

# UNITED STATES PATENT OFFICE.

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## METHOD OF TREATING VEGETABLE SUBSTANCES FOR THE RECOVERY OF THEIR VALUES.

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No Drawing.

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*To all whom it may concern:*

Be it known that I, MARK W. MARSDEN, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Methods of Treating Vegetable Substances for the Recovery of Their Values, of which the following is a specification.

My present invention relates to the treatment of vegetable matter, and more particularly annual plants, such as cotton stalks, sugar cane, straw, and analogous growths, containing saccharin, starch, and invertible carbohydrates, as distinguished from those containing resinous or oily matter, for the removal of the extractive in such form as to permit of the easy rendering or recovery of the chemical values or by-products thereof, and for the ultimate recovery of the fibrous portion, consisting of well-defined cylindrical bast fibers and short cellulose or woody fibers, which is available for the manufacture of a high grade of paper, or which, and this applies especially to the purified cotton cellulose, may be nitrated and after-colloiding employed in the manufacture of smokeless powder either as a pulp dried in layers and afterward comminuted or disintegrated or as an unsized paper or in any other suitable form.

The commercial value of the cellular and fibrous portions as well as the various by-products of the stock mentioned is well known, but the methods of treatment heretofore in vogue are expensive and injurious because large quantities of chemicals were used to decompose the rather considerable amount of pectin and cementing matter present in the cellulose. Indeed, attempts were made to reduce the cost and to some extent have the treatment pay for itself by recovering and using the chemicals over and over again. The use of alkali, its recovery by causticizing, etc., are too well known to require comment. The losses of the alkali amount to about ten per cent., depending upon the care taken. It is true that the alkali or equivalent chemical treatment

makes for a rapid reduction of the stock, but it diminishes the yield both of by-products and fiber and impairs the strength of the fiber, tending as it does to weaken and disintegrate it; and, further, I find that the compound or extractive which is to furnish the sugars and other valuable by-products is injuriously affected by the hot alkali or its equivalent, and the use of alkali makes it impossible to recover the alkali except at the cost of all the sugar, and under perfect conditions about ten per cent. of the stalks is convertible into sugar.

It is the object of the present invention to obviate and overcome the above mentioned disadvantages and to provide for the economical separation and recovery of the extractive, and for the economical recovery of the fibrous portion of vegetable stock of the nature indicated, each of which operations is effected by my method of treatment without the aid of alkali or equivalent chemical substance and in such a way as to insure a maximum yield of bast and cellulosic fibers retaining all of their original strength and pliancy. With this and other objects in view my invention resides in the matters hereinafter described and claimed.

The stock remainder, after harvesting, is cut into uniform lengths of from one to two inches and steeped or soaked in a bath of hot or cold water until complete saturation occurs whereby it undergoes a conditioning not unlike retting as applied to the flax plant, the effect of which is to loosen the outer coating of the bark and soften the woody fibrous tissue. When this is accomplished, the stock is removed from the bath and run through a grinder or shredder, which breaks up the cut stalks into a uniform and fibrous mass. This is put in a closed digester containing water and steam under a pressure of from ten to forty pounds, more or less. The effect of this treatment with heat, moisture, and pressure, is to separate and dissolve the soluble bodies and to convert the starch and invertible carbohydrates into saccharin. It is evident that the initial treatment of softening and shredding the

stock insures a uniform cooking and facilitates the solvent process and leaves the fiber portion possessed of all its natural inherent strength. The liquor is then run off into  
 5 a receptacle and treated for the recovery of the sugars, residual gums, coloring matter, and other valuable components, and this recovery may be accomplished by inversion, fermentation, distillation, or in any appropriate way. The comparatively pure fibrous  
 10 portion, that is to say the stock relieved of its extractive and with the liquor drawn off, is now subjected to the direct action of steam at a pressure in excess of that previously employed. This operation may be  
 15 facilitated and shortened if the fibrous material is subjected to a shaking or tumbling action so as to present all parts thereof to the pressure scouring and separating action of the steam. The effect of this treatment  
 20 is to separate the fibers and to condition them for their after treatment in the ordinary beating engine for the manufacture of pulp. When so reduced and if desired  
 25 the pulp may be bleached or colored in any appropriate manner.

As regards the pure cellulose obtained from cotton stalks by the above method of treatment, the presence of a large percentage of short woody fibers in admixture with  
 30 the long bast fibers will be of benefit to it for paper making since one class of fibers will complement the other, the long fibers interlacing and strengthening the sheet and  
 35 the shorter ones filling in and giving it body. Both are equally capable of conversion into pyroxylin and gun cotton and available for celluloid or smokeless powder manufacture. Test treatments demonstrated  
 40 that nitration took place readily and that an excellent product with a high percentage of nitrogen was obtainable. This applies to the pulp as well as to paper both of which are contemplated by this invention.

45 Having described the nature and objects of the invention, I claim:—

1. The herein described method of treating vegetable matter containing starch and invertible carbohydrates for the recovery of  
 50 its values, which consists in subjecting it in a uniformly divided state to an initial treatment analogous to retting, digesting it in the presence of water and steam pressure in order to convert the starch and invertible  
 55 carbohydrates into saccharin, drawing off and recovering the liquor in the form of useful by-products, and subjecting the fibrous material to the direct action of steam at a pressure in excess of that previously employed.  
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2. The herein described method of treating vegetable matter containing starch and invertible carbohydrates for the recovery of its values, which consists in subjecting it in

uniformly divided lengths to an initial 65 treatment analogous to retting, then shredding it, then digesting it in the presence of water and steam pressure in order to convert the starch and invertible carbohydrates into saccharin, drawing off and recovering 70 the liquor in the form of useful by-products, and subjecting the fibrous material to the direct action of steam at a pressure in excess of that previously employed.

3. The herein described method of treating vegetable matter containing starch and invertible carbohydrates for the recovery of its values, which consists in immersing it in lengths of from one to two inches in water until complete saturation takes place, then 80 shredding it, then digesting it in the presence of water and steam pressure of from ten to forty pounds, more or less, until the extractive is in the form of a saccharin liquor, drawing off and recovering the liquor 85 in the form of useful by-products, subjecting the fibrous material to the direct action of steam at a pressure in excess of that previously employed, and thereafter proceeding in any suitable manner for the manufacture 90 of pulp or paper.

4. The herein described method of treating vegetable matter containing starch and invertible carbohydrates for the recovery of its values, which consists in subjecting it in 95 comparatively short lengths to saturation with water, then shredding it, then digesting it in the presence of water and steam pressure in order to convert the starch and invertible carbohydrates into saccharin, 100 drawing off and recovering the liquor in the form of useful by-products, and subjecting the fibrous material to agitation in the presence of steam at a pressure in excess of that previously employed. 10

5. The herein described method of treating vegetable matter containing starch and invertible carbohydrates for the recovery of its values, which consists in subjecting it in comparatively short lengths to saturation 11 with water, then shredding it, then digesting it in the presence of water and steam pressure in order to convert the starch and invertible carbohydrates into saccharin, drawing off and recovering the liquor in the 11 form of useful by-products, steam scouring the fibrous material and agitating the latter so as to present all parts thereof to the action of the steam, and thereafter proceeding in any suitable manner for the manufacture 12 of paper.

6. The herein described method of treating vegetable matter containing starch and invertible carbohydrates for the recovery of its values, which consists in subjecting it in 12 comparatively short lengths to saturation with water, then shredding it, then digesting it in the presence of water and steam at

a pressure of from ten to forty pounds, more or less, until the soluble bodies are in solution, drawing off and recovering the liquor in the form of useful by-products, and tumbling or shaking the fibrous material in the presence of steam at a pressure in excess of that previously employed.

In testimony whereof I affix my signature in presence of two witnesses.

MARK W. MARSDEN.

Witnesses:

E. W. STRAIN,

ALLAN I. HUCKINS.