(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
04 June 2020 (04.06.2020)

WIPO | PCT

(10) International Publication Number
WO 2020/109669 A2

(51) International Patent Classification:
B27K 3/02 (2006.01) *C08L 91/00* (2006.01)
B27K 3/50 (2006.01) *E04F 15/00* (2006.01)
B32B 21/00 (2006.01)

(21) International Application Number:
PCT/FI2019/050856

(22) International Filing Date:
29 November 2019 (29.11.2019)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
20186031 30 November 2018 (30.11.2018) FI

(71) Applicant: **METSÄLIITTO OSUUSKUNTA** [FI/FI]; Revontulenpuisto 2, 02100 ESPOO (FI).

(72) Inventors: **SOKKA, Kasperi**; c/o Metsä Wood, Plywood, Vaneritehtaankatu 1, 44200 SUOLAHTI (FI). **EKMAN, Jussi**; c/o Metsä Wood, Plywood, Vaneritehtaankatu 1, 44200 SUOLAHTI (FI). **HINTIKKA, Milla**; c/o Metsä Wood, Plywood, Vaneritehtaankatu 1, 44200 SUOLAHTI (FI).

(74) Agent: **LAINE IP OY**; Porkkalankatu 24, 00180 HELSINKI (FI).

(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, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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, SA, 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, ST, 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, KM, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WO 2020/109669 A2

(54) Title: A METHOD OF INCREASING RESISTANCE OF A TRANSPORT FLOORING PANEL AGAINST ROLLING WEAR, A TRANSPORT FLOORING PANEL, AND A FLOORING STRUCTURE

(57) Abstract: Transport flooring, method of producing the same and the uses thereof. The present invention provides a way of increasing resistance of a transport flooring panel against rolling wear. Thus, in a panel which comprises a multiply panel formed by a plurality of wood veneers and an overlay, which is bonded to the top veneer of the panel and which forms the surface of the panel, the top veneer of the multiply panel is saturated with a hydrophobic agent before the overlay is attached to the top veneer. The veneer layers containing wood fibers, which are filled with hydrophobic agent, will act as a damping layer which dampens the pressure caused by rolls and thereby improves the panels' resistance to shear strain exerted to the panel surface by the high pressure caused by rolls.

A method of increasing resistance of a transport flooring panel against rolling wear, a transport flooring panel, and a flooring structure

Field

The present invention relates to transport flooring panels. In particular the present invention concerns a method of increasing resistance of a transport flooring panel against shear strain, in particular shear strain caused by rolling wear. The invention also concerns a transport flooring panel which comprises a multiply panel with an overlay, as well as a flooring structure of a freight transport vehicle.

Background

Plywood panels are commonly used as flooring in freight transportation vehicles and trailers. For that purpose they are typically provided with a wire mesh-patterned surface to increase friction between the flooring and any good loaded or stored as well as between the flooring and any wheels or rolls moving along on the flooring.

Flooring panels are expected to have good mechanical properties, in particular the panels should be capable of withstanding shear strain exerted to the surface of the panel. This shear strain is caused for example by rolling wear. The small and hard wheels of, for example hand pallet trucks which are commonly used in loading, unloading and handling goods, cause a very high surface pressure and, accordingly, a very high strain on the flooring material. The surface pressure exerted by a 1.5-ton hand pallet truck can be up to 2 to 5 N/mm^2, though the wheel loads are low, i.e. about 3 to 4 kN/wheel. An even greater surface pressure may be caused by hard and small nylon wheels of retail distribution trolleys, when such trolleys are moved along vehicle floors made of plywood. In these cases, the surface load may rise to 5 to 15 N/mm^2, though the wheel load may be only about 1 to 2 kN/wheel.

The largest surface pressure is directed at the panel overlay and the face veneer immediately under it. When the strain due to rolls becomes too high, the face veneer may

break, splitting in the middle of the veneer in the direction of the glue joints.

Birch plywood clearly has better resistance to rolling wear than combi-plywood. This is because the rolling shear strength of birch veneer is higher than that of spruce veneer.

Still, the resistance to rolling wear of conventional surfaced flooring panels, even if made of birch plywood, is unsatisfactory.

In the art various solutions have been proposed to enhance mechanical properties of flooring panels by the use of mechanically strong overlays composed of, for example, materials consisting of epoxy resin materials or reinforced by such material. However, such materials are typically expensive and even if the mechanical strength is increased, the overall cost of the flooring panel becomes unacceptably high. Epoxy materials are also difficult to apply onto the panel surface by conventional plywood processing.

There is a need for novel transport flooring panels with enhanced mechanical strength, in particular against shear strains caused by rolling wear and similar surface pressure, which can be manufactured basically by conventional plywood manufacturing processes.

Summary of the Invention

It is an aim of the present invention to provide method of increasing resistance of a transport flooring panel against rolling wear.

It is another aim of the present invention to provide a transport flooring panel which comprises a multiply panel.

It is still a third aim of the present invention to provide a flooring structure of a freight transport vehicle.

The present invention is based on the finding that for a transport flooring panel, which typically has a friction-enhancing overlay, the strength of the panel against shear strain can

be enhanced by impregnating, preferably saturating, the top veneer, below the overlay, with a hydrophobic agent. Surprisingly it has been found that the top veneer after such treatment will effectively dampen the pressure caused by the rolls and improve the resistance of the flooring panel against rolling wear.

Thus, the present invention provides a method of increasing resistance of a transport flooring panel, the panel comprising a multiply panel formed by a plurality of wood veneers and an overlay, which is bonded to the top veneer of the panel and which forms the surface of the panel, by saturating the top veneer with a hydrophobic agent before the overlay is attached to the top veneer.

More specifically, the present invention is characterized by what is stated in the characterizing portion of the independent claims.

According to a first aspect of the present invention, there is provided a method of increasing resistance of a transport flooring panel against rolling wear, which panel comprises

- a multiply panel formed by a plurality of wood veneers and
- an overlay, which is bonded to the top veneer of the panel and which forms the surface of the panel,

wherein the top veneer of the multiply panel is impregnated with a hydrophobic agent before the overlay is attached to the top veneer.

Various embodiments of the first aspect may comprise at least one feature from the following bulleted list:

- The hydrophobic agent is applied on the top veneer from a composition which contains the hydrophobic agent in an amount of 10 to 100 % by weight, for example 60 to 100 % by weight.
- The hydrophobic agent is selected from the group of waxes, oils, fats, fatty acids, alkanes, alkenes, their derivatives and their mixtures.
- Paraffin wax, silicone oil or alkene ketene dimer is used as the hydrophobic agent.

- Paraffin wax or alkene ketene dimer is used as the hydrophobic agent, said paraffin wax or alkene ketene dimer being used in solid form and molten before or during application on the top veneer.
- The amount of the hydrophobic agent applied on the surface of the wood panel is 20 to 100 g/m^2.
- The hydrophobic agent is applied on the top veneer such that the wood fiber cavities are filled with hydrophobic agent.
- The hydrophobic agent is applied on the top veneer such that at least a part of the hydrophobic agent will migrate from the top veneer to the next veneer below it.
- The hydrophobic agent is applied on the top veneer such that at least the top veneer and the veneer below it will be saturated with the hydrophobic agent.
- The overlay comprises layer having a rough surface, in particular the overlay has a wire mesh-patterned surface.
- The overlay comprises a phenolic coating layer having a surface weight of about 100 to 300 g/m^2, for example 120 to 220 g/m^2.
- The phenolic coating layer comprises a paper substrate impregnated with a phenolic resin, said paper substrate having a grammage of 40 to 80 g/m^2 and containing 80 to 140 g/m^2 phenolic resin.
- The overlay comprises a paper substrate impregnated with a phenolic resin which has been applied on the surface of the top veneer of the multiply panel by pressing, in particular by hot pressing.
- The overlay has been attached to the top veneer using hot pressing with a pressing plate having a wire mesh-pattered surface.
- The overlay is attached to the top veneer using a phenolic resin, in particular a heat-activated phenolic resin, impregnated in a substrate, such as a non-woven substrate.
- The panel is capable of resisting a surface pressure of up to 15 kN/mm^2 without breaking of the top veneer, in particular of any of the three top veneers.

According to a second aspect of the present invention, there is provided a transport flooring panel obtained by a method according to the first aspect.

According to a third aspect of the present invention, there is provided a transport flooring panel which comprises a multiply panel formed by a plurality of wood veneers and an overlay, which overlay is bonded to the top veneer of the panel and which forms the surface of the panel, wherein the top veneer of the multiply panel is impregnated with a hydrophobic agent; and the overlay has a rough surface for enhancing friction between the surface of the overlay and the rolls.

Various embodiments of the third aspect may comprise at least one feature from the following bulleted list:

- The overlay is formed by a phenolic coating layer having a first, rough surface capable of facing the rolls and a second, opposite smooth surface.
- The overlay has a wire mesh-pattered surface capable of facing the rolls.
- The overlay comprises a paper substrate impregnated with a phenolic resin which has been applied on the surface of the top veneer of the multiply panel by pressing, in particular by hot pressing.
- The overlay has been attached to the top veneer using hot pressing with a pressing plate having a wire mesh-patterned surface.
- The overlay is attached to the top veneer using a phenolic resin, in particular a heat-activated phenolic resin, impregnated in a substrate, such as a non-woven substrate.
- The hydrophobic agent is selected from the group of waxes, oils, fats, fatty acids, alkanes, alkenes, their derivatives and their mixtures, in particular paraffin wax, silicone oil and alkene ketene dimer.
- The wood fiber cavities of at least the top veneer are filled with the hydrophobic agent.
- The panel is capable of resisting a surface pressure of up to 15 kN/mm^2 without breaking of the top veneer, in particular of any of the three top veneers.

According to a fourth aspect of the present invention, there is provided a flooring structure of a freight transport vehicle, comprising a frame and a flooring formed by one or more transport flooring panels attached to the frame, said panels comprising one or more panels according the third aspect.

Various embodiments of the fourth aspect may comprise at least one feature from the following bulleted list:

- The flooring structure comprises a frame of a train wagon, a vessel, such as a roro vessel, a trailer, a roll cart or a truck.

Considerable advantages are obtained by the invention. Thus, the invention provides for an efficient way of improving the panels' resistance to the shear strain exerted to the panel surface by high surface pressure caused by, for example, rolls without there being any need for using expensive epoxy-type polymer reinforcements.

It is possible that this improvement is reached when the hydrophobic agent is caused to penetrate into the grains of the wood layer so that it replaces water inside the wood fibers. The veneer layers containing wood fibers, which are filled with hydrophobic agent, will then act as a hydroelastic layer which dampens the pressure caused by rolls. This is, naturally, merely one possible explanation and the scope of the invention is not to be construed as limited to the proposed explanation.

The hydrophobic agent can be applied on the top veneer by conventional applications means, and after application of the hydrophobic agent, the overlay can be attached to the thus treated top veneer layer by using a separate glue layer or by means of resin migrating from the overlay into the top veneer during conventional plywood overlay hot pressing.

It has been found that the bond between the overlay and the top veneer is not impaired by hydrophobic agent provided that it penetrates into the wood grains.

Further features and advantages of various embodiments of the present invention will appear from the following detailed description.

Brief Description of the Drawing

The attached drawing shows in side-view the cross-section of a panel according to one embodiment of the present invention.

Embodiments

By means of the present technology, a method is provided for increasing resistance of a transport flooring panel against rolling wear, which method comprises impregnating at least the top veneer of the multiply panel with a hydrophobic agent before the overlay is applied on and in particular hot pressed to the top veneer.

In one embodiment, a transport flooring panel of the present kind comprises a wood panel with an overlay which has a rough surface for enhancing friction of the surface.

In the drawing, the principal composition of a panel of an embodiment of the present technology is disclosed.

Thus, reference numeral 4 designates a multiply panel comprising a plurality of overlapping wood layers, such as layers of wood veneer. Reference numeral 3 designates the top layer of the multiply panel, which layer has been impregnated with a hydrophobic agents, as will be discussed more closely. Reference numeral 1 relates to the overlay which forms the upper surface of the flooring and reference numeral 2 refers to a glue layer for bonding of the overlay 1 to the top layer 3.

"Flooring panel" refers to a wood panel for use as or used as flooring either on its own or preferably in conjunction with a supporting structure such as a frame. Typically, the present flooring panels are used in transport vehicles in which the flooring is built up by a plurality of flooring panels placed in lateral and longitudinal configuration (i.e. side-by-side, and one after the other), to form the floor of the vehicle.

"Impregnate" refers to the action of causing the material (such as the veneer, at least the top veneer of the panel) to be permeated with the hydrophobic agent. "Saturate" is used for designating that the impregnation is carried out to a point at which the veneer will not be capable of taking up (absorbing) more hydrophobic agent at the prevailing conditions.

In the present context, the term "wood panel" refers to a board comprising a plurality of overlapping and/or superimposed wood layers (in the following also referred to as a "multiply panel" or "multiply structure").

"Multiply panel", for example as depicted in the attached drawing and designated the numeral 4, stands for boards which comprise a plurality of layers of overlapping and/or superimposed sheet-like material. There are at least 2, preferably at least 3 layers, of such material. There can be up to about 250 overlapping and/or superimposed layers, although in practice the maximum number is typically less than 100. The sheet-like material can be continuous or it can consist of several sheets orientated in the same plane; conventionally at least a majority of the layers of sheet-like material is formed by wood veneer or wood strands.

The term "wood based layer" covers, e.g., wood veneer and wood strand.

In one embodiment, the multiply panel comprises, or consists of, or consists essentially of, a plurality of layers of wood veneer.

There can, however, be a number of layers formed by material capable of conferring preselected mechanical or chemical properties in the board, as well. Such materials are exemplified by metal foils, such as aluminium foils and films, textile layers, for example non-woven sheets, polymeric films and sheet, such as polyolefin, polyamide and EVOH films for barrier purposes, and polyamide and polyaramid films and fabrics for structural purposes.

Typically, in the present multiply panels, the majority of the layers are of or comprise wood material.

The sheet-like materials are typically bonded together using intermittent and/or intralayer layers of adhesive.

The term "board" is used interchangeably with "panel" and stands for a piece of material which has at least one planar surface. Preferably the "board" (or "panel") has two opposite planar surfaces which are generally orientated in parallel.

Typically, in the present context, the core board is an elongated planar structure. It has dimensions in the range from 10…15,000 mm times 10…20,000 mm. In particular the present board has a width of 50…2500 mm and a length of 300…13,500 mm. The thickness of the "core board" is generally between 3 and 250 mm, in particular 4 to 120 mm.

In the present context, "one step pressing" stands for a pressing procedure wherein a stack, which is formed by overlapping and/or superimposed layers of structural material and adhesive, is pressed by a pressing operation, typically carried out at one pressing station, until a predetermined compression strength of the board is obtained. The pressing can be carried out applying continuously increased compression or by applying compression at successive stages of different pressures.

"Stack" stands for an organized pile of overlapping and/or superimposed layers.

"Hot pressing" stands for pressing at increased temperature and surface pressure (in comparison to ambient conditions) over a period of time.

According to embodiments of the present technology, methods are provided for producing boards suitable for flooring purposes.

One embodiment comprises in a combination the steps of

- providing a wood based material in the form of a plurality of layers of such material and an adhesive suitable for bonding said layers to each other; and

– arranging the layers of the wood based material into a stack with layers adhesive on between the wood based material layers.

Any functional layers (cf. below) are preferably incorporated into the stack.

Such a method is typically referred to as a "one-step method" since all layers are first stacked and then pressing is carried out in one step for the whole stack.

Pressing is typically carried out at a temperature of 120 to 225 °C, for example 120 to 160 °C for a time of approximately 4 to 90 minutes and at a pressure of 1 to 2.5 MPa, for example 1.1 to 1.7 MPa.

The wood based material used for forming the core board is obtained by peeling or cutting of a suitable wood raw-material.

Typically, the wood layers or strands are produced from softwood or hardwood, such as spruce, pine, larch, birch, poplar, aspen, alder, eucalyptus or mixed tropical hardwood, or combinations thereof.

Particularly preferred embodiments comprise using hardwood, such as birch, at least as top veneer, in particular the panel comprises only hardwood, such as birch, as wood veneer layers.

The thickness of the wood based layers is generally from about 0.5 to 5 mm, in particular about 0.9 to 3.5 mm.

In one embodiment, the wood based layers consist of wood veneer. The core board is typically a multi-ply veneer panel or laminated veneer lumber.

In another embodiment, there are one or several layers of a non-wood material in the stack. Such layers, which can also be referred to as "functional layers", will provide improved mechanical, chemical, biological and acoustic properties to the final product. The thickness

of such non-wood layers is about 0.01 to 5 mm. For metal foils, the thickness is typically 0.01 to 0.5 mm, for polymeric layers typically 0.1 to 3 mm, for cork layers about 0.5 to 5 mm.

The wood based layers and optionally non-wood layers are bonded together with an adhesive (not shown in the drawing). The adhesive can be an adhesive resin. The adhesive resin can be provided in the form or a dry powder, for example as a hot melt adhesive, or as a liquid or as a combination thereof. The adhesive can be applied so as to form adhesive layers which uniformly cover at least a part, in particular all or essentially all, of the adjacent surfaces. The adhesive can also or alternatively be applied in the form of discontinuous spots or stripes.

The adhesive is in particular a thermosetting polymer. Such polymers can be selected from the groups of phenol-formaldehyde adhesives, melamine-formaldehyde adhesives, urea-formaldehyde adhesives, polyurethane adhesives and lignin based resins and combinations thereof. The adhesive can be applied on the layers of wood based material and non-wood material in manners known per se, for example by coating or spraying. In one embodiment, the adhesive is applied in the form of fibrous sheets which are impregnated with adhesive.

To meet the requirements of a flooring panel, the present wood panels are provided with an overlay (reference numeral 1 in the attached drawing), which enhances friction. Although the present technology will also improve shear strain resistance of panels having a smooth surface which provides low friction between the panel surface and any goods placed upon it, the present technology is particularly advantageous for flooring panels which have a friction-enhancing surface. Such a surface is typically rough or uneven, and will lessen or prevent the risk of sliding movements of goods placed upon the flooring panel.

In one embodiment, the surface of the panel is granulated. Such a surface can have a plurality of protruding spots to enhance friction

In one embodiment, the surface has a regular pattern with linear depressions separated by ridges, defining a grid on the surface.

The surface of the panel can be made during processing to have a friction-enhancing pattern. In such an embodiment, the overlay is then simply hot pressed upon the wood panel. In one embodiment, the surface is wire mesh-patterned, which can be achieved by using pressing plates that have a corresponding patterning. In another embodiment, engraved plates or platters that have a suitable pattern are used during pressing to confer friction-enhancing surface patterns onto the surface of the panel.

Friction-enhancing web can also be glued to the surface in a separate phase after the hot-pressing of the coating.

In order to improve shear strain of the flooring panel, a hydrophobic agent is applied on the top veneer (reference numeral 3 of the attached drawing).

In one embodiment, the hydrophobic agent is selected from the group of waxes, oils, fats, fatty acids, alkanes, alkenes, their derivatives and their mixtures.

In particular, the hydrophobic agent is selected from paraffin wax, silicone oil or alkene ketene dimer. The alkene ketene dimer (abbreviated AKD) is particularly preferred since it has an affinity to the hydroxyl groups present in wood.

In one embodiment, the hydrophobic agent is applied from a composition which contains the hydrophobic agent in an amount of 10 to 100 % by weight, for example 60 to 100 % by weight. Thus, the hydrophobic agent can be used in the form of a dispersion, in particular an aqueous dispersion, or as a solid material.

Preferably, paraffin wax or alkene ketene dimer is used as the hydrophobic agent, and the paraffin wax or alkene ketene dimer is used in solid form. The solid material is then molten before or during application on the top veneer.

To achieve saturation, the hydrophobic agent is preferably applied on the top veneer such that the wood fiber cavities of at least the top veneer are filled with hydrophobic agent.

Further, in a particular preferred embodiment, the hydrophobic agent is applied on the top veneer such that at least a part of the hydrophobic agent will migrate from the top veneer to the next veneer below it.

In one embodiment, the hydrophobic agent will penetrate to a depth of at least 50 % of the total thickness of the top veneer, in particular at least 75 %, in particular at least 90 % of the total thickness of the top veneer.

In one embodiment, the hydrophobic agent is applied on the top veneer such that at least the top veneer and the veneer below it will be impregnated, or even saturated, with the hydrophobic agent.

Generally, in order to achieve to achieve a thorough treatment of the top veneer, the hydrophobic agent, such as AKD, is applied on the surface of the wood board in an amount of at least 5 g/m^2, in particular at least 10 g/m^2 and preferably from 15 to 300 g/m^2, for example 17 to 100 g/m^2 or 20 to 100 g/m^2 of 20 to 75 g/m^2. In one embodiment the amount of hydrophobic agent is about 20 to 55 g/m^2.

The hydrophobic agent can be applied by spraying or coating, in particular roller coating. The hydrophobic agent can be applied in 1 to 5 portions on the veneer. Thus, in one embodiment, about 15 to 25 g of hydrophobic agent is applied 1 to 3 times. The interval between the applications will be sufficient to allow the hydrophobic agent migrate at least partially into the wood before the application of the next portion of the hydrophobic agent. The overlay covering the top veneer typically comprises at least one polymer resin coating layer having a surface weight of about 100 to 300 g/m^2, for example 120 to 220 g/m^2. The "polymer coating layer" is preferably a layer formed by a resin selected from phenol-formaldehyde adhesives, melamine-formaldehyde adhesives, urea-formaldehyde adhesives, polyurethane adhesives and lignin based resins and combinations thereof. In particular, the overlay comprises phenol-formaldehyde resin.

In one embodiment, the phenolic coating layer comprises a paper carrier substrate impregnated with a polymer resin, the paper substrate having a grammage of 40 to 80 g/m^2 and containing 80 to 140 g/m^2 resin, such as phenolic resin.

Thus in an embodiment, the overlay comprises a paper substrate impregnated with a resin which has been applied on the surface of the top veneer of the multiply panel by pressing, in particular by hot pressing. Typically, the surface is given that structure during the pressing of the wood panel by using a pressing plate having a wire mesh pattern.

Hot pressing of the coated panel is typically carried out at a temperature of 120 to 225 °C, for example 120 to 200 °C for a time of approximately 30 to 900 seconds and at a pressure of 1.1 to 3 MPa, for example 1.5 to 2.4 MPa.

In order to attach the overlay to the top veneer a resin is used. The bonding resin layer is depicted at reference numeral 2 of the attached drawing. The resin can be selected from phenol-formaldehyde adhesives, melamine-formaldehyde adhesives, urea-formaldehyde adhesives, polyurethane adhesives and lignin based resins and combinations thereof. It is preferred to using a phenolic or a urethane resin, in particular a heat-activated resin, for example a heat-activated phenolic resin.

Such a glue layer (or adhesive layer) 2, will firmly bind the coating layer to the surface of the top wood-veneer layer even when the wood-veneer layer has been impregnated and at least partly saturated with a hydrophobic agent.

The resin can be applied by coating, brushing, rolling or spraying. In one preferred embodiment the resin is applied impregnated in a carrier substrate, such as a non-woven substrate which substrate layer is placed as a sheet of material between the top layer and the overlay layer, and then bonded to the overlay and top layer during hot pressing.

As a result, in one embodiment of the invention, a composite laminate is formed, firmly bonded to the top veneer, comprising two overlapping and/or superimposed carrier substrates, both of which are impregnated with resin and wax after the pressing, and which

cannot be separated without breaking up of the composite laminate. Typically, the composite laminate is so firmly bonded to the top veneer that it cannot be separated from the top veneer either without breaking the veneer.

Based on the above, the present technology provides a transport flooring panel comprising a multiply panel formed by a plurality of wood veneers and an overlay, which forms the surface of the panel, the panel having increased resistance to shear strain caused by rolling wear.

As has been referred to above, the flooring panels according to the present technology and the various embodiments discussed can be used for providing flooring structures, for example flooring structure suitable for use in freight transport vehicles or trailers. The flooring structure typically comprises a frame and a flooring formed by one or more transport flooring panels of the present kind attached to the frame. The panels can be mechanically bonded to the frame or they can be glued to the frame or they can be bonded by a combination of such steps.

Examples of uses for the present flooring panels include as flooring of a train wagon, a vessel, such as a roro vessel, or a truck. It has been found that with embodiments of the present technology a rolling resistance can be achieved which is on the same order as that obtained for much thicker and more expensive overlays used in, for example, commercial products.

Example

A 30 mm birch ply panel was manufactured in a conventional way and hot pressed into a multiply panel.

The top wood-veneer of the multiply panel was sanded after pressing to smoothen out the surface. Then solid AKD wax was molten and spread upon the surface at about 50 g/m^2.

An impregnated non-woven adhesive film comprising a low-molecular PF resin was applied upon the surface treated with the AKD wax applied with a coating roller. On the uncured adhesive film, a second film (a coating film) comprising a 220 g/m² phenol formaldehyde (PF) on an 80 g/m2 kraft paper was placed. The stack formed by the multiply panel with the PF resin film and the coating film were then overlaid by hot-pressing at 138 °C for 12 minutes at 2.2 MPa during the high-pressure section of the hot pressing schedule.

Resistance to rolling wear was tested with the aid of a roller tester. In the tester a steel wheel with a diameter of 125 mm and a width of 50 mm capable of exerting on the plywood surface a pressure of 2 kN was used, by moving the tester in a pattern across the panel surface. The surface pressure exerted by the wheel is about 2 to 4 N/mm^2, depending on the wheel's imprint into the panel surface. The resistance to rolling wear is expressed in terms of the number of revolutions that the wheel of the tester has made at the point of wear. The test method corresponds fairly closely to Swedish standard SS 923508.

Table 1 gives the results of tests carried out as described above.

Table 1

Test no.	Treatment	Number of revolutions	Number of revolutions/4	Average
1.	1xW + Glue Film + 220	67926	16981.5	13752
2.	1xW + Glue Film + 220	42088	10522	
3.	2xW + Glue Film + 220	129760	32440	37363
4.	2xW + Glue Film + 220	115844	28961	
5.	2xW + Glue Film + 220	188938	47234.5	
6.	2xW + Glue Film + 220	240692	60173	
7.	2xW + Glue Film + 220	72018	18004.5	
8.	3xW + Glue Film + 220	164814	41203.5	43795
9.	3xW + Glue Film + 220	162102	40525.5	
10.	3xW + Glue Film + 220	143746	35936.5	
11.	3xW + Glue Film + 220	230060	57515	
12.	Ref. 220	12027	3006.75	
13.	Ref. Glue Film + 220	40000	10000	7874
14.	Ref. Glue Film + 220	25793	6448.25	
15.	Ref. Glue Film + 220	28697	7174.25	

In the table, the following abbreviations were used:
"W" for wax (AKD), "1xW" for one application of wax with a coating roller, "2xW" for two applications of wax with a coating roller and "3xW" stands for three applications of wax with a coating roller; "Glue Film" for PF resin film, and "220" for 220 g/m² phenol formaldehyde coating film.

The applied amount of wax was about 20 to 25 g/m^2 for one application with a coating roller.

As will appear from the test results, the application of a combination of wax, a resin film and a coating film, will provide a significant improvement on the resistance to rolling wear of the multiply panel. Compared to the bonding of a coating film to the surface of multiply panel with a resin film, the incorporation of wax (for example AKD) into the top veneer will already at an application amount of about 20 to 25 g/m^2 give a rolling resistance which is 1.75 times greater than for the corresponding panel not containing wax. For greater application amounts, the rolling resistance becomes close to 5 times greater.

Claims:

1. A method of increasing resistance of a transport flooring panel against rolling wear, which panel comprises

- a multiply panel formed by a plurality of wood veneers and
- an overlay, which is bonded to the top veneer of the panel and which forms the surface of the panel,

wherein

- the top veneer of the multiply panel is impregnated with a hydrophobic agent before the overlay is attached to the top veneer.

2. The method according to claim 1, wherein the hydrophobic agent is applied on the top veneer from a composition which contains the hydrophobic agent in an amount of 10 to 100 % by weight, for example 60 to 100 % by weight.

3. The method according to claim 1 or 2, wherein the hydrophobic agent is selected from the group of waxes, oils, fats, fatty acids, alkanes, alkenes, their derivatives and their mixtures.

4. The method according to any of claims 1 to 3, wherein paraffin wax, silicone oil or alkene ketene dimer is used as the hydrophobic agent.

5. The method according to claim 4, wherein paraffin wax or alkene ketene dimer is used as the hydrophobic agent, said paraffin wax or alkene ketene dimer being used in solid form and molten before or during application on the top veneer.

6. The method according to any of the preceding claims, wherein the amount of the hydrophobic agent applied on the surface of the wood panel is 20 to 100 g/m^2.

7. The method according to any of the preceding claims, wherein the hydrophobic agent is applied on the top veneer such that the wood fiber cavities are filled with hydrophobic agent.

8. The method according to any of the preceding claims, wherein the hydrophobic agent is applied on the top veneer such that at least a part of the hydrophobic agent will migrate from the top veneer to the next veneer below it.

9. The method according to any of the preceding claims, wherein the hydrophobic agent is applied on the top veneer such that at least the top veneer and the veneer below it will be saturated with the hydrophobic agent.

10. The method according to any of the preceding claims, wherein the overlay comprises layer having a rough surface, in particular the overlay has a wire mesh-patterned surface.

11. The method according to any of the preceding claims, wherein the overlay comprises a phenolic coating layer having a surface weight of about 100 to 300 g/m^2, for example 120 to 220 g/m2.

12. The method according to any of the preceding claims, wherein the phenolic coating layer comprises a paper substrate impregnated with a phenolic resin, said paper substrate having a grammage of 40 to 80 g/m^2 and containing 80 to 140 g/m^2 phenolic resin.

13. The method according to any of the preceding claims, wherein the overlay comprises a paper substrate impregnated with a phenolic resin which has been applied on the surface of the top veneer of the multiply panel by pressing, in particular by hot pressing.

14. The method according to any of the preceding claims, wherein the overlay has been attached to the top veneer using hot pressing with a pressing plate having a wire mesh-pattered surface.

15. The method according to any of the preceding claims, wherein the overlay is attached to the top veneer using a phenolic resin, in particular a heat-activated phenolic resin, impregnated in a substrate, such as a non-woven substrate.

16. The method according to any of the preceding claims, wherein the panel is capable of resisting a surface pressure of up to 15 kN/mm^2 without breaking of the top veneer, in particular of any of the three top veneers.

17. A transport flooring panel obtained by a method according to any of claims 1 to 16.

18. A transport flooring panel which comprises a multiply panel formed by a plurality of wood veneers and an overlay, which overlay is bonded to the top veneer of the panel and which forms the surface of the panel, wherein

- the top veneer of the multiply panel is impregnated with a hydrophobic agent; and
- the overlay has a rough surface for enhancing friction between the surface of the overlay and the rolls.

19. The panel according to claim 18, wherein the overlay is formed by a phenolic coating layer having a first, rough surface capable of facing the rolls and a second, opposite smooth surface.

20. The panel according to claim 18 or 19, wherein the overlay has a wire mesh-pattered surface capable of facing the rolls.

21. The panel according to any of claims 18 to 20, wherein the overlay comprises a paper substrate impregnated with a phenolic resin which has been applied on the surface of the top veneer of the multiply panel by pressing, in particular by hot pressing.

22. The panel according to any of claims 18 to 21, wherein the overlay has been attached to the top veneer using hot pressing with a pressing plate having a wire mesh-patterned surface.

23. The panel according to any of claims 18 to 22, wherein the overlay is attached to the top veneer using a phenolic resin, in particular a heat-activated phenolic resin, impregnated in a substrate, such as a non-woven substrate.

24. The panel according to any of claims 18 to 23, wherein the hydrophobic agent is selected from the group of waxes, oils, fats, fatty acids, alkanes, alkenes, their derivatives and their mixtures, in particular paraffin wax, silicone oil and alkene ketene dimer.

25. The panel according to any of claims 18 to 24, wherein the wood fiber cavities of at least the top veneer are filled with the hydrophobic agent.

26. The panel according to any of claims 18 to 25, which panel is capable of resisting a surface pressure of up to 15 kN/mm^2 without breaking of the top veneer, in particular of any of the three top veneers.

27. A flooring structure of a freight transport vehicle, comprising a frame and a flooring formed by one or more transport flooring panels attached to the frame, said panels comprising one or more panels according to any of claims 18 to 26.

28. The flooring structure according to claim 27, comprising a frame of a train wagon, a vessel, such as a roro vessel, a trailer, a roll cart or a truck.

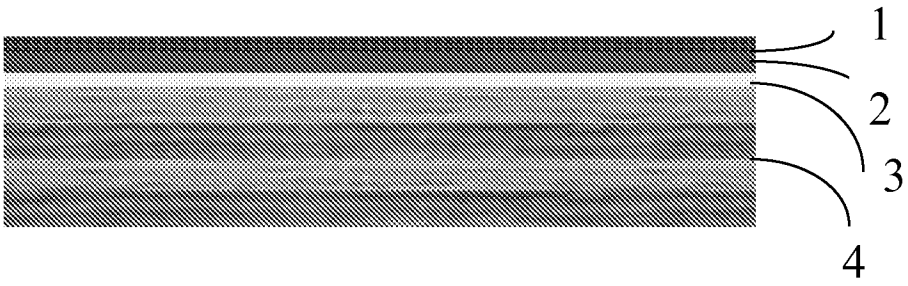

Fig. 1