E. E. WERNER.

METHOD OF TREATING STRAW AND THE LIKE FOR MAKING PAPER PULP.

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1,347,979. Patented July 27, 1920.

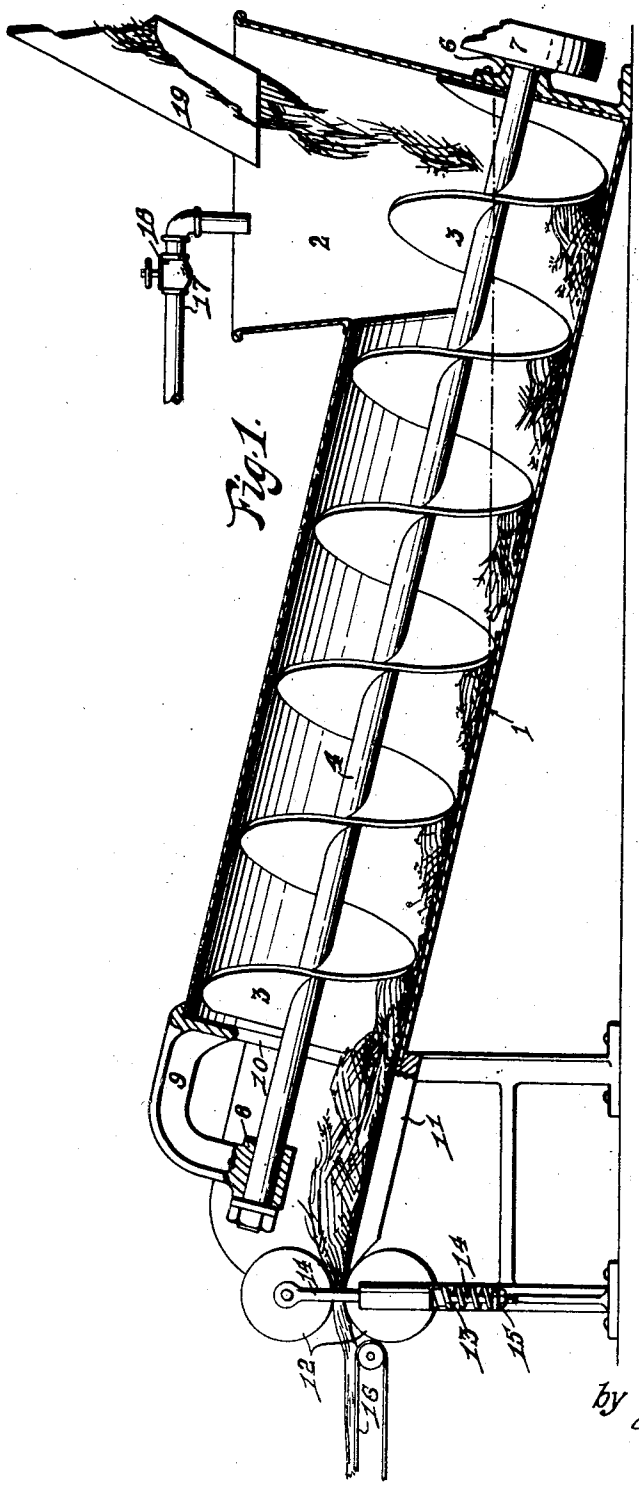


Fig. 1.

Inventor
Ernest E. Werner.
by Elliott & Ammen
his Attys.

UNITED STATES PATENT OFFICE.

ERNEST E. WERNER, OF ST. LOUIS, MISSOURI.

METHOD OF TREATING STRAW AND THE LIKE FOR MAKING PAPER-PULP.

1,347,979. Specification of Letters Patent. Patented July 27, 1920.

Application filed May 5, 1919. Serial No. 294,780.

To all whom it may concern:

Be it known that I, ERNEST E. WERNER, a citizen of the United States, residing in the city of St. Louis and State of Missouri, have invented new and useful Improvements in Methods of Treating Straw and the like for Making Paper-Pulp, of which the following is a specification.

This invention relates to improvements in processes for making paper and card board pulps from straw and the like. The main object of the invention is to produce from straw paper-making stocks of great strength and in more economical manner, than has heretofore been possible. Other objects will more clearly appear from the description of the invention to follow.

Paper and card board stocks in general, as well as those made from straw, and the like, in particular, have been heretofore manufactured by exposing the raw material to the action of an alkali in the presence of steam under pressure. This is usually performed in either rotary or percolating cookers and the resulting half-stock is subjected to beating after washing and the pulp produced made into card board or paper. My process is mainly concerned with the production of a half-stock, that is, the stock in the condition prior to beating.

It may be stated that straw and the like, have been cooked in the presence of divers caustic alkalis for many years. In this country, lime cooking is almost invariably practised; whereas, foreign countries have produced from straw higher grades of pulp by means of other alkaline treatments. Each of these treatments is objectionable, either in result, or on account of cost. Alkaline processes of treatment, in general, may be divided into two classes: treatment by alkaline or caustic materials of slight solubility and, *per contra*, treatment by alkaline and caustic materials of high solubility. My process concerns itself mainly with the latter class. In order that my improvements may be clearly understood a brief description of the generalities of present methods is here in order.

It has been and is the custom to place the straw into one of the above mentioned types of cookers, and to add to the charge a material excess of an alkaline solution. The straw being bulky and somewhat harsh in nature, occupies a very large space for its bulk weight. It is at first impossible to get more than about one-half of the total cooker charge into the cooker, and, therefore, this first charge is exposed to the action of the added alkaline solution and steam to soften it and permit adding other charges, which are similarly treated, until the capacity of the cooking device has been reached. As will be obvious, this is a slow, laborious process and uniform impregnation cannot be uniformly accomplished except by the use of an excess of liquor. This objection applies both to the rotary as well as to the percolating type of cooker, the former calling for excess liquor to saturate the entire charge, and the latter calling for still greater excess to maintain percolation or circulation.

In the practice of lime cooking, the excess solution or, rather, the excess alkali present and undissolved, is mainly undesirable on account of the inferior stock produced. The alkali itself is inexpensive, and recovery, therefore, not necessary.

When using expensive caustics, such as sodium hydroxid, the necessity of using excess liquor is very objectionable, since but from 25% to 40% of the alkali is used in the conversion of raw material to half-stock and the balance must be recovered to make the use of such expensive chemicals possible, in commercial practice. To make such recovery the "black liquor" is carefully collected, as is the water from the first washings, and this dilute liquid is evaporated, burned, and by suitable treatment the useful alkali recovered

I have ascertained that the effectiveness of the more soluble alkalis, for example, caustic soda, depends, within certain limitations, more upon the concentration of the solution than upon the amount of the solution employed; and that by impregnating straw with a given quantity of a solution of such soluble caustic alkali, in maximum concentration, the best results are accomplished. In other words, a given quantity of caustic soda will give the best results when applied to the straw with the minimum quantity of water necessary to uniformly impregnate the mass. Where caustic soda is now used in connection with recovery processes, the maximum recovery is from 60% to 75%. But in practising my process, it is possible to use in the first place a quantity substantially equivalent in amount to the 25% to 40% of alkali

which is lost in manufacture and the recovery process, and accomplish parallel, and, in certain respects, superior results, while obviating the economic necessity of employing any recovery process.

Primarily my process consists, therefore, in exposing straw, or the like, to the action of a caustic alkali solution of a given strength and in sufficient quantity to obtain uniform saturation and at the same time impart to the material an amount of alkali in excess of the amount required, and thereafter, and prior to the further treatment, removing from the said material the excess liquid by means of pressure and thereby imparting to each particle of the mass a regulated and uniform quantity of alkali dissolved in the minimum amount of water.

In order that my process may be more readily understood, I attach hereto a drawing of a conventional apparatus by means of which my process may be practised, the view being in longitudinal section.

Referring now to this drawing, the numeral 1 indicates a cylindrical container inclined downwardly toward its receiving end, and at said end being provided with a hopper 2. Extending throughout the length of the container 1 is a worm conveyer 3, the shaft 4 of which projects through the container at the receiving end and is mounted in a bearing 6, and beyond said bearing is provided with a pulley 7 by means of which it may be rotated. At the opposite end of the container, the shaft is mounted in a bearing 8 supported on the bracket-arm 9 which is part of a support 10, for holding the elevated end of the container. The numeral 11 indicates a base for supporting the said elevated end of the container, and suitably mounted on this base is a pair of pressure rolls 12 held in yielding contact against resistance of a coil-spring 13 acting on a pull rod 14 connected to the shaft of the upper roller. The upper roller 12 is adjusted toward the lower roller by means of the coil-spring 13 and an adjusting nut 15.

The numeral 16 indicated an endless conveyer, the receiving end of which is located adjacent to the rollers 12 and in position to receive the stock as it passes between the rollers. Mounted above the hopper 2 is a pipe 17 provided with a valve 18 by means of which a regulated quantity of the alkaline solution may be supplied to the container 1 to maintain a desired level of liquid therein, as indicated.

The numeral 19 indicates a chute for conveying comminuted straw to the hopper 2. The straw passing into this hopper drops into the caustic alkali solution and remains therein, a greater or less length of time, according to the speed of rotation of the worm conveyer 3, and the height of the liquid maintained in the container 1.

Eventually the straw impregnated with the alkali solution is forced out of the upper end of the container 1 and between the rollers 12, the latter operating to express the excess solution from the straw which immediately returns to the container 1. The amount of the solution pressed from the straw is regulated, of course, by the pressure of the rollers 12.

The mass passing from the rollers, and which may be straw which has been comminuted by means of an ordinary chaff cutter and is now impregnated with its own weight of a 3° B. solution of sodium hydroxid, will ultimately produce a bright pulp of a strength approximating "Kraft" stocks, and will be superior in strength to stock which has been impregnated in the ordinary fashion, prior to cooking, with three or four times the amount of caustic solution of the same strength, *i. e.*, 3° B. Aside from the factor of strength, the yield is materially increased. By means of my process from 2,600 to 2,800 pounds of straw will readily yield a ton of air-dried pulp of quality which can be ordinarily only obtained from 3,400 to 3,500 pounds of straw per ton of pulp.

The mass after passing the rollers, is carried by means of a conveyer to the cooker, and being in a soft mushy condition, the cooking vessel may be filled to its full capacity at once.

In proceeding according to my invention, I initially use a solution which is of the concentration desired for the final impregnation of the straw, whereby after the impregnating process, the excess quantity of the solution embodied in the straw may be expressed by mechanical pressure and immediately returned for re-use with a body of fresh straw. The straw, after being subjected to pressure to remove the excess solution, is then in the ideal condition for the cooking process, during which the alkali is consumed. As an example, it will be assumed that for each 1,000 pounds of straw, the prior ascertained quantity of caustic soda necessary to produce the desired result is 20 pounds, when maintained in a concentration of 3° B. solution. By the ordinary processes now employed, it would be absolutely impossible to uniformly saturate 1,000 pounds of straw with 1,000 pounds of this solution, the minimum quantity necessary being from two and one-half to three times the weight of the straw. By means of my process, however, and the immediate subsequent use of pressure, 3,000 pounds of 3° B. solution may be readily used, containing 60 pounds of caustic soda, but the quantity of soda in the straw, however, being immediately reduced by means of pressure to 20 pounds. Furthermore, by the practice of this process and the use of a concentrated

solution in the first place, the knots in the straw, which are difficult to saturate, and, therefore, take a longer time in cooking than the body of the straw, will receive their proper impregnation, and in consequence a uniform conversion of the straw into half stock may be accomplished in the minimum time.

I claim:—

1. The method of treating straw, and the like, for producing paper pulp, which consists in subjecting the material to the action of an excess of an alkaline solution and thereafter, and before further treatment, expressing excess solution to reduce the alkalinity of the material to a given degree.

2. The method of treating straw, and the like, for producing paper pulp, which consists in impregnating the material with an alkaline solution and thereafter, and before further treatment, subjecting the mass to mechanical pressure to cause a uniform impregnation of the material by a given quantity of the solution.

3. The method of treating straw, and the like, for producing paper pulp, whereby to impregnate the material with a predetermined quantity of alkali, which consists in first exposing the material to the action of an excess of an alkaline solution and thereafter removing excess solution by pressure.

4. The method of treating straw, and the like, for producing paper pulp, whereby to impregnate the material with a predetermined quantity of alkali in concentration, which consists in first exposing the material to the action of an excess of an alkaline solution of uniform strength, and thereafter removing excess solution by pressure.

5. The method of treating straw, and the like, in the production of paper pulp, whereby to impregnate the material with a predetermined quantity of alkali, which consists in first saturating the material with an alkaline solution, quantitatively proportioned to impart an excess of alkali to the material, and thereafter removing excess solution by pressure to reduce the quantity of alkali to the required amount.

6. The method of treating straw, and the like, in the production of paper pulp, whereby to impregnate the material with a predetermined quantity of concentrated alkaline solution, which consists in first saturating the material with an alkaline solution quantitatively proportioned to impart an excess of alkali to the material, and thereafter removing excess solution by pressure to reduce the quantity of alkali solution to the required amount.

7. The method of treating straw, and the like, for producing paper pulp, which consists in impregnating the material with an excess of an alkaline solution and thereafter expressing the excess solution and returning it for use with fresh straw.

8. The method of treating straw, and the like, for producing paper pulp, which consists in treating the material with an excess of an alkali solution, subjecting the material to mechanical pressure and thereby expressing the excess solution, and returning the latter for use with fresh material.

9. The method of treating straw, and the like, for producing paper pulp, which consists in treating the straw with an excess of an alkaline solution of given concentration, reducing the alkalinity of the mass to a required amount by expressing excess solution, and returning the latter for use with fresh material.

10. The method of treating straw, and the like, for producing paper pulp, which consists in subjecting the material to an alkaline solution of higher concentration and in greater amount than is necessary to impregnate the material with a given amount of alkali, then subjecting the impregnated mass to pressure to remove excess solution, and returning the latter to use with a fresh body of material.

11. The herein described method which consists in feeding straw, and the like, into a receptacle containing an alkaline solution in concentration sufficient to impart an excess of alkali to the material, conveying the material through said solution, passing the material through pressure devices to express excess solution therefrom, and returning the latter to the receptacle.

In testimony whereof, I have hereunto set my hand.

ERNEST E. WERNER.