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TREATMENT OF CELLULOSIC MATERIALS
SUCH AS PAPER AND FABRICS TO MAKE
THEM RESISTANT TO WATER

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This invention is concerned with the treating of paper, cotton fabrics and other fabrics formed from natural cellulosic materials to make them resistant to water. In accordance with the invention the paper or fabric is dried by subjecting it to heat and a vacuum while in contact with rosin. As the result of this treatment the fibres of the paper or cellulosic fabric become coated with a film of material which appears to be an ester formed by the interaction of the cellulose and the rosin, that is cellulose-rosinate. This coating reduces the water absorptive capacity of the fibrous material and, in the case of paper or felted fabric, gives it the power to resist the softening and disintegrating action of water.

The presence of moisture prevents the commencement or continuation of the chemical change which takes place during the treatment. Since this reaction involves the production of water, it is therefore necessary to dry the paper or fabric initially to cause the reaction to start, and to continue the removal of moisture until the reaction is complete. The process of drying under vacuum is preferably continued until the absolute pressure has fallen to about 1 mm. of mercury and is carried out at a temperature above normal atmospheric temperatures. Conveniently a temperature of about 120° C. is employed.

The rosin may in general be applied in any way which brings it into intimate contact with the fibres of the paper or fabric. This is, of course, subject to the qualification that the method does not involve the use of any material which disadvantageously affects the paper or fabric, either in its structure or in its properties required for its subsequent use. The rosin may, for instance be applied in solution or in the form of a suspension. Where the paper or fabric is to be used for electrical insulating purposes it is preferable to use a solution rather than a suspension, since the solvent can be removed whereas the dispersion agents may remain and may cause a reduction of the desired electrical properties. A solution may, for instance, be made by the aid of trichlorethylene, alcohol or other organic solvent for rosin. Satisfactory results are obtained if the solution strength is such as to leave about 5 parts by weight of rosin in 100 parts by weight of paper or fabric. When the proportion of rosin is less the waterproofing effect is correspondingly lower. However when the proportion of rosin is greater than about 5% by weight of the paper or fabric the waterproofing effect is not correspondingly higher because the reaction is merely a surface reaction. Solutions containing from 2 to 20 parts

by weight of rosin in 100 parts by weight of solvent may be used. The actual strength of solution to be employed will naturally depend upon the type of paper or fabric to be treated, the degree of waterproofing required, the time of immersion of the material in the solution and the conditions under which the solvent is removed. It is here explained that the process by which the paper takes rosin from the solution appears to be one of adsorption. For this reason the amount adsorbed by the paper depends not only on the concentration of the rosin solution but also on the time of soaking. Thus the requisite amount of rosin can be got into the paper or fabric by soaking in a weak solution for a long time or by soaking it in a stronger solution for a shorter time. In general it will be satisfactory to use a solution of such a strength that after being treated with the solution for a convenient period of time the material will contain about 5% by weight of rosin. The paper or fabric is soaked in the solution or suspension, for instance, by running it through a bath of the solution or suspension and the solvent or suspension medium may be removed by drying in air or under a pressure less than atmospheric pressure. In the case of paper, the rosin may be incorporated in the process of manufacture of the paper, for instance during the beating stage. Satisfactory results are obtained if the amount of rosin introduced into the pulp is such that the resulting paper contains about 5 parts by weight of rosin in each 100 parts by weight of paper. It may be more convenient in practice to employ a paper which has been given a heavy rosin sizing by the paper manufacturer. Such paper, which may contain from 5-7% of rosin is known and is to some extent already water-resistant.

The rosin-containing material thus produced or obtained is treated in accordance with the invention by heat drying it under vacuum until the reaction has been completed or substantially completed. A suitable treatment comprises drying the rosin-containing material under vacuum for a period varying from about 20 to about 50 hours at a temperature of about 120° C., the absolute pressure at the end of the process being not greater than 1 mm. of mercury. In general a period of about 24 hours is satisfactory but where a higher degree of waterproofing is required the drying may be continued for a longer period say for about 50 hours. Further drying beyond a period of about 50 hours produces little increase in the waterproofing effect. The treatment may be applied to the paper or fabric while it is in

roll form. This will generally be more convenient in view of the prolonged time of treatment than a treatment in which the material is fed continuously through a drying oven.

- 5 To provide an indication of the water-resistant property imparted to paper by the process in accordance with the invention, the following test procedure has been adopted. A test specimen of paper is soaked in distilled water at 20° C.;
 10 at the end of this period the specimen is quickly transferred to a tensile testing machine and the breaking load determined. The degree of water-proofing is taken to be the breaking load when wet as a percentage of the breaking load when
 15 dry. By this method the following figures are obtained:

	Per cent
Paper as received from manufacture.....	9
Paper soaked in 5% rosin solution in tri- 20 chlorethylene and dried in air.....	19
The above rosin-treated paper after treatment in accordance with the invention.....	50

What I claim as my invention is:

- 25 1. A process for rendering resistant to water a material consisting of paper or cotton or other fabric formed from natural cellulosic material, which process comprises drying the material and forming on the fibres thereof a film of cellulose
 30 rosinat by subjecting it to heat and a vacuum whilst the fibres are in intimate contact with rosin.
2. A process for rendering resistant to water a material consisting of paper or cotton or other
 35 fabric formed from natural cellulosic material, which process comprises soaking the material in a solution of rosin, drying the material to remove the solvent therefrom, and then drying the material and forming on the fibres thereof a film of
 40 cellulose rosinat by subjecting it to heat and a vacuum.
3. A process for rendering resistant to water a material consisting of paper or cotton or other
 45 fabric formed from natural cellulosic material, which process comprises soaking the material in a suspension of rosin, drying the material to re-

move the suspension medium, and then forming on the fibres thereof a film of cellulose rosinat by subjecting it to heat and a vacuum.

4. A process for rendering resistant to water a material consisting of paper or cotton or other
 5 fabric formed from natural cellulosic material, which process comprises adding a suspension of rosin to the material at the beating stage of its manufacture and drying the resulting rosin-
 10 containing material and converting the surfaces of the fibres thereof into cellulose rosinat by sub-
 15 jecting it to heat and a vacuum.

5. A process for rendering more resistant to water a material, which consists of paper or cotton or other fabric formed from natural cellu-
 15 losic material and contains about 5 parts by weight of rosin in each 100 parts by weight of the material, which process comprises drying the rosin-containing material and converting the
 20 rosin-coated surfaces of the fibres thereof into cellulose rosinat by subjecting it to heat and a vacuum.

6. A process for rendering more resistant to water, a material which consists of paper or cotton or other fabric formed from natural cellu-
 25 losic material and contains up to about 5 parts by weight of rosin in each 100 parts by weight of material, which process comprises drying the rosin-containing material for from 20 to 50 hours
 30 at a temperature of about 120° C. at an absolute pressure which at the end of the process is not greater than 1 mm. of mercury.

7. As a new article of manufacture, a liquid pervious material which consists of paper or cotton or other fabric formed from natural cellu-
 35 losic material and of which the fibres individually consist of a core of natural cellulosic material and an enveloping skin consisting of the reaction product of the surface cellulose of the fibre and
 40 rosin.

8. As a new article of manufacture, a liquid-pervious, water-resistant material in sheet form, which consists of superficially rosin esterified
 45 cellulose fibres.

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