

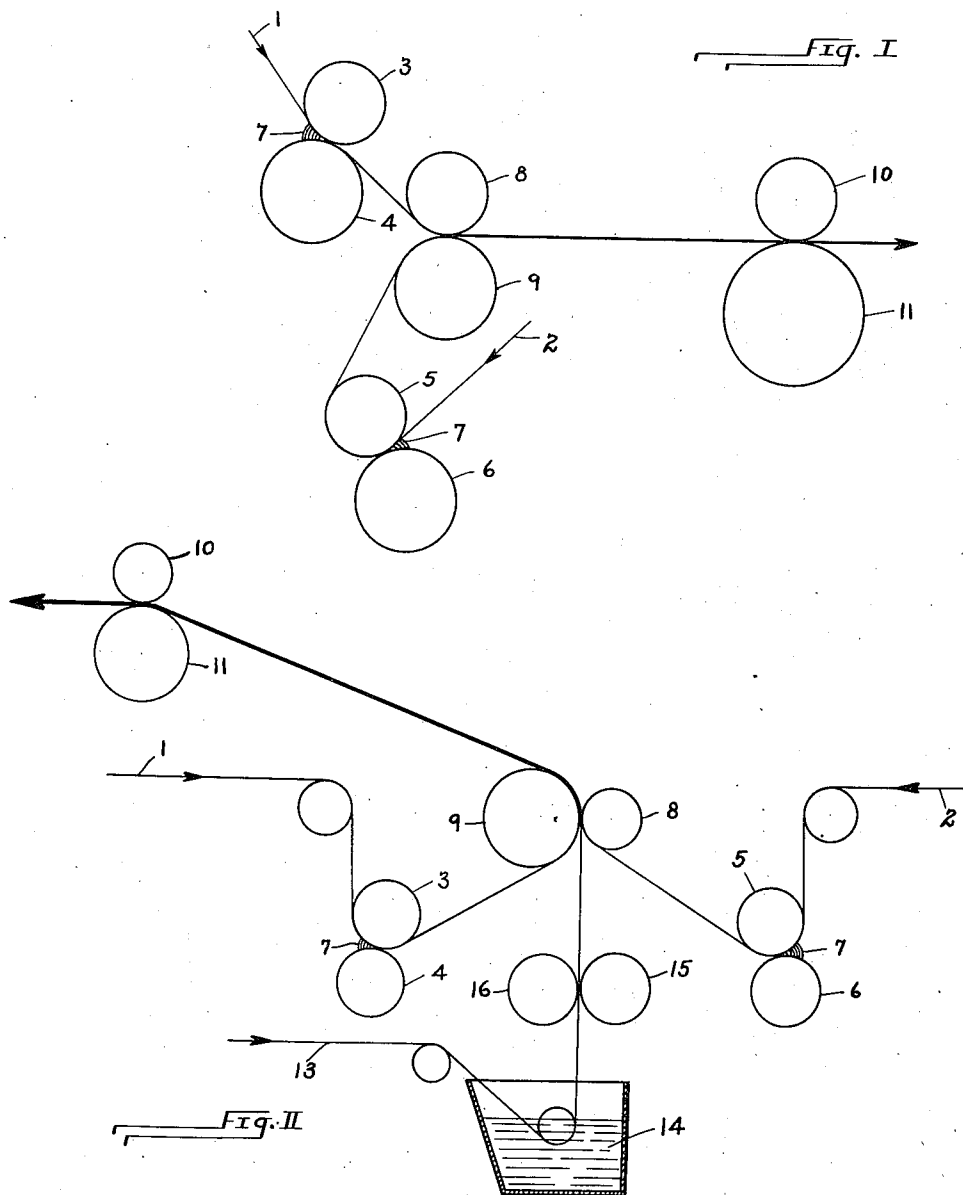
Feb. 18, 1936.

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2,031,035

METHOD OF MAKING MOISTUREPROOF PAPERBOARD AND THE LIKE

Filed Oct. 11, 1933



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UNITED STATES PATENT OFFICE

2,031,035

METHOD OF MAKING MOISTUREPROOF
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Application October 11, 1933, Serial No. 693,110

3 Claims. (Cl. 154-40)

This invention relates to the art of making cardboard, paper board, and the like, and is found in a method whereby sheets of such material may be produced that are impervious to moisture laden air in higher degree than can otherwise be attained.

The accompanying drawing is diagrammatic and it serves to show in side elevation the instrumentalities by which the method is performed. Fig. I shows apparatus in the use of which the method is performed more simply; Fig. II shows apparatus for performing the method with refinement in detail.

It is common practice to make multiple-ply paper and cardboard by facing two component sheets with thermoplastic adhesive in liquid state and bringing the coated sheets together, coated face to coated face, under pressure; and, in the practice of this invention, the procedure so generally characterized is followed. The invention, however, is based on the perception that in particular circumstances or conditions of operation the causes and reasons, why the procedure as commonly pursued is relatively ineffective to produce an article that is truly resistant to moisture-laden air; and consists in such departure from and such addition to the usual procedure, in respect to details, as to afford the desired superior product.

I have perceived that the effectiveness of the adhesive as a screen and dam, preventive of the passage of moisture-laden air, is in the usual practice seriously reduced and impaired by its penetration into and its impregnation of the substance of the sheet of board or paper to which it has been applied. For, proportionately as it disseminates into the interstices of the fibre, it tends to lose continuity, and minute gaps or pinholes or pores tend to open through the impregnated surface or surfaces; and I have further perceived of the usual practice that, in consequence of the pressure applied to unite the plies, plastic adhesive is squeezed out from between the progressively meeting surfaces; and, consequently, the remaining material is not sufficiently effective as a preventive of moisture penetration.

The first feature of the method of my invention is that the uniting of the plies is a two-step procedure, instead of the usual one-step procedure. Referring to Fig. I of the drawing, two plies of paper or thin cardboard 1 and 2 (one may, for example, be a ply of paper, and the other of board) are between rolls 3, 4 and 5, 6 coated with a thermoplastic substance 7. The coating is thus applied certainly to one, and preferably

to both, of the plies. The two plies, after coating, are brought together, with coated surfaces in contact, between a pair of rolls, 8, 9. The pass between the rolls 8, 9 is of such width as to bring the coated plies together along a progressive line of contact, without appreciable compression. A second pair of rolls 10, 11 is provided spaced at an interval from the pair 8, 9, and between this second pair of rolls the united plies come after they have advanced through the intervening interval. The pass between rolls 10, 11 is of less width than that between rolls 8, 9, and is of such width as to compress the advancing material and consolidate it into the finished product.

The adhesive that I employ may be one of the moisture-proof adhesives commonly employed for such purpose. It is, in my practical procedure, a resin-containing adhesive. Adhesiveness is, to be sure, its characteristic; but, primarily, and essentially—with the success I contemplate in view—it must be a substance adequate to afford a dam, a practically impervious wall, against penetration by moisture. The material that I employ may, typically, be a resin modified by a paraffin, in a compound that, after liquefaction by heat, stiffens at 65° to 80° C.

The paper or pressboard as it advances between rolls 3, 4 and 5, 6 is at room temperature; such an adhesive as I have indicated may be applied when at a temperature of 110° C.; the adhesive 7 is in the roll-passes 3-4 and 5-6 spread upon the paper or pressboard in a coating or coatings that are heavier than such coatings ordinarily are. In consequence of contact with the relatively cold paper and in consequence of the heaviness of the coating, the adhesive, though it gains firm anchorage, is not completely absorbed in the porous substance, but continues as an uninterrupted film upon the surface of the supporting web of paper or board. In the roll-pass 8-9 the surface of the film or films is still relatively hot and fluid; and in this pass the parts of the ultimate product are integrated. Particularly when both plies bear coating films of the adhesive, the two films merge in roll-pass 8-9 in a single intercalated film. The coating films are, on their meeting faces relatively hot and fluid, and between these rolls 8, 9 the films meet along a progressive line of contact and merge.

The second pair of rolls 10, 11 is spaced at an interval of a few feet (an interval related obviously to the speed of operation) from rolls 8, 9—an interval sufficient to allow the radiation of heat to bring the combined film of adhesive between the plies to approximate the temperature

of stiffening. Under the pressure exerted by rolls 10 and 11 the now semi-hardened adhesive will not be squeezed out from between the piles, but the multiple-ply article will be compressed and consolidated. A multiple-ply sheet is formed in which is included an intercalated continuous film of a material that resists and prevents penetration by moisture-laden air.

The moisture-proof adhesive is applied to the sheet in a heavier layer than heretofore practiced; and the temperature of the adhesive is kept sufficiently low to prevent undue absorption by the fibers, but sufficiently high to keep it in a fluid condition, so that the two coated surfaces when brought together flow into each other without the need of being subjected to pressure. This is effected by passing the two sheets initially between the two rolls 8, 9, whose distance is equal to the combined thickness of the two sheets and the two coatings.

The adhesives which I have been using congeal at a temperature that varies from 65° to 80° C.; and, since the sheets to which the adhesive is applied are of room temperature, it takes only a few seconds before the coatings lose their fluidity. At the moment congealing sets in, and while the adhesive is still in a plastic condition, the piled board is, between rolls 10, 11, subjected to a second and slightly heavier pressure, which unites the two coatings more firmly, densifies their structure, and closes up any pinholes that may have been formed during the coating operation.

The effectiveness of this procedure is best illustrated by a comparative test of the amount of moisture that passes through a ply-board made by the known procedure and one made in accordance with the present invention. A cardboard made under the most favorable conditions by the old process lets pass from 95 to 105 milligrams of moisture per 1000 square centimeter-hour, whereas a board made with the same adhesive by my two pressure system lets pass only 10 milligrams per 1000 square centimeter-hour, when tested in a chamber which was maintained at 35° C. and 100% moisture.

Excellence of result requires, necessarily, operation under optimum conditions, and these conditions have to be set up empirically, since there is variation in particular cases. In order to obtain a continuous film of sufficient thickness to give maximum protection against passage of moisture-laden air, and at the same time properly to unite two sheets of paper or board, the following factors have to be brought into harmony, namely: temperature of the moisture-proof adhesive, its viscosity at the time of coating, its congealing point, the speed at which the sheet material is coated, the porosity of the sheet material, the time interval between plying the material and the application of the final pressure. A slight change of any one of these factors necessitates a correction of the other ones. Those familiar with the behavior of colloids in general, and of resinous materials, adhesives and moisture-proof materials in particular, will be able to determine such optimum conditions, in order to accomplish the ends described.

Without departing from the practice of the method in its essence, it still remains possible by heat applied (in relatively low degree) to rolls 10 and 11, or to one of them, to vary the denseness and compactness of the finished article.

Turning to Fig. II of the drawing, a sheet of paper 13 is impregnated with a substance or com-

pound (in fluid condition) that is impervious to moisture-laden air. The sheet may be of absorbent or of non-absorbent nature, according to the type and quality desired of the finished product, and according to the character of the moisture-proof substance used. The operation of impregnation is diagrammatically indicated. The sheet passes through a bath 14 of the impregnating substance in fluid condition, and as it rises from the bath it passes between stripping rolls 15 and 16; thence, with a proper burden of the impregnating substance, it advances to the pass between rolls 8 and 9. This impregnation is, it will be perceived, a thorough one, so that no appreciable voids can remain within the impregnated sheet. And the stripping rolls 15, 16 are so set that the sheet 13 is but the carrier of a continuous film of the impregnating substance.

In the pass between rolls 8 and 9 the sheets of paper or thin cardboard 1 and 2 are brought progressively to surface contact with the impregnated sheet 13. The two sheets 1 and 2 may or may not, preliminarily, have been coated in the manner already described. In case they have been so coated, the coating material may be the same as the material with which the sheet 13 is impregnated; or, if not, it will be an adhesive compatible with such impregnating material. And, generally speaking, the material with which the sheet 13 is impregnated, has the characteristics already indicated to be possessed by the material 7, and it may, indeed, be precisely such material.

Between the rolls 8 and 9 the components are united, without squeezing and without exudation, as in the case already described. The material advancing from roll-pass 8—9 to roll-pass 10—11 gives up heat; the content of impregnating and coating material comes approximately to the temperature at which it sets; and then, between rolls 10 and 11, the components are consolidated. And from the roll-pass the finished sheet advances.

The advantage of using a centre sheet impregnated with the moisture-proof material (the particular procedure illustrated in Fig. II) is that it offers a simple means to apply the moisture-impervious material in a thicker layer, without the danger that the fluid material may run away, or be squeezed out when passing through the rollers. The board thus produced has greater stiffness, and can endure rougher treatment. If, for example, it be employed to form cartons for breakfast food, it will under creasing and bending operations be stronger to resist cracking. And cracking must for such use be prevented, for through cracks moisture will find paths of penetration.

In following the specific procedure described in connection with Fig. II, not only do I obtain a layer of the moisture-impervious material of always the same thickness; but, since the fibers of the paper exercise a capillary attraction towards the material with which it is impregnated, the viscous moisture-impervious material is kept in position as if it were solid. As a consequence, the temperature of the impregnated material can be kept somewhat higher than otherwise would be possible, and this in turn insures a more perfect union with the two sheets between which it is intercalated. By varying the thickness of the centre sheet, and by employing in its preparation paper that is more or less absorbent, I have a simple means for regulating the

thickness of the moisture-resisting layer and therewith the degree to which the cardboard becomes impervious to moisture-laden air. In both cases there will be found in the finished article, between the plies, a layer of the impervious adhesive; and this layer or film, regardless of such absorption as may have taken place, will still be a continuous layer of the adhesive alone and of substantial thickness—not less than one one-thousandth of an inch thick. Ordinarily, it will be of greater thickness than that—two to three one-thousandths, for example.

It will be remarked that in both operations—that illustrated in Fig. I and that illustrated in Fig. II—essentially the same treatment is performed. Two sheets of paper, or of equivalent board, are by rolling brought along a progressive line into contact upon an interposed continuous body of adhesive while that body of adhesive is still in fluid condition. This initial contact is effected without compression. Cooling ensues; and then, as the temperature is approached at which the adhesive sets, the material is rolled under pressure. The interposed body of adhesive may be borne by a separate sheet; or it may have been spread previously (and in subdivision) upon the two sheets of paper themselves; or, again, it may be borne in part both by a separate sheet, and by the two sheets of paper themselves.

I claim as my invention:

1. The method herein described of forming a multiple-ply sheet of moisture-repellant cardboard, paper-board, and the like, which consists in spreading superficially upon two plies of paper uninterrupted films of heated thermoplastic moisture-proof adhesive, bringing the two plies together, without pressure, film to film, along a progressive line of contact and while the substance of the films still continues superficially in hot and fluid condition, thereby effecting the merging of the films into a single film inter-

calated between the plies, allowing the united article to cool to the temperature of stiffening of the intercalated material, and, finally, at such temperature, subjecting the article to consolidating pressure.

2. The method herein described of forming a multiple-ply sheet of moisture-repellant cardboard, paper-board, and the like, which consists in spreading superficially upon a ply of paper an uninterrupted film of a thermoplastic, moisture-proof adhesive, in heated and fluid condition, bringing such filmed ply, while the film superficially continues in fluid condition, together with a second ply, into a roll-pass of a width equal to the combined thickness of such components, whereby union is effected without compression, allowing the united article to cool to the point of stiffening of the film material, and, finally, at such temperature, subjecting the article to consolidating pressure.

3. The method herein described of forming a multiple-ply sheet of moisture-repellant cardboard, paper board, and the like, which consists in impregnating a sheet of paper with a thermoplastic moisture-proof adhesive in heated and fluid condition, rolling together along a progressive line of contact and between rolls spaced apart at an interval corresponding to the total thickness of the introduced material, such impregnated sheet, while still the impregnating material is in fluid condition, and two sheets of paper coated with thermoplastic adhesive in heated and superficially fluid condition, the two sheets being applied to the first upon its opposite sides and with their coatings meeting the surfaces of the first, whereby union is effected without compression, allowing the so united material to cool, and at a temperature approximating that at which the adhesive sets rolling the material under pressure.

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