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FLOOR COVERING AND METHOD

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This invention relates to a hard-surfaced, flexible floor covering and method of making the same, and has particularly to do with a floor covering having a flexible sheet or fabric backing carrying thereon a plastic wearing layer presenting an ornamental design on the exposed surface thereof, and with said design extending down through substantially the entire thickness of said wearing layer.

Heretofore, hard-surfaced floor coverings such as linoleum, rubber, or any of the compositions suitable to form a relatively thick wearing surface have been made by mixing together a mass of cork, wood powder and/or mineral matter and color, together with a binder. The binder in the case of linoleum is linoxyn and resins, or a binder of nitro-cellulose or resins may be used with such filling materials. These materials, after mixing, are formed initially into a dense sheet with or without a backing and, when cured, form a hard, dense, tread-resisting surface, through-and-through decoration of which depends upon a pre-mixing of the color with the plastic mixture at or before the time of application thereof to the base fabric, thus necessarily limiting the character of any element of the design to the hit or miss mixing of the colors stirred through the plastic mass and requiring for a regular pattern the assembling of pieces cut from sheets of different colored plastic materials or depositing granulated material through stencils, thus limiting the designs which commercially can be made from the linoleum or like materials. Also, heretofore, Graham & Lines, in their U. S. Patent No. 1,971,036, have described and claimed a floor covering not limited in design as is linoleum, rubber, or like materials, but which is made by first mixing a light colored mixture of wood powder and mineral matter with a small amount of primary binder (preferably nitro-cellulose) with a very considerable amount of solvent to make a mass which can be formed into a layer on a base, and yet, because of the character and small amount of binder used, becomes sufficiently open and absorptive in texture as to be printed with a liquid coloring material on the usual floor covering printing machines, and absorbs such an amount of the coloring material that the design of one or more colors and shades penetrates substantially the entire thickness of the tread-surface, after which the coloring material is dried and the wearing layer then filled with a secondary or supplementary binder (which may, however, include coloring matter) and is then dried so that the material then becomes a desirable and

durable tread-surface for floor covering in which the decoration retains its integrity throughout the useful life of said tread-surface. Such floor covering as just described has gone into considerable commercial use.

The present invention provides an improved floor covering product and method of the general type of said Graham & Lines patent, but presents many advantages in both method and product over said patent, as will hereinafter appear. In the commercial practice of the invention of said patent a relatively large proportion of solvent for the binder is required in order to form a plastic mixture that may be readily and smoothly sheeted on a flexible backing or base material,— usually asphalt-saturated felt, which may or may not have applied thereto an undercoat or filler to prevent staining by the asphalt of the after-applied wearing layer. There are various disadvantages in the use of such solvent material or thinner, among which are the softening action of the thinner upon the undercoat and saturant of the felt base; the slower evaporation of the heavier fractions of the thinner; the high cost of such thinners which are ordinarily entirely lost; the risk of fire and explosion in their application, or in the drying ovens due to their volatile and inflammable characteristics; and the lack of uniformity of the solvent content and difficulty of control of solvent evaporation from the plastic mixture due to different and changing temperatures and atmospheric conditions in the machine rooms, with the result that the uniformity of application and smoothness of the exposed surface of the plastic mixture are adversely affected. Aside from their relatively high cost, there are also other disadvantages in the use of any considerable quantity of high-boiling plasticizers, for example, tri-cresyl phosphate, in that they remain in a liquid state and/or tend to interfere with the hardening of drying oil and, to whatever extent that they do either, tend to diminish the firmness and strength of the wearing layer. The product and method of the present invention avoid all of the difficulties just referred to and have, in addition, various other advantages in product and method as will hereinafter appear.

The present invention contemplates the manufacture of floor covering involving a plastic mixture which, as applied to the base may be, and desirably and preferably is, substantially in accordance with the following example (all parts being by weight):

200–300 parts wood powder (substantially all

passing a 60 mesh screen, at least $\frac{1}{2}$ passing a 100 mesh screen, and a substantial portion passing a 200 mesh screen);

20-50 parts of a stabilizing medium (bentonite is preferred but other colloidal clays, soap, casein, or other aqueous gel-forming material will answer, though when clay is not used, it is ordinarily preferable to add 20-60 parts of a finely ground filling pigment);

50-225 parts of resins or equivalent hardenable material,—a mixture of resin and drying oil which hardens is preferred, though various natural or artificial resins (somewhat plasticized or not), for example, phenol-formaldehyde resin, gums, rubber bodied linseed or other drying oils, will answer, said hardenable materials, or combinations of the same being herein termed "resinous material"; and

200-400 parts water.

In the preferred practice, the plastic mixture constituents above set forth are thoroughly mixed, preferably in a bladed mixer followed by germans, and it is found, as a result, that a gelled emulsified mixture is formed, with the water and clay lubricating and stabilizing the wood powder and so-called resinous material in the mixture, though the resinous material may be entirely omitted and the remaining constituents still produce a useful plastic product.

After having been thoroughly mixed, the plastic wet mixture including the wood powder and other constituents, in commercial practice, by suitably driven rolls, is frictioned in situ in layer form to the base to the thickness desired, (say, .010" to .040"). Because it is so well lubricated by means of the gel, the complete aqueous mixture under pressure is very easily workable and is smoothly applied to the flexible base by means of the pair of frictioning rolls. Despite the fact that the mixture is non-flowable, viscous and stiff, the gel permits it to be sheeted readily with sufficient adherence to the base but without adherence to the exposed roll, for the clay or other aqueous gel-forming material and water practically eliminate any adhesion to said roll by the resinous material or other constituents of the mixture.

The intermediate product thus formed is then dried from two to six hours at 150° F. and, as a result of this drying, the water passes off leaving the wood powder held together and to the base by the bentonite, together with the resinous material hardened or partially hardened by said drying, if it be employed, thus providing a smooth but porous and uniformly open though still relatively strong and firm structure,—the strength and firmness or hardness of the intermediate dried product of the above preferred proportions being materially greater than that of said patent. The clay in practice (when employed) not only stabilizes the mixture, but also functions as a mineral filling pigment in the finished material, and, within the limits of the example, does not adversely affect the permeability of the mixture. In fact, it appears to make the dried plastic mixture more permeable, gives a smoother surface finish, and does not appreciably affect the color. Strangely enough, a large amount of the resinous material may be employed, if desired, and still not appreciably affect the application of the wet plastic to the base or the color absorption of the dried sheet. The particles of wood powder are adhesively attached together by the resinous material and the water is carried between such coated particles, and, upon drying,

gives the required porosity for printing. Moreover, the surface of the sheet is very smooth, despite the use of the relatively large amount of water, due apparently, to the fact that during mixing because of preferential adsorption, the clay, because of its great attraction or affinity for the water, adsorbs or carries practically all of the water, thus minimizing wetting of the wood powder. Evidence of this is found in the fact that the sheet remains smooth when dried and the wood powder does not become swelled, puckered or rough-surfaced as a result of the drying operation.

Following the drying off of the water and the hardening of the intermediate product due to such drying and the partial or complete hardening of the hardenable resinous material, it is ready for the coloring or decorating step which may be done on a flat bed print machine or otherwise as desired so as to print on the intermediate porous product the desired design, though any method of applying color, rotary or flat bed, may be used. The coloring material may be a water-soluble dye or pigmented oil, though the latter is ordinarily employed in commercial practice, the pigments in such case preferably being of extremely finely ground or colloidal type in drying oil so as to readily permeate into the intermediate product. The liquid color is ordinarily applied in the amount of approximately 35-45 lbs. per 100 sq. yds. of the material and the colored product, thus printed with the design, is dried for a period of several hours in a moderately heated oven, as a result of which, substantially all of the liquid carrier of the coloring material is evaporated and/or hardened.

This step of drying or hardening the liquid carrier of the coloring material may serve to harden or further harden the resinous material, though, as a practical matter, the hardening thereof (whether by heat, oxidation, polymerization, etc.) may take place at any time after the drying off of the water from the gel.

The next operation is that of filling up the remaining voids or pores of the colored plastic mixture by adding thereto a suitable hardenable material, for example, drying oil, wax, or wax-like material, resin, lacquer, or a mixture of two or more of them. The amount required for this purpose, because of the great strength of the intermediate printed product, is ordinarily of the order of 20 lbs. per 100 sq. yds. of the material, and this final filling operation may be done in either one or two coats, the result in either case being a marked increase in durability and strength as well as greatly improved appearance. In practice, drying oils such as linseed and China-wood or their substitutes, have been found satisfactory, and there is ordinarily incorporated therewith a small amount of resin in order that the finished product may provide a firmer and harder surface and greater wear-resistance. The hardening of these drying oils or other hardenable material may conveniently be accomplished by a drying step such as that employed for drying the liquid carrier of the coloring material, or, the drying or hardening of the latter, if a hardenable carrier is employed, may be accomplished at the same time as the hardening of the filling material. It is also contemplated that the colors may be mixed with an additional binder and applied to the partially completed wearing layer. In the typical preferred product the completed wearing layer includes 40-55% wood powder; 5-9% bentonite; 20-35% resinous materials; 75

with the balance made up of coloring material (dry) plus the after-applied or supplementary-filler binder.

This product is found in practice to be denser and harder and more rigid than any heretofore made, and provides a tougher sheet or floor covering which not only gouges and dents less but following any denting returns more nearly to its original surface condition. It is also less susceptible to temperature changes and to water,—primarily because it includes little or no liquid phase since the resinous material is hardenable to substantially solid form. On account of the presence of the stabilizing medium, the color is also found to more uniformly impregnate the sheet because of its more uniform porosity prior to the printing and thus tends to increase the strength of the preferred product of this invention.

This application is a continuation in part of our application Serial No. 162,162, filed September 2, 1937.

Having described our invention, what we wish to claim and secure by Letters Patent is:

1. The method of making a hard-surfaced floor covering which consists in first forming an aqueous mixture including finely powdered wood, an aqueous gel-forming emulsifying agent, and a substantial quantity of water, said agent being present in sufficient quantity to hold practically all of the water, said mixture having lubricating characteristics, then applying to a flexible base a layer of substantial thickness of said aqueous mixture, then drying off the water therefrom to provide a smooth-surfaced though porous firm and adherent layer consisting mainly of said powdered wood and said agent on said base, and then applying thereto coloring and binding material to fill the pores thereof with said binding and coloring material extending through at least the major portion of the vertical depth of said wearing layer.

2. The method of making a hard-surfaced floor covering which consists in first forming an aqueous mixture including finely powdered wood, an aqueous gel-forming emulsifying agent, a quantity of drying oil and a substantial quantity of water, said agent being present in sufficient quantity to hold practically all of the water, said mixture having lubricating characteristics, then applying to a flexible base a layer of substantial thickness of said aqueous mixture, then drying off the water therefrom to provide a smooth-surfaced though porous layer consisting mainly of said powdered wood and said agent on said base, and then applying thereto coloring and binding material to fill the pores thereof with said binding and coloring material extending through at least the major portion of the vertical depth of said wearing layer.

3. The method of making a hard-surfaced floor covering which consists in first forming an aqueous mixture including finely powdered wood, an aqueous gel-forming emulsifying agent, a quantity of drying oil and a substantial quantity of water, said agent being presented in sufficient quantity to hold practically all of the water, said mixture having lubricating characteristics, then applying to a flexible base a layer of substantial thickness of said aqueous mixture, then drying off the water therefrom thereby providing a smooth-surfaced though porous layer consisting mainly of powdered wood and said agent on said base, and then applying thereto coloring material including finely divided colloidal coloring pig-

ment and finally, after drying said coloring material, applying a hardenable binding material to further fill the pores thereof with said binding and coloring material extending through at least the major portion of the vertical depth of said wearing layer.

4. The method of making a hard-surfaced floor covering which consists in first forming an aqueous mixture including finely powdered wood, an aqueous gel-forming colloidal clay emulsifying agent, and a substantial quantity of water, said agent being present in sufficient quantity to hold practically all of the water, said mixture having lubricating characteristics, then applying to a flexible base a layer of substantial thickness of said aqueous mixture, then drying off the water therefrom to provide a smooth-surfaced, though porous, firm and adherent layer consisting mainly of said powdered wood and said agent on said base, and then applying thereto coloring and binding material to fill the pores thereof with said binding and coloring material extending through at least the major portion of the vertical depth of said wearing layer.

5. The method of making a hard-surfaced floor covering which consists in first forming an aqueous mixture including finely powdered wood, an aqueous gel-forming colloidal clay emulsifying agent, a quantity of drying oil and a substantial quantity of water, said agent being present in sufficient quantity to hold practically all of the water, said mixture having lubricating characteristics, then applying to a flexible base a layer of substantial thickness of said aqueous mixture, then drying off the water therefrom to provide a smooth-surfaced though porous layer consisting mainly of said powdered wood and said agent on said base, and then applying thereto coloring and binding material to fill the pores thereof with said binding and coloring material extending through at least the major portion of the vertical depth of said wearing layer.

6. A smooth hard-surfaced flexible floor covering produced in accordance with the method defined in claim 1.

7. A smooth hard-surfaced flexible floor covering produced in accordance with the method defined in claim 2.

8. A smooth hard-surfaced flexible floor covering produced in accordance with the method defined in claim 4.

9. A smooth hard-surfaced flexible floor covering produced in accordance with the method defined in claim 5.

10. The method of making a hard-surfaced floor covering which consists in first forming an aqueous mixture including finely powdered wood, a quantity of liquid though hardenable resinous material, an aqueous gel-forming emulsifying agent, and a substantial quantity of water, said agent being present in sufficient quantity to hold practically all of the water, said mixture having lubricating characteristics, then applying to a flexible base a layer of substantial thickness of said aqueous mixture, drying off the water therefrom to provide a smooth-surfaced, though porous, firm and adherent layer consisting mainly of said powdered wood and said agent on said base, applying thereto coloring and binding material to fill the pores thereof with said binding and coloring material extending through at least the major portion of the vertical depth of said wearing layer, and at some stage of the process after drying off the water, hardening said resinous material.

11. The method of making a hard-surfaced floor covering which consists in first forming an aqueous mixture including finely powdered wood, an aqueous gel-forming emulsifying agent, a quantity of drying oil and hardenable resin, and a substantial quantity of water, said agent being present in sufficient quantity to hold practically all of the water, said mixture having lubricating characteristics, then applying to a flexible base a layer of substantial thickness of said aqueous mixture, drying off the water therefrom to provide a smooth-surfaced though porous layer consisting mainly of said powdered wood and said agent on said base, applying thereto coloring and binding material to fill the pores thereof with said binding and coloring material extending through at least the major portion of the vertical depth of said wearing layer, and at some stage of the process after drying off the water, hardening said drying oil and hardenable resin.
12. The method of making a hard-surfaced floor covering which consists in first forming an aqueous mixture including finely powdered wood, a quantity of liquid though hardenable resinous material, an aqueous gel-forming colloidal clay emulsifying agent, and a substantial quantity of water, said agent being present in sufficient quantity to hold practically all of the water, said mixture having lubricating characteristics, then applying to a flexible base a layer of substantial thickness of said aqueous mixture, then drying off the water therefrom to provide a smooth-surfaced, though porous, firm and adherent layer consisting mainly of said powdered wood and said agent on said base, and then applying thereto coloring and binding material to fill the pores thereof with said binding and coloring material extending through at least the major portion of

the vertical depth of said wearing layer, and at some stage of the process after drying off the water, hardening said resinous material.

13. The method of making a hard-surfaced floor covering which consists in first forming an aqueous mixture including finely powdered wood, an aqueous gel-forming colloidal clay emulsifying agent, a quantity of drying oil and hardenable resin, and a substantial quantity of water, said agent being present in sufficient quantity to hold practically all of the water, said mixture having lubricating characteristics, then applying to a flexible base a layer of substantial thickness of said aqueous mixture, drying off the water therefrom to provide a smooth-surfaced though porous layer consisting mainly of said powdered wood and said agent on said base, applying thereto coloring and binding material to fill the pores thereof with said binding and coloring material extending through at least the major portion of the vertical depth of said wearing layer, and at some stage of the process after drying off the water, hardening said drying oil and hardenable resin.

14. A smooth hard-surfaced flexible floor covering produced in accordance with the method defined in claim 10.

15. A smooth hard-surfaced flexible floor covering produced in accordance with the method defined in claim 11.

16. A smooth hard-surfaced flexible floor covering produced in accordance with the method defined in claim 12.

17. A smooth hard-surfaced flexible floor covering produced in accordance with the method defined in claim 13.

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