

UNITED STATES PATENT OFFICE

2,083,441

LACQUER COATED SHEET MATERIAL AND
METHOD OF MAKING THE SAMEFrederick H. Frost, Westbrook, Maine, assignor
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Serial No. 62,713

11 Claims. (Cl. 91—68)

This invention relates to lacquer coated sheet material having a highly lustrous, water-resistant finish, and to the method of producing the same. More particularly the invention relates to a lacquered sheet material characterized by a layer of slack-sized mineral coating composition interposed between a lacquer coating and a fibrous or textile base. A slack-sized mineral coating composition means a composition containing less than the normal ratio of adhesive to pigment, as will be explained more fully hereinafter.

In the following description and claims both lacquering and varnishing are referred to simply as "lacquering" and both calendering and supercalendering are referred to generically as "calendering", excepting where the two words are used together or the words "supercalendering" is used alone with its customary meaning.

Lacquers have been applied to plain papers, especially calendered papers, with only fair results, while somewhat better results have been obtained by applying lacquer to the usual mineral coated papers, including the higher grade enameled or art papers used in the printing trade for fine half-tone reproduction. Such papers, however, do not possess surfaces providing all the qualities desired in a base for lacquers.

Past attempts to improve the surface of coated paper have been mainly confined to subjecting the paper to heavy calendering and to variations in the composition of the pigment constituents of the coating itself. These treatments have resulted in surfaces improved for printing purposes, but still lacking in the extreme levelness and even absorptiveness desired for lacquering. Indeed heavy calendering tends to increase uneven absorptiveness owing to the unequal compacting of the high and low spots on the uncalendered sheet. Furthermore, extremely heavy calendering may objectionably blacken the sheet if a clear (i. e. undyed) transparent lacquer is to be used. Consequently it is customary to calender the sheet as heavily as possible without undue blackening and leave it with a surface satisfactory for printing, but still far from ideal in respect to levelness.

As a result, to obtain a lacquered sheet of uniformly high luster, it has been necessary heretofore to apply a comparatively thick film of lacquer. A thin film applied to heavily calendered but still comparatively rough paper shows a mottled effect due both to the unevenness of the surface and to variations in absorptiveness of the surface. Even with a heavy film of lacquer the resulting product may not be entirely free

from mottle. Furthermore, in case a transparent lacquer is applied, it is possible that a relatively thick lacquer film may accentuate the unevenness of the surface of the base because of the refractive properties of the lacquer film itself. Then again, aside from the uncertainty in regard to the resulting appearance, the use of a heavy lacquer film is disadvantageous economically, because of the comparatively high cost of the ingredients of the highgrade lacquers generally used for this purpose.

The smoothness has been improved by applying to mineral coated paper a coating of clear casein or nitrocellulose prior to the application of the final lacquer film. This procedure may make the surface more level, but simultaneously the surface is rendered substantially non-absorptive. At the same time, of course, the step of applying the extra intervening coating is disadvantageous.

An object of the present invention is to produce an improved lacquered sheet material having a level and brilliant surface.

Another object is to produce an improved base for lacquering.

Another object is to produce a mineral coated paper having an extremely level and evenly absorptive surface.

Another object is to improve the printing characteristics of lacquered paper.

Another object is to enhance the brilliancy of colored lacquered paper.

Other objects and advantages of this invention will appear hereinafter.

In accordance with the invention a fibrous or textile base is coated with a mineral coating composition similar to those used for the production of the usual printing or art paper, but containing less adhesive than is necessary in printing papers, i. e. a slack-sized coating, and dried and calendered and finally coated with a relatively thin coating of lacquer. The lower than normal adhesive content of the mineral coating composition in itself makes for even absorptiveness as well as for much greater ease of calendering. That is, a slack-sized coating is much easier to calender to a flat surface than is one containing more adhesive. The less severe calendering required by such a coating likewise makes for even absorptiveness of surface, as well as for avoiding danger of blackening.

The benefits of such an evenly absorptive and very level base are well shown when a coating of bronzing lacquer is applied thereto. The object in applying a metallic lacquer (as for example a

nitrocellulose lacquer containing aluminum powder) is to simulate the appearance of sheet metal. It is well known that such metallic lacquers have a higher, more metallic sheen when the film applied is thin. This is doubtless because the plates or scales of metal must in such a case lie in a substantially horizontal position relative to the surface. In addition, of course, the lacquered surface must be smooth and free from mottle. The desired qualities in the metallic lacquer film, i. e. thinness, smoothness and freedom from mottle, are promoted by the levelness and uniform absorptiveness of the improved coated base to a degree not, as far as I am aware, previously attained in a lacquered paper.

In addition I find when I apply lacquer over a slack-sized mineral coating that in subsequent printing operations the ink dries more quickly and more evenly on the sheet than when a normally sized coating is used. Moreover, the brilliancy of the lacquer coat, particularly if the lacquer is colored, is materially enhanced by the use of the lower adhesive content in the underlying mineral coat.

Furthermore, by using a weak or slack-sized mineral coating which is colored instead of white, I may produce a sheet which after lacquering shows a depth and brilliancy of coloring not obtainable by merely using a colored lacquer. At the same time a saving in cost is effected owing to the relative cheapness of the coloring materials (including pigments, lakes and soluble dyes) that may be used in the mineral coating.

A particular embodiment of this invention consists of a colored base coating beneath a coating of so-called crystallizing lacquer, that is, a lacquer containing material which is deposited in crystal form upon the evaporation of the solvent medium. In this instance the colored base showing through the translucent crystal design gives an effect which is both attractive and novel.

To practice my invention I take as a base for the mineral coating a fabric, as for instance Holland cloth or the cloth used in making artificial leather, or paper as made on a Fourdrinier or cylinder paper machine or other flexible sheet material. The exact nature of the base is immaterial provided that mineral coating composition will adhere to its surface and that its surface be sufficiently closed so that the coating material will be held up in a continuous layer thereon and that the base be sufficiently strong and sufficiently flexible for passage through a calender or supercalender.

The mineral coating consists of pigment and adhesive dispersed in water. The pigment may be one or more of the common pigments either white or colored, such as China clay, blanc fixe, calcium carbonate, talc, satin white, lithopone, titanium dioxide, ochre, ultramarine, and the like. Any adhesive dispersible in water, either with or without a peptizing agent, may be used. I prefer to use the common paper-coating adhesives, such as casein, animal glue, and modified starch; but in special cases other materials may be used, such as proteins like soya-bean protein and zein, or gums like gum arabic, gum ghatti, and locust-bean gum, or rubber latex. In general starches and gums are dispersible in water upon heating, while dilute alkali solutions may be used to disperse the proteins, if necessary.

The coating may be applied to the web by any known process on the usual types of coating ma-

chines, preferably by an air brush coater; or if the base is paper, the coating may be applied if desired on the paper machine itself. After being coated the web may be dried, calendered and/or supercalendered in known ways.

The lacquer used for the final coating may comprise cellulose compounds and/or resins, either natural or synthetic, together with plasticizing or softening agents, if desired; all being dispersed in a volatile medium usually consisting of volatile organic solvents and diluents. The lacquer may be colorless or colored, and may if desired contain pigments, metallic powder, or materials which crystallize upon the evaporation of their solvents.

The lacquer may be applied in any desired way, as by blades or rolls, or by spraying.

When the lacquer is a solution of resin alone, i. e. without the presence of any cellulosic material, I prefer to use a solution of medium viscosity rather than of very low viscosity in order to prevent excessive penetration of the lacquer into the coated base. The viscosity may be controlled by increasing the concentration of resin, or by using a resin of higher inherent viscosity.

For the sake of clearness the invention will hereinafter be described with respect to paper, but the invention is not restricted thereto.

The optimum proportion of adhesive to pigment used in the practice of this invention, while naturally varying depending upon the particular base and the particular pigment or pigments used, and upon the weight of coating applied, as is well understood by those familiar with coating paper, will nevertheless, for any combination of base and pigment used, be lower than the adhesive-pigment ratio required by the same base and pigment combination to give a sheet suitable for general printing use.

On mineral coated paper suitable for printing the coating must contain sufficient adhesive so that when printed, say with a half-tone plate, with a printing ink (for example, Geographic Black No. 148 of Sigmund Ullmann Company) the coating will not be pulled away from the fiber base by the ink on the plate. Such lifting or "picking" of the coating renders the paper unsatisfactory for printing. Coating which does not pick in this test may be said to have normal sizing, while coating which does show picking is slack-sized. In the practice of my invention I require my mineral coated surface to show picking by this test and in consequence to be slack-sized.

A test for degree of sizing more convenient than actually printing the sheet is provided by the paper testing waxes of graduated melting points made by the Dennison Manufacturing Company. Dennison's waxes are made in sets of sticks numbered consecutively from 1 for the lowest melting to 30 or more for the high melting waxes. In general the lower third of this series includes all waxes useful for testing ordinary coated papers. To test by this method, consecutive waxes are softened by heat, applied to the coated surface, cooled, and pulled away from the paper. The strength of the coating is set at the lowest numbered wax which does not pick any coating from the surface of the sheet.

The wax test that must be shown to ensure freedom from picking on the printing press will vary somewhat depending upon the type of fiber base and the kind of adhesive used, as is understood by those skilled in the art of coating paper.

The point to be emphasized is that, having fixed the fibrous base, the pigment combination, and the kind of adhesive to be used, in my invention the supercalendered mineral coating must, by the wax test, show picking on at least one wax lower in number than is permissible for printing paper made with the same base and coating ingredients. For instance, if on a specific body stock a coating to be safe for printing purposes must not pick on a wax lower than No. 5, on the same body stock a coating suitable for use according to my invention must pick on No. 4 wax. It may show picking on No. 3 wax or even on No. 2 wax and still be satisfactory for my use.

Marked improvement in the calendered surface of the mineral coating occurs as the adhesive is reduced below the normal proportion, and this improvement continues progressively as further decreases in adhesive are made. After a decrease of about 20 percent, however, the rate of improvement with further decrease in adhesive is materially lessened. Consequently I prefer ordinarily to keep the adhesive content between 50 and 80 percent of the quantity normal for printing papers. The point within this range that I find to be the optimum will depend upon the particular pigment combination used. With some pigment combinations it is permissible to exceed 80 percent of normal sizing, while with other combinations less than 50 percent may be used satisfactorily. As far as I have found, however, any pigment combination can be used within my preferred limits, as stated above.

Weakness of the mineral coating is compensated for in the lacquered sheet by the increased strength given by the lacquer itself as it penetrates into the interstices of the mineral coating and binds the resulting double coating firmly to the fibrous base. The wax test shown after the lacquering is more than ample for printing. A specific instance is a paper which after the application of the mineral coating with subsequent drying and calendering had a wax test of only 3, but which after lacquering gave a wax test of 10.

In the following examples showing specific embodiments of my invention I have, unless otherwise noted, used body stocks comprising equal parts of fibers made, respectively, by the sulfite and soda pulping processes, together with 12 percent of clay as filler, the mixture being beaten moderately and engine-sized to show an ink penetration test of from 50 to 70 seconds, the whole being run into a web on a Fourdrinier machine and dried and calendered before the application of the mineral coating. It is obvious, however, that other base stocks can be used without exceeding the scope of this invention.

The cellulosic lacquers referred to in the example all contain plasticizers similar to the following: tricresyl phosphate, dibutyl phthalate, methyl phthalyl ethyl glycolate, etc.

The weights mentioned refer to ream weights of 500 sheets cut 25 x 38 inches.

The specific examples follow:

Example 1.—Take a paper base of 57 pounds basis weight; apply thereto 13 pounds (dry weight) of mineral coating containing by weight clay 70 parts, blanc fixe 30 parts, and casein 9 parts; supercalender the coated paper and coat it with a film of clear cellulose nitrate lacquer.

Example 2.—Take the supercalendered coated paper of Example 1 and apply thereto a film of nitrocellulose lacquer containing bronze powder.

Example 3.—Take a paper base of 300 pounds; apply a 14 pound coating consisting of 100 parts

of clay and 10 parts of casein; supercalender it and coat it with a film of cellulose acetate lacquer containing powdered aluminum.

Example 4.—Take a 60 pound paper base; apply a 10 pound coating containing clay 100 parts to casein 10 parts; supercalender and coat with a film of benzyl cellulose lacquer.

Example 5.—Take the supercalendered coated paper of Example 4 and apply thereto a lacquer comprising a synthetic resin made by condensing vinyl compounds known as Vinylite A dispersed in benzol and ethyl acetate.

Example 6.—To the supercalendered coated paper of Example 4, apply a solution in benzol of a synthetic resin made by chlorinating rubber known as Tornesit.

Example 7.—To a 60 pound paper base apply 10 pounds of coating containing 55 parts of clay, 45 parts of finely ground ultramarine blue, and 10 parts of casein; supercalender and coat with a crystallizing lacquer comprising a cellulose ester and a crystallizing substance (for example, phthalic anhydride or 2, 4, 6-tribromoanisole).

Example 8.—To a 57 pound paper base apply 13 pounds of coating containing 100 parts of clay and 16 parts of oxidized sago starch; supercalender and apply a film of nitrocellulose lacquer containing aluminum powder.

Example 9.—To a 60 pound paper base of kraft fiber apply a 10 pound coat consisting of 100 parts of clay, 10 parts of casein, 11 parts of Crocein Scarlet N Extra and 7 pounds of Orange II; supercalender and coat with a film of nitrocellulose lacquer.

Example 10.—To a paper web on the paper machine before complete drying, apply 3 pounds of a mixture comprising clay 100 parts, and oxidized corn starch 15 parts; dry; calender and supercalender; and apply nitrocellulose lacquer.

Example 11.—To a 100 pound web of cotton cloth filled with starch, apply a 10 pound coating comprising clay 100 parts and casein 10 parts; supercalender and apply nitrocellulose lacquer.

When in the foregoing description I have used the term "slack-sized" in connection with mineral coating, I have meant that the coating contains too little adhesive to allow of its being printed without picking in the printing operations to which coated paper is customarily subjected. By normal sizing I have meant that the coating contains sufficient adhesive to print without picking. By the term "printing paper" I have meant the usual mineral coated papers in general use for fine half-tone reproductions. For the purpose of the present invention a slack-sized coating is defined as being one which will pick with No. 4 Dennison wax.

I claim:

1. Sheet material comprising a fibrous or textile base, a calendered slack-sized mineral coating, and a top coating of lacquer.

2. Paper having a calendered slack-sized mineral coating and a top coating of lacquer.

3. Paper having a colored calendered slack-sized mineral coating and a top coating of lacquer.

4. A process comprising applying to paper a slack-sized mineral coating, drying said coating, calendering, and applying a top coating of lacquer.

5. A process comprising applying to a paper web a slack-sized mineral coating, drying the coating, supercalendering the coated web and applying a top coating of lacquer.

6. Paper with an under calendered mineral

coating consisting of pigment and casein in which the casein is less than 10 percent of the total weight of the mineral coating, and a top coating of lacquer.

5 7. Paper as defined in claim 2 in which the lacquer comprises cellulose nitrate.

8. Paper as defined in claim 2 in which the lacquer comprises metallic powder.

9. Paper as defined in claim 2 in which the lacquer comprises cellulose nitrate and aluminum powder.

10. Sheet materials defined in claim 1 in which the lacquer is a cellulosic lacquer.

11. Processes as defined in claim 4 in which the lacquer is a cellulosic lacquer.

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