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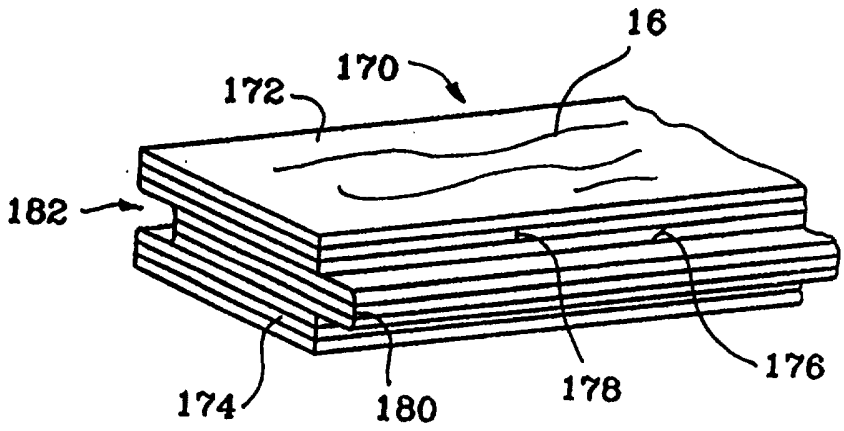
(54) Title: FLOORBOARD MADE FROM LAMINATED VENEER LUMBER

(57) Abstract

A floorboard (170) is made by forming a piece of laminated veneer lumber with an uppermost ply of wood (172) suitable for flooring and profiling the edges in a suitable mating pattern. Various tongue (180) and groove (182) and interlock patterns are disclosed. A floor made from the novel floorboards can be laid directly on joists without a subfloor, leading to cost savings in material and labor.



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FLOORBOARD MADE FROM LAMINATED VENEER LUMBER

Field of the Invention

This invention relates to a novel floorboard, and to a method of making it. The invention also relates to a novel floor construction.

Background of the Invention

Tongue-and-groove floorboards are a known type of lumber which is intended for use in floor constructions. Tongue and groove lumber is sawn, generally from hardwood, into long strips, and is profiled by being passed through a moulder or profiling saw to put a tongue on one longitudinal edge, and a corresponding groove on the other. Generally, wood tongue and groove flooring is laid over a plywood or particle board subfloor, and is nailed to the subfloor, which in turn is nailed to joists.

Besides sawn lumber, another type of lumber is known. This is called laminated veneer lumber, or LVL. In LVL, veneers of wood are laid together, usually with their grain all going in the same direction, although it is known sometimes to put in one or more layers of the grain at right angles as well. LVL is typically made in long lengths of rectangular cross-section. Typically, the cross section is made to be the same as common sizes of structural sawn lumber. LVL tends to be stronger and more uniform in its properties than sawn lumber of the same cross-sectional dimensions.

Brief Description of the Invention

The invention comprises in one embodiment a tongue and groove floorboard made of laminated veneer lumber. Preferably, the floorboard comprises a top outer veneer, at least three interior veneers and a bottom outer veneer. The top outer veneer is formed from a wood which has a good wearing capability and/or good appearance. Preferably, it is formed from hardwood. Preferably, all veneers have their grains aligned in the longitudinal direction of the board. In a preferred embodiment, the floorboard is profiled with a tongue and groove, having on one side of its transverse profile a tongue, and on the other side a groove to mate with the tongue of an adjacent

similar board, so that adjacent boards can be assembled together in a tongue and groove relationship. In other embodiments, the floorboard has longitudinal edges of other complementary forms which mate or interlock with like boards adjacent to them.

The invention also relates to a method for making a floorboard, which comprises selecting at least five veneer sheets, drying said veneer sheets, gluing them together to make a billet, sawing the billet into boards and profiling boards so obtained with complementary longitudinal edges so that like boards can mate or interlock. Preferably, the complementary shapes are a tongue on one longitudinal edge and a groove on the opposing longitudinal edge, said tongue and groove being sized for mating, such that adjacent boards having the same profile can be assembled in tongue and groove relation. Preferably, the top veneer is made of a wood which has desirable wearing or appearance qualities. The remaining veneers can be made of a cheaper wood.

The invention also relates to a method for making wood floors, in which tongue and groove floorboards according to the invention are nailed directly to joists, without a subfloor.

Description of the Drawings

The invention will be further illustrated with reference to the drawings in which:

FIGURE 1 (which comprises SUBFIGURES 1A to 1F) is a schematic diagram of a process for making floorboards according to the invention.

FIGURE 2 is a perspective view of a floorboard according to the invention.

FIGURE 3 is a perspective view of a floor made according to the invention.

FIGURE 4 is a detail along the lines 4-4 of Figure 3.

FIGURES 5 and 6 are end views of additional embodiments of floorboards according to the invention.

Detailed Description of the Invention

According to the invention, a floorboard is assembled from veneers, with optional other layers as described below. The veneers are made in known fashion by peeling logs. For example, veneer can be made using machinery supplied by Durand-Raute Industries Ltd. of New Westminster, B.C. Such equipment includes debarking machinery for removing the bark from logs, lathes or spindleless lathes for turning the logs and peeling a veneer of substantially constant thickness from the logs, and veneer drying equipment for drying the veneers.

The veneers are dried in a veneer drier to a dryness sufficient so that the glues used for assembling the veneers together will bond. Typically, most glues used for assembling veneers do not bond well when more than about 10% water content is in the veneers. Therefore, it is usually desired to dry the veneers to a water content of below 10%, preferably about 7% - 8%.

After drying, veneer sheets are chosen for assembly. At least four veneer sheets are chosen. These will be glued together in face-to-face relationship.

The number of sheets chosen to be assembled to form the product will depend on what its ultimate use will be, and also to some extent on aesthetic factors. The sheets, once glued together, are known as plies. A minimum of four plies is needed to give the product strength. Generally, strength increases with the number of plies, if all plies are of the same species and wood quality. The quality and the species of the wood also affect strength as is well known in the LVL art.

Usually, there is not much advantage to having more than 15 plies, particularly as it becomes harder with increasing numbers of plies to apply heat and pressure evenly to bond the adhesive, It is generally preferred to have from 5 to 12 plies, depending on the intended use. Floorboards which are to be laid on a subfloor need no more than 4 or 5 plies. Floorboards which are to be laid directly onto joists with no subfloor preferably have 5 to 12 plies, depending on the intended distance to be spanned and the wood used. For aesthetic and customer acceptance reasons, it is often preferred to use a number of plies which gives rise to a thickness dimension equivalent to that of sawn lumber for the same application. Customers are reassured about the strength of the product when it is as thick as a product they have already

used, and the same thickness permits it to be used interchangeably with sawn lumber.

The veneer sheet which will form the top outer face of the product is chosen to be one which has desirable wearing properties or a desirable appearance. The reason that such a veneer is chosen is that the top face is the portion of the floorboard which will be most readily seen after assembly, and also because it forms the wear surface. Preferably, the top sheet is a hardwood veneer of a species frequently used for floorboards, such as maple or birch. The remaining veneers can be of a less expensive wood, such as a softwood. For example, lodgepole pine is cheap and reasonably durable. It is preferred that the sheet which will form the bottom face of the board also be substantially knot and blemish free, as when the board is used as part of a floor according to the invention, it may in some installations be visible from below.

The veneers chosen preferably all have their grain running in the same direction, in the direction which will form the longitudinal direction of the finished decking boards. As is known in the art, each veneer has two different faces, known as the "tight" and "loose" face. The "tight" face is the surface which was farther away from the centre of the log when the veneer was peeled from the log. Wood fibres tend to be closer together on this face than on the opposite, or "loose", face. It is preferred, as known in the LVL art, to arrange (or "lay up") the veneers so that loose faces are glued to loose faces, and tight faces are glued to tight faces, as this is found to reduce splitting, cracking or curling of the product and its external veneers.

Preferably, the veneers are of conventional thickness, being either 1/10", 1/8" or 1/6". Preferably also, all veneers are of the same thickness in any one board. The veneers are not crushed appreciably during manufacture of the board product, so the finished product has plies of approximately the thickness of the veneers chosen.

It is possible to replace one or more of the veneer sheets with a sheet of some other suitable material. For example, a sheet of oriented wood strands glued together, such as is used in the making of oriented strand board (OSB) can be used. Obviously, the OSB sheet should not replace the top veneer, as it is desirable to have a hard wearing wood veneer surface for the floor.

Each of the interior veneers is coated on both faces with adhesive, and each of the top and bottom veneers is coated with adhesive on the face which will contact the face of an interior veneer. Alternately, it is possible to coat only one face (for example, the top face) of each of the interior veneer sheets, of the bottom sheet.

The adhesive should preferably be one which is moisture resistant after it bonds. It is preferred to use a thermo-setting adhesive which is not sticky until heat activated, as this facilitates the handling and positioning of the sheets. Suitable adhesives are phenolic adhesives, such as phenolic PF20/20 (trademark) manufactured by the Borden Chemical Company of Belleview, Washington, or phenol resorcinol adhesives, such as LT75 (trademark) manufactured by the Borden Chemical Company of Belleview, Washington. It is also possible to use isocyanate adhesives, but these are generally not preferred because they are more costly than the phenolics or phenol resorcinols. There are certain advantages to use of isocyanates, however, as they can cure faster under heat and pressure than the phenol resorcinol or phenol formaldehyde glues, and because they are moisture resistant. A suitable isocyanate glue is PMDI, manufactured by ICI Chemicals Ltd., which is a polymethyl di-isocyanate glue.

The amount of adhesive coated on the faces of the veneers is as is known in the art of LVL manufacture, and follows the recommendations of adhesive manufacturers recommend how much of their particular adhesive should be applied. For example, when phenolic PF 20/20 (trademark) adhesive is used, the recommended coating is 30 to 34 pounds per 1000 square feet of surface to be bonded.

After the adhesive is coated onto the faces of the veneers, the veneers are assembled in face-to-face aligned relationship. They are then held together with heat and pressure to bond the adhesive. Suitable temperatures and pressures are those recommended by the adhesive manufacturer. For example, when phenolic adhesives are used, a pressure of about 180 psi is applied to the sheets at a temperature of about 300°F. When phenol resorcinol adhesives are used, a pressure of about 180 psi is preferably applied to the sheets at a temperature of about 200 degrees F.

After the sheets have been bonded together, they form a block of wood

known as a billet. The billet is then sawn parallel to the grain of the sheets (or the majority of the sheets) into strips suitable for the intended final use. The width of the strips into which the billet is sawn depends upon the desired width of the floorboards to be made from it. Typically, floorboards have a width of between 1" and 6". The width to which each strip is sawn is about 1/4 inch greater than the width of the finished floor board, to provide material for the making of the tongue in a subsequent step. This subsequent step is carried out immediately after, using a moulder or profiling saw. The strips are passed through this saw, so that a tongue is placed in one longitudinal edge of the strips, and a matching groove in the opposite longitudinal edge of the strip.

Once they have been sawn to the desired sizes, the strips are dried if necessary to achieve a desired humidity level. The desired humidity will depend on the climate in which the flooring is to be used. It is generally desirable that flooring have a humidity level which is not greater than that of the surrounding air, to prevent it from drying out and cracking. For most climates, a humidity level of 15% to 18% is satisfactory. Humidity levels can be determined by taking a small sample of the product, weighing it, heating it until all water is driven off, and weighing it again. The loss in weight is equivalent to the weight of water in the original sample, and from this the % moisture content of the original sample can be calculated. In some cases, the humidity level of the wood is already at an acceptable level, and drying is not necessary.

Where drying is appropriate, this can be done in a drying kiln if desired, but it is usually quicker to remove moisture by applying a vacuum. To do this, the strips are loaded into a pressure vessel. In the pressure vessel, a vacuum is created to remove moisture from the wood. The exact amount of vacuum used for the vacuum treatment is not critical. Generally, a vacuum treatment of from 15 to 50 minutes at an absolute pressure of 15 to 20 inches of mercury is suitable, depending on the moisture content of the wood.

After the vacuum treatment, the top veneer can be treated with a surface finish if desired, and/or stained with a wood stain. Alternately, it can be left natural, for finishing once it is in place as part of a floor. The strips are then packaged or bundled for sale as floorboards.

Figure 1 shows the process of the invention in a diagrammatic form.

Prior to carrying out the process of the invention, a veneer sheet 10 is made in known fashion, as by peeling a log 12 using a lathe knife 14 to peel off the veneer (Figure 1A). This may be done on several types of equipment, such as spindled or spindleless lathes, and does not form a part of this invention.

The prevailing grain of the wood is shown schematically at 16.

The veneer is split into sheets of suitable size 18 by a suitable knife blade 20. The sheets 18 are then dried in a veneer drier 22 (Figure 1B) if necessary to reduce the moisture level to one at which bonding with a suitable adhesive can take place. As mentioned previously, this is 10% moisture or less for most commercially available adhesives.

Suitable veneers are then assembled for the product which is to be made. This is known as "laying up " the product. In a high speed veneer mill, the lay up is a continuous process, and veneers are joined together end-to-end to make continuous sheets which are run together in an assembly line with the subsequent steps to make very long billets of veneer, which are then cut to size at the end of the assembly line. In smaller, discontinuous, processes, the laying up is done by manually selecting and orienting sheets, As Figure 1 is intended to be diagrammatic of the process, not to show particular apparatus for continuous or discontinuous operation, the illustration will show sheets of discrete size rather than continuous sheets for ease of illustration.

In Figure 1C, the veneers for a particular product are chosen and "laid up". There is a top veneer 24. As mentioned, this is a veneer which is substantially free of knots or other imperfections. It is also preferably of a wood which is prized for floor boards, such as birch or maple. The remaining veneers may be any of the species which are usually used in the making of plywood or LVL. As is common in LVL, the grain of at least the majority of the sheets (preferably all of the sheets, as in the illustration) run in the same direction, as shown by grain lines 16. This direction will become the longitudinal direction of the product to be made.

In the embodiment shown in Figure 1, the product is to have a 5 veneer thickness. The bottom veneer 32 is also chosen as being one with few knots or other surface imperfections. The veneers which will form the interior layers, 26, 27 and 30,

need not be of such good quality and for example, in veneer 28 there are several knots 38 shown.

.Although not preferred, it is possible to select as top veneer a veneer of a species commonly used for LVL or plywood. If this is done, the top veneer is generally selected to be one with a pleasing appearance, for example one without many knots or imperfections. If the underside of the flooring will be seen after installation, the bottom veneer is chosen so that its outward-facing face is of a pleasing appearance as well. For example, a veneer of the same hardwood used for the top veneer could be used as the bottom veneer.

In the drawing of veneer sheet 30, it is illustrated that the veneer need not be one single piece. Veneer 30 is actually two veneers 40 and 42 which have been joined together by joint 44. Joint 44 is what is known as a scarf joint, which means that it is cut at an angle to thickness of the wood. Such joints are known in the art of laminated veneer lumber and plywood manufacture for joining the ends of veneers.

Adhesive is sprayed onto the upper surface of sheet 32 by adhesive sprayer 46. It is possible to spray adhesive on only the upper surface of each of the sheets 32, 30, 28 and 26. Alternately, it is possible to spray adhesive onto the upper surface of the sheets 32, 30, 28 and 26 and to have another adhesive sprayer or roller coater (not shown) apply adhesive onto the bottom of sheets 30, 28, 26 and 24.

The five sheets are then assembled in face-to-face relationship, and are subjected to heat and pressure in a press 48. (Figure 1D) This press 48 has platens 50 and 52 which press the sheets together and activate the thermo-setting adhesive, to form a block-like form 54 known as a billet. This billet is comprised of the glued together sheets (now known as plies).

The billet is then passed through a gang of saws 56, (Figure 1E) which cut it into strips of the desired width. As mentioned, this width varies with respect to the desired product.

The strips are then given a desired profile along their longitudinal edges. This is done by passing the strips separately through a profiling saw or moulder. As shown in FIGURE 1F, a tongue 62 is formed on one longitudinal edge of strip 60 by moulder blades 64 and a corresponding groove 66 is formed on the opposed

longitudinal edge by moulder blades 68 By using moulder blades of other shapes, other profiles can be given.

Figure 2 shows a floorboard according to the invention, with a tongue and groove profile. This board has 9 plies, rather than the five plies shown in Figure 1. To show the plies of the board, the thickness has been greatly over-emphasized with respect to the length and width. Typically, such a board would be about 2" in width, 1 1/8" in thickness and would have a length of from 2' to 20'.

The board is shown at 170. There is a top ply 172 of a wood having good wearing properties and good appearance, and 8 other plies, generally indicated as 174. In some cases, pieces of veneer have been joined end-to-end to make a ply by either a scarf joint, as shown at 176, or a butt joint (vertical to the surface of the ply) as shown at 178. A tongue 180 runs longitudinally along one side edge of the board, and a groove 182 runs along the other side edge. The tongue and groove are sized so that when two similar boards are placed side by side, the tongue of one fits into the groove of the other. The tongue is large enough so that it is formed of more than one ply (to improve its strength), and in the illustration it is formed of three plies.

Figure 3 shows a floor, for example on the second story of a house, constructed according to the invention. Horizontal beams 250 are spanned by parallel joists 258. In the embodiment illustrated, joists 258 are spaced on 16" centres.

In normal construction practice, when installing tongue and groove flooring, a subfloor of plywood or particle board would be installed over the joists, and the tongue and groove flooring would be nailed to the subfloor. However, with the floorboards of the invention, a subfloor is not necessary. Instead, tongue and groove floorboards 170 made according to the invention are laid directly on the joists, with their top plies 172 uppermost. The detail in Figure 4 shows how they are nailed to the joists by nails 204. This nailing technique is the same as is used in attaching tongue and groove floor boards to a subfloor. However, because of the strength of the floor boards made according to the invention, no subfloor is needed.

The flooring according to the invention can be of any thickness which is suitable for the spacing between joists 258. If the joists are spaced on 16" centres from one another, a floor board of 5 plies of 1/8" veneer is suitable, making a thickness of

5/8". If wider spacings are preferred, such as 24", then 9 plies, for a total of 1 1/8" is preferred.

The fact that the flooring of the invention can be assembled without a subfloor leads to great savings in material and labour costs. The material cost of the subfloor is avoided, as is the labour cost to put it in place. There is also another advantage, as relative movement between the subfloor and the tongue and groove flooring often causes creaking in conventional floors. By eliminating the subfloor, the invention therefore eliminates a major cause of creaking floors.

It is also possible to assemble the tongue and groove flooring onto a subfloor if desired. This may be desirable, for example, where the flooring replaces previous flooring and a subfloor is already in place.

The flooring disclosed to this point in the disclosure has a conventional mating tongue and groove. This is preferred because it is a pattern which is familiar to flooring installers, and also because it lends itself to nailing as shown in Figure 4. However, other mating profiles can also be made according to the invention, by using a moulder of a different profile. For example, board 290 having a double tongue and groove arrangement as shown at 291 in Figure 5, or board 300 having an interlock arrangement 301 as shown in Figure 6, or any other desired longitudinal edge profile can be made, by using a moulder with the desired configuration. With these profiles, adjacent boards are joined by applying adhesive to their edges, or by nailing through the thickness of the boards as shown by the dotted nail at 292 in Figure 5, or by nailing through a portion of the interlock if the interlock design permits this, as shown by the dotted nail at 302 in Figure 6. Other interlocking shapes will be evident to persons skilled in the art in the light of this disclosure. The invention in its broad embodiments therefore comprises any LVL floorboards which have edges which mate or interlock when like boards are assembled in side-by-side relationship. The invention also comprises the floor that results when such boards are assembled together directly on joists, without a subfloor.

While the foregoing has disclosed various embodiments of the invention, it is not desired that the invention be limited by the particular embodiments disclosed, but instead that it be limited as set out in the attached claims.

What is claimed is:

1. A piece of laminated veneer lumber, said piece of lumber being dimensioned as a floorboard and having an upper face, a lower face and two longitudinal edges, said upper and lower faces being the faces of veneer layers, and having complementary shapes along opposite longitudinal edges, whereby like boards, when assembled in side-by-side relation, can mate with one another,.

2. A piece of laminated veneer lumber as claimed in claim 1, in which said complementary shapes are a tongue and a groove, said groove being sized and shaped to receive the tongue of a like board.

3. A piece of laminated veneer lumber as claimed in claim 1, in which said compementary shapes are mating interlock portions said interlock portions being sized and shaped to receive the interlock portions of a like board .

4. A piece of laminated veneer lumber as claimed in claim 1, in which the veneer forming the uppermost face of said floorboard is substantially free of knots and imperfections.

5. A piece of laminated veneer as claimed in claim 1, in which the veneer forming the upper face is of a wood species commonly used as a flooring materal.

6. A piece of laminated veneer lumber as claimed in claim 1 and having at least three and not more than eleven interior veneers bonded together in face to face relationship between the veneers forming the upper and lower faces, the outermost of the interior veneers being bonded to the inner faces of the veneers which form said upper and lower faces of said piece of laminated veneer lumber.

7. A piece of laminated veneer lumber as claimed in claim 6, in which all layers including the outer faces are wood veneers having their grain in the longitudinal

direction of the piece of lumber.

8.. A piece of laminated veneer lumber as claimed in claim 1, said piece having a substantially rectangular cross-section, with the upper and lower faces being of the same width, the width of said faces being at least four times as great as the thickness of the board.

9. A piece of laminated veneer lumber as claimed in claim 1, in which:
(a) said complementary shapes are a tongue and a groove, said groove being sized and shaped to receive the tongue of a like board,
(b) the veneer forming the uppermost face of said floorboard is substantially free of knots and imperfections, and
(c) the veneer forming the upper face is of a wood species commonly used as a flooring materal.

10. A process for making a laminated veneer lumber article, which comprises :
(a) selecting at least four veneer sheets
(b) gluing said veneer sheets together in face to face relationship to form a billet, , at least the majority of such sheets being oriented so that their grain runs in the same direction;
(c) sawing the billet in a direction parallel to the grain of said majority of said sheets to form laminated veneer lumber, and
(d) profiling the laminated veneer lumber to provide complementary shapes on the longitudinal edges thereof, whereby pieces of such lumber with complementary shapes can be assembled together tightly in side by side relationship.

11.. A process as claimed in claim 10, in which the complementary shapes are a tongue on one longitudinal edge and a groove on the opposite longitudinal edge.

12. A process as claimed in claim 10, in which the uppermost of the veneer sheets is a wood commonly used for floor surfaces.

13. A process as claimed in claim 10, in which the uppermost veneer is birch or maple, and is substantially free of knots, holes and imperfections.

14. A process as claimed in claim 10, in which the total number of sheets of veneer which are glued together are sufficient to make a billet of from 5 to 12 plies.

15. A process as claimed in claim 10, including the step of drying the veneers prior to the step of gluing so that they have a water content of not more than 10% by weight..

16. A process as claimed in claim 10, in which the gluing step comprises:
(i) coating at least one of each two mating faces with a thermosetting adhesive which, once applied, is not sticky until it is heat activated.
(ii) holding the veneers in face-to-face contact while applying sufficient heat and pressure for sufficient time to bond the veneers together.

17. A process as claimed in claim 10, additionally comprising the step of drying the lumber article to a humidity level of 15-18% after forming the complementary shapes.

18. A process as claimed in claim 10 in which:
(e) the complementary shapes are a tongue on one longitudinal edge and a groove on the opposite longitudinal edge,
(f) the uppermost veneer sheet is a wood commonly used for floor surfaces,
(g) the uppermost veneer sheet is substantially free of knots, holes and imperfections, and
(h) the total number of sheets of veneer which are glued together are sufficient to make a billet of from 5 to 12 plies.

19. A method of laying a floor on spaced joists which are not joined by a subfloor, which comprises:
(a) nailing a first piece of laminated veneer lumber as claimed in claim 2 directly to

at least two spaced joists, at right angles to such joists and spanning the space between them, such that the nails used for nailing extend from the groove of such first piece through a portion of the thickness of said first piece into the joists, the heads of such nails being in the groove of said first piece and are placed so as not to prevent the entry of a tongue into said groove

(b) placing another piece of laminated veneer lumber as claimed in claim 2 parallel to and in contact with the first said piece, with the tongue of the second piece in the groove of the first piece, and

(c) nailing said second piece to the joists such that the nails used for nailing said second piece extend from the groove of such second piece through a portion of the thickness of such second piece into the joists.

20. A floor made according to the method of claim 19.

FIG. 1A

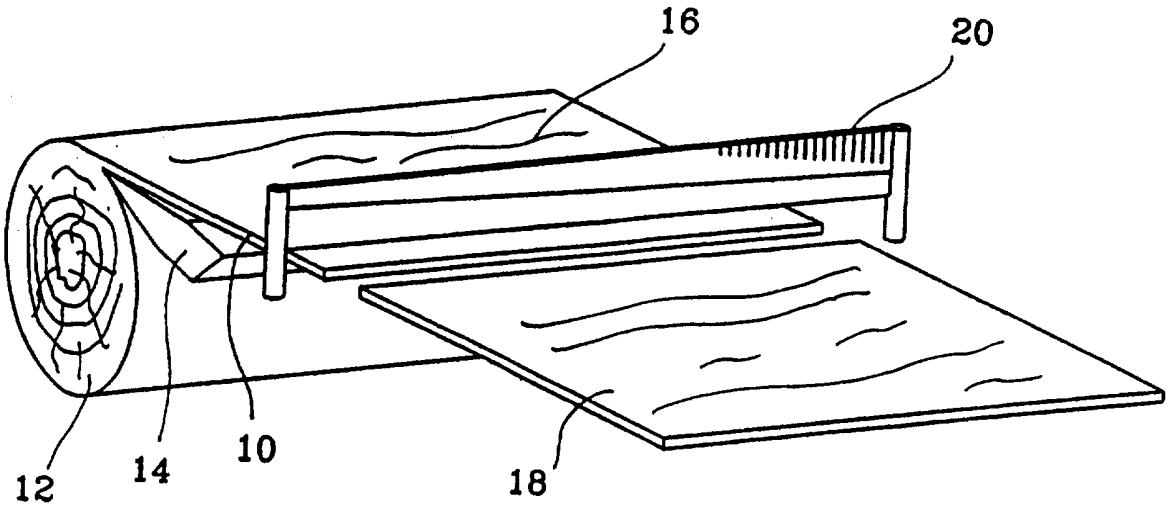


FIG. 1B

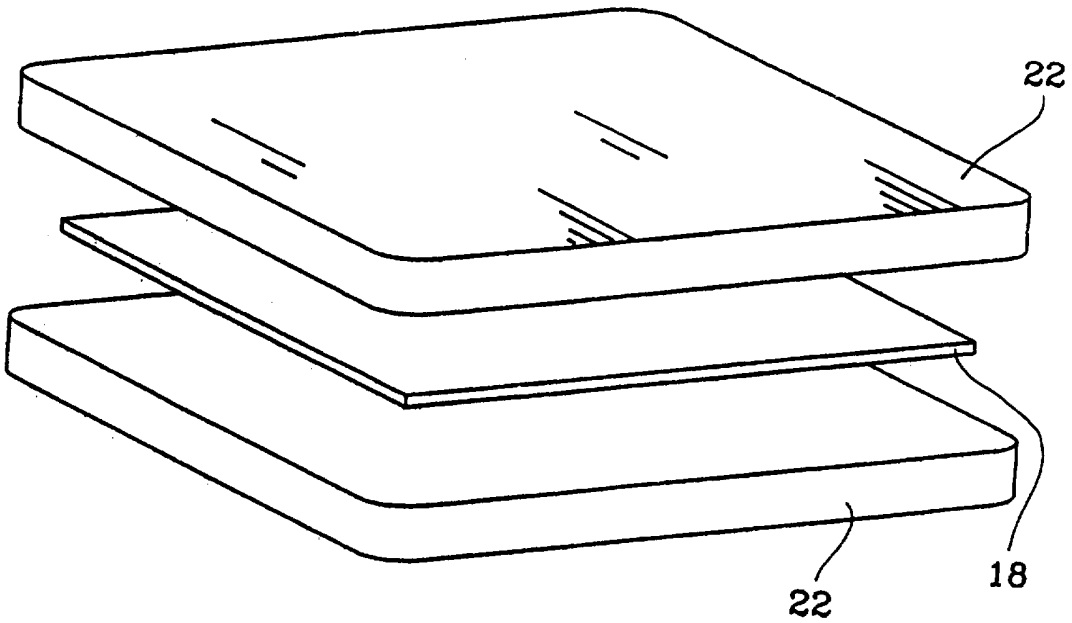


FIG. 1C

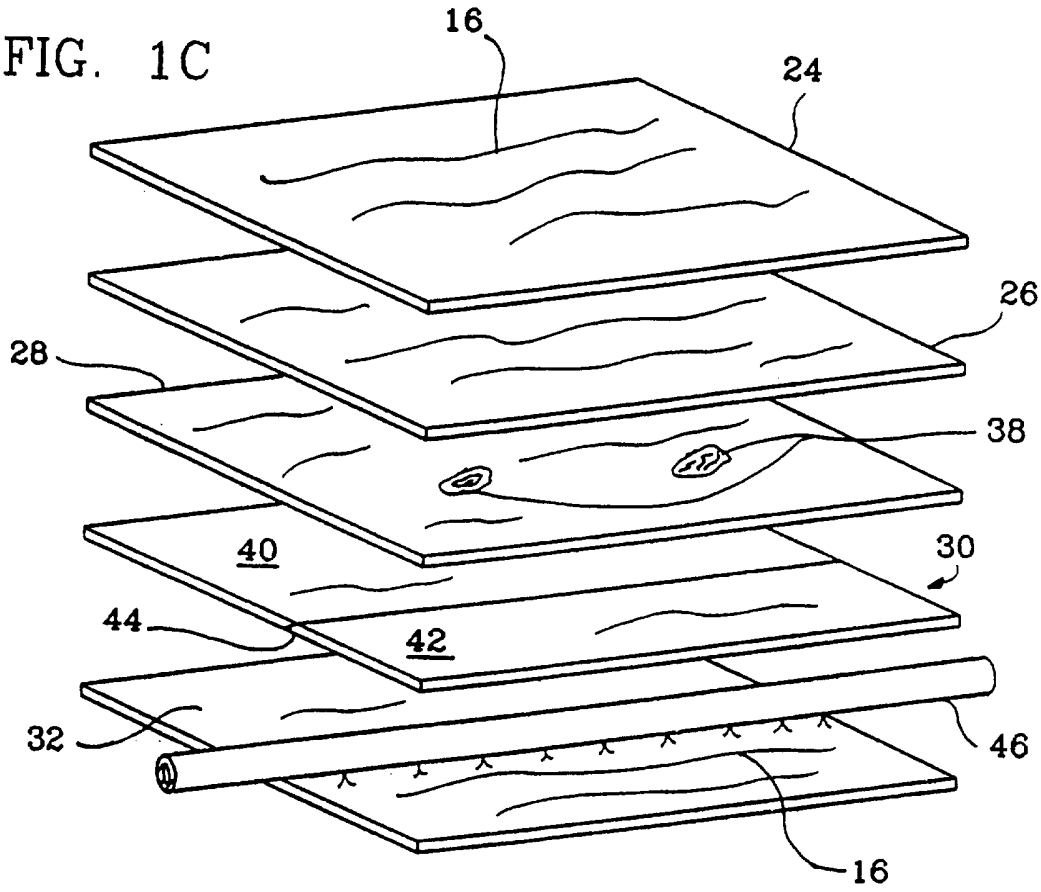
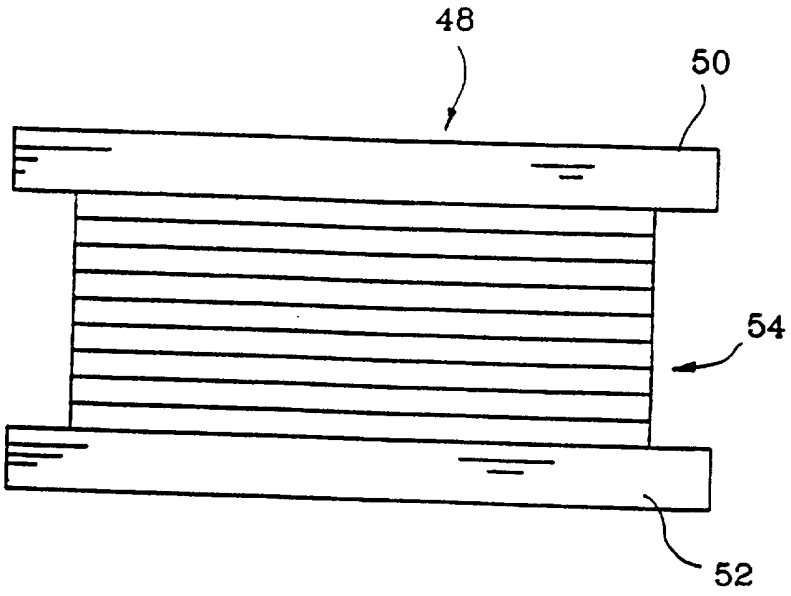


FIG. 1D



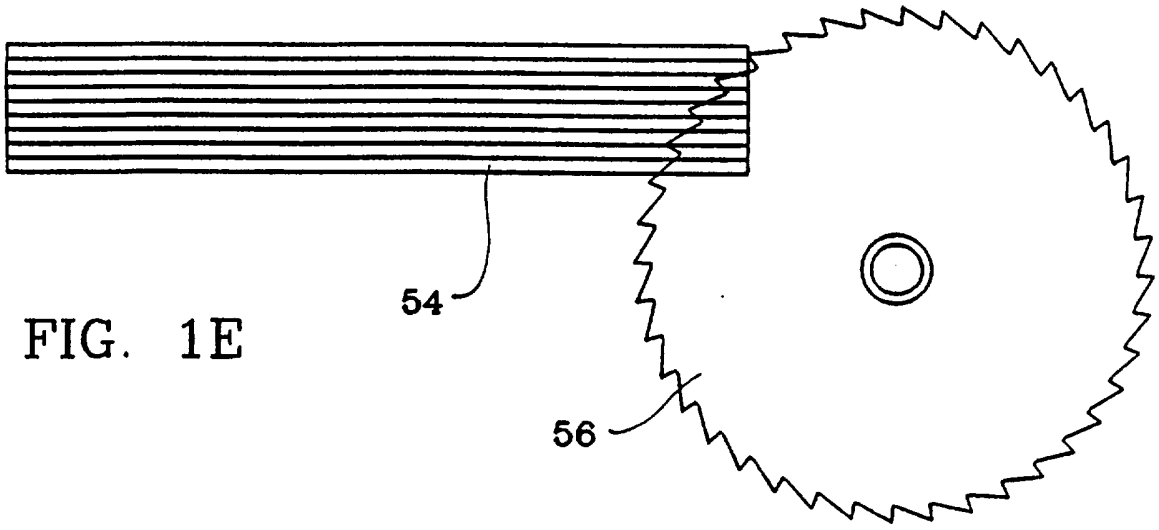
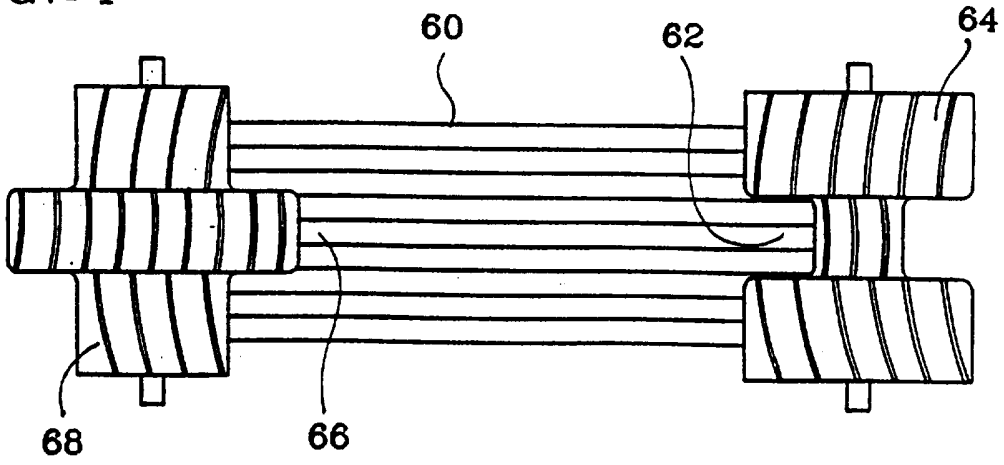


FIG. 1E

FIG. 1F



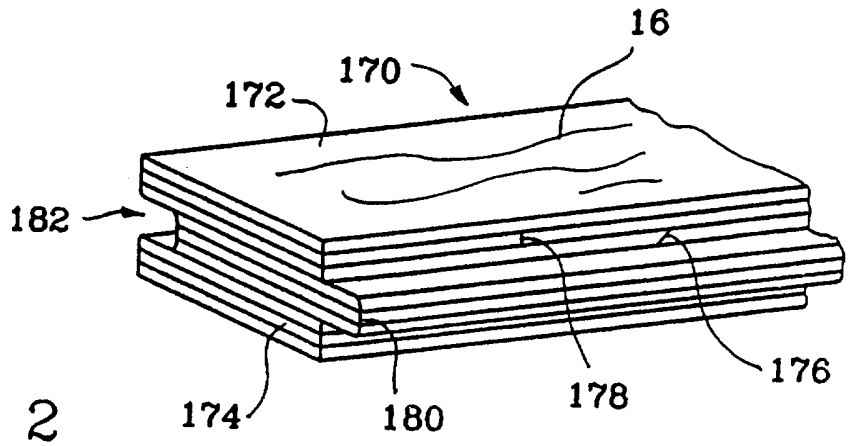


FIG. 2

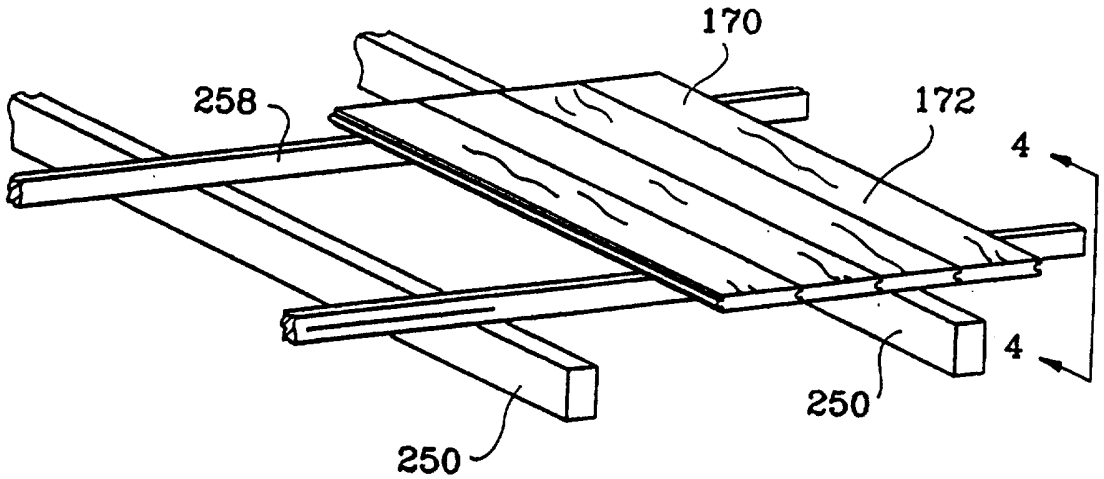


FIG. 3

FIG. 4

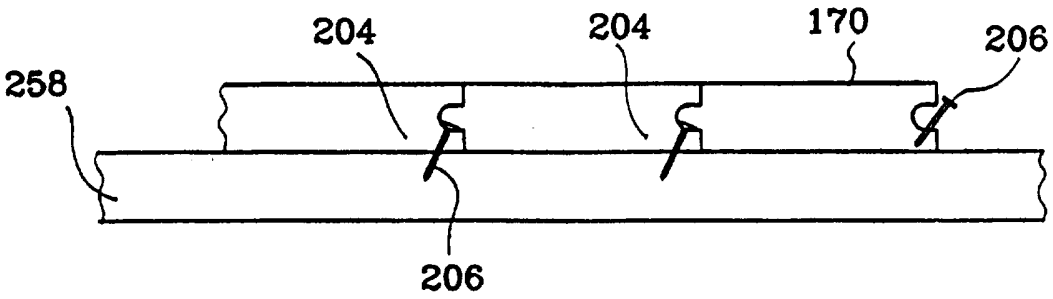


FIG. 5

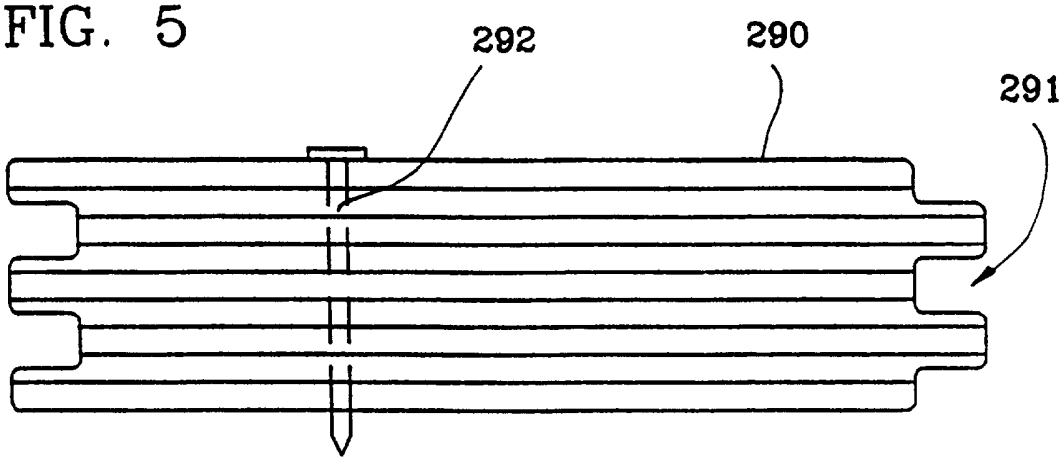
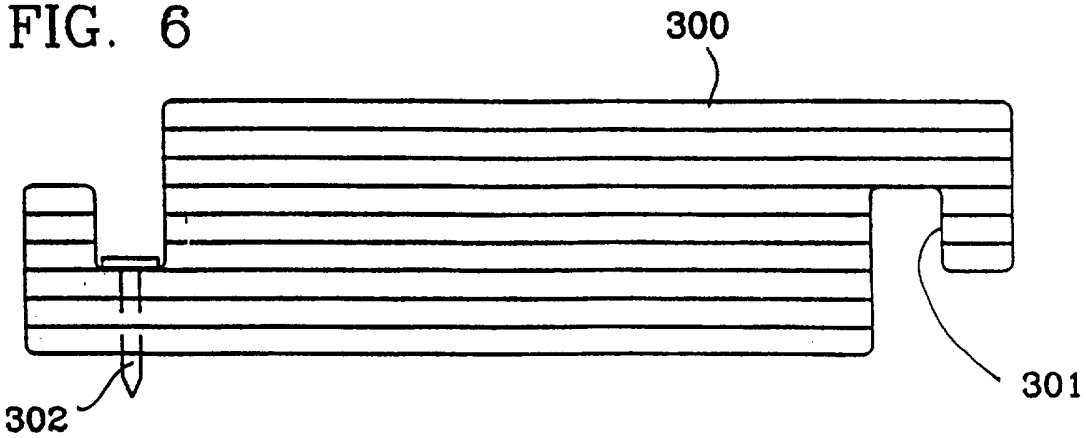


FIG. 6



INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 97/00224

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E04F15/04 B27D1/00 B32B21/12

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 6 E04F B27D B32B

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 618 826 A (BOISNE JACK) 3 February 1989 see page 1, line 1 - line 5 see page 5, line 20 - line 21 see page 6, line 6 - line 16 see page 6, line 24 see page 7, line 14 - line 18 see page 7, line 22 - page 8, line 5; claim 1; figures 3-6	1-9
Y	---	19,20
Y	DE 93 01 761 U (SCHNEIDER) 22 April 1993 see figures 1,2	19,20

A	GB 852 547 A (INSULARBO) 26 October 1960 see page 1, line 79 - line 83; figure 3	8

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
15 July 1997	- 4. 08. 97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Huggins, J

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/CA 97/00224

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2 257 048 A (FULBRIGHT) 23 September 1941 see page 1, left-hand column, line 1 - line 11 see page 1, left-hand column, line 20 - line 42 see page 1, right-hand column, line 9 - line 11; claim 1; figure 2	1-3,5-7, 9,12-14
X	US 5 040 582 A (HSU W ERNEST) 20 August 1991 see column 3, line 67 - column 4, line 2 see column 4, line 22 - line 33 see column 5, line 4 - line 8 see figures 1,2	10, 12-14,16
Y		11,18
Y	US 5 103 614 A (KAWAGUCHI SHIRO ET AL) 14 April 1992 see column 2, line 13 - line 34 see column 2, line 56 - line 61 see column 3, line 24 - line 31; figure 2	11,18
X	US 5 411 066 A (TSUDA SOTARO) 2 May 1995 see column 1, line 6 - line 19 see column 2, line 15 - line 21 see column 5, line 1 - line 6 see column 5, line 19 - line 34; figure 4	10,14,15
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PCT/CA 97/00224

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