July 1, 1969 J. V. ERWIN 3,452,861

DECORATIVE WOOD GRAIN SHEET MATERIAL FOR AUTOMOBILE PANELS

Filed March 9, 1966

FIG. 1

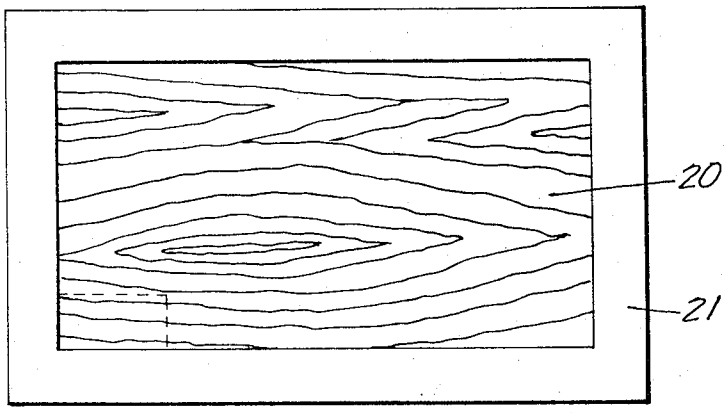


FIG. 2

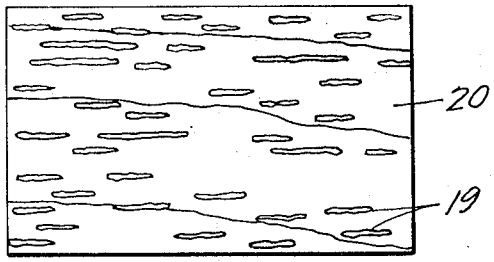
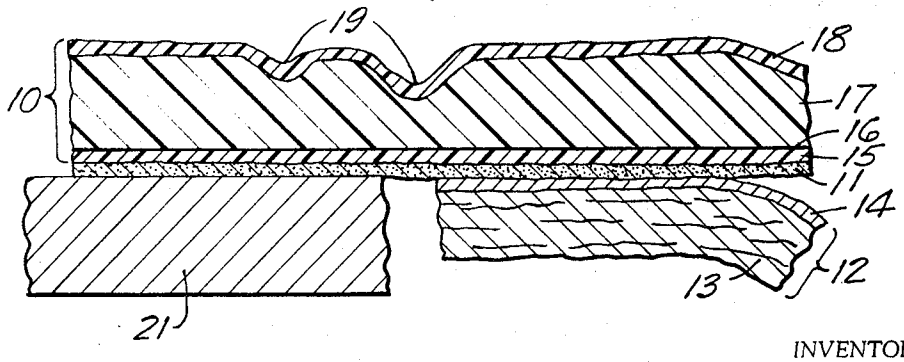


FIG. 3



INVENTOR.
JAMES V. ERWIN
BY
Carpenter, Kinney & Coulter
ATTORNEYS

United States Patent Office

3,452,861

Patented July 1, 1969

3,452,861

DECORATIVE WOOD GRAIN SHEET MATERIAL FOR AUTOMOBILE PANELS

James V. Erwin, North St. Paul, Minn., assignor to Minnesota Mining and Manufacturing Company, St. Paul, Minn., a corporation of Delaware

Filed Mar. 9, 1966, Ser. No. 532,947
Int. Cl. B65d 75/26, 75/30
U.S. Cl. 206—59 4 Claims

ABSTRACT OF THE DISCLOSURE

A decorative multi-layer sheet material having a simulated wood grain pattern, is covered with a transparent bodying layer of plasticized polyvinyl chloride resin embossed with simulated tick holes, and a non-glossy weather-resistant outer layer of transparent acrylate resin. The material is attachable to exterior automobile panels by a pressure-sensitive adhesive layer which is covered with a removable protective backing.

This invention relates to a new attractively natural-appearing decorative simulated wood grain sheet material highly resistant to discoloration upon weathering and especially useful, among other possibilities, as a trim decoration for automobiles. The invention also relates to wood grain trimmed automobile panels formed by using the new wood grain sheet material.

Trimming of automobiles with wood grain panels resistant to discoloration upon weathering is not new. It has been accomplished heretofore. However, the techniques before this invention required several steps and special facilities to accomplish the decorative trim result. For example, a known commercial process in the United States which has given quite satisfactory results in terms of resistance to discoloration, but which has always given artificial-appearing end results, requires the following steps: (1) coating a varnish on an auto panel, (2) converting the coating to a tacky state by evaporation of solvent therefrom, (3) affixation of a wood grain printed film removably held on a releasable carrier, usually also with a water-soluble release coating between the film and carrier, over the tacky varnish coating, (4) removal of the releasable carrier and water-soluble release coating (suitably by water washing), (5) baking the built-up structure on the auto panel to cure the varnish as a binder, (6) spraying a weather-resistant protective top coat over the structure, and (7) finally baking the resultant structure to cure the protective top coating.

The present invention provides automobile manufacturers with a new wood grain sheet material, conveniently manufactured, which can be applied as a decorative panel to automobiles simply by pressure lamination thereto. No longer is it necessary for auto manufacturers who desire wood grain trim to engage in a series of coating and solvent evaporation and baking steps.

The wood grain sheet material of this invention is highly resistant to discoloration on weathering. In addition to this feature, which is an essential feature for all wood grain paneling for exterior trim on automobiles, the decorative wood grain sheet material of this invention also exhibits an attractive natural appearance comparable to the appearance of natural wood.

It is this combination of simplicity of application, realistic wood grain appearance, and resistance to degradation as well as discoloration on weathering that is unique in the automobile wood grain exterior trim art.

The invention will be described by reference to a drawing made a part hereof wherein:

FIGURE 1 is a sketch in plan view of a representation of an automobile panel decorated with the wood grain trim of this invention;

FIGURE 2 is a greatly enlarged schematic plan view of the decorative surface of the sheet material hereof, illustrating a pattern of tick marks, and

FIGURE 3 is a composite showing in cross section through a wood grain sheet material of this invention, with the left part of the sheet material firmly adhered to the surface of an automobile panel and with the right part of the sheet material carrying a removable temporary liner.

The new sheet material of the invention has several layers. The portion carrying the wood grain is conveniently referred to as a base laminate structure **10**. On one side (i.e., the back side or underside) of the base laminate is a firmly adhered normally-tacky and pressure-sensitive adhesive layer or coating **11**. Over the adhesive coating, as the sheet material is sold in commerce, is a temporarily adhered removable disposable protective liner **12**.

The normally-tacky and pressure-sensitive adhesive layer **11** of this structure is one having high tack and high grab, preferably one of the acrylic type. Suitable acrylate pressure-sensitive adhesives are described and claimed in Ulrich U.S. Patent Re. 24,906, reissued Dec. 13, 1960 (original U.S. Patent No. 2,884,126 issued Apr. 28, 1959), here incorporated by reference. Normally the adhesive layer has a dry (or solvent-free) weight of about 8 to 14 grains (preferably 10 to 12 grains) per 24 square inches (the broad range being about 0.5 to 1.0 grams per 150 square centimeters). In thickness, it may vary from about 15 to 35 microns, usually about 20 to 30 microns. It is essentially uniform in thickness, when considered from a practical standpoint.

As the disposable liner, any of a variety of self-supporting strippable sheet materials **13** (e.g., paper) having a low adhesion or release surface or coating **14** (e.g., silicone release compound) for releasable contact with the adhesive layer may be employed.

The base laminate structure **10** which carries the wood grain pattern will now be described. This structure, without the top or outermost layer taught herein, has been sold for several years in the United States for indoor uses.

Characteristically the base laminate structure **10** is between about 3 and 15 mils (75 and 375 microns) thick, preferably between 3 and 8 mils (75 and 200 microns) thick, and is made up of several layers firmly and permanently adhered and united or bonded together.

The bottom layer of the base laminate (i.e., the layer nearest or actually in contact with the pressure-sensitive adhesive coating) is a flexible opaque pigmented flexible resin layer sometimes called a background layer **15**, which softens at least above 70° C. It is formed of pigmented plasticized polyvinyl chloride resin, and has a thickness of about one mil, plus or minus 0.5 mil (25 microns plus or minus 15 microns).

Next to this pigmented background layer is a decorative multicolor wood grain pattern layer **16**, which is not a self-supporting layer. The pattern is only a few microns up to about 5 microns thick. This wood grain pattern is labeled **16** in the drawing, but is so thin it is illustrated in the drawing as consisting essentially of a line. It may be and frequently is discontinuous, relying upon some color from the pigmented background layer **15**. It is suitably formed of pigmented resin material, usually polyvinyl chloride, applied as an ink pattern by rotogravure printing from a cylinder carrying the wood grain pattern onto the supported background layer. Normally a separate printing step is required for each color of the pattern. The technology of printing wood grain patterns is now well-known.

The next layer or film in the structure is preferably a prime coating of transitional adhesive material (not shown in the drawing) to effect strong adhesion or bonding between the upper surface of the wood grain pattern, which usually consists of differently pigmented polyvinyl chloride inks, and the transparent bodying and cushioning layer **17** over the wood grain pattern. The prime coating of transitional adhesive is no more than about 5 microns thick, and usually is as thin as one micron or a few microns in thickness. While it normally is a continuous film, it may be a discontinuous film. Depending upon the method of manufacture employed in putting the layers of the base structure together, this prime adhesive layer may or may not be omitted. It is normally an in situ chemically-reacted film.

Over the wood grain pattern **16**, (and also adjacent to the prime coating when the prime coating is employed) is a flexible transparent protective bodying and cushioning resin layer **17** of plasticized polyvinyl chloride resin of substantial thickness, which softens above 70° C. This transparent layer is essentially free of pigment material. The wood grain pattern is visible through it. But the transparent layer must have a substantial thickness—usually at two mils (50 microns) up to about 12 mils (300 microns) of thickness—so as to body the structure and cushion the underlying layers against damage from surface impact, scuffing and the like. It is, however, at least thin enough to conform to underlying surfaces, which means that it does not exceed about 12 mils in thickness.

The transparent bodying layer is embossed with a tick pattern on the surface thereof away from the wood grain pattern. This tick pattern is in the nature of small line-like dash marks of random length and of random spacing. Spacing between tick marks will vary, usually from a space about equal to the width of the marks up to about one-quarter inch (6 mm.). These imitation tick marks are line-like depressions no deeper than three-fourths the thickness of the transparent layer. They usually are about 2 mils deep, but may vary from as little as about 1 mil (25 microns) or so to about 3 mils (75 micorns) in depth. They are about as wide as they are deep, but may vary in width from about one-half to about two times their depth. Their length is not uniform. It varies from about 2 to 100 or 200 or even 300 or 400 times their width. Generally lengths from 10 to 100 times width are more predominant, with a predominance of those having a length below 50 times their width for preferred realistic wood grain results. Stated another way, length varies from about 3 mils (75 microns) up to about ½ inch (12 mm.).

These embossed tick marks are substantially aligned with the grain pattern of the wood, but may not be aligned in the sense of always being parallel. However, they are most easily formed as somewhat parallel marking by rolling a cylinder with the desired pattern of line-like protrusions over the surface of the transparent layer under heat and pressure sufficient to permanently emboss or deform the resin of the transparent bodying layer (e.g., surface of bodying layer heated at least to 100° C. up to 250° C., and pressure at the nip of the cylinder at 200–600 p.s.i.g. or 550–1,700 kg. per square cm.). Normally the concentration of line-like depressions, or tick marks as they are called, should at least be in excess of 10 per square inch (1 per square centimeter of surface area. These tick marks impart a natural wood appearance to the surface and cause the surface to be nonplanar. They add depth or a three-dimensional characteristic to the article.

The top or outermost or surface layer **18** of the base laminate structure is the layer which converts the other parts of the sheet material of this invention into a new article having a combination of properties heretofore lacking in exterior trim wood grain laminates.

The outermost layer **18** is applied by solvent coating and is a non-tacky acrylate clear or transparent resin film (preferably polyethyl methacrylate) which is relatively rigid or stiff as compared with the underlying transparent bodying layer. It softens at least above 60° C., preferably above 70° C. At least the material of the outermost layer is more stiff or inflexible than the material of the body layer; but the unity of the outer layer to the relatively flexible bodying layer **17**, as well as the very thin character of the outer layer and the back-up character of the bodying layer, work in combination to impart a flexible integrity and non-shattering character to the outer layer and the entire laminate in use applications.

The thickness of the outer layer is usually about 1 mil (25 microns), but it may be as thin as 0.5 mil (10 microns). Of greatest significance, and contrary to what one would normally expect, is the fact that the outer layer carries in it a replication of the tick pattern of the bodying layer **18** of the laminate. This is true even though it would not normally be expected that solvent application of a relatively rigid or brittle protective film over an embossed surface of depressions would, on drying, give one a final exterior film carrying a replication of the irregularities or embossing of the underlying surface. Instead of such a result as here taught, one would expect a solvent applied coating of topcoat material to fill or obliterate the depressions of the embossed area. But the solvent applied top coating **18** is essentially uniformly thick overall surface parts of bodying layer **17**, and conforms evenly to the tick depressions therein.

The replication of the tick pattern in the outer acrylate layer serves to preserve the natural wood grain appearance of the sheeting. Equally important, the acrylate layer imparts resistance to weathering to the total structure and makes it practical for exterior automobile-trim decorative use.

The following example, in parts by weight, is offered to further illustrate the invention.

The pigmented background color layer is first coated onto a low adhesion sized paper surface. A typical formula for the background layer coating composition is an intimately blended mixture consisting of 16.6 parts of a polyvinyl chloride resin such as a terpolymer softening at about 80–100° C. (the terpolymer consisting of 91% vinyl chloride, 3% vinyl acetate and 5.7% vinyl alcohol monomers), 2.7 parts of a plasticizer for the terpolymer (e.g., a liquid polymeric epoxidized soybean oil of about 1000 molecular weight and a softening temperature or freezing temperature of about 5° C.), 0.8 part of stabilizers for the terpolymer resin (e.g., suitably made up of .5 part organic tin chelate and 0.3 part alkyl-aryl phosphite), 12.8 parts of pigment material (e.g., made up of 4.3 parts titanium dioxide, 5.8 parts yellow light chromium oxide, 1.7 parts red iron oxide and 1.0 part carbon black pasts), and .2 part of dispersants, e.g., a mixture of long chain fatty acid esters of glycols)—all dissolved or dispersed in a solvent mixture suitably consisting of 38 parts methyl isobutyl ketone, 25 parts toluene, 2 parts 2-nitropropane, and 2.1 parts isopropanol. This coatable mixture is cast with a roll coater to a thickness which on drying gives a solid layer thickness of about 0.8 to 0.9 mil. Solvent removal or drying is accomplished in a convection oven at about 160° C.

A wood grain pattern is printed from a rotogravure press on the background layer using an ink formula such as, for example, one having the basic ingredients of the pigmented background composition. An illustrative formula is one having 13 parts of the polyvinyl chloride resin, 2.2 parts of the plasticizer, 0.7 parts of the stabilizers, 0.6 part of the dispersant, and 19.5 parts of light red iron oxide pigment—all dissolved or dispersed in a solvent mixture of 31 parts methyl isobutyl ketone, 28 parts toluene, 2.5 parts 2-nitropropane, and 2.5 parts isopropanol. Solvent removal is again accomplished in the convection oven.

To the foregoing structure is applied the transparent polyvinyl chloride bodying layer. The bodying layer may

be directly applied, but preferably is first formed to have a dry thickness of about 6 mils (150 microns). It suitably consists of the ingredients of the background layer, excluding all pigment from the same so as to end up with a transparent or clear 6 mil layer; but instead of the terpolymer of the background layer, other polyvinyl chlorides may be employed. Over one surface of the preformed clear layer is applied a size coating of a prime adhesive composition illustratively consisting of 26 parts of a polyester solution resin containing hydroxyl groups available for isocyanate reaction and 13 parts of liquid polymethylene polyphenyl isocyanate (reaction of which with the polyester is accelerated by heat) dissolved in 52 parts toluene and 9 parts 2-nitropropane. This size coating is suitably applied by a rotogravure cylinder in such sparse quantity that the dry coating is hardly measurable. It is dried by convection oven and then the sized side of the transparent bodying layer is laminated to the printed wood grain surface of the background layer. Lamination is accomplished by passing the layers through pressure rolls heated to 110–130° C. and under a pressure of 150 p.s.i.

The tick pattern on the surface of the bodying layer is then applied by passing the laminate, preheated to a temperature of 220–235° C., through a cylindrical nip under a pressure of 400–600 p.s.i.g. (1,000–1,700 kg. per sq. cm.). The cylinder carries the pattern of outward projections which form the tick marks. The outward projections suitably are 2 mils (50 microns) deep and about 2 to 3 mils wide and 3 to 50 mils in length in this illustration. They were spaced from 5 to 50 mils in random relationship.

Over the exposed surface of the transparent bodying layer is applied, by means of a roll coater, a transparent lacquer coating consisting of 32 parts of polyethyl methacrylate softening above 70° C., 1.65 parts of a plasticizing ingredient such as the liquid polymeric epoxidized soybean oil of the ground coat, 1.65 parts of an ultraviolet absorber such as 2,2′-dihydroxy-4,4′-dimethoxy benzophenone (suitably in admixture with other tetra substituted benzophenones), and 64.7 parts of xylene as a volatile solvent. If desired, a small amount of silica fines may be added to the lacquer to further reduce gloss beyond the reduction caused by the tick marks. The lacquer is dried to a solvent content of less than 2% based on the weight of the original wet coating. It is applied at a thickness such that its dry weight is about 5.5 to 6.5 grains per 24 square inches (0.3 to 0.5 gram per 150 square centimeters). Interestingly, the lacquer coating does not obliterate the tick marks of the bodying layer. In fact, the lacquer conforms to those depressions and is essentially uniformly thick over all surface parts of the bodying layer.

Next the low adhesion sized paper is removed from the background coating surface, and the pressure-sensitive adhesive and temporary liner is applied. The temporary liner suitably consists of clay sized kraft paper coated with a non-migrating release agent such a non-adhesive release silicone (or for that matter, a polytetrafluoroethylene coating). Release liners of this type are available commercially.

The adhesive is suitably a copolymer of 90 parts fusel oil acrylate and 10 parts acrylic acid (Example 24 of United States Patent No. Re. 24,906). It is applied to the release surface of the temporary liner at a coating weight of 10–12 grains per 24 square inches (0.6 to 0.8 gram per 150 square centimeters).

The adhesive coated liner is then passed with its adhesive side next to the background layer of the base laminate through nip rolls pressed together at a pressure of 40–60 p.s.i. The product is usually wound in overlapping convolutions into a roll, normally a jumbo roll at least 2 feet in diameter, and is sold in commerce.

Automobile manufacturers apply the product **20** to automobile panels **21** by stripping the temporary linear from it to expose the adhesive surface. Then they press the adhesive surface against those panels which are to carry a wood grain trim.

That which is claimed is:

1. A non-glossy weather-resistant decorative sheet material suitable for adhesive affixation at room temperature to an automobile panel to be decorated, said sheet material comprising a base laminate structure, a normally tacky pressure-sensitive coating firmly adhered to one side thereof, and a disposable removable protective liner temporarily adhered over said adhesive coating, said base structure being between **4** and **15** mils thick and comprising, from said adhesive coating, the following layers permanently bonded together: a flexible opaque background pigmented layer of plasticized polyvinyl chloride resin about 1 mil plus or minus 0.5 mil in thickness, a decorative multicolor wood grain pattern of differently pigmented inks printed on said background layer at a thickness no greater than about 5 microns, a flexible transparent protective bodying layer of plasticized polyvinyl chloride resin of substantial thickness but no more than 12 mils thick and at least 2 mils thick with an embossed tick pattern on the surface thereof away from the decorative wood grain pattern, said embossed tick pattern consisting of a multiplicity of minute essentially parallel but staggered line-like depressions in said bodying layer, said depressions being at least one mil deep and no more than ½ inch long and no wider than two times their depth and simulating the tick pattern in natural wood, and an outer hard non-tacky acrylate resin transparent film adhered over said bodying layer and containing ultraviolet absorbers dispersed within said transparent film, said transparent film being between about 0.5 and 1 mil thick, resistant to discoloration, and being a protector for the underlying resin layers against degradation by weathering, said transparent film further being essentially uniformly thick over all surfaces of said bodying layer whereby the exterior exposed surface of said transparent film exhibits a replication of said tick pattern.

2. The sheet material of claim **1** wound in overlapping convolutions into a roll at least 2 feet in diamter.

3. The sheet material of claim **1** having in addition, a prime coating of transitional adhesive material up to about 5 microns thick between the wood grain pattern and the bodying layer.

4. The sheet material of claim **3** wherein the composition of the prime coating includes ingredients chemically reacted together in situ to form the firm bond between the printed wood grain pattern and the bodying layer of the base laminate structure.

References Cited

UNITED STATES PATENTS

3,008,858	11/1961	Blake et al.	161—413 X
3,194,725	7/1965	Pounds.	
3,330,784	7/1967	Anspon	161—5 X
3,361,609	1/1968	Borack et al.	161—6 X
3,363,956	1/1968	Vingren et al.	161—123 X
3,385,748	5/1968	Neale et al.	161—6

OTHER REFERENCES

Carpenter: "Cover it With Stick-on Plastics," Popular Mechanics, vol. 104, No. 6, pp. 169–171 (December 1955).

Buob: "Installing Decals," Auto Body and the Reconditioned Car, pp. 8, 39 (May 1964).

ROBERT F. BURNETT, *Primary Examiner.*

W. W. SCHWARZE, *Assistant Examiner.*

U.S. Cl. X.R.

52—316; 161—5, 6, 119, 406, 413