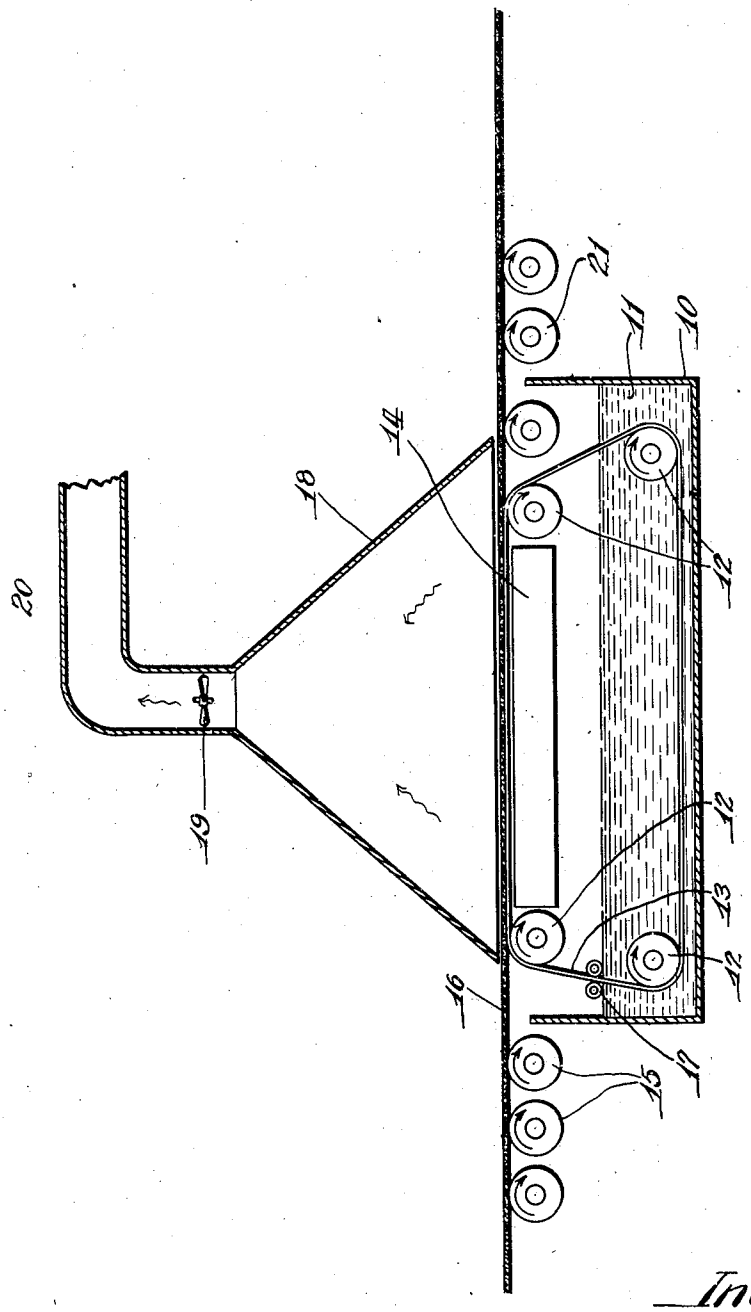
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APPARATUS FOR DRYING FIBROUS MATERIALS

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Inventor
Elton R. Darling
By Jones, Addington, Ames & Seibold
Attys.

Witness:
David S. Magnusson.

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UNITED STATES PATENT OFFICE

ELTON R. DARLING, OF DANVILLE, ILLINOIS, ASSIGNOR TO CORNSTALK PRODUCTS COMPANY, INC., OF DANVILLE, ILLINOIS, A CORPORATION OF DELAWARE

APPARATUS FOR DRYING FIBROUS MATERIALS

Application filed December 16, 1929. Serial No. 414,466.

The present invention relates to an improvement in drying fibrous material.

One of the objects of the invention is the preparation of high-alpha cellulosic pulp in a particularly suitable form for esterification or for use in the manufacture of artificial silk and the like.

High-alpha pulp is simply a trade designation for a cellulosic pulp of such characteristics that it will substantially withstand the action of a cold 17½% solution of sodium hydroxide, such as is used in preparing alkali-cellulose crumbs for the preparation of cellulose xanthogenate in the viscose process. This means that cellulose having a "high alpha" content will not substantially dissolve in such caustic soda solutions. It has been found that high-alpha cellulose is also very suitable for nitration, acetation and for conversion into cellulose ethers and other compounds. The recent great expansion in the utilization of cellulose and its compounds has created a great demand for cellulose having a relatively high (above 90%) "alpha cellulose" content. In the past most of this demand has been met by the preparation of "high alpha" cellulose from cotton linters and cotton waste, although recently high-alpha pulps derived from sulfite wood-pulp have appeared on the market.

A still more recent development has been the preparation of high-alpha cellulosic pulps from farm-wastes such as cornstalks, bagasse, rice-straw, wheat-straw, etc. One of these modern processes of manufacturing high-alpha cellulosic pulp forms the subject matter of my co-pending application Serial No. 385,061, filed August 10, 1929, in which I have described the treatment of cornstalk cellulose with cold 6% sodium hydroxide solutions, whereby constituents other than "high-alpha" cellulose are removed from the pulp, leaving the desired high-alpha cellulose therein.

It has now been found that when washing the alkali-treated cellulose, that the same can very conveniently be sheeted on a paper machine according to standard procedure. However, when drying such a sheet of high-alpha cellulose in the ordinary way, it compacts and becomes very hard, so that when it is subsequently desired to acetate, nitrate or otherwise to convert the sheet of high-alpha cellulose it is quite resistant to penetration by the reagents employed for carrying out such conversion.

The present invention, therefore, has for one of its objects a new method of treating the sheeted high-alpha cellulose while still containing considerable moisture, so as to remove this moisture by means of the vapors of a volatile solvent that has the properties of entraining water-vapor.

Among the solvents suitable for this purpose are benzene, benzine, acetone, and the volatile alcohols, especially ethyl alcohol, the latter on account of its cheapness and ready recoverability being perhaps the best for the purpose. In the description hereinbelow it will be assumed that alcohol is the liquid employed, although the invention is most definitely not limited to the use of alcohol as such. Even suitable mixtures of solvents, such as a mixture of benzene and alcohol may be employed with success.

Essentially the new method that forms the subject matter of the present invention consists in advancing a continuous web of wet high-alpha cellulose, or other fibrous material requiring drying through a heated zone while supported by an endless belt of absorbent material that is wet with a volatile liquid. The said belt is in contact, or in very close proximity to, a suitable heater, whereby the volatile liquid absorbed by the belt will be volatilized and driven into the web of high-alpha cellulose or other fibrous material supported by the belt. A suitable hood, provided with draft or suction-producing means surmounts the heated zone through which the web of fibrous material and the belt travel, thereby providing means for carrying the vapors of the volatile liquid arising from the belt through the web of fibrous material, whereby the water contained in the latter is likewise driven off. The combined solvent and water vapors are then conducted from the hood to a suitable condenser or absorbing tower in which the volatile solvents and water vapor are condensed to form solvent or a

solution of solvent in water; from which latter the solvent may be recovered for re-use by any known suitable manner. The method of recovering the solvents is entirely a matter of choice and does not form a part of the present invention, as such solvent recovery means are well known and have been described and patented hitherto.

Ordinary denatured ethyl alcohol serves excellently for the purpose. Methanol (methyl alcohol) will also serve, but because of its more or less poisonous nature is not preferred. Acetone will also do, but is somewhat more expensive. Benzene, especially in admixture with alcohol, also is suitable, but complicates the solvent-recovery problem, and, moreover, benzene vapors are poisonous. For the aforesaid reasons, I prefer to operate with ordinary commercial denatured alcohol.

Referring now to the drawing forming part of the present application:

A suitable container 10, preferably in the form of a flat trough, is partially filled with the volatile liquid (alcohol) 11. Suitably mounted in the trough are rollers 12, upon which an endless belt 13 of absorbent material, such as felt, travels. Means, (not shown) for propelling the belt are likewise provided. Placed above the level of the liquid in the trough 10 is a suitable heater 14. This may consist of a hollow metallic box through which steam or hot water is passed; or it may be an electrically heated plate. The belt 13 preferably is closely enough positioned to the heater to insure the volatilization of the liquid absorbed and carried thereby. It is not absolutely necessary that the belt actually make contact with the heater, although such construction will be considered as within the scope of my invention.

Suitably supported by, for example rollers 15, there arrives a wet web 16 of fibrous material, for example, high-alpha cellulose, containing about 70% of water in the form of moisture. The speed of the advancing web of fibrous material (travelling in the direction of the arrows on the drawing) is so adjusted that it coincides with the peripheral speed of the travelling belt 13, so that the belt and the web which is superimposed thereon as shown will travel along over the heater 14 simultaneously and at the same speed.

The amount of volatile liquid (alcohol) carried by the belt 13 may be adjusted by tightening or loosening the squeeze rollers 17. Under the influence of the heat arising from the heater 14, the volatile liquid in the belt will be volatilized and will escape upwardly into the web of wet fibrous material. At the same time the water contained in the web of material will come under the influence of the hot vapors of liquid and will therefore be entrained by the latter and thus likewise volatilized and removed from the web of material. This procedure is accelerated and aided by maintaining a draft in the hood 18, which surmounts the heated zone as shown, by providing the hood with suitable suction means, for example with a propeller 19. The hood 18 is provided with an exit pipe 20 leading to a solvent recovery apparatus (not shown). The course of travel of the water vapors and liquid vapors is indicated by the wavy arrows in the hood and exit pipe.

After the web of cellulose leaves the belt it is transported on rollers 21 and eventually is rolled up and forms an article of commerce in that form. Alternatively the web may be cut into suitable lengths, or may pass into a machine in which it is broken up and made still more fluffy by mechanical means such as tearing, teasing, etc.

When drying alpha cellulose by the method hereinabove described, it forms a very loose, soft mass that has very much the appearance of cotton batting. It lends itself most readily to acetation, nitration and the other processes for the conversion of cellulose into its derivatives.

The present method of drying cellulosic webs differs from the older known methods of dehydrating cellulose esters in which alcohol is employed for the physical displacement of water. For example, in the manufacture of smokeless powder from cellulose nitrate, the thoroughly boiled, poached and stabilized cellulose nitrate, in finely divided form, is highly compressed in hydraulic presses to form what is technically termed "a cheese" of compressed water-wet cellulose nitrate. Ordinary alcohol is then mechanically forced through the compressed mass of the "cheese" whereby the water therein contained is actually physically propelled through the cheese before the advancing mass of alcohol. The liquid coming from the apparatus is tested from time to time, and when the specific gravity thereof shows that it is pure alcohol, then the operator of the apparatus thereby is informed that all of the water has been removed from the mass of cellulose nitrate. This is a very efficient and safe way of drying cellulose nitrate, but is entirely due to the mechanical displacement of the water by alcohol, as no heat whatever is used—in fact heat at this stage would be very dangerous. My purpose in describing this method of drying cellulose nitrate is to point out that my improved method of drying an advancing web of cellulose is essentially different from the method of forcing water out of wet cellulose nitrate. As, however, my improved method of drying cellulosic webs is also applicable to the drying of webs of other than alpha cellulose; for example, may serve for the drying of an advancing web of cellulose nitrate (if the temperature is kept low enough), or of an advancing web of a cellulose ester in fibrous form, I do not wish to be limited to the mere drying of high-alpha cellulose by my method. Any

suitable fibrous material may be dried in this manner.

While I have shown one means of applying volatile vapors to the web of material, it is an obvious expedient to replace the belt by a perforated or otherwise porous plate or sheet; or by passing preliminarily volatilized alcohol through the advancing web of fibrous material.

With only the above limitations, and withholding for myself such obvious changes or minor mechanical improvements as may suggest themselves to those skilled in the art into which this invention falls, I desire to protect by Letters Patent of the United States of America the following:

1. Apparatus for drying a web of fibrous material which comprises a container for containing a volatile liquid, belt-supporting means in said container, an absorbent belt traveling over said means and for a portion of its length so arranged as to be below the level of said liquid, a heater over which a portion of the belt above the liquid travels, means for applying a web of wet fibrous material to the surface of said belt on the side thereof away from said heater, and means above said web and belt for withdrawing vapors arising from said belt and web.

2. In an apparatus as defined in claim 1, wherein means are provided for regulating the amount of volatile liquid absorbed by the belt.

3. Apparatus for drying a web of fibrous material which comprises an endless belt, means for propelling the same, means for applying volatile liquids to said belt, a heater over which said belt may pass, means for applying a web of fibrous material to the belt, and means for withdrawing vapors from the zone of the belt above said heater.

4. Apparatus for drying a web of fibrous material which comprises means for continuously moving said web, means for applying vapors of a volatile liquid to said web while so moving, and means for causing said vapors to pass through said web and for conducting said vapors away with entrained moisture from said web.

In witness whereof, I have hereunto subscribed my name.

ELTON R. DARLING.