

UNITED STATES PATENT OFFICE

2,656,286

PROCESS OF COATING PAPER WEBS AND
PRODUCT THEREOF

Harry C. Fisher, Cincinnati, and Brainard E. Sooy, Middletown, Ohio, assignors, by mesne assignments, to Consolidated Water Power & Paper Company, Wisconsin Rapids, Wis., a corporation of Wisconsin

No Drawing. Application August 29, 1945,
Serial No. 613,436

4 Claims. (Cl. 117—60)

1

In our application for patent, Serial Number 558,042 filed October 10, 1944, now abandoned, we have described a practice employing the industrial paper web coating process known as coating by imprinting, wherein we prepare the web surface for taking coating from the surface of an imprinting roll by treating it with an insolubilizing agent for the starch adhesive of the coating mixture, and in the coating mixture introduce a substance which activates the insolubilizing agent, with the overall result of producing a coated web by continuous process, which has a water-resistant surface. Alternatively, we may treat the web surface with activating substance and introduce the insolubilizing agent into the coating mixture, and otherwise, the principal feature being that the complete reactive or reacted mixture is not applied with the mineral matter.

The present specification relates to an additional development based on subsequent treating of the coated web in order to bring about a very glossy effect upon printing of the coated web with oil or varnish base inks.

To review briefly the practice set forth in our earlier application, we indicate the use of a breaker stack of calender rolls which is the first stack of calenders used in general practice to smooth out a web of paper or paperboard as it comes from a paper or board machine, prior to sheeting or reeling the web. Immediately after this breaker stack of calender rolls, we provide a coating imprinting roll on which is spread a thin coating of mineral matter and starch in an aqueous base, the binder element of the mineral coating mixture perhaps including other adhesive and carrier agents, but in which starch is the principal one. Then follows a drier including heated rolls over which the web passes after it has picked up its coating from the imprinting roll. Finally the web may be passed through one or more stacks of finishing calenders depending upon the surface finish desired.

As set forth in said application we apply, where the binder of the mineral coat is mainly starch, an aqueous solution to the web while it passes through the breaker stack of calender rolls which contains, for example, urea formaldehyde resin in its syrupy stage of incomplete polymerization. We can use, alternatively, melamine resin or other resin substances having the quality of insolubilizing starch in the presence of a catalyst.

The imprinting roll is supplied, as set forth in the said specification, with a mineral matter

2

coating mixture in an aqueous base, the binder consisting mainly of starch. We note in our application an example wherein a coating of adhesive and mineral pigment containing 54% solids and 46% water was used, and spread onto the imprinting roll which was in turn coated by means of a gate roll, taking the mixture from a supply, and by spreading rolls in a series from the gate roll to the imprinting roll, operating similarly to the mode of supplying ink to the inking roll of a rotary printing press. The film on the imprinting roll was, and indeed must be, quite thin or else the operation will not be a success due to treeing, patterning, etc. Thus in our said specification we mention as an example a coating picked up by the web while still moist from its treatment in the calender stack, of a film of around .001" thick, more or less, of the wet coating mixture.

In this coating mixture we introduce the catalyst for the resin reaction when the resin has been introduced on the breaker stack. Thus in one example we employ 15 parts of ammonium chloride to 85 parts of the wet coating mixture above noted.

In another practice in our application we supply both the incompletely polymerized resin and its catalyst on the breaker stack of calender rolls. We also note that the resin can be supplied with the coating and the catalyst supplied on the breaker stack. Also it is noted that we can apply a thickened starch or starch and polyvinyl alcohol material to the web in the breaker stack along with one or the other of the two resin reactants, giving the web a plastic working in the presence of this material before it reaches the imprinting roll.

After the web has passed the imprinting roll it moves to the heated driers where the reaction which insolubilizes the starch is completed. The whole process can be timed to take the product from a board machine or paper machine using standard drier rolls so as to be fully continuous. As noted in the said specification we may also calender the web after the coating is dry and cured, in calenders, in the presence of water, impossible when the starch is not insolubilized.

The above is intended as a statement of our development exclusive of the added step to be described below.

Our investigations have gone further in connection with the final calendering treatment, in an effort to develop an insolubilized coating which takes an extremely glossy ink impression. We have found that following the process of our

application above referred to, we may calender the dried, insolubilized starch and mineral coated web with a variety of substances which act to seal or close the tiny pores of the coating to a considerable degree, whereby the after-applied oil or varnish base inks will drop out to a very glossy appearance because the coated surface no longer is so absorbent to the inks' vehicles. The coated board itself, when finished and before printing, does not differ markedly in outer appearance over board which does not have the final treatment which we will discuss in more detail, and the difference appears only in the result of the oil or varnish base ink printing. For convenience we will refer to the substance applied over the coated surface as a sealer. It dries out on the coated surface of board.

Our present improvement over our practice as above described has been to add by means of the water boxes of the calender stack different agents which will have film-forming or surface-filling or sealing power when applied in water solution or dispersion to the insolubilized coated surface. Where the paper or board machine is equipped with more than one stack of calenders to finish the web as a final treatment, we may employ water boxes on more than one stack or run certain stacks dry.

Thus we have used on a finishing calender stack a strong solution of modified or converted starch in water, for example, a gelled solution of 8% by weight of a chlorinated corn starch in water. In this solution we included a small amount of wax size which acts as a lubricant to overcome any stickiness of starch solution. We have also applied a 3% by weight solution in water of carboxymethyl cellulose. We have used a 3% solution by weight in water of the alginate compound known as Kelgin. Another substance we have used is sodium silicate or water glass of 42° Bé. gravity (factor 3.25 $\text{SiO}_2:1\text{Na}_2\text{O}$) in the ratio of one volume silicate to 3 volumes of water. Another type of starch used 4% in water was Flexgum, as it is known in the trade, being a modified corn starch which gels rapidly in cool water. Among other substances usable in water are methyl cellulose, carboxyethyl cellulose, polyvinyl alcohol and vegetable protein as from soya beans. The list can be extended to include a wide variety of substances which are water-borne to be handled in an inexpensive practical manner in the water boxes of a stack of calenders, as described. For purposes of economy, to obtain special effects, etc., blends of certain of these substances can be used. Such a blend might comprise polyvinyl alcohol and modified starch, in water, in almost any desired proportion and to which a small amount of plasticizer such as a polyhydric alcohol can be added. There are many possible blends and variations thereof.

Each of these substances as applied to the coated surface of the web is a minute film or filling in and on the waterproof coated surface to seal and reduce or eliminate the comparatively porous or absorbent surface of the coating thus to prevent the absorption of vehicle and/or ink from the printing ink down into the coated surface. We do not require that those substances be film-formers in the strictest sense of the word providing that they do fill in the coated surface to reduce its absorptivity to the subsequently applied ink. While it is unlikely that any substance used, as described, will be soluble in the base or vehicle of the ink, we note that such solubility must be absent or at least be negligible

in effect if the printing ink is to remain substantially unabsorbed into the coated surface.

The amount of sealer used is quite small with reference to the area covered since it is not desired to create a complete visible film of material on the coated surface, but merely to employ a material dispersible in water which will during the finishing calendering stage be deposited on or into the surface pores of the existing mineral coating and fill them.

Were the coating not made water resistant by our insolubilizing process, it would be impossible to use aqueous dispersions of sealers on the finishing calenders. The result would simply be to remove the coating which the web had received which removal would be accompanied by a plugging of the rolls of the calender stack due to the reformation of a sticky mixture of mineral coating and adhesive in water. Also, so far as we are advised, an attempt to use such sealers as on a web with a relatively thick mineral coating, such as is ordinarily applied in an aqueous starch vehicle, followed by polishing with brushes or reversely-turning rolls, would not be successful. It is because we have the thin printed-on coating which has been insolubilized that we are able not only to give the coated surface a finish-calendering with water but to add to that water an ink-resistant substance which is ironed into the pores of and onto the coated surface.

The amount of dry material imposed on the coating of the web in the final calendering naturally will vary with each one of the sealer substances as was set forth above, with its concentration in water, the number of water boxes used to apply it to the coated surface, the absorptivity of the coated surface, etc. The amount needed to give desirable gloss of printed ink on the coated surface similarly will vary, depending, as it does, on the quality of printing ink. However, all these variations are relatively unimportant in view of the low quantity of sealer required, which is of the order of a few ounces dry sealer per one thousand square feet of coated surface.

Since the nip pressure of a stack of calender rolls is extremely high and the concentration of sealer substance in the water solution used on the calender stack is low, a natural safeguard exists against use of too much sealer substance.

The sealer should have the following characteristics:

It should be—

1. Soluble or dispersible in water.
2. Effective in small amount.
3. Inert toward mineral coating and printing ink.
4. Non-sticky in water when applied to web by calender nip.
5. Substantially colorless on the coated surface.
6. Odorless, tasteless, non-toxic, etc.
7. Capable of forming a solution or dispersion of low viscosity.
8. Without adverse effect on foldability of the coated board.
9. Permanent in effect, as regards life of the coated board.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A process of producing a non-gloss paper-board suitable for gloss ink printing which comprises applying to the surface of finished paper-board a coating of plasticizing agent in an aqueous vehicle and plasticizing the said surface by passing the paperboard through rolls, thereafter

5

applying to the plasticized surface a coating of mineral matter and starch in an aqueous vehicle by imprinting, one of said coatings containing a resin capable of reacting with starch to insolubilize it and the other of said coatings containing a catalyst for said insolubilizing reaction, heating the treated board so as to produce said reaction and insolubilize the starch thereon, and afterward passing said treated board through a calender stack and applying to the coated surface thereof in said calender stack a water solution of a sealing substance resistant to the vehicles of gloss printing inks in quantity sufficient to seal the pores of said starch-mineral matter coating without affecting the non-gloss characteristics thereof, the said sealing substance being a water soluble substance chosen from a class consisting of starch, methyl cellulose, carboxymethyl cellulose, carboxyethyl cellulose, polyvinyl alcohol, vegetable protein, sodium silicate and alginate compounds.

2. A process of treating non-gloss mineral coated paperboard which is resistant to wet rubbing, to render the mineral coating thereof non-absorptive to gloss printing inks, whereby said inks will print with a glossy finish while at the same time the non-gloss characteristics of the coated board are retained, which process involves calendering the coated paperboard while applying thereto a water solution of a sealing substance resistant to the vehicles of gloss printing inks in quantity sufficient to seal the pores of said mineral coating but insufficient to destroy the non-gloss characteristics thereof, the said sealing substance being a water soluble substance chosen from a class consisting of starch, methyl cellulose, carboxymethyl cellulose, carboxyethyl cellulose,

6

polyvinyl alcohol, vegetable protein, sodium silicate and aliginate compounds.

3. A non-gloss mineral coated paperboard suitable for gloss ink printing produced by the process of claim 1.

4. A non-gloss mineral coated paperboard suitable for gloss ink printing produced by the process of claim 2.

HARRY C. FISHER.
BRAINARD E. SOOY.

References Cited in the file of this patent

UNITED STATES PATENTS

	Number	Name	Date
15	1,913,329	Bradner	June 6, 1933
	1,940,363	McLaurin	Dec. 19, 1933
	1,982,018	Owen	Nov. 27, 1934
	2,083,441	Frost	June 8, 1937
	2,121,205	Lippert et al.	June 21, 1938
20	2,185,746	Goencz et al.	Jan. 2, 1940
	2,212,314	Bauer	Aug. 20, 1940
	2,256,853	Schwartz	Sept. 23, 1941
	2,293,278	Cates	Aug. 18, 1942
	2,301,509	Boch	Nov. 10, 1942
25	2,304,818	Grupe	Dec. 15, 1942
	2,317,696	Rich	Apr. 27, 1943
	2,322,887	Schwartz	June 29, 1943
	2,331,922	Montgomery	Oct. 19, 1943
	2,333,023	Manor	Oct. 26, 1943
30	2,342,785	Boch	Feb. 29, 1944
	2,356,879	Pense et al.	Aug. 29, 1944
	2,359,858	Iler	Oct. 10, 1944
	2,369,427	Bennett	Feb. 13, 1945
35	2,414,313	Leek	Jan. 14, 1947
	2,419,207	Fischer	Apr. 22, 1947
	2,424,284	Olpin et al.	July 22, 1947
	2,460,998	Nelson	Feb. 8, 1949