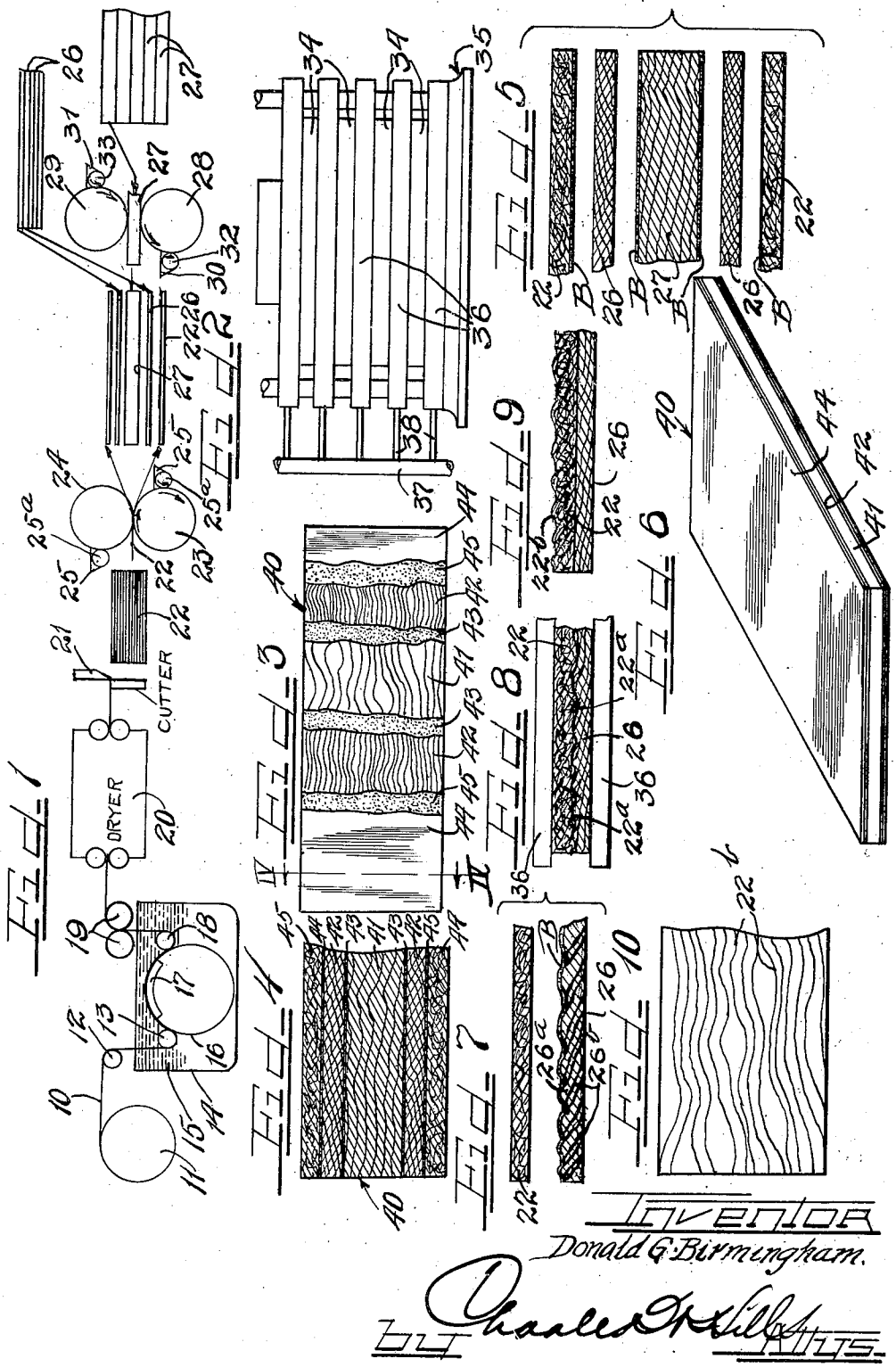
March 7, 1944. D. G. BIRMINGHAM 2,343,740

FIBROUS SHEET COVERED PLYWOOD

Filed Sept. 18, 1940



INVENTOR
Donald G. Birmingham.
BY Charles O. Gilbert
ATTYS.

Patented Mar. 7, 1944

2,343,740

UNITED STATES PATENT OFFICE

2,343,740

FIBROUS SHEET COVERED PLYWOOD

Donald G. Birmingham, Aberdeen, Wash., assignor to Harbor Plywood Corporation, Hoquiam, Wash., a corporation of Delaware

Application September 18, 1940, Serial No. 357,196

11 Claims. (Cl. 154—40)

This invention relates to wood veneer covered with a matted fibrous sheet and includes a method of making such laminated products.

More specifically the invention relates to plywood panels having the broad faces thereof covered with a resin impregnated loosely matted pulp sheet integrally bonded to the wood and presenting finished smooth surfaces on the panels. The invention also specifically provides a method of making paper covered plywood which eliminates wood grain swelling and results in the complete masking of all wood imperfections.

Commercial plywood panels must have at least one broad face thereof presenting a smooth surface free from pitch pockets, knotholes, and other imperfections. The surface veneers for such panels must therefore be carefully graded and matched. Only a very small percentage of the veneer sheets peeled from a log are useful as surface veneers in the plywood panels. A plywood mill therefore rapidly accumulates a surplus of imperfect veneer sheets. These sheets are used to form cores or inner veneers in the panels.

Due to the increasing scarcity of good peeler logs from which plywood veneers are made, more and more of the imperfect veneer sheets are being accumulated and, in order to use up these imperfect sheets, it is now necessary to select the best of them for surface sheets and patch up the imperfections in the best manner possible. The patching operations are time-consuming, expensive, and the finished panels will always contain somewhat visible patches.

The present invention now provides a covering for imperfect surface veneers of plywood panels which completely masks all imperfections and produces a smooth, uniform finish on the panels. According to the invention, fibrous sheets such as ground wood pulp sheets, asbestos sheets, or any other loosely matted fibrous webs are impregnated with a thermosetting or thermoplastic binder. The impregnated sheets are next dried and coated on one face thereof with a water solution of a thermosetting or thermoplastic binder. The coated face is then united with the wood veneer by heat and pressure. If a multi-ply panel is being made, the cores and inner wood veneers of the panel are united to the surface veneers at the same time that the fibrous sheets are united to the surface veneers.

It is, then, an object of this invention to provide plywood panels with finished paper surfaces completely masking all imperfections in the wood.

A further object of the invetnion is to utilize imperfect wood veneers in the making of plywood panels having finished surfaces.

A further object of the invention is to provide a method of covering wood veneers with fibrous webs to completely mask all imperfections in the wood.

A specific object of the invention is to mask imperfections in wood veneers by covering the same with a thermosetting or thermoplastic binder-impregnated loosely matted fibrous sheet.

A specific object of the invention is to provide a method of masking imperfections in wood veneers covered with fibrous sheets by coating an aqueous binder solution only on the fibrous sheet to prevent grain raising of the wood.

Other and further objects of the invention will become apparent from the following specification including the description of the annexed sheet of drawings, in which:

Figure 1 is a diagrammatic view illustrating the method of making paper covered plywood panels according to this invention.

Figure 2 is a diagrammatic view illustrating the hot pressing operation employed in the method of this invention.

Figure 3 is a progressive top plan view of a plywood panel made according to this invention illustrating the various layers of the panel.

Figure 4 is an enlarged vertical cross-sectional view taken along the line IV—IV of Figure 3.

Figure 5 is an enlarged exploded cross-sectional view of the constituent elements forming the plywood panel shown in Figures 3 and 4.

Figure 6 is an isometric view of a plywood panel according to this invention.

Figure 7 is a fragmentary end elevational view of a wood veneer coated with an aqueous binder and a fibrous covering sheet for the veneer illustrating the manner in which the aqueous binder will swell the soft or summer grain of the wood.

Figure 8 is a view similar to Figure 7 illustrating the hot pressing of the fibrous sheet onto the coated wood veneer and the resulting imbedding of the sheet into the soft grain of the wood.

Figure 9 is a view similar to Figure 8 illustrating the wavy surface obtained on the fibrous sheet when the pressure is released due to expanding of the compressed soft wood grain.

Figure 10 is a plan view of the fibrous sheet covered wood veneer shown in Figure 9, illustrating the visibility of the wood grain formation through the fibrous sheet.

As shown in Figure 1 of the drawing, a dry continuous sheet of fibrous pulp 10 is unreeled from a roll 11, passed over a guide roll 12 and

under a guide roll 13 immersed in a tank 14 containing an aqueous dispersion or solution 15 of a thermosetting cresylic acid-formaldehyde partial condensation product. A rotatable foraminous suction roll 16 is immersed in the binder solution 15 and has a stationary suction head 17 therein acting through the roll to define a localized suction area on the periphery of the foraminous roll. The pulp sheet 10 is passed from the roll 13 over the roll 16 to cover the entire suction area defined by the suction head 17. It is next passed under another guide roll 18 and then upwardly between a pair of squeeze rolls 19 disposed above the tank 14. After passage through the nip of the squeeze rolls, the web is fed into a drier 20.

The suction head 17 is evacuated so as to draw the solution 15 through the entire thickness of the sheet 10. The sheet is thus thoroughly impregnated with the solution 15 and excess solution is squeezed out of the sheet by the rolls 19.

The initial sheet 10 is preferably relatively dry, containing in the neighborhood of only about 7% moisture, and is prepared from pulp that is about 90% ground wood. The fibers in the sheet have not been refined as in the case of a finished paper sheet, but are merely felted or loosely matted together to the usual extent obtained on "wet machines" in the manufacture of pulp. The sheet is not calendered so that the fibers will readily absorb the solution 15. The ground wood content of the sheet can be partially replaced with sulphite pulp or, if a high quality sheet is desired, a relatively pure sulphite liner can be formed on one of the surfaces of the sheet so as to improve the finish thereof.

In place of wood pulp, various other vegetable fibers may be employed. Inorganic fibers such as asbestos may be used in sheet form.

The preferred impregnating medium 15 for the pulp sheet is an aqueous solution of a cresylic acid-formaldehyde partial condensation product having a viscosity of not over 1,000 centipoises. The thermosetting cresylic acid-formaldehyde partial condensation product can be prepared as described in the James V. Nevin United States Letters Patent No. 2,150,698 to produce an aqueous binder solution. The resin solution can be diluted with water in any amount necessary to produce a relatively thin solution which will be readily sucked through the sheet by the suction roll 16.

In place of the aqueous solution of cresylic acid-formaldehyde partial condensation product, it should be understood that any other aqueous thermosetting binder can be used. Likewise, thermoplastic natural or artificial aqueous binder dispersions or solutions can be used. If desired, the mastic types of aqueous glue solutions can be used. However, unless the selected resin or glue is thermosetting the resultant product will not be waterproof. Thermosetting materials such as the phenolic resins will produce waterproof products.

Various plasticizers, hardeners, and natural or synthetic thermoplastic resins can be incorporated into the thermosetting resin solutions to impart special properties thereto.

The squeeze rolls 19 are preferably regulated so as to permit the impregnated sheet to retain from 10 to 30% of dried resin solids based on the dry weight of the pulp sheet.

The drier 20 dries the impregnated pulp sheet to a moisture content of about 7% without, however, setting the binder impregnated therein. Temperatures of about 170° F. are used in the drier.

The dried impregnated sheet is then passed through a cutter 21 which cuts the sheet into lengths 22 which are stacked in front of the cutter. The sheet lengths 22 are sized in accordance with standard plywood panel dimensions so as to completely cover the broad faces of the panel.

Two superimposed sheet lengths 22 are then passed between coating rolls 23 and 24. Films of an aqueous binder solution, such as a cresylic acid-formaldehyde binder solution, are applied to the rolls 23 and 24 from troughs 25 by rollers 25a. These films are deposited onto the outer faces of the superimposed sheet lengths 22 and are preferably applied when the binder solution is hot to insure a good flowing of the binder. The binder solution has the water content thereof regulated so that the coating applied to 1,000 square feet of surface of each impregnated pulp sheet does not contain more than 10 lbs. of water.

For example, the solids content of the solution can be about 30% and the spread can be 7½ lbs. of solution on each 1,000 square feet of coated pulp sheet surface. This produces a water content of 5.25 lbs. per 1,000 square feet of coating. The binder solids content per 1,000 square feet of coating is thus only 2.25 lbs. Such a small amount of binder, however, is sufficient to create a good bond between the pulp sheet and the wood veneer since the binder impregnated in the sheet is active in aiding the bond.

In other words, a minimum amount of binder solution is applied to one face of each impregnated sheet to effect a good bond with a wood veneer sheet. In accomplishing this, the water content of the coating is regulated so that 1,000 square feet of spread coating will not contain more than 10 lbs. of water, and will preferably contain only about 5 lbs. of water. This moisture content of the coating on the pulp sheet is important, as will be hereinafter explained.

One of two coated pulp sheets is then laid on an assembly table (not shown) with the coated face exposed. A stack of wood veneer sheets 26 is provided adjacent the assembly table and one of these wood veneer sheets is disposed on top of the coated surface of the sheet length 22 as indicated by the arrow.

A stack of wood core sheets 27 is also provided adjacent the assembly table and these sheets are fed between coating rolls 28 and 29 which coat both broad faces thereof with an aqueous thermosetting cresylic acid-formaldehyde resin solution applied to the rolls from troughs 30 and 31 by means of regulating rollers 32 and 33. The binder solution coated onto the core sheet preferably contains from 40 to 45% of dry solids and is preferably applied in a somewhat heated condition so as to be readily coated over the entire broad faces of the cores. The thickness of the coating is regulated to apply from 7½ to 25 pounds of dry binder per 1,000 square feet of coated area.

The coated cores 27 are then deposited on top of the veneer 26 and covered with another uncoated veneer 26 as indicated.

The other of the two coated pulp sheets 22 is then mounted on top of the top veneer sheet 26 as indicated, with the coated face contacting the veneer.

The thus assembled pulp sheets, veneer sheets and cores form a stack 34 which is next placed

in a hot platen press 35 together with a plurality of other stacks 34 as indicated in Figure 2.

The press 35 has a plurality of steam heated platens 36 each receiving a stack 34 therebetween. Steam from a steam header pipe 37 is supplied to each platen through connecting conduits 38.

The stacks 34 are heated by the platens 36 to temperatures around 330° F. for setting the cresylic acid-formaldehyde binder into a hard, infusible and insoluble mass permanently welding the cores to the veneers and the veneers to the impregnated pulp sheet. At the same time the binder impregnated into the pulp sheet is set into a hard mass materially increasing the strength of the fibrous sheet. The platens have polished surfaces and the surfaces of the pulp sheet are thus provided with a smooth, glossy finish.

Pressures of about 175 pounds per square inch of panel surface are used in the hot press when the veneers are formed of Douglas fir. If the veneers are formed of redwood, lower pressures of around 130 pounds per square inch of panel surface are used.

After the hot pressing operation the welded-together panels are immediately inserted in a humidifier before they cool down. This humidifier will impart a desired moisture content into the panels so that the humidified panels contain between 6 to 12% moisture. Such a moisture content will prevent subsequent warping of the panels and will also prevent checking along the glue lines.

The finished panels 40 shown in Figures 3, 4 and 6 are thereby produced. These panels comprise wood cores 41 permanently welded to wood veneers 42 through the thermoset glue lines 43, and paper covers 44 impregnated with a thermoset resin and united to the outer faces of the veneers 42 through thermoset glue lines 45. As will be noted from Figures 3 and 6, the paper covers 44 have smooth, glassy surfaces. These surfaces, due to the thermoset binder impregnated therein, are weatherproof, hard, and wear-resisting.

As best shown in the exploded view in Figure 5, the panels 40 are initially made from the cores 27 coated on both faces with a thermosetting binder B, the uncoated veneers 26, and the impregnated pulp sheets 22 having thicker binder coatings B on their inner faces as shown.

In order to insure the complete masking of any imperfections in the veneers 26 it has been found that the coating B should be applied to the pulp sheets 22 instead of to the outer surfaces of the veneers 26. It has also been found that when the binder coatings B are applied from aqueous solutions or dispersions, the moisture content of the coating B on the pulp sheets 22 should contain less than 10 lbs. of water per 1,000 square feet of coated surface.

Figures 7 to 10 illustrate what will happen if the moisture content exceeds 10 pounds per 1,000 square feet of coated surface and if the coatings B are applied to the veneers 26 instead of to the pulp sheets 22.

In Figure 7, a veneer 26 is coated with an aqueous binder B. The water content of the binder swells the summer or soft grain in the wood as at 26*a*. The winter or hard grain 26*b* does not swell appreciably, thereby producing a wavy surface on the veneer.

The impregnated pulp sheet 22 does not have a binder coating B thereon, but the binder is dispersed throughout the body of the pulp sheet as described above.

As shown in Figure 8, when the pulp sheet 22 is deposited on the coated veneer 26 and the assembly placed between the platens 36 of the hot press, the loose matted fibers of the pulp sheet will be pressed into the soft swollen summer grain as at 22*a*, thereby becoming embedded in the wood and compressing the soft grain. After the release of pressure by the platens 36, as shown in Figure 9 of the drawing, the compressed summer grain of the wood, now dried by the hot pressing operation, springs back into flush relation with the hard grain, thus producing a flat surface in the veneer 26. However, since the pulp sheet 22 has been embedded in the compressed soft grain and is thickened at the embedded portions, this springing back of the soft grain moves the embedded pulp sheet portions therewith and produces a wavy surface 22*b* in the sheet. As shown in Figure 10, the wavy contour 22*b* will reproduce the grain formation in the veneer 26 and, if any imperfections, such as pitch pockets and the like soft spots are present in the wood veneer, these will also show up in the surface of the panel.

Thus, according to this invention, the pulp sheets 22 are coated with the binder coating B instead of the wood veneer 26 being coated with the binder coating. As a result, the invention provides paper covered plywood panels with smooth, glossy surfaces completely masking all imperfections in the underlying wood structure.

It will, of course, be understood that various details of the invention may be varied through a wide range without departing from the principles thereof and it is, therefore, not the purpose to limit the patent granted hereon otherwise than necessitated by the scope of the appended claims.

I claim as my invention:

1. The method of making fibrous web covered wood products which comprises superficially coating a broad face of a fibrous web with a resinous binder, pressing the coated face against a wooden surface to be united thereto and heating the pressed-together surfaces for uniting the members to mask any imperfections in the wood surface.

2. The method of making laminated wood products having fibrous web covers thereon which comprises coating a fibrous web with an aqueous dispersion of a resinous binder having a water content such as to produce a superficial water content of less than 10 pounds of water per 1,000 square feet of coated surface, pressing the coated surface against a wooden sheet, heating the pressed-together web and sheet to drive the water out of the binder and to permanently unite the fibrous sheet to the wood for completely masking any imperfections in the wood surfaces.

3. The method of making fibrous web covered laminated wood products which comprises coating fibrous webs with an aqueous dispersion of a resinous binder having a water content such as to effect a superficial water content of less than 10 pounds of water per 1,000 square feet of coated surface, covering the outer surfaces of a pair of wooden veneer sheets with said coated webs, disposing a binder-coated core sheet between the veneer sheets, and heating the assembly under pressure to simultaneously unite the veneer sheets to the core and the fibrous sheets to the veneer sheets whereby the fibrous sheets will completely mask all imperfections in the veneer sheets.

4. The method of making pulp covered laminated wood products which comprises superficially coating one face of a loosely matted fibrous pulp sheet with an aqueous dispersion of a thermosetting resinous binder having a water content such as to effect a superficial water content of less then 10 pounds of water per 1,000 square feet of coated surface, pressing the coated surface against a wooden veneer sheet and heating the assembly to set the resin for permanently uniting the pulp sheet to the wood whereby the pulp sheet will completely mask any imperfections in the wood surface.

5. The method of making fibrous web covered laminated wood products which comprises diffusing a resin forming dispersion through a fibrous web to retain in the web an amount of resin insufficient to saturate the web, drying the fibrous web, coating one face of the web with a resinous binder, pressing the coated face of the web against a wood veneer and heating the assembly to unite the web with the veneer.

6. The method of making fibrous web covered laminated wood products which includes diffusing a thermosetting resin forming dispersion through a fibrous web to retain in the web an amount of resin insufficient to saturate the web, drying the web at temperatures below the setting point of said resin, coating one face of the web with an aqueous dispersion of a thermosetting resinous binder in amounts insufficient to effect a superficial water content of more than 10 pounds of water per 1000 square feet of coated surface, pressing the coated surface against a wood veneer, and heating the assembly to set thermally the diffused resin and the binder for uniting the web to the wood and for hardening the fibrous web.

7. The method of making pulp covered laminated wood products which includes diffusing an aqueous dispersion capable of forming a thermoseting resin through a paper pulp sheet to retain in the sheet an amount of resin insufficient to saturate the sheet, drying the sheet at temperatures below the setting point of the resin, coating one face of the dried sheet with a thicker dispersion of a thermosetting resinous binder in amounts insufficient to effect a water content of more than 10 pounds of water per 1000 square feet of coated surface, pressing the coated surface against a wood veneer sheet, and heating the pressed-together assembly for thermally setting the binder in the coating and the resin diffused through the sheet.

8. The method of making pulp covered plywood which comprises diffusing an aqueous resin forming solution of a cresylic acid-formaldehyde condensation product through a loosely matted fibrous sheet to retain in the sheets an amount of resin insufficient to saturate the sheet, drying the sheet at a temperature below the setting point of the condensation product, coating one face of the dried sheet with a thicker aqueous solution of a cresylic acid-formaldehyde binder in amounts insufficient to effect a superficial water content of more than 10 pounds of water per 1000 square feet of coated surface, forming a stack of wood veneers and wood core sheets with thermosetting cresylic acid-formaldehyde binder on the core sheets, covering at least one of the veneer sheets with a coated pulp sheet having said resin forming product diffused therethrough, and hot pressing the assembly to set thermally the cresylic acid-formaldehyde products for permanently welding the cores, veneers and pulp sheets to produce a plywood panel with a pulp cover completely masking all imperfections in the wood.

9. The method of making pulp covered plywood which comprises passing a pulp sheet through an aqueous solution of cresylic acid-formaldehyde partial condensation product, sucking the solution completely through the sheet to impregnate the sheet thoroughly, squeezing the impregnated sheet to remove excess solution therefrom and to leave insufficient solution for binding the sheet to wood veneer, drying the impregnated sheet at temperatures not substantially above 170° F., cutting the dried sheet into plywood panel lengths, forming a stack of wooden cores and veneers with a cresylic acid-formaldehyde aqueous binder solution therebetween, coating one side of each of a pair of sheet lengths with a cresylic acid-formaldehyde aqueous binder solution in amounts insufficient to effect a superficial water content of 10 pounds of water per 1000 square feet of coated surface, inserting the wooden stack between the coated surfaces of the pair of sheets, compressing the resulting stack and heating the same to temperatures sufficient for thermally setting the cresylic acid-formaldehyde condensation product into a hard infusible and insoluble resin thereby permanently welding each of the laminations together.

10. A hot pressed laminated product comprising a wood veneer and, covering and integrally bonded to a broad face of said veneer, a loosely matted fibrous sheet having a thermosetting resin diffused therethrough in amounts insufficient to saturate the sheet, the region of said bond having a higher concentration of resin particles than the fibrous sheet, and said sheet and resin diffused therethrough forming a smooth hard uniform finished surface completely masking the grain of the wood.

11. A hot pressed fibrous sheet covered plywood panel comprising a wood core sheet, wood veneer sheets having the grain running at an angle to the core sheet integrally bonded to the core sheet on both broad faces of the core sheet and covering and integrally bonded to a veneer sheet, a fibrous sheet having a thermosetting resin diffused therethrough in amounts insufficient to saturate the fibrous sheet, the region of the bond between the fibrous sheet and the veneer sheet having a higher concentration of resin particles than the fibrous sheet, and said fibrous sheet and resin diffused therethrough forming a smooth hard uniform finished surface completely masking the grain of the wood.

DONALD G. BIRMINGHAM.