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PROCESS FOR SMOOTHING COATED PAPER BY HYDRO-SWAGING

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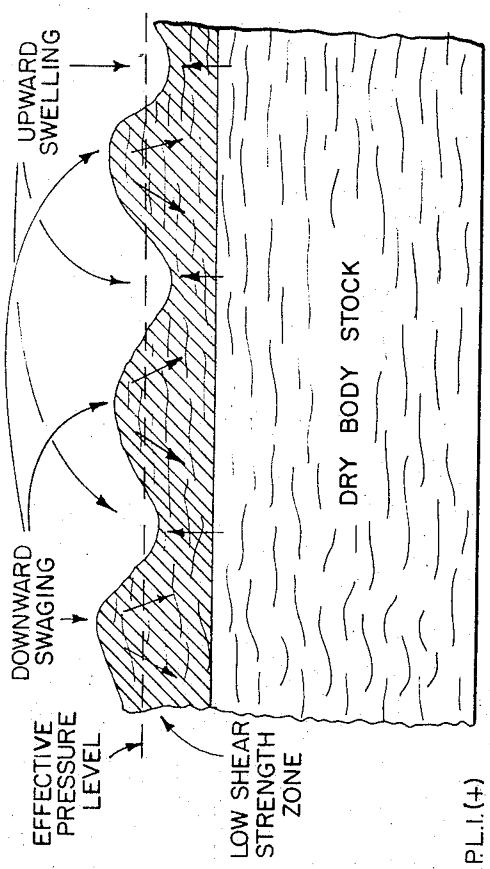

FIG. 2

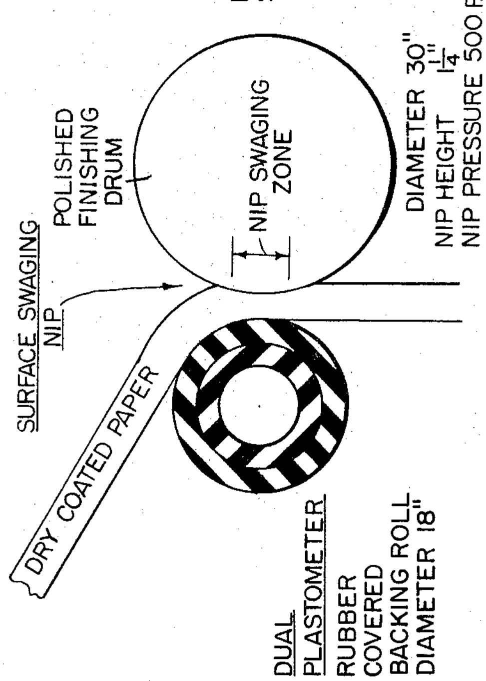

FIG. 1

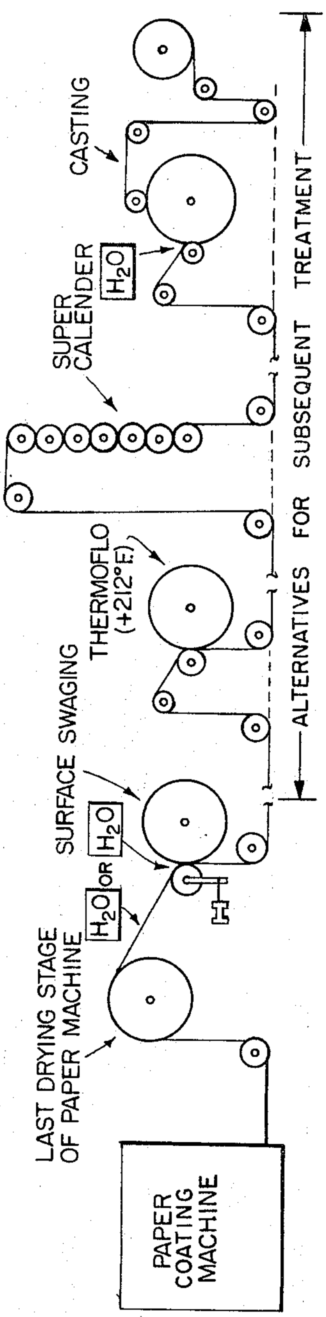

FIG. 3

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PROCESS FOR SMOOTHING COATED PAPER BY HYDRO-SWAGING

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ABSTRACT OF THE DISCLOSURE

A method of producing a printing paper having a smooth coated surface at paper-making machine speeds without destructive bulk loss and uneven densification is described. This method in essence consists of taking a sheet of relatively dry paper coated with a known mineral pigment—adhesive binder coating composition and adjusting the moisture content of just the top surface of the coating, as by wetting in a water bath, to create a zone of low shear strength at the surface, followed by swaging of the coating in the nip formed by a finishing roll and a resilient backing roll at relatively low nip pressures in the order of 500 to 600 pounds per linear inch.

This application is a continuation-in-part of Ser. No. 134,638, filed Aug. 29, 1961 and now abandoned.

This invention relates to coated paper, and more particularly to smoothing or flattening the surface of coated paper by means of a swaging action, and is useful either to improve the printability of the paper or to condition the paper for later finishing.

A primary broad object of this invention is to smooth or flatten coated paper at paper machine speeds without locally densifying the same or substantially destructively reducing its bulk the way calenders do. Another primary object is to flatten the surface of coated paper without unevenly densifying the same as a preliminary step in the process of gloss finishing coated paper by various subsequent techniques including calendering, supercalendering, cast coating, or the so-called "Thermoflo" treatment described in one of its forms in Example No. 8 in U.S. Patent No. 2,919,205.

Our invention and its more detailed objects and features will best be understood by way of contrast to various hitherto known processes and by an explanation of the drawbacks of those processes which the present invention attempts to avoid. Several prior art processes are known to accomplish our above-stated broad objects and to produce flat coated surfaces having substantially uniform densities below the surface. For instance, this aim can be accomplished fairly well by the well-known "trailing blade" coating technique, because in blade coating the blade does not follow the relatively rough contour of the paper base but rather fills in the low spots and eliminates excess coating from the high spots. However, since the coating contracts on drying, it contracts more where the coating is thicker, and this renders the blade coated surface slightly uneven after drying. Blade coating also has other drawbacks. It involves such a complex interrelationship between (a) the blade pressure, (b) the paper speed, (c) the coating viscosity, (d) the temperatures of the coating and the paper, (e) the water retentivity of the coating, (f) water absorptivity of the paper, and (g) the length of contact between coating composition and paper base ahead of the blade, that successful use of the blade coating process requires great skill. A less sensitive process is highly desirable. Another process which results in a flat uniformly dense sheet is described in one example

in our copending application Ser. No. 48,497, filed on Aug. 9, 1960, and now abandoned, in which the surface of a wet coating is substantially gelled by chemical treatment and thereafter while the sheet and coating are both still wet and essentially soft, they are given a "wet squeeze" between two rolls. This latter process provides excellent results because the overall contraction of the sheet on drying is more uniform than with blade coating, but chemically treating an essentially wet coating without disrupting it is very difficult at high speeds. Another process which both flattens the surface without uneven internal densification and increases the surface gloss is one we call "Thermoflo" described in one of its forms in Example 8 in U.S. Patent No. 2,919,205. In "Thermoflo," the roll temperature is above 212° F. and this temperature is used to create an internal expansive force in the nip between two rolls which pressure is released after the paper passes through the nip. Rupture of the coating by the release of this pressure is prevented by gelling the coating prior to its entrance into the nip. "Thermoflo" also suffers from speed problems because the amount of finishing that can be accomplished in the "Thermoflo" nip depends on both time and temperature, and if the pressure in the nip is released too rapidly, the coating ruptures unless the moisture content is very low. Of course, various cast coating techniques in which the coating bonds adhesively to the finishing surface may be employed to produce flat high gloss sheets having uniform internal densities, but cast coating is comparatively slow and expensive.

Accordingly among the more detailed objects of our invention is to provide a process which is capable of flattening the coating without substantial destructive loss of bulk or uneven internal densification and which is, at the same time, simple in its operation. A further object is to provide such a process which is also capable of operation at paper machine speeds.

In the accomplishment of these and other objects of our invention in a preferred embodiment thereof which, for convenience of reference we call "surface swaging," we flatten only the top surface of the paper by shearing or swaging it against a polished finishing roll. We have found that this can be done without destructive loss of bulk or rupturing the coating by running the paper through a relatively soft and low-pressure nip between a backing roll and a finishing drum provided (a) the paper is dry and hence strong enough to resist permanent destructive loss of bulk at that pressure; (b) the upper surface of the paper has a sufficiently low shear strength zone near its surface to cause the raised areas or "hills" on the coating to yield at that pressure; and (c) the pressure is maintained long enough to allow most of the "hills" on the coating surface to yield downwardly to an essentially flat state. The resulting sheet is exceptionally flat and uniformly dense, and since the conditions necessary for its production are, in fact, not difficult to achieve and maintain, the process is simple to operate. In addition, since a relatively dry paper is employed and since the swaging can be done at high speeds by appropriate roll surface selection, our process lends itself to operation in a direct series with the paper machine at paper machine speeds.

A major feature of the process of our invention is that it performs excellently as a preliminary step in sequence with a number of other finishing techniques. Thus, due to the extreme flatness of the surface it produces and the evenness of density of the over-all sheet, simple calendering or supercalendering greatly increases its gloss. Naturally, calendering reduces the opacity, brightness and bulk of the sheet, but we note that with our sheet an equivalent finish can be attained with substantially less calendering and hence less destructive treatment. Another technique which greatly upgrades the product of the "surface swaging" process described herein is the so-called "Thermoflo" technique described in one of its forms in Example No. 8 in U.S. Patent No. 2,919,205. It will be understood that the amount of work the hot "Thermoflo" nip can accomplish is limited to some extent by the temperature of the roll and the speed at which the product can be passed through the nip. Thus with a very flat surface of uniform over-all density such as the sheet produced by the process of this invention, the amount of work which needs to be done in the "Thermoflo" nip is thereby greatly reduced, and therefore, this product can be processed through a "Thermoflo" nip at much higher speeds and still receive a very marked upgrading in gloss without loss of opacity, brightness or bulk.

Still another feature of our invention is that the simplicity and ease of operation under it is greatly increased by the use of acid or acidic salts in the coating composition to inhibit the cross-linking tendency of proteinaceous adhesives used in the coating and also by the use of more malleable adhesives such as the salt peptized casein or soy protein described in U.S. Patent No. 3,081,182.

Another feature of our invention relates to increasing the speed of operations employing it. It will be understood that the roll pressure on the paper surface in the nip is initially effective only against the tops of the raised areas or "hills" on the surface of the sheet. However, as the paper progresses through the nip and the "hill" are swaged downwardly, the effective area of contact increases, and also simultaneously the effective roll pressure level approaches nearer and nearer to the bottom of the low areas or "valleys" on the surface. Naturally, the design for optimum operating conditions indicates that the more complete this action is the better will be the result. However, since the swaging action is progressive it takes time, and it cannot be done too rapidly because there is an upper pressure limit at which substantial bulk loss commences to appear. We solve this in the process of our invention by increasing the height of the nip thereby permitting the paper to remain longer under a given effective roll pressure at the same throughput speed or to operate at faster speeds for a given dwell time under pressure. Thus, by the proper selection of roll surfaces we can operate "surface swaging" at paper machine speeds.

Other objects and features of our invention will best be understood and appreciated from a detailed description of a preferred embodiment thereof and examples, selected for purposes of illustration and shown in part in the accompanying drawings in which:

FIG. 1 is a diagrammatic view in side elevation showing the paper and rolls of the "surface swaging" nip with dimensions exaggerated for purposes of clarity of illustration;

FIG. 2 is a fragmentary illustrative view of the coating surface showing how the high spots are swaged into the low spots; and

FIG. 3 is a diagrammatic view showing the various sequences useful in combination with "surface swaging."

Example 1

In a representative illustration of "surface swaging," we start with a dry paper base weighing about 185 pounds per ream of 3300 square feet to which a conventional coating has been applied by means of an air knife or transfer roll coater. A coating we have used successfully includes 100 parts by weight of a mineral pigment, such as clay, and 20 parts by weight of adhesive, divided equally between conventional alkaline cut casein and a latex, such as the styrene-butadiene latex of Dow Chemical Co. numbered 512R. A suitable coating weight may be 15 lbs. per ream of 3300 square feet. The sheet is then dried to approximately 4.8% total moisture content.

The "surface swaging" nip is formed between a polished chromium finishing drum of 30" diameter, and a rubber-

covered backing roll of 18" diameter. The backing roll covering consists of two rubber layers of different plastometer—the outer layer being 3/16" thick and having a plastometer of 18 to 20 P & J (at room temperature), and the inner layer being 5/8" thick and having a plastometer of 35 P & J.

The paper is run through this nip at a speed of about 325 feet per minute at a compression of about 600 pounds per linear inch between the rolls. At this speed and pressure, the nip appears to be about 15/16" in height. The temperature of the roll is about 150° F. and is sufficiently hot only to avoid condensation of moisture on it from the surrounding atmosphere. Shortly before the paper enters this nip, a small quantity of water is applied to the coating. This can be done by introducing water directly into the "surface swaging" nip or by applying it to the paper in advance of the nip. In the illustration in which the water is applied at the "surface swaging" nip, a small pool of about 3/4" in height is used and the total water pick-up of the sheet is about .4%. Thus after passing through the "surface swaging" nip the total moisture content becomes approximately 5.2%, or an increase of about 0.8 pound per ream, substantially all in the surface of the coating. Thus, based on the dry weight of solid material in the coating the percentage moisture added in the swaging operation is about 5.3%. More water can be used if it is applied in advance of the nip and is allowed to dry sufficiently so that the surface will not stick to the finishing surface. Thus about 2.5% (or 5 pounds per ream based on the total weight of the sheet or about 33% based on dry weight of solid material in the coating) moisture was added to the sheet approximately 25' in advance of the nip when the speed was about 300 f.p.m. In this latter case the moisture sank into the coating and the surface became substantially non-sticking by the time it reached the "surface swaging" nip. Where the water is applied at the nip, the roll apparently squeezes off the excess and leaves so little on the surface of the coating that it does not stick. Whether the water is applied immediately at the "surface swaging" nip or in advance of the nip as above described, it is apparent that the water treatment establishes in the immediate area of the coating a zone of relatively low shear strength.

Since the action of the "surface swaging" nip is that of swaging the high spots on the coating into the low spots without causing any substantial destructive loss of bulk, several interrelated conditions must be maintained simultaneously. Thus, at a given operating roll pressure, the shear strength in the immediate sub-surface of the "hills" must be low enough to permit them to be swaged downwardly. At the same time, however, the body stock must be dry enough and strong enough to resist permanent loss of bulk at that pressure. And finally, the dwell time must also be long enough to allow the swaging action effectively to reach a major proportion of the surface at that same roll pressure.

In practice, we find that these conditions are not difficult to meet. Having once selected a given body stock and coating weight and determined other factors such as the coating application method, the other variables necessary for "surface swaging" can be easily worked out by trial and error based on observation.

Perhaps the simplest way to explain how the variables are selected by observation is to describe the process in operation and to discuss how certain of the variables are controlled to maintain optimum results.

Since in "surface swaging" we establish a low shear strength zone in the coating surface and we can accomplish this by applying water to it and since the coating surface also contains a hydrophilic adhesive, sticking to the finishing surface becomes a problem. We avoid this by applying the water to the coating surface sufficiently in advance of the nip to permit the immediate contacting surface to dry before it reaches the nip or by squeezing the water off the coating surface in the nip. Also the roll temperature influences the sticking problem, and accordingly sticking is avoided both by controlling the water application conditions and the roll temperature. Thus, although it is not actually difficult to avoid sticking by these techniques and still have a surface zone of sufficiently low shear strength, the need to avoid sticking does limit how soft the coating can be made.

Once the water application and anti-sticking conditions have been met the only thing left to do is to regulate the throughput speed and roll pressure so that with a given dwell time in the nip and with a roll pressure below the pressure at which destructive bulk loss occurs adequate swaging takes place. By "adequate swaging" we mea n that a major proportion of the "hills" on the coating surface have been flattened and that the effective compression level of the roll has reached a point near the bottom of the "valleys." Under the microscope we observe that, after "surface swaging," the "valleys" are largely closed in. They are still visible but their walls appear rounded by the water treatment and by material swaged from the "hills" toward the "valleys." One thing to note about "surface swaging," however, when visual observation is employed for controlling the operating variables, is that the "surface swaged" sheet does not readily appear to be markedly improved. To the casual observer "surface swaging" appears to give the sheet only a very minor increase in gloss and the marked benefits of "surface swaging" actually only appear when the sheet is subsequently printed, calendered, "Thermoflo'd" or cast.

By "destructive bulk loss" we mean the type of treatment encountered in calendering. Naturally some minor bulk loss will result from the mere flattening of the "hills" on the coating, and we do not refer to bulk loss of that sort when we say "without substantial destructive bulk loss." Usually destructive bulk loss does not appear until the thickness of the sheet is reduced more than 7%, but even this varies somewhat depending on the coating application method.

Adjusting the roll pressure to a point between the maximum at which destructive bulk loss appears and the minimum at which (for a given dwell time) adequate swaging takes place is not hard. The first thing to do is to put the pressure up to the maximum. If swaging is adequate at that pressure and speed, either the pressure can be reduced or the throughput speed increased, if desired. If the swaging is not adequate at that pressure and speed, the simplest thing to do is to slow down the throughput speed. This will increase the dwell time under pressure and increase the effective swaging action. Another solution, if slowing down is impossible, is to increase the nip height. We do this by employing a relatively soft roll but other equivalent methods are equally applicable as long as they effectively increase the dwell time. Using more than one "surface swaging" nip in close sequence is an effective way to increase the dwell time, but there is a danger with sequential nips that the water will leave the low shear strength zone and soften the body stock. If this occurs, the paper can be dried and subsequently "surface swaged" again.

Example 2

In discussing the subsequent examples, it will be understood that the comments made in connection with Example No. 1 as to the mode of operation and general variables will also apply.

In Example No. 2, we carry out all the steps of Example No. 1, and after the sheet has passed through the "surface swaging" nip, we supercalender it. The resulting sheet shows a marked gloss, which is substantially superior to the gloss observed when the same coated body stock is supercalendered without the previous "surface swaging" treatment. In addition, the loss of bulk by supercalendering of the "surface swaged" sheet is less for the same gloss than that of the same coated body stock supercalendered without "surface swaging." Moreover, the "dingy" appearance or mottle of the conventional calendered sheet is much less after "surface swaging." We believe that this is due to the more uniform leveling of the sheet by "surface swaging" which permits satisfactory gloss to be attained without so much destructive treatment in the supercalender.

Example 3

In Example No. 3, we employ the "surface swaged" sheet of Example No. 1 and pass it through a "Thermoflo" nip in accordance with one variation of the process previously described in Example No. 8 in U.S. Patent No. 2,919,205. By the "Thermoflo" treatment the coated surface is subjected to high temperature in a confined nip and pressed against the finishing drum. The high temperature creates an expanding force which is released as the paper issues from the "Thermoflo" nip. The paper, being essentially dry, does not stick to the drum, and it is sufficiently gelled so that the release of the pressure at the far side of the "Thermoflo" nip does not explode the coating. The "Thermoflo" nip, unlike the "surface swaging" nip, causes a very marked increase in gloss; and when used in sequence with "surface swaging" as in this example, the two processes complement each other such that the upgrading of the product is very marked and approaches that of cast coated quality. It would appear that the "surface swaging" action makes it possible for the glossing action of the "Thermoflo" nip to be effective on a much wider area of the coating surface.

Example 4

In Example No. 4, we follow the same basic "surface swaging" steps as in Example No. 1, and thereafter cast the sheet against a polished finishing drum by the rewetting technique described in U.S. Patent No. 2,759,847. Since the "surface swaging" sheet is substantially more uniform than the form hitherto used in that type of cast coating process, a marked upgrading in both quality and speed is made possible.

Example 5

In Example No. 5, we follow the same basic "surface swaging" steps described in Example No. 1, except that the coating is treated with an aqueous acid solution either concurrently with the water application steps or prior thereto. The acid selected for this purpose is preferably a volatile organic acid, such as formic acid, but we wish it to be understood that a great many acids and acidic salts may be employed. The addition of the acid decreases the tendency of the coating to stick to the finishing surface, but primarily the purpose of the acid or acid radical is to reduce the chemical re-activity of the casein and to free it from its chemical association with the alkaline material used to cut it. Accordingly any suitable acid will suffice, as long as it is compatible with the mineral pigment and not overly destructive to the cellulose. When acid is applied in this fashion, the coating is substantially more malleable, yields more readily to the swaging action in the "surface swaging" nip, and consequently is smoothed to a greater degree than the coating of Example No. 1. In this example the paper base used was an unsized paper web weighing 60 pounds per ream of 3300 square feet. To one side of this was applied by an air-knife coater 15 pounds, dry weight, of a coating composition containing 100 parts by weight of coating clay, 10 parts of styrene-butadiene copolymer (from Dow's 512R latex), and 10 parts of casein dissolved by ammonia. The coated paper was dried to a moisture content of 3.6%. The coated side of the web was contacted with an aqueous solution of 1% formic acid; the excess acid solution was wiped off; and the web was then immediately passed into a "surface swaging" nip as described in Example No. 1. In this case the polished chromium finishing drum had a diameter of 18"; the backing roll was the same as the one used in Example No. 1; the speed was about 400 feet per minute; the pressure was 500 pounds per linear inch; the temperature of the roll was about 150° F.; and the pool of water in the nip was about ½″ in depth. The weight of water picked up from both the acid treatment and the swaging nip amounted to 2¼ pounds per ream.

Example 6

In Example No. 6, we use the acid treated "surface swaged" sheet of Example No. 5 and calender it as in Example No. 2. Here the acid treatment again renders the sheet more malleable, and an upgrading over Example No. 2 can be observed.

Example 7

In Example No. 7, we use the acid treated "surface swaged" sheet of Example No. 5 and subsequently "Thermoflo" it as in Example No. 3. Here again due to the added malleability brought about by the presence of the acid, the product is upgraded somewhat over the product of Example No. 3.

Example 8

In Example No. 8, we employ the "surface swaged" sheet of Example No. 5 and subsequently cast coat it as in Example No. 4. Here again the added malleability due to the presence of the acid contributes to a slight upgrading of the product.

Example 9

In Example No. 9, we employ the same steps as in Example No. 1, except we use as an adhesive a protein we call "SPC." These letters stand for "salt peptized casein," but as in the case of many abbreviated descriptives, the term "SPC" is not in itself complete. Peptizing the protein by means of an acidic acid salt is only one phase of the process which produces the adhesive we have labeled "SPC," and when the protein is finally used in the coating it is not peptized at all but rather is actually dispersed in the free state. As such, it is described in detail in our copending applications, Ser. No. 862,336, filed on Dec. 28, 1959, now abandoned, and Ser. No. 48,497, filed on Aug. 9, 1960. Accordingly, we incorporate herein by reference the examples of "SPC" in those applications and intend to include in our concept thereof any casein or equivalent proteinaceous adhesive which has been peptized in a solution of a neutral to acidic salt of an alkali metal or ammonium having a monovalent anion, and subsequently dispersed in the relatively free state in a mineral pigment slurry.

The particular paper web used in this example weighed 85 pounds per ream of 3300 square feet. It was coated on one side by means of an air-knife coater with 15 pounds dry weight of a coating composition containing clay 100 parts, 8 parts of styrene-butadiene copolymer (added as Dow's 512R latex) and 12 parts of casein peptized by 2½ parts of ammonium nitrate and 2½ parts of dicyandiamide. The coated web was dried to a moisture content of about 5%. It was then "surface swaged" under the same conditions described in Example No. 5. By this treatment water in the amount of 2 pounds per ream was taken up.

With "SPC" as the adhesive, the sheet is "surface swaged," and the result is superior to either Example Nos. 1 or 5. The "SPC" is more insoluble and a coating made therefrom has excellent wet-rub resistance. When lacquered or varnished, it exhibits a surprising increase in surface gloss. Likewise its ink setting time and other printing characteristics are improved.

Example 10

In Example No. 10, the "SPC" adhesive "surface swaged" sheet of Example No. 9 is supercalendered. Here again the resulting product is superior to that of Example Nos. 2 and 6.

Example 11

In Example No. 11, the "SPC" adhesive "surface swaged" sheet of Example No. 9 is "Thermoflo'd," and an even better product results without the loss of bulk or brightness of Example Nos. 2, 6 and 10.

Example 12

In Example No. 12, the "SPC" adhesive "surface swaged" sheet of Example No. 9 is re-wet and cast against a finishing drum, and the product has an extremely high gloss and flatness.

Example 13

A paper web moderately sized with rosin, and weighing 125 pounds per ream of 3300 square feet, was cooled and then coated by means of a trailing-blade coater with 5 pounds, dry weight, of the following composition:

	Parts
Coating clay	100
Soy protein dispersed in water with ammonium hydroxide and urea	14
Styrene-butadiene copolymer (as Dow latex 512R)	5
Water to make solids content 60%.	

The base-coated web was dried and then top-coated, by means of an air-knife, with 10 pounds, dry weight, per ream of the following composition made as disclosed in our aforesaid application Ser. No. 48,497:

	Parts
Premium English clay	100
Casein (peptized in 50 parts of water containing 3 parts ammonium nitrate and 1½ parts dicyandiamide)	15
Styrene-butadiene copolymer (as Dow latex 512R)	4
Tributyl phosphate (anti-foam agent)	1
Tallow soap	0.5
Water to make solids content about 44%.	

The coated web was dried to a moisture content of about 5%.

The dried web was then swaged by being passed at 400 feet per minute through a pool of water 1″ deep held in a nip between a rubber-covered backing roll of 18″ diameter and a polished chrome-plated finishing roll of 16″ diameter heated at 140° F. at a pressure of about 500 pounds per linear inch. The paper took up 2.2 pounds per ream of water from the swaging nip.

The sheet was thereafter pressed against a polished chromium plated cylinder heated to 400° F. by means of a rubber-covered backing roll. The pressure used was 500 pounds per lineal inch, and the depth of the compression nip was ½″. The speed was 350 feet per minute. The coated surface upon emerging from the nip had a very high gloss, approaching that of a cast coated sheet.

We have discussed in Example No. 1 variations thereof coming within the scope of our invention. It should be understood that corresponding variations also apply to Example Nos. 2 to 13, where appropriate.

In addition to the process steps outlined above, we also intend to claim the sheet itself. As for the "surface swaged" sheet, it comprises fibers, mineral pigment, and adhesive; and presents a structure including a major proportion of relatively flat portions disposed on the surface of the sheet generally in the areas of the sheet which represented high spots on the surface thereof before the "surface swaging" treatment and a minor proportion of small valleys filled in both by swaging and water swelling.

Having thus described and illustrated preferred embodiments of our invention, what we claim as new and desire to secure by Letters Patent of the United States is:

1. In a process for smoothing the surface of a coated paper without unevenly densifying the same or substantially reducing the bulk thereof, the steps of: applying to a fibrous paper web an aqueous coating composition, the principal ingredients of which are a mineral pigment and an adhesive binder therefor, the shear strength of which composition varies inversely in proportion to the moisture content thereof; thereafter treating said paper and coating thereon at least in part by drying to obtain a moisture content of said coating to form a relatively low shear strength zone in the surface portion of said coating and to prevent said coating from sticking to the surface of a finishing roll; passing the coated paper while the coating material in said zone is still in the said low shear strength state through a nip formed between a resilient backing roll and a finishing roll with said paper in contact with the resilient backing roll and said coating in contact with the finishing roll; adjusting the rolls to obtain a pressure in said nip above the pressure at which the shear strength in said zone of said coating is exceeded in the raised areas on said coating surface and near the maximum pressure to which said paper can be subjected without permanent loss of substantial bulk, the percentage of moisture in said coating being in the range of 5⅓ to 33% based on dry weight of solid material in said coating and the pressure in said nip being that developed between a 16″ to 30″ finishing roll and an 18″ resilient backing roll at be tween about 500 and 600 pounds per linear inch, the pressure used within this range decreasing as the moisture content of said coating increases; and maintaining said pressure in said nip while the coated paper is passing therethrough until a major portion of the raised areas in said coating are flattened substantially completely, whereby a flat uniformly dense web is produced.

2. The process as set forth in claim **1** further including the step of calendering said coated paper after it has passed through said nip.

3. The process as set forth in claim **1** further including the step of passing said coated paper through a second nip formed between a second polished finishing roll and a second resilient backing roll while maintaining the temperature of said second finishing roll substantially above 212° F.

4. The process as set forth in claim **1** further including the step of passing said coated web through a second nip formed between a second polished finishing roll and a second resilient backing roll, simultaneously therewith re-wetting said coating sufficiently to cause the same to adhere to said second finishing roll, drying the same in contact therewith, and removing the same therefrom.

5. The process as set forth in claim **1** further characterized by employing, as a major ingredient in said coating composition a hydrophilic proteinaceous adhesive.

6. The process as set forth in claim **5** further including the step of calendering said coated paper after it has passed through said nip.

7. The process as set forth in claim **5** further including the step of passing said coated paper through a second nip formed between a second polished finishing roll and a second resilient backing roll while maintaining the temperature of said second finishing roll substantially above 212° F.

8. The process as set forth in claim **5** further including the step of passing said coated web through a second nip formed between a second polished finishing roll and a second resilient backing roll, simultaneously therewith re-wetting said coating sufficiently to cause the same to adhere to said second finishing roll, drying the same in contact therewith, and removing the same therefrom.

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