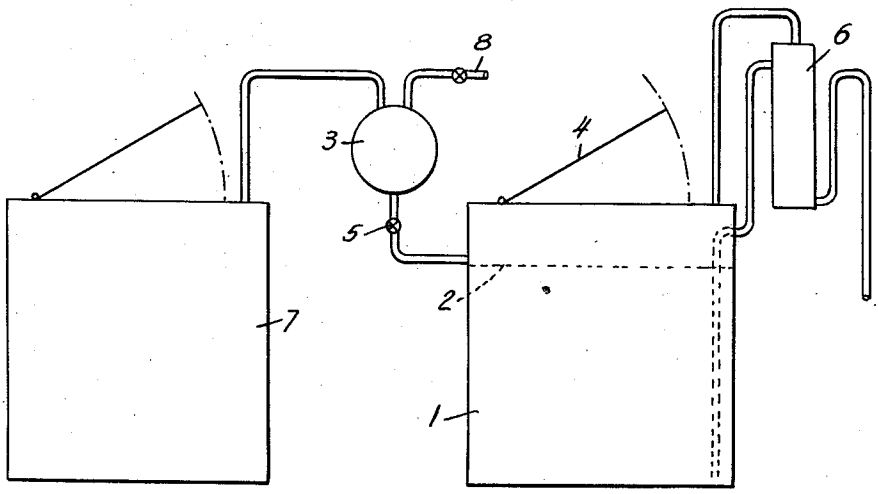
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CELLULOSIC MATERIAL

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INVENTOR

A. W. Schorger

BY

Pennie, Davis, Marvin & Edmonds

ATTORNEYS

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# UNITED STATES PATENT OFFICE

ARLIE W. SCHORGER, OF MADISON, WISCONSIN, ASSIGNOR TO C. F. BURGESS LABORATORIES, INC., OF MADISON, WISCONSIN, A CORPORATION OF DELAWARE

## CELLULOSIC MATERIAL

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This invention relates to a cellulosic product which results from a drying process applied to cellulose fibers or a mixture of cellulose fibers and hydrated (gelatinized) cellulose.

It is an object of this invention to dry cellulose fibers in such a way as to render them softer and more pliable than is possible with ordinary drying processes. It is a further object to dehydrate and dry hydrated or gelatinized cellulose fibers in such a way as to prevent the shrinkage and warping which accompany the ordinary air drying of such material, and to obtain a product that is soft and flexible in contrast to the hard, horny, and brittle product which results from air drying and to further obtain a product which will not gelatinize and swell when subsequently wet with water or aqueous solutions.

Fibrous cellulose, such as wood pulp and cotton, is capable of hydration to varying degrees. In the process of hydration by mechanical beating, as in the ordinary paper mill beater, if the operation is stopped relatively soon the fibrous structure is only partially broken down whereas if the beating is continued sufficiently long the cellulose becomes completely hydrated and consists essentially of a structureless, gelatinous mass. When dried in air, the properties of the resulting cellulose product depend upon the degree to which it was previously hydrated. For instance, cellulosic material, entirely fibrous or only slightly hydrated, when fabricated into sheet or other form, and subsequently dried in air, is relatively soft and does not shrink to any considerable extent. A more highly hydrated or gelatinized cellulose product, however, when subsequently dried in air becomes extremely hard and horny and when in thin sheets, is translucent and will shrink as much as thirty per cent of its length and consequently warp out of shape. The shrinkage and hardness of the dried product is proportional to the degree to which the material has been previously hydrated.

The excessive shrinkage, hardness, horniness and tendency to warp are objectionable for many of the uses to which the material may otherwise be put. Its translucency may also be objectionable. For instance, where sheets are to be used as dry cell liners it may be desirable to introduce the sheets into the cells in a dry condition. Excessive swelling when the liner becomes soaked with electrolyte is objectionable. If the paper is to be used in books, the translucency is objectionable because the printing shows through the paper. Paper is gradually finding its way into commercial use as a substitute for cloth. Hardness, horniness and warped condition are characteristics that are highly objectionable for such uses.

I have found that if the fibrous or partially hydrated cellulose is immersed in a bath or the vapors of a suitable liquid which possesses the ability to dry by displacing the contained moisture and water of hydration, the cellulose dries into a uniformly soft and pliable condition, is more opaque, and does not undergo more than slight shrinkage. Ordinary paper stock, as in the form of sheets, if dried in this manner, is soft and pliable without the usual "rattle" characteristic of most papers. Even cellulosic fibers which have not even been slightly hydrated are much softer in texture and are more pliable and absorbent when dried according to my invention. Such cellulosic fiber products need not consist of pure cellulose but may consist of impure cellulosic materials such as wood pulp and the like such as is used in the manufacture of ordinary pulp products, of which paper is an example. I contemplate the application of my improved method of drying to cellulosic material which may be entirely fibrous in character or may be partially fibrous and partially hydrated. The hydration shall have been accomplished by mechanical means, as by beating. I do not contemplate application of my drying process to wood as such, or to a completely hydrated cellulose nor to cellulose hydated by chemical means. In the following specification and the appended claims it shall be understood that the term "cellulose" or "cellulosic" material contemplates a cellulosic material entirely fibrous in character or partially fibrous and partially mechanically hy-

drated. The drying operation, therefore, functions to drive off moisture and displace water of hydration.

My invention contemplates a method for drying such material by heating it in a compound, liquid at room temperature which possesses the ability of displacing the contained water. My compound is preferably organic and may be insoluble in water or entirely miscible therewith, preferably the latter. The cellulosic raw material may be in the form of sheets, films, moulded articles, and the like.

The accompanying drawing is a diagrammatic illustration of one form of apparatus suitable for use in practicing the process.

The practical application of my improved method for drying cellulose products comprises introducing said products into a suitable chamber containing the drying medium and either submerging it directly therein and heating the liquid to its boiling temperature or subjecting the cellulose to the vapors of the medium. In the accompanying drawing I have shown schematically the required equipment for the drying operation. Still 1 of iron or other suitable material is adapted to have a source of heat applied thereto. The drying liquid 2 may be supplied from storage reservoir 3 until the still is filled to a predetermined level as indicated by the dotted lines. The material to be dried may be introduced through an opening in the top of the still which may then be closed by suitable door or lid 4. The liquid is kept at its boiling temperature until drying is substantially complete, the valve 5 in the supply line being kept closed during this operation. The water immediately upon being displaced from the cellulose evaporates and may be conducted away along with some liquid to a chamber 6. If the liquid is not miscible with water the water and liquid separate into layers. Means for continuously returning the liquid to the still and conducting the water to waste may be provided. If the liquid is miscible with water it may be fractionated in chamber 6 and the water dis carded. Drying is substantially complete when a sample of distillate shows no water to be present. If it is desired to remove the liquid from the dried cellulose it may now be removed from still 1 and placed in chamber 7 which is also adapted to have heat applied thereto. The cover or lid may be securely closed and the contained liquid distilled from the cellulose and conducted to storage reservoir 3. Make up liquid may be supplied thereto from a suitable source by means of pipe 8.

The product dried in this manner is very soft and pliable, exhibits increased opacity, softness, and absorption over that possessed by an air-dried product of a similar material. In products containing mixtures of fibrous cellulose and dehydrated gelatinized cellulose, the dehydrated gelatinized cellulose possesses the very desirable property of resisting gelatinization and swelling when subsequently wet with water or aqueous solutions. To my knowledge there is no other method by which this property can be obtained. A sample product in sheet form, dried by means of an organic compound under specific tests, showed a decrease of twenty-two per cent in resistance to bending and a shrinkage of from two and one-half to four and one-half per cent of its hydrated length. Organic compounds miscible with water, such as alcohol and acetone, give greater opacity and softness to cellulose than do compounds not miscible with water, such as gasoline, xylene, benzole, etc.

I have found that many drying agents may be employed with beneficial results. I may use liquid acetone, benzene, or any of the low-boiling homologues of benzene, or an alcohol for my dehydrating medium. The alcohol may be methyl or any higher alcohol but I prefer to use ethyl alcohol denatured with any common denaturant. I may use the drying agents in the form of a liquid or a vapor. Ordinary gasoline or naphtha may be used. I prefer using an organic liquid having a low boiling point so that it may be readily evaporated from the dehydrated cellulose without injury to the cellulose.

A specific sample of cellulose dried by benzene exhibited great softness and pliability and shrinkage took place equal to approximately five per cent of its wet length. A specific sample dried by alcohol exhibited increased opacity, softness and pliability.

I may combine two or more of the heretofore described methods of accomplishing drying. I may soak the cellulose for a period, say five minutes, in an alcohol bath and then boil it in a xylene bath as heretofore described.

I claim:

1. A cellulosic material, produced by drying and dehydrating a mixture of fibrous and gelatinized cellulose in an organic compound, liquid at room temperature and capable of displacing the contained moisture and water of hydration, said material being characterized by pliability and opacity substantially greater than, and shrinkage less than that of a product resulting from drying directly in air a similar mixture of fibrous and gelatinized cellulose, and being further characterized by resistance to re-gelatinization when subsequently wet with water.

2. A cellulose sheet produced by drying and dehydrating partially hydrated cellulosic fibers in an organic compound, liquid at room temperature and capable of displacing the contained moisture and water of hydration, said sheet being characterized by pliability and opacity substantially greater

than, and shrinkage less than that of a product resulting from drying directly in air a similar mixture of fibrous and gelatinized cellulose, and being further characterized by resistance to re-gelatinization when subsequently wet with water.

3. A paper sheet produced by drying and dehydrating a cellulosic material in an organic compound, liquid at room temperature and capable of displacing the contained moisture and water of hydration, said material being characterized by pliability and opacity substantially greater than and shrinkage less than that of a product resulting from drying directly in air a similar mixture of fibrous and gelatinized cellulose and being further characterized by resistance to re-gelatinization when subsequently wet with water.

4. A wood pulp product, produced by drying and dehydrating a mixture of fibrous and gelatinized wood pulp in an organic compound, liquid at room temperature and capable of displacing the contained moisture and water of hydration, said product being characterized by pliability and opacity substantially greater than and shrinkage less than that of a product resulting from drying directly in air a similar mixture of fibrous and gelatinized cellulose, and being further characterized by resistance to re-gelatinization when subsequently wet with water.

In testimony whereof I affix my signature.

ARLIE W. SCHORGER.