Aug. 13, 1935. R. G. JACKSON ET AL 2,011,150

DECORATED AND SATURATED SHEET AND PROCESS OF PREPARING THE SAME

Original Filed Sept. 29, 1931

FIG. 1.

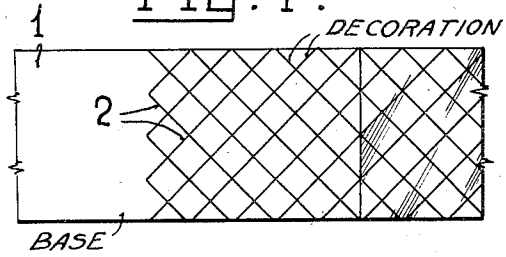


FIG. 2.

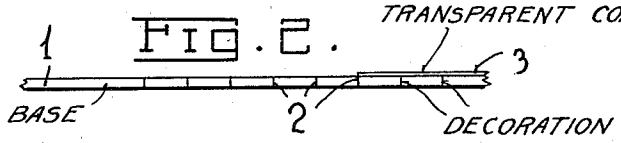


FIG. 3.

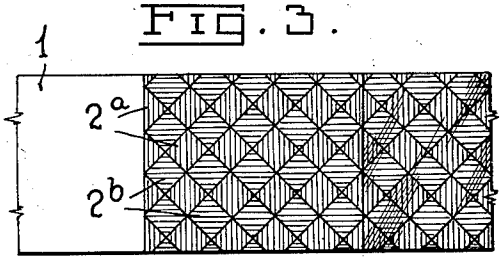


FIG. 4.

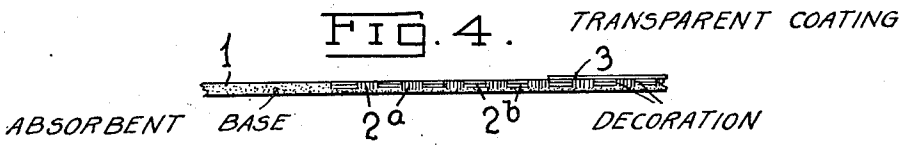
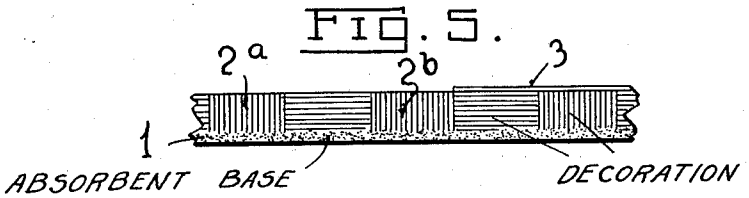


FIG. 5.



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DECORATED AND SATURATED SHEET AND PROCESS OF PREPARING THE SAME

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Original application September 29, 1931, Serial No. 565,872. Divided and this application June 19, 1935, Serial No. 27,436

6 Claims. (Cl. 91—67.9)

This invention relates to the manufacture of decorated coverings particularly adapted for use as floor coverings.

This is divided from the application Serial 565,872, filed by Ralph G. Jackson and Julian T. Baldwin, September 29, 1931 and relates specifically to a paper or felt sheet carrying design decorations penetrating deep into the body of the sheet and sealed in by a specific type of saturant containing a resin and a plasticizer, and the steps of making it all as claimed.

The improvement involves the decoration of absorbent or porous sheets and the subsequent saturation of such sheets by a particular method and with the use of a material capable of being rendered fluid by heat and of solidifying when cool and peculiarly serviceable in the use described. The resulting sheet may be hot pressed and calendered, thus completing the manufacture of remarkably fine products in which the characteristic feature is a decorative sheet have either solid colors or designs which are sealed by a transparent saturant.

In proceeding in accordance with this invention, absorbent sheets of substantially even texture throughout, such as porous paper, are given a first treatment by which they are decorated so that the decorations extend substantially throughout the thickness of the sheet, or optionally solid color sheets of paper may be used in which the decorative material is added to fiber particles while in the beater stage. A second treatment includes the saturation of the decorated sheet by use of a particular transparent saturant the qualities of which include ability to quickly solidify to a condition suitable for floor covering use, and the solidified sheet is of such character that it may be hot pressed and calendered to provide desired qualities or effects.

The floor covering provided by the present invention is of that general type known as "smooth surface" coverings, such as linoleum and felt base floor coverings having decorative paint coats, and the invention is an improvement over such materials known as bitumen impregnated felt base coverings, linoleums, oil cloth and the like.

One feature of the invention is a decorative floor covering of the smooth surface type in which the decorative effects, patterns, and designs are applied directly to the material of the base and penetrate the base for part or all the way through the thickness thereof from top to bottom. Another feature of the invention is that the covering possesses tensile strength to a pronounced degree, and may be handled similarly to the usual smooth surface floor covering.

One advantageous feature of the product of this invention is the provision in a single continuous ply or layer of floor covering of decorative effects similar in appearance to those used in linoleums and felt base goods, but having superior wearing quality due to the fact that the design extends into the base. This latter quality is in contrast to decorative effects which are merely painted on the surface or printed with paint on the surface, or consisting of ordinary paper merely printed as usual, as wall paper is printed and subsequently varnished or lacquered. The product of this invention is to be distinguished from the usual paper decorated by printing.

In usual printing operations the work is so conducted as to preclude as far as possible any substantial penetration by the ink into the body of the paper. To such end most paper used in printing contains sizing or a filling material to prevent absorption of the printing ink. The surface of such paper is often calendered smooth and tight in order to present a satisfactory finish to receive ink from the printing type. Contrasted to such standard print paper, the material preferred for use in this invention is purposely selected for its fibrous qualities. These are absorbent papers, such as blotting paper and other especially manufactured absorbing papers which are not commercially desirable for printing purposes. Contrasted to printing practice, in this invention the decoration or figures will extend well below the surface of the sheet. In other words, the sheet may be worn down well below the original surface but the figure or decoration will still remain in the sheet.

The product possesses the appearance of linoleum and is susceptible to treatment to produce much finer and more delicate designs than is possible in the manufacture of linoleum type goods. Unlike linoleum, the entire decorative portion possesses strength and wearing qualities as a sheet and does not require a supporting base of fabric, such as the known burlap base used with linoleum. Another advantage in the product resides in the fact that the covering has tensile strength, even greater than the bitumen impregnated felt base covering, and in contrast to such latter, the present product has its decorative effects extending into the thickness instead of being applied by painting or printing and remaining on the surface, as is common in felt base

goods. A comparatively thin sheet of fibrous material which has been saturated with the saturant of this invention and then calendered has as much or more wear to it as the best printed felt base rugs purchaseable at this stage in the art.

Of major importance is the feature which provides a rug or floor covering in which the coloring or decoration is sealed in the fibrous material of the covering by the same impregnating saturant which provides the toughness and wearing qualities so desirable in floor coverings. According to this important feature the fibrous sheet is first decorated or colored and thereafter it is saturated with a water proof transparent saturant which not only seals the color and decoration in place but waterproofs the sheet and also binds the fibers of the sheet, toughens it, and makes it wear resistant. The sheet is preferably calendered while yet the saturant is in a plastic condition and this treatment insures thorough saturation for the sheet, or it may be permitted to cool and subsequently be hot pressed and calendered. All the pores and spaces between the fibers are filled and the particles are bonded together and will not scuff off under floor usage.

The decorating of the fibrous base, preliminary to the saturating treatment, may be accomplished in several ways. By one procedure, the color may be added to the paper pulp while it is in the beaters and thus prior to the actual formation of the sheet. In this way a solid color base may be obtained. The color materials added at the beaters may be either a dye or pigment, provided that if pigment be used it is not of such amount or nature as to fill the spaces between the fibers and thus prevent adequate saturation by the subsequently applied toughening transparent saturant. The solid color effects may also be obtained by printing with surface contact application to the sheet of a penetrating dye or stain which will saturate the sheet throughout.

Decorative designs are applied by printing and stenciling in restricted zones according to the configuration of the desired design, and multiple color effects are obtained, as will be described.

Referring to the accompanying drawing, there are illustrated diagrammatically floor coverings embodying the use of several types of decorative paper-like materials or supporting sheets. All of these figures are predicated on the broad idea expressed in the application for patent of Ralph G. Jackson, Serial No. 46,189, now Patent 1,729,832 and Serial No. 111,769, now Patent 1,729,833 and include the feature of saturating with transparent saturant filling material a decorated sheet or a sheet containing coloring matter.

Referring in detail to the several views of the drawing;

Figure 1 is a top plan view of a section of floor covering sheet showing a portion which is decorated with relatively fine lines;

Figure 2 is an edge view of the floor covering shown in Figure 1 illustrating the decorating lines extending downward through the material of the sheet;

Figure 3 is a view similar to that shown in Figure 1 but showing a modification of the coloring scheme, displaying solid colors arranged in squares;

Figure 4 is an edge view of the covering illustrated in Figure 3, showing an example wherein the colors extend into the body of but not completely through the sheet; and

Figure 5 is an enlarged view of a portion of Figure 4.

Referring in detail to the several figures of the drawing, 1 indicates a sheet of unsaturated porous fibrous absorbent material such as paper felt. The floor covering felt, such as is commonly saturated with bitumen, is satisfactory if used in its open and unsaturated condition. 2 indicates the decorative coloring material which extends well down into, substantially through, the thickness of the paper felt from top to bottom. This may be applied in lines of different color, as indicated in Figures 1 and 2, or it may be applied in solid colors, as indicated by the Figures 3 and 4, in which the parts 2^a represent red and the parts 2^b represent blue, thus simulating a tile effect. This coloring effect may be worked out as desired, as for instance, in alternate squares of black and white. 3 indicates an outer transparent wear coat such as may be provided by a coating of a solution of a cellulose ester. In lieu of the celiulose ester coating, any transparent coating of any other material may be added as desired, as for instance a transparent varnish. In lieu of the geometrical figures illustrated in the drawing, the decorations may be of any shape or style. In fact, one of the advantages of this invention is the almost unlimited degree of variation with which decorating effects may be used. It is fully as extensive in its possibilities as are wall paper decorations.

The material of the colors and decorative effects may extend completely through the thickness of the article as indicated in Fig. 2, or it may extend merely well down into the goods and not quite through the thickness thereof, as represented in Figs. 4 and 5. The degree of penetration, impregnation, depends on the density and absorbability of the material of the sheet when in its original dry porous fibrous condition. Penetration depends also on the thickness of the sheet and on the pressure used when the dye is applied, and also on the amount of and the degree of fluidity of the dye. These factors are within the knowledge of the operator and his control of the procedure may be modified according to conditions. It suffices to emphasize the result that a very considerable thickness of goods is colored or decorated by a penetrating or dye type of color after which the color is sealed in and the material made tough and wear resistant by the saturating filler. Fig. 5 shows a very much enlarged view of a fibrous sheet in which the color does not extend completely through but in which the wearable depth is vastly greater than mere surface decorated material. The saturant filler preferably treats the whole sheet and not merely the colored portion.

In preparing the floor covering of this invention, the untreated and saturated sheet, such as paper felt, is decorated with the desired designs which are so applied with materials in such a state of fluidity that the decorated medium permeates partially or entirely through the thickness of the sheet, impregnating the sheet within the zone to which that particular color or shade is applied. Under some conditions, it may be desirable at times to have the colors blend together, and have one color laid partly over or exactly over another color. Reference has been made hereinbefore to the use of suitable mechanism, not illustrated, which may be used for compressing the sheet and thus to outline the outer margins of the decorated portion, and under such

conditions the decorative medium will not spread beyond the specified limits of the zone to be decorated. Where solid colors are applied, a lesser degree of care need be exercised to prevent spreading of the coloring material, and where the designs are delicate and the sheet is relatively thick, then corresponding care must be used in applying the decorative fluid.

The decorative fluid may be made up from paints having the necessary fluidity, but preferably the medium is a dye which is capable of carrying the desired color through the thickness of the sheet without any tendency toward accumulating a filtrate or relatively dense accumulation of pigment on one surface of the sheet.

An optional method of providing a decorated sheet is to incorporate the dye or coloring matter with the paper particles while in the beater stage. In forming the sheet from such material, the particles are collected on the usual paper making machine and the resultant single thickness of paper or paper felt will have the coloring matter extending completely therethrough. The primary requisite in such sheets is that the coloring matter added at the beater stage shall not tend to fill the voids between the fibrous particles which would thus interfere with the subsequent saturation.

The next step in the process is drying the sheet of felt or fabric thus decorated. This drying step is relatively speedy and may be accomplished remarkably readily if a dye is used and if oil is not present.

After drying, the sheet is saturated with a transparent saturant capable of impregnating throughout the thickness of the material and capable of quickly solidifying to be suitable for floor covering usage. Emphasis is placed on the quickness of the solidification step because this is characteristic of the saturants used and hereafter described and is in contrast to the slow time of solidifying or drying common to materials which dry by oxidation, as for example linseed oil or materials containing large proportions of similar oil.

It is desired, in accordance with this invention, to treat the absorbent sheet which has been decorated or which contains decorations, as heretofore described, with a saturant which is susceptible to being rendered fluid with the aid of heat and which, after solidification, is further susceptible to being hot pressed and calendered. Heat damages some materials, such as the cellulose esters, but in the present invention, heat may be used to advantage.

Among the saturants which may be employed is preferably one of a formulae including a so-called resin-plasticizer composition and consists generally of resins and plasticizers for the resins. Modifiers, colloidal substances, and solvents may be used with the resin and plasticizer composition if desired. This composition in comparison with other plastics, such as cellulose esters, for instance, is easier to apply, less expensive, less inflammable, and produces more striking effects.

The resins employed may be either natural or synthetic, examples of which are acroides gum, rosin, manila, copal, shellac, cumaron, ester gum, urea formaldehyde resins, and the like. Clear resins such as bleached shellac or water white rosin may be used. Rosin is easy to melt and easy to handle without danger of decomposition. It is to be understood that by resin is meant a true resin as technically distinguished from a gum. A true resin, for instance, is insoluble in water, whereas a gum is soluble in water.

Plasticizers are substances or mixtures of substances which apparently form a permanent gel or state of solution with resins. When a plasticizer is mixed with a resin, the resulting composition is generally considered to be a solution of the resin in the plasticizer, the plasticizer being the external phase. It is desirable in the present case to have the plasticizer as the internal phase or in solution in the resin. The solution is probably not a true solution but a gel or a dispersion of plasticizer in the resin, and it will be observed that one characteristic of this dispersion is that the amount of resin by weight far exceeds the amount of the plasticizer.

Plasticizers are generally liquid and have practically no vapor pressure at ordinary temperatures (70° F.). They are high boiling point solvents for resins, their boiling points ranging not much below 300° C.; they are chemically stable; free from tackiness; and impart to the resins the important properties of flexibility, toughness, impermeability, durability and smoothness of surface. Examples of plasticizers are: diethyl phthalate, dibutyl phthalate, diamyl phthalate, dibutyl tartrate, triphenyl phosphate, and tricresyl phosphate.

Modifiers are used optionally to attain certain qualities such as elasticity, hardness, stability toward light, and resistance to wear. They are also used as cheapeners. Examples of modifiers are: waxes (such as Montan wax), rubber, fatty acids of vegetable oils, polymerized oils, drying oils such as tung oil, and hydrocarbons such as spinacene and squalene. Cellulose ethers and cellulose esters may also be used if heat is not applied but such materials should not be used in the operation of the present invention because heat disintegrates the cellulosic product.

The colloidal substances may be used to make an opaque, colored saturant. They add weight to the material saturated, and improve the wearing qualities of the material. The colloidal particles are fine, insoluble particles that exist in the saturant in such a fine state of division that they will penetrate into the fibrous material along with the saturant. They are practically ultramicroscopic in size. Examples of these substances are: zinc oxide, Prussian blue, carbon black, mica, and chrome yellow.

Dyes may be added to the saturant, or the fibrous base may be colored before saturating, in which case, if the saturant is a transparent resin-plasticizer composition, the color of the base will be visible through the saturant.

The use of volatile solvents is optional, depending upon the manner of applying the saturant. Examples of solvents are: ethyl alcohol preferably denatured, benzol, toluol, naphtha, and the like.

The fibrous material may have added to it in the process of its manufacture, mineral fillers or pigments. The fibrous material is generally treated in beaters with the pigments and fillers. The colloidal particles in the saturant will be an auxiliary supply of minerals and pigments. The base of the floor covering may be a fibrous material to which fillers and pigments have been added during the process of its manufacture, or it may be just a plain fibrous sheet subsequently decorated.

The following is a general formula for a saturant:

	Parts by weight
Resin	100
Plasticizer	40
Modifier	10
Colloidal particles	20
Solvent (if used)	75–150

An example of a transparent, practically colorless saturant for use without solvent is the following:

	Parts by weight
Water white rosin	100
Dibutyl phthalate	25
Diethyl phthalate	15

To produce a transparent colored saturant, a dye may be added preferably by dissolving the dye in the plasticizers and adding the solution to the molten resins. To produce an opaque, colored saturant add 20 parts of weight of Prussian blue to the plasticizers in the above formula. The Prussian blue and plasticizers may be mixed in a colloid mill and the resulting mixture added to the resins which may be either molten or in solution. If a solvent is used, 75–150 parts by weight of denatured alcohol give satisfactory results.

The fibrous material may be saturated in the same manner in which felt is saturated with bitumen. The material may be run through a tank containing a heated resin plasticizer saturant and then through squeeze rollers. The saturant may be applied cold when in solution and in this case the material is run through several times to completely fill the voids.

A decided advantage of a resin-plasticizer saturant over bitumen is that bitumen saturants are commonly black and opaque, while resin-plasticizer saturants may be transparent and colorless, transparent and colored, or opaque and colored.

Resin-plasticizer saturants are more desirable than cellulose esters for a number of reasons. Resin-plasticizer compositions are less inflammable than cellulose esters. They are very much cheaper, and are easier to apply since a resin-plasticizer may be rendered fluid with heat and used without the use of solvents, while cellulose esters are not rendered sufficiently fluid by heat to make satisfactory saturants.

Since a resin-plasticizer composition with the use of heat may be used without the use of solvents, the voids in the fibrous material are filled by fewer treatments than where cellulose ester solutions are employed. In the case of resin-plasticizers all of the composition will remain in the voids whereas in the case of cellulose ester solutions where only 10 to 30% is solid matter, the voids are not as quickly filled and therefore more treatments are necessary. Even in the case of resin-plasticizer solutions where 40 to 70% or more is solid matter, fewer treatments are required, and there is incidentally a saving in the cost of solvents. When solvents are used, a much higher concentration of resin may be obtained than with pyroxylin for the same viscosity. The concentration of solids in a resin solution may often be ten times as great as in a cellulose ester solution of the lowest viscosity.

Cheaper solvents can be used with resins than with cellulose esters. Solvent naphtha, benzol, and 188 proof denatured alcohol are the most important resin solvents. Esters, which are many more times expensive, are quite necessary for the dissolving of cellulose esters. Expensive slow evaporating solvents need not be used with resins.

A saturant that can be used hot, as in the case of resin-plasticizer saturant, penetrates a fibrous material more readily than a cold saturant. The heat expands the air in the voids and tends to drive it out. When the material is cooled after saturation, a suction is created and upon retreatment the material absorbs the saturant more readily, thereby filling all the remaining voids.

It will thus be seen that a floor covering or a covering suitable for other purposes may be made by printing a design with dyes or other suitable substances upon or preferably completely through a fibrous sheet, or optionally such a sheet may contain decorative coloring completely therethrough, and either type may be saturated with a transparent resin-plasticizer saturant according to this invention. The resulting sheet may be used as a covering by itself or it may be cemented to any supporting base or surface.

The decorated and saturated sheet is susceptible to treatment by the use of hot plates to modify the surface characteristics of the sheet. It may be embossed or calendered or burnished and it is possible to somewhat lift the fibrous particles or nap and thus provide a soft appearance.

As an optional example of a formula of a saturant which under this invention may be used in hot molten condition and which will dry or solidify promptly, the following materials are specified:

	Pounds
Ester gum	80
Chlorinated naphthalene	20

This latter material, sometimes known as Halowax, has a melting point of above 200° F.

In connection with the use of subsequently applied heat and pressure for densifying or changing the surface of saturated sheets made in accordance with this invention, it has been found that a combination of an oxidizing oil and a plastic material such as a resin or wax will make a satisfactory plastic saturant. Indeed, gums may be used as substitutes for resins in this combination. A peculiar result is afforded because, whereas oxidizing oils will not melt and move under heat and are of a spongy nature and will not solidify under heat and pressure as many other materials, the above mentioned combination does make a plastic saturant and one that will move when heat is applied under pressure. This is true of the above mixture of ester gum and chlorinated naphthalene. It also applies to a mixture of ester gum 85 pounds, China-wood oil, 15 pounds.

Pursuant to the foregoing, it has been found that if a sheet is saturated with oil and allowed to oxidize, as known before this invention, and then is calendered and pressed, the results fall far short of the results obtained when the decorated sheet is saturated with such materials as above specified or of a wax or resin nature that will soften under heat and take the form of the press to which it is subjected and which will solidify when allowed to cool. Such improved products are substantially ready for use when cool.

In addition to the above mentioned difficulties with the use of oxidizing oils alone, it has been shown that embossing cannot be performed due to the fact that the oils are of a spongy nature and goods saturated with them possess the same characteristics.

With respect to the saturant formula, this may vary depending on the vehicle used to carry the decorative materials into the absorbent sheet. Thus, it has been found that if a water soluble dye is used, it requires more plasticizer in the saturant than is required if an oil coloring matter be used. It is also necessary to use about twice the amount of plasticizer in the resin-plasticizer mixture when water soluble dyes are used than is necessary when oil soluble dyes or paints are used. These variations are within the knowledge of the well trained chemist and operator of this type of work. The reasons for the variations are to be found in the fact that when coloring matter is carried with oil, the oil toughens the sheet and the same saturant is not as hard or brittle and hence undesirable, as though it were applied to a sheet that has been decorated with water dyes.

From the foregoing, it will be obvious that the present invention provides a product and process of making an improved decorated covering which is subsequently saturated with a material that can be melted to a plastic state, pressed after saturation to a definite shape of surface characteristic, and retain that shape when cooled.

It will also be obvious that this invention provides a sheet which is decorated and the decorations extend through the sheet, the sheet being saturated with a plastic material which may be pressed together to close the voids in the sheet, thus solidifying the sheet and the surface thereof assuming the form of the press or calender to which it is subjected.

In its broadest analysis, the invention provides a sheet of uniform density carrying decorative material substantially throughout its thickness, the sheet being preferably of a homogeneous mass of fibers, decorating material, and saturant, being so bonded together that the fibers have no particular direction in relation to each other or to the length or width of the sheet.

What we claim is:

1. A sheet covering comprising a sheet of fibrous material having decorative coloring matter in printed designs extending substantially throughout the thickness thereof and tinting the fibrous particles but not closing the voids between the particles, said sheet being saturated substantially throughout its thickness with a substantially transparent saturant having as its two major ingredients a resin and a substantially chemically stable plasticizer for the resin and which plasticizer is selected from the following: dibutyl phthalate, diamyl phthalate, dibutyl tartrate, triphenyl phosphate, and tricresyl phosphate.

2. A sheet covering comprising a sheet of fibrous material having decorative coloring matter in designs extending substantially throughout the thickness thereof and tinting the fibrous particles but not closing the voids between the particles, said sheet being impregnated with a saturant having as its two major ingredients a resin and a substantially chemically stable plasticizer for the resin, the surface of said impregnated sheet being free from tackiness under ordinary conditions of floor covering usage.

3. The process of making a decorative sheet covering which comprises the treatment of a sheet of absorbent non-woven fibrous material of substantially even density and thickness throughout by applying penetrating decorative matter in designs substantially through the thickness of the sheet so as to tint the fibrous particles but not close the voids between the particles, and subsequently applying to the said decorated sheet a hot fluid saturant comprising essentially a dispersion of a chemically stable plasticizer in a resin, cooling the saturated sheet and thereby producing an impregnated sheet free from tackiness.

4. A sheet covering comprising a sheet of fibrous material having decorative coloring matter in printed designs extending from the surface well into the body of the sheet and tinting the fibers but not filling the voids between the fibers, said sheet being impregnated substantially throughout its thickness with a substantially transparent saturant which fills the voids between the fibers and has as its two major ingredients a resin and a substantially chemically stable plasticizer for the resin and which plasticizer is selected from the following: dibutyl phthalate, diamyl phthalate, dibutyl tartrate, triphenyl phosphate, and tricresyl phosphate.

5. A sheet covering comprising a sheet of fibrous material having decorative coloring matter in designs extending from the surface well into the body of the sheet and tinting the fibers but not filling the voids between the fibers, said sheet being impregnated substantially throughout its thickness with a saturant which fills the voids between the fibers and has as its two major ingredients a resin and a substantially chemical stable plasticizer for the resin, the surface of said impregnated sheet being free from tackiness under ordinary conditions of floor covering usage.

6. The process of making a decorative sheet covering which comprises the treatment of a sheet of non-woven fibrous material of substantially even density and thickness throughout by applying penetrating decorative matter in designs so as to extend from the surface well into the body of the sheet and tinting the fibers but not filling the voids between the fibers, and subsequently applying to the said decorated sheet a hot fluid saturant which fills the voids between the fibers and comprises essentially a dispersion of a chemically stable plasticizer in a resin, cooling the saturated sheet and thereby producing an impregnated sheet free from tackiness.

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