UNITED STATES PATENT OFFICE.

CHARLES M. CRESSON, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO ROBERT P. DECHERT, OF SAME PLACE.

IMPROVEMENT IN THE MANUFACTURE OF PAPER-PULP FROM STRAW.

Specification forming part of Letters Patent No. 116,933, dated July 11, 1871.

To all whom it may concern:

Be it known that I, CHARLES M. CRESSON, M. D., of the city of Philadelphia and State of Pennsylvania, have made an invention of Improved Processes for the Manufacture of Paper-Pulp from Straw; and I now declare the following to be a true and accurate description of the said invention.

The object of the invention is to produce a fibrous mass from straw which shall be capable of being felted and formed into sheets and suited for paper making, and, when desired to be of a white color, to be easily bleached; the production of such a pulp to be accomplished with the least expenditure of time, labor, fuel, alkali, and bleach, the process being capable of such modifications as will admit of the relative adaptation or proportioning of these expenditures so as to suit the changes of the market value of each element, from time to time, and thus to secure the most economical results. The invention consists in the combined use of a water-bath in an open vessel, or under pressure, together with boiling in caustic or carbonated alkaline solutions, either under pressure or in an open vessel, as hereinafter described; bleach to be used with the product when desired.

By experiment I have ascertained that, by boiling straw in ordinary soft-water, we can extract a certain amount of its substance, amounting in some instances to more than seventy per cent. of its weight, the amount depending upon the volume of water used and upon the duration of the boiling and the temperature to which the solution is subjected. The straw, when subjected to the treatment of boiling in a moderate amount of water and at not too high a temperature, loses its bright color and characteristic rigidity, and becomes changed into a soft and pliant material which will easily split into filaments, but which will not without further chemical treatment be converted into suitable pulp or easily whiten by the application of bleach, and is not fit to be formed into white paper. If this boiling in water is made at too high a temperature the straw will be broken up into a fibrous mass of dark color, which cannot be converted into a pulp fit for white paper by means of subsequent treatment with a moderate percentage of alkali or bleach. I have also found that the matter extracted from straw by boiling in water has acid reactions, and that it will neutralize a considerable amount of alkali. I have also found that the acid solution produced is capable of dissolving portions of the intercellular matter of the straw which are not so readily dissolved either in water or solutions of caustic or carbonated alkali. I have further found that, by treating straw with a proper amount of water for a longer time at a low temperature, or for a shorter time at a high temperature, we are enabled to produce a good pulp by boiling the resultant product in a solution containing a much less percentage of caustic or carbonated alkali than is necessary when the straw is treated only by caustic-alkali solutions, and at a lower temperature than by any other means known to me, and that the said pulp will whiten with less percentage of bleach than any pulp produced at similar temperatures, and by the use of an equal percentage of alkali. Furthermore, I have found that by the combined use of a water treatment at a high temperature, and the use of an alkaline bath of much less percentage of caustic alkali than is now employed, also at a high temperature, a pulp is produced from straw that will whiten with a less percentage of bleach than that produced by any process now known to me; and that by properly proportioning the amount of water used, and the pressure, and the percentage of caustic or carbonated alkali used, and the temperature, we can obtain from straw a greater percentage of pulp fit for making good white paper than can be obtained by any other process or processes that I have a knowledge of.

I take any given amount of straw and (after washing it and cutting it into short pieces, or not, at pleasure) place it in a boiler with from six to nine times its weight of water—say seventy to one hundred and ten gallons of water to one hundred pounds of straw—and boil it from two to ten hours in an open boiler, (keeping up the supply of water as lost by evaporation,) or from thirty minutes to three hours in a closed boiler, at any temperature that is convenient, say from zero to one hundred and fifty pounds per square inch. The temperature and volume of water and time of boiling determine the amount of alkali and the temperature necessary for the second part of the process, and greatly influence the percentage of pulp obtainable. The less the amount of extractive matter (within the limits hereinafter in-

dicated) removed by the water, the greater is the amount of alkali and temperature necessary to produce a pulp that will whiten with a given percentage of bleach. I do not limit myself to the exact amount of water as herein expressed in which the straw is to be boiled; for, in order to produce the most economical results, it is necessary to adapt it to the age and condition of the straw to be treated. In the operation with an open vessel, water enough should be used to remove from twelve to twenty per cent. of the substance of the straw. For the production of a finer pulp, and when the boiling in water is under pressure, the volume of water and temperature should be so proportioned as to remove from twenty to forty per cent. of the substance of the straw. The volume of water to be employed, as before specified, I have found suitable for use with good dry wheat and rye straw from six to twelve months old, and from which the knots have not been removed. If the boiling in water is carried on in such a manner as to remove more than forty-five per cent. of the substance of the straw the percentage of the pulp obtained will be very much diminished, and without a corresponding useful diminution of the alkali necessary for the second part of the treatment, or of the bleach necessary to whiten the pulp. And if the boiling be carried on with such a volume of water, and at such a high temperature as to break up the structure of the straw and to reduce it to filaments or fibers, it will be found that the result cannot be easily converted into a pulp fit for white paper by subsequent treatment with alkali or bleach, or both combined. I find that the best results can be obtained by the employment of from fifty-five to eighty pounds to the square inch, as a "high" pressure for either the first or second part of the treatment, and that the only advantage in using a higher pressure is to shorten the time of treatment necessary, and that, as a general rule, the use of such higher pressures entail a percentage of loss by the mechanical detachment and separation of the more minute vessels in the pulp, so that they pass off in the water employed to cleanse the pulp in subsequent stages of its preparation. I have found that, by boiling straw in an open vessel for ten hours with nine times its weight of water, I could, by boiling the result in a solution of caustic soda (NaO) containing of caustic soda an amount equal to fourteen per cent. of the weight of the straw, produce a pulp at forty-five pounds pressure (about 300° Fahrenheit) that would whiten with less than twenty per cent. of its weight of bleach; and that, by boiling straw in seven times its weight of water, at a pressure of one hundred to one hundred and twenty pounds per square inch, for half an hour to an hour, and again boiling the result in a solution of caustic soda (NaO) containing of caustic soda an amount equal to eleven per cent. of the weight of the straw, for two hours, at a pressure of seventy pounds, I could produce a pulp that would whiten with less than twelve per cent. of its weight of bleach. The straw is best prepared by cutting into small pieces and washing it, although neither operation is absolutely necessary. It is then to be subjected to the process of boiling in water, as before described, either in an open vessel, or under pressure; the water is then to be drawn off or blown off, and while the material is still hot the alkaline solution is to be run on, and the second part of the treatment gone on with.

I have allowed the resultant material from the water boiled to become dry between the stages of the process, but it is much better not to do so. As soon as the material is sufficiently boiled in the alkaline solution it can be treated by any preferred mode for disintegrating, screening, washing, and bleaching. By boiling straw in the larger volume of water and at a high pressure (over fifty-five pounds) we obtain a result which, if treated with a solution of caustic alkali containing of caustic soda (NaO) an amount equal to ten or twelve per cent. of the original weight of straw, also at a high pressure, we obtain a moderate percentage of pulp which will readily whiten with a small amount of bleach, and will make a soft and fine white paper. By boiling straw with about seven times its weight of water at a pressure of sixty to eighty pounds to the square inch, from thirty minutes to an hour, and blowing out the solution, and then boiling the resultant product in a solution of caustic alkali containing of caustic soda (NaO) an amount equal to ten or twelve per cent. of the original weight of straw, at a pressure of forty-five to fifty pounds to the square inch, we obtain a larger percentage of pulp, and one that will whiten readily with a moderate amount of bleach.

To produce a pulp from which an ordinary paper can be made—one not required to be of a pure white color—it is only necessary to make the boiling in water in a large volume of water, and in an open vessel, and to boil the result in a caustic alkaline solution, at any pressure above atmospheric pressure, (the less the pressure the greater percentage of pulp obtained,) or to boil the straw in a smaller volume of water, at any pressure above atmospheric pressure, (212° Fahrenheit,) and then to boil the result in a solution of caustic alkali, in an open vessel.

To produce a pulp that will make a fine and soft white paper from straw alone requires that both boilings be made under pressure, and, if both be made at a pressure giving a temperature above 310° Fahrenheit, a minimum of alkali and bleach will be required; but, at temperatures above 310° Fahrenheit, the yield of pulp diminishes considerably, and such temperatures should only be used when great economy of time and of bleach is necessary, and a very soft white paper is desired.

I find it useful to run or blow the acid liquor (obtained by boiling the straw in water) through the straw that is about to be subjected to the process of boiling in water, and that it is useful, after having blown off the acid liquor, to blow or run the waste alkaline solution over the result, (obtained from the straw by boiling it in water,) to insure the removal or neutralization of the acid extract, which would otherwise neu-

tralize and render inefficient a portion of the alkali employed in the second part of the process. The waste solution retains sufficient alkaline properties to neutralize the acid solutions remaining in the interstices of the material about to be subjected to a boiling in an alkaline solution. In the treatment in an open vessel the boiling may be by means of a fire beneath it, or by steam-pipes or jackets, or by jets of steam blown into or through the liquid in which the straw or material has been immersed.

I do not here claim the use of the solution produced by boiling straw in water for breaking down a second batch of straw, as it will form the subject of another application for Letters Patent; but

I claim—

The production of a pulp from straw, by a process in which two branches or treatments solely are combined, namely, the preliminary boiling in water in the manner described, followed by subjecting the product to caustic or carbonated alkali, as set forth.

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

CHARLES M. CRESSON, M. D.

Witnesses:

HENRY LEFFMAN, M. D.,

WM. A. STEEL.