direction.

Such a beam will provide a greater moment of inertia and can be designed to readily replace existing engineered wood beams.

The web member may be joined to the flange portion by means of glued joint, preferably a glued finger joint.

The flange portion may be formed by a set comprising at least two wood lamellae, which are glued together side surface to side surface, such that major base surfaces of immediately adjacent lamellae face opposite directions.

Hence, the flange portion can be provided with any width while still making optimum use of the raw material and minimizing material waste.

The flange portion may be formed by at least two sets of wood lamellae, which sets are glued together base surface to base surface.

Hence, a flange portion providing very high bending stiffness may be provided.

The flange portion may be formed by a single wood lamella.

Such a beam may be compactly designed.

The beam may further comprise at least one elongate reinforcement element, which extends at an angle less than 45° to the principal transverse load direction.

The reinforcement element may extend through at least one of the flange portions.

According to a second aspect, there is provided a building element, comprising at least two beams as described above, which are identically oriented and spaced apart in a direction perpendicular to the longitudinal direction and to the transversal load direction, and a pair of face panels,

arranged on opposite sides of the beams as seen in the transversal load direction, such that the beams are sandwiched by the face panels.

Such a building element can be used as a floor element, a ceiling element or for any other load bearing surface.

At least one of the face panels may be formed by at least two elongate members, longitudinal directions of which extend non-parallel to the longitudinal directions of the beams, preferably approximately perpendicular to the longitudinal directions of the beams.

According to a third aspect, there is provided a method of making a beam, which is at least partially formed of wood-based material and which presents a longitudinal direction and a principal transverse load direction, perpendicular to the longitudinal direction, the method comprising providing at least two wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces, forming a flange portion of the beam by arranging said wood lamellae such that their minor base surfaces face each other, and directly or indirectly connecting the wood lamellae to each other.

The method may further comprise connecting the minor base surfaces directly to each other.

The method may further comprise providing a web member and connecting the web member to the wood lamellae, such that a major surface of the web member extends in parallel with the transversal load direction.

The method may further comprise providing a set comprising at least two wood lamellae, which are glued together side surface to side surface, such that major base surfaces of immediately adjacent lamellae of the set face opposite directions, and forming the flange portion from the set.

The method may further comprise gluing together at least two sets of wood lamellae base surface to base surface.

According to a first aspect of a third concept, there is provided a rib slab, comprising at least one panel presenting a first face, coinciding with a

main face of the rib slab, a plurality of elongate beams, which extend in parallel with, and spaced from, each other, and which are bonded to a second face of the panel. The beams are formed by wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces.

Such a rib slab can be produced with less waste of raw material and higher strength to weight ratio than existing wood based rib slabs.

The rib slab may further comprise a second panel, which is bonded to the beams, such that the beams are sandwiched between the panels.

The rib slab may further comprise a second plurality of elongate beams, which extend in parallel with, and spaced from, each other, and which are bonded to a second face of the second panel, and a third panel, which is bonded to the second plurality of beams, such that the second plurality of beams are sandwiched between the second and third panels.

In the rib slab, major base surfaces of adjacent beams may face opposite directions.

Alternatively, major base surfaces of adjacent beams may face the same direction.

The wood lamellae may be spaced apart by a distance corresponding to 10-300 % of a major base surface width, preferably 50-200 % or 50-100 %.

In particular wood lamellae which are closely spaced apart, say 10-100 % or 10-50 % of the width, may be used to provide noise attenuating properties.

According to a second aspect, there is provided a rib slab system comprising a pair of rib slabs described above, wherein at least two of the wood lamellae of each rib slab is bonded to its associated panel by its minor base surface, such that the wood lamellae provide a respective undercut edge, and wherein one of the rib slabs is suspended from the other one of the rib slabs by engagement of the undercut edges.

Such a rib slab may be used to attenuate impact sounds and reduce vertical propagation of such sounds.

In the rib slab system, the rib slabs may be connected mechanically to each other.

For example, the connection between the two rib slabs could be purely mechanical, that is without glue, which would allow the slabs to move slightly relative each other, with some hysteresis being provided in the joint area.

In the rib slab system a sound attenuating device may be arranged between surfaces forming said engagement.

Such a sound attenuating device may further reduce transfer of sound in the direction perpendicular to the rib slab system.

According to a third aspect, there is provided a method of making a rib slab, comprising providing at least one panel presenting a first face, coinciding with a main face of the rib slab, and bonding a plurality of elongate beams to a second face of the panel, such that they extend in parallel with, and spaced from, each other. The beams may be formed by wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces.

According to a first aspect of a fourth concept, there is provided a laminated wood board, presenting a principal plane, the board comprising a plurality of elongate wood lamellae, which are glued together along longitudinal planes, wherein at least some pairs of wood lamellae are glued together along a plane, which provides an angle of less than 30° to the principal plane, preferably less than 23° or less than 18°.

Such laminated wood boards provide great potential in that they make optimum use of the wood raw material, as mentioned above, but also in that they may be provided with relatively isotropic properties. That is, year rings can be a more even orientation over the entire surface of the board.

At least some pairs of wood lamellae may be glued together along a plane, which is substantially perpendicular to the principal plane.

The board may present a thickness in a direction perpendicular to the principal plane, a length in a longitudinal direction and a width in a direction perpendicular to the longitudinal direction. The thickness may be less than 1/10 of the width, preferably less than 1/20, less than 1/30, 1/40, 1/50 or 1/70 of the width.

Year rings exposed at a face which is perpendicular to the principal plane and to a principal fiber direction of the wood, may present a tangent, which at no portion of the face presents an angle smaller than 60° to the principal plane, preferably smaller than 40°, smaller than 40° or smaller than 20°.

Preferably, this will apply to substantially all year rings, such as at least 90 % of the year rings, preferably at least 95 % of the year rings or at least 99 % of the year rings.

According to a second aspect, there is provided a multi-layer laminated wood product, comprising at least two laminated wood products as described above, wherein the laminated wood products are laminated principal plane to principal plane.

Such a laminated wood product may achieve very good strength properties.

The laminated wood products may be arranged with their respective longitudinal directions in a non-parallel manner, preferably substantially perpendicular to each other.

The multi-layer laminated wood product may comprise at least three laminated wood products, which are arranged with alternating longitudinal directions.

In the multi-layer product, at least 90 %, preferably at least 95 % of year rings visible at a cross section of the product, perpendicular to the longitudinal direction of the lamellae, may present an angle to the principal plane, which is greater than 70°, preferably greater than 75°, greater than 77° or greater than 80°.

However, the angle will always be less than 90°

The multilayer laminated wood product may further comprise a layer which is formed of a plurality of adjacent wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces, wherein the lamellae are glued together side surface to side surface, such that major base surfaces of immediately adjacent lamellae face opposite directions.

Such a laminated wood product can be given very high strength in all directions.

According to a third aspect, there is provided a method of making a laminated wood product, comprising providing a billet formed of a plurality of adjacent wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces, wherein the lamellae are glued together side surface to side surface, such that major base surfaces of immediately adjacent lamellae face opposite directions, wherein the base surfaces define principal planes of the billet, cutting the billet along cutting planes which are substantially perpendicular to the principal plane of the billet and parallel with the longitudinal direction of the wood lamellae, such that planks are formed having major planes which are defined by the cutting planes, applying glue to longitudinal edges of the planks, pressing the planks together along a direction which is parallel with the major plane of the planks for a sufficient time to bond the wood lamellae to each other to form the laminated wood product.

According to a fourth aspect, there is provided a method of making a multi-layered laminated wood product, the method comprising laminating together at least two laminated wood products produced according to the method set forth above.

The laminated wood products may be arranged with fiber directions being non-parallel, preferably orthogonal.

The method may further comprise providing a second billet formed of a plurality of adjacent wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces, wherein the lamellae are glued together side surface to side surface, such that major base surfaces of immediately adjacent lamellae face opposite directions, wherein the base surfaces define principal planes of the second billet, laminating the laminated wood product to the second billet with its principal plane parallel to the principal plane of the second billet.

According to a first aspect of a fifth concept, there is provided a laminated wood product for use as a pillar or pylon, comprising a plurality of wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces, wherein the lamellae are glued together side surface to side surface, wherein the wood product comprises at least one first pair of adjacent wood lamellae, which are glued together side surface to side surface such that their major base surfaces face directions which form an angle of less than 90° to each other, less than 60° or less than 30°.

Such a wood product can be used to provide an elongate construction element which is adapted for receiving a load in a longitudinal direction. Such loads may be compressive and/or tensile.

The laminated wood product may comprise 3-15 wood lamellae which are glued together side surface to side surface such that major base surface of any adjacent pair of said wood lamellae face directions which form an angle of less than 90° to each other, less than 60° or less than 30°.

The laminated wood may comprise at least one second pair of adjacent wood lamellae, which are glued together side surface to side surface such that their major base surfaces face opposite directions.

The laminated wood product may present a generally facetted convex face, exposing more major base surfaces than minor base surfaces and a generally facetted concave face, exposing more minor base surfaces than major base surfaces.

In any of the methods disclosed above, a wood billet may be formed according to the following method, comprising: providing a half log having semi cylindrical cross section, cutting the half log along at least one radial cutting plane to form a wood lamella, planing pith and bark side portions of the wood lamella such that the wood lamella is formed into a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces, applying glue to the side surfaces, arranging the wood lamellae side surface to side surface, and pressing the sides surfaces towards each other for a sufficient time to bond the wood lamellae to each other to form a the laminated product.

In this method, the wood lamellae may be arranged such that major base surfaces of immediately adjacent lamellae face opposite directions and the base surfaces define the respective major surfaces of the wood product.

The method may further comprise cutting the thus formed billet along a plane parallel with the longitudinal direction and perpendicular to the major surfaces.

The method may further comprise subjecting the wood lamellae to a drying step prior to the application of glue.

The term “drying” is understood as deliberately subjecting the object to a controlled environment for a time sufficient for the object to attain a moisture level of below 30 % by dry mass, preferably below than 25 %.

The method may comprise a step of surface drying the wood lamellae prior to the application of glue. Such surface drying removes free water from the wood surface and basically has no effect except for on the very surface of the wood lamellae, and may be performed e.g. by means of a fan.

The method may further comprise subjecting the billet to a drying step subsequent to the bonding.

In the method, the bark side portion may be used as a reference surface for planing the pith side portion, such that the base surfaces thus provided taper along a longitudinal direction of the lamellae.

Alternatively, in the method, the pith side portion may be used as a reference surface for planing the bark side portion, such that the base surfaces thus provided are substantially rectangular.

According to one aspect there is provided a method of making a laminated wood product for use as a ceiling or floor element having major surfaces and a thickness as seen in a direction perpendicular to the major surfaces, of about 6-30 cm, preferably 8-26 cm. The method comprising providing a plurality of wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface, a minor base surface and a pair of opposing side surfaces, subjecting the wood lamellae to a surface drying step. The method further comprises steps of applying glue suitable for wet gluing to the side surfaces of the wood lamellae, a moisture content of the wood lamellae being greater than 25 % by dry mass, preferably greater than 30 % by dry mass, arranging the wood lamellae side surface to side surface, such that major base surfaces of immediately adjacent lamellae face opposite directions and the base surfaces define the respective major surfaces of the wood product, pressing the side surfaces towards each other for a sufficient time to bond the wood lamellae to each other to form a billet, subjecting the thus formed billet to a drying step, reducing the moisture content of the billet to 8-18 % by dry mass, and cutting the billet along a plane parallel with the longitudinal direction and perpendicular to the major surfaces to form a plank.

According to another aspect there is provided a method of forming a wood billet for use in the methods as described above, the method comprising the steps of providing a half log having semi cylindrical cross section, cutting the half log along at least one radial cutting plane to form at least two circle sector shaped radial sections, planing pith and bark side portions of the circle sector shaped sections such that wood lamellae are

formed each having a generally trapezoidal cross section having a height of at least 50 %, preferably at least 60 % or 70 %, of the circle sector radius, and having a major base surface, a minor base surface and a pair of opposing side surfaces, applying glue to the side surfaces, arranging the wood lamellae side surface to side surface, and pressing the sides surfaces towards each other for a sufficient time to bond the wood lamellae to each other to form a laminated product.

Brief Description of the Drawings

Figs 1a-1h schematically illustrate a method of making an intermediate product in the form of a billet.

Fig 2a is a schematic side view of a system for producing wood lamellae

Fig. 2b is a schematic sectional view taken along line A-A of Fig. 2a.

Figs 3a-3b schematically illustrate a billet formed according to an alternative method.

Figs 4a-4f schematically illustrate a method of making a construction element which is useful for making ceilings and/or floors.

Figs 5a-5d schematically illustrate an alternative method of making a construction element, which is useful for making ceilings and/or floors.

Figs 6a-6i schematically illustrate a method of making load bearing construction elements.

Figs 7a-7f schematically illustrate a method of making panels.

Figs 8a-8e schematically illustrates a method of making a single ply board.

Figs 9a-9b schematically illustrates a method of making a multi-ply board.

Figs 10a-10h schematically illustrates methods of making a pillar or an arcuate structure.

Detailed Description

The description will initially be directed to a new method of making a wood billet. This wood billet forms the starting material for making the

laminated wood product which will be described with reference to the subsequent drawings.

The machine concept is merely one example of a way of producing such lamellae, and is not intended to limit the scope of protection.

Fig. 1a schematically illustrates a log 2, which has been cut longitudinally into two halves 2'. The log 2 may have been debarked prior to this cutting. The cutting may be performed by any type of cutting device, such as, but not limited to, a saw, e.g. a circular saw or a band saw.

Fig. 1b schematically illustrates a log half 2' after it has been provided with a longitudinally extending groove 23 along its pith and cut longitudinally into six radial sections 2"a, 2"b, as will be further described with reference to Figs 2a-2b.Fig. 1c schematically illustrates processing of one of the radial sections 2"a, 2"b into a lamella 20a, 20b. The lamella 20a, 20b is subjected to forming of base surfaces bs1, bs2, to form a lamella 20a, 20b, which will present a trapezoidal cross section. As seen in Fig. 1c, the circle sector shaped radial sections 2´´a, 2´´b are sawn to lamellae 20a, 20b and planed at pith and bark side portions of the circle sector shaped radial sections such that wood lamellae are formed each having a trapezoidal cross section having a height of at least 50 %, preferably at least 60 % or 70 %, of the circle sector radius.The base surfaces bs1, bs2 thus formed comprise a major base surface bs1, which is formed by tool 31 closest to the bark of the log and along the bark side. The base surfaces further comprise a minor base surface bs2, which is formed close to the pith and parallel with the major base surface bs1 by tool 32. The tools 31, 32 may be any type of tool capable of forming a planar surface, including but not limited to milling cutters, circular saw blades or band saw blades.

The first tool 31, which forms the major base surface bs1, is arranged to use the bark side as reference, such that the major base side bs1 is formed along a direction parallel with the bark side.

The second tool 32, which forms the minor base surface bs2, is arranged to use the major base surface and/or the bark side as a reference,

such that the minor base surface bs2 is formed along a direction parallel with the major surface and/or the bark side.

The cross section of the lamellae 20a, 20b is trapezoidal having a constant height. With the major base surface bs1 being formed substantially parallel with the bark, and with the log presenting a frusto-conical shape, it is recognized that the major base surface bs1 will taper along the central direction of the log C. That is, the log will taper in a direction towards the top of the tree from which it was formed. This direction is also parallel with the principal fiber direction of the log and of the wood lamellae.

Moreover, the minor base surface bs2 will also taper along the central direction C of the log.

The fact that the radius of the log would also diminish towards the top of the tree from which it was formed, implies that while the amount of material removed at the bark side, by tool 31, in the forming of the major base sides bs1 will be substantially constant along the length of the lamella 20a, 20b, as seen in the radial direction.

However, the amount of material removed at the pith side, by tool 32, will diminish towards as seen in the direction towards the top of the tree from which the lamella 20a, 20b was formed.

Referring to Fig. 1d, after the lamellae 20a, 20b have been formed, each lamella will have a major and a minor base surface bs1, bs2 and a pair of side surfaces ss1, ss2, which will be identical.

Referring to Fig. 1e, every second lamella 20b will now be turned or flipped about 180° about its longitudinal axis and about 180° about an axis perpendicular to the longitudinal axis and perpendicular to the major base surface bs1, such that the lamellae will become positioned as illustrated in Fig. 1e. That is, the directions of taper Ca and Cb will extend in opposite directions.

At this point, the base surfaces of every pair of adjacent wood lamellae 20a, 20b will taper towards substantially opposite directions. Moreover, major base surfaces bs1 of every pair of adjacent wood lamellae will face

substantially opposite directions, i.e. one upwards in Fig. 1e and the other one downwards in Fig. 1e.

At this point, the wood may still be “wet”, that is, its moisture content may be more than 25 % by dry mass, preferably more than 30 %. Hence, the wood has not been subjected to any accelerated or intentional drying, such as kiln drying. When wet gluing, i.e. gluing performed at a moisture content of the wood lamellae greater than 25 % by dry mass, preferably greater than 30 % by dry mass, it is recommended to reduce the amount of free water on the wood surface to a minimum. Hence, a brief surface drying step, basically having no effect except for on the very surface, may be performed, e.g. by means of a fan. Fig. 1f schematically illustrates the two lamellae 20a, 20b when arranged adjacent each other, side surface ss1 to side surface ss2 and with base surfaces bs1, bs2 of the pair of thus adjacent lamellae 20a, 20b tapering in opposite directions.

Referring to Fig. 1g, there is illustrated a pair of glue applicators 33a, 33b, which apply glue to side surfaces of lamellae 20a, 20b, respectively. A single, or even more, glue applicators may be used.

The lamellae are then arranged as illustrated in Fig. 1g, i.e. with the base surfaces bs1, bs2 of every pair of adjacent wood lamellae 20a, 20b tapering towards substantially opposite directions and major base surfaces bs1 of every pair of adjacent wood lamellae facing substantially opposite directions.

The glue used is a glue adapted for wet gluing wood, such as a water activated glue. One example of such glue is a polyurethane (PU) based glue.

The lamellae 20a, 20b will be subjected to a pressing tool 34 pressing the lamellae 20a, 20b together in directions perpendicular to the base surfaces 20a, 20b and/or parallel with base surfaces 20a, 20b and perpendicular to the longitudinal axes C.

Depending on the design of the pressing equipment, the billet 200 that is formed may be of a predetermined length or it may be continuous in a direction perpendicular to the lamellae fiber direction and parallel with the base surfaces bs1, bs2, that is, lamellae are added to one end of the billet

and fed into the press while at the output side of the press, pieces of the billet 200 are sawn off at predetermined intervals.

As illustrated in Fig. 1h, after the gluing process, an intermediate wood product, here referred to as a "billet" 200 is provided, made up of wood lamellae 20a, 20b glued together first side surface ss1 to first side surface ss1 and second side surface ss2 to second side surface ss2.

After the gluing step, the billet 200 formed may be dried reducing the moisture content of the billet to 8-18 % by dry mass.

In the illustrated example, the billet 200 consists of a single layer of lamellae 20a, 20b, which are arranged side surface to side surface and with major base surfaces bs1 of immediately adjacent lamellae facing opposite directions and with base surfaces bs1, bs2 of immediately adjacent lamellae tapering in width in opposite directions.

It is noted that an alternative billet may be produced from logs which are sawn according to Figs 1a-1b and wherein the lamellae are formed with the pith side as a reference. Such lamellae may have constant cross section, such that base surfaces will be rectangular rather than tapering in width.

Fig. 2a is a schematic side view of a device 300 for producing wood lamellae 20a, 20b from a half-log 2'. The device comprises a groove cutter 311 and a set 312 of radial cutters 321a, 321b, 321c, 321d and 321e. Moreover, the device 300 may comprise a conveyor arrangement 300a, 300b, 300c for causing relative movement between the log and the cutters 311, 312. Typically, the log may be moved relative to stationary cutters 311, 312. However, it is also possible to provide cutters 311, 312, which are capable of moving along the length of the half-log 2'.

The half log 2' has typically been longitudinally cut in half prior to being introduced into the device 300. That is, the log has been cut longitudinally along a plane containing a central axis C of the log. The log may have been pre-cut into an appropriate length, such as 1-10 m, preferably 1-5 m, 1-3 m or 1-2 m. Moreover, the log may have been wholly or partially debarked. Hence, the log can be said to present a planar surface 22 and a convex surface 21.

For practical reasons, the log may be conveyed with its planar surface facing downwardly and oriented horizontally.

Fig. 2b is a cross sectional view taken along line A-A in Fig. 2a. In Fig. 2b, it is illustrated how the groove cutter 311 provides a longitudinal groove at the central portion of the log, i.e. at the pith area.

The groove cutter 311 may be formed as a circular, rotatable cutter having a cutting edge with a cross section that corresponds to a desired cross section of the groove 23.

The groove 23 formed by the groove cutter 311 may presents a substantially concave surface, which may be substantially half circular, or which may be polygonal.

The groove cutter 311 may extend upwardly from a support on which the log is to be supported with its planar surface 22 facing downwardly.

Figs 3a-3b illustrate an alternative way of forming a billet.

Referring to Figs 3a-3b, it is noted that lamellae 25a, 25b may also be formed using the pith side as a reference, in which case a constant cross section may be achieved and the base surfaces will be substantially rectangular, without taper.

The lamellae may be glued together when in the wet state, as described above, or in a dry state, potentially subsequent to a forming operation, such as planing.

As illustrated in Fig. 3a, such lamellae may be individually joined by joints J1, which may be finger joints or the like, so as to provide extended lamellae 26a, 26b, which each is made up of a plurality of lamellae 25a; 25b.

As illustrated in Fig. 3b, such lamellae 25a, 25b or extended lamellae 26a, 26b may be used to form a billet 260, which is similar to the billet 200 previously discussed.

This billet 260 may be provided with reinforcements R1, which may extend perpendicular to the longitudinal direction of the lamellae and in parallel with the principal surface.

Such reinforcements R1 may be provided by a rod made of wood or polymer material, that is, preferably a material which can be sawn without

causing damage to the sawing equipment. The reinforcement may be bonded to the structure by glue. It is also possible to make the reinforcement from a metallic material.

Such reinforcements may be useful and optional for any type of billet described herein.

Referring to Figs 4a-5d, the description will now focus on a construction element and a method of its fabrication. Such construction elements may be used as a floor or ceiling element, or as a wall or roof element. Yet another use may be as a noise reduction wall.

Fig. 4a schematically illustrates a billet 200, which may be the result of the process described with reference to Figs 1a-1h.

Such a billet, when formed to a suitable thickness, may be used as a ceiling or floor element. Typical thicknesses for such floor or ceiling elements may be on the order of 50-300 mm. Particular thicknesses may be 80, 100, 120, 140, 160, 180, 200, 220, 240 or 260 mm, with a tolerance of +/- 5 %, preferably +/- 2 %, +/- 1 % or +/- 0.5 %.

The billet may have a width which may be on the order of 50-150 cm. For example, the billet may be produced to provide a standard width, such as 62 cm or 62.5 cm. the billet may also be produced with a width forming a multiple (x2, x3, x4, etc) of such a standard width. Preferably, the width may be on the order of 50-100 cm, e.g. 60-80 cm.

The billet may be produced to any length. Typical lengths for elements of the present type may be up to 15 m. Lengths may vary from 2-15 m, preferably 3-15 m, 3-10 m, 5-15 m or 5-10 m. Referring to Fig. 4b, in order to provide a construction element 260, such as a floor or ceiling element, having a desired length, billets 261 may be joined by means of any type of joint J2, such as a finger joint, in a per se known manner. Many different types of finger joints are known. The fingers of the joint may extend in any direction, including parallel with the principal plane of the billet or orthogonal to the principal plane of the billet. Referring to Fig. 4c, the billet 261' or construction elements 260' may be provided with mechanical locking devices J3a, J3b for

providing mechanical interconnection between identical floor or ceiling elements.

As illustrated, such mechanical locking devices J3a, J3b may provide mechanical connection in a direction perpendicular to the principal plane of the floor or ceiling element.

Moreover, such mechanical locking devices may give room for such shrinkage and/or swelling as occurs as a consequence of variations in humidity and temperature.

The locking devices prevent the formation of gaps (or at least visible gaps) between elements, thus enhancing appearance and preventing draft or spreading of fire.

In the particular example, the locking devices J3a, J3b comprise a tongue and groove joint (the function of which is known per se), which here includes a pair of tongues and a matching pair of grooves. It is recognized that other types of locking devices for providing mechanical interconnection perpendicular to and/or parallel with the principal plane can be provided. Inspiration for such locking devices may be found in the field of mechanically interconnectable floor panels.

In the particular example, the mechanical locking devices J3a, J3b extend along long side edges of the floor or ceiling element, i.e. substantially parallel with a principal fiber direction of the wood lamellae making up the billet(s).

It is conceivable to also provide mechanical locking devices on short side edges of the floor or ceiling elements. Such short side mechanical locking devices may be identical with, or different from, the ones provided on the long sides.

Moreover, it is conceivable also to provide mechanical interconnection in a direction perpendicular to the joint edge, i.e. typically horizontally when the panel is used as a floor or ceiling element. Hence, adjacent panels can be prevented from separating horizontally from each other. As is known in the flooring industry, it may be desirable to provide a stronger such horizontal joint on short side edges than on long side edges.

Fig. 4d illustrates, in cross section, a pair of interconnected floor construction elements of the kind described in Fig. 4c.

Glue may, but need not, be applied to the locking device(s) before the floor or ceiling elements are joined by a horizontal movement whereby the tongue is driven into the groove.

Fig. 4e schematically illustrates an alternative mechanical locking device, which is based on the floor or ceiling elements being formed with grooves J3a on both long sides, wherein a separate tongue J3c is inserted into the grooves and the floor or ceiling elements are interconnected as described with respect to Fig. 4d.

The separate tongue may be formed of a wood material, which may be the same or different from that of which the floor or ceiling elements are formed. For example, it is possible to use a wood material having better strength properties. Alternatively, the separate tongue may be formed of a polymer material, a wood based material (MDF, HDF, particle board, chip board, plywood) or even a metallic material.

Fig. 4f schematically illustrates a construction element 280 which has been formed from a plurality of elongate planks 260, which are formed from planks 261 that are joined in an end-to end manner, just like illustrated in Fig. 4b, by means of a joint J2, which may be a finger joint or the like.

In Fig. 4f, however, at least two such elongate planks 260 are joined along a plane that is parallel with the longitudinal direction and perpendicular to the principal plane.

Moreover, joints J2, such as finger joints, of immediately juxtaposed elongate planks 260 are offset relative one another in the longitudinal direction. The offset may correspond to 5-50 % of a length of the planks 261, preferably 10-30 % of said length.

Such a construction element 280 may present enhanced strength as compared to the ones illustrated in Fig. 4b.

Figs 5a-5d schematically illustrate another embodiment of a construction element, such as a floor or ceiling element 270.

As is shown in Fig. 5a, the billet is formed differently from that of Fig. 4a in that adjacent lamellae 25a, 25b are slightly offset in a direction perpendicular to the principal plane of the floor or ceiling element 270.

For example, the lamellae 25a, 25b may be offset by a distance corresponding to 1-50 % of the lamellae height, preferably 5-30 % or 10-20 %.

Hence, the construction elements 270, 271 thus formed will not have a smooth upper surface but one with grooves. Such grooves may, but need not, be filled with a filler, e.g. an expanding/foaming filler.

As illustrated in Figs 5b-5d, this billet formed into elongate construction elements 271' by cutting cuts S3, lengthwise joining J4 and forming of mechanical locking devices J5 just like the one illustrated in Fig. 4a.

Offset arrangements such as illustrated in Fig. 4f is also possible.

Referring to Figs 6a-6f, the description will now focus on a beam and a method of its fabrication.

Fig. 6a schematically illustrates an I- or H-beam 500, the flange portion 502, 503 of which is formed from a billet of the type disclosed in Fig. 1h. The web portion 501 of this beam may be formed by any type of sheet shaped material, such as wood material, wood based material, polymer material (including reinforced/composite polymer material) or even metallic material.

The beam illustrated in Fig. 6a thus comprises a pair of flange portions 502, 503 including a plurality of adjacent wood lamellae 20a, 20b, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface bs1, a minor base surface bs2 and a pair of opposing side surfaces ss1, ss2. In the flange portion, the lamellae are glued together side surface ss1 to side surface ss2, such that major base surfaces bs1 of immediately adjacent lamellae face opposite directions. The major base surfaces bs1 define respective major surfaces of the flange portion.

The web portion may be connected to the flange portion by means of glue. Optionally, a mechanical connection may be provided, including a

tongue and groove joint, a finger joint (extending along a length direction of the beam), a plurality of fasteners, such as wood plugs, polymer plugs, nails or screws.

It is noted that the beam 500 may be designed with only one flange 502, 503 portion and that other beam configurations may be provided, including L-beams and W-beams.

It is noted that the beam 500 of Fig. 6a may be formed from a billet provided from lamella having tapering (lamellae 20a, 20b) or rectangular (lamellae 25a, 25b) base surfaces.

The beam 510 illustrated in Fig. 6b is formed with each flange portion 512, 513 provided from a single wood lamella having a longitudinal direction which is substantially parallel with a principal fiber direction of the wood lamella, and a generally trapezoidal cross section providing a major base surface bs1, a minor base surface bs2 and a pair of opposing side surfaces ss1, ss2.

The flange portions 512, 513 may be attached to the web portion 511 in the same manner as disclosed with respect to Fig. 6a.

In this embodiment, it is preferred that the wood lamellae present rectangular base surfaces.

The beam 520 illustrated in Fig. 6c is formed with only flange portions 522, 523 according to the same principle as the one in Fig. 6b, but with no separate web portion.

Instead, the tapering cross section of the lamellae provides the narrower “web-like” portion of the beam in Fig. 6b.

The interconnection of the lamellae may be provided according to the same principles as for the connection to the web in Figs 6a and 6b.

In this embodiment, it is preferred that the wood lamellae present rectangular base surfaces.

The beam 530 illustrated in Fig. 6d is very similar to the one disclosed in Fig. 6a, but with each flange portion 532, 533 formed of three adjacent wood lamellae 20a, 20b, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood

lamella, and a generally trapezoidal cross section providing a major base surface bs1, a minor base surface bs2 and a pair of opposing side surfaces ss1, ss2. In the flange portion, the lamellae are glued together side surface ss1 to side surface ss2, such that major base surfaces bs1 of immediately adjacent lamellae face opposite directions. The major base surfaces bs1 define respective major surfaces of the flange portion.

The flange portions 532, 533 present a width that tapers towards the web, which is a consequence of the fact that the two outer lamellae are arranged with their major base surfaces facing away from the web portion, while the major base surface of the respective middle lamella faces, and is connected to, the web portion.

The flange portions 532, 533 may be attached to the web portion 531 in the same manner as disclosed with respect to Fig. 6a.

Fig. 6e schematically illustrates a beam which is very similar to that of Fig. 6d, but where the flange portion is provided from at least two layers of adjacent wood lamellae 20a, 20b, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface bs1, a minor base surface bs2 and a pair of opposing side surfaces ss1, ss2. In the flange portion, the lamellae are glued together side surface ss1 to side surface ss2, such that major base surfaces bs1 of immediately adjacent lamellae face opposite directions. The layers are connected to each other base surface to base surface. The connection may be provided by glue or in the same manner as disclosed with respect to Fig. 6a regarding the attachment of the flange portion to the web portion.

The flange portions 542, 543 present a width that tapers towards the web, which is a consequence of the fact that the two outer lamellae are arranged with their major base surfaces facing away from the web portion, while the major base surface of the respective middle lamella faces, and is connected to, the web portion 541.

The flange portions 542, 543 may be attached to the web portion 541 in the same manner as disclosed with respect to Fig. 6a.

It is noted that an arbitrary number of layers may be provided for each flange portion.

Fig. 6f discloses a sandwich construction 550, wherein a number of beams 552, 553, which can be formed as disclosed with reference to any one of Figs 6a-6e, are sandwiched between a pair of boards 554, 555.

The boards 554, 555 may be provided from any type of board material, including wood material, wood based material, polymer material (including reinforced/composite polymer material) or even metallic material.

In particular, the boards may be formed from the single-ply or multi-ply materials that are discussed with respect to Figs 1h, 4a-4e, 5a-5d, 8a-8d or 9a-9b.

The beam portion(s) may be connected to the board by glue and/or by means of mechanical fastening devices, including tongue-and-groove or finger type joints, wood plugs, fasteners (screws, nails) etc.

Fig. 6g-6h schematically illustrate a reinforced beam 560, 560', comprising a reinforcement element 565, which extends at an angle less than 45° to the principal transverse load direction. Preferably, the reinforcement elements extends at an angle less than 30°, less than 20°, less than 10° or about parallel with the principal transverse load direction.

The reinforcement element may extend at least partially through at least one of the flange portions, preferably at least partially through both. Moreover, where the beam presents a web portion, the reinforcement element may extend through this web portion as well.

The reinforcement element may be formed of wood or polymer material, that is, preferably a material which can be sawn without causing damage to the sawing equipment. Preferably, the reinforcement may be formed of a wood material having greater strength than the wood from which the beam is formed.

The reinforcement may be bonded to the structure by glue. It is also possible to make the reinforcement from a metallic material.

It is possible to provide a plurality of reinforcement elements along the length of a beam. For example it may be possible to provide 1-10 reinforcement elements per meter in length.

Each reinforcement element 565 may have a diameter of about 5-50 mm, preferably about 15-40 or about 20-30 mm. A length of the reinforcement element may be on the order of 70-100 % of a thickness of the beam as seen in a direction of insertion of the reinforcement element.

Referring to Fig. 6g, a joint 566 between the flange portions 562, 563 may be have the form of a finger joint, having fingers with a height corresponding to 10-50 % of a height of the flange portion 562, 563, preferably about 15-30 %.

Referring to Fig. 6h, side portions of the flange portions may be cut away so as to provide side surfaces 5621, 5631, which are substantially flat and substantially perpendicular to the principal load bearing surface of the beam.

Referring to Fig. 6i a plurality of beams 560' such as the one illustrated in Fig. 6h may be arranged side by side with side surfaces 5621, 5631 contacting each other, in a juxtaposed manner and joined to each other, e.g. by glue, such that a slab like structure 570 is formed.

Reinforcement elements such as described with respect to Figs 6g-6i may be used with any of the beams disclosed with respect ot Figs 6a-6f.

Referring to Figs 7a-7f, the description will now focus on a rib slab 600, 620, 630, 630', 640 and on a method of its fabrication. A rib slab is essentially a light weight construction element intended for providing a floor or a ceiling. That is, the construction element is light weight in the sense that it is a composite structure formed of a board and a plurality of reinforcing elements in such a way that the structure will provide voids, thus reducing weight.

In Fig. 7a, there is illustrated a basic version of a rib slab 600, comprising a panel portion 601 and a plurality of rib portions 602, 603.

The panel portion 601 may be provided from any type of board material, including wood material, wood based material, polymer material (including reinforced/composite polymer material) or even metallic material.

In particular, the panel portion 601 may be formed from the single-ply or multi-ply materials that are discussed with respect to Figs 1h, 4a-4e, 5a-5d, 8a-8d or 9a-9b.

The rib portions 602, 603 may be provided from wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the wood lamella, and a generally trapezoidal cross section providing a major base surface bs1, a minor base surface bs2 and a pair of opposing side surfaces ss1, ss2.

The rib portions 602, 603 may be arranged to extend substantially parallel to each other and laterally spaced apart. The lateral spacing may be determined based on the strength requirement of the respective rib slab.

Typical spacing may be on the order of 1-5 times a width of the major base surfaces of the lamellae, preferably 1-2 times.

The panel portion 601 may be connected to the rib portions by means of glue. Optionally, a mechanical connection may be provided, including a tongue and groove joint, a finger joint (extending along a length direction of the beam), a plurality of fasteners, such as wood plugs, polymer plugs, nails or screws.

The rib portions 602, 603 may be connected to the panel portion by their major base surfaces bs1 or by their minor base surfaces bs2.

As an alternative, the rib portions 602, 603 may be connected to the panel portion alternatingly by major base surfaces bs1 and minor base surfaces bs2.

Fig. 7b schematically illustrates a rib slab 610 which may be formed just like the one in Fig. 7a, but with a pair of panel portions 601, 604 sandwiching the rib portions 602, 603. The forming of the rib slab in Fig. 7a may be the first step of forming the rib slab of Fig. 7b.

Fig. 7c schematically illustrates a rib slab 620 comprising three panel portions 601, 604, 605 and two layers of rib portions 602, 603; 612, 613, wherein rib portions and panel portions are arranged alternatingly, as seen in a direction perpendicular to the principal face of the rib slab. Forming of the

rib slab 600, 610 as illustrated in Figs 7a and/or Fig. 7b may be the first step or steps in the forming of the rib slab of Fig. 7c.

Fig. 7d schematically illustrates a rib slab 630, comprising an upper part 601, 602, 603 which is formed like the one illustrated in Fig. 7a, and a lower part 632, 633, which is suspended from the upper part 601, 602, 603. The lower part 631, 632, 633 may also comprise a panel portion 633 and a rib portion 632. The panel portion 633 may be formed of any of the materials previously discussed for panel portions.

The rib portion 632 may be formed by a plurality of lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the wood lamella, and a generally trapezoidal cross section providing a major base surface bs1, a minor base surface bs2 and a pair of opposing side surfaces ss1, ss2.

In the lower part 631, 632, 633, at least some lamellae are connected to the panel portion by their minor base surfaces bs2, such that the lamellae provide undercut edges.

These lamellae may be positioned such that their undercut edges can engage correspondingly arranged undercut edges of rib portions 603 of the upper part, such that the lower part is suspended from the upper part.

In particular, a pair of adjacent lamellae 631, 632 at the lower portion may be arranged such that their respective undercut edges engage a respective undercut edge of a rib of the upper part. That is, a rib which is connected to the panel portion of the upper part by its minor base surface.

The connection between the upper and lower portions may be entirely mechanical, i.e. without glue.

Such a rib slab 630 can be used to reduce impact sound and other sounds which would be transmitted through coupling, for example through a ceiling. In particular it may reduce propagation of impact noise in the vertical direction, past the rib slab, such as between floors of a building.

Fig. 7e schematically illustrates a rib slab 640 which is formed according to the principles set forth above, but with a higher density of rib portions 641, which are laterally spaced with a distance (at the lamella major

base surface) which is less than the width of the lamella major base surface, preferably on the order of 10-90 % of the width of the lamella major base surface.

Such a rib slab 640 can be used to reduce noise, especially in the space below the rib slab and in particular reverberation-related noise. Hence, it may be used to provide a noise attenuating, yet decorative, ceiling.

Fig. 7f schematically illustrates a rib slab 630', which is similar to the one disclosed in Fig. 7d, but wherein a sound attenuating device 635 is arranged between contact surfaces between the beams 602 and 631, 632.

This sound attenuating device 635 may extend over all or part of the contact surfaces (i.e. the surfaces that would have contacted each other but for the sound attenuating device 635).

The sound attenuating device may be formed of a material having reduced sound coupling properties as compared to the material from which the beams are formed. For example, the sound attenuating device may be formed of a rubber elastic material, such as rubber, thermoplastic elastomer, polyurethane, combinations thereof, or the like. As other options, the sound attenuating device may comprise an expanded polymer material, a wood fiber material (including pulp based materials), a 2D or 3D woven or nonwoven material, or a soft natural material, such as leather, sponge, or the like.

Hence, the sound attenuating device may be a separate part, which is arranged between and optionally adhered to the beams.

As another alternative, the sound attenuating device may be formed in situ, e.g. by means of extrusion of a cooling, hardening, setting, cross-linking and/or foaming composition

Figs 8a-8e schematically illustrate a method of forming a board material from a billet, such as the one disclosed in Fig. 1h.

Referring to Fig. 8a, the starting material is, as mentioned, a billet 200, which is formed of a plurality of adjacent wood lamellae 20a, 20b, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface bs1, a minor base surface bs2

and a pair of opposing side surfaces ss1, ss2. In the billet, the lamellae are glued together side surface ss1 to side surface ss2, such that major base surfaces bs1 of immediately adjacent lamellae face opposite directions. The major base surfaces bs1 define respective major surfaces of the billet.

Alternatively, the billet 260 as disclosed with respect to Figs 3a-3b may be used.

Referring to Fig. 8b, the billet 200 is sawn up by cuts S4 which are preferably perpendicular to the major surface of the billet and parallel with the longitudinal direction of the lamellae, thus providing a plurality of planks 701 having a width corresponding to a thickness of the billet 200.

Referring to Fig. 8c, after the sawing, the planks 701 may be subjected to a drying step.

Optionally, the planks 701 may then be formatted, such as planed.

Referring to Fig. 8d, glue may then be applied to long side edges of the planks by means of a glue applicator 710, after which the planks 701 are glued together long side to long side, such that major surfaces of the planks define a major surface of the board.

At this point, the planks 701 may be subjected to pressing perpendicularly to the longitudinal edges by means of a press 711. That is, the longitudinal edges which are glued together are also pressed together. Optionally, the planks may also be subjected to pressing in a direction perpendicular to the major surfaces.

Referring to Fig. 8e, the board 700 thus formed may be sawn up into panels 702 of a desired shape and size by means of a saw 712.

These panels 702 may then be used, for example in providing panels or boards for use in any of the products (e.g. rib slab, glulam beams, ceiling or floor elements, etc.) discussed above, or as a general board material.

Referring to Fig. 9a, a plurality of such panels 702 may be laminated major surface to major surfaces to form a multi-ply board 703 comprising two, three, or more, layers. Typically, the number of layers may be an uneven number, such as 1, 3, 5, 7 etc. Adjacent panels 702 may be arranged with

their principal fiber directions in a non-parallel manner, such as, but not limited to, perpendicular to each other.

Referring to Fig. 9b, the panels 702 thus formed may, alternatively or as a complement, be laminated to a billet 200, 260, such as the one disclosed in Fig. 1h or 3b. For example, a pair of panels 702 may sandwich the billet 200, 260. In such an embodiment, the panels 702 may be arranged with their principal fiber directions being substantially parallel, while the principal fiber direction of the billet 200, 260 may be non-parallel with those of the panels, e.g. perpendicular.

Referring to Figs 10a-10h, the description will now be directed to a method of making a pillar or beam 820, 830, 840, 850, 860 adapted for receiving a load in its longitudinal, or axial, direction. Such products may potentially be used as columns, pillars, pylons, poles, pipes, tubes or barrels.

Fig. 10a illustrates a billet 200, 260 such as the one disclosed in Fig. 1h or 3b, that is, a billet, which is formed of a plurality of adjacent wood lamellae 20a, 20b, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface bs1, a minor base surface bs2 and a pair of opposing side surfaces ss1, ss2. In the billet, the lamellae are glued together side surface ss1 to side surface ss2, such that major base surfaces bs1 of immediately adjacent lamellae face opposite directions. The major base surfaces bs1 define respective major surfaces of the billet.

As illustrated in Fig. 10b, the billet 200 may be sawn along a plurality of cuts S6, S7, which are parallel with a principal fiber direction of the lamellae, and which are perpendicular or non-perpendicular to the major surface of the billet, depending on which parts are being formed and for which type of structure. Hence, a plurality of elements 800 are formed, each of which being made up of more than one of the lamellae. The elements 800 may be provided with joint portions to form joinable elements 800'.

As illustrated in Fig. 10c, such joinable elements 800' may be joined together by joints J6, short end to short end, for example by finger jointing, thus forming an elongate element 810.

As illustrated in Fig. 10d, a plurality of such elongate elements 810 may be connected long side to long side to form a pillar 820. In the example of Fig. 10d, 12 such elongate elements 810 have been joined together by gluing and optionally additional mechanical fasteners.

The structure thus formed presents a polygonal cross section with facetted inner and outer faces.

It is recognized that the structure may be subjected to milling, lathing or grinding to provide a desired final shape thereof, such as circular. Provided that sufficient material thickness is provided, other shapes, such as barrel shapes may be provided, should the structure be used as a column.

Referring to Fig. 10e, there is disclosed an alternative design for providing a 12-sided pillar or column 830. The mutually identical elongate elements 831 from which this pillar or column is made up may be provided either according to the method disclosed in Figs 10a-10c, or according to the method disclosed with reference to Fig. 3a-3b, that is individual lamellae which are joined together end to end, e.g. by finger jointing.

Figs 10f-10h schematically illustrate the freedom of design provided by the present concept.

Thus, tube cross sectional shapes may be provided which are symmetric about e.g. a vertical plane through a centre of gravity of the tube.

As another option, tube cross sectional shapes may be provided which are asymmetric about such a vertical plane.

In Fig. 10f, a 12 sided pillar or column 840 having an approximately rectangular cross section is provided by a combination of elongate elements 831, 810, or by a combination of elongate elements, billets and extended lamellae.

In Fig. 10g, a 12 sided pillar or column 850 having an approximately triangular cross section is provided, also by a combination of elongate

elements 831, 200, or by a combination of elongate elements, billets and extended lamellae.

In Fig. 10h, an arched or arcuate structure 860 is provided, also by a combination of elongate elements, or by a combination of elongate elements 861 (formed analogously with the elements 810), billets and extended lamellae.

Such arched structures may be used as ceiling or wall elements and may be formed with any symmetric or asymmetric curvature.

CLAIMS

1. A laminated wood product (260, 260', 261', 271, 271', 280) for use as a construction element, comprising:

a plurality of adjacent wood lamellae (20a, 20b), each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2),

wherein the lamellae are glued together side surface (ss1) to side surface (ss2), such that major base surfaces (bs1) of immediately adjacent lamellae face opposite directions,

wherein the major base surfaces (bs1) define respective major surfaces of the wood product, and

wherein a thickness of the wood product, as seen in a direction perpendicular to the major surfaces, is about 6-30 cm, preferably 8-26 cm.

2. The laminated wood product as claimed in claim 1, wherein the lamellae present year rings, and wherein year rings at the major base surface (bs1) have a greater bending radius than year rings at the minor base surface (bs2).

3. The laminated wood product as claimed in any one of the preceding claims, wherein an edge portion of the wood product presents means (J3a, J3b, J3c) for mechanically connecting the wood product in at least one direction to another identical wood product.

4. The laminated wood product as claimed in claim 3, wherein said connecting means comprise at least one of:

a tongue and/or a groove extending substantially parallel with the base surfaces for providing a mechanical connection in a direction perpendicular to the base surfaces, and

locking member extending substantially perpendicular to the base surfaces for providing a mechanical connection in a direction parallel with the base surfaces and perpendicular to the longitudinal direction.

5. The laminated wood product as claimed in any one of claims 1-4, wherein major (bs1) and minor (bs2) base surfaces, which are provided by a pair of immediately adjacent lamellae (20a, 20b, 25a, 25b), and which face the same direction, are situated in a common plane.

6. The laminated wood product as claimed in any one of claims 1-4, wherein major (bs1) and minor (bs2) base surfaces, which are provided by a pair of immediately adjacent lamellae (20a, 20b, 25a, 25b), and which face the same direction, are situated in spaced apart planes.

7. The laminated wood product as claimed in any one of claims 1-6, wherein the base surfaces (bs1, bs2) taper along said longitudinal direction.

8. The laminated wood product as claimed in any one of claims 1-6, wherein the base surfaces (bs1, bs2) present a substantially constant width along the longitudinal direction.

9. The laminated wood product as claimed in any one of claims 1-8, wherein the wood lamellae (20a, 20b, 25a, 25b) are glued together by means of a glue that is suitable for wet gluing, i.e. gluing at a moisture content of the wood lamellae greater than 25 % by dry mass, preferably greater than 30 % by dry mass, and optionally subsequently dried.

10. An elongate laminated wood product, comprising at least two laminated wood products as claimed in any one of the preceding claims, which are joined together in an end-to-end manner, preferably by means of a finger joint (J1, J2, J4).

11. The elongate laminated wood product as claimed in claim 10, comprising at least two pairs of laminated wood products, which are joined together in an end-to-end manner by a respective joint (J4), wherein said joints are offset from each other in the longitudinal direction, preferably by 10-50 % of a length of the laminated wood products.

12. A method of making a laminated wood product for use as a ceiling or floor element having major surfaces and a thickness as seen in a direction perpendicular to the major surfaces, of about 6-30 cm, preferably 8-26 cm, the method comprising:

providing a plurality of wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2),

applying glue to the side surfaces (ss1, ss2),

arranging the wood lamellae side surface (ss1) to side surface (ss2), such that major base surfaces (bs1) of immediately adjacent lamellae face opposite directions and the base surfaces (bs1, bs2) define the respective major surfaces of the wood product,

pressing the side surfaces towards each other for a sufficient time to bond the wood lamellae to each other to form a billet (200, 260), and

cutting the thus formed billet along a plane parallel with the longitudinal direction and perpendicular to the major surfaces to form a plank.

13. The method as claimed in claim 12, further comprising subjecting the wood lamellae to a drying step prior to the application of glue.

14. The method as claimed in claim 12, further comprising subjecting the billet (200, 260) to a drying step subsequent to the bonding.

15. The method as claimed in any one of claims 12-13, further

comprising forming locking means (J3a, J3b) along at least one long side edge of the plank.

16. Use of a laminated wood product as claimed in any one of claims 1-11 as a wall, roof, floor or ceiling element.

17. A beam (500, 510, 520, 530, 540, 560, 560', 570), which is at least partially formed of wood-based material and which presents a longitudinal direction and a principal transverse load direction, perpendicular to the longitudinal direction,

characterized in that

a flange portion (502, 503, 512, 513, 522, 523, 532, 533, 542, 543, 552, 553, 562, 563) of the beam comprises a wood lamella (20a, 20b), having a longitudinal direction which is substantially parallel with a principal fiber direction of the wood lamella, and a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2),

wherein, as seen in the transverse load direction, the wood lamella is arranged such that its major base surface (bs1) is closer to an outermost part of the beam than the minor base surface (bs1).

18. The beam as claimed in claim 17, wherein the beam comprises a pair of wood lamellae, which form part of a respective flange and major base surfaces of which face opposite directions.

19. The beam as claimed in claim 18, wherein the wood lamellae are connected to each other minor base surface to minor base surface.

20. The beam as claimed in claim 18, wherein the wood lamellae are spaced apart by a generally planar web member (501, 511, 531, 541), a major plane of which being parallel with the transverse load direction.

21. The beam as claimed in claim 20, wherein the web member is joined to the flange portion by means of glued joint, preferably a glued finger joint.

22. The beam as claimed in any one of claims 17-21, wherein the flange portion is formed by a set comprising at least two wood lamellae, which are glued together side surface (ss1) to side surface (ss2), such that major base surfaces (bs1) of immediately adjacent lamellae face opposite directions.

23. The beam as claimed in claim 22, wherein the flange portion is formed by at least two sets of wood lamellae, which sets are glued together base surface to base surface.

24. The beam as claimed in any one of claims 17-21, wherein the flange portion is formed by a single wood lamella.

25. A beam as claimed in any one of claims 17-24, further comprising at least one elongate reinforcement element (565), which extends at an angle less than 45° to the principal transverse load direction.

26. The beam as claimed in claim 25, wherein the reinforcement element (565) extends through at least one of the flange portions.

27. A building element, comprising:

at least two beams (500, 510, 520, 530, 540, 560, 560', 570) as claimed in any one of claims 17-25, which are identically oriented and spaced apart in a direction perpendicular to the longitudinal direction and to the transversal load direction, and

a pair of face panels (554, 555), arranged on opposite sides of the beams as seen in the transversal load direction, such that the beams are sandwiched by the face panels.

28. The building element as claimed in claim 27, wherein at least one of the face panels is formed by at least two elongate members, longitudinal directions of which extend non-parallel to the longitudinal directions of the beams, preferably approximately perpendicular to the longitudinal directions of the beams.

29. A method of making a beam, which is at least partially formed of wood-based material and which presents a longitudinal direction and a principal transverse load direction, perpendicular to the longitudinal direction, the method comprising:

providing at least two wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2),

forming a flange portion of the beam by arranging said wood lamellae such that their minor base surfaces face each other, and

directly or indirectly connecting the wood lamellae to each other.

30. The method as claimed in claim 29, further comprising connecting the minor base surfaces directly to each other.

31. The method as claimed in claim 29, further comprising providing a web member and connecting the web member to the wood lamellae, such that a major surface of the web member extends in parallel with the transversal load direction.

32. The method as claimed in any one of claims 29-31, further comprising:

providing a set comprising at least two wood lamellae, which are glued together side surface (ss1) to side surface (ss2), such that major base

surfaces (bs1) of immediately adjacent lamellae of the set face opposite directions, and

forming the flange portion from the set.

33. The method as claimed in claim 32, further comprising gluing together at least two sets of wood lamellae base surface to base surface.

34. A rib slab (610, 620, 630, 630', 640), comprising:

at least one panel (601, 604, 605, 633) presenting a first face, coinciding with a main face of the rib slab,

a plurality of elongate beams (602, 603, 612, 613, 632, 633, 641), which extend in parallel with, and spaced from, each other, and which are bonded to a second face of the panel,

characterized in that

the beams are formed by wood lamellae (20a, 20b), each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2).

35. The rib slab as claimed in claim 34, further comprising a second panel, which is bonded to the beams, such that the beams are sandwiched between the panels.

36. The rib slab as claimed in claim 35, further comprising:

a second plurality of elongate beams, which extend in parallel with, and spaced from, each other, and which are bonded to a second face of the second panel, and

a third panel, which is bonded to the second plurality of beams, such that the second plurality of beams are sandwiched between the second and third panels.

37. The rib slab as claimed in any one of claims 34-36, wherein major base surfaces of adjacent beams face opposite directions.

38. The rib slab as claimed in any one of claims 34-36, wherein major base surfaces of adjacent beams face the same direction.

39. The rib slab as claimed in any one of claims 34-38, wherein the wood lamellae are spaced apart by a distance corresponding to 10-300 % of a major base surface width, preferably 50-200 % or 50-100 %.

40. A rib slab system comprising a pair of rib slabs as claimed in claim 34, wherein at least two of the wood lamellae of each rib slab is bonded to its associated panel by its minor base surface (bs2), such that the wood lamellae provide a respective undercut edge, and

wherein one of the rib slabs is suspended from the other one of the rib slabs by engagement of the undercut edges.

41. The rib slab system as claimed in claim 40, wherein the rib slabs are connected mechanically to each other.

42. The rib slab system as claimed in claim 40 or 41, wherein a sound attenuating device (635) is arranged between surfaces forming said engagement.

43. A method of making a rib slab, comprising:

providing at least one panel (601, 604, 605, 633) presenting a first face, coinciding with a main face of the rib slab,

bonding a plurality of elongate beams (602, 603, 612, 613, 632, 633, 641) to a second face of the panel, such that they extend in parallel with, and spaced from, each other,

wherein the beams are formed by wood lamellae (20a, 20b), each having a longitudinal direction which is substantially parallel with a principal

fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2).

44. A laminated wood board (702), presenting a principal plane, the board comprising a plurality of elongate wood lamellae, which are glued together along longitudinal planes,

wherein at least some pairs of wood lamellae are glued together along a plane, which provides an angle of less than 30° to the principal plane, preferably less than 23° or less than 18°.

45. The laminated wood board as claimed in claim 44, wherein at least some pairs of wood lamellae are glued together along a plane, which is substantially perpendicular to the principal plane.

46. The laminated wood board as claimed in claim 44 or 45, wherein the board presents a thickness in a direction perpendicular to the principal plane, a length in a longitudinal direction and a width in a direction perpendicular to the longitudinal direction,

wherein the thickness is less than 1/10 of the width, preferably less than 1/20, less than 1/30, 1/40, 1/50 or 1/70 of the width.

47. The laminated wood product as claimed in any one of claims 44-46, wherein year rings exposed at a face which is perpendicular to the principal plane and to a principal fiber direction of the wood, present a tangent, which at no portion of the face presents an angle smaller than 60° to the principal plane, preferably smaller than 40°, smaller than 40° or smaller than 20°.

48. A multi-layer laminated wood product (703, 704), comprising at least two laminated wood products (702) as claimed in any one of claims 44-

47, wherein the laminated wood products are laminated principal plane to principal plane.

49. A multi-layer laminated wood product as claimed in claim 48, wherein the laminated wood products are arranged with their respective longitudinal directions in a non-parallel manner, preferably substantially perpendicular to each other.

50. The multi-layer laminated wood product as claimed in claim 48 or 49, comprising at least three laminated wood products, which are arranged with alternating longitudinal directions.

51. The multi-layer product as claimed in any one of claims 48-50, wherein at least 90 %, preferably at least 95 % of year rings visible at a cross section of the product, perpendicular to the longitudinal direction of the lamellae, present an angle to the principal plane, which is greater than 70°, preferably greater than 75°, greater than 77° or greater than 80°.

52. The multilayer laminated wood product as claimed in any one of claims 48-51, further comprising a layer which is formed of a plurality of adjacent wood lamellae (20a, 20b), each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2), wherein the lamellae are glued together side surface (ss1) to side surface (ss2), such that major base surfaces (bs1) of immediately adjacent lamellae face opposite directions.

53. Method of making a laminated wood product, comprising:

providing a billet formed of a plurality of adjacent wood lamellae (20a, 20b), each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally

trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2),

wherein the lamellae are glued together side surface (ss1) to side surface (ss2), such that major base surfaces (bs1) of immediately adjacent lamellae face opposite directions, wherein the base surfaces define principal planes of the billet,

cutting the billet along cutting planes which are substantially perpendicular to the principal plane of the billet and parallel with the longitudinal direction of the wood lamellae, such that planks are formed having major planes which are defined by the cutting planes,

applying glue to longitudinal edges of the planks,

pressing the planks together along a direction which is parallel with the major plane of the planks for a sufficient time to bond the wood lamellae to each other to form the laminated wood product.

54. A method of making a multi-layered laminated wood product, the method comprising laminating together at least two laminated wood products produced according to the method set forth in claim 53.

55. The method as claimed in claim 54, wherein the laminated wood products are arranged with fiber directions being non-parallel, preferably orthogonal.

56. The method as claimed in claim 54 or 55, further comprising:

providing a second billet formed of a plurality of adjacent wood lamellae (20a, 20b), each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2),

wherein the lamellae are glued together side surface (ss1) to side surface (ss2), such that major base surfaces (bs1) of immediately adjacent

lamellae face opposite directions, wherein the base surfaces define principal planes of the second billet,

laminating the laminated wood product to the second billet with its principal plane parallel to the principal plane of the second billet.

57. A laminated wood product (820, 830, 840, 850, 860) for use as a pillar or pylon, comprising:

a plurality of wood lamellae (20a, 20b), each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2),

wherein the lamellae are glued together side surface (ss1, ss2) to side surface (ss1, ss2),

wherein the wood product comprises at least one first pair of adjacent wood lamellae, which are glued together side surface (ss1) to side surface (ss2) such that their major base surfaces (bs1) face directions which form an angle of less than 90°, preferably less than 60° or less than 30°.

58. The laminated wood product as claimed in claim 57, wherein the wood product comprises 3-15 wood lamellae which are glued together side surface to side surface such that major base surface of any adjacent pair of said wood lamellae face directions which form an angle of less than 90°, preferably less than 60° or less than 30°.

59. The laminated wood product as claimed in claim 57 or 58, wherein the wood product comprises at least one second pair of adjacent wood lamellae, which are glued together side surface to side surface such that their major base surfaces (bs1) face opposite directions.

60. The laminated wood product as claimed in any one of claims 57-59, wherein the wood product presents a generally facetted convex face,

exposing more major base surfaces than minor base surfaces and a generally facetted concave face, exposing more minor base surfaces than major base surfaces.

61. A method of forming a wood billet for use in the methods as claimed above, the method comprising:

providing a half log having semi cylindrical cross section,

cutting the half log along at least one radial cutting plane to form a wood lamella,

planing pith and bark side portions of the wood lamella such that the wood lamella is formed into a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2),

applying glue to the side surfaces (ss1, ss2),

arranging the wood lamellae side surface (ss1) to side surface (ss2), and

pressing the sides surfaces towards each other for a sufficient time to bond the wood lamellae to each other to form a laminated product.

62. The method as claimed in claim 61, wherein the wood lamellae are arranged such that major base surfaces (bs1) of immediately adjacent lamellae face opposite directions and the base surfaces (bs1, bs2) define the respective major surfaces of the wood product.

63. The method as claimed in claim 61 or 62, further comprising cutting the thus formed billet along a plane parallel with the longitudinal direction and perpendicular to the major surfaces.

64. The method as claimed in any one of claims 61-63, further comprising subjecting the wood lamellae to a drying step prior to the application of glue.

65. The method as claimed in any one of claims 61-63, further comprising subjecting the billet to a drying step subsequent to the bonding.

66. The method as claimed in any one of claims 61-65, wherein the bark side portion is used as a reference surface for planing the pith side portion, such that the base surfaces thus provided taper along a longitudinal direction of the lamellae.

67. The method as claimed in any one of claims 61-66, wherein the pith side portion is used as a reference surface for planing the bark side portion, such that the base surfaces thus provided are substantially rectangular.

68. The method as claimed in claim 12, wherein the step of applying glue comprises applying glue suitable for wet gluing to the side surfaces (ss1, ss2) of the wood lamellae while a moisture content of the wood lamellae is greater than 25 % by dry mass, preferably greater than 30 % by dry mass.

69. The method as claimed in claim 12, further comprising subjecting the wood lamellae to a surface drying step prior to the application of glue.

70. A method of making a laminated wood product for use as a ceiling or floor element having major surfaces and a thickness as seen in a direction perpendicular to the major surfaces, of about 6-30 cm, preferably 8-26 cm, the method comprising:

providing a plurality of wood lamellae, each having a longitudinal direction which is substantially parallel with a principal fiber direction of the respective wood lamella, and a generally trapezoidal cross section providing a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2),

subjecting the wood lamellae to a surface drying step,

applying glue suitable for wet gluing to the side surfaces (ss1, ss2) of the wood lamellae, a moisture content of the wood lamellae being greater than 25 % by dry mass, preferably greater than 30 % by dry mass,

arranging the wood lamellae side surface (ss1) to side surface (ss2), such that major base surfaces (bs1) of immediately adjacent lamellae face opposite directions and the base surfaces (bs1, bs2) define the respective major surfaces of the wood product,

pressing the side surfaces towards each other for a sufficient time to bond the wood lamellae to each other to form a billet (200, 260),

subjecting the thus formed billet (200, 260) to a drying step, reducing the moisture content of the billet to 8-18 % by dry mass, and

cutting the billet along a plane parallel with the longitudinal direction and perpendicular to the major surfaces to form a plank.

71. A method of forming a wood billet for use in the methods as claimed above, the method comprising:

providing a half log (2´) having semi cylindrical cross section,

cutting the half log (2´) along at least one radial cutting plane to form at least two circle sector shaped radial sections (2´´a, 2´´b),

planing pith and bark side portions of the circle sector shaped sections (2´´a, 2´´b) such that wood lamellae are formed each having a generally trapezoidal cross section having a height of at least 50 %, preferably at least 60 % or 70 %, of the circle sector radius, and having a major base surface (bs1), a minor base surface (bs2) and a pair of opposing side surfaces (ss1, ss2),

applying glue to the side surfaces (ss1, ss2),

arranging the wood lamellae side surface (ss1) to side surface (ss2), and

pressing the sides surfaces towards each other for a sufficient time to bond the wood lamellae to each other to form a laminated product.

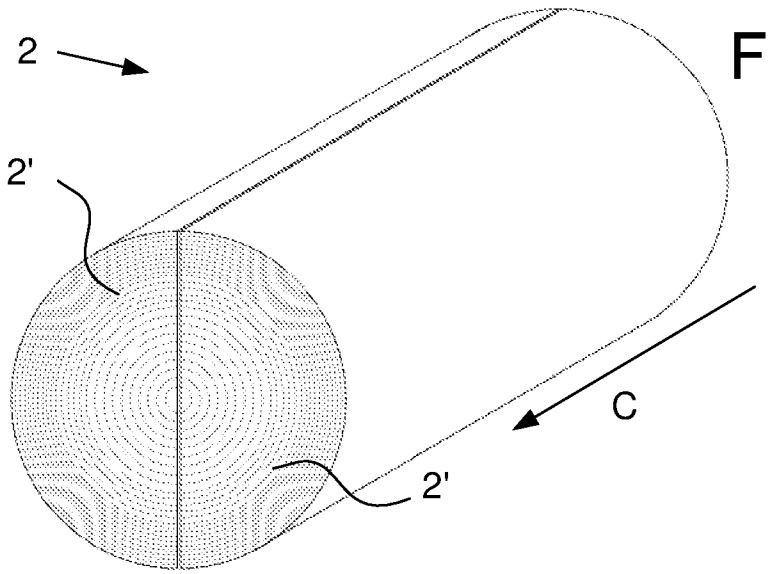


Fig 1a

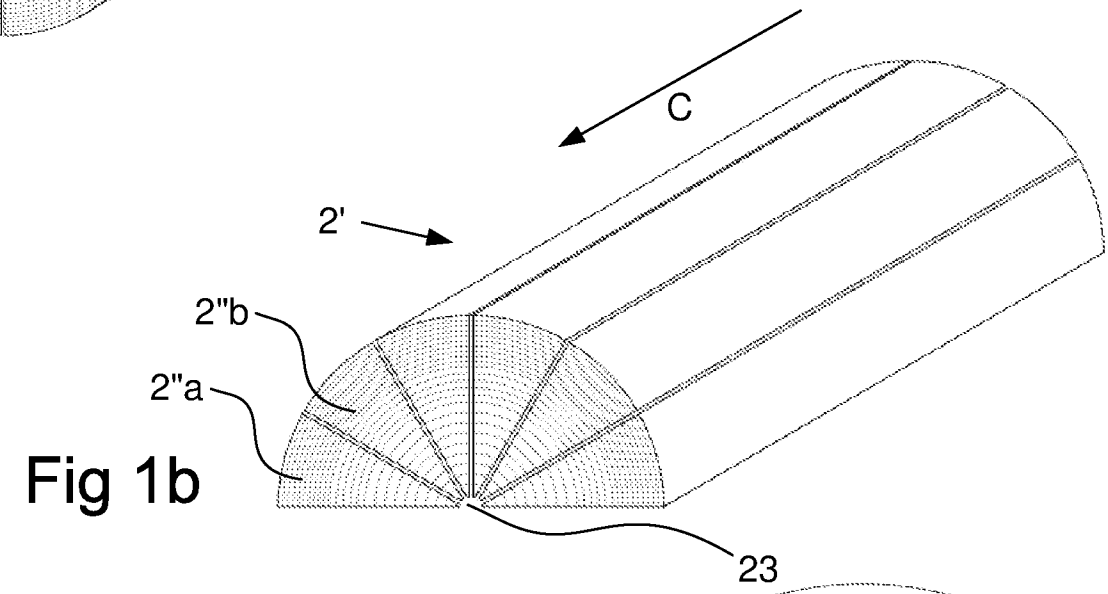


Fig 1b

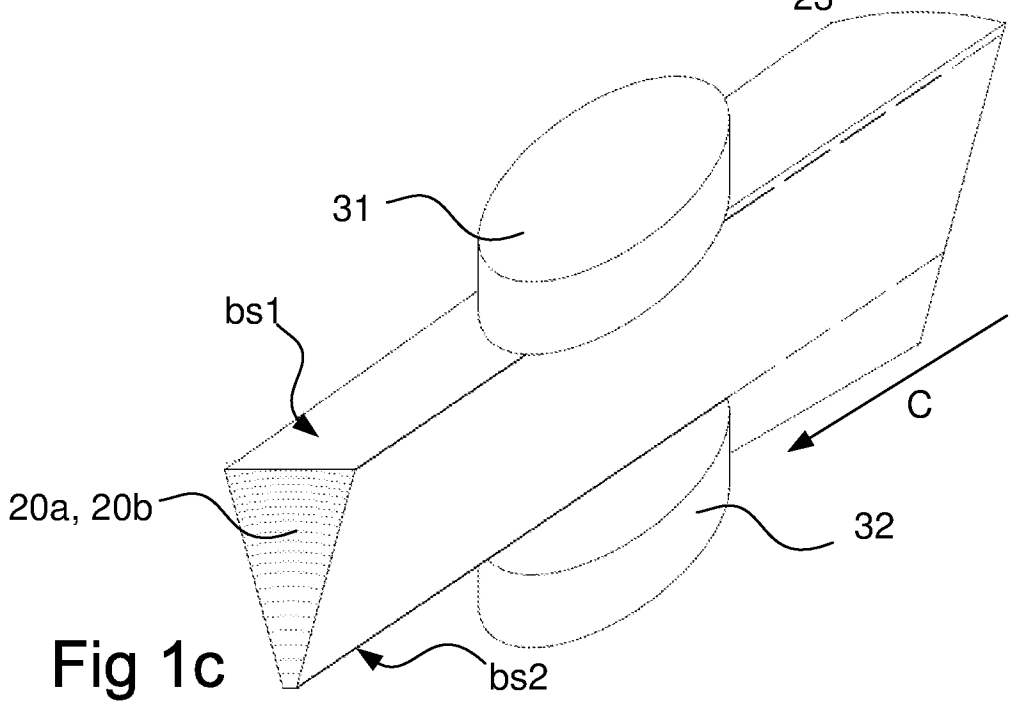


Fig 1c

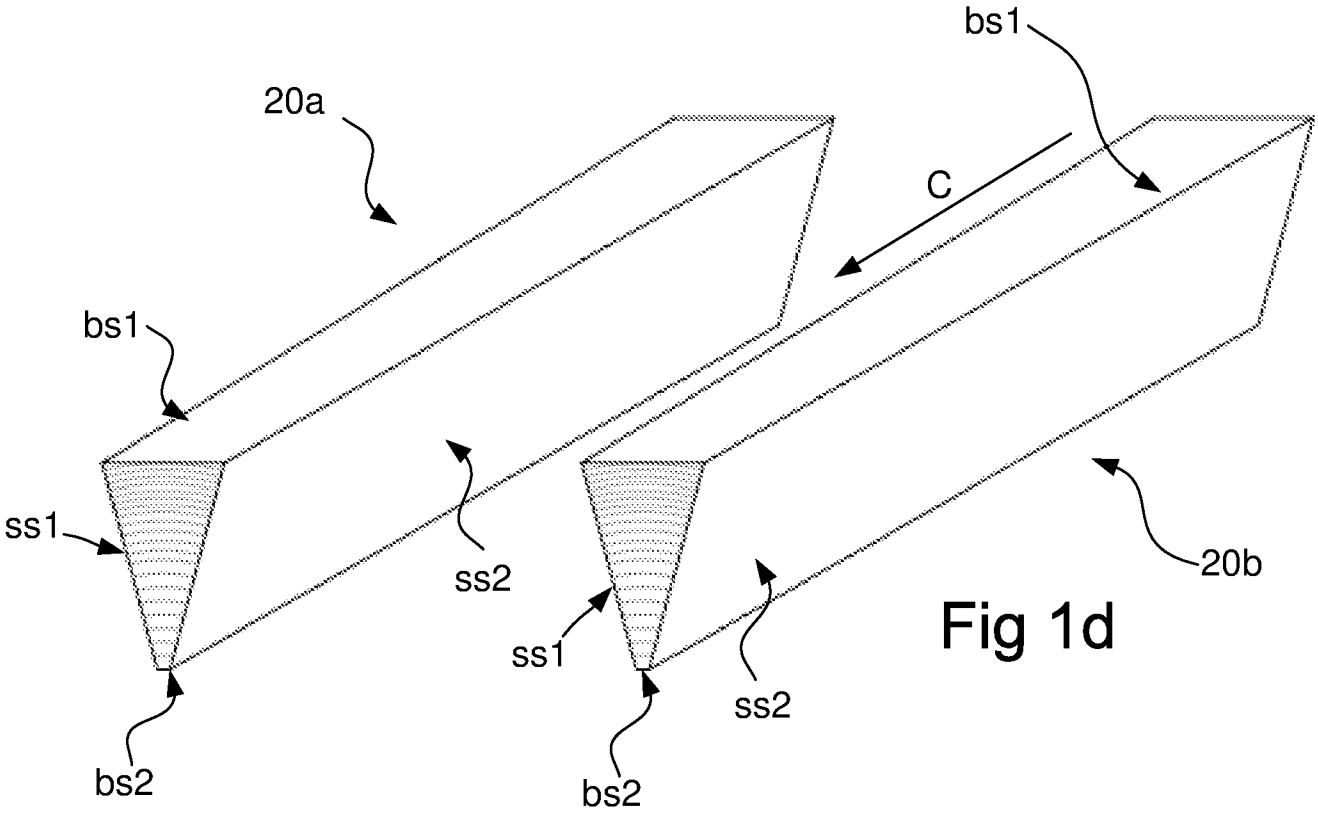

bs1
20a
C
bs1
ss1
ss2
20b
ss1
ss2
bs2
bs2

Fig 1d

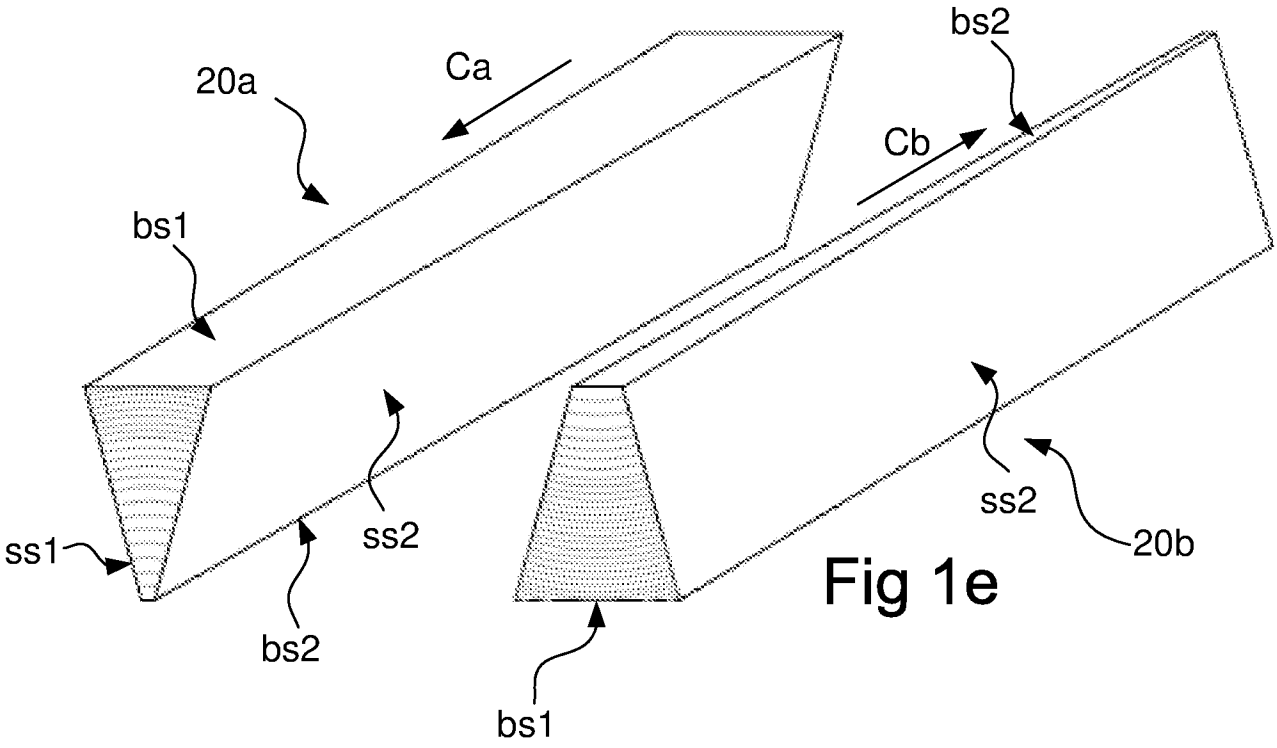

bs2
20a
Ca
Cb
bs1
ss1
ss2
ss2
20b
bs2
bs1

Fig 1e

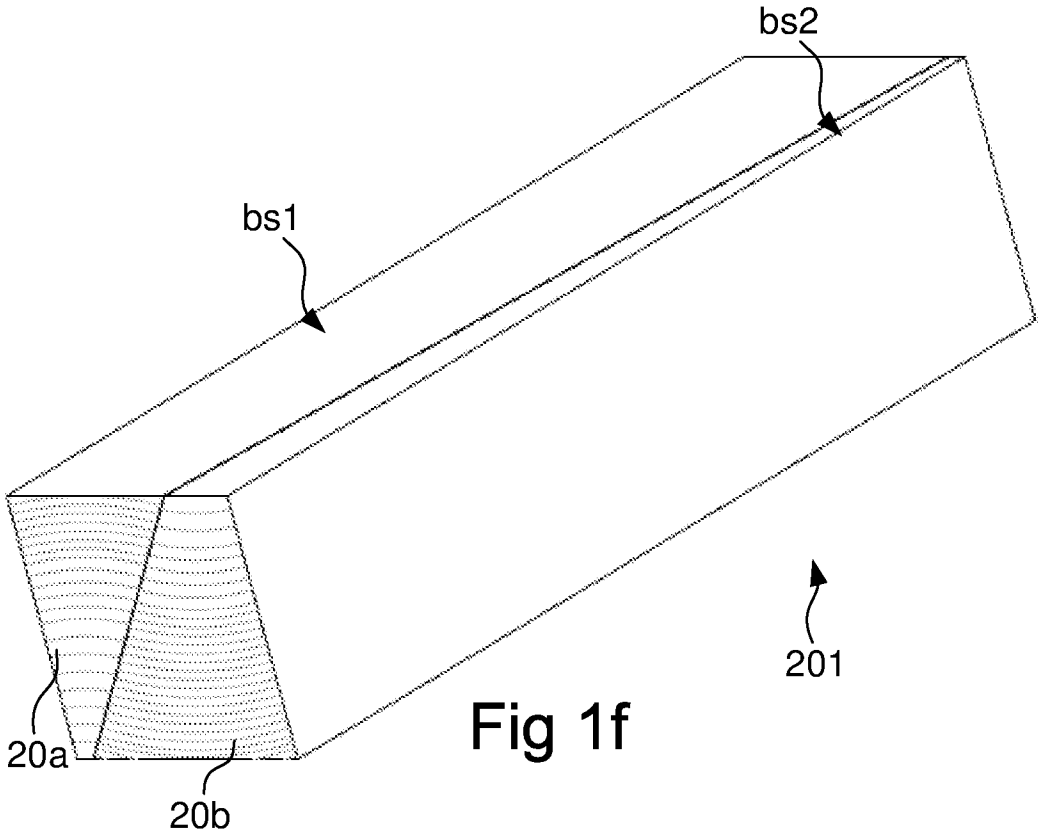


Fig 1f

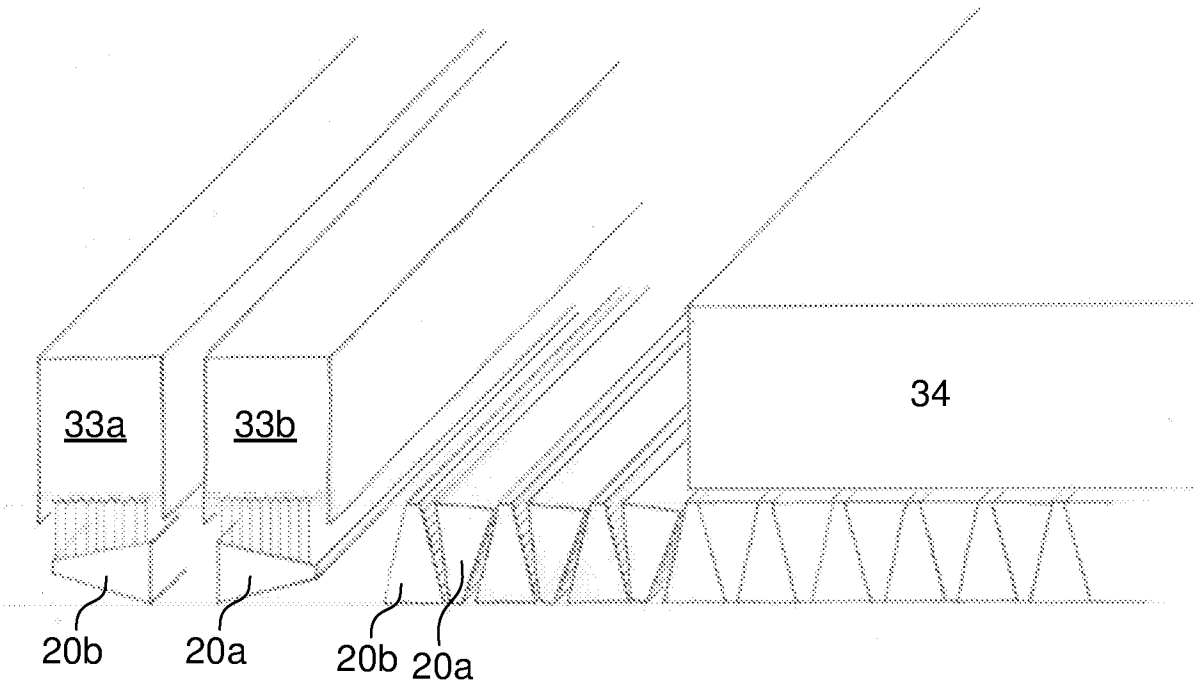


Fig 1g

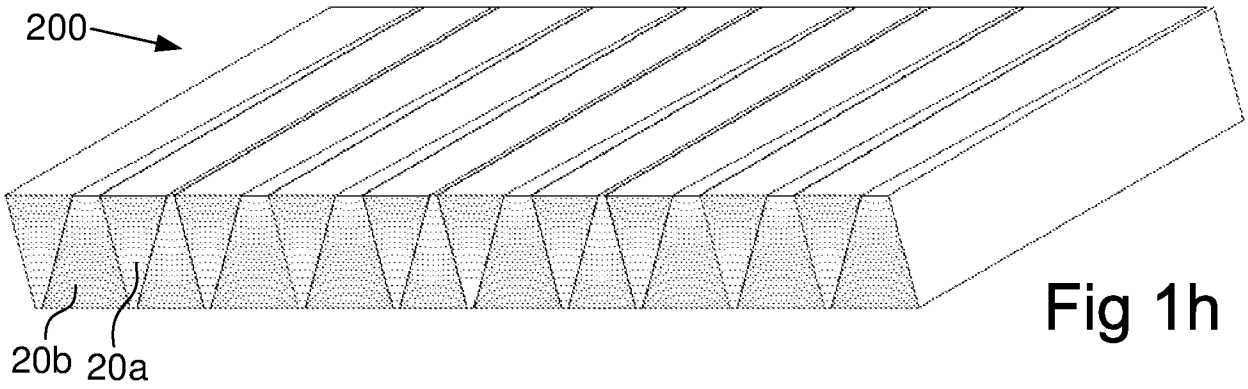


Fig 1h

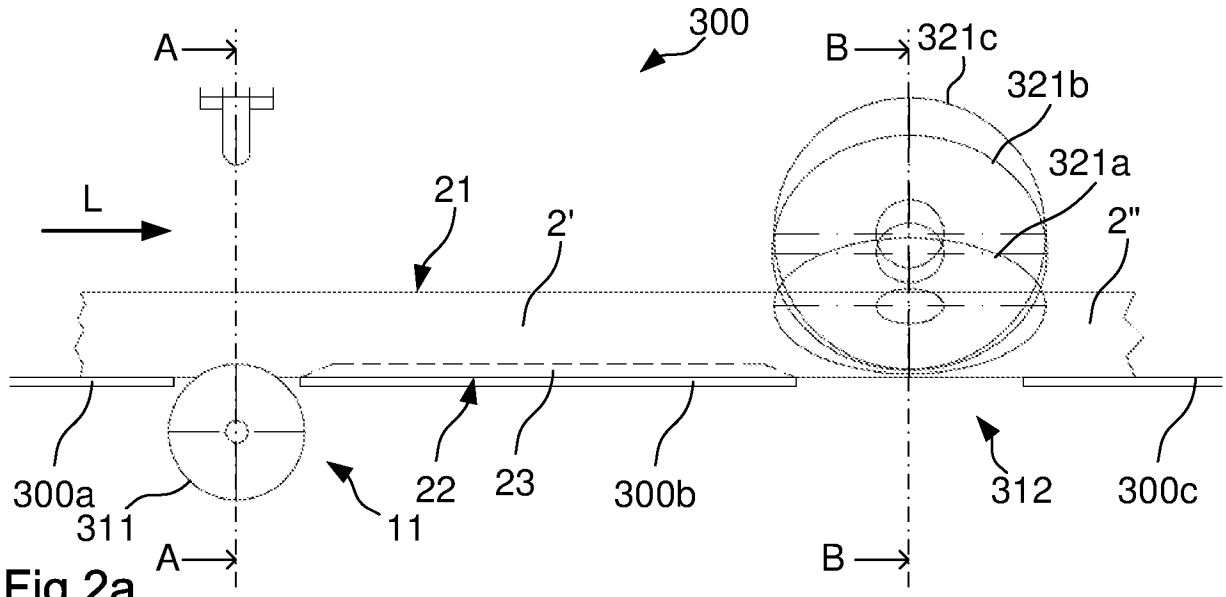


Fig 2a

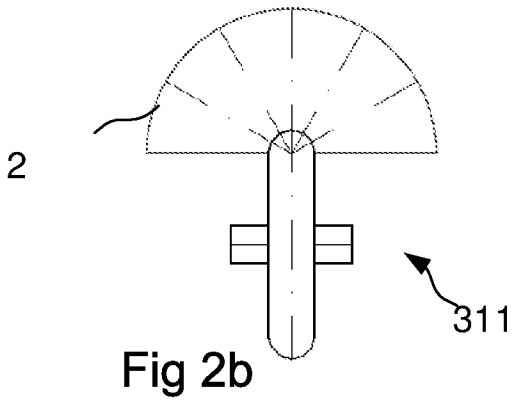


Fig 2b

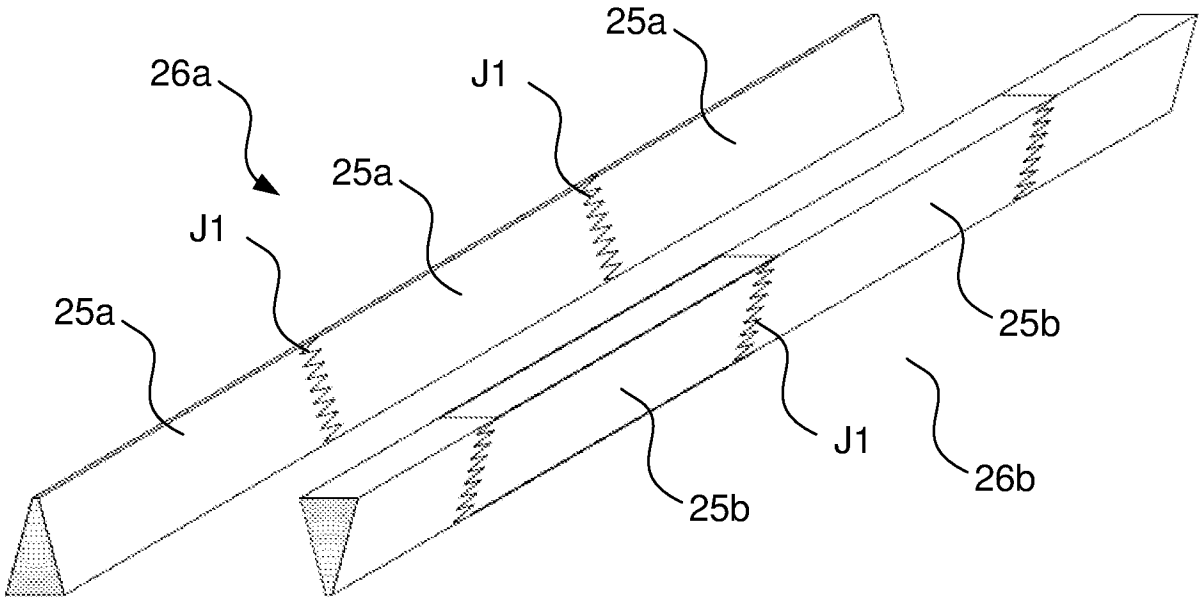


Fig 3a

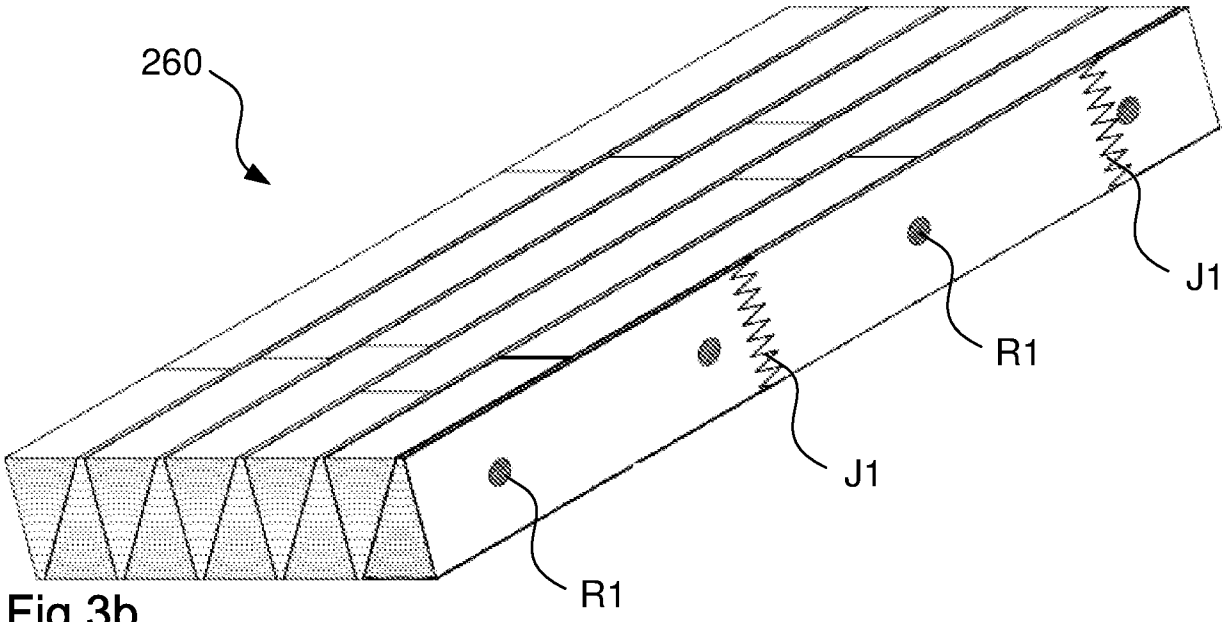


Fig 3b

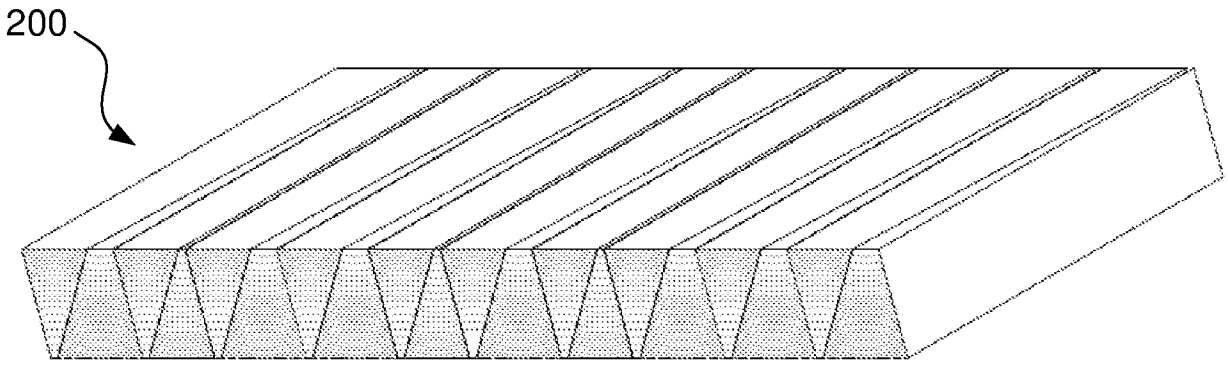


Fig 4a

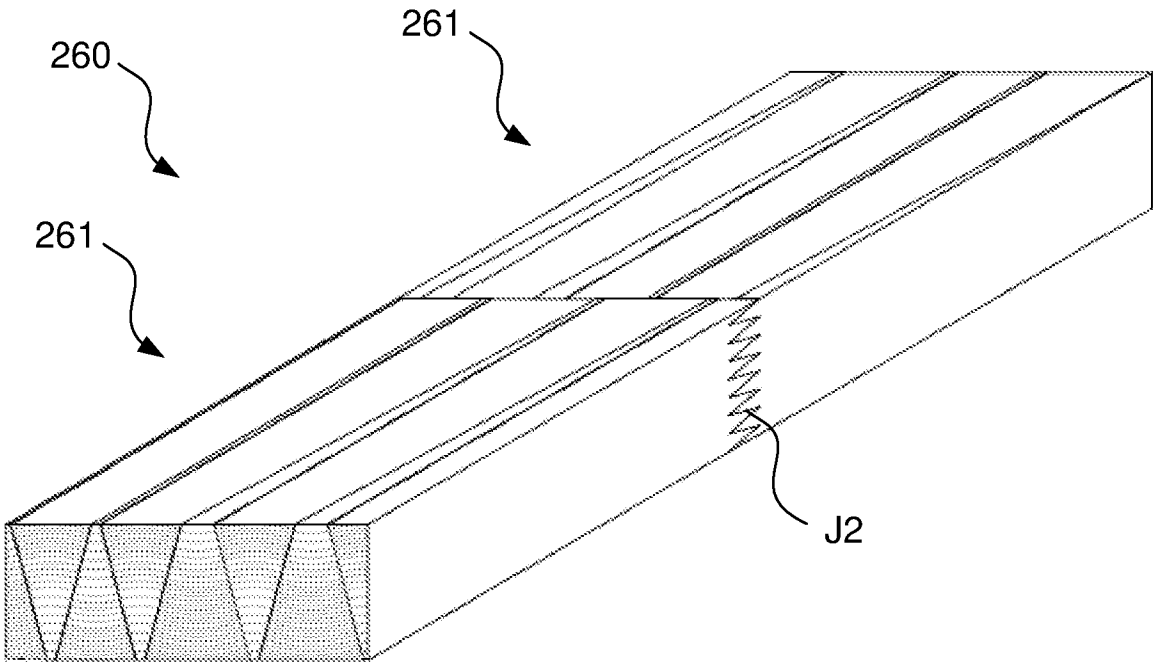


Fig 4b

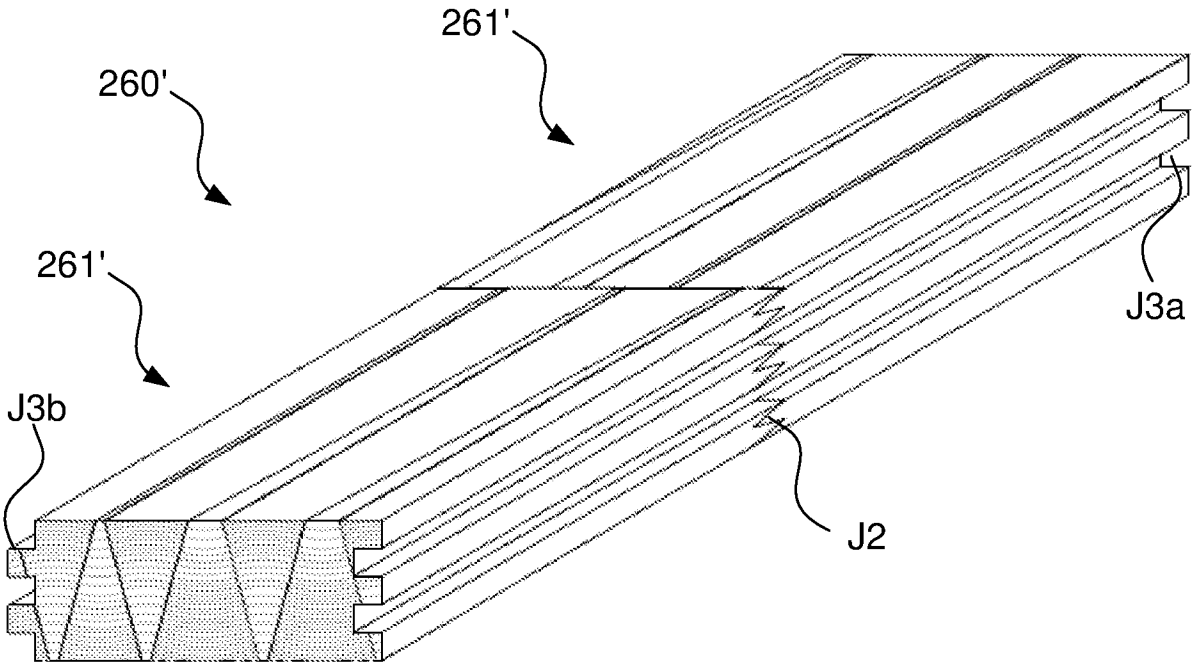


Fig 4c

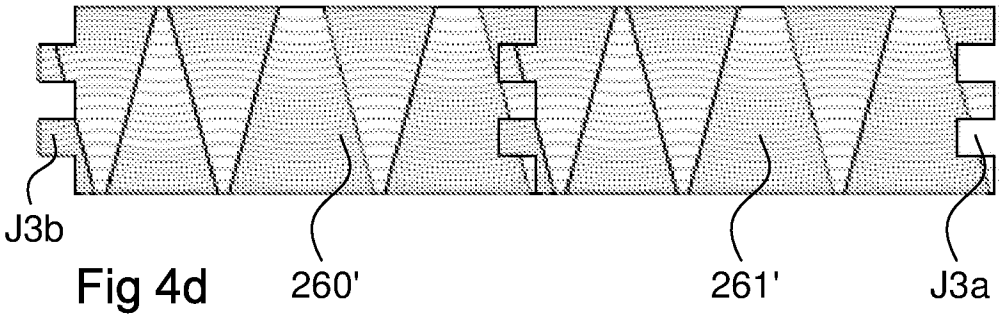


Fig 4d

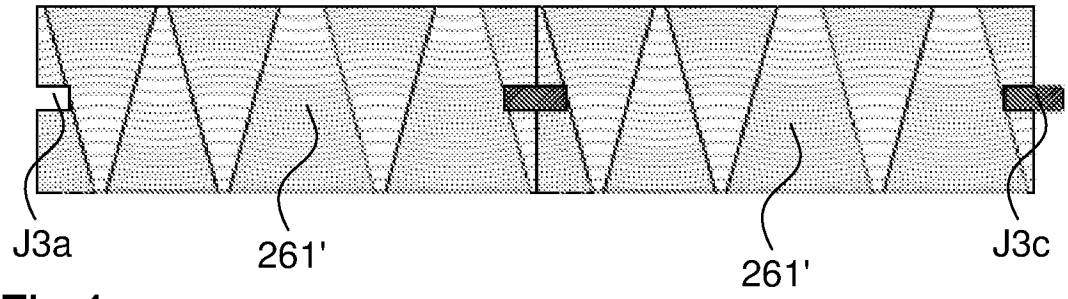


Fig 4e

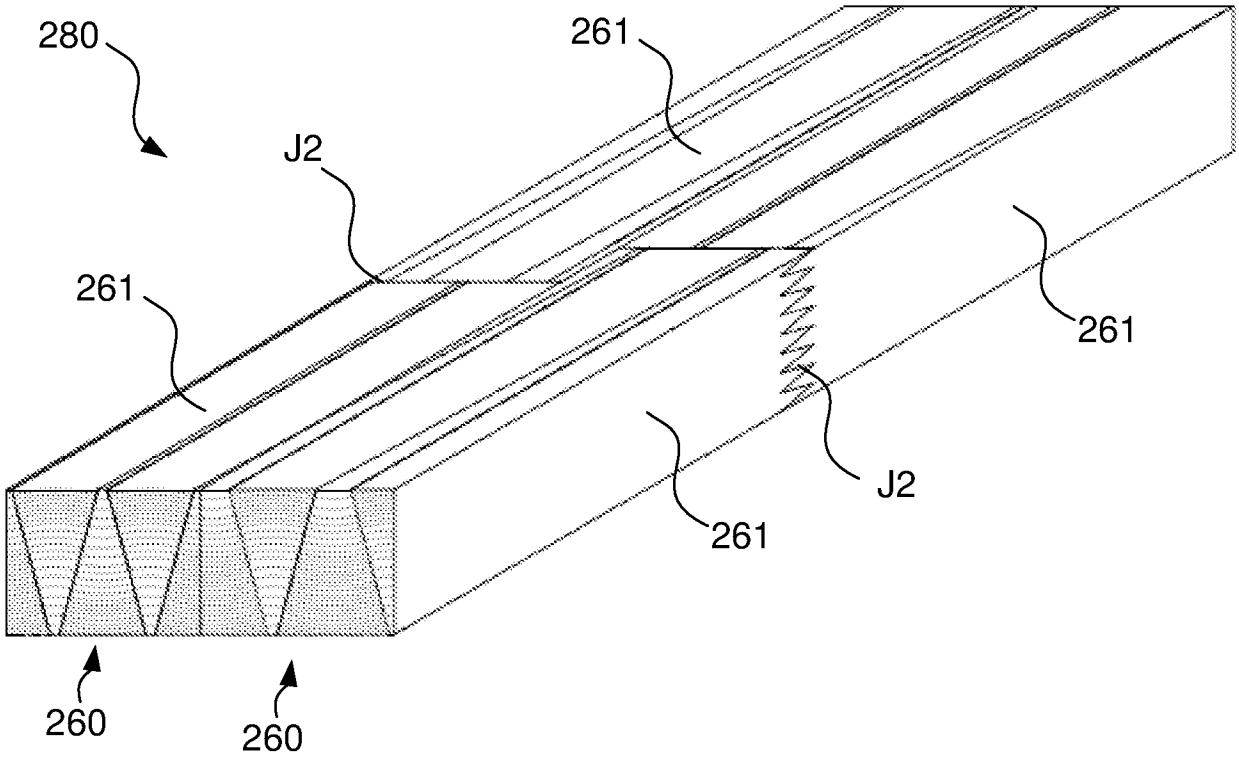


Fig 4f

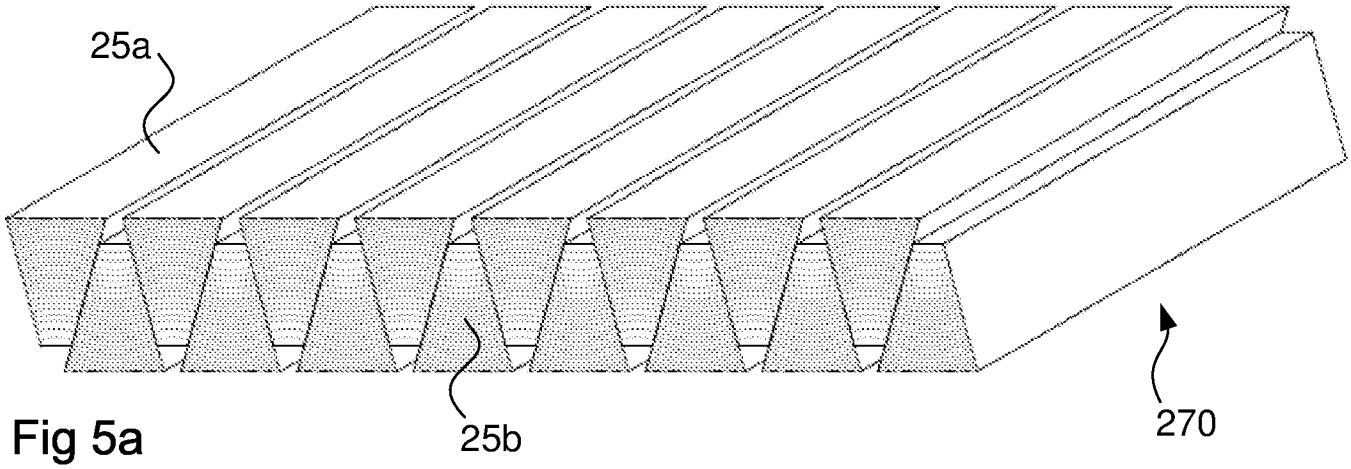


Fig 5a

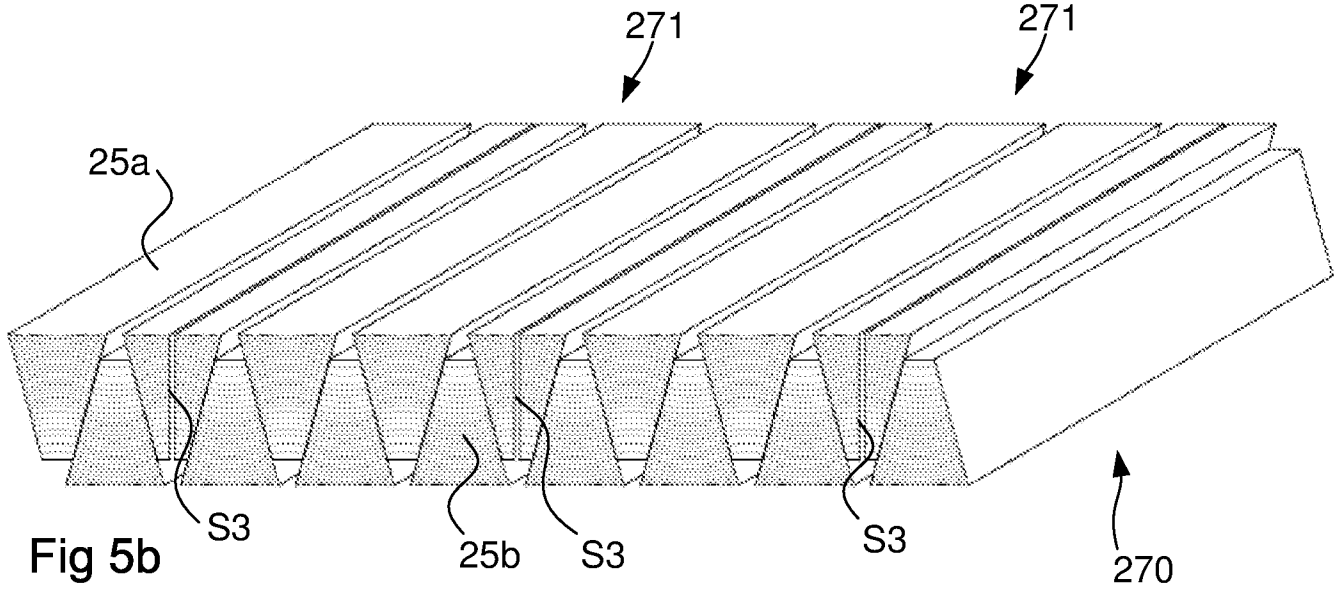


Fig 5b

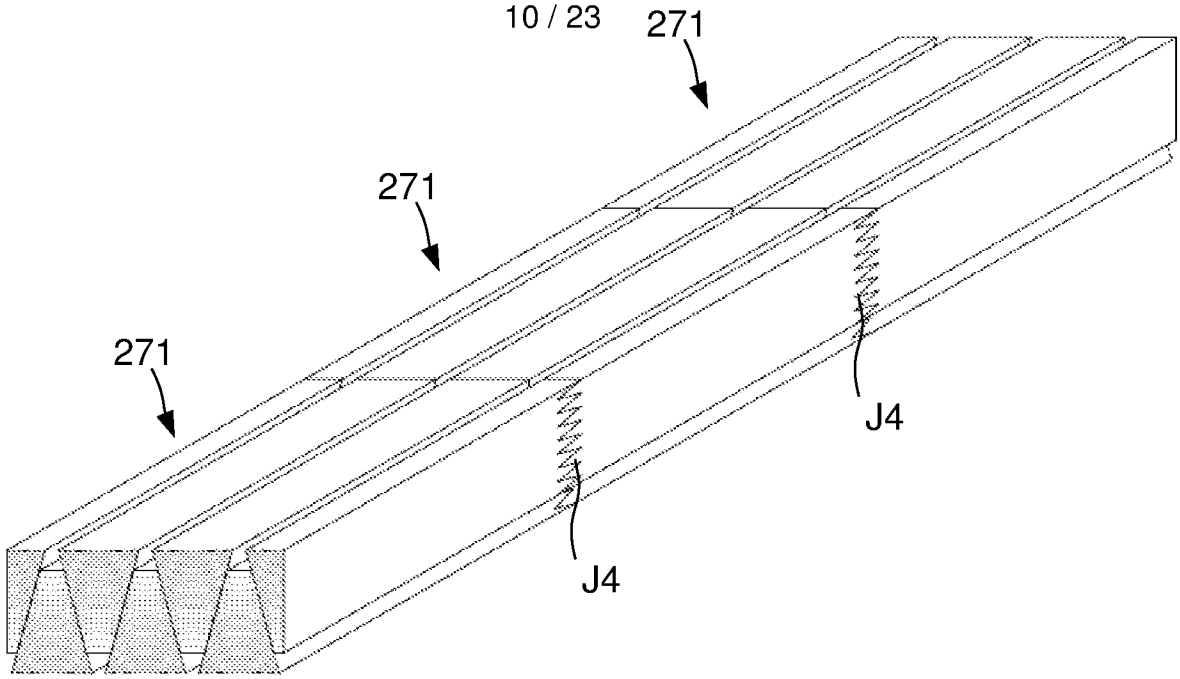


Fig 5c

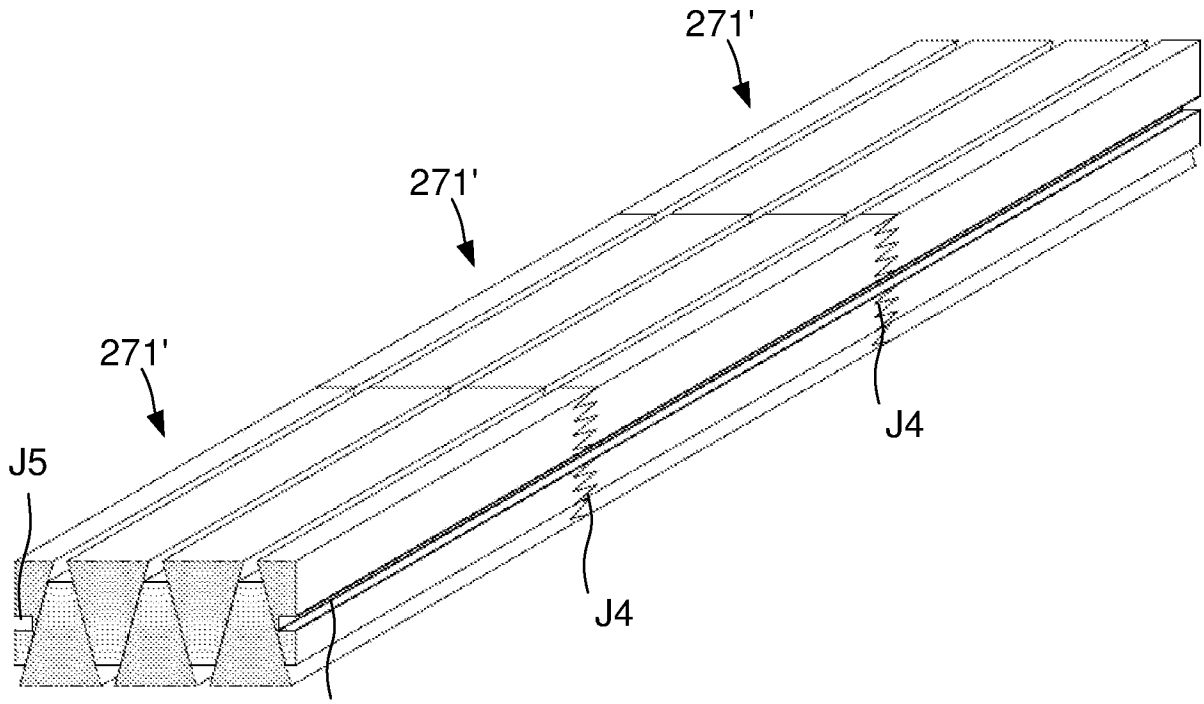


Fig 5d

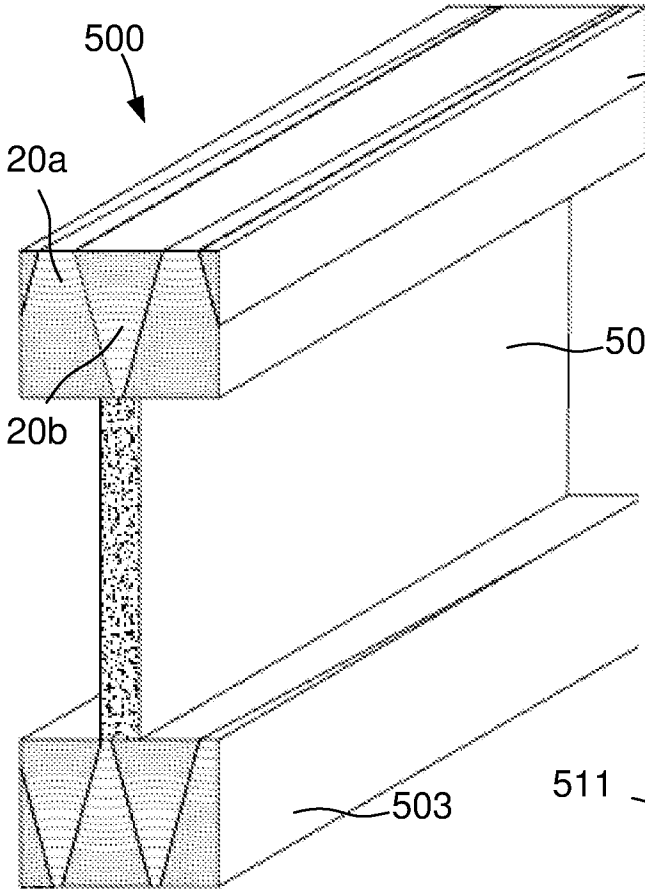


Fig 6a

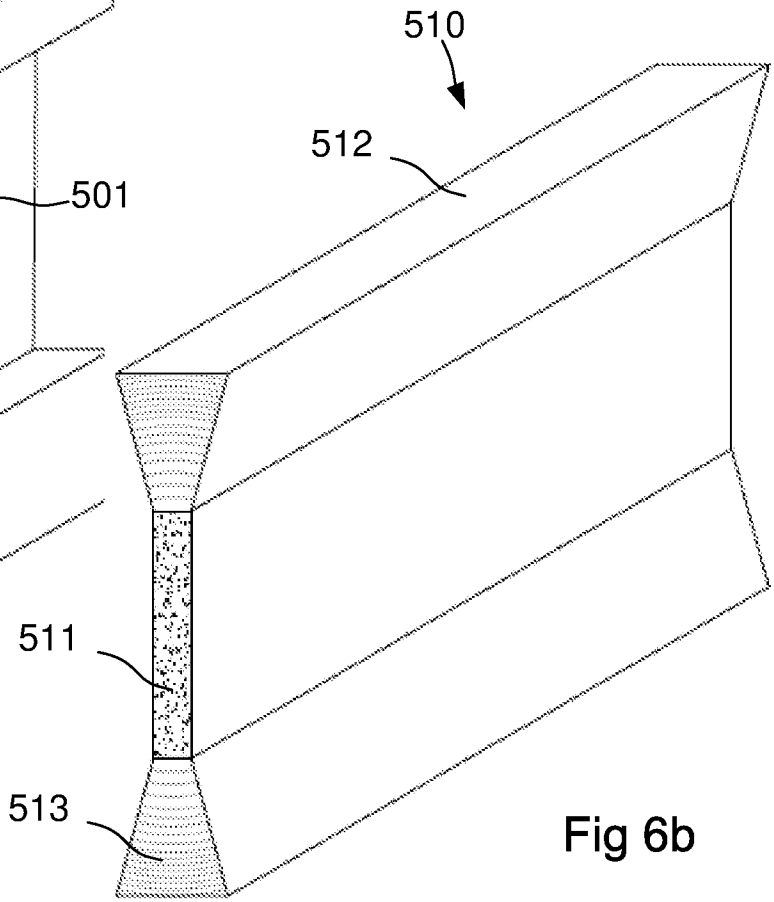


Fig 6b

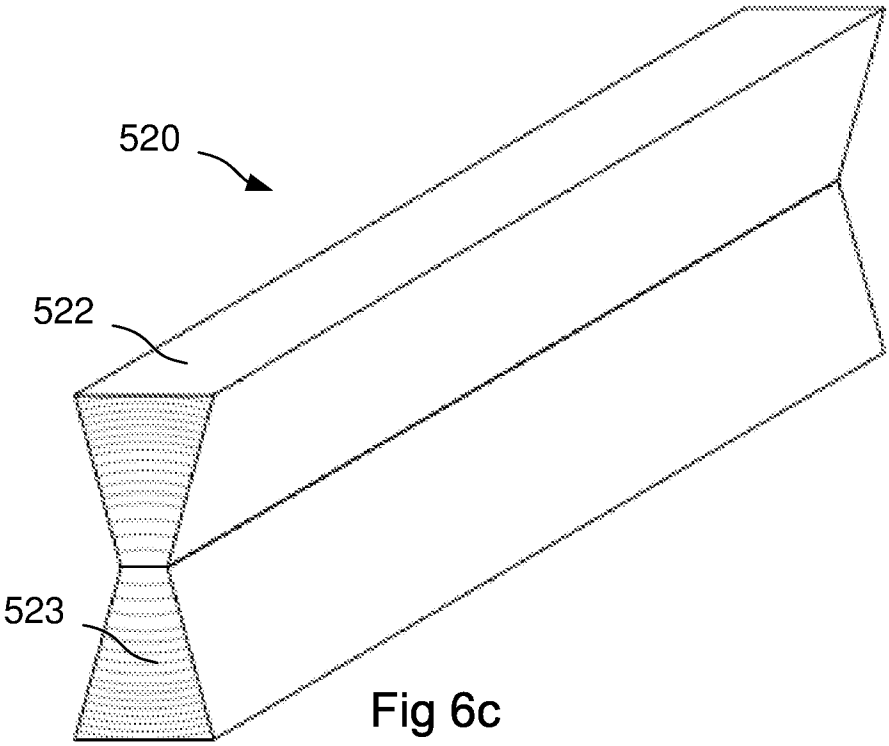


Fig 6c

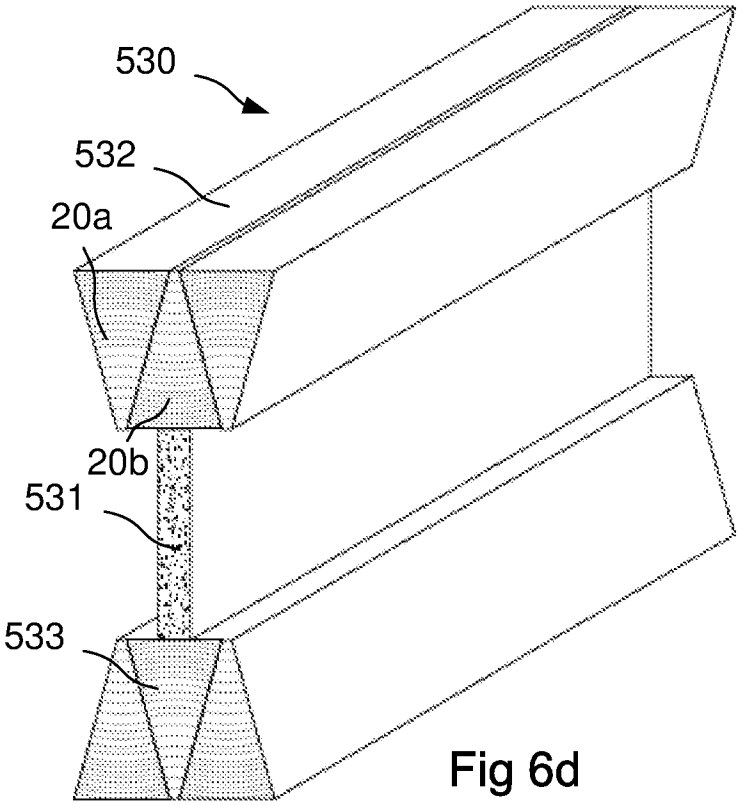


Fig 6d

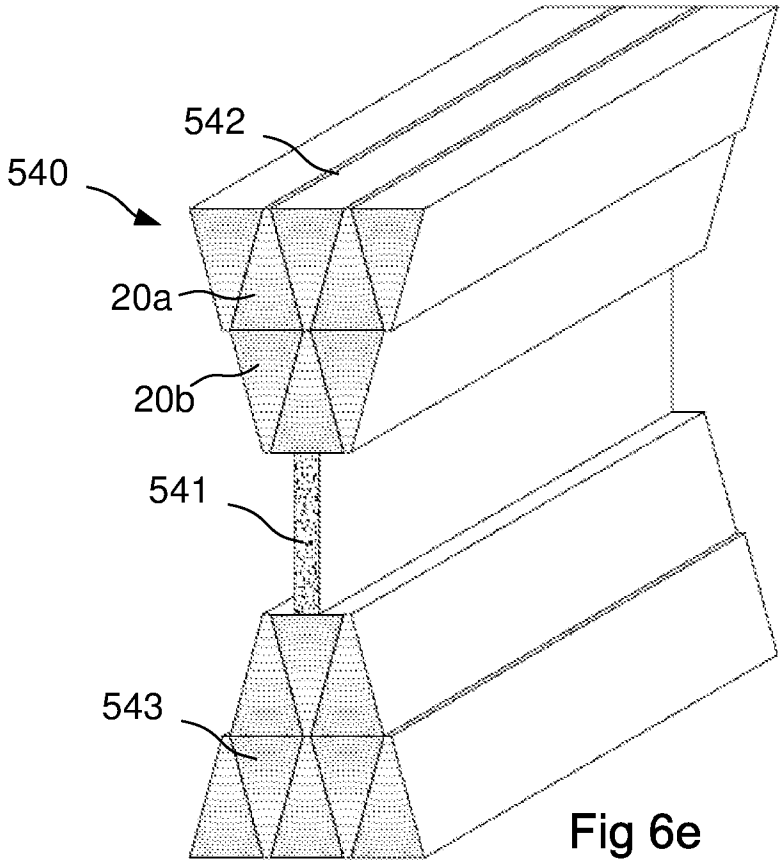


Fig 6e

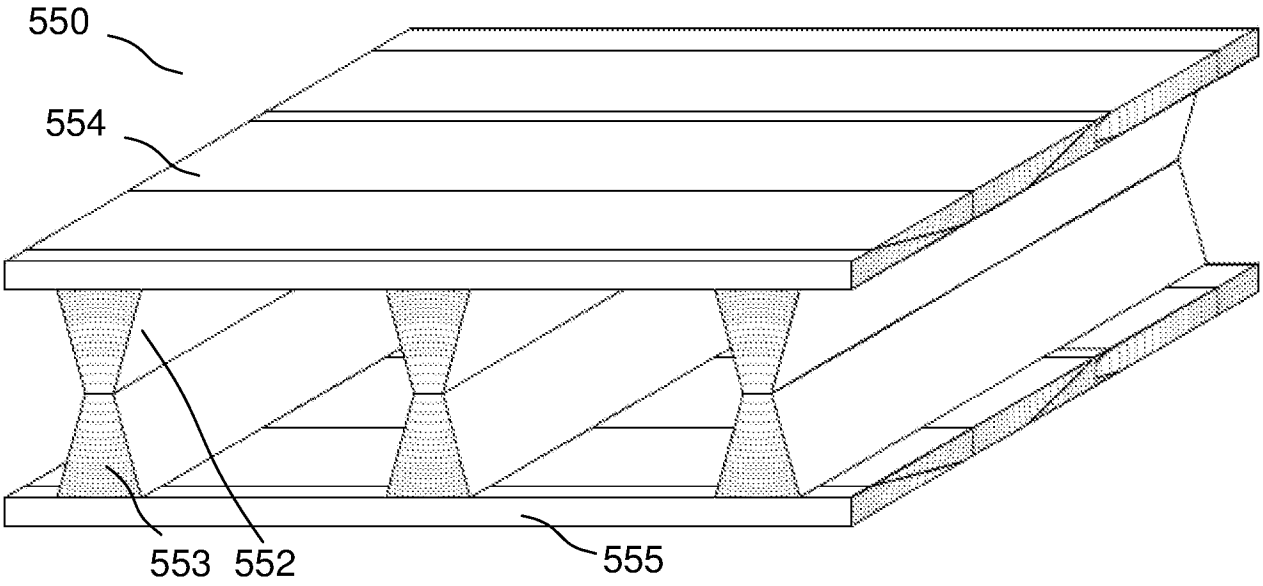
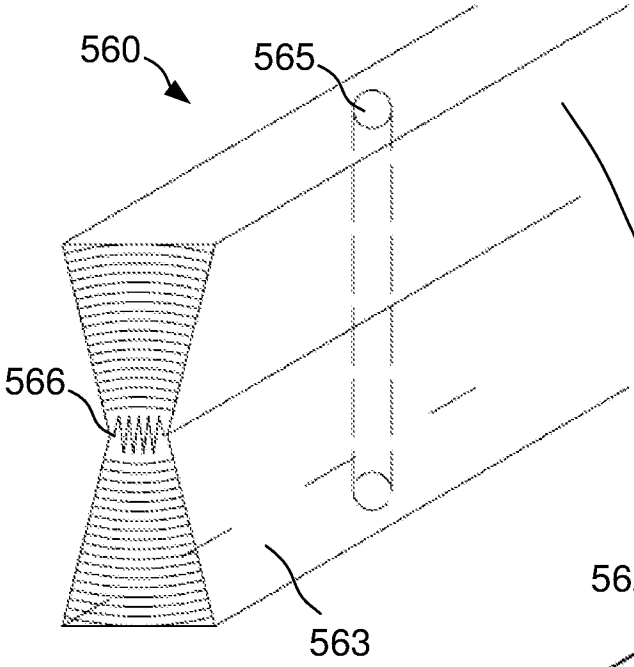


Fig 6f

Fig 6g



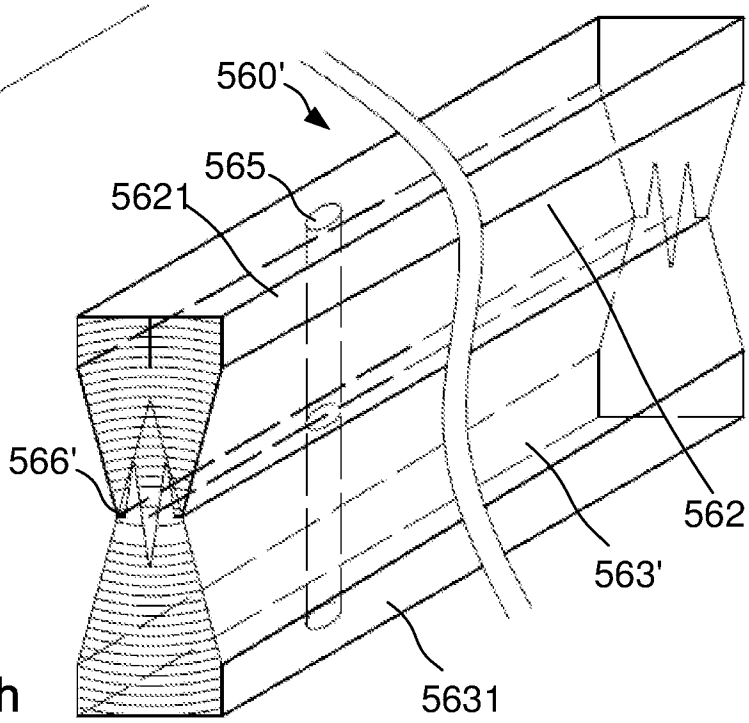
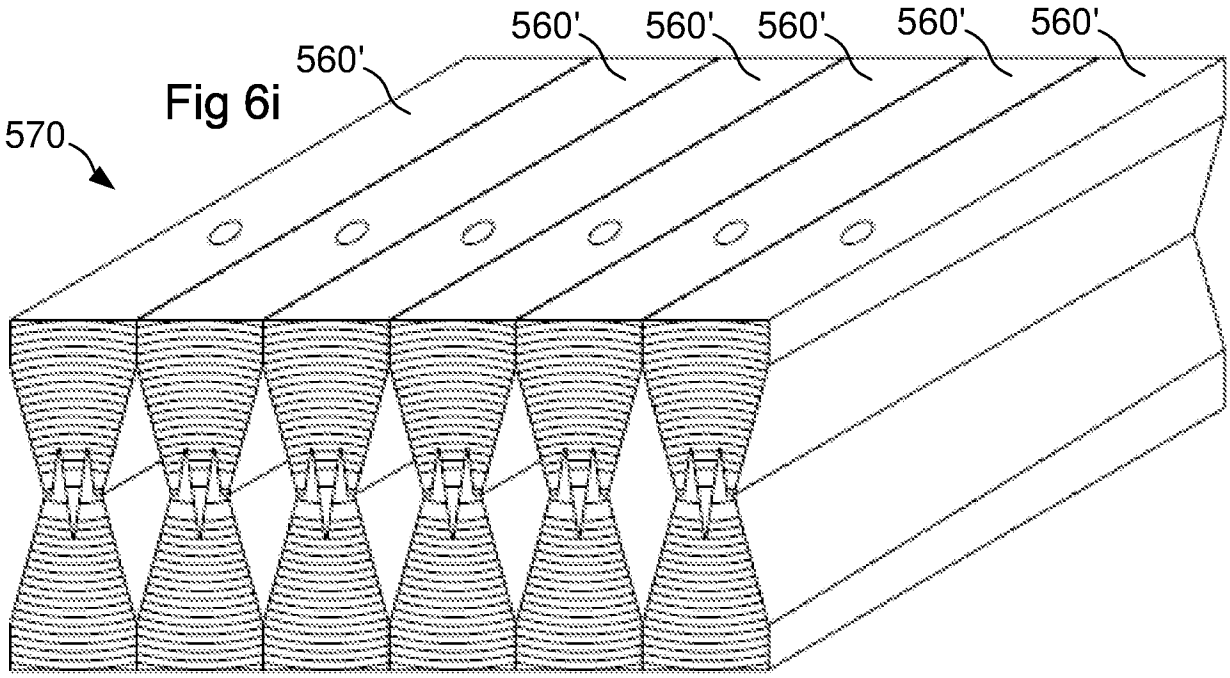


Fig 6h

Fig 6i



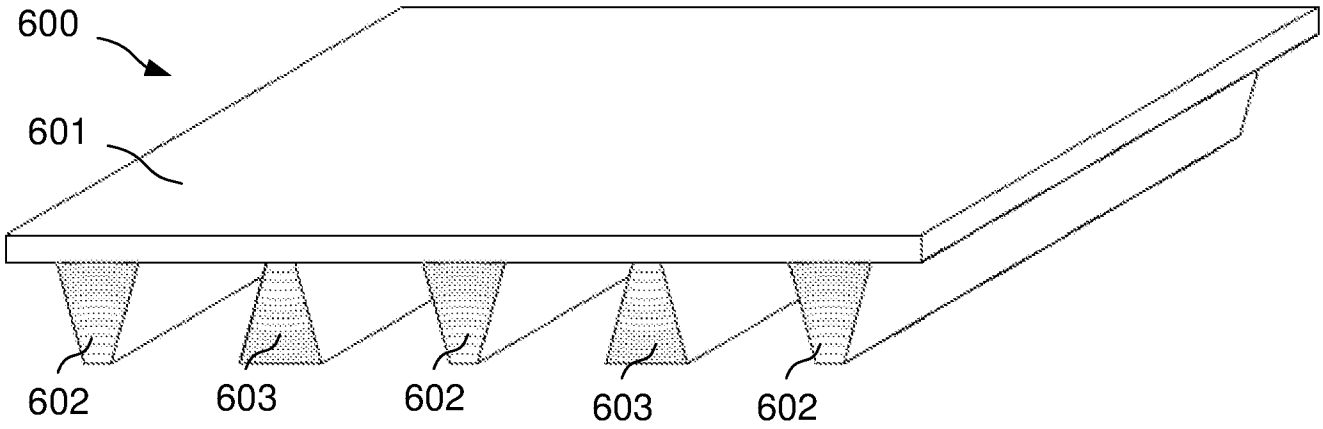


Fig 7a

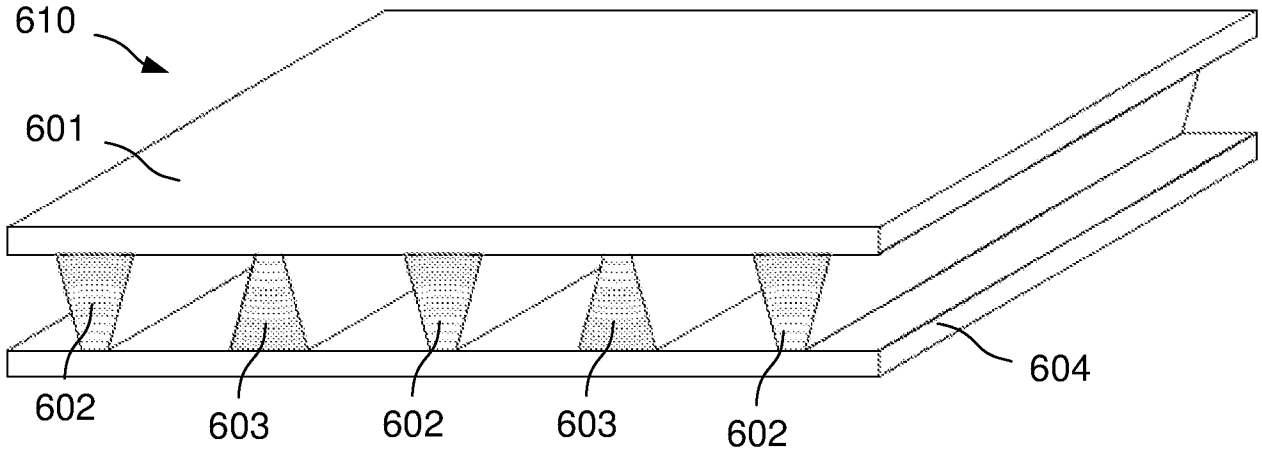


Fig 7b

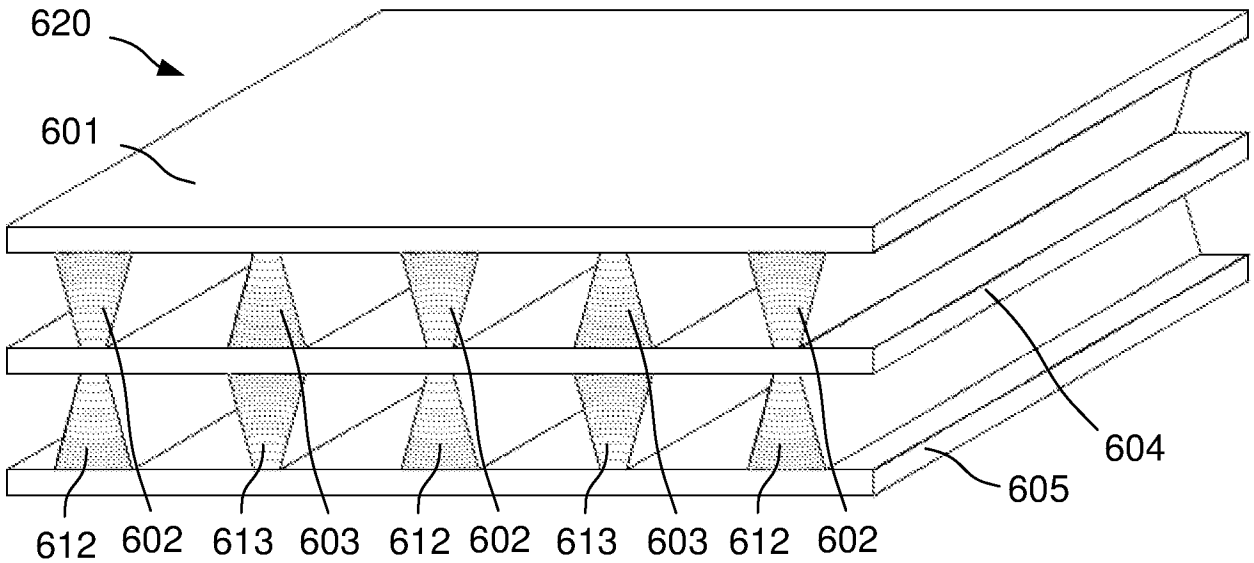


Fig 7c

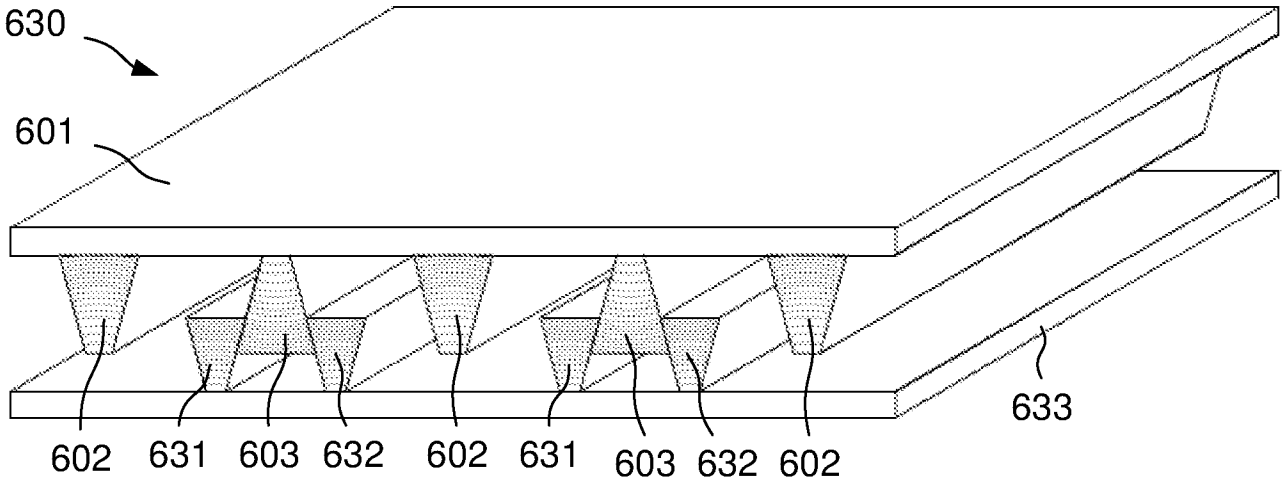


Fig 7d

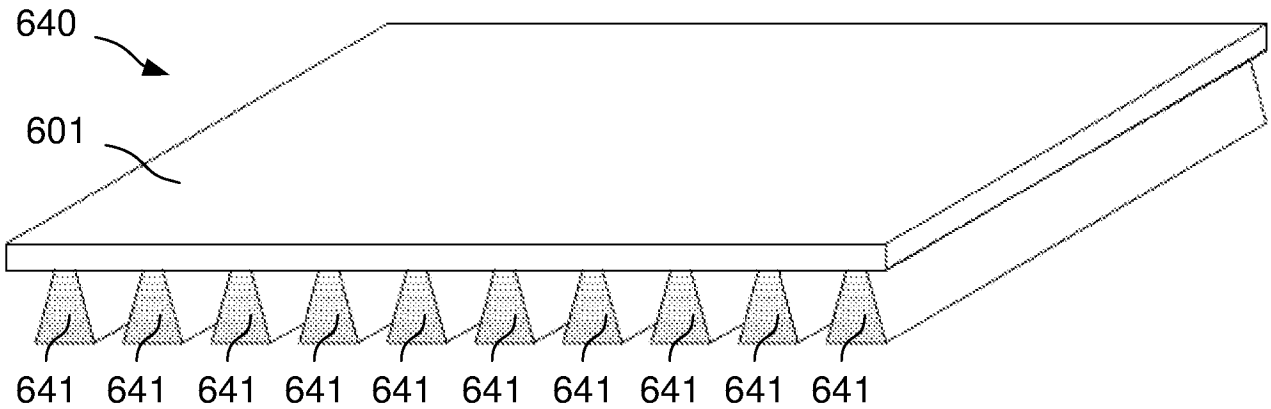


Fig 7e

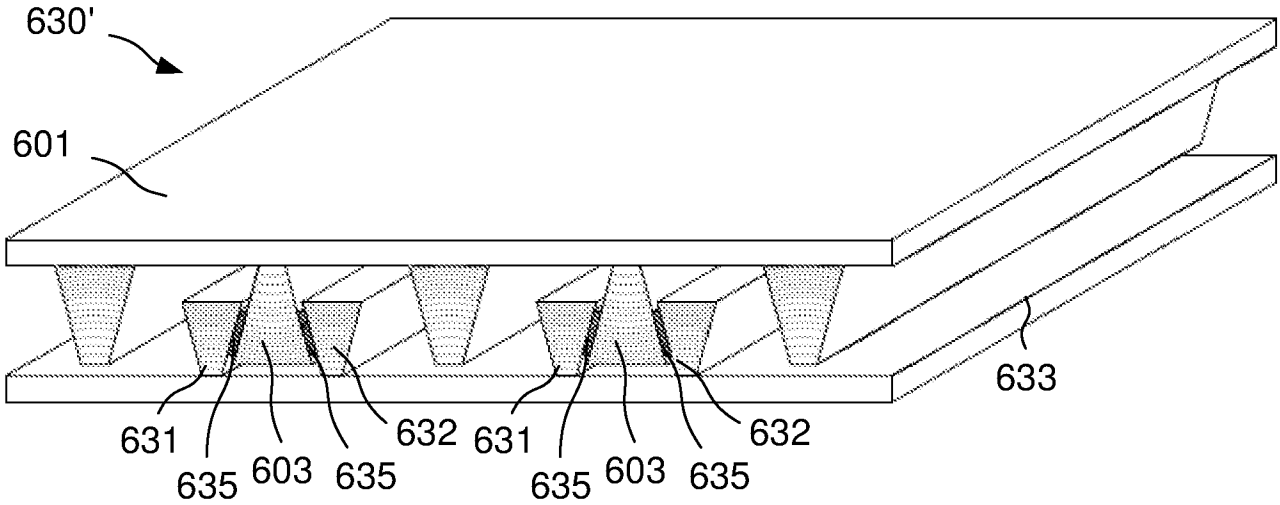


Fig 7f

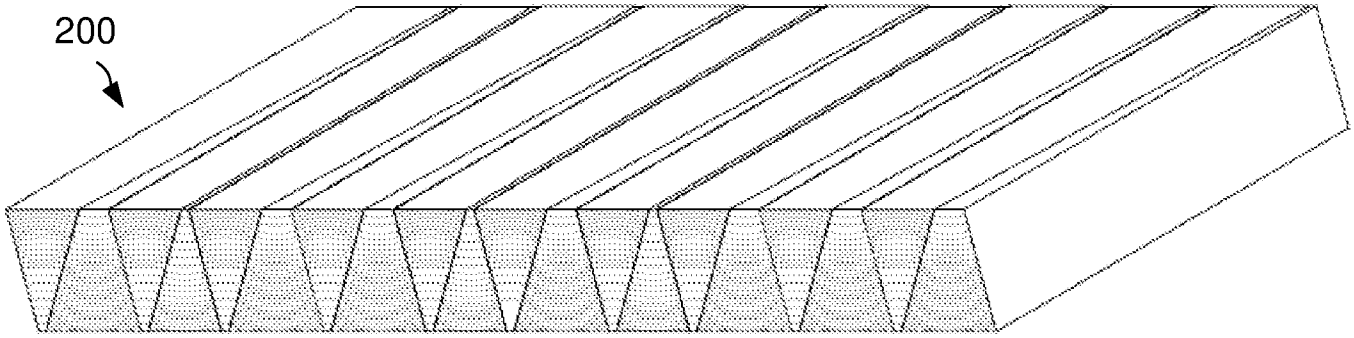


Fig 8a

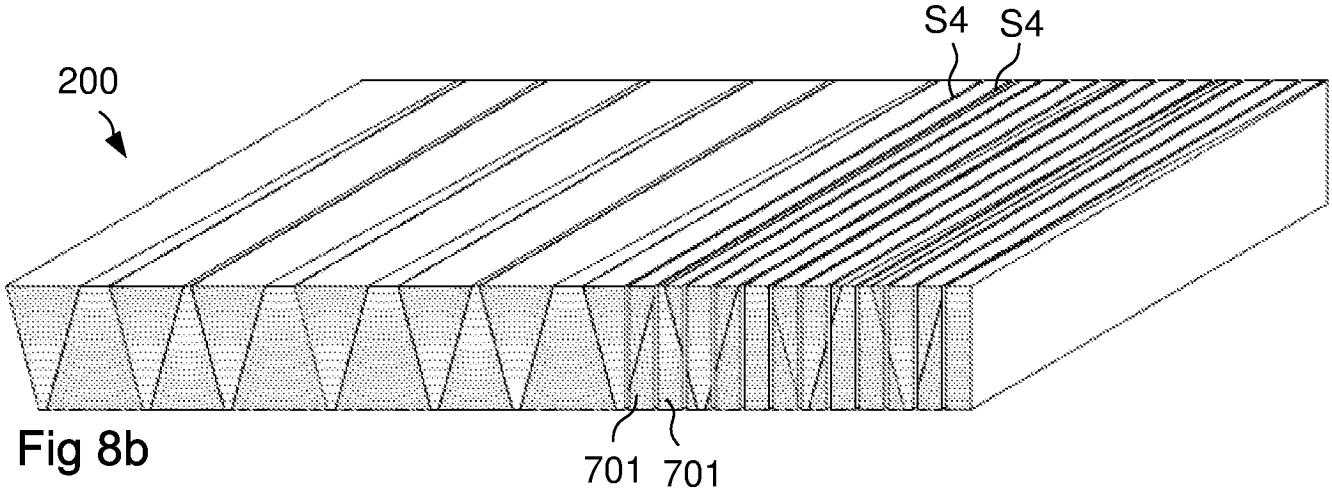


Fig 8b

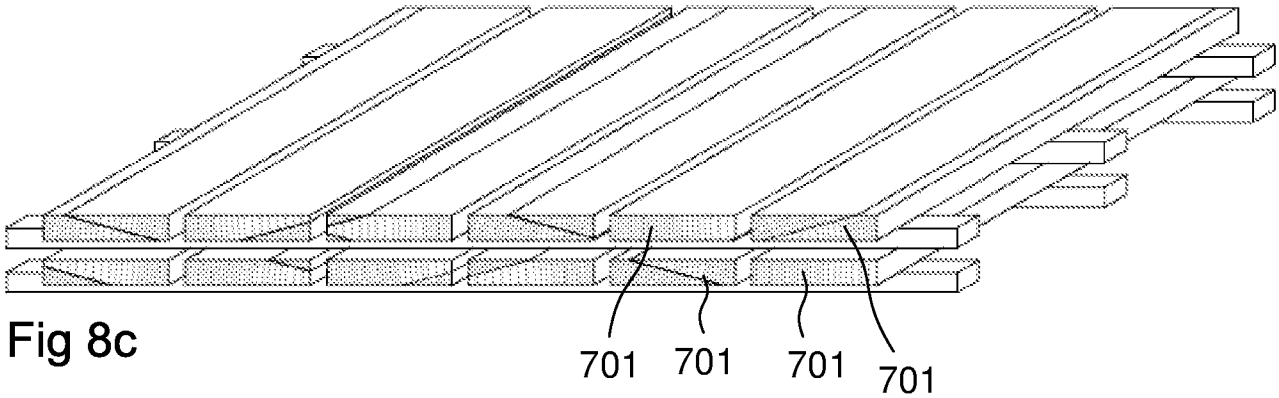


Fig 8c

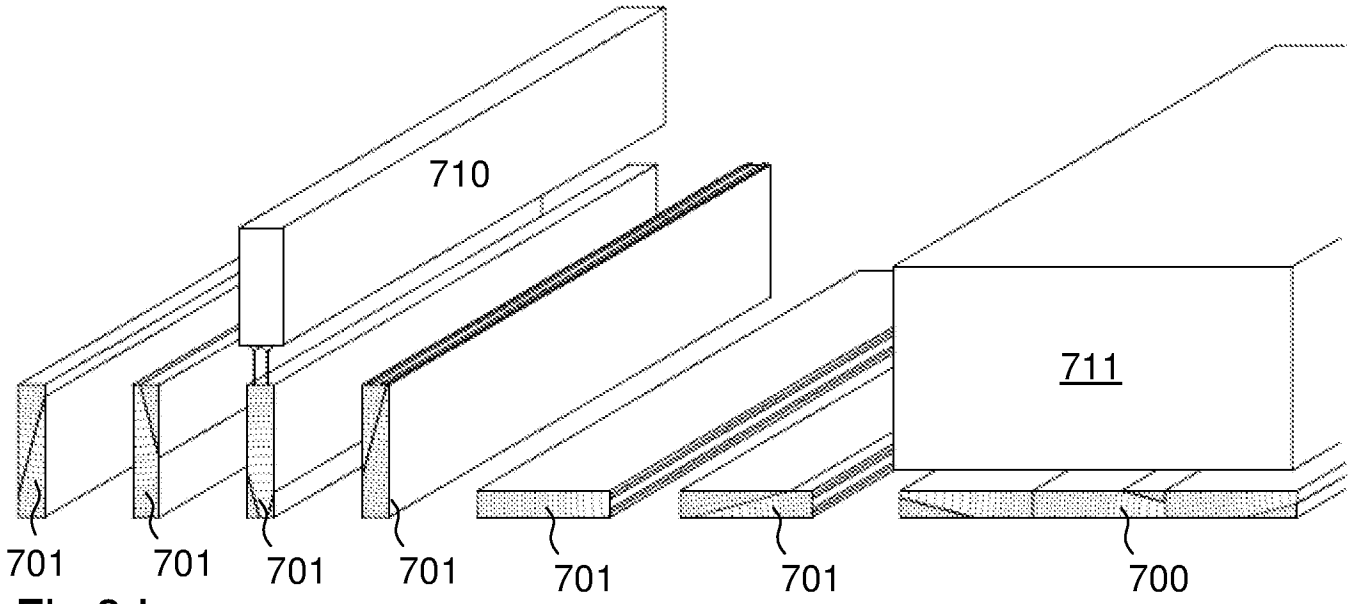


Fig 8d

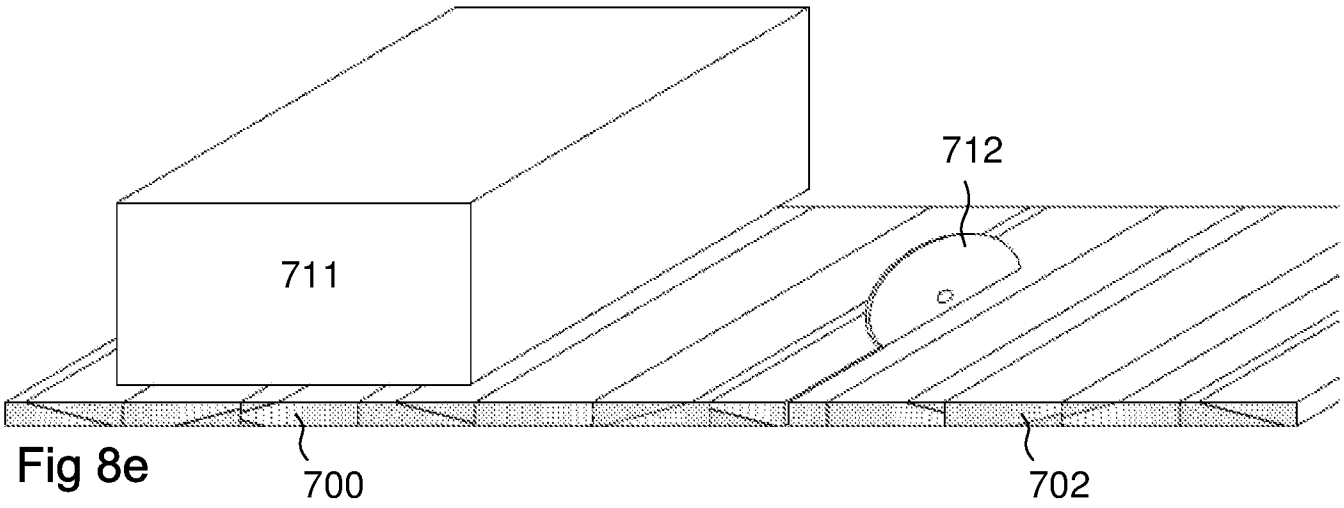


Fig 8e

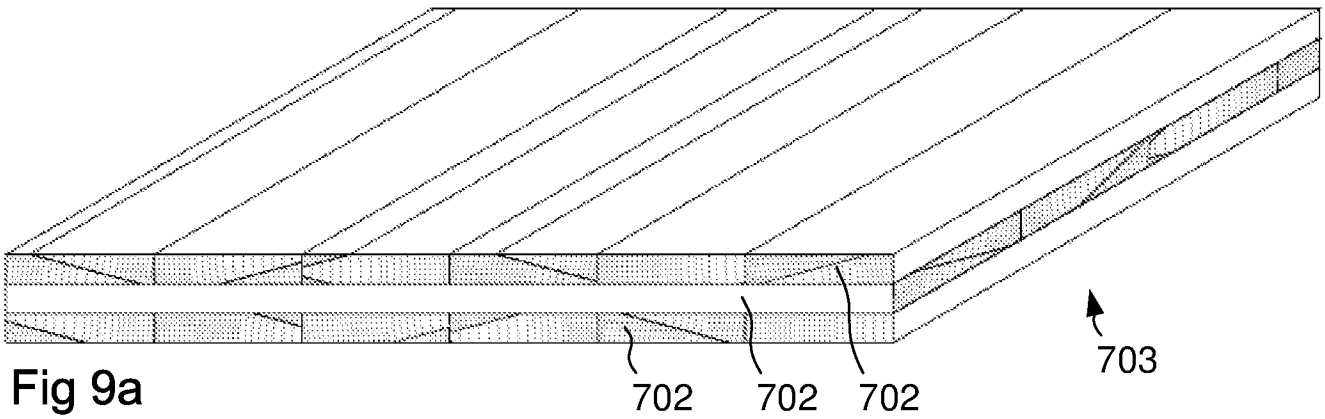


Fig 9a

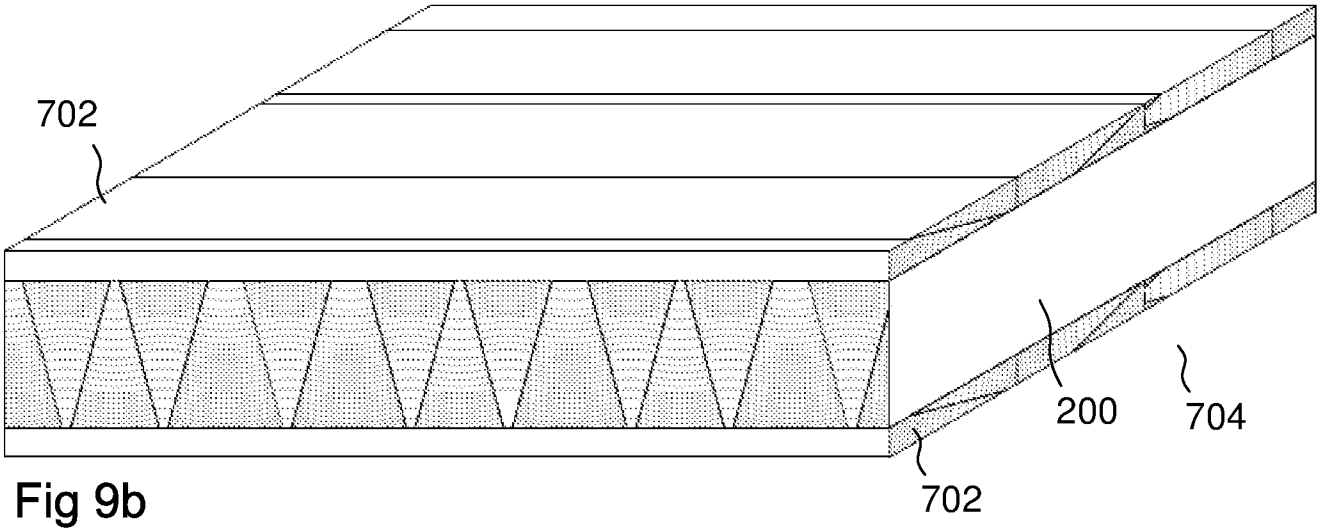


Fig 9b

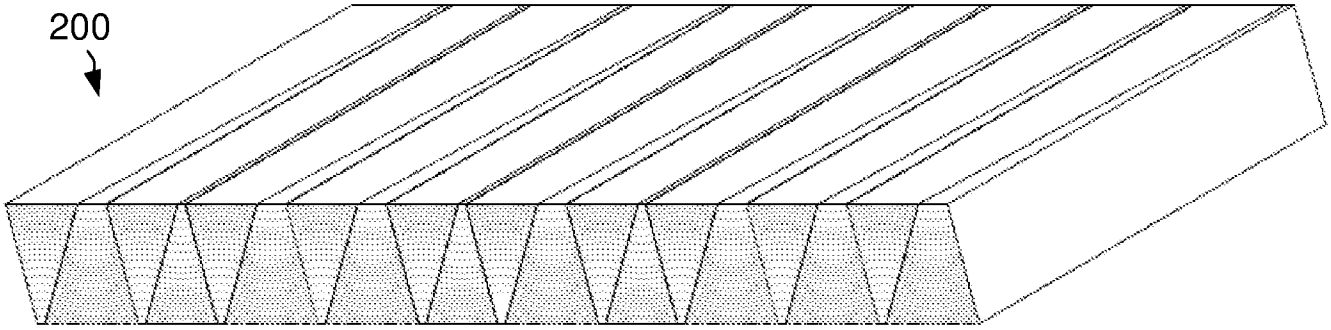


Fig 10a

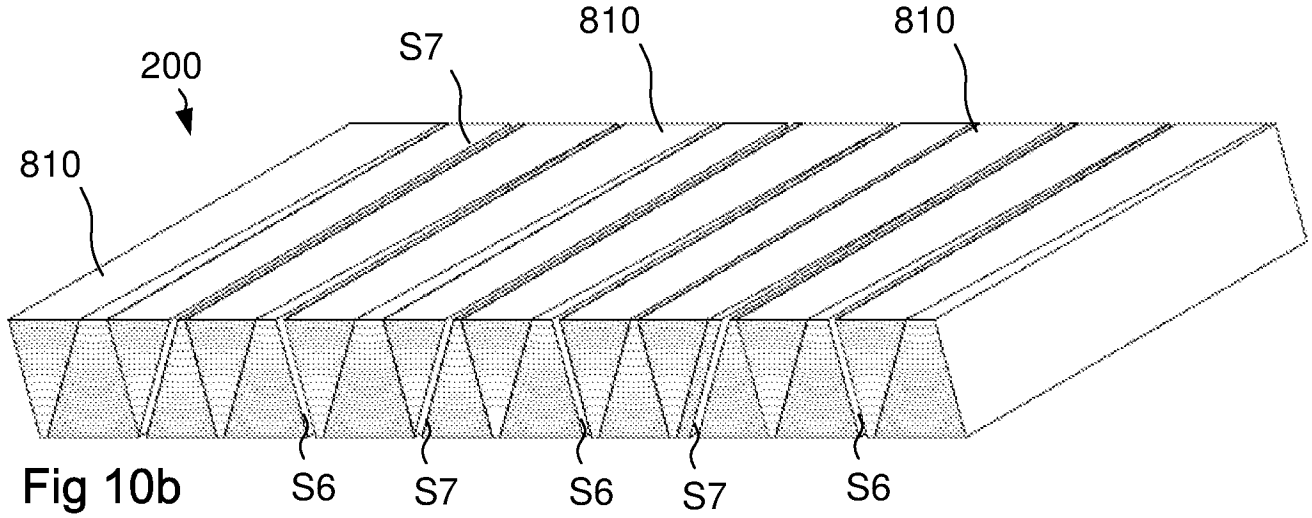


Fig 10b

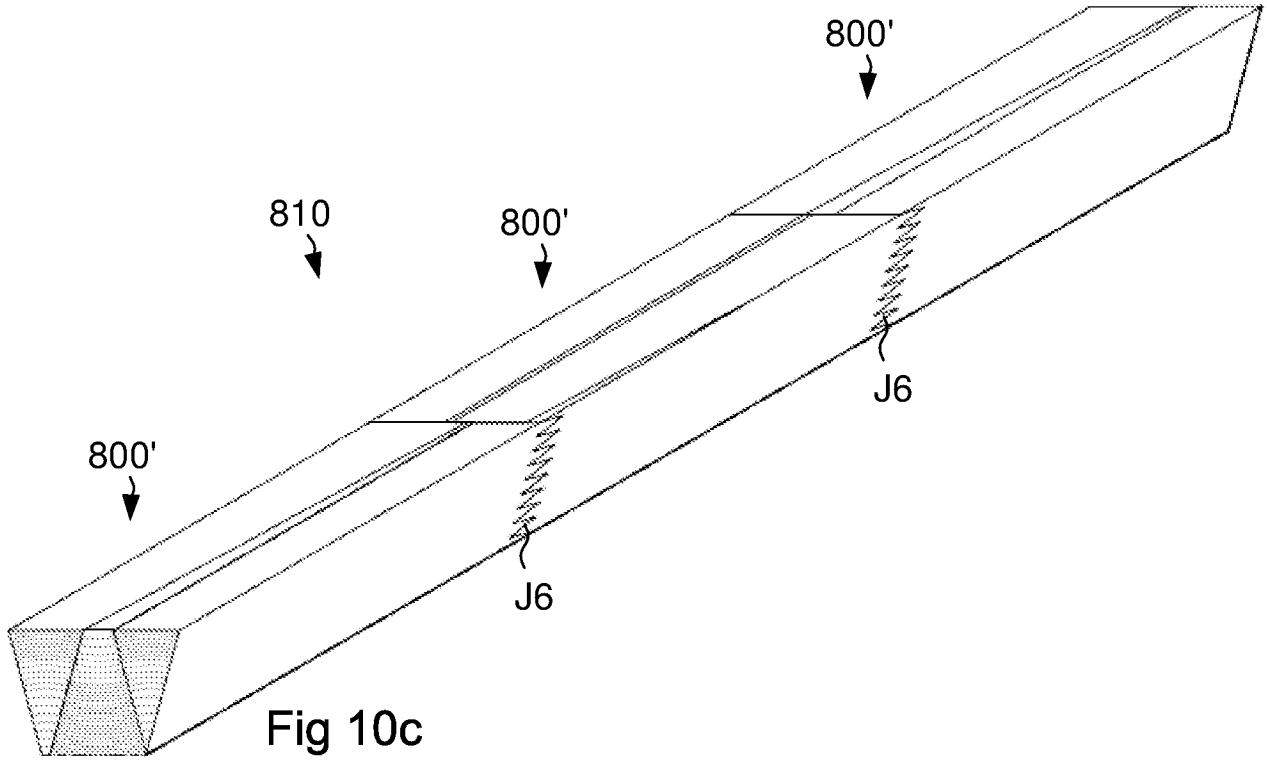


Fig 10c

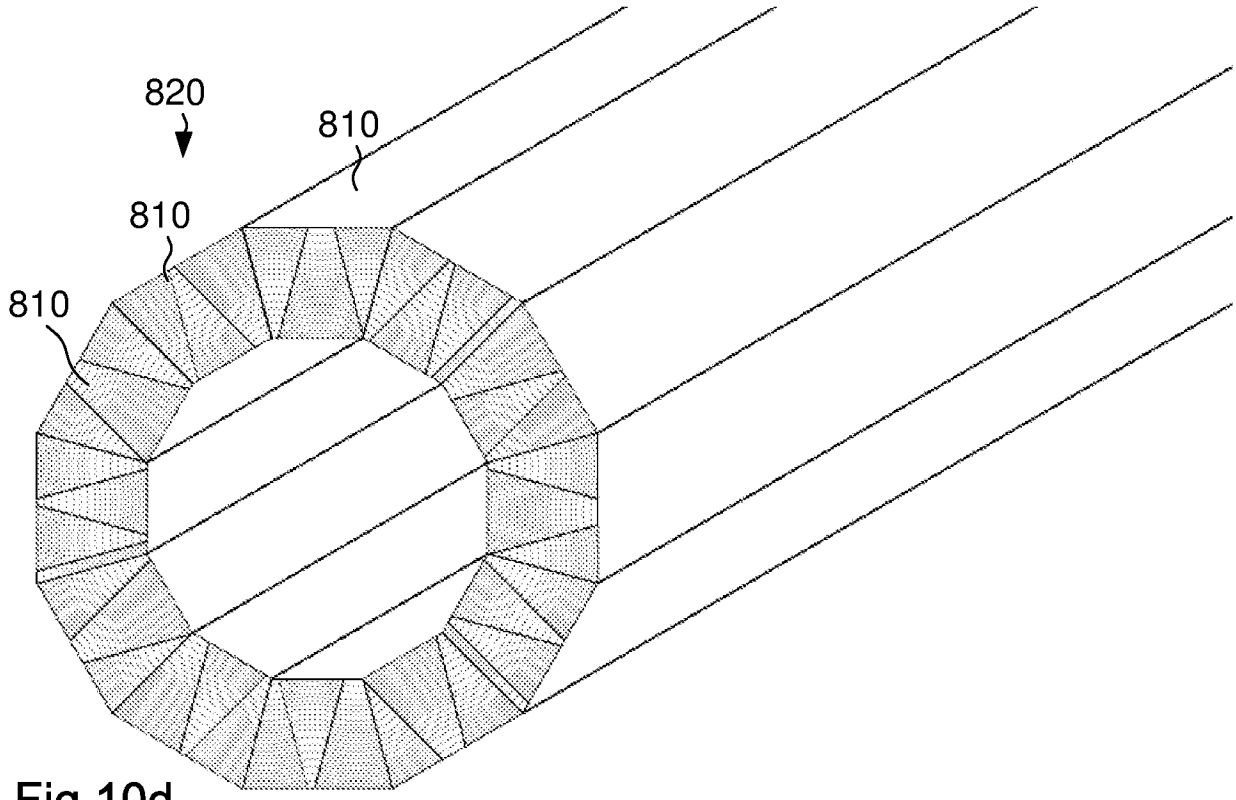


Fig 10d

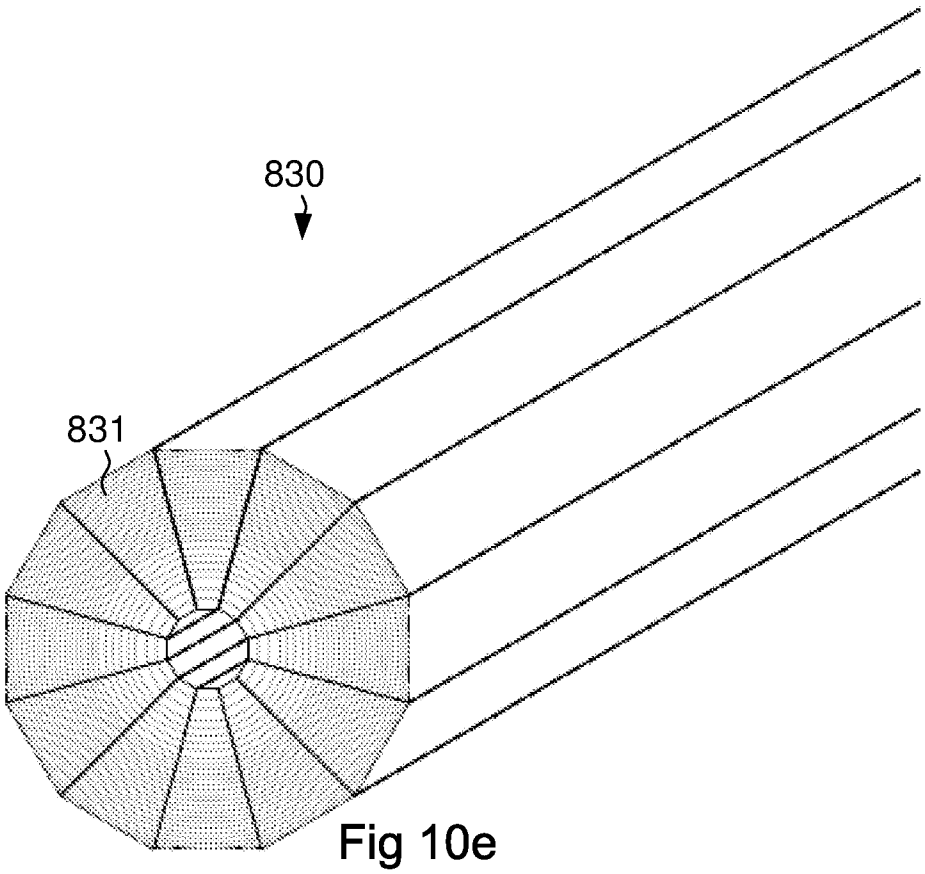


Fig 10e

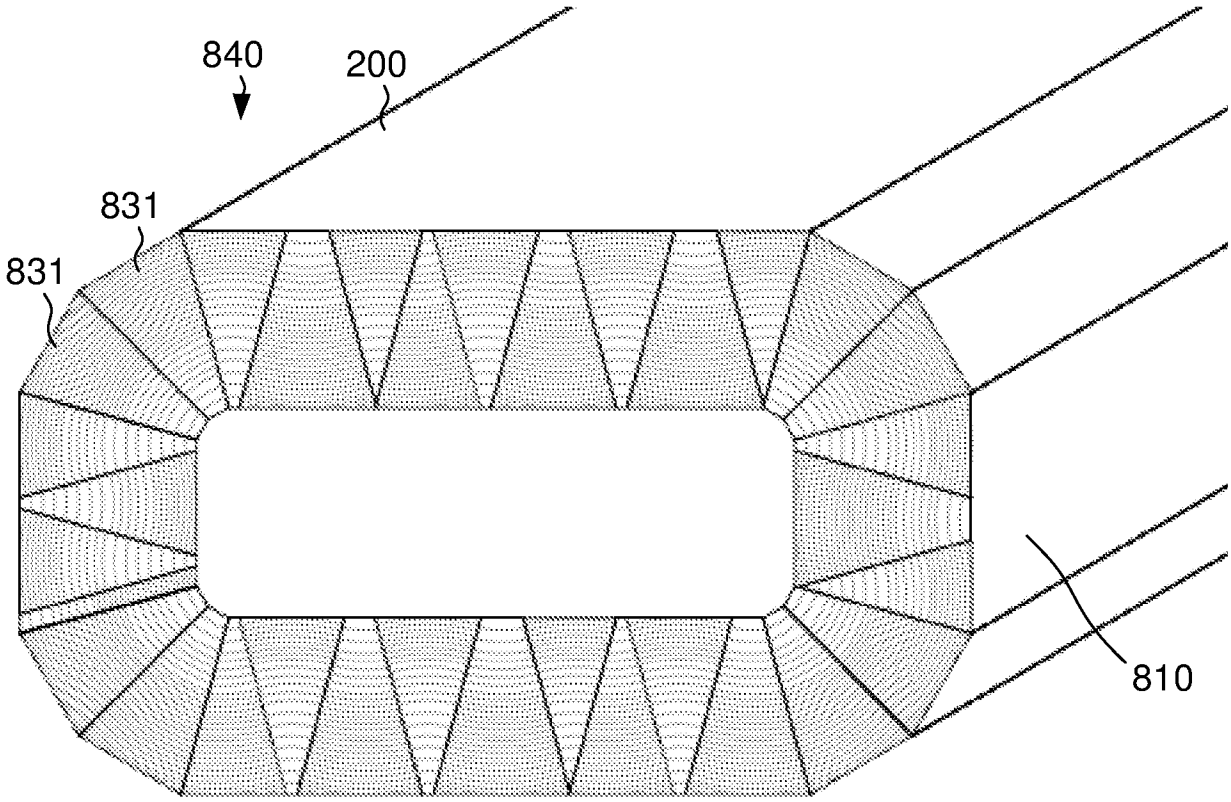


Fig 10f

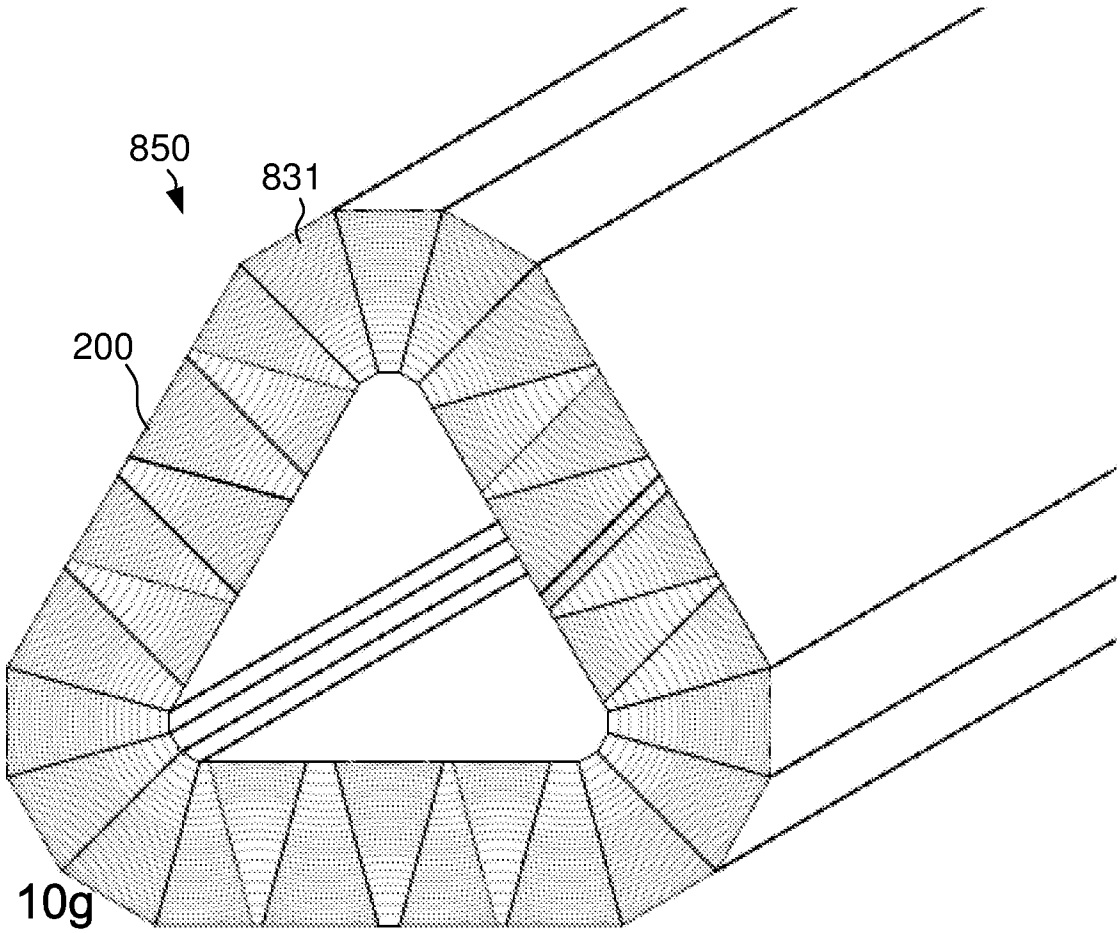


Fig 10g

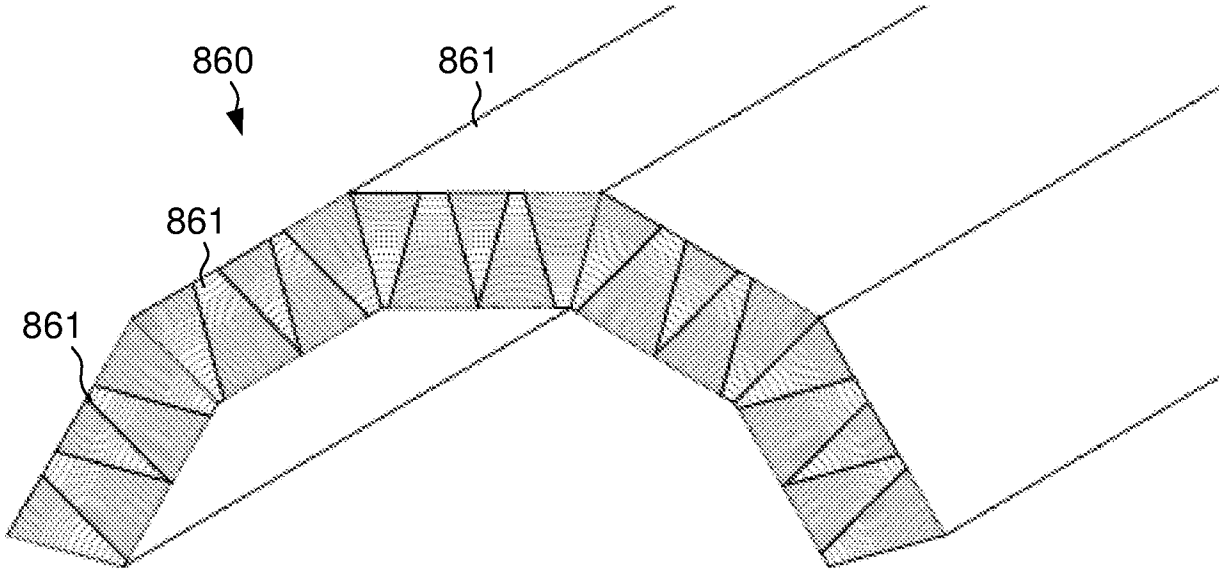


Fig 10h

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2016/056462

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B27B, B27M, E04B, E04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4111247 A (HASENWINKLE EARL DEAN), 5 September 1978 (1978-09-05); column 3, line 58 - column 4, line 10; column 5, line 2 - line 22; column 8, line 12 - line 22; column 8, line 27 - line 46; column 4, line 31 - line 35; claim 1 --	1-16, 68-70
A	US 4122878 A (KOHN JEAN), 31 October 1978 (1978-10-31); whole document --	1-16, 68-70
A	US 20130183477 A1 (LEITINGER SEBASTIAN ET AL), 18 July 2013 (2013-07-18); whole document --	1-16, 68-70

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08-03-2017	08-03-2017

Name and mailing address of the ISA/SE	Authorized officer
Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. + 46 8 666 02 86	Erika Stenroos Telephone No. + 46 8 782 28 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2016/056462

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 10135123 A1 (FRIES PETRA), 14 February 2002 (2002-02-14); whole document --	1-16, 68-70
A	US 4476663 A (BIKALES VICTOR W), 16 October 1984 (1984-10-16); whole document --	1-16, 68-70
A	FR 2458365 A1 (FRANCIOSI GIOVANNI), 2 January 1981 (1981-01-02); whole document --	1-16, 68-70
A	EP 0650811 A1 (HOLZBAU KRAEMER GMBH), 3 May 1995 (1995-05-03); whole document --	1-16, 68-70
A	US 3977449 A (SADASHIGE TAKESHI), 31 August 1976 (1976-08-31); whole document --	1-16, 68-70
A	WO 2013033736 A2 (SPENCER DRAKE TRUST IT 8663 95 ET AL), 7 March 2013 (2013-03-07); whole document -- --------	1-16, 68-70

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2016/056462

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

If there are two or more inventions in an application, these are considered to be mutually independent if there is no technical link between the inventions involving one or more of the same or corresponding special technical features. In this context, "special technical features" means those technical features with which each invention contributes over the prior art.

In case the independent claim lacks novelty and/or inventive step it is investigated whether

.../...

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 1-16,68-70

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Continuation of: Box No. III

there are any common special technical features that unite the dependent claims. This is investigated irrespective of whether one or more dependent claims lack novelty and/or inventive step beyond the prior art as defined in the document D1. If these dependent claims lack a common special technical feature, the application is considered to include several independent inventions.

The following separate inventions were identified:

1. Claims 1, 10, 12 and 70 (1-16 and 68-69) directed to a laminated wood product for use as a construction element, an elongate laminated wood product and a method of making a laminated wood product.

2. Claims 17, 27 and 29 (17-33) directed to a beam which at least partially formed of wood-based material, a building element comprising at least two beams, a method of making a beam

3. Claims 34, 40 and 43 (34-43) directed to a rib slab, comprising at least one panel, a rib slab system comprising a pair of rib slabs and a method of making a rib slab.

4. Claims 44, 48 and 53 (44-56) directed to a laminated wood board and a multilayer wood product, a multilayer wood product and a method of making a laminated wood product.

5. Claim 57 (57-60) relates to a laminated wood product for use as a pillar or pylon

6. Claim 61 (61-67) and 71 relates to a method of producing a laminated wood billet

A partial search has been carried out, which relates to invention 1 above.

The present application has been considered to contain 6 inventions which are not linked such that they form a single general inventive concept, as required by Rule 13 PCT for the following reasons:

The single general concept of the present application is the teaching that a wood lamellae cut from a log in the principal fiber direction, cut in a trapezoidal cross section so that the lamellae has a major base surface and a minor base surface.

The single general concept is known from document D1, see under “Reasoning”,

Thus, the single general concept is known/obvious and cannot be considered as a single general inventive concept in the sense of Rule 13.1 PCT.

No other features can be distinguished which can be considered as the same or corresponding special technical features in the sense of Rule 13.2 PCT.

Thus, the application lacks unity of invention.

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International Patent Classification (IPC)

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