

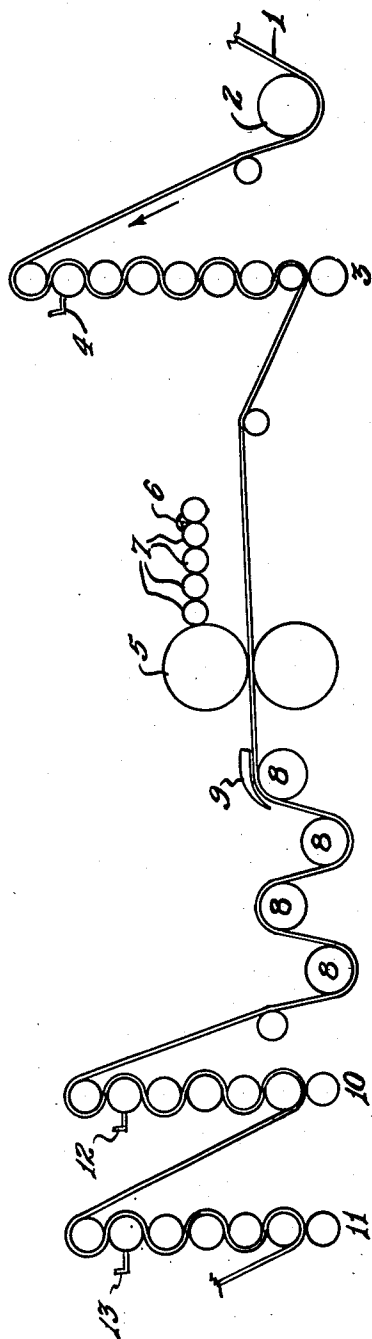
April 30, 1957

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2,790,730

PROCESS OF MAKING AND FINISHING COATED PAPERBOARD AND THE LIKE

Filed July 12, 1954



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PROCESS OF MAKING AND FINISHING COATED PAPERBOARD AND THE LIKE

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Application July 12, 1954, Serial No. 442,633

15 Claims. (Cl. 117—64)

The invention pertains primarily to the securing of finishes on coated paper or paperboard, i. e. webs which have been given a surface coating of mineral-adhesive coating substance.

It is an object of the invention to provide a method whereby an improved surface finish can be imparted to such webs.

It is an object of the invention to provide a method whereby the mineral-adhesive coating on such webs can be consolidated, glossed, and rendered more suitable both for the application of gloss printing inks and for the reception of an all-over varnish coating, where this is desired.

It is an object of the invention to provide a method whereby the mineral-adhesive coating on coated webs can be consolidated, glossed, and rendered more suitable for the application of inks without consequent yellowing and darkening.

It is an object of the invention to provide a method for treating coated webs whereby in spite of very great thinness of the coating, the webs may be varnished without substantial darkening or loss of brilliance.

It is an object of the invention to provide a method of making and treating coated webs including the imparting thereto of what is known in the art as water finishes, without encountering the problem of picking and sticking on the calender rolls despite the fact that the adhesive component of the mineral-adhesive coating mixture has not been insolubilized prior to the water finishing step.

The invention is applicable to mineral-adhesive coated webs produced in a wide variety of ways and irrespective of the manner in which the coating substance is applied. However, since an especial field of utility has to do with the manufacture of paperboard bearing a very thin imprinted coating of mineral-adhesive mixture, for the purpose of making an exemplary showing herein, the process will be described in connection with a particular way of making coated board, it being understood that this is not a limitation on the invention.

The objects of the invention, which have been mentioned above and others which will be set forth herein after or will be apparent to one skilled in the art upon reading these specifications, I accomplish by that procedure and in the use of that apparatus of which the aforesaid exemplary embodiment will now be described. Reference is made to the accompanying drawing wherein the figure is a semi-diagrammatic showing of an apparatus assembly suitable for carrying on the invention in the exemplary embodiment.

As set forth in Patent 2,370,344, dated February 27, 1945, in Patent 2,419,206, dated April 22, 1947, and in Patent 2,419,207, dated April 22, 1947, in the name of Harry C. Fisher, processes of producing coated paper or board by imprinting have hitherto been developed. These processes are based on the discovery by Fisher that very beautiful surfaces can be produced on paper or board with very thin imprinted coatings of mineral-adhesive substance, if the surface of the web is first "plasticized."

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The plasticization is accomplished by passing the web (preferably from the end of the paper or board making machine) through a breaker calender stack, there being water boxes on the stack containing a plasticizing solution such as a solution of starch, converted starch, polyvinyl alcohol, carboxymethylcellulose or other film forming media, and mixtures of them.

The surface of the paper or board is worked by the rolls of the breaker stack of calenders in the presence of the plasticizing solution and is thus prepared for the reception of a very thin imprinted coating of mineral-adhesive mixture. The coating is applied during a persistence of the plasticizing effect, i. e. before the surface of the web has completely dried. The initial plasticizing step so softens and smooths the surface of the web tending, among other things, to minimize roughness and surface irregularities and to lay down fibers therein, that excellent coatings are obtained with very thin imprinted layers of mineral-adhesive composition of relatively heavy body.

After having been imprinted, the board is dried and then is usually passed through one or more finishing stacks of calender rolls.

Reference may also be made to Patent 2,515,340, dated July 18, 1950, and Patent 2,611,717, dated September 23, 1952, which deal with securing wet rubbing resistance and surface finishes on coated webs of this type and to Patent 2,578,345, dated December 11, 1951, which relates to the provision of an improved coated condition by the application of the coating in successive increments

When a heavy bodied mineral-adhesive mixture, i. e. one high in mineral content and relatively low in adhesive solution, is applied to the plasticized surface of a web, the tendency is toward the formation of a somewhat porous coating characterized by a matte surface. A more glossy and less porous surface is frequently desired, especially where an all-over varnish coating is to be employed or where printing is to be done with gloss printing inks. It is well known also that the step of imprinting a mineral-adhesive mixture tends to some extent to produce an irregular or patterned coating. Merely passing the coated web through a dry finishing calender stack will produce some consolidation of the coating and may contribute some gloss; but it cannot reduce the porosity to the desired degree nor eliminate the effect of pattern. If the adhesive in the coating substance has been rendered insoluble prior to the time the web reaches the finishing calender stack or stacks, the same thing will be true even though water boxes are employed on the finishing calenders. This is because the water applied to the web surface cannot sufficiently soften the insolubilized adhesive. On the other hand, if an attempt is made to water-finish the web while the adhesive of the mineral-adhesive coating substance remains in a readily water soluble condition, after a short period of operation the coating will begin to pick from the surface of the web and stick to the calender rolls, ruining the product and making the finishing operation inoperative.

Coated paperboards of the character just described were first made with mineral-adhesive compositions in which the adhesive binder was a starch. Methods of rendering the adhesive substantially insoluble so as to produce a product resistant to wet rubbing were developed, usually including the addition of a melamine or similar resin to the mineral-adhesive substance and the imposition in a separate step of a catalyst of acidic character for the resin. The use of proteinaceous adhesives in place of starch has become more general. Casein has thus been employed, and more recently the trend is the use of alpha protein derived from soy beans. Such proteinaceous adhesives may be insolubilized through the use of such agents as alum, formaldehyde, and the like.

The problem of finishing paper or paperboard coated with a mineral-adhesive mixture in which the adhesive is a proteinaceous material was taken up in the copending application of myself, Harry C. Fisher and Simeon R. Holmes, now allowed, Serial No. 164,748, filed May 27, 1950 and entitled Manufacture of Water Finished Board Having an Insolubilized Protein-Mineral Coating Thereon. In that application it is taught that an insolubilizing agent for the protein may be included in the water in the water box or boxes on a finishing calender stack. This is operative, and many thousands of tons of coated board have successfully been manufactured in this way. The procedure has a certain disadvantage in that it requires careful control. If the insolubilizing action occurs too rapidly, the mineral-adhesive coating may not be sufficiently softened to enable the best water finishing results to be obtained. If, on the other hand, the insolubilizing reaction proceeds too slowly, difficulty may be encountered with picking and sticking.

The copending application of Brainard E. Sooy and Harry C. Fisher, Serial No. 248,372, entitled The Wet Finishing of Coated Board teaches the application on a finishing calender stack of a water solution of an organic volatile liquid such as an alcohol, to a coated web whereon the mineral-adhesive coating has soluble characteristics. The volatile organic solute so diminishes the solubility of the adhesive of the mineral coating in the water solution so applied that picking and sticking can be prevented in this fashion.

The present invention is based in large part on my discovery of a convenient, inexpensive and highly effective way of preventing picking and sticking on finishing calender rolls while permitting such softening of a non-insolubilized mineral-adhesive coating, such as a protein adhesive, as will enable me to secure a true water finish, i. e. a finish in which the coating is consolidated, is rendered less porous, and is glossed while at the same time the coating is reworked by the finishing calenders to the extent of destroying or minimizing any initial pattern therein. The coating is not yellowed or darkened.

I have found that this may be accomplished by applying to the surface of the coated web on a finishing calender stack and by means of one or more water boxes, a solution of salt having a concentration of about 5% to 20%. The salt should be a neutral salt of a strong acid and a strong base, and should not have an insolubilizing reaction on the adhesive of the coating. It should, of course, be a water soluble salt. Salts of nitric, sulfuric and hydrochloric acid are thus available for my purpose. Potassium chloride or sulfate may be employed, as may calcium chloride. However, the cheapest and most available salt is common sodium chloride, and this is employed by me in commercial operation.

If the concentration of the salt is less than about 5% in the solution in the water boxes, picking and sticking is likely to be encountered. The concentrations preferably employed approach saturation; but their precise strengths may be governed by economic considerations. In some fashion which is not fully understood, when salt is added as described to the water in the boxes on finishing calender rolls, the adhesive in the mineral-coating mixture softens sufficiently to permit the coating to become plastic and workable by the calender rolls without developing such tackiness as is productive of picking and sticking.

The exact strength of the salt solution may be regulated to that which will prevent picking and sticking in a particular operation. The nature of the coating substance may vary so that some coatings exhibit a greater tendency to pick and stick than do others. The relative quantity of adhesive in the coating mixture has an effect. Mineral-adhesive coatings containing protein which has been dissolved by the use of non-volatile alkalies, for example sodium hydroxide, will have a greater tendency toward picking and sticking than will those in which a volatile

alkali has been used, as for example, ammonium hydroxide.

It has also been ascertained that it is possible to include in the treating solution a material which, while it does not produce picking and sticking, will nevertheless act to soften or plasticize the mineral-adhesive coating. Glycerin and the glycols are substances of this class. The amount employed can be controlled to produce a specific desired softening effect.

The general procedure for making coated paperboard in accordance with the exemplary embodiment is illustrated in the drawing. The board 1, coming from a multicylinder board machine, is shown as passing over the last of the board machine driers indicated at 2. The product next passes through a breaker stack of calender rolls 3 having at least one water box 4, by means of which a suitable plasticizing solution, as set forth above, is applied to the board surface at an early point in the calender operation. The surface of the board is thus plasticized and, during a persistence of the plasticizing effect, it is next imprinted with a very thin layer of the mineral-adhesive coating by means of an imprinting roll 5 fed with the coating composition 6 by a series of transfer rolls 7.

The coated board may, if desired, be subjected to an air blast from the device 9, and will be dried by being passed over and under a series of heated drying rolls 8.

Finally, the web of dried coated board passes through the nips of one or more stacks of steel calender rolls where the calender-finished coated surface of the board is produced. One or both of these stacks may be provided with water boxes acting against rolls contacting the coated surface of the web, and which may be used in the manner later to be described. Of course, the uncoated back of the web may be treated from calender boxes in the well-known manner employed in making paperboard.

The procedure outlined above permits the obtaining of very fine water finishes on coated paper and board when the adhesive of the mineral-adhesive coating mixture has not been insolubilized, although, as noted, the use of water alone in the water boxes of the calender finishing stack would soon dissolve the adhesive of the coating. It will be understood by the skilled worker in the art that a prior complete insolubilization or surface insolubilization of the coating would prevent the obtaining of the true water finish. A water finished product wherein the adhesive of the mineral coating has not been insolubilized is useful for many purposes; and the process may end with the steps which have been outlined above. Where surface-insolubilization is required, as where the coated web must be resistant to wet rubbing, surface-insolubilization can readily be accomplished on the finishing calender stack through the use of a water box or boxes containing a water solution of an insolubilizing agent, for example formaldehyde, alum or the like, such water box or boxes being so located as to treat the coated surface of the web at some point subsequent to the point of treatment thereof with the salt solution. It has been found that such a subsequent treatment for insolubilization will not in itself produce picking and sticking after the treatment with the salt solution.

The principles of the present invention are not departed from by the inclusion of an insolubilizing agent in the initial plasticizing solution on the breaker stack of calenders prior to the coating operation. This results normally in an insolubilization of a thin layer of the coating mixture lying against the web surface, but does not produce insolubilization of the mineral-adhesive coating throughout. Hence, the coating remains capable of being softened by the salt solution sufficiently to enable a water finish to be obtained.

In the event it is desired to treat the coated surface of the web with a film-forming substance to effect a further decrease in the porosity thereof, this also may

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be done without departing from the spirit of the invention. A water solution of starch, protein, polyvinyl alcohol, carboxymethylcellulose, a water soluble wax or the like may be used either in a separate water box or boxes, or alone with an insolubilizing agent.

As indicated in the drawing, it is preferred to employ two stacks of finishing calenders indicated respectively at 10 and 11. Normally, the first of these is operated as a "wet" stack, and the second as a dry stack. One or more water boxes 12 may be employed to apply to the coated surface of the board the salt or salt-glycerin solution above mentioned whereby to soften the coating and attain the water finish described. Following this, the coating may be insolubilized through the application to it of an insolubilizing solution by means of one or more water boxes 13, which water boxes may also contain a film-forming substance as set forth above. Box 13 may be transferred to stack 10, if circumstances warrant.

The mineral-adhesive coating substance may contain casein, alpha protein or their equivalents either alone or in admixture and will contain mineral pigments or coating agents. These may be of a wide variety including clays, titanium, dioxide, or other suitable substances. The coating composition may contain plasticizers, dispersing agents for the mineral substances, colored pigments, dyes or the like. Starch may be included in the adhesive, but ordinarily it does not comprise the entire adhesive where salt or salt-glycerin is used. The specific nature of the mineral-adhesive coating is not a limitation on the invention. An exemplary mineral coating will contain upwards of 50% solids including the adhesive in a water vehicle, and may have a Brookfield viscosity at 98° F. with the No. 7 spindle at 20 R. P. M. upwards of 25,000 centipoises. The mineral matter will, of course, be in a fine state of subdivision, preferably having a particle size such that 82% of the particles or more are below 2 microns in their greatest dimension.

In the following examples polyvinyl alcohol is the plasticizer used on the breaker calender stack, but it should be recalled that other effective plasticizers may be used, including modified starch, carboxymethylcellulose, mixtures of these various substances, and the like.

Example 1

Paperboard was treated on the breaker stack 3 with one water box containing a 5% solution of polyvinyl alcohol in water for plasticization. It was then coated, as at 5, with a mineral coating mixture in water containing 56% solids in which the ratio of protein adhesive to finely divided minerals was 21.4%. In the water box 12 the coated surface of the board was treated with a solution of approximately 4½% of sodium chloride made by dissolving 41.6 pounds of common salt in enough water to make 100 gallons. In the water box 13 there was employed a treating solution made by dissolving 40 pounds dry alum, 16 ounces liquid formaldehyde, and 17 pounds Carbowax PF-45 in sufficient water to make 100 gallons of solution. The Carbowax is a water soluble organic wax. The board produced was devoid of pattern, had an enhanced gloss, and was improved for the reception of gloss printing inks.

Example 2

A board similarly plasticized and coated was treated on the wet finishing stack 10 with a water solution in the box 12 made by dissolving 41.6 pounds common salt and .8 pound Emulfor ELA (a wetting agent) in enough water to make 100 gallons of solution.

The previously used insolubilizing solution was employed in the box 13. The characteristics of the board were substantially the same as before with slightly decreased porosity and slightly higher gloss without darkening. Gloss inks applied to the coated board printed evenly to a high gloss.

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Example 3

A board similarly plasticized and coated was treated on the wet finishing calender stack 10 with a solution in the water box 12 made by dissolving 200 pounds common salt and 10 gallons of glycerin in water enough to make 100 gallons. The same insolubilizing solution was applied to it by means of the water box 13 as is set forth in connection with Example 1. The coated board, after treatment, had the same characteristics as above noted with improved gloss and lessened porosity.

Example 4

A paperboard, plasticized and coated as set forth above, was treated on the wet stack with a solution in water box 12 made by dissolving 100 pounds common salt, 10 gallons glycerin and .8 pound Emulfor (ELA) in water enough to make 100 gallons. The insolubilizing solution in water box 13 was the same as previously noted.

An excellent low porosity, relatively glossy board was produced in this fashion.

Example 5

Paperboard, plasticized as in the preceding examples, was coated with a mineral coating mixture in water containing 56% solids in which the ratio of protein adhesive to finely divided minerals was 21.4%, by imprinting, as at 5 in the drawing. The water finishing solution was made by dissolving 200 pounds of common salt in water to make 100 gallons. The insolubilizing solution was made by dissolving 40 pounds of dry alum and 16 ounces formaldehyde in water to make 100 gallons. An excellent, smooth, non-porous board was produced.

Example 6

Paperboard, similarly plasticized and coated as in Example 5, was treated with a water finishing solution in the water box 12 made by dissolving 200 pounds common salt and 10 gallons of glycerin in water sufficient to make 100 gallons. The insolubilizing solution was employed in the box 13 and was the same as in Example 5. An excellent board having a somewhat higher gloss was produced.

No picking or sticking was encountered in any of the procedures outlined in the above examples. The final products were all smooth and devoid of pattern, indicating a true water finish. They could all be varnished, as by the application of any of the clear over-print varnishes current in the art, and when so treated, attained a high varnished luster without darkening.

It will be noted that in some of the examples above a film forming substance was included in the insolubilizing solution in box 13 on the wet finishing stack. The function of such a film forming substance is to assist in closing up the pores of the mineral-adhesive coating. Various film forming substances can be employed, including chemically converted starch, dilute protein, polyvinyl alcohol, carboxymethylcellulose, and the like, in place of or in addition to the Carbowax and mixtures of such substances. Carbowax also increases the slipperiness and non-dusting characteristics of the mineral coating.

The high glossing characteristics of gloss ink or varnish on coated board finished as described herein results in part from the high ratio of adhesives to minerals employed. With a lower ratio the glossing characteristics of the varnish and printing ink decrease, although the coated board itself will retain the high, glossy, smooth, even surface finish produced by the finishing calender treatment with salt and glycerin.

Modifications may be made in my invention without departing from the spirit of it. Having thus described my invention in certain exemplary embodiments, what I claim as new and desire to secure by Letters Patent is:

1. A process of securing a water finish on a web of paper or paperboard coated with a mineral-adhesive

mixture in which the mineral is a finely divided insoluble solid and the adhesive is organic and water soluble, which process comprises passing the coated web through a finishing stack of metallic calender rolls and, by means of a water box on said stack applying to the coated surface of said web a water solution of a neutral salt of a strong acid and a strong base in a concentration in said water solution of substantially 5 to 20%, whereby to soften said mineral-adhesive coating to permit the attainment of a water finish while preventing the development of tackiness in said mineral-adhesive coating which would produce picking and sticking.

2. The process claimed in claim 1 including the subsequent step of passing said web through a dry stack of metallic calender rolls.

3. The process claimed in claim 1 including the step of applying to the coated surface of said web on said calender stack a plasticizing material chosen from a class consisting of glycerin and the glycols.

4. The process claimed in claim 1 including the step of applying to the coated surface of said web at a point subsequent to the point of application of said salt solution on said calender stack, a water solution of an insolubilizing agent for the adhesive of said mineral-adhesive coating mixture.

5. The process claimed in claim 1 including the step of applying to the coated surface of said web at a point subsequent to the point of application of said salt solution on said calender stack, a water solution of an insolubilizing agent for the adhesive of said mineral-adhesive coating mixture, and a film forming agent chosen from a class consisting of starch, protein, polyvinyl alcohol, carboxymethylcellulose and waxy polyethylene glycol and mixtures thereof.

6. The process claimed in claim 5 wherein there is included in said salt solution a water soluble plasticizing agent chosen from a class consisting of glycerin and the glycols.

7. The process claimed in claim 5 wherein there is included in said salt solution a water soluble plasticizing agent chosen from a class consisting of glycerin and the glycols, and in which said coated web is subsequently passed through a dry stack of metallic calender rolls.

8. A process according to claim 1 wherein the adhesive in said mineral-adhesive mixture is a proteinaceous adhesive.

9. A process according to claim 1 wherein the adhesive in said mineral-adhesive mixture is a proteinaceous ad-

hesive chosen from a class consisting of casein and alpha protein derived from soy beans.

10. A process of securing a water finish on a web of paper or paperboard coated with a mineral-adhesive coating mixture in which the mineral is a finely divided insoluble solid and the adhesive is organic and water soluble proteinaceous substance, which comprises passing the coated web through a stack of metallic calender rolls and applying to its surface while on said rolls a water solution of sodium chloride having a concentration of substantially 5 to 20%.

11. The process claimed in claim 10 in which said solution contains also a material chosen from a class consisting of glycerin and the glycols.

12. A process of producing a coated web of paper or paperboard which comprises passing said web through a breaker stack of calender rolls and while the web is on said rolls applying to its surface a water solution of a plasticizing substance, thereafter substantially immediately imprinting upon the treated surface a thin layer of mineral-adhesive mixture in which the mineral is a finely divided insoluble solid and the adhesive is organic and water soluble, drying the said web, passing it through a stack of metallic finishing calender rolls and applying to its coated surface while on said rolls a water solution of a neutral salt of a strong acid and a strong base having a concentration of substantially 5 to 20%.

13. The process claimed in claim 12 including the subsequent step of passing the web through a dry stack of metallic finishing rolls.

14. The process claimed in claim 13 including the step of applying to the coated surface of said web while on said first mentioned stack of finishing calender rolls, but at a point subsequent to the point of application of said salt solution, a water solution of an insolubilizing substance for the adhesive of said mineral-adhesive mixture.

15. The process claimed in claim 13 wherein said salt solution also contains a material chosen from a class consisting of glycerin and the glycols.

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