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FIG. 1

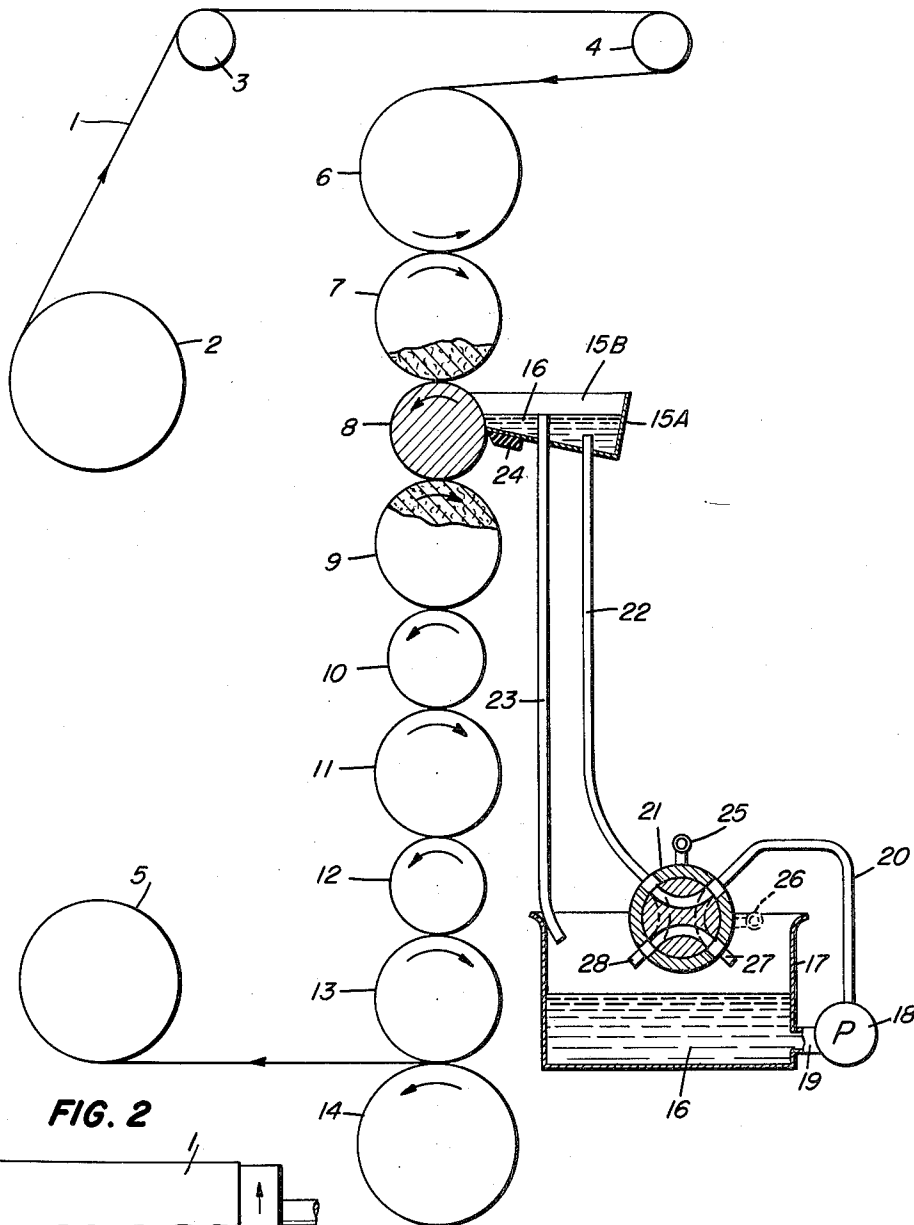
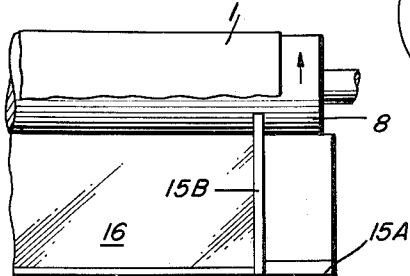


FIG. 2



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1

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This invention relates to an improved process of finishing coated paper and more particularly to enhancing the finishing effect of a supercalender on coated papers.

The prior art discloses methods by which paper, coated and uncoated, can be moistened with water and subsequently subjected to a supercalendering operation. The purpose of the moisture is to soften the surface of the coating, or of the web in the case of uncoated papers, so that during the supercalendering operation the softened surface may be smoothed to a higher degree than is possible with normal supercalendering. Montgomery, in Patent No. 2,251,890, discloses a method of moistening a web of paper as it passes through a supercalender stack. Water is applied to a partially supercalendered web of paper by a wetting roll while the web is out of contact with the rolls of the supercalender. The amount of water applied is controlled by a scraper blade acting on the web to remove surplus water. In this process there is a delay period between the time of water application to the web and the subsequent supercalendering of that portion of the web. The delay period allows for penetration of the water into the surface of the paper before the wetted paper passes between calender rolls. Cates, in Patent No. 2,293,278, also discloses a moistening process using water for coated and uncoated papers, the moistening of the web taking place prior to any supercalender operation. In this process also there is a delay period between the moistening operation and subsequent supercalendering of the moistened web allowing for penetration of the water into the surface of the paper before the paper is supercalendered.

It has been found that on certain type coated papers a moistening operation using water as disclosed in the prior art is not entirely satisfactory due to picking of the softened coated surface on the metal supercalender rolls. The finish on the surface of the coated web is very much dependent upon the smoothness and cleanliness of the surfaces of the calender rolls. When coating picks adhere to the metal rolls, the smoothness and cleanliness of the surfaces of these rolls is impaired, and the finish on the surface of a coated web subjected to the action of these rolls is greatly reduced. To some extent the pick problem can be overcome by the use of doctor or scraper blades bearing against the metal rolls to help provide clean roll surfaces, but this approach does not eliminate the actual problem. I have found that this pick problem can be eliminated by employing a particular solution of ingredients in the moistening operation in place of pure water. This solution tends to act as a lubricant between the metal rolls of the supercalender stack and the coated paper web while at the same time it has a plasticizing effect on the coated surface and allows for a smoothing of the coating without picking as will be apparent from the disclosure given hereinafter. The word supercalender as used in this specification and claims is intended to cover

2

a calender stack in which paper is pressed against hard surfaced metal rolls by softer resilient non-metal rolls.

My invention also provides an improved method of applying the moistening solution to a web of paper in a manner to insure surface treatment only of the coated paper by eliminating the delay period between the moistening operation and subsequent supercalendering of the coated paper.

In carrying out my invention, the moistening solution is supplied to a metal roll of a supercalender, and the metal roll carries the moistening solution into the nip formed by said metal roll and an adjacent resilient roll. A web of coated paper passing through this nip is thus wetted on one side at the nip, and the delay period between the moistening operation and subsequent supercalendering is essentially eliminated. The depth of penetration of the solution will be at a minimum because of the position of the moistening operation, insuring a surface treatment only of the coated paper. By placing the moistening solution supply means on the supercalender at a position such that the paper web is partially supercalendered before being moistened, the depth of penetration of the solution is reduced even more.

The moistening solution is supplied to a metal supercalender roll by any conventional means, such as by a spray arrangement or by a waterbox in contact with the metal roll. The use of various other moistening solution supply means will be apparent to those skilled in the art, and it is intended that this invention cover their use as set forth in this specification and claims.

It has been found that a coated paper which has been supercalendered under normal operating conditions (that is supercalendered without any type of moistening operation) contains small pits in the coated surface which are visible under microscopic examination. These pits are primarily due to the roughness of the base stock, and while the coating tends to fill in the major imperfections of the base stock, it does not form a completely smooth surface. When the coated web is supercalendered on a dry stack, very little filling in of these pits occurs. However, by moistening and plasticizing the surface of the coating, the supercalendering action on this surface is greatly enhanced. The coating tends to flow out and fill in the pits, providing a smoother sheet than is possible with normal supercalendering operations. By limiting as much as possible the depth of penetration of the moistening solution to the surface of the coated web, a densification of the coated surface of the nature described is obtained without adversely affecting the body characteristics of the coated paper. It has been found that by wetting a partially supercalendered web of coated paper as the web passes through the nip between supercalender rolls, the depth of penetration is held to a minimum, and that by using a solution of particular ingredients the coated web passes through the supercalender without suffering any adverse effects due to picking of the coating on the supercalender rolls.

The invention will be described in greater detail by reference to the accompanying drawing forming part of this specification, in which:

FIGURE 1 represents a diagrammatic elevation view partly in section of a supercalender stack equipped with moistening apparatus which might be employed to supply a moistening solution to the metal supercalender roll;

FIGURE 2 is a fragmentary top plan view of the moistening apparatus and means for deckling the moistening treatment.

A coated paper web 1 from the unwinder roll 2 passes over guide rolls 3 and 4 and is fed into and through the supercalender stack and is rewound on reel 5. The supercalender stack consists of metal rolls 6, 8, 10, 12 and 14 which are alternated with softer, resilient non-metal rolls 7, 9, 11, and 13. A waterbox 15A is mounted preferably against the metal roll 8, and the waterbox 15A serves as the source of supply for the moistening solution 16 to be applied to the coated web 1 by roll 8. As roll 8 rotates, it carries a supply of moistening solution 16 into the nip formed by roll 8 and the resilient roll 7. Roll 8 applies the moistening solution 16 to the side of the web 1 which is in contact with roll 8, and the resilient roll 7 presses the web 1 against roll 8. Throughout the supercalender stack, resilient rolls 7, 9, 11, and 13 press the moistened surface of the web 1 against metal rolls 8, 10, 12, and 14.

The moistening solution 16 is supplied to the waterbox 15A from supply tank 17 by means of pump 18 circulating the moistening solution 16 through conduits 19 and 20, valve 21, and conduit 22 into waterbox 15A. The waterbox 15A is equipped with an overflow conduit 23 which automatically controls the level of the moistening solution 16 which is preferably held from $\frac{1}{4}$ to $\frac{1}{2}$ inch above the point of contact of the rubber lip 24 and the roll 8. The rubber lip 24 acts as a seal and forms the contact between waterbox 15A and roll 8. When the level of the moistening solution 16 rises above the preferred level, the moistening solution 16 will flow by gravity through conduit 23 and back into the storage tank 17.

The supply of moistening solution 16 may be discontinued to roll 8 when desired, as for instance when the supercalender stack is being rethreaded after a roll change. When operating arm 25 on valve 21 is in its normal position as shown, moistening solution 16 is supplied to waterbox 15A. When, however, the operating arm 25 is placed in the reverse position illustrated by broken lines 26, the conduits within valve 21 assume the positions indicated by the dotted lines, and pump 18 will then cause the moistening solution 16 to circulate through conduits 19 and 20, valve 21, conduit 27, and back into storage tank 17. At the same time moistening solution 16 in waterbox 15A will drain by gravity through conduit 22 into valve 21 and through conduit 28 into storage tank 17. The level of the moistening solution 16 in waterbox 15A will then be approximately $\frac{1}{2}$ inch below the point of contact of the rubber lip 24 and the roll 8, and the latter may rotate freely without carrying additional moistening solution 16 into the nip formed by rolls 7 and 8.

Adjustable end dams 15B are provided at each side of waterbox 15A to control the width or deckle of the moistening treatment on web 1. In operation, the end dams 15B are placed against roll 8 in relation to web 1 so that approximately one inch on each side of web 1 is left untreated, thereby preventing the moistening solution from coming into contact with the resilient rolls 7 and 9.

The preferred moistening solution for softening the coated surface and for providing lubrication between the coated surface and the metal supercalender rolls has been found through experimentation to be a water solution of sodium stearate. This solution is applied to a web of coated paper, preferably coated with a water resistant type coating, in the amount of about $1\frac{1}{2}$ pounds per 3300 square feet of web. The exact amount of solution applied to the web can be varied by varying the pressure loading of the supercalender stack. It had been found that the above mentioned amount of solution is applied to the web when the stack is loaded at about 1700 lbs. per linear inch at the bottom nip, and traveling at a web speed of about 850 ft. per minute.

The following examples set forth the application of various solutions under these operating conditions, and the utility of the improved moistening solution will be

apparent from the disclosures set forth. The paper used in the following examples was paper of 60 lbs. basis weight (ream of 500 sheets, 25 x 38 inches) roll coated on each side with 10 lbs. per ream of an offset coating containing 16% adhesive based on pigment, the adhesive comprising 55% casein and 45% latex.

Example 1

Sodium stearate, pound.....	1
Defoamer (Dow Antifoam A), grams.....	20
Water, gallons.....	20

The ingredients were mixed in the following manner: the sodium stearate was dissolved in 5 gallons of hot water and the final 15 gallons of water were then added along with the defoamer. The coated paper web was moistened with this solution and supercalendered in the manner previously described. The coated web passed through the supercalender stack without any evidence of picking of the coated surface on the metal rolls of the stack and the final web had a gloss according to TAPPI Standard T-480m-51 of 80.5. Upon subsequent printing of the paper, it exhibited an excellent printing surface and had a very uniform ink receptivity.

Example 2

The coated web was moistened with water only and supercalendered according to the method of this invention. The coated web picked very badly in passing through the supercalender stack, and exhibited a gloss of 63.2.

Example 3

The coated web was moistened with a solution of water and a silicone additive, the proportions of ingredients being 100 grams of silicone LE 45 (as manufactured by Union Carbide Corp.) per 5 gallons of water, and the web was submitted to a supercalendering operation as set forth above. Picking of the coated web was less severe than in Example 2 but still was of the order to be detrimental to the finish of final web as is indicated by a gloss reading of 75.7.

Example 4

The coated web was moistened with a dispersion containing 1 quart of calcium stearate (solids content of 50%), 50 grams of silicone LE 45, and 5 gallons of water, and the web was supercalendered as previously described. Picking of the coated surface upon passing through the supercalender stack was eliminated and the final web exhibited a gloss of 81.2. However, the finished paper was unsatisfactory because it exhibited a nonuniform ink receptivity upon subsequent printing.

Coated paper moistened during the supercalendering operation with the solution as set forth in Example 1 affords definite advantages to the final finished web in the amount of gloss and smoothness developed and uniformity of ink receptivity as compared to the same paper supercalendered without the aid of the moistening solution and application according to my invention. The following examples set forth data comparing various types of finishing operations.

Example 5

Paper with a basis weight of 60 lbs. (ream of 500 sheets, 25 x 38 inches) was roll coated 10 lbs. per ream on one side with an offset coating containing 16% adhesive based on the pigment, the adhesive comprising 55% casein and 45% latex. The coated paper was passed through a supercalender at 500 ft./min. and the paper was subjected to various finishing conditions, including the supercalendering of both dry paper and paper moistened with the solution of Example 1. In all cases the

5

coated side of the web was in contact with the metal rolls as it passed through the supercalender stack.

Calendering lbs./linear inch	Moistened or dry	Gloss	Bekk smoothness
425-----	Moistened-----	57	190
1,100-----	do-----	63	220
1,700-----	do-----	67	225
1,700-----	Dry-----	66	165

As is apparent from the above table, paper with a higher gloss and a smoother surface was produced at the same operating conditions when the coated paper was moistened during the supercalendering operation as compared to the coated paper which was supercalendered while dry. Even more significant is the fact that coated paper of equal gloss and better smoothness was produced at lower calender stack loadings when moistened with the improved solution as compared to paper finished while in a dry condition.

Example 6

Paper with a basis weight of 60 lbs. (ream of 500 sheets, 25 x 38 inches) was roll coated 10 lbs. per ream on one side with an offset coating containing 16% adhesive based on pigment, the adhesive comprising 55% casein and 45% latex. The coated paper was passed through a supercalender at 850 ft./min. and the paper was subjected to various finishing conditions and moistening solutions.

Calendering lbs./linear inch	Moistened or dry	Moistening solution	Gloss	Bekk smoothness	Picking
1,700-----	Dry-----	-----	51.7	240	None.
1,700-----	Moistened-----	Steam-----	64.9	350	Do.
1,700-----	do-----	Water-----	63.2	240	Moderate.
1,700-----	do-----	Solution from Example 1.	77.9	450	None.

The data from the above table again indicate that moistening of the coated web with the moistening solution of Example 1 enhanced the finishing action of the supercalender rolls and did not cause the softened coating to pick. Moistening with water did offer some gloss advantages over dry supercalendering but caused the coating to pick. The moderate picking of the water softened coating is probably responsible for the low Bekk smoothness value. The smoothest sheet produced was with the application of the moistening solution of Example 1. Steaming the sheet during the supercalendering operation did increase the gloss and smoothness over dry supercalendering, but the gloss developed was much less than that of the paper moistened with the improved solution.

In carrying out the present invention, it is to be understood that various amounts of sodium stearate in water may be employed depending upon the nature and degree of the pick problem. I have experimented with solutions comprising 1 pound of sodium stearate in from 5 to 20 gallons of water, and other proportions of ingredients may also be used to overcome various degrees of picking. The proportions given in Example 1 are the preferred amounts of ingredients for the type of picking encountered using the particular paper and coating as set forth, and it is not intended to imply that these exact proportions of sodium stearate and water will be preferable in preventing the picking of coating resulting when other types of paper and coatings are employed.

It has been found that small amounts of a silicone additive may be added to the solution of Example 1 as an aid to non-picking of the coated surface on the metal supercalender rolls. When used, the additive is added to the solution in an amount of about 100 grams per the proportions of ingredients as disclosed in Example 1.

It has also been found that small amounts of am-

6

monium hydroxide or other alkalies are advantageously employed in the moistening solution as disclosed in Example 1. The purpose of the alkali is to insure that the solution remains on the basic side preferably with a pH of 8 or greater. The acidic nature of many offset coated papers may require that the moistening solution be sufficiently basic to prevent the formation and precipitation of stearic acid in the moistening solution. Such precipitation would prevent a uniform moistening treatment of the coated web.

The location of the moistening solution supply means on the supercalender stack may be varied to meet operating conditions. It may be placed anywhere throughout the stack as long as it is placed in a position to supply moistening solution to one of the metal rolls such that the metal roll will carry the moistening solution into the nip formed by the metal roll and an adjacent resilient roll. In this manner, only the side of the web which is in contact with the metal rolls of the stack will be moistened.

By placing two resilient rolls adjacent to each other intermediate of the stack, a finishing operation on both sides of the coated web can be performed.

Web speeds up to 850 ft. per minute have been employed with satisfactory results, and there is no reason why greater web speeds cannot be used.

While a certain preferred embodiment of the invention has been illustrated and described, it is to be understood that various changes may be made therein and the invention embodied in other structures, and it is not intended to limit the patent to the specific construction illustrated.

I claim:

1. A process of finishing coated paper on a supercalender which comprises the steps of partially supercalendering a traveling web of paper, wetting the surface of one of the metal rolls of the supercalender with a moistening solution, confining the moistening solution to the surface of said metal roll at a deckle less than the deckle of the traveling web, applying the moistening solution to the coated surface of the traveling web intermediate of the web edges to moisten the coated surface of the web at the nip formed by the metal roll and an adjacent resilient roll and to leave the web edges unmoistened, and smoothing the web by pressing the moistened surface of the web against the metal roll by the resilient roll.

2. The process of claim 1 in which the moistening of the coated surface of the web and the initial supercalendering of such moistened web takes place at essentially the same time.

3. The process of claim 1 in which the treated paper is paper coated with a water resistant type coating.

4. Process of finishing coated paper on a supercalender which comprises the steps of partially supercalendering a traveling web of paper, wetting the surface of one of the metal rolls of the supercalender with a moistening and lubricating solution comprising water and sodium stearate, confining the moistening and lubricating solution to the surface of said metal roll at a deckle less than the deckle of the traveling web, applying the moistening and lubricating solution to the coated surface of the traveling web intermediate of the web edges to moisten and lubricate the coated surface of the web at the nip formed by the metal roll and an adjacent resilient roll and to leave the web edges unmoistened, and smoothing the web by pressing the moistened surface of the web against the metal roll by the resilient roll.

5. Process of finishing coated paper on a supercalender which comprises the steps of partially supercalendering a traveling paper web, wetting the surface of one of the metal rolls of the supercalender with a moistening and lubricating solution comprising sodium stearate and water and having a pH above 8, confining the moistening and lubricating solution to the surface of said metal roll at a

7

deckle less than the deckle of the traveling web, applying the moistening and lubricating solution to the coated surface of the traveling web intermediate of the web edges by means of the metal roll rotatively carrying said solution into the nip formed by said metal roll and an adjacent resilient roll, leaving the web edges unmoistened and thereby preventing said solution from contacting the resilient roll at the nip formed by said metal roll and said resilient roll, and supercalendering the moistened web before the moistening and lubricating solution penetrates appreciably into the coated web, the moistening of the coated surface of the web and the initial supercalendering of such moistened web taking place at essentially the same time.

5

10

8

6. The process of claim 5 in which the sodium stearate content of the moistening solution comprises approximately 0.6% to 2.5%.

References Cited in the file of this patent**UNITED STATES PATENTS**

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