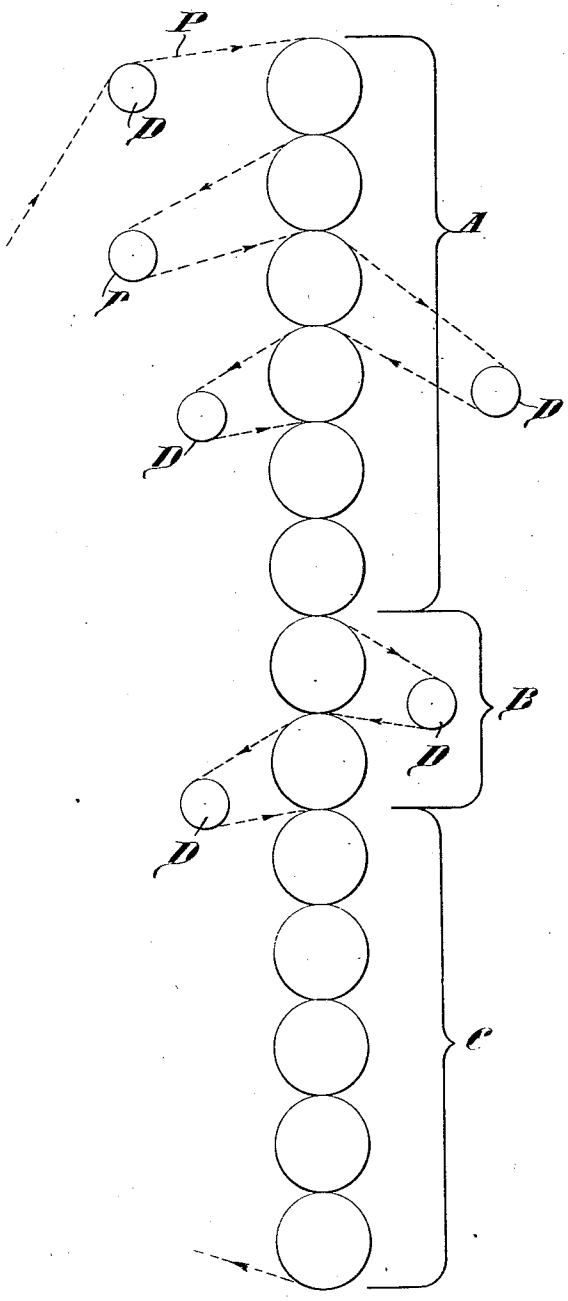
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MANUFACTURE OF TRANSPARENT PAPER

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UNITED STATES PATENT OFFICE

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MANUFACTURE OF TRANSPARENT PAPER

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My invention relates to the manufacture of transparent paper of the kind commonly used in window envelopes, and consists in improvements in calendering apparatus for treating and finishing such paper, and in the method to which this apparatus is contributory.

As heretofore manufactured, paper of the character designated has been made of a well-beaten and hydrated sulfite stock, which after formation into the paper web has been remoistened with water containing a modicum of glycerine, and then roll pressed and dried down to a proper residual content of water in a calender in which hard steel rolls alternated with soft rolls furnished with jackets of impregnated and compacted paper or cloth. This arrangement of the calender rolls produced a uniform compacting and smoothing effect which, however, in respect to condensation of the paper web necessarily fell short of that which would be effected by calendering between hard steel roll surfaces. On the other hand, the use of hard steel rolls alone I have found to be unsatisfactory for the reason that irregularities or departures from true cylindricity of the rolls and irregularities in the thickness of paper web make the paper spotty, or non-uniform both in surface finish and degree of transparency. Thus portions only of paper calendered between hard steel rolls possess a higher degree of transparency than the entire area of similar paper after passage through a calender in which the hard and soft rolls alternate.

By means of the calendering apparatus herein to be described and of the method of treatment performed thereby, one is enabled to secure the higher transparency in the paper product due to condensation of the paper web between the surfaces of the hard rolls and nevertheless to eliminate the defect of non-uniformity in transparency and surface texture.

The drawing hereto annexed illustrates diagrammatically the roll arrangement in a calender. Reference to this drawing or diagram shows a series of calender rolls, represented by circles, in their usual superposed relation. The frame, driving mechanism, etc. are not shown; the lowermost roll, as is usual, is the power driven roll, and the other rolls of this vertical series are frictionally driven in succession from the bottom roll. Beginning at the top of the series, the first set, A, comprising say 5 or 6 rolls, consists of hard steel rolls only; the lower set, C, also comprising 5 or 6, consists only of hard steel rolls; the rolls B intermediate between these top and bottom sets are soft rolls such as represented by metal rolls jacketed with impregnated or indurated paper or cloth. These soft rolls B constitute a set of at least two, and preferably three, soft rolls.

The hard steel faced rolls are provided with means for internal heating as usual, for the purpose of progressively drying the paper as it passes from the top to the bottom of the calender.

My improved method of transparentizing paper is as follows. The paper web indicated by P on the accompanying drawing, after having been initially dried, is moistened with water containing preferably not more than 8% of glycerine, (for which a glycol, mannitol, or the like may be substituted as an an equivalent) the moisture content of the paper being brought to about 30% water on the dried paper weight. This paper enters the calender at the top, passing in succession between the hard steel surfaces of the upper set, A, of hard rolls. This treatment between hard unyielding surfaces condenses the body of the paper web, smooths it and enhances its transperency, but inevitably, for the reasons above indicated, the densely compacted areas do not extend over the entire paper web, irregularly distributed portions of the paper web have escaped the full effect of condensation and smoothing, and were the paper to be withdrawn in this condition its physical irregularities would be too apparent. This defective condition is corrected by the operation of the midway series of soft rolls B between which the paper web passes after leaving the upper set of hard rolls. The deformability of the superficial portions of the soft rolls enables them to reach with effective compression and smoothing action the hitherto untreated or partially

treated spots on the paper, and effects thereon a condensation which approaches in degree to that of the hard roll condensed areas with sufficiently close approximattion as to produce in the paper web as a whole the appearance of substantial uniformity. The heat applied to the upper set of hard surface rolls should be so regulated with regard to the rate of travel of the paper that when the web arrives at the set of soft rolls, it will have retained a moisture content sufficiently large to prevent injury to the web by the soft rolls which grip the web a little more firmly than the hard rolls. This protective water content should be of the order of 10% to 12% on dried paper weight. This has been found effective to guard against injury to the web by reason of the slight differential slip between the frictionally driven rolls. When the soft roll treatment of the paper is completed, it is necessary to carry the extraction of water by drying to that minimum percentage which is essential to preserve proper mechanical strength in the finished paper product. This final extraction of moisture must be accompanied by continued roll pressure, otherwise the paper is liable to cockle and be injured in quality by the formation of voids on the evaporation of water. I conduct the paper web therefore from the set of soft rolls through the lower set C of hard rolls, which are so heated that when the paper is delivered from the calender it will contain about 6% or 7% of water. This water content conserves the strength of the paper, which is quite tough enough to be safely manipulated in folding and wrapping machine. For the purpose of more nicely regulating the progressive drying of the paper, fly rolls such as indicated at D, D may be employed, over which the paper is led from and then back to the calender rolls. These fly rolls, provided with means for internal heating, may have their temperatures varied, and adjusted to fluctuating external atmospheric conditions, and one or more of such fly rolls can be employed, as occasion demands.

While it is technically possible to obtain the desired result by the use of water alone to moisten the paper before it passes into the calender, it is difficult so to do because of variations in conditions both in and surrounding the calender apparatus; the modicum of glycerine or its equivalent in the moistening water serves to control evaporation so as to insure the proper content of moisture, both at the soft rolls and at delivery of the paper from the calender.

Paper treated in the mode above described is uniform in superficial appearance, and possesses transparency to higher degree than paper of the same character as manufactured heretofore, this by reason of the superior condensation of the web over the major part of its area under the action of hard roll pressure simultaneously on both sides of the sheet.

I claim:

1. Method of enhancing transparency of paper, characterized by subjecting the paper while moist, to hard roll compression, meanwhile reducing the moisture content, then to soft roll compression while the paper still contains enough moisture to prevent injury between soft rolls, then subjecting the paper again to hard roll pressure while reducing its moisture content to the percentage requisite to maintain paper strength.

2. Method of enhancing transparency of paper, characterized by subjecting the paper, with an initial moisture content of about 30% on the dry paper weight, to hard roll compression, meanwhile reducing the moisture content, then to soft roll compression while the paper retains a moisture content of the order of 12%, then subjecting the paper again to hard roll pressure while reducing its moisture content to a residue of the order of 6%.

3. Calender for transparentizing paper, comprising a series of pressure rolls, the first part and last part of the series consisting respectively of a plurality of adjacent, contacting hard rolls, rolls forming an intermediate part of the series being soft rolls.

4. Calender for transparentizing paper, comprising a series of pressure rolls, the first part and last part of the series consisting respectively of a plurality of adjacent, contacting hard rolls, rolls forming an intermediate part of the series being soft rolls, the hard rolls provided with internal heating means.

5. Calender for transpartentizing paper, comprising a series of pressure rolls, each frictionally driven by the next in series, the first part and last part of the series being hard rolls, rolls forming an intermediate part of the series consisting respectively of a plurality of adjacent soft rolls, the hard rolls provided with internal heating means.

6. Calender for transparentizing paper, comprising a series of pressure rolls, those of the first part and last part of the series being hard rolls, rolls forming an intermediate part of the series being soft rolls, and fly-rolls provided with internal heating means.

7. Calender for transparentizing paper, comprising a series of pressure rolls, each frictionally driven by the next in series those of the first part and last part of the series being hard rolls, rolls forming an intermediate part of the series being soft rolls, and fly-rolls provided with internal heating means.

8. Calender for transparentizing paper, comprising a series of pressure rolls, those of the first part and last part of the series being hard rolls, rolls forming an intermediate part of the series being soft rolls the hard rolls provided with internal heating means,

and fly-rolls provided with internal heating means.

9. Calender for transparentizing paper, comprising a series of pressure rolls, each frictionally driven by the next in series those of the first part and last part of the series being hard rolls, rolls forming an intermediate part of the series being soft rolls, the hard rolls provided with internal heating means, and fly-rolls provided with internal heating means.

Signed by me at Cumberland Mills, Maine, this 23rd day of May, 1930.

SYLVESTER BOYER.