



(51) International Patent Classification:

**B27D 1/08** (2006.01)      **B32B 21/14** (2006.01)  
**B27D 3/02** (2006.01)      **B32B 21/13** (2006.01)  
**B27D 1/06** (2006.01)

(21) International Application Number:

PCT/MY20 13/000036

(22) International Filing Date:

28 February 2013 (28.02.2013)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

PI20 120047 18 24 October 2012 (24.10.2012)      MY

(71) Applicant: **BESGRADE PRODUCTS SDN. BHD**  
[MY/MY]; Batu 10, Man Pokok Sena, Mukim Jabi, Alor  
Setar 06400, Kedah (MY).

(72) Inventor: **PEK, Woei Shyong**; Batu 10, Man Pokok  
Sena, Mukim Jabi, Alor Setar 06400, Kedah (MY).

(81) Designated States (unless otherwise indicated, for every  
kind of national protection available): AE, AG, AL, AM,  
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,  
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,  
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP,  
KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD,  
ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI,  
NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU,  
RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ,  
TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA,  
ZM, ZW.

(84) Designated States (unless otherwise indicated, for every  
kind of regional protection available): ARIPO (BW, GH,  
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,  
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,  
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,  
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,  
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,  
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,  
ML, MR, NE, SN, TD, TG).

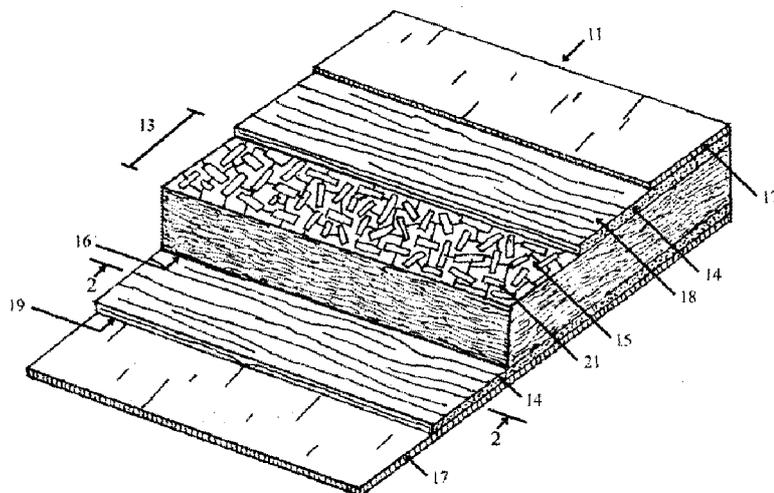
Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.1 7(i))
- as to applicant's entitlement to apply for and be granted a  
patent (Rule 4.1 7(H))

Published:

- with international search report (Art. 21(3))

(54) Title: VENEER LAMINATED WOOD STRAND BOARD



(57) Abstract: Wood veneers are laminated both top and bottom sides of wood strand board by an adhesive to form veneer laminated wood strand board. The board has a central core of monolayer wood strand or if multilayer, normally three layers of wood strands, sandwiched between two layers of short grain wood veneers, and again is laminated with long grain face and back wood veneer at top and bottom side of the short grain wood veneers, respectively. However, either type of wood strand board can also be laminated with only one layer of wood veneer instead of two layer, either short or long grain wood veneer alone. The wood strand board is firstly formed by hot pressing adhesive coated wood strand together, with monolayer or multilayer type, and then it is laminated with wood veneers to form veneer laminated wood strand board by another hotpressing process.



**Title**

Veneer Laminated Wood Strand Board

**5 Technical Field**

This invention relate to a wood composition board that use for exterior infrastructure construction use and interior home improvement application. However, the applications of the invention is not limited to, but also to others application where other wood composition board is being used. It is rather an alternative wood composition board with extra benefits  
10 compare to existing wood composition boards that already available in the market.

**Background Art**

Due to increase demand of wood composition board and depleting natural forests area by years, the availability of round wood log with acceptable quality suitable for plywood production is getting tighter by years, we can foresee plywood industries will end up with  
15 cease production in a matters of years.

Plywood is relatively strong and stable wood composition board suitable from exterior infrastructure construction use to interior home improvement application, and other applications. Both medium density fiberboard and particle board are made from lower grade wood species and waste from other wood product production, but has their own  
20 limitation due to their relative weaker strength, durability, stability and suitable only for interior condition, light duty use, principally due to small wood particle size that has contributed to very low mechanical strength. Oriented strand board seems to be the close alternative to plywood but again the strength property is not able to matched with plywood, even though it is much better than both medium density fiberboard and particle board , and  
25 couple with its poor visual appearance and surface roughness, making it less favourable to the industries.

In view of this, there is a market for a veneer laminated wood strand board that has equivalent or greater strength relative to plywood, and also give good durability, stability as well as good surface appearance similar to plywood. Most importantly, during the  
30 production of veneer laminated wood strand board, the need of round wood log from natural forest is considerably reduced, and in turn, reduce natural forest logging and devastation.

## Disclosure of Invention

The present invention aims to provide a useful alternative to known wood composition boards for exterior infrastructure construction use and interior home improvement application, as well as other applications where other wood composition boards suitable.

- 5 The veneer laminated wood strand board is made from wood veneers and wood strands, bonded together by an adhesive, to form a wood composition board that has equivalent or greater strength relative to plywood, and give good durability, stability as well as surface appearance similar to plywood.

- 10 The principal goal in producing veneer laminated wood strand board is having equivalent or greater strength to plywood, and give good durability, stability as well as surface appearance similar to plywood under exposure to expected environmental and application conditions.

The construction of the wood strand board, can either be monolayer or multilayer.

- 15 In monolayer wood strand board, the wood strands are randomly mixed together to form a homogeneous mixture of monolayer wood strand core structure layer, where directions of all wood strands in the mixture are in random alignment position.

- 20 In multilayer wood strand board, the wood strands are oriented to define a selected mean length direction, in several layers, in which each layer is perpendicularly laid-up to adjacent wood strand layer, to form a multilayer wood strand core structure, mimic the structure construction of plywood.

For both types of core construction, the wood strands are having an average length substantially greater than their average width, and the wood strands have wood grains extending generally parallel to the length of the strands.

- 25 Not only the wood strand board show poorer strength to the strength property of equivalent dimension of hardwood plywood, and also the wood strands forming wood strand core layers structure will form a rough surface and messy visual appearance, which although can be improved after sanding, but still rough compare to smooth and clean plywood surface, making it only suitable to certain applications where the properties of strength, durability, stability and surface visual appearance are not so important. The
- 30 acceptability of wood strand board to use as plywood application is presumably low, which need years for people and market to accept by great effort of training and educating. It is virtually impossible to get plywood users in all field to switch to wood strand board in a matter of months. In order to improve the properties of strength, durability, stability and surface appearance, wood veneers are laminated both sides of wood strand core structure.
- 35 Consequently, the properties of strength, durability, stability and surface appearance are

improved dramatically, and market accepts the veneer laminated wood strand board due to it looks similar to plywood.

As wood veneers laminate the outer surfaces of wood strand board, thus improve the durability and stability of wood strand board, by blocking water being absorbed into wood strand core structure, during application, in which water is a main culprit that usually reduce any wood composition boards' durability and stability.

The wood strands have much smaller size and thinner than wood veneer, this mean the contact surface area is much larger, a much stronger bond is capable of being formed between strands as well as layers. Conclusively the bonding strength between wood strand layers is much better than between wood veneers, as wood veneer has small surface contact and thicker, as happen in plywood.

By combining wood veneer and wood strand board together , good properties of strength, durability, stability and surface appearance are achieved.

The intended application and desired properties of the veneer laminated wood strand board is determined by the particular adhesives or adhesives selected.

Wood veneer can be easily produced by existing available plywood mill and wood strand board can produced by existing available wafer board production line or oriented strand board production line.

The wood strand board will be sandwiched between two pieces of adhesive coated short grain wood veneer, one side each, respectively, and again it is sandwiched between two pieces of long grain face back wood veneer, one side each, respectively. This is called double wood veneer lamination. However, the wood strand board can also be laminated with either short grain or long grain wood veneer alone, instead of both short and long grain together as per previously described, and this is known as single wood veneer lamination. They are then compressed under a selected combination of temperatures and pressure conditions in two different presses, one followed by one, to activate and effect curing of adhesive, to become veneer laminated wood strand board. After curing, the veneer laminated wood strand board is then sending for sizing, sanding, grading and packing.

Thus, the present invention is to provide a wood composition board has equivalent or greater strength to plywood, and give good durability, stability as well as surface appearance similar to plywood under exposure to expected environmental and use conditions. Generally, multilayer wood strand board has greater strength compare to monolayer wood strand board, and double layers of wood veneer lamination (short and long grain wood veneer together) also has greater strength compare to single layer wood veneer lamination (either short or long grain wood veneer alone), due to its characteristic of wood strand construction mentioned above.

A further object of present invention is to provide veneer laminated wood strand board having a good surface property similar to plywood, which is not possible in oriented strand board.

5 It is a further object of the present invention to provide veneer laminated wood strand board that make efficient use of harvested timber.

It is still another object of the present invention to provide veneer laminated wood strand board that permits to use of low grade wood species and plywood production by-products and other waste materials such as sawmill residue, weak wood and pre-sorted untreated recycled wood, while retaining the ability to meet the various objects described above.

10 Most importantly, during the production of veneer laminated wood strand board, the need of round log from natural forest is considerably reduced, and in turn, reduce natural forest logging and devastation.

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## Specification Example

## 1) Wood Strand Production

FIG. 1 is a perspective view of a portion of an embodiment of the veneer laminated monolayer wood strand board and FIG.2 is a perspective view of a portion of an embodiment of the veneer laminated multilayer wood strand board of the invention, FIG. 3 is a cross-sectional view taken along line 2—2 of a portion of the board illustrated in FIG. 1 and FIG.2.

FIG. 1 illustrates a portion, indicated generally by reference number 11, of a five-layer embodiment of the veneer laminated wood strand board and FIG. 2 illustrates a portion, indicated generally by reference number 12, of a seven-layer embodiment of the veneer laminated wood strand board.

Veneer laminated monolayer wood strand board has a single core portion 13 and two identical inner surface layers 14, one covering each of the opposite top and bottom surfaces 15 and 16 of the core portion 13 and two identical outer surface layers 17, one covering each of the opposite top and bottom short grain wood veneer surfaces 18 and 19.

In veneer laminated multilayer wood strand board has a multilayer, in this case, three-layer core portion 20 is described, and two identical inner surface layers 21, one covering each of the opposite top and bottom surfaces 22 and 23 of the core portion 20 and two identical outer surface layers 24, one covering each of the opposite top and bottom short grain wood veneer surfaces 25 and 26.

The only difference between present invention of FIG 1 and FIG 2 is the wood strand board, in FIG 1, is monolayer, and in FIG 2, is multilayer, in this case, three layers.

It should be readily apparent from the entire description of the present invention, the illustrated number of layers and configuration of the wood strand board is merely exemplary and can be varied without departing from the scope of the present invention. Also, to facilitate illustrating the wood veneer and layup patterns in the various layers, one end of the veneer laminated wood strand board illustrated in FIG. 1 and FIG 2 has been feathered and the layup pattern wood veneer have been exaggerated in the FIGS. 1, 2 and 3, with the wood veneer in the various layers somewhat enlarged.

As illustrated in FIG. 1, mono core layer 13 is composed substantially of thin wood strands 21, which have a length several times greater than their width and which are produced so that their wood grains are substantially parallel to their length. While the wood strands are generally straight, they have an irregular contour. The wood strands 21 are randomly mixed together to form a homogeneous mixture of monolayer wood strand core structure, where directions of all wood strands in the mixture are in random alignment position. In accordance with the present invention, random alignment position is used to define a

distribution of wood strands in which the acute angle between wood strands can be varied from 0° to 90°.

As illustrated in FIG. 2, each core layer 20 is composed substantially of thin wood strands 27, which have a length several times greater than their width and which are produced so that their wood grains are substantially parallel to their length. While the wood strands are generally straight, they have an irregular contour. The wood strands 27 are distributed in each layer relative to each other with their length in substantial parallel orientation and extending in a direction approaching a line which is parallel to one edge of the layer. The configuration and distribution of wood strands 27 suited for the construction of core layers 20 for the wood strand board of the present invention.

The wood strands should have a length in the range of about 12 mm to 150 mm, a width in the range of about 2.0 mm to 20.0 mm and a thickness in the range of about 0.2 mm to 0.8 mm.

With respect to the parallel orientation of the wood strands 21, FIG. 2 shows wood strands crossing one another in a woven fabric-like pattern while having a mean direction parallel to one edge of the layer. In accordance with the present invention, parallel orientation is used to define a distribution of wood strands in which the average acute angle between crossing strands is less than about 40° and the mean direction of the strands is parallel to one edge of the layer.

The three layers of the core portion 20 are arranged in a layer-to-layer cross-oriented strand pattern. In other words, the top and bottom outer core layers 28 and 29 are formed to have their wood strands 27 parallel and the central core layer 30 is formed to have its wood strands 27 perpendicular to those forming the outer core layers. The core portion 20 can be formed of any number of two or more layers.

However, superior strength, durability and stability properties are achieved by a core construction of monolayer or multilayer of three or a greater odd number of layers of oriented wood strands arranged in a layer-to-layer cross-oriented strand pattern. In addition, improved bending and tensile strengths are obtained by orienting the wood strands in a core structure composed of an odd number of layers so that the wood strands in the outer two layers have their lengths extending in the direction of the length dimension of the veneer laminated wood strand board and the wood strands of inner layers cross-oriented to form the desired layer-to-layer cross-oriented strand pattern.

Generally, multilayer wood strand board is having greater strength property than monolayer wood strand board, with or without wood veneer lamination.

In FIG 1, both the top and bottom surfaces 15 and 16 of the core portion 13 are covered by an inner surface layer 14, composed of short grain wood veneer, in a direction where the

wood grain of the short grain wood veneer is perpendicular to the lengthwise core portion 13.

In FIG 2, both the top and bottom surfaces 22 and 23 of the core portion 20 are covered by a inner surface layer 21, composed of short grain wood veneer, in a direction where the wood grain of the short grain wood veneer is perpendicular to the direction of wood strand of each of the opposite top and bottom surfaces 22 and 23 of the core portion 20.

The short grain wood veneer having a dimension larger than the average width and length of the wood strands forming core layers. For constructing wood strand board having core layers formed by wood strands, has average dimensions in the above-specified ranges. The short grain wood veneer is having a thickness between 0.3mm to 6.0mm and is used to form the two inner surface layers 21.

The long grain face back wood veneer having a dimension larger than the average width and length of the wood strands forming core layers. For constructing wood strand board having core layers formed by wood strands, has average dimensions in the above-specified ranges. The long grain face back wood veneer is having a thickness between 0.3mm to 6.0mm and is used to form the two outer surface layers 17 in FIG 1 and two outer surface later 24 in FIG 2.

When forming a veneer laminated wood strand board, adhesive coated short grain wood veneers 14 (21 in FIG 2), both sides, sandwiched with wood strand board 13 (20 in FIG 2), and again it is sandwiched between two pieces of long grain face back wood veneer 17 (24 in FIG 2), one side each, respectively, then good properties of strength, durability, stability and surface appearance properties are achieved. Consequently, a smooth surface finish mimic to plywood surface can be formed on the exposed outer surfaces comparable to rough finishes achievable on surfaces of wood strand board.

In many wood product applications, ability to form a smooth finish on the exposed surfaces enables the veneer laminated wood stand board of the present invention to be used as a substrate for decorative overlays, such as clear films, printed papers, foils and the like, and those overlays for infrastructure applications either single or double sides of the veneer laminated wood strand board. Substrates with rough finishes can form impressions in such overlays that detract from their decorative effect as well as bonding ability of overlays.

The construction of the veneer laminated wood strand board of the present invention permits the use of various special property-imparting additives. If it is desired to render the resulting product more resistant to fire, insects, moisture, fungus or other wood deteriorating causes or to add a selected color tone to the resulting product, a suitable common additive is mixed with the adhesive to be used in the formation of the treated layer or layers.

FIGS. 4A, 4B and 4C together comprise a schematic representation of separate arrangement of equipment suitable for producing the wood strand board illustrated in FIG. 1 and 2. FIG

4A illustrates the wood strand board production line, FIG 4B illustrates the veneer production line and FIG 4C illustrates the veneer lamination production line that laminate wood veneer and wood strand board together to form veneer laminated wood strand board.

Various processes and equipment can be employed to produce the veneer laminated wood strand board of the present invention.

5

FIGS. 4A illustrates one arrangement of equipment suitable for producing the both monolayer and multilayer (three layers) wood strand board embodiment illustrated in FIGS. 1 and 2. An important advantage of the present invention is the ability to use presently known equipment arranged in a manner that able forms the both monolayer-homogeneous mixture pattern and multilayer-layer to-layer cross-oriented pattern wood strand board.

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Generally, the wood strand board 13 is produced by depositing adhesive coated wood strands on a substrate to form loosely felted core layer having the wood strands randomly mixed together to form a homogeneous mixture of monolayer wood strand core structure, where directions of all wood strands in the mixture are in random alignment position.

15

The wood strand board 20 is produced by first depositing adhesive coated wood strands on a substrate to form a first loosely felted bottom outer core layer having the wood strands orientation characteristic described above with reference to FIG. 2. Then second deposition of adhesive coated wood strands on exposed surface of bottom outer core layer, to form a second loosely felted center core layer and lastly third deposition of adhesive coated wood strands on exposed surface of center core layer, to form a third loosely felted center core layer.

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The three layers of the core portion 20 are arranged in a layer-to-layer cross-oriented strand pattern. In other words, the top and bottom outer core layers 28 and 29 are formed to have their wood strands 27 parallel and the central core layer 30 is formed to have its wood strands 27 perpendicular to those forming the outer core layers.

25

Both mono or three deposited layers form a loosely felted mat that is compressed under a selected combination of temperature and pressure conditions to effect compacting and bonding of the adhesive coated wood strand, whereby an integral highly compacted monolayer or three-layer wood strand board is formed.

30

As is common practice in the manufacture of wood strand board structures, both mono- or three-layer wood strand board is formed on a conveyed substrate by depositing loosely felted layer of the wood strand and compressing the formed loosely felted layers at successive stations along the path traveled by a conveyed substrate.

35

The adhesive/wood strand admixtures from which the wood strands is formed must be prepared carefully in order to produce wood strand board for veneer lamination to become the present invention with above-described desirable properties.

FIG. 4A illustrates one equipment arrangement for preparing wood strand board from bulk wood.

With reference to FIG. 4A (1), wood strand used in forming the various layers are produced from logs 31. A drum chipper 32 chips the logs in certain length to become wood chips, and is stored in a roller chain storage bin 33 until needed or conveyed directly to a knife ring flaker 34 to flake the wood chips so that elongated wood flakes are produced having their wood grains parallel to the length of the wood strands, and is then stored in roller chain storage bin 35.

Wood strands produced from logs 31, or obtained from other sources, such as waste products of other wood production processes, usually have a high moisture content that varies over a wide range. Consequently, the wet wood strand produced by the knife ring flaker 34 are passed through a wood strand drying apparatus 36, which is operated so that the wood strand emerge there from with a substantially uniform moisture content of about 4%, on an oven dry weight basis. After drying, the dried wood strands are separated.

In monolayer wood strand board, wood strands are separated into two fractions, one of which is used to form the layer of the monolayer wood strand board 13 and the second fraction contains fine wood strand and wood particles that are unsuitable for use in forming the layer and, therefore, is sent to heat energy plant as biomass for burning.

In the arrangement of equipment illustrated in FIG. 4A(2), the dried wood strands are first passed through a screen-type wood strand separator 37.

In multilayer wood strand board, wood strands are separated into three fractions, two of which are used to form the layer layers of the multilayer wood strand board 20. The third fraction contains fine wood strand and wood particles that are unsuitable for use in forming the layers and, therefore, is sent to heat energy plant as biomass for burning.

In the arrangement of equipment illustrated in FIG 4A(3), the dried wood strands are first passed through a screen-type wood strand separator 37.

The wood strand separator is designed to classify and separate the dried wood strands into three fractions; surface layer wood strand (SL), core layer wood strands (CL) and fine. Both surface and core layer wood strand fractions are used for multilayer wood strand board production. However, the surface and core layer wood strand fractions can be combined together, and the homogeneous mixed wood strands are used for monolayer wood strand board.

### la) Monolayer Wood Strand Board Production

FIG. 4A(2) illustrates an arrangement of equipment for forming the monolayer wood strand board. The homogeneous mixed wood strands are conveyed directly to roller chain storage bin 38, which may be of the kind described above for storing wet wood flakes produced by the knife ringflaker 34.

5 For homogeneous mixed wood strands are needed to form monolayer wood strand board 13, they are transferred from roller chain storage bin 38 to metering bin 39 operatively associated with blenders 40. Metering bin 39 serves to discharge wood strand into its operatively associated blender at a controllably constant rate of feed. Blender also is arranged to receive adhesive (and other additives, if desired) at a controlled feed rate. The blenders thoroughly mix the received components to form adhesive/wood strand admixtures. The component feed rates are controlled to produce the adhesive-to-wood strand ratios desired for the admixtures.

15 Adhesive is dispensed to the blender 40 by a conventional resin mixer 41. The resin mixer 41 serves to mix the individual components forming the adhesive, and other additives when used, and meter the required quantity of adhesive to the blender. Any of the resins and associated components used to make adhesives for forming common reconstituted wood composition board can be used to make the adhesive for forming the wood strand board of the present invention.

20 A variety of adhesives may be used to form the wood strand admixtures. For example, urea formaldehyde, phenol formaldehyde or melamine urea formaldehyde adhesives, can be used to form the admixtures. The type of adhesive and the adhesive-to-wood strand ratio selected for the core and surface layer wood strand admixtures usually is determined by the intended use of the end product, the properties desired for the end product, and the process selected to form the wood strand board 13. Phenol formaldehyde resin based adhesives can be used in the production of wood strand board intended for most end-product uses.

30 The resin loading on the wood strand is between 10% to 15% should produce satisfactory bonding and the average moisture content of wood strands should be between 4% to 8%. Preferably, the overall moisture content of the wood strand admixture is within the range of about 8 to 15% on an oven dry weight basis.

The blended admixture of adhesive coated wood strands are conveyed to feeding bins 42 associated with the forming station employed to form the loosely felted mat from which the wood strand board is produced.

35 More specifically, a forming caul 43 is employed to provide a conveyed substrate upon which the loosely felted monolayer monolayer-homogeneous mat of adhesive coated wood

strand 44 is formed as it is being conveyed to a single opening hot press system 45 for compressing and bonding.

A loosely felted monolayer monolayer-homogeneous mat of adhesive coated wood strand 44 is formed by a movable wood strands forming device 46 located on top of forming line 47.

The movable wood strands forming device 46 travels and deposits adhesive coated wood strands on forming caul 43 starting from one end 48 near to the single opening hot press system 45 to the opposite end 49, while the forming caul is in stationary during wood strand depositing. When the movable wood strands forming devices 46 reaches the finished end, a loosely felted monolayer-homogeneous mat of adhesive coated wood strand is established and is fed into single opening hot press system 45, and is subjected to the necessary pressure and temperature conditions to effect compressing of the mat and setting and curing of the adhesive, whereby an integral, highly compacted monolayer wood strand board is produced.

After the loosely felted monolayer monolayer-homogeneous mat adhesive coated wood strand is fed into single opening hot press system 45, the process of mat forming procedure is repeated for the next forming mat.

After the hotpress duration is reached, the formed wood strand board is established and are being cut, typically include edge and end trim saws for forming straight edges and ends in the wood strand board sections, into master board and stack on start cooler 50 in order to cool down the formed wood strand board before it can be cut into final required size, end trim saw 51.

#### lb) Multilayer Wood Strand Board Production

FIG. 4A(3) illustrates an arrangement of equipment for forming the multilayer wood strand board. The surface layer wood strand and core layer wood strand are conveyed directly to a roller chain storage bin 52 and 53, respectively, which may be of the kind described above for storing wet wood flakes produced by the knife ring flaker 34.

As wood strands are needed to form multilayer wood strand boards 20, they are transferred from their respective bins 52 and 53 to metering bins 54 and 55 operatively associated with blenders 56 and 57. Each metering bin serves to discharge wood strand into its operatively associated blender at a controllably constant rate of feed. Each blender also is arranged to receive adhesive (and other additives, if desired) at a controlled feed rate. The blenders thoroughly mix the received components to form adhesive/wood strand admixtures. The component feed rates are controlled to produce the adhesive-to-wood strand ratios desired for the admixtures.

Adhesive is dispensed to each of the blenders 56 and 57 by conventional resin mixer 58 and 59. Both resin mixers serve to mix the individual components forming the adhesive, and other additives when used, and meter the required quantity of adhesive to the blenders. Any of the resins and associated components used to make adhesives for forming common  
5 reconstituted wood composition board can be used to make the adhesive for forming the wood strand board of the present invention.

While different adhesive-to-wood strand ratios may be used in the core layer wood strand and surface layer wood strand admixtures (usually, a lower adhesive-to-wood particle ratio is preferred for admixtures of core layer wood strand), mixers are available that can  
10 simultaneously dispense adhesive at different feed rates.

In any event, a variety of adhesives may be used to form the core and surface layer wood strand admixtures, and the admixtures can be formed to have any of a wide range of adhesive-to-wood strand ratios. For example, urea formaldehyde, phenol formaldehyde, melamine urea formaldehyde, or combinations of them, can be used to form the admixtures.  
15 The type of adhesive and the adhesive-to-wood strand ratio selected for the core and surface layer wood strand admixtures usually is determined by the intended use of the end product, the properties desired for the end product, and the process selected to form the wood strand board 20. Phenol formaldehyde resin based adhesives can be used in the production of wood strand board intended for most end-product uses.

20 The resin loading is on the wood strand is between 10% to 15% should produces satisfactory bonding and the average moisture content of wood Strand should be between 4% to 8%. Preferably, the overall moisture content of the wood strand admixture is within the range of about 8 to 15% on an oven dry weight basis.

25 Two separate resin mixers with different mixing mechanism are needed to furnish and disperse the desired adhesives for both the surface and core layer wood strand admixtures respectively.

The blended admixtures of adhesive coated wood strands are conveyed to feeding bins associated with the forming station employed to form the loosely felted mat from which the wood strand board is produced.

30 More specifically, a forming caul 60 is employed to provide a conveyed substrate upon which the loosely felted three-layer (multilayer) mat of adhesive coated wood strand 61 is formed as it is being conveyed to a continuous hotpress system 62 for compressing and bonding.

35 The loosely felted three-layer mat of adhesive coated wood strand is formed by three separate wood strands forming devices located, in succession, along the path of the forming line 63.

5 The first of the three wood strands forming devices 64, which is a in-line mechanical wood strand orienting and distribution system, deposits a first outer core layer of wood strands on the forming caul 60, with the wood strands in substantial parallel orientation and having their length extending in a mean direction that approaches the direction of travel of the forming caul 60.

10 The second of the three wood strands forming devices 65, which is a transverse mechanical wood strand orienting and distribution system, deposits a second layer of wood strands on the previously formed first outer core layer, to form a central core layer, in such as way that the deposited wood strands are in substantial parallel orientation, but with their length extending in a mean direction that approaches a line perpendicular to the travel of the forming caul 60, hence, perpendicular to the mean direction of extent of the lengths of the wood strands forming the first outer core layer.

15 The third of the three wood strands forming devices 66, which is also a in-line mechanical wood strand orienting and distribution system, deposits a third layer of wood strands on the previously formed central core layer, to form a second outer core layer, with the wood strands in the same orientation as the first outer core layer.

Thus, the three forming devices produce a three-layer core structure characterized by a layer-to-layer cross-oriented strand pattern.

20 In the illustrated arrangement of equipment for producing a three-layer wood stand board embodiment, outer core layers and central core layer are produced from separate wood strand admixture. If it is desired that different core layers have different wood strand size ranges, it is only necessary adjust the flap setting of at discharge of screen type wood strand separator. For example, the surface layer wood strand which is generally larger than core layer wood strand, can be included in core layer wood strand roller chain storage bin 53 so  
25 that the average wood strand size of the core layer is larger, and vice versa.

30 The mat leaving the third wood strands forming devices 66 is a fully formed three-layer continuous mat of loosely felted adhesive coated wood strand and is continuously feeding into continuous hot press system 62 and is subjected to the necessary pressure and temperature conditions to effect compressing of the mat and setting and curing of the adhesive, whereby an integral, highly compacted three-layer multilayer wood strand board is produced.

35 After the pressing through continuous hotpress system 62, a formed wood strand board is established and are being cut, typically include edge and end trim saws for forming straight edges and ends in the wood strand board sections, into master board and stack on start cooler 67 in order to cool down the formed wood strand board before it can be cut into final required size, with center saw 68 and end trim saw 69.

For both type of hotpress system, either single opening hotpress for monolayer wood strand board production or continuous hotpress system, a wide range of pressure and temperature combinations can be employed to form the wood strand board. The press pressure and temperature conditions can be manipulated to either enhance certain properties or to

5 obtain the best overall combination of properties in the produced wood strand board. The particular temperature and pressure required to produce a desired set of properties in a wood strand board of particular construction can be determined empirically. Temperatures up to 230° C. and pressures in the range of 2-4 N/mm<sup>2</sup> can be used to form the wood strand board.

10 The press duration requires 5 to 10 minutes depending upon the thickness and desired density of the finished mat of wood strand board 70.

The equipment also are controlled to impart other of the above-described properties, as may be desired. Whereas a particular embodiment of the multilayer wood strand board of the present invention has been described and is illustrated in detail, such embodiment is

15 only exemplary of the present invention. Variations and modifications are possible without departing from the spirit of the present invention. Therefore, it is not intended that the present invention be limited to the specific details enumerated in the foregoing description.

## 2) Wood Veneer Production

20 FIGS. 4B (1) and (2) comprises a schematic representation of one arrangement of equipment suitable for producing wood veneer.

Wood log 71 is cut by log cutting machine 72 into certain length that suit the size of wood strand board, in two types of length, one for short grain wood veneer and another one for long grain face back veneer production. The log blocks 73 are then sent to short grain wood

25 veneer rotary peeling machine 74, directly, to produce green (wet) veneer, or send to debarker 75 to remove the bark and any contaminants such as soil, sand and stone that stick on the log blocks. The log blocks are then sent to long grain face back wood veneer rotary peeling machine 76 to produce green (wet) veneer. Rotary peeling machine for peeling short grain wood veneer and long grain face back wood veneer is different.

30 Once green short grain wood veneer is produced and is cut into certain width that suit the width of wood strand board, it is stacked on the a pallet, and one it is full, will send to roller jet box type veneer dryer 77 for drying. On the other hand, green long grain face back wood veneer is produced, it is then rolled up on a bobbin 78 at bobbin stacker 79, then send to net jet box type dryer 80 for drying and then cut into certain width that suit the width of

35 wood strand board.

The drying process need a combination of temperature and drying speed, which must be adjusted, either manual and automatically, to archive required moisture content of dried wood veneer. The usual temperature for drying is between 160° to 180° and the required moisture content of dried wood veneer is between 8% to 16%, depending on the adhesive type to be applied.

The full sheet dried short grain wood veneer then send to repair and setting section 81 for minor repair and veneer setting. Random sheet of dried short grain wood veneer will send to short grain core veneer composer 82 to join with polyester yarn and hotmelt glue to become full sheet, then send to repair and setting section 81. During veneer setting, one first and one second short grain wood veneer set together to become a pair 83. The set dried short grain wood veneer is then send assembly section for lamination.

The full sheet dried face back wood veneer will send for grading, repair and setting section 84. Random sheet of dried long grain back wood veneer will send to long grain back veneer composer 85 to join with veneer tape to become full sheet, then send to repair and setting section 84. During veneer setting, one face and one back long grain wood veneer set together to become a pair 86. The set dried long grain face back wood veneer is then send assembly section for lamination.

### 3) Wood Veneer Lamination (Assembly)

FIG 4C(1) and FIG4C(2) comprise a schematic representation of one arrangement of equipment suitable for veneer lamination process (assembly) for wood strand board, which in turn to produce veneer laminated wood strand board illustrated in FIG. 1 and FIG 2.

The wood strand board that have been finally cut to required size for lamination, is then sent to for veneer lamination.

At outfeed of glue spreader, firstly long grain back veneer 87 is placed on a substrate, then first short grain core veneer 88 is passed through top 89 and bottom 90 rubber rollers with adhesive coated. During the pass through process, the adhesive of top 89 and bottom 90 rubber rollers are transferred to top 91 and bottom 92 side of short grain core veneer. The bottom side 92 of short grain core veneer with adhesive coated, is then put on top of the previous long grain back veneer 87. The wood strand board 93 is then put on top of the short grain core veneer, which the top surface of short grain core veneer 91 with adhesive coated, in contact with the bottom of the wood strand board 94.

The second short grain core veneer 95 is passed through top 89 and bottom rubber rollers 90 with adhesive coated. During the pass through process, the adhesive of top 89 and bottom 90 rubber rollers are transferred to top 96 and bottom 97 side of second short grain core veneer. The bottom side of second short grain core veneer 97 with adhesive coated, is

then put on top 98 of the previous wood strand board. The long grain face veneer 99 is then put on top of the second short grain core veneer 95, which the top surface of second short grain core veneer with adhesive coated, in contact with the bottom of the long grain face veneer 100. A complete loose veneer laminated wood strand board is then formed. The

5 adhesives used are mostly similar to those adhesives used in wood strand board, but the chemical properties are slightly different in order to suitable for use in veneer application.

The same procedures about is repeated until several complete loose veneer laminated wood strand boards 101 are formed and stacked on top, one by one, until reach a certain height, which is determined by both assembly time, usually less than 30 minutes, and cool

10 press platen opening height, whichever is shorter. The whole stack is then sent to cool press 102 for pressing so that each layer of each stack is completely and firmly in contact and stick together, to archive pre-bonding condition. The pressing time is usually 30 minutes at specific pressure of 8 - 10 kg/cm<sup>2</sup>. However, the combination of pressure and pressing time can be adjusted if the pre-bonding quality not satisfactory.

15 After cool pressing, a full stack of firmed veneer laminated wood strand board is formed and is transferred, one by one, to loader 103 of hotpress 104, waiting for hotpressing. In hotpressing, a combination of pressing time, temperature and pressure must be manipulated in order to achieve optimal quality, depending on the type of adhesive used and moisture content of veneer. However, the usual pressing time is about 5 to 10 minutes,

20 at temperature of 100° to 130°, at specific pressure of 10 to 12 kg/cm<sup>2</sup>. In hotpressing process, the adhesive is cured to form strong bonding between each layer, holding the veneers and wood strand together. The veneer laminated wood strand boards are then unloaded on unloader 105 of hotpress, then stack again with automatic stacker.

After hotpressing, the veneer laminated wood strand board is sent for surface puttying 106

25 to cover the surface defect, then to double sizer machine 107 for trimming to required size and surface sanding 108 to improve surface quality.

The finished product is then subject to grading into several grades and packing for sale.

## Industrial Applicability

The present invention aims to provide a useful alternative to known wood composition boards for exterior infrastructure construction use and interior home improvement application. However, the applications of the invention is not limited to, but also to others application where other wood composition board is being used. It is rather an alternative wood composition board with extra benefits compare to existing wood composition boards that already available in the market.

In infrastructure construction such as building or bridge construction, it is use as floors, walls and roofs in house constructions, fencing, concrete shuttering (concrete molding), concrete form work systems, ready-to-paint surfaces for constructions, floors subjected to heavy wear in various buildings and factories, scaffolding materials, signs and fences for demanding outdoor advertising. It is also use in home improvement project such as furniture construction, home partition, structure support for parquet, playground equipments and even use for package and boxes.

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## The Claims

1. A monolayer veneer laminated wood strand board is comprising:

5 a monolayer wood strand board with core structure formed principally of adhesively bonded wood strands having an average length substantially greater than their average width, and the wood strands have wood grains extending generally parallel to the length of the strands with wood strands are randomly mixed together to form a homogeneous mixture of monolayer wood strand core structure, where directions of all wood strands in the mixture are in random alignment position and,

10 a first inner surface layer formed principally of adhesively bonded short grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain wood veneer, with adhesive on both sides, is adhered on one of the exposed surface of monolayer wood strand board, in a direction where the wood grain of the short grain wood veneer is perpendicular to the lengthwise direction monolayer wood strand board and,

15 a first outer surface layer formed principally of long grain face back wood veneer having a dimension larger than the average width of the wood strands forming core layers. The long grain face back wood veneer is adhered on the exposed surface of the first inner surface comprising of first short grain wood veneer which is already adhesive coated, in a direction where the wood grain of the long grain face back wood veneer is perpendicular to the direction of wood grain of the first short grain wood veneer, and

2. The veneer laminated monolayer wood strand board of claim 1 further comprising a second inner surface layer formed principally of adhesively bonded short grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain wood veneer, with adhesive on both sides, is adhered on another exposed surface of multilayer wood strand board, in a direction where the wood grain of the short grain wood veneer is perpendicular to the lengthwise direction monolayer wood strand board and,

3. The veneer laminated monolayer wood strand board of claim 2 further comprising a second outer surface layer formed principally of long grain face back wood veneer having a dimension larger than the average width of the wood strands forming core layers. The long grain face back wood veneer is adhered on the exposed surface of second inner surface comprising of second short grain wood veneer which is already adhesive coated, in a direction where the wood grain of the long grain face back wood veneer is perpendicular to the direction of wood grain of the second short grain wood veneer

4. A monolayer veneer laminated wood strand board can also be comprising:

a monolayer wood strand board with core structure formed principally of adhesively bonded wood strands having an average length substantially greater than their average width, and the wood strands have wood grains extending generally parallel to the length of the strands with wood strands are randomly mixed together to form a homogeneous mixture of monolayer wood strand core structure, where directions of all wood strands in the mixture are in random alignment position and,

a first surface layer formed principally of either short or long grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain or long grain wood veneer, is adhered on one of the exposed surface of adhesive coated monolayer wood strand board, in a direction where the wood grain of the short grain wood veneer is perpendicular to the lengthwise direction monolayer wood strand board and, whereas the wood grain of the long grain wood veneer is parallel to the lengthwise direction of monolayer wood strand board.

5. The veneer laminated monolayer wood strand board of claim 4 further comprising a second surface layer formed principally of either short or long grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain or long grain wood veneer, is adhered on another exposed surface of adhesive coated monolayer wood strand board, in a direction where the wood grain of the short grain wood veneer is perpendicular to the lengthwise direction monolayer wood strand board and, whereas the wood grain of the long grain wood veneer is parallel to the lengthwise direction of monolayer wood strand board.

6. A multilayer veneer laminated wood strand board is comprising:

a multilayer wood strand board with core structure including first and at least second core layers, each core layer formed principally of adhesively bonded wood strands having an average length substantially greater than their average width, and the wood strands have wood grains extending generally parallel to the length of the strands and are oriented to define a selected mean length direction. The core layers are adhesively bonded together with the selected mean length direction of the wood strands forming each core layer, perpendicular to the selected mean length direction of the wood strands forming the adjacent core layer to which each core layer is bonded; and

a first inner surface layer formed principally of adhesively bonded short grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain wood veneer, with adhesive on both sides, is adhered on one of the exposed surface of multilayer wood strand board, in a direction where the

wood grain of the short grain wood veneer is perpendicular to the lengthwise direction of multilayer wood strand board.

5 a first outer surface layer formed principally of long grain face back wood veneer having a dimension larger than the average width of the wood strands forming core layers. The long grain face back wood veneer is adhered on the exposed surface of the first inner surface comprising of first short grain wood veneer which is already adhesive coated, in a direction where the wood grain of the long grain face back wood veneer is perpendicular to the direction of wood grain of the first short grain wood veneer, and

10 7. The veneer laminated multilayer wood strand board of claim 6 further comprising a second inner surface layer formed principally of adhesively bonded short grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain wood veneer, with adhesive on both sides, is adhered on another exposed surface of multilayer wood strand board, in a direction where the wood grain of the short grain wood veneer is perpendicular to the lengthwise direction of multilayer wood strand board.

15 8. The veneer laminated multilayer wood strand board of claim 7 further comprising a second outer surface layer formed principally of long grain face back wood veneer having a dimension larger than the average width of the wood strands forming core layers. The long grain face back wood veneer is adhered on the exposed surface of second inner surface comprising of second short grain wood veneer which is already adhesive coated, in a direction where the wood grain of the long grain face back wood veneer is perpendicular to the direction of wood grain of the second short grain wood veneer.

20 25 9. A multilayer veneer laminated wood strand board can also be comprising:

30 a multilayer wood strand board with core structure including first and at least second core layers, each core layer formed principally of adhesively bonded wood strands having an average length substantially greater than their average width, and the wood strands have wood grains extending generally parallel to the length of the strands and are oriented to define a selected mean length direction. The core layers are adhesively bonded together with the selected mean length direction of the wood strands forming each core layer, perpendicular to the selected mean length direction of the wood strands forming the adjacent core layer to which each core layer is bonded; and

35 a first surface layer formed principally of either short or long grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain or long grain wood veneer, is adhered on one of the exposed surface of adhesive coated monolayer wood strand board, in a direction where the wood grain of the short grain wood veneer is perpendicular to the lengthwise direction multilayer

wood strand board and, whereas the wood grain of the long grain wood veneer is parallel to the lengthwise direction of multilayer wood strand board.

- 5 10. The veneer laminated multilayer wood strand board of claim 9 further comprising a second surface layer formed principally of either short or long grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain or long grain wood veneer, is adhered on another exposed surface of adhesive coated monolayer wood strand board, in a direction where the wood grain of the short grain wood veneer is perpendicular to the lengthwise direction monolayer wood strand board and, whereas the wood grain of the long grain wood veneer is parallel to the lengthwise direction of monolayer wood strand board.
- 10
11. The veneer laminated multilayer wood strand board of claim 8 and claim 10 wherein the multilayer wood strand board includes an odd number of at least three stacked core layers.
- 15
12. The veneer laminated monolayer and multilayer wood strand board of claim 3, claim 5, claim 8 and claim 10 respectively, wherein all of the core layers are formed by wood strands having about the same average length, average width and average thickness.
- 20
13. The veneer laminated monolayer wood strand board of claim 3 and claim 5 has a length greater than its width and thickness, and the wood strands.
- 25
14. The veneer laminated multilayer wood strand board of claim 8 and claim 10 have a length greater than its width and thickness, and the wood strands in the outer core layers are oriented to define the selected mean length direction that approaches a line which is parallel to the lengthwise direction of multilayer wood strand board.
- 30
15. A veneer laminated multilayer wood strand board is comprising:
- a first outer core layer,
  - a central core layer,
  - a second outer core layer,
- 35
- each of the core layers formed principally of adhesively bonded wood strands having an average length substantially greater than their average width, the wood strands have wood grains extending generally parallel to the length of the strands and are oriented to define a selected mean length direction, the core layers adhesively bonded together with the central core layer sandwiched between the first and second outer core layers and with the selected mean length direction of the wood strands forming each core layer perpendicular to the selected mean length direction of the wood strands forming
- 40

the adjacent core layer to which each core layer is bonded, to become multilayer wood strand board, and

5 a first inner surface layer formed principally of adhesively bonded short grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain wood veneer, with adhesive on both sides is adhered on one of the exposed surface of multilayer wood strand board, in a direction where the wood grain of the short grain wood veneer is perpendicular to the lengthwise direction of multilayer wood strand board, and

10 a first outer surface layer formed principally of long grain face back wood veneer having a dimension larger than the average width of the wood strands forming core layers. The long grain face back wood veneer is adhered on the exposed surface of the first inner surface comprising of first short grain wood veneer which is already adhesive coated, in a direction where the wood grain of the long grain face back wood veneer is perpendicular to the direction of wood grain of the first short grain wood veneer, and

15 16. The veneer laminated multilayer wood strand board of claim 15 further comprising

20 a second inner surface layer formed principally of adhesively bonded short grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain wood veneer, with adhesive on both sides is adhered on second core layer of multilayer wood strand board, in a direction where the wood grain of the short grain wood veneer is perpendicular to the lengthwise direction of multilayer wood strand board, and

25 a second outer surface layer formed principally of long grain face back wood veneer having a dimension larger than the average width of the wood strands forming core layers. The long grain face back wood veneer is adhered on the exposed surface of second inner surface comprising of second short grain wood veneer which is already adhesive coated, in a direction where the wood grain of the long grain face back wood veneer is perpendicular to the direction of wood grain of the second short grain wood veneer.

30 17. A veneer laminated multilayer wood strand board is comprising:

35 a first outer core layer,  
a central core layer,  
a second outer core layer,

40 each of the core layers formed principally of adhesively bonded wood strands having an average length substantially greater than their average width, the wood strands have

wood grains extending generally parallel to the length of the strands and are oriented to define a selected mean length direction, the core layers adhesively bonded together with the central core layer sandwiched between the first and second outer core layers and with the selected mean length direction of the wood strands forming each core layer perpendicular to the selected mean length direction of the wood strands forming the adjacent core layer to which each core layer is bonded, to become multilayer wood strand board, and

a first surface layer formed principally of either short or long grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain or long grain wood veneer, is adhered on one of the exposed surface of adhesive coated monolayer wood strand board, in a direction where the wood grain of the short grain wood veneer is perpendicular to the lengthwise direction multilayer wood strand board and, whereas the wood grain of the long grain wood veneer is parallel to the lengthwise direction of multilayer wood strand board.

18. The veneer laminated multilayer wood strand board of claim 17 further comprising a second surface layer formed principally of either short or long grain wood veneer having a dimension larger than the average width of the wood strands forming core layers. The short grain or long grain wood veneer, is adhered on another exposed surface of adhesive coated monolayer wood strand board, in a direction where the wood grain of the short grain wood veneer is perpendicular to the lengthwise direction monolayer wood strand board and, whereas the wood grain of the long grain wood veneer is parallel to the lengthwise direction of monolayer wood strand board.

FIG 1

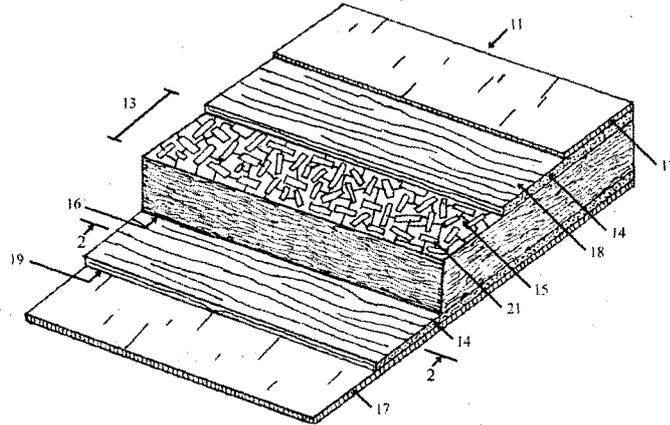


FIG 2

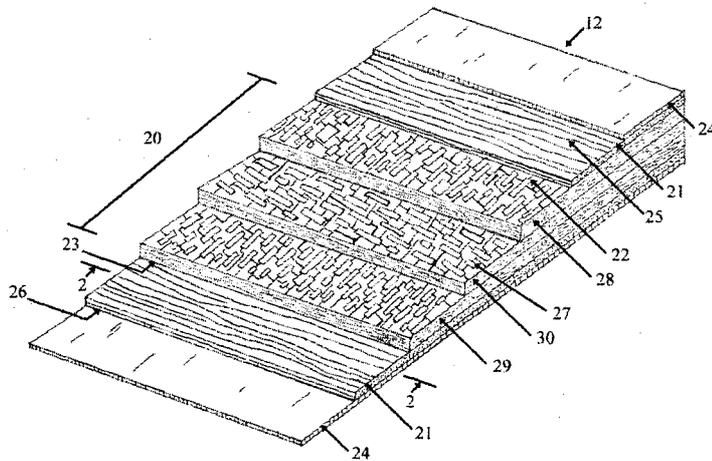


FIG 3

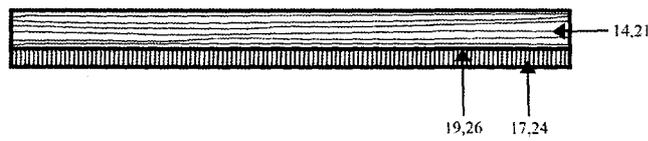


FIG.4A(I)

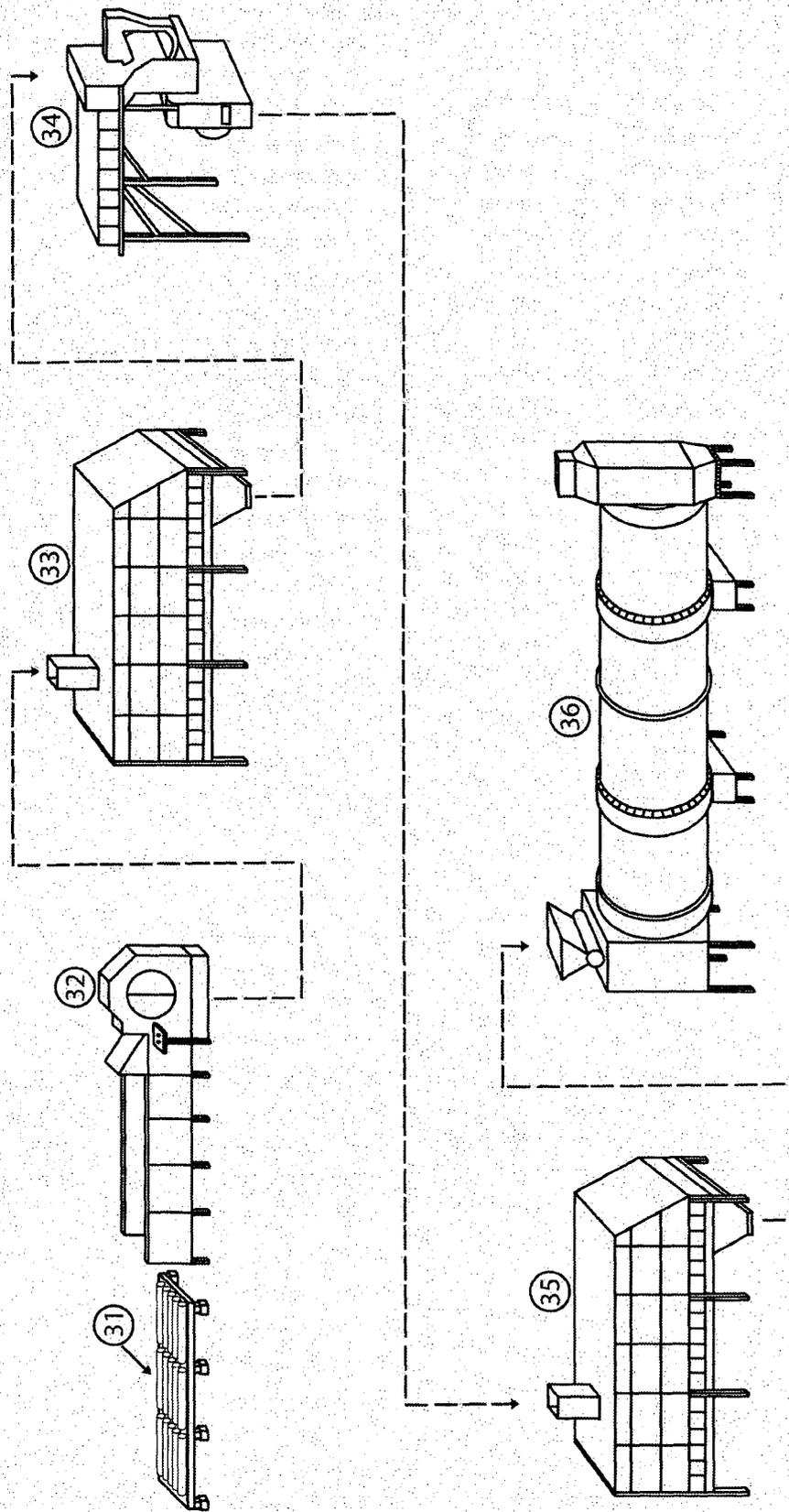


FIG.4A(2)

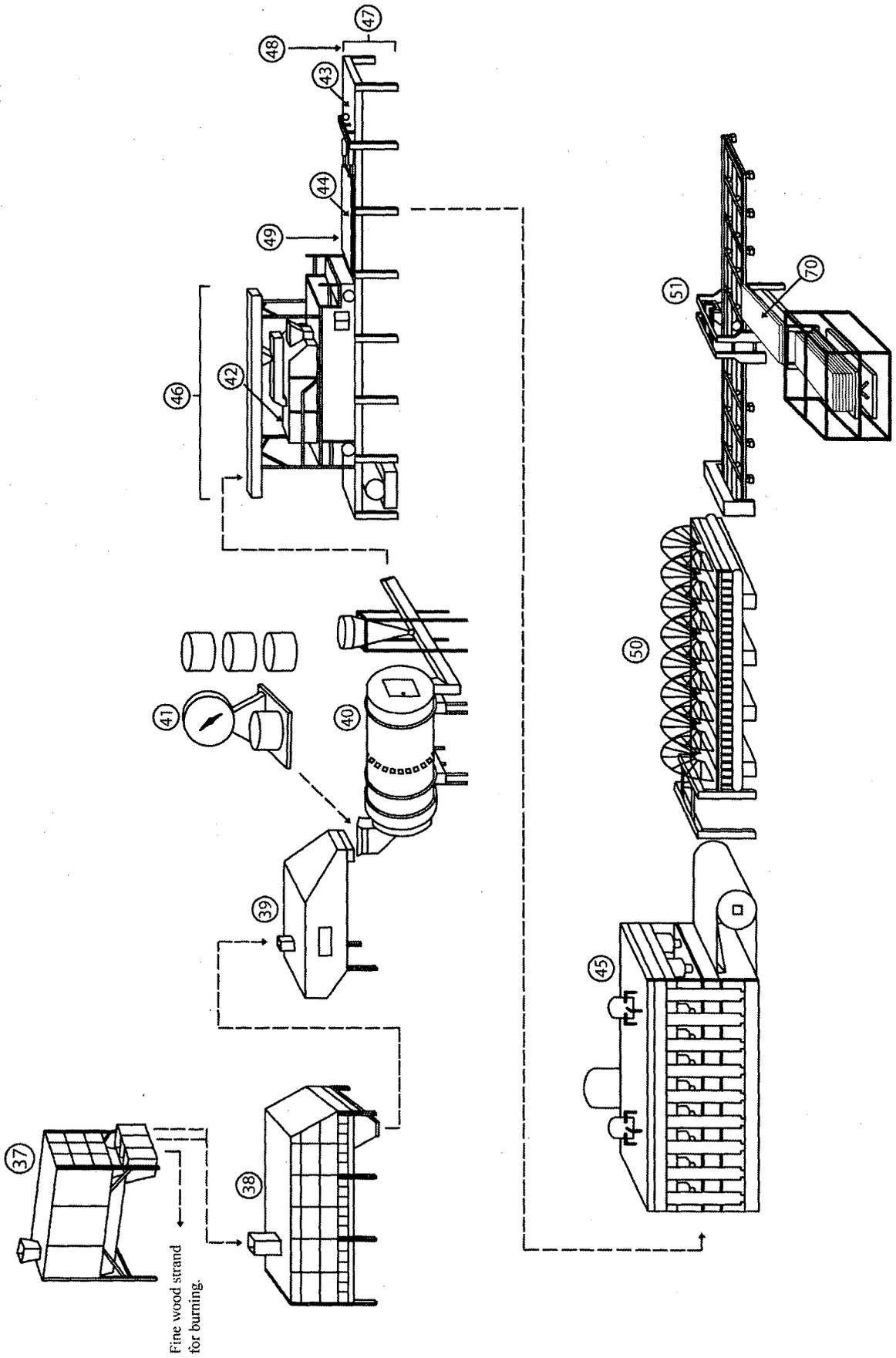


FIG. 4A(3)

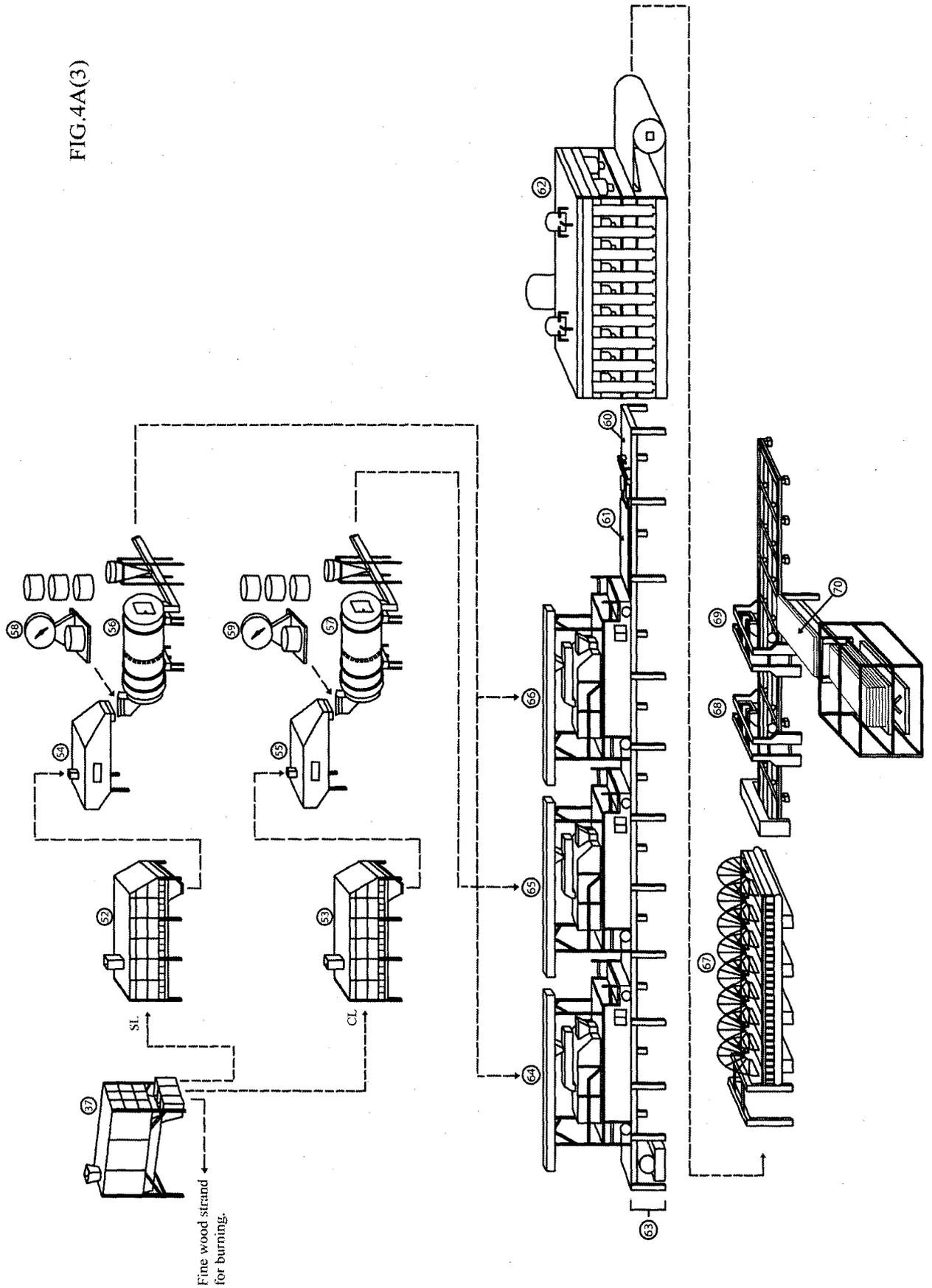


FIG.4B(1)

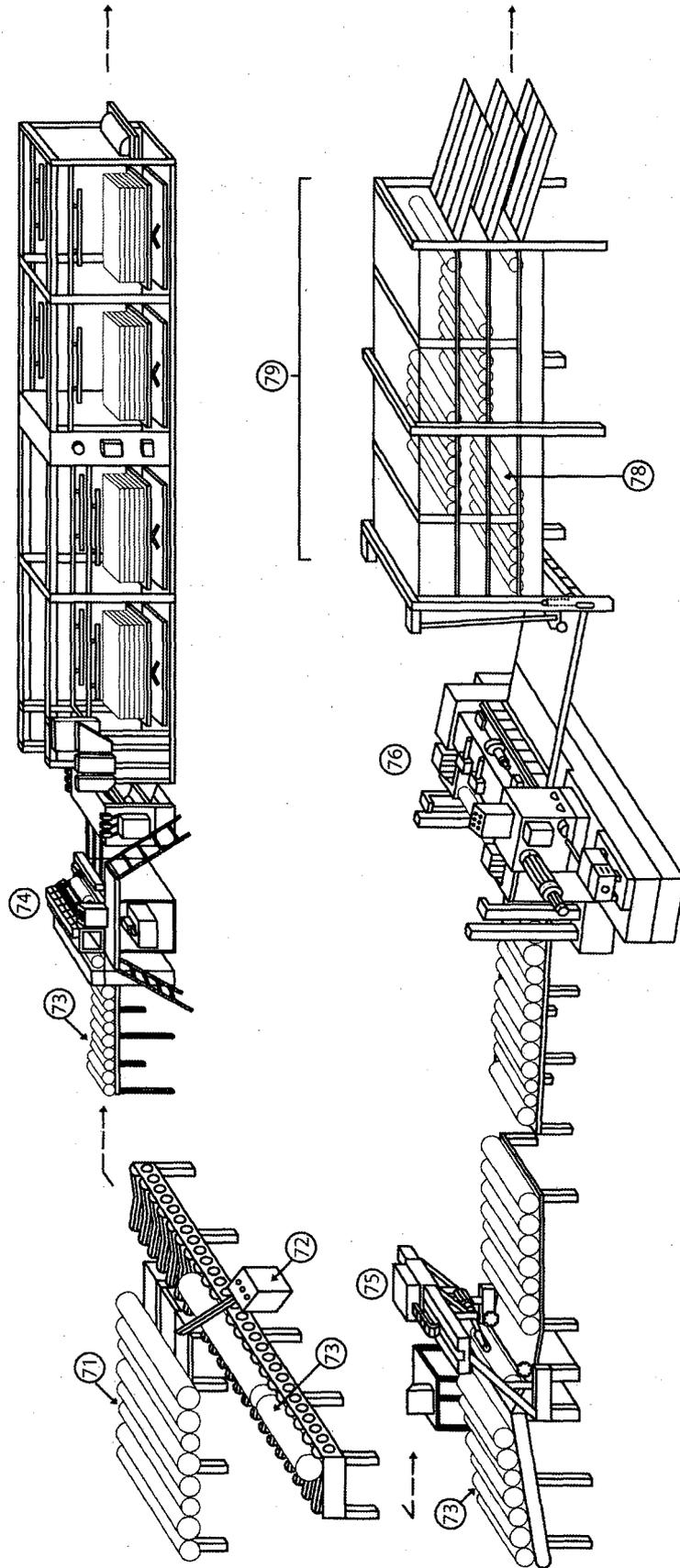


FIG. 4B(2)

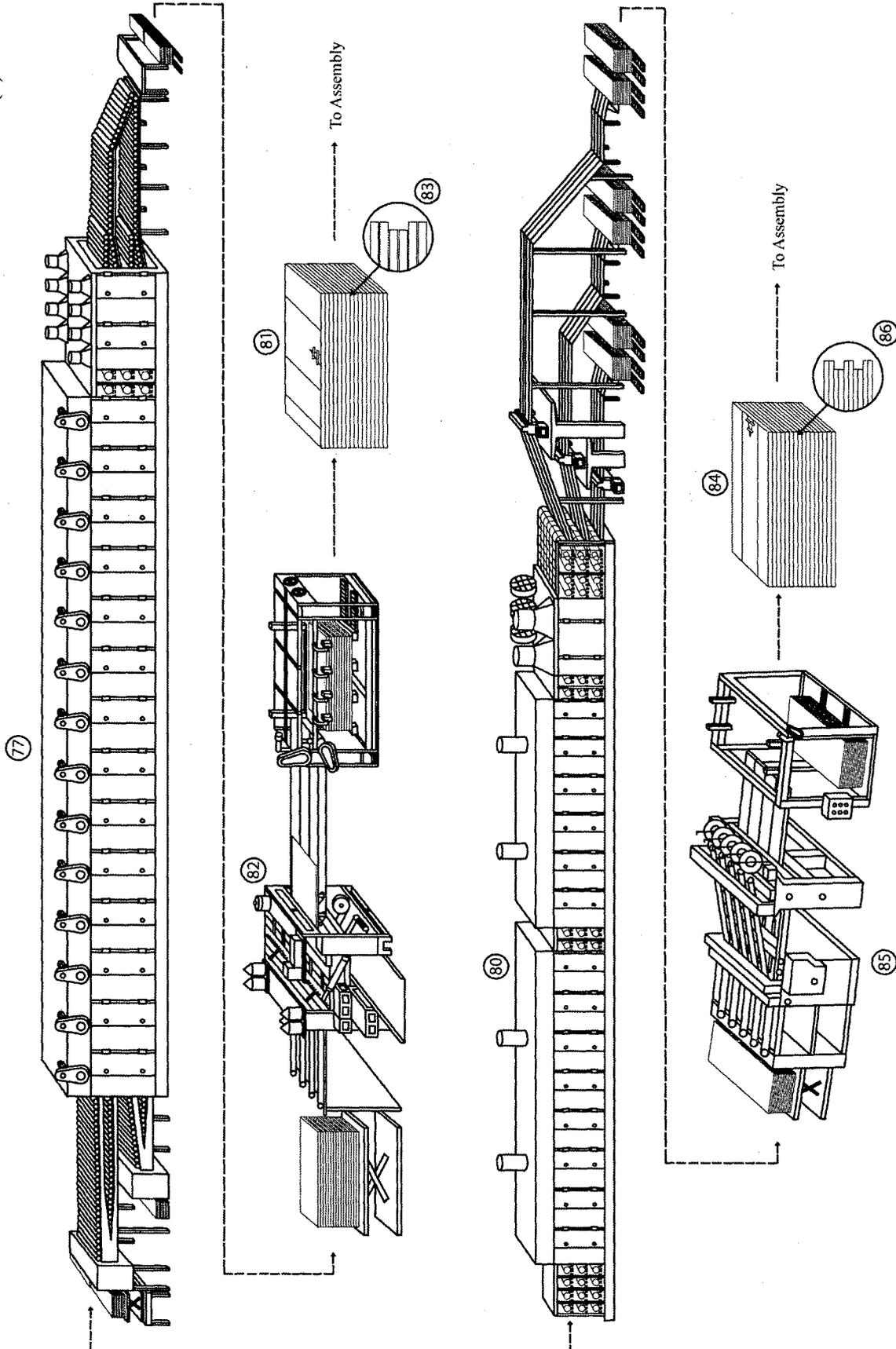


FIG.4C(1)

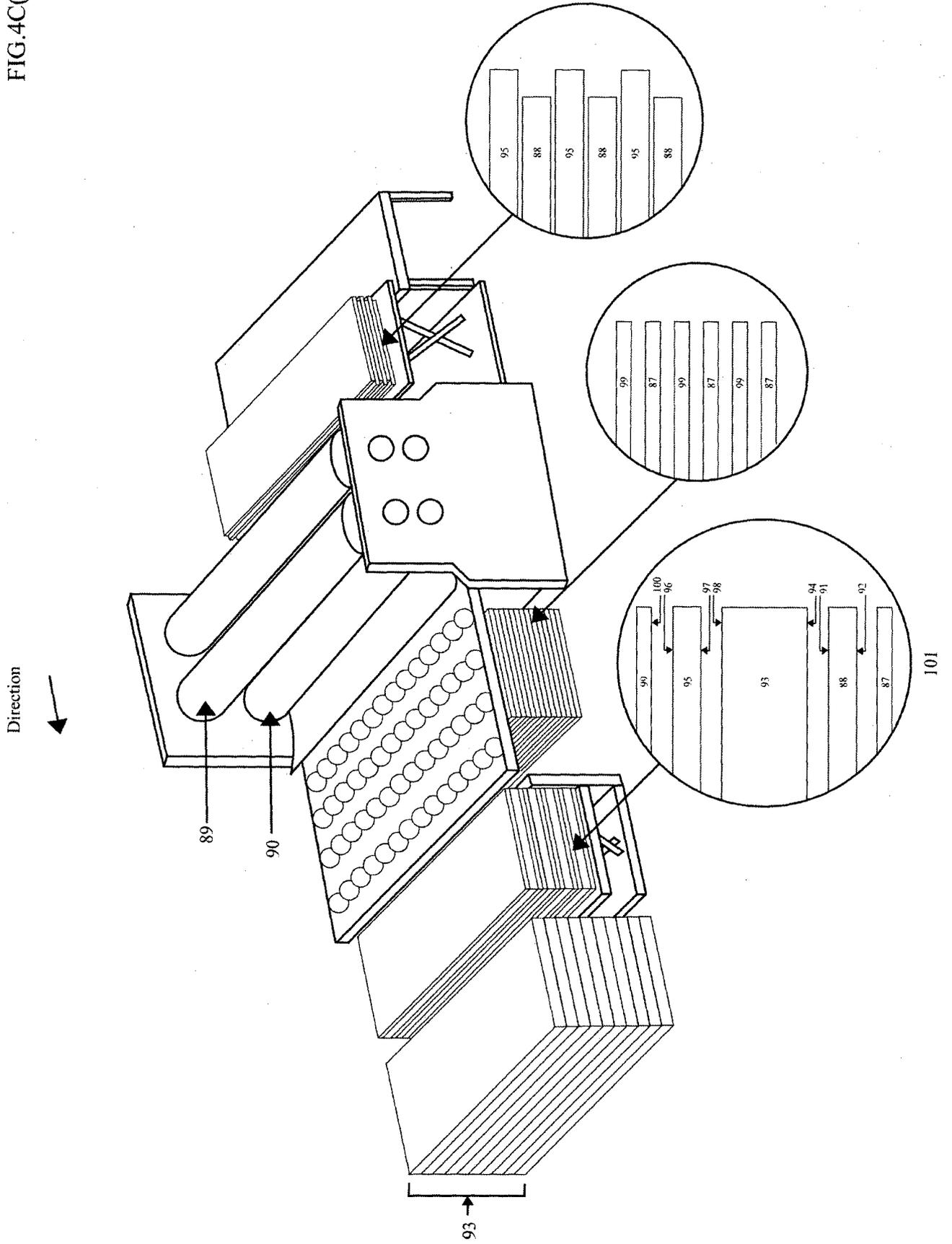
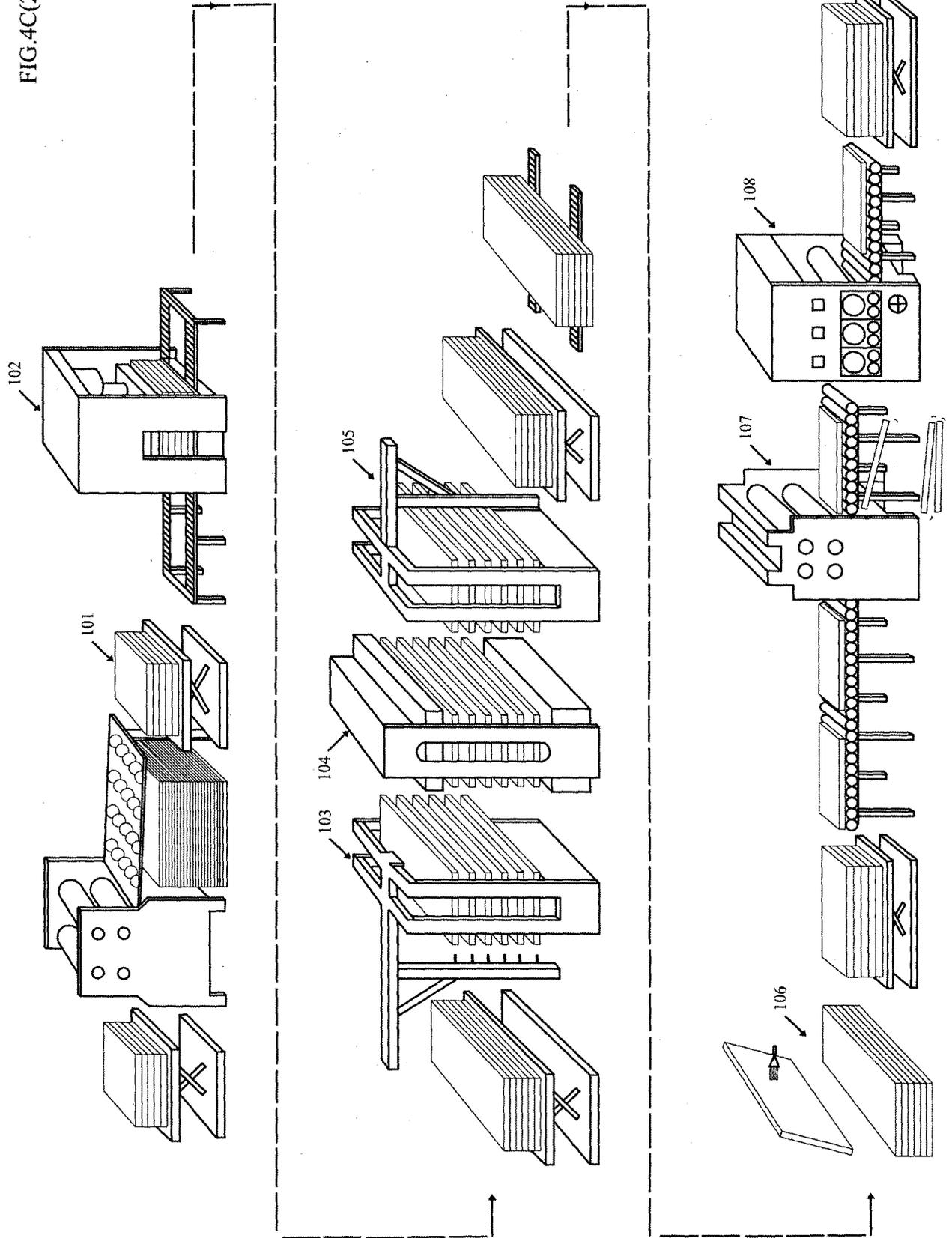


FIG. 4C(2)



## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/MY2013/000036****A. CLASSIFICATION OF SUBJECT MATTER****B27D 1/08(2006.01)i, B27D 3/02(2006.01)i, B27D 1/06(2006.01)i, B32B 21/14(2006.01)i, B32B 21/13(2006.01)i**

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)

B27D 1/08; B27D 1/04; B27D 5/00; B62D 29/02; B62D 29/04; B32B 5/12; B27M 3/04; B32B 21/02; B27N 3/04; B27D 3/02; B27D 1/06; B32B 21/14; B32B 21/13

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

Korean utility models and applications for utility models  
Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) &amp; Keywords: veneer wood strand laminate stack perpendicular parallel

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 07-013669 U (NISSIN WOOD INDUSTRY CO., LTD.) 7 March 1995 See paragraph [0005]; claim 1; figure 1.	1-10,15-18
A	JP 2005-161624 A (DAIKEN TRADE & IND CO., LTD.) 23 June 2005 See abstract; claim 1; figure 1.	1-10,15-18
A	US 2004-0142144 A1 (COURTNEY, R.) 22 July 2004 See abstract; claims 1, 5, 9, 13, 14.	1-10,15-18
A	JP 07-009404 A (YAMAHA CORP.) 13 January 1995 See abstract; claims 1, 2; figures 1, 2.	1-10,15-18
A	JP 08-108503 A (NODA CORP.) 30 April 1996 See abstract; claim 1; figure 1.	1-10,15-18

**I** 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 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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

30 July 2013 (30.07.2013)

Date of mailing of the international search report

**30 July 2013 (30.07.2013)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office  
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City,  
302 -70 1' Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

**YANG In Su**

Telephone No. +82-42-481-8131



INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/MY2013/000036**

**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.: 11-14  
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:

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 an additional fee, this Authority did not invite payment of any additional fee.
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.:

**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.

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/MY2013/000036**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 07-013669 U	07/03/1995	JP 2500869 Y2	12/06/1996
JP 2005-161624 A	23/06/2005	None	
us 2004-0142144 AI	22/07/2004	AU 7589401 A US 2002-0064622 AI US 6695944 B2 US 6878228 B2 W0 02-06041 AI	30/01/2002 30/05/2002 24/02/2004 12/04/2005 24/01/2002
JP 07-009404 A	13/01/1995	JP 02817572 B2	21/08/1998
JP 08-108503 A	30/04/1996	JP 3052181 B2	12/06/2000