

March 7, 1967

B. C. GOTTWALD ETAL  
PROCESS OF CAST COATING PAPER AND  
SIMULTANEOUSLY LAMINATING

3,307,993

Filed Nov. 12, 1963

3 Sheets-Sheet 1

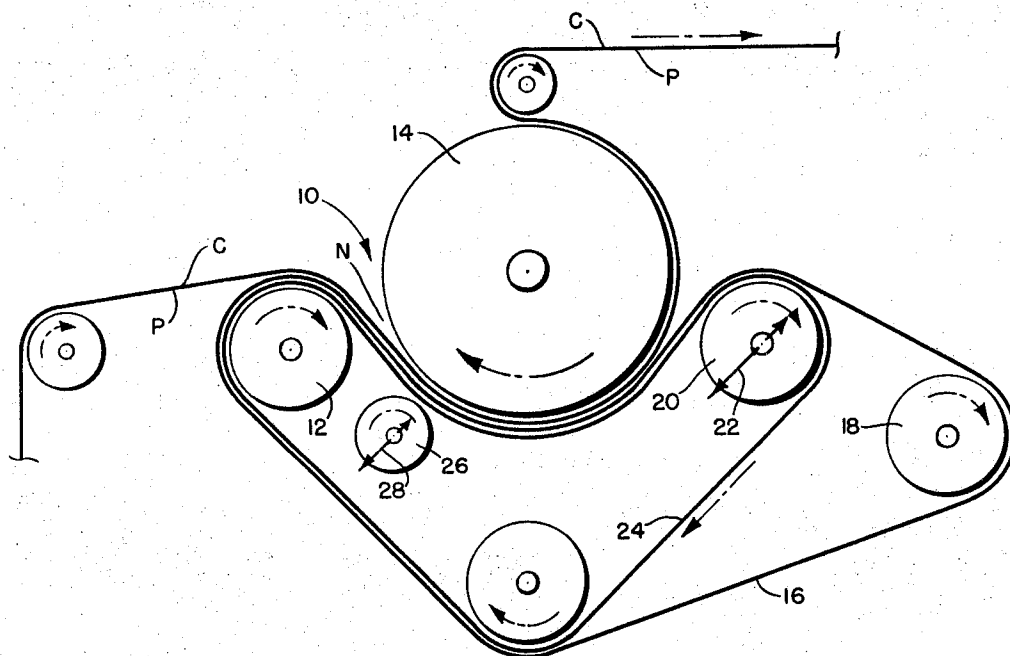


FIG. 1

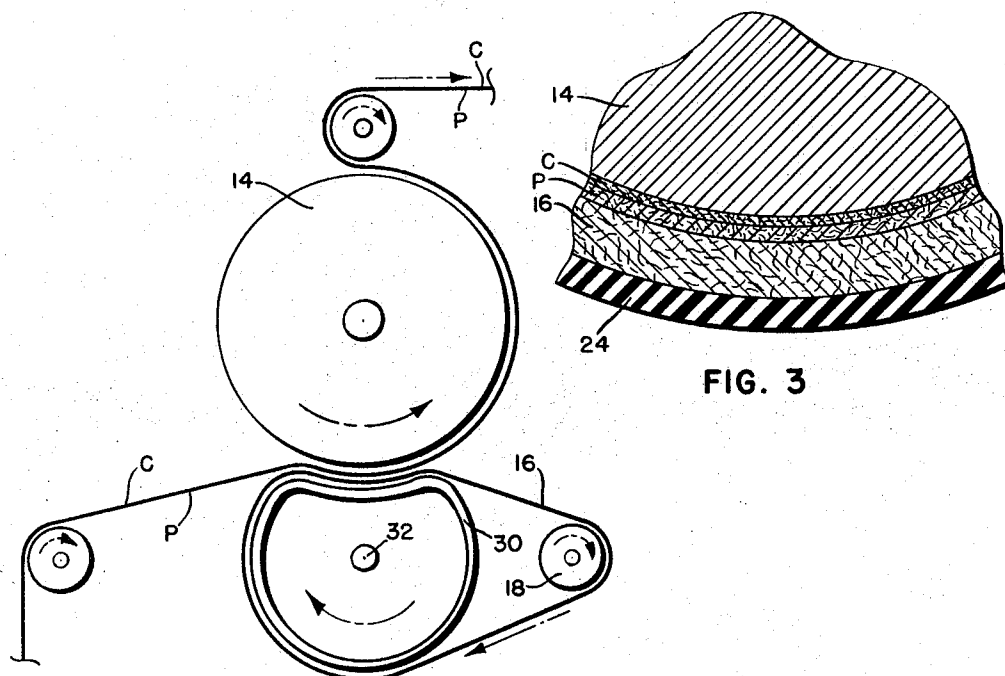


FIG. 3

FIG. 2

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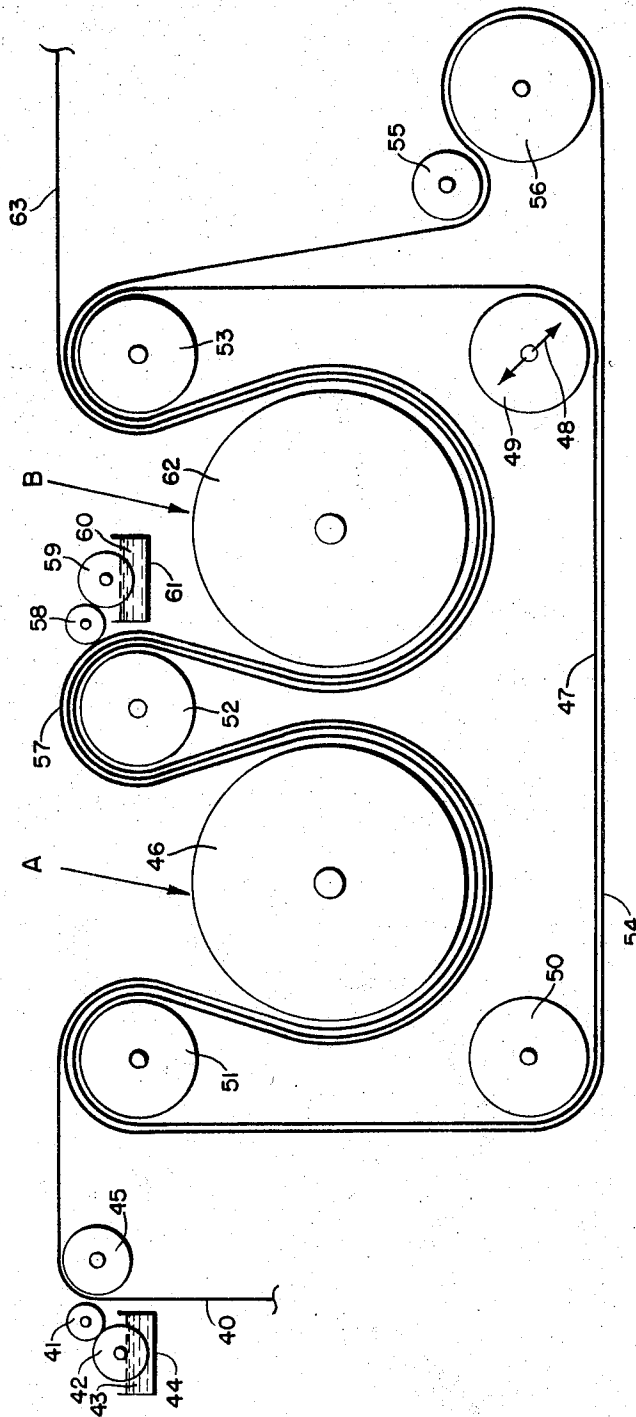


FIG. 4



1

2

3,307,993

## PROCESS OF CAST COATING PAPER AND SIMULTANEOUSLY LAMINATING

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7 Claims. (Cl. 156—278)

This application is a continuation-in-part of our previously copending application Serial Number 77,083, filed December 20, 1960, and now issued as U.S. Letters Patent Number 3,110,612.

This invention relates generally to a method and apparatus for the high speed coating of paper with an extremely smooth surface. More particularly, this invention is concerned with a process and apparatus for coating a web of paper with a cast surface or other smooth surface at a speed, at a cost, and of a quality heretofore unobtainable.

The manufacturer today, as is well known, utilizes a colorful and attractive packaging or wrapping for his product, which is appealing to the prospective purchaser, for the reason that such eye catching packagings are a significant factor in the sale of any individual product. This is particularly true when competitive products are often side by side on the retail shelf, each vying for the attention of the consumer. Thus, more attractive wrappings or packages have been sought by manufacturers to sell their product without adding appreciably to the cost of the product.

One of the most desirable type of packages from the standpoint of attractiveness is a cast coated paper such as was disclosed in the basic Bradner Patent 1,719,166. A paper so produced has a very smooth surface which is the image of the chromium plated highly polished dryer drum used. While the patented apparatus and process has produced a smooth product, there are inherent disadvantages which attend such prior means and method. Among these disadvantages is the fact that the paper produced was often distorted and spotty, due to the fact that the coating was forced away from the drum before drying, by reason of the liquid boiling at the surface between the coating and the drum. In an attempt to eliminate this undesirable situation, the temperature of the drum was maintained below the boiling point of the liquid in the coating, which in most cases was water. Thus, the temperature of the drum was limited to a temperature below 212° F.

While the distorted or spotty product was to some extent avoided by reducing the temperature of the drum, it is obvious that the production rate was considerably reduced because of the resulting slower drying rate. As a matter of fact, the average speed of prior cast coating operations was limited to about 50–80 feet per minute, due to the necessity of assuring proper drying of the wet coating. Obviously, this slow production rate greatly increased the cost of the coated paper product.

Attempts to raise the temperature of the drum above the boiling temperature of the liquid in the coating, to speed up the drying and thus the production rate, resulted in the boiling of the liquid and the "blowing" of the coating away from the drum immediately after its release from the pressure nip. This "blowing" causes a splitting of the coating and the distortion mentioned above. In addition, part of the coating will adhere to the dryer and part will remain on the paper. One of the reasons for the splitting of the coating is that the usual aqueous coating, such as starch or starch and clay, has higher adhesive properties than cohesive properties while wet. However, the reverse is true after the coating has dried. Thus, the "blowing" which occurs before the coating surface has dried, will cause the coating at least partially

to adhere to the drum dryer. Further use of this dryer with the adhering portion of the coating on its surface, only compounds the problem.

According to prior practices to produce the cast effect on the coating, the coating must initially contact completely the dryer surface. This is accomplished by means of a single pressure roller at the nip in the prior constructions. In order pressure roller at the nip in the prior constructions. In order to avoid sticking of the coating to the drum after the drying, the surface of the dryer was coated with an oleaginous material. This is disclosed in the Montgomery Patent 2,568,288. However, the production rate still could not be safely raised above approximately 80 feet per minute.

A later attempt to increase the speed of production of a cast coated paper is shown in Hart 2,919,205. Although the production rate is increased by this process to about 200 feet per minute, it requires a special gellable coating which must be gelled before the coating is contacted by the dryer drum.

Consequently, it is the primary object of this invention to produce a method and apparatus which will permit the production of a smooth coated paper at a high rate of speed.

Another object of this invention is the production of a cast coated paper with a dryer drum heated to above the boiling temperature of the liquid coating vehicle.

Another object of this invention is to produce a cast coated paper at high speed, without permitting the coating to "blow" from the dryer drum.

Another object of this invention is the provision of method and means for receiving and absorbing the vapor vaporizing from the coating to be cast on a paper, without permitting the coating to separate from the dryer drum.

This invention also has for its object the provision of a means and method for continuously maintaining the coating against the dryer drum to dry the coating sufficiently, such that the cohesive strength of the coating will resist any distortion due to further drying.

An additional object of this invention is to provide a means and method for drying and casting a liquid coated paper at a temperature higher than the boiling temperature of the liquid without the necessity of using a pressure sufficient to overcome the vapor pressure of the liquid at the dryer temperature while continuously maintaining the coating against the casting surface and preventing the separation of the coating from the dryer surface until the coating is sufficiently dry, whereby the cohesive strength of the coating will resist any distortion due to further drying.

A further somewhat more limited object of this invention is to produce at high speed a cast coated paper by receiving the vapor from the vaporizing liquid in the coating before it has an opportunity to separate the coating from the drum and additionally maintaining the coating continuously against the dryer drum.

A particular object of this invention is to produce cast coated paper of a quality and at a speed and cost heretofore unobtainable.

A very specific object is to provide a pressure-cast coating process involving the application of dual layers of coatings, each of which is cast under high pressure and temperature conditions.

Another very specific object is to provide a pressure-cast coating process involving the application of a coating to a composite web and casting the coating upon the composite web under high pressure and temperature conditions.

Other objects and advantages of the present invention will become apparent to those skilled in the art, from the following description when read in conjunction with the accompanying drawing, wherein:

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FIGURE 1 is a schematic side elevational view of a casting unit utilized in the present invention;

FIGURE 2 is a schematic side elevational view of another embodiment of a suitable casting unit which may be used in the present invention showing the use of a soft flexible roller as the pressure means;

FIGURE 3 is a fragmentary sectional view of the area between the dryer drum and the pressure applying means;

FIGURE 4 is a schematic side elevational view of that embodiment of this invention wherein the application and pressure coating of dual layers of coatings is accomplished;

FIGURE 5 is a schematic side elevational view of that embodiment of this invention wherein a coating is applied to a composite web and thereupon subjected to pressure-cast coating.

Briefly, this invention utilizes a method and apparatus for drying a liquid coating on a paper into a smooth surface such as a cast surface at high speed, by the use of a drum heated to a temperature above the boiling point of the liquid in the coating, the "blowing" of the coating being prevented by providing a vapor receiving void behind the paper surface having the coating, and by continuously maintaining the coating pressed against the dryer drum with a pressure means until the cohesiveness of the coating is such that further drying will not distort the coating. A simple casting unit embodying this method and apparatus is described and claimed in our prior copending application Serial Number 77,083, filed December 20, 1960, and now issued as U.S. Letters Patent Number 3,110,612.

As brought out in that application, it has been discovered that the "blowing" of the coating away from the surface of the dryer drum can be avoided by providing a means of escape for the vaporized liquid in the wet coating rather than reducing the temperature of the drum. Thus, it is proposed to heat the dryer drum to temperatures as high as 325° F. or even higher, and permit the vapor to escape from the coating and into a vapor receiving void or backing layer which is pressed against the back of the paper surface having the coating thereon.

As can be seen, the vapor from the boiling liquid will not force the coating from the drum surface, but rather, with the proposed construction can pass from the coating and through the normally porous paper surface into the vapor receiving void in back of the paper surface. The only pressures necessary for holding the coating on the drum surface, therefore, are those that will overcome the resistance offered by the coating, the paper and the vapor receiver to the passage of the vapor. In other words the pressures necessary to hold the coating on the drum are those sufficient to overcome the vapor pressure of the liquid at the drying temperature less the loss in pressure due to the vapor passing from the coating, through the paper and into the porous backing. These pressures that may be around 20 p.s.i. are less than the vapor pressures of the liquid at the drying temperature and considerably less than the pressures suggested in the Hart 2,919,205 patent, which are in the neighborhood of 300-380 pounds per linear inch.

In order to adequately dry the coating so that it will not stick to the dryer drum, it is usually sufficient, as with a starch adhesive, to dry the surface of the coating whereby the cohesiveness of the coating is greater than the adhesiveness to the dryer drum. However, regardless of the amount of drying, it is important that pressure be applied continuously to the coating, such as will overcome the resistance of the vapor to flow into the vapor receiving layer for a long enough time until the cohesiveness of the coating is such that further drying will not distort the coating. This can only be accomplished if there is a means for applying continuous pressure to the coating, thereby forcing it against the drum along a substantial portion of the drum surface. A feature of this invention,

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therefore, is the method and means for applying the necessary pressure over a substantial circumferential portion of the drum for sufficient time to dry the surface of the coating sufficiently so that the cohesiveness of the coating is such that further drying of the coating will not distort the coating.

The fundamental casting apparatus for carrying out this invention in the manner disclosed hereinafter is shown in FIGURE 1, wherein the numeral 10 generally designates the high speed apparatus for providing an ultra smooth coating C on a web of paper P.

The paper P may be rough kraft type paper, which is frequently used for making cartons for articles that may, for example, be placed on the usual retail grocery or drug shelf. This type of paper has a rough surface which does not present as an attractive a package as it could if the surface were smooth. To provide this smooth surface, the paper before entering the apparatus is coated in any conventional manner as by a wet roller and air knife, not shown, with the usual adhesive or mineral-adhesive containing aqueous coating. The mineral may be any of the fine particle type, such as calcium carbonate, clay, etc., while the adhesive may be selected from the group such as a protein, starch or a starch derivative, such as acetylated, oxidized, chlorinated, enzyme converted, corn or potato starch, rubber or acrylic latex and polyvinyl alcohol, thermosetting plastics, etc.

Conveying roller 12 conducts the paper P with the wet coating C to the nip of the dryer drum 14, which is heated to a temperature which may be as high as 275-325° F. by a convenient means, such as high pressure steam, within the drum. The drum 14 preferably has the usual 10-12 foot diameter and a highly polished chromium coated surface, which acts as a casting surface in the known manner, but also, it has been found that a machine finishing of the drum will permit the obtaining of a paper surface with a smooth coat.

Wrapped around the conveying roller 12 also is the vapor receiving void or backing layer 16 composed of any relatively thick (approximately 1/4 inch thick) layer, such as the continuous felt belt shown. The type of felt is that commercially used and known. For the purposes of this invention, any other smooth surface continuous belt-like layer may be used, and may be composed of wool, cotton, fiberglass or like closely knit, woven or pressed material. The drum 18 is a dryer roll for the felt, and increases the water removing capacity of the apparatus.

As is clearly shown in FIGURE 1, the layer 16 is urged against the drum 14 around a substantial portion of the circumference of the drum. By means of this feature of the invention, sufficient drying time is achieved. This wrapping which may be up to 270° around the drum, but generally at least 5° is accomplished by means of the adjustable tensioning roller 20 having suitable jack means, such as shown at 22. Due to the fact that the layer 16, when made of wool felt for instance, does not have sufficient tensile strength to withstand even the reduced pressures that can be used in this invention, a pressure means such as the flexible pressure belt 24 may be utilized. It should be understood, however, that if the vapor receiving layer 16 were strong enough to apply the needed pressure and also capable of absorbing the vapor from the coating, the flexible pressure belt 24 would not be necessary. The belt 24 may be made of any flexible material that is smooth, such as a rubber or plastic material, or even may be constructed of wire that may, for example, be of the woven type. The belts may also be porous or nonporous. However, the use of a porous pressure belt provides an unlimited void or vapor receiving volume, inasmuch as the vapor can pass out of the layer 16 through the pores or openings that exist in the porous belt.

As we have noted in our earlier application, the amount of void or vapor receiving volume necessary is dependent upon the amount of vapor generated by the wet coating,

and upon the type of coating. For instance, with a coating that sets quickly and sufficiently at the surface, so that its cohesiveness exceeds its adhesiveness of the dryer drum, the subsequent flashing of the remaining liquid in the coating or paper may not affect the smooth surface. In such an instance, there is no need for a large enough volume of void space to receive the additional vapor flashed from the coating after the initial drying, but only that which evolved while the coating passed through this initial drying.

In instances where a relatively low coat weight is used, for example,  $\frac{1}{2}$ –5 pounds per ream, as in the case of an unpigmented coating such as starch, there of course would be less need for as great a vapor receiving void in this low liquid containing wet coating, as in the case of a heavier pigmented coating having a weight range of 12–20 pounds per ream, which would normally contain a greater amount of liquid. Therefore, the layer 16 may be considerably thinner. It is also possible to omit the use of the layer 16 entirely, when the low weight coating is placed upon a porous bulky low density paper board having a density of up to about 10 pounds per ream per mil. In such a case, the void volume presented by the board behind the paper surface upon which the low weight coating is placed, can be sufficient to receive all the vapor evolved while the paper is pressurized against the dryer drum. The paper board behind the paper surface, therefore, acts as the equivalent of the backing layer 16, to absorb the relatively small amount of liquid vaporized from the wet coating. It is emphasized that the omission of the layer 16 is only permitted during the practice of this invention when (1) the coating is unpigmented, (2) of a solids coating weight less than 5 pounds per ream applied at not less than 20 percent solids, (3) placed upon a paper board having a density of up to about 10 pounds per ream per mil, and a minimum thickness of 5 mils.

As best shown in FIGURE 1, there is provided at the nip N a pressure roller 26, which has pressure adjusting means 28 which is similar to means 22 on roller 20. The purpose of roller 26 is to form an accurately defined nip, wherein the coated paper enters the nip tangential to the dryer drum surface. The pressure need not be in excess of the pressure applied by the pressure belt 24 throughout its wrap around the drum 14.

In FIGURE 3, there is shown the usual practice of the invention, in which the paper P has a coating C backed up by a vapor receiving void or layer 16, all of which are continuously pressed by the pressure belt 24 against the dryer drum 14, heated up as high as 325° F. As previously stated, the pressure need only be sufficient to overcome the resistance of the passage of the vapor through the coating of the paper and into the layer 16.

Instead of using the pressure belt 24, as shown in FIGURE 1, the necessary pressure may be applied as shown in FIGURE 2 by means of a soft rubber roller 30 rotating about an axis 32. The roller must be soft enough to cover a substantial area of the dryer drum, considerably in excess of the contact that would be provided with the normally used pressure roller. Such a roller can be inflated with air and pressed against the drum to achieve the desired pressure. In order to maintain the pressure of the coating against the drum for sufficient time to dry the coating, and yet retain the desired production rate, less pressure can be used to inflate the roller 30. Thus, there will be a greater pressured wrap of the paper around the drum.

By utilization of the foregoing methods and apparatus, speeds of production as high as 400 feet per minute have been reached on only a 6 foot diameter dryer and a satisfactory product obtained. With a larger drum diameter, considerably higher speeds are possible.

The wrapping of the pressure means about the dryer drum, as stated, is to afford sufficient drying time for the coated paper between the pressure means and the drum.

It should be clear that if a smaller drum than the usual 10–12 feet diameter drum is used, a greater wrapping in terms of degrees of wrap must be accomplished to achieve the necessary pressurized drying. Conversely, if a larger drum is used, less degrees of wrapping are necessary.

In the practice of one embodiment of the present invention, a paper web 40 is given a primary coating by suitable coating means such as that shown in FIGURE 4 which comprises the rollers 41 and 42 in contact with the source of coating material 43 in container means 44. The wet primary coated paper web 40 is then fed over conveying means 45 in the casting unit A which comprises the heated dryer drum 46 in combination with the pressure belt means 47 which is kept under tension by tensioning means 48 whereby the paper web 40 is pressed against the dryer drum 46 so as to dry or cast the primary coating on the web 40. The tensioning means 48 acts in combination with the roller 49 which together with rollers 50, 51, 52 and 53 serve as the conveyance system for the web 40, the pressure belt 47, and vapor receiving means 54. The vapor receiving means 54 receives moisture driven out of the web coating material under the influence of heat and pressure. The conveying system for the vapor receiving means 54 further comprises the rollers 55 and 56, the latter generally being a heated roller to remove moisture from the vapor receiving means 54 picked up during its travel through the casting units A and B. The web 40 after passage through the casting unit A exits therefrom as the primary cast coated web 57. The coated web 57 is then given a secondary wet coating by appropriate coating means such as that shown in FIGURE 4 comprising the rollers 58 and 59 in contact with the coating material 60 contained in container means 61. The web 57 is then fed into the second casting unit B which is similar in detail to casting unit A. The secondary coating on the web 57 is cast upon the dryer drum 62 under the influence of temperature and pressure, pressure being applied by the pressure means 47. The dual layer cast coated web 63 is then fed to suitable windup means.

The features and advantages of the above dual pressure cast coating embodiment of this invention are numerous. For one, any cracks, distortions, or the like remaining in the coating on the web 40 leaving casting unit A are obviated by the application of the second layer in casting unit B. In the second place, production speeds may be even increased as compared to the use of a single unit, e.g. either unit A or unit B employed alone. Thus, production costs are significantly reduced. Thirdly, it has been found that less overall coating weight need be employed. This results in a substantial reduction in the cost of the exceptionally high quality product produced. Furthermore, it is possible to reduce the quantity of coating normally maintained in the entrance nip defined by the web and the dryer drum and under some conditions of operation, the puddle of coating in the nip may be eliminated entirely. As it is well known, it is common practice in the art in order to insure high quality coatings it is necessary to maintain a puddle at the entrance nip to reduce the likelihood of entrapment of air in the coating, which if occurs, results in the formation of pockets and other distortions in the surface of the cast coated paper. By virtue of the dual coating process described above, such air entrapment, especially in the first entrance nip, is less of a problem because the second coating operation results in a smoothing out of the final coating. Moreover, the above dual coating operation can be applied to the coating of exceptionally long lengths and widths of paper web without the anticipation of intermittent shutting down of coating operation to rectify previously encountered difficulties in operation, e.g. such as maintenance of the proper consistency of the coating material maintained at the entrance nip. Therefore, it can be seen that this embodiment provides a high speed, low cost, pressure-cast coating operation which can be operated for long periods of time while producing a

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coated paper of exceptionally fine properties and characteristics, e.g. exceptionally high surface gloss, smoothness, and the like.

The following examples illustrate the dual coating embodiment of the present invention, and are not to be considered as limiting the scope of the invention. In the following runs an apparatus arrangement as depicted in FIGURE 4 is employed.

*Examples*

(1)

## Base stock—

1 sheet of uncalendered board, density 7 lbs./ream/  
mil, weight 126 lbs./ream  
18 mil thickness  
60% kraft, 40% groundwood.

## Total coating—

20 lbs./ream, composed of 100 parts clay,  
18 parts protein and water to make 55% solids.

Primary coating weight—15 lbs./ream.

Secondary coating weight (top layer)—5 lbs./ream.

Dryer temperatures—300° F.

Belt pressure—33 p.s.i. applied continuously over entire sheet.

Felt thickness— $\frac{1}{4}$  inch.

Dryer surfaces—chrome plated mirror finish.

Results: Paper has ultra smooth finish and high gloss characteristic of cast coatings.

(2)

## Base Stock—

1 sheet of uncalendered board, density 7 lbs./ream/  
mil, weight 126 lbs./ream  
18 mil thickness  
60% kraft, 40% groundwood.

## Total coating—

18 lbs./ream, composed of 100 parts clay,  
18 parts protein and water to make 55% solids.

Primary coating weight—15 lbs./ream.

Secondary coating weight (top layer)—3 lbs./ream.

Dryer temperatures—300° F.

Belt pressure—33 p.s.i. applied continuously over entire sheet.

Felt thickness— $\frac{1}{4}$  inch.

Dryer surfaces—chrome plated mirror finish.

Results—paper has ultra smooth finish and high gloss characteristic of cast coatings.

(3)

## Base stock—

1 sheet of uncalendered board, density 7 lbs./ream/  
mil, weight 126 lbs./ream  
18 mil thickness  
60% kraft, 40% groundwood.

## Total coating—

18 lbs./ream, composed of 100 parts clay,  
18 parts protein and water to make 55% solids.

Primary coating weight—12 lbs./ream.

Secondary coating weight (top layer)—6 lbs./ream.

Dryer temperatures—300° F.

Belt pressure—33 p.s.i. applied continuously over entire sheet.

Felt thickness— $\frac{1}{4}$  inch.

Dryer surfaces—chrome plated mirror finish.

Results: Paper has ultra smooth finish and high gloss characteristic of cast coatings.

(4)

## Base stock—

1 sheet of uncalendered board, density 7 lbs./ream/  
mil, weight 126 lbs./ream  
18 mil thickness  
60% kraft, 40% groundwood.

## Total coating—

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20 lbs./ream, composed of 100 parts clay,  
18 parts protein and water to make 55% solids.

Primary coating weight—15 lbs./ream.

Secondary coating weight (top layer)—5 lbs./ream.

5 Dryer temperatures—350° F.

Belt pressure—60 p.s.i. applied continuously over entire sheet.

Felt thickness— $\frac{3}{8}$  inch.

Dryer surfaces—chrome plated mirror finish.

10 Results: Paper has ultra smooth finish and high gloss characteristic of cast coatings.

(5)

## Base stock—

1 sheet of uncalendered board, density 7 lbs./ream/  
mil, weight 126 lbs./ream  
18 mil thickness  
60% kraft, 40% groundwood.

## Total coating—20 lbs./ream

Primary: 100 parts clay, 18 parts protein and water  
to make 55% solids.

Secondary: oxidized starch in 20 percent solids  
aqueous solution.

Primary coating weight—15 lbs./ream.

Secondary coating weight—3 lbs./ream.

25 Dryer temperatures—350° F.

Belt pressure—60 p.s.i. applied continuously over entire sheet.

Felt thickness— $\frac{3}{8}$  inch.

30 Dryer surfaces—chrome plated mirror finish.

Results: Paper has ultra smooth finish and high gloss characteristic of cast coatings.

(6)

## Base stock—

1 sheet uncalendered board, density 7 lbs./ream/  
mil  
weight 200 lbs./ream  
28 mil thickness  
60% kraft, 40% groundwood,

## 40 Total coating—

2 lbs./ream, oxidized starch from 20% solids  
aqueous solution.

Primary coating weight—1 lb./ream.

Secondary coating weight—1 lb./ream.

45 Dryer temperatures—300° F.

Belt pressure—33 p.s.i., applied continuously over entire sheet.

Felt—none.

50 Dryer surfaces—chrome plated mirror finish.

Results: Paper has ultra smooth finish and high gloss characteristic of cast coatings.

(7)

55 Base stock—calendered board, density 11 lbs./ream/mil,  
weight 250 lbs./ream, 23 mil thickness, 100% kraft.  
Total coating—20 lbs./ream, solids composed of 100 parts  
clay, 12 parts protein and 6 parts latex (butadiene-  
styrene) and water to make 55% solids.

Primary coating weight—17 lbs./ream.

Secondary coating weight—3 lbs./ream.

Dryer temperatures—300° F.

Belt pressure—33 p.s.i., applied continuously over entire sheet.

Felt thickness— $\frac{1}{4}$  inch.

65 Dryer surfaces—chrome plated mirror finish.

Results: Paper has ultra smooth finish and high gloss characteristic of cast coatings.

(8)

70 Base stock—uncalendered board, density 7 lbs./ream/  
mil, weight 126 lbs./ream, 18 mil thickness, 60% kraft,  
40% groundwood.

Total coating—3 lbs./ream oxidized starch from 20%  
solids aqueous solution.

75 Primary coating weight—2 lbs./ream.

Secondary coating weight—1 lb./ream.

Dryer temperatures—260° F.

Belt pressure—18 p.s.i., applied continuously over entire sheet.

Speed—400 ft./min.

Wrap—90° on 6 ft. diameter dryer drums.

Dryer surfaces—chrome plated.

Felt thickness—¼ inch.

Results: Paper has ultra smooth finish and high gloss characteristic of cast coatings.

Another run with a board of density 10 lbs./ream/mil is made under identical conditions as Example 8, with satisfactory results. This would seem to substantiate the position that for the lower density board used in Example 8, a higher temperature or lower pressure is possible if the felt were retained, or the felt could be eliminated entirely, because the less dense board would have sufficient void space to receive the released vapor.

As used herein, the term "ream" refers to 500 sheets of paper, each sheet being 24 inches by 36 inches.

Another embodiment of the present invention is that as depicted in FIGURE 5. A base paper web 70 is conveyed over rollers means 71 and 72 to the casting unit comprising the drum 73. A second paper web 74 which is a thinner and higher quality web than the base web 70 receives the coating material by suitable means such as that depicted in FIGURE 5 wherein the web 74 is conveyed into contact with the coating material 75 by the rollers 76, 77, 78, and 79. After being coated with the coating material 75 as contained in container 80, the coating thickness is adjusted by virtue of the air knife doctor 81 whereafter the wet coated web 82 is conveyed over the roller means 79 into the casting unit. In this embodiment, the base web 70 can be an inexpensive coarse-off-white board whereas the web 74 is a very thin white web. The web 74 should be white to the degree of whiteness desired in the final product inasmuch as only a very thin layer of coating material need be employed to produce a very white high gloss cast coated paper. In other words, the whiteness of the final product will be mainly influenced by the extent of whiteness of the web 74 where a thin coating is employed, this arrangement being preferred since it offers a cost advantage.

The wet coated web 82 is fed into the casting unit comprising the heated dryer drum 73 in combination with the pressure belt-felt means 83 and 84. The casting unit depicted in FIGURE 5 is similar in construction and operation to that of FIGURE 1 or can be constructed as illustrated in FIGURE 2. The wet coated web 82 and the base web 70 is connected together in the course of casting the coating on the web 82 by virtue of a portion of the adhesive in the coating 75 flowing through the web 74 and into contact with the base web 70. This simultaneous gluing and casting of the coating is accomplished by the pressure applied by the belt member 84 which is arranged relative to the dryer drum 73 so as to cause the web undergoing treatment to extend over a considerable portion of the circumferential surface of the dryer drum 73. This is accomplished by virtue of the positions of the rollers 85 and 86 which together with roller 87 constitute the conveying system of the belt 83. Tensioning means 88 in combination with the roller 86 is provided whereby the desired amount of pressure to be applied to the paper web undergoing treatment is effected.

The pressure roller 89 is provided at the entrance nip in combination with its adjusting means 90 so as to form an accurately defined nip wherein the coated paper enters the nip tangential to the dryer drum surface. The pressure applied by the roller 89 need not be in excess of the pressure applied by the pressure belt 83 throughout its wrap around the drum 73.

The vapor receiving void or backing layer 84, which is preferably constructed of papermaker's felt, serves the same function as its counterpart illustrated in FIGURE 1. As depicted in FIGURE 5, the vapor receiving means 84

can be conveyed over a dryer drum 91 to remove moisture picked up during the casting operation. After casting, the composite cast coated paper web 92 is taken off the dryer drum 73 over the roller means 93 and conveyed to windup.

Among the advantages and features of this embodiment (FIGURE 5) is that savings in the cost of the base stock are realized since a coarse or off-white base stock can be employed because the intermediate white layer web provides a masking effect. Moreover, the brightness of the cast coating is essentially a function of the second layer which allows the use of a very thin low strength, but of high whiteness, paper web whereby less coating material or coating weight need be employed. This results in a savings in the cost of cast coating since a considerable portion of such cost is attributed to the cost of the coating formulation itself. In this manner, the brightness of the final product being largely a function of that of the intermediate paper web, a greater degree of color control is made possible. In conducting the present embodiment there is no need for a separate cementing step for bonding the web 74 to the base web 70 since this is accomplished in the casting operation. It has also been found that the puddle of coating material normally maintained at the entrance nip can be reduced and in some cases entirely eliminated, while still obtaining a very suitable product. Furthermore, if desired, dual casting units such as that illustrated in FIGURE 4 and discussed supra may be utilized in conducting the instant embodiment to achieve even more advantages.

Therefore, it can be seen that this embodiment also provides a high speed, low cost, pressure-cast coating operation which can be operated for long periods of time while producing a coated paper of exceptionally fine properties and characteristics, e.g., exceptionally high surface gloss, smoothness, and the like.

The following runs illustrate the improved method of operating by way of the apparatus depicted in FIGURE 5. The dryer drum 73 has a chrome plated mirror finish and is heated to 300° F. The member 84 is constructed of ¼ inch thick papermaker's felt. The pressure belt member 83 is adjusted so as to exert a pressure of 33 p.s.i. on the paper web undergoing treatment. The base web 70 is an uncalendered board having a density of 7 lbs./ream/mil and a thickness of 18 mils and consists of 60% kraft and 40% groundwood. The web 74 is a calendered board having a density of 11 lbs./ream/mil with a thickness of 5 mils and manufactured from 100% kraft. The coating comprises 100 parts of clay, 12 parts protein, 50 parts latex (butadiene-styrene) and sufficient water to make a 55% solids solution by weight. Operating under these conditions and applying a coating weight of 16 lbs./ream produces an exceptionally white smooth finished high gloss cast coated paper at production rates higher than obtainable when casting a single paper web under the same conditions.

Employing the above procedure, except that the dryer drum 73 is heated to 350° F. and a belt pressure of 60 p.s.i. is employed, produces similar results.

When the above procedure is again conducted except that oxidized starch from a 20% solids aqueous solution is utilized to produce a coating weight of 1.5 lbs./ream, a very smooth finished and high gloss cast coated paper is produced at production rates greater than that realized when coating a single web under similar conditions.

From the foregoing detailed description, it will be evident that there are a number of changes, adaptations, and modifications of the present invention which come within the province of those skilled in the art. However, it is intended that all such variations not departing from the spirit of the invention, be considered as within the scope thereof as limited solely by the appended claims.

We claim:

1. A process for cast coating paper and the like comprising in combination,

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- a. coating one surface of a substantially dry first paper web with a hardenable liquid coating containing a volatile liquid and an adhesive which coating is conformable to a smooth forming surface,
  - b. passing the uncoated surface of said first paper web into contact with a substantially dry second paper web to form a composite paper web having an exterior coating and no interior adhesive,
  - c. compressing said composite paper web by means of a continuous pressing surface against a heated smooth forming surface with said exterior coated surface against said heated smooth forming surface, said heated smooth forming surface being heated to a temperature sufficient to boil said volatile liquid and said compressing being at sufficient pressure to continuously maintain said coating against said heated smooth forming surface,
  - d. maintaining a vapor receiving web between the exterior surface of said second paper web of said composite paper web and said pressing surface, and
  - e. continuously maintaining the heating and compressing for a period of time to vaporize and remove sufficient volatile liquid from the surface of the coating to cause the cohesive strength of the coating to resist any distortion due to further drying and to adhere the first paper web to said second paper web.
2. The process of claim 1 further characterized by said hardenable liquid coating being pigmented.
  3. The process of claim 1 further characterized by said first paper web being a substantially thin high quality

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paper and said second paper web being a substantially coarse low quality paper web.

4. The process of claim 1 further characterized by said sufficient pressure being from about 33 p.s.i. to about 65 p.s.i.

5. The process of claim 1 further characterized by said temperature being from about 250° F. to about 400° F.

6. The process of claim 1 further characterized by said first paper web being a calendered board having a density of from about 9 to about 13 lbs./ream/mil and a thickness of from about 3 to about 7 mils and said second paper web being an uncalendered paperboard having a density of from about 5 to about 9 lbs./ream/mil and a thickness of from about 15 to about 20 mils.

7. The process of claim 1 further characterized by said hardenable liquid coating being applied in a coating weight of from about 1.0 to about 20 lbs./ream.

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MURRAY KATZ, *Primary Examiner.*

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,307,993

March 7, 1967

Bruce C. Gottwald et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, line 4, for "Bruce C. Gottwald and John M. Haigh, Richmond, Va.," read -- Bruce C. Gottwald, Richmond, Va., and John M. Haigh, Magnolia Mass., --; column 2, lines 8 and 9, strike out "In order pressure roller at the nip in the prior constructions."; column 9, line 50, for "connected" read -- cemented --.

Signed and sealed this 7th day of November 1967.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

EDWARD J. BRENNER  
Commissioner of Patents