

# UNITED STATES PATENT OFFICE.

WALDO SPAULDING, OF EAST PEPPERELL, MASSACHUSETTS, ASSIGNOR  
TO VELLUMOID PAPER COMPANY, OF WORCESTER, MASSACHUSETTS,  
A CORPORATION OF WEST VIRGINIA.

## METHOD OR PROCESS OF TREATING FABRIC TO RENDER IT IMPERVIOUS.

No. 837,005.

Specification of Letters Patent.

Patented Nov. 27, 1906.

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*To all whom it may concern:*

Be it known that I, WALDO SPAULDING, a citizen of the United States of America, residing at East Pepperell, in the county of Middlesex and Commonwealth of Massachusetts, have invented a new and useful Method or Process of Treating Fabric to Render it Impervious, of which the following is a specification.

My invention relates to the method or process of rendering paper or other like material impervious; and the object of my invention is to render such fabric substantially impervious to water, grease, acids, &c.

My invention consists in the method or process herein described.

In the treatment I employ as the agent in one of the steps a casein emulsion, casein being, as is well known, the chief nitrogenous ingredient of milk. This emulsion consists of about ten parts casein, eighty parts water, and 6.4 parts borax, by weight, and is prepared by first soaking casein in one-half the quantity of water for some twelve hours, more or less, then adding the balance of the water and heating the mass at a temperature of perhaps 100°, stirring meanwhile until an emulsion of the proper constituency and homogeneousness is produced. The borax may be introduced at any convenient point during the preparation of the emulsion. Of course this formula may be varied somewhat in order to meet different conditions.

The treatment may be applied while the mass of pulp is being formed into paper, beginning the new treatment when the web of pulpy material leaves the Fourdrinier wire or the cylinders, as the case may be, it then being in a damp condition, but with the larger percentage of moisture removed, or such treatment may be applied to the finished paper. In any event, however, the treatment of the paper from this point is the same whether it be pulp in a web or the finished article.

The treatment consists first in saturating the paper with a solution of the casein emulsion, preferably while the latter is in a heated state, since a more rapid absorption and more complete permeation, impregnation, and deposit of the casein within the microscopic interstices throughout the body of the paper being treated is thus brought about.

A tank may be provided in which the casein solution can be kept heated to a constant temperature, the paper being passed through the tank and saturated during its passage. Since it is more expedient, if for no other reason, to keep the paper being treated in constant motion and to handle it in a continuous sheet or strip, I prefer generally to feed the untreated paper from a roll and to wind it onto a roll again after treatment. As the paper passes from the tank containing the casein solution the surplus of the latter is removed from the surfaces of said paper by mechanical means, as press-rolls, rather than by simply allowing such surplus to pass off by gravity.

As before intimated, the casein emulsion is reduced with water for the purposes of the above step in the process, the amount of such reduction varying according to the weight and texture of the paper and the uses for which said paper is desired. It may, however, be stated that in a majority of cases a hot solution of about one part of the emulsion and about two parts of water, by weight, gives the best results. After leaving the casein-bath and having the surplus adhering to the surfaces removed the paper is passed into or through a solution of formaldehyde and water. The strength of this solution may be varied, depending, as heretofore stated, upon the paper and uses for which it is designed. In the majority of cases, however, a solution of one part formaldehyde, thirty-five-per-cent. solution, to five parts of water, by weight, gives the best results. This bath should be cold instead of hot in order properly to precipitate the casein, though any particular degree of temperature is not essentially necessary. The effect of the formaldehyde solution upon the casein-emulsion-saturated paper is to precipitate the casein and render it insoluble. As the paper comes from the formaldehyde-bath I prefer that the surplus adhering to the surfaces be removed by mechanical means as before. The paper is then dried in any convenient manner. The drying removes all the watery constituents and leaves the paper in condition to resist the absorption and passage of water, grease, &c., but not in proper condition for all commercial uses. To temper and render the treated paper soft and pliable and



adapted for most commercial uses, I subject it to moisture. This causes a swelling in all directions, filling the interstices perfectly and resulting in "hydration" throughout the entire cellular structure. For this purpose I prefer to pass the paper at this stage into a bath of hot water, saturated steam, or equivalent heat and moisture medium, thus causing the fibers and the non-soluble matter filling the interstices to expand in all directions and forcing such matter into all the microscopic pores or openings and into the masses of fiber, causing a thorough commingling and incorporation with the fibers of the casein compound, and at the same time, as heretofore indicated, a change (hydration) takes place, whereby the mass of fiber, filling material, and formaldehyde becomes tempered and softened.

To heighten the tempering and softening effect, I may in some instances introduce glycerin into the tempering-bath, one two-hundredths, in volume, of glycerin giving the best results in most cases.

The paper is again dried, when it is in condition for the market.

Should it be desired to remove all traces of acids and any disagreeable odor and taste that may be present in the paper at this time, it is simply necessary to pass it through a bath of water and a suitable volatile alkali. If the paper is to be subjected to the alkali-bath, it is not necessary to dry it between this bath and the tempering-bath.

By the term "hydration" as used herein I mean the subjection of the paper (after treatment with the casein solution and formaldehyde and drying) to moisture, whereby two actions, mechanical and chemical, appear to take place, the mechanical action being apparently the temporary absorption of water analogous to the absorption of water by a dry sponge and the chemical action being the permanent union of water with the treated fabric analogous to the union of wa-

ter with tapioca, causing swelling, or like the chemical combination of water with lime or cement.

By this process a sheet or strip of paper can be treated as rapidly as it is manufactured, as the time for exposure to the casein solution need not be longer than the time required for it to become saturated, this of course varying with different thicknesses and densities, and the length of time of exposure may be fixed without checking the speed by making the tank of such length that the requisite time will elapse while the strip is passing through it and the guides so arranged as to maintain the strip in position to be acted upon by such solution the requisite length of time. Only a few seconds' exposure to the action of formaldehyde is required in most instances.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The improvement in the art of treating fabric to render the same impervious consisting in first forming an emulsion of ten parts casein, eighty parts water and 6.4 parts borax by weight, saturating the fabric with said emulsion, then subjecting the fabric so saturated to the action of formaldehyde, then drying the fabric, then hydrating the same and then drying it.

2. The improvement in the art of treating fabric to render the same impervious consisting in forming a solution of casein, borax and water substantially in the proportions as hereinbefore defined, then subjecting the fabric so saturated before it is dried to the action of formaldehyde, then drying the fabric, then hydrating the same and then drying it.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WALDO SPAULDING.

Witnesses:

GEORGE G. TARBELL,  
ARCHIBALD G. PIKE.