The present invention relates to the cast coating of cellulosic paper webs and more particularly to a process involving the simultaneous laminating of separate paper webs and the cast coating thereof. The manufacture of cellulosic paper webs having a cast coating, i.e., one in which the surface is a replica of a finishing surface such as a polished chromium drum, is described in U.S. Patent 1,719,166. The so-called "cast coated" products thus obtained have found a unique use in a variety of applications owing to their characteristic of outstanding high gloss finish and to the excellent resolution afforded by all types of conventional printing processes.

Although in fulfillment of the needs for these many applications, cast coated papers have been commercially manufactured in a broad range of basis weights, there has been particular difficulty in economically manufacturing a suitable quality cast coated paper from the heavier basis weight or higher caliper stocks. Such products, ideally employed for a variety of packaging uses such as folding boxes and cartons, have heretofore been inordinately expensive because of the comparatively low operating speeds associated with their manufacture. These speeds have previously been regarded as necessary with such heavy stocks in order to minimize the formation of curl and provide the characteristic of a flat and level cast surface. Although a number of techniques have been suggested, often satisfactorily employed, for increasing the speed of the cast coating process, in general these have not been wholly satisfactory for the manufacture of the basis weight cast coated products. In this regard the techniques of U.S. Patent 2,360,919 to Warner involving the application of water to the uncoated side of the sheet during the casting surface to increase speed and reduce curl is less well adapted to heavy weight stocks which are more slowly penetrated by the applied water.

For many applications, paper sheet materials with a cast surface have been obtained by merely laminating a light weight cast coated paper, for example a litho grade, to a heavier basis weight sheet. This method has not, however, been fully satisfactory from the standpoint of either the economics, an extra converting operation being required, or the product acceptability, any irregularities in the heavier sheet being pressed into the cast coated sheet with resultant losses in flatness. Furthermore a considerable amount of care has been required to prevent the adhesive vehicle from striking through the paper web and impairing the finish of the cast surface.

In accordance with this invention, it has been found that the problems heretofore encountered with the manufacture of heavy weight cast coated stocks can be successfully overcome by a procedure involving the simultaneous lamination of two separate plies of cellulosic paper webs while providing one of the exposed surfaces of the plies with a cast coating.

More particularly, according to the invention cast coated stocks of relatively heavy basis weight are manufactured by the lamination of two moving plies of paper by means of an intermediate layer of aqueous based bonding composition containing a tacky adhesive. Before substantial evaporation of water from the angle of contact with the coating and to thereby control the amount of bonding composition so applied. The nature of coater 25 is not critical, rather it may be any and finely divided mineral pigment. The laminated and coated sheet material is dried against a finished casting surface and finally stripped from that surface.

The foregoing process is particularly advantageous for the manufacture of cast coated stocks of a comparatively heavy basis weight, e.g., those having a caliper of 0.014 inch or more. For this purpose a number of significant advantages can be obtained from the standpoint of product improvement, process simplification and versatility, and economics.

Thus according to the invention, several advantages accrue from the regulation of the process such that a significant amount of water in the bonding composition is not evaporated prior to contacting the casting surface. In the first place the water within the substrate serves to internally plasticize and soften the combined webs such that a greater degree of conformity to the finishing surface is facilitated without the need for excessive compression which would reduce the caliper. Since of conformity, and the resulting high degree of flatness and levelness of the product, would not be readily obtained in the absence of the plasticizing effect, whether the substrate was a single ply or double ply.

Secondly, the presence of water within the substrate actually serves to assist in volatilizing the water of the coating composition while in contact with the casting finishing surface such that increases in operating speed can be obtained. In this regard, as well as from the standpoint of reduced curl, the process accomplishes much the same beneficial results as the technique of the aforementioned Warner patent which is less suitable for the manufacture of heavier basis weight cast coated stocks.

The process of the invention affords still other significant advantages. Thus it normally requires considerably less of the cast coating composition to achieve a flat and level surface in comparison with that which would be required with a substrate comprising a single ply of greater thickness, i.e., increases in surface irregularities of a web can be expected as the caliper increases and these must be filled in to give a true cast surface. Even aside from the economic benefits thereof afforded, the resultant product is thus characterized by a reduced tendency for the coating to fracture upon folding. As a further benefit of reducing the coating thickness, the tendency of the product to curl, normally toward the coated side in proportion to amount of coating, is decreased.

Of significant practical value, the process of the invention affords wide versatility with respect to the utilization of available paper manufacturing equipment in order to provide a cast coated product of the desired caliper. Thus a manufacturer not possessing a cylinder or other paper machine capable of producing the heavier basis weight stocks can conveniently laminate two lighter weight stocks without the need for a separate operation. Indeed there would be no obstacle to the lamination and coating of three or more webs by the instant process although the complexities of the unwind system would ordinarily make this unattractive for most purposes.

The invention will be further described with reference to the drawings.

Two moving webs of paper 18 and 23 are separately unwound from rolls 15 and 20 respectively. Although it will be apparent that various arrangements and modifications can be utilized to provide a layer of aqueous bonding composition between the webs in parallel superimposed relationship, the apparatus as illustrated employs coater 25 to apply such a layer to web 18. For this purpose guide rolls 21 are approximately positioned to adjust the angle of contact with the coater and to thereby control the amount of bonding composition so applied. The nature of coater 25 is not critical, rather it may be any
of the well known roll coaters, knife coaters and the like. As shown, the coater simply comprises a rotating roll 28 diametrally bonded to and driven by a hollow roll 24 containing bonding composition 26, with a doctor rod 27 to smooth the layer of bonding composition and remove any excess.

Following the application of bonding composition containing tacky adhesive to a surface of one, or both if desired, of the running webs, the plies are at least superficially bonded to one another by a positive pressure exerted by the nip of rotating pressure rolls 35. Desirably these rolls will have a resilient exterior layer, e.g. rubber, in order to minimize compression of the sheets. As a result of the partial bonding, virtually no separation or slippage of the plies will be encountered throughout the remainder of the operation and hence any tendency toward blistering will be avoided.

After bonding of the plies in the foregoing manner, one of the two exposed faces thereof is provided with an aqueous coating comprising a mixture of paper coating adhesive and finely divided mineral pigment. In a preferred embodiment this coating is the same as the bonding composition 26; that is, the paper coating adhesive serves as the tacky laminating adhesive. In this way a single coating supply can be employed for both coaters and there is no problem if a small amount of the first applied coating is inadvertently carried over into the second coater. In addition, the tendency of the product to curl upon drying by virtue of differing compositions is at least partially minimized.

As hereinbefore indicated it is essential that the water of the bonding composition not be volatilized from the laminate before being pressed into contact with the casting finishing surface 55. Thus although the water will be in part absorbed by the adjacent plies of paper, it should be largely confined within the laminate in order to afford the operating advantages hereinbefore enumerated.

With regard to coater 45, this may be similar or different from coater 25. As shown it comprises a turning roll 48, doctor rod 47 and a suitable pan or trough 49 containing coating mixture 46. Guide roll 41, being adjustable in a vertical position, serves to regulate the quantity of coating applied to laminate. The laminate, bearing a freshly applied layer of coating, is then pressed by means of roll 56 into adherent contact with the heated casting drum 55. The latter should have a smooth hard finishing surface and for this reason polished chromium is preferred. Nickel and brass are other surfaces which also can be employed. Roll 66 facilitates stripping of the dried coated laminate from the casting drum and roll 68 is simply a windup reel.

The coating mixtures employed for producing the cast surface upon the laminate are aqueous dispersions of finely divided pigments together with a paper coating adhesive such as casein, soy protein, alpha protein, starch and the like. Such adhesives will normally be water soluble or water dispersible hydrophilic materials. The synthetic latexes of polymeric material such as styrene butadiene copolymers, polyvinyl acetate and copolymers of a predominate amount of vinyl acetate with other ethylenically unsaturated monomers can be employed as the sole adhesive or in combination with other adhesives. Examples of suitable mineral pigments include calcium carbonate, clay, titanium dioxide, zinc oxide, etc. The solids content of the coating will usually be in the range of 25–65% by weight although it may contain more or less depending upon the desired thickness of the coating on the laminate. Such thickness will ordinarily be at least 8 pounds, dry basis, per 3000 sq. ft. of surface. Usually it is desired to work within the range of 45–65% by weight solids content in order to give maximum coverage of the sheet. Various additives such as anti-foamers, dispersants, plasticizers, dyes, etc., may also be included in the coating compositions.

The bonding composition for the plies can be identical to the cast coating mixture if preferred, or may be of different composition so long as it contains a tacky adhesive. An aqueous dispersion of a vinyl acetate polymer without pigment or other adhesive is quite satisfactory. Desirably the bonding composition should have a total solids content of 25 to 65% by weight, contain at least 10% by weight of adhesive, and be applied to the extent of at least 4 pounds, wet basis, per 3300 square feet of surface in order to achieve a sufficient degree of bonding and attain the mentioned advantages resulting from the internal plasticization of the laminate with water.

The webs to be simultaneously laminated together and cast coated in accordance with the invention can be of a wide variety. Thus they can be bleached or unbleached stocks of paper, including paperboard, which have been coated, tubsized, or otherwise surface filled. The invention has particular application in the lamination of two, or more if desired, individual webs to form a combined laminate of comparatively heavy basis weight, i.e. a caliper of 0.014 inch or more. For this purpose the individual webs may be identical in terms of formation, composition and thickness or may differ somewhat depending upon the matter of their availability and the desired character of the resulting product.

In order to facilitate removal of the cast sheet from the casting drum it is desirable to maintain a monomolecular film of an oleaginous release agent on the surface of the drum as disclosed in the U.S. Reissue Patent No. 23,637 to Montgomery. The film of release agent can be formed by buffing the drum with the oleaginous material and by replenishment from the incorporation of a small amount of the agent directly in the aqueous pigment coated. The proteinaceous cast coatings employed in the aforesaid Montgomery patent are also suitable for use in the present invention.

Although the process has been especially described with reference to the attaining of a cast coated surface by the direct application to the laminate of coating followed by casting, it will be apparent that the variations and modifications known in the cast coating art can also be employed. For example, rather than coating the laminate and casting that against the drum, it is also possible to cast the drum and to press the laminate into contact with the at least partially dried coating layer upon the drum; this technique being described in U.S. Patent 2,029,273 to Montgomery. Similarly the use of gelled or plural coatings are also known expedients. As still another means of providing a cast surface, a layer of dried coating as contained on one of the exposed surfaces of the laminate may be remoistened with water alone, as by coater 45, and then pressed into contact with the casting drum as disclosed in British Patent 712,717. For that matter the intermediate layer of bonding adhesive can also be a previously dried coating which is simply remoistened with water, e.g. from coater 25 to thereby unite the plies.

The following examples are given to further illustrate the practice of this invention. Proportions of the materials are by weight, unless otherwise stated.

Example 1
(a) Employing the arrangement illustrated in the drawing, a laminate was formed of two separate moving webs of paper followed immediately by cast coating.

The cellulosic webs employed had each been formed of fully bleached, sulfite pulped fibers, were uncoated and had a caliper of 0.011 inch.

The same adhesive composition was used to effect both the lamination and cast coating steps. It was prepared of the following ingredients:

- 100 parts of finely divided clay
- 11 parts of casein
- 10 parts of a polymer from 40% by weight butadiene
and 60% by weight styrene in the form of a 50% total solids latex
0.1 part of formaldehyde, insolubilizing agent
0.1 part of monoethanol amine, cooking agent for the caseln
0.1 part of stearic acid, drum release agent made up with water to a total solids content of 53.0%, at which it had a pH of 7.0

The coating was applied by a roll and doctor blade coater to the underside of the top sheet of the two parallel moving webs to the extent of about 4 pounds, dry basis, per 3300 square feet of surface to form the laminate. The underside of the laminate was then coated with about 20 pounds, dry basis, per 3300 square feet with the same composition. The moving coated laminate was pressed into contact with a 12 foot diameter casting drum having a polished chromium finish and which had been internally heated to a temperature of 185° F. It was apparent from the operation that the presence of moisture within the laminate facilitated greater conformity to the casting than that which would be obtained with a single ply of equal thickness without such water being present. When the coating had dried, the resulting sheet material spontaneously released from the casting drum.

The caliper of the resulting sheet material was 0.0265 inch. It was characterized by the typical high gloss finish of cast coated papers. Moreover, it had a flat level appearance with only a very slight degree of curl, particularly considering the heavy basis weight. There was no observable tendency of the product to delaminate upon storage or use.

(b) The procedure of (a) was repeated with virtually identical results using paper webs having a caliper of 0.0135 inch. The caliper of the resulting product was 0.0290 inch.

Example II

The procedure of parts (a) and (b) of Example 1, were repeated except that an aqueous emulsion of poly-vinyl acetate having a total solids content of 40% was employed as the bonding composition for laminating the two webs. The properties of the products were nearly identical to those of Example 1 aside from a slightly greater tendency to curl.

Having described the invention, what is claimed is:

1. Method for the continuous production of cast coated stocks of heavy basis weight comprising the steps of: (a) laminating two moving piles of paper by means of an intermediate layer of aqueous based bonding composition containing a tacky adhesive, (b) before substantial evaporation of the water contained in the aqueous bonding composition, contacting an exposed surface on one of the plies with an aqueous based mixture of paper coating adhesive and finely divided mineral pigment, (c) before substantial evaporation of the water contained in the aqueous bonding and coating composition, and drying the thusly laminated and coated sheet material against a heated finishing casting surface, and (d) finally stripping the resultant sheet material from said casting surface.

2. The method of claim 1 wherein the said aqueous based bonding composition contains a paper coating adhesive and finely divided mineral pigment.

3. The method of claim 1 wherein the said aqueous based bonding composition is the same as said aqueous mixture.

4. The method of claim 1 wherein the tacky adhesive of the bonding composition is a polymer of vinyl acetate.

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EARL M. BERGERT, Primary Examiner.

J. J. BURNS, H. F. EPSTEIN, Assistant Examiners.