UNITED STATES PATENT OFFICE.

CHARLES HEATON, OF NEW YORK, N. Y.

IMPROVED PROCESS FOR DISINTEGRATING FIBERS.

Specification forming part of Letters Patent No. **53,247**, dated March 13, 1866.

To all whom it may concern:

Be it known that I, CHARLES HEATON, at present residing in the State, county, and city of New York, in the United States of America, have invented a new and useful process or method of producing pulp suitable for the manufacture of paper, and for other purposes, from bamboo, cane, and other vegetable fibrous substances; and I hereby declare that the following is a full, clear, and exact description of the same.

Nearly all vegetable fibrous productions are alike in their general structure. For instance, the structure of bamboo consists of bunches of fibers, and the interstices among these bunches, and also among the fibers of which the bunches are composed, are filled with a gum possessing a peculiar pithy or frothy appearance. This gum is very hard and brittle and adheres tenaciously to the fibers which it surrounds. When a stick of bamboo is cut at right angles to its length the portion of its structure which is visible to the eye is what may be termed the "outer" or "first" series of these bunches. This series is composed of an infinite number of these bunches, which lie closely together, somewhat resembling threads, in regular parallel layers, and they constitute the main body of the plant. All around and among these bunches are numberless interstices, and these interstices are filled with the gum of which I have spoken; but each one of the component bunches of this first series is itself made up of an infinite number of finer fibers, also apparently arranged in bunches, and these latter fibers, if not the ultimate fibers of the plant, are at least sufficiently fine and minute for all purposes for which fiber is employed in the arts. I call these last-mentioned fibers the "second" series of fibers or bunches, and they, like the first series, appear to lie closely together in regular parallel layers, and to have all around and among them interstices filled, like those of the first series, with gum already described.

Practical experience shows that it is impossible to convert vegetable fibrous substances into a pulp suitable for making paper without reducing them to what I have above termed the "second series." All the processes which have heretofore been proposed for producing paper-pulp from these substances have, so far as I am aware, contemplated the employment of chemical agents of different characters to effect the desired reduction of the fibrous matter to the proper pulpy state, and although some of these processes have included the use of pressure produced by mechanical means, yet this pressure has always been designed as merely an auxiliary to the chemical agents, the latter being the real means relied upon to produce the pulp; but if chemicals are wholly or mainly relied upon to reduce fibrous substances to pulp, certain serious practical difficulties are encountered. For instance, unless the chemical employed is of considerable strength and is applied in conjunction with great heat, it will not act upon the material with sufficient effect to reduce it to pulp, and if it is of considerable strength and is applied with great heat its action is liable to be so violent that it will disintegrate the material too much and will reduce it almost to a sort of punk, rendering it hard to wash and entirely too short in its staple to felt well, and therefore making it unsuitable for paper; or, if in some cases its disintegrating effect does not extend so far as to produce this result, it will still act with too much force upon the material, and will rot or weaken it to such a degree that the paper made from it will not possess a desirable strength. In addition to this the gummy portions of the vegetable fibrous matters contain elements capable of evolving a powerful dye, and when these elements are exposed to the action of the alkaline chemicals, which, in the processes prior to my invention, have always been used to reduce the fibers to pulp, this dye is formed and imparts its color to the pulp, and then bleaching solutions of very great strength must be employed in order to bleach the pulp and render it suitable to be manufactured into fine grades of paper; but when bleaching solutions of sufficient strength for this purpose are applied, they, too, tend to seriously weaken the fibers, while in many instances they fail, however strong they may be, to entirely remove the effects of the dye, so that the paper made from such dyed pulp is of very inferior color, and if they do remove the dye the paper produced, though white, is so rotten as to be of little value.

The object of my invention is to overcome all these difficulties in a ready and practical manner, and at the same time to greatly lessen the cost and improve the quality of paper made from vegetable fibrous productions.

To this end it consists in first treating the

crude material with a caustic-alkaline solution, or with a solution in which caustic-alkaline properties predominate, not for the purpose of reducing the fibers to pulp, but only for the purpose of properly preparing them to be acted upon by mechanical pressure, and in then reducing them to a state of pulp suitable for paper without the aid of any further chemical reducing agents.

In order to enable others to understand and apply my invention, I will proceed to describe how I put it in practice when operating in the manner which I prefer, detailing first my preferred method of procedure for making brown paper, and next my preferred method for making white paper.

It is proper to mention that my improvements are applicable to bamboo, cane, reeds, and all other analogous jointed vegetable productions; but for the sake of convenience I n this specification speak chiefly of bamboo, because it will serve as a sufficient illustration of the entire class of such substances.

I take the crude bamboo, in the condition in which it grows in nature, and cut it into suitable lengths, leaving the joints with it, (though I sometimes split it up or otherwise open it,) and place it in a solution of caustic alkali of a strength of 1° or 2° Baumé, or thereabout. I prefer to use about ten pounds of the caustic alkali and about one hundred gallons of water to every hundred pounds of bamboo, and I usually allow the bamboo to remain in this solution until it becomes soft, though sometimes I accelerate the softening by heating the solution as much as may be desired. When the bamboo is sufficiently softened, which will be in about six days if I do not apply heat, and in from about six to twelve hours if I do apply heat, I remove it from the solution, and while thus softened I subject it to a quite powerful mechanical pressure, preferably by passing it through very heavy smooth rollers, which either may be of sufficient weight to produce the required result, or the upper roller may be loaded down so as to produce the necessary pressure, and by this means I smash the softened material not only down to that part of the plant which I have above called the "first series," but I also smash the structure of what I have above called the "second series," thus reducing the material at once and at one operation to a fiber sufficiently fine to be manufactured into paper without subsequent boiling.

Having thus smashed the material, I transfer the resulting product, which is a sort of a paste of gums and sufficiently fine fiber, to an ordinary paper-maker's rag-engine, which, as is well known, is commonly used for beating and washing rags and for mixing bleaching-liquor with material to be bleached, but which I employ for a different purpose. I raise the cylindrical wire-cloth washing-drum of this machine so that there shall be no place of exit from the engine, and I then introduce into the latter the smashed material in the condition in which it comes from the rollers, adding to it, say, about one gallon of water to each pound of the material. The alkali still contained in the material will render this water sufficiently alkaline for the desired purpose, and I now cause the material to travel round in the engine under the mild action of the roll or beater until it is thoroughly opened up from the compressed state in which the rollers left it. This operation of opening usually takes from twenty minutes to half an hour, and when it has been carried to a sufficient extent I let the material into the stock-chest below the engine, and from thence I pump it through a Kingsland engine or other equivalent grinder, and then to the paper-machine, where it may be made into paper in the usual way, gums and all, as I find that when strength is desired in the manufactured product, without regard to color or appearance, the gums give a body and strength to the material, and in the manner I have described I am able to obtain from every one hundred pounds of bamboo fully eighty-five to ninety pounds of good tough paper.

But when I wish to produce a fine white paper, I first place the crude material in a solution of caustic alkali of a strength of, say, 5° Baumé, or thereabout, employing about twenty pounds of the caustic alkali and about one hundred gallons of water to every one hundred pounds of the vegetable fibrous material. I leave the latter in this solution until it has become soft, and then pass it through rollers or subject it to other equivalent mechanical pressure in the same manner as that already described in relation to the brown paper. I next, as also above directed, transfer the smashed material to the beating-engine, raising the washer of the latter, as before, and after causing the material to travel around, as above mentioned, under the mild action of the roll or beater in order to open it up, I lower the washer and turn on the wash-water, when it will be found that the gums will be carried off with the outgoing water from the engine. This operation of removing the gums is greatly aided by the result of the mechanical pressure employed to break down the structure of the second series, because this pressure so disintegrates the gums that they are divided up into extremely fine particles, which readily pass off, as described, while the pure fiber remains in the engine. This fiber may next be thoroughly washed, and it will then be ready for bleaching by a chlorine or other suitable solution, and after being bleached and again properly washed so as to remove all traces of the bleaching-liquid the material may be pumped through the Kingsland engine or other equivalent grinder, and then into the paper-machine, to be fabricated into white paper in the ordinary manner.

The practical advantages of my improved process will be found to be very great, inasmuch as by its means a weak caustic alkaline solution produces the required softness of the

material and destroys the close affinity of the gums for the fiber, while by other methods it would be necessary to use a solution from six to ten times as strong as the solution I propose, and to employ great heat in addition, in order to eat up or destroy the gums. Moreover, the fiber is by my process much more uniformly set free, and the material is much more uniformly reduced than can be effected by a boiling process. Again, by my method of operation the fiber is not injured, weakened, nor dyed by the action of long boiling or great heat, and, by reason of being separated from its surroundings by mechanical means only, remains after separation in as soft a state as that in which it is found in nature.

It will therefore be evident that the great results of my invention are that while, more especially in the case of bamboo, it requires an excess of caustic alkali, coupled with great heat, to disolve or eat up the gums, a comparatively weak caustic alkaline solution will by my process penetrate the material and soften and destroy the brittle nature of the gums and break up their above-mentioned close affinity for the fiber, and thus enable material softened in this manner to be readily reduced to pulp by mechanical action, hence dispensing with a large portion of the chemical solution heretofore considered necessary, while at the same time the product is much improved because great heat has not been required to reduce it.

I wish it to be understood that I do not limit myself to any particular mode of applying the caustic-alkaline solution or solution wherein caustic alkaline properties predominate, which I employ, as above stated, for the purpose of merely preparing the material to be mechanically reduced in the manner described; nor do I limit myself to any particular mode of applying the mechanical pressure in order to reduce or to aid in reducing the material which has been thus prepared.

I do not claim the use of a caustic-alkaline solution to reduce vegetable fibrous material to pulp, for I am aware that such a solution, in connection with heat and boiling, is commonly adopted for that purpose; nor do I claim the use of rollers or other equivalent mechanical pressure for breaking down fibrous material in a crude state, nor for breaking down material which has been acted upon by simple heat and moisture or fermentation; neither do I claim rollers or equivalent mechanical pressure for reducing fibrous material which has been brought, by being pickled in acid and lime, to a state of coarse fiber, or to what I have herein called the "first series" of fiber; but,

Having thus described my invention, what I do claim as new, and desire to secure by Letters Patent, is—

1. The above-described process of converting vegetable fibrous material into pulp by first applying to the material a caustic-alkaline solution, or a solution in which caustic-alkaline properties predominate, in order to prepare the material to be acted upon mechanically, and then reducing such material so prepared to pulp by mechanical action, or its equivalent, substantially in the manner set forth.

2. The process of treating crude vegetable fibrous material by a caustic-alkaline solution, or a solution in which caustic-alkaline properties predominate, when such treating is not for the purpose of reducing the material to pulp by dissolving its gummy portions, but is for the purpose of simply softening the material.

3. The process of subjecting vegetable fibrous material to mechanical pressure for the purpose of reducing or disintegrating such material, when it has previously been treated with a caustic-alkaline solution, or with a solution in which caustic-alkaline properties predominate, substantially in the manner described, whether the material is afterward further reduced or not.

4. The process of making coarse paper from vegetable fibrous productions by separating the fibers without dissolving or removing the gums, so that the gums shall enter into and form a part of the paper, substantially as set forth.

CHAS. HEATON.

Witnesses:
JNO. BUTLER,
CHAS. M. DE LACY.