

UNITED STATES PATENT OFFICE.

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BLEACHING PULP AND APPARATUS THEREFOR.

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To all whom it may concern:

Be it known that I, ROBERT B. WOLF, a citizen of the United States, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Bleaching Pulp and Apparatus Therefor; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to the bleaching of pulp or paper stock, and particularly to an apparatus wherein a dense or substantially non-fluid mixture of the pulp and bleaching agent may be rapidly and effectively treated.

In the bleaching of paper stock it has been usual heretofore to employ a mixture having a maximum concentration of pulp of approximately 6%, at which concentration the mass is substantially fluid. In bleaching the relatively fluid mixture it has been customary to employ a horizontal tank having a medial partition or midfeather about which the mixture of pulp and bleaching liquor is sluggishly circulated by one or more transversely arranged propellers. The limited concentration has been necessary in order that the mass might be circulated and agitated to secure uniform action of the bleaching agent upon the pulp. Inasmuch as the bleaching action is relatively slow under the conditions mentioned, it has been usual to heat the mass to relatively high temperatures, 110° F., for example, for the purpose of expediting the bleaching operation so far as is possible.

The bleaching operation as heretofore practiced has consumed approximately eight hours and is relatively expensive for that reason. Furthermore, the attempt to accelerate bleaching by increase of temperature results in a tendency of the cellulose to break down, thus causing an additional loss. The bleaching is also unsatisfactory because the discolored fibres commence to bleach too rapidly on the outside and the bleaching solution is prevented from thoroughly penetrating the fibre.

After a prolonged study of the conditions affecting bleaching operations, I have previously devised a method of bleaching which is described in U. S. Letters Patent No. 1,433,865, issued to me October 31, 1922. This method permits the bleaching of relatively thick pulp having a concentration of

more than 10%, the bleaching being conducted preferably at a relatively low temperature, i. e., 80° F. or lower. In accordance with this method, the thick pulp is circulated by moving it bodily in a closed circuit. Among other advantages of the method, the pulp is circulated more rapidly, a larger quantity may be treated in a given time in an apparatus of the given capacity, a larger proportion of bleaching agent may be employed, the operation may be conducted at a lower temperature, and the bleaching is materially accelerated without adversely affecting the quality of the product. In fact, it is possible to obtain a more uniformly bleached pulp by the patented method than by treatment in accordance with methods heretofore in use. The preferred apparatus for conducting the operation of bleaching thick pulp is a horizontal tank provided with a midfeather and with means for bodily conveying the pulp about the midfeather.

The object of the present invention is the provision of an improved apparatus which in some respects may be advantageously employed in treating thick pulp, the characteristic of the present application being the circulation of the pulp vertically in the tank or container therefor. The use of a vertical tank permits maximum capacity within a minimum space. Furthermore, the mechanical parts may be of lighter construction and less power is consumed in circulating the pulp therein. The method employed is substantially identical with that described in the Letters Patent heretofore mentioned, although the pulp travels vertically rather than horizontally in the tank.

Further objects and advantages of the invention will be apparent as it is better understood by reference to the following specification and accompanying drawing in which the preferred structure is illustrated. It should be understood that aside from the more important features as hereinafter set forth the details of construction may be varied to meet particular conditions.

In the drawing, Fig. 1 is a vertical section through a bleacher constructed in accordance with the invention;

Fig. 2 is a section on the line 2—2 of Fig. 1; and

Fig. 3 is an enlarged section on the line 3—3 of Fig. 2.

In carrying out the invention, the pulp

may be treated in a suitable dewatering apparatus such as a wet machine for the removal of a portion of the water therefrom, the pulp being thus reduced to a concentration of 25 to 40% for example. The pulp is then mixed with a suitable proportion of the bleaching agent which may contain 20 to 30 grams of available chlorine per liter. The mixture of pulp and bleaching agent is delivered to the tank by means of a suitable conveyor and is therein circulated until the bleaching is effected. The bleached pulp is then withdrawn through a valved opening, the bleaching agent is drained therefrom and the pulp is washed in a suitable washer. It may be diluted thereafter and passed over riffles or other devices for the purpose of separating any agglomerated material, or it may be delivered directly to the stock tanks from which it goes to the paper machine, beater room or to the wet or drying machines preparatory to shipment.

The volume of bleaching solution which is added to the pulp prior to or after its introduction into the tank should be sufficient to bring the pulp mass to the desired concentration. Concentrations as low as 10% may be effectively treated, but the advantages of the invention are developed to the fullest extent when a thicker pulp is employed. At concentrations of 10% the pulp is thick, but the treatment is preferably carried out at concentrations of 15% or more, and more successful bleaching can be conducted when the concentration of the pulp is from 18 to 25% or even higher. Of course, the preliminary dewatering of the pulp should be carried to an extent which will permit the addition of sufficient bleaching solution without reducing the concentration of the pulp below that desired for the operation.

The treatment of pulp at high concentrations is peculiarly effective in horizontal apparatus of the type disclosed in the Letters Patent above referred to. In vertical tanks certain difficulties are met owing to the tendency of the pulp mass to "hang" in a tank, thus interrupting the circulation. This interruption can be avoided, however, in the bleaching tank which is hereinafter described, by eliminating constrictions in the tank and providing for the delivery of the pulp mass to the elevator. Preferably a feeding means, which is substantially co-extensive with the area of the bottom of the tank, moves the thick pulp toward the elevator whereby it is lifted and the circulation is maintained. While it is not essential, it is very desirable that the cross-sectional area of the pulp space in the tank adjacent its bottom be somewhat larger than the area at the top. Thus the material dropping by gravity in the tank is prevented from wedging. At the bottom the material is drawn

inwardly and delivered to the mouth of the elevator whence it is moved upwardly by suitable conveying means such as worm or screw. It is also desirable, although not essential, that the pulp mass be subjected at the top of the elevator to a brushing or agitating action whereby the mass is broken up and caused to mingle for the purpose of thoroughly disseminating the bleaching agent through the mass and obtaining uniform action.

Referring to the drawing, 5 indicates a tank which may be of any desirable dimensions and which is preferably constructed of tile-lined concrete or other suitable material adapted to withstand the action of the bleaching solution. The tank may be supported upon a platform 6 and is closed at its top by a cover 7. The inner wall of the tank preferably tapers outwardly in a downward direction to a slight degree. A conveyer tube 8 is supported within the tank and preferably tapers inwardly in the downward direction to a slight degree to additionally facilitate the downward travel of the pulp mass. As will be recognized, this construction insures a cross-sectional area of the pulp space at the bottom of the tank slightly in excess of the area at the top of the tank and prevents wedging of the material.

A shaft 9 is mounted in a suitable bearing in the top 7 of the tank and carries a worm 10 within the conveyer tube 8 which forms therewith the elevator for the pulp mass. The worm 10 extends slightly below the lower edge of the conveyer tube in order that it may pick up material and lift the same to the upper part of the tank. The shaft 9 may be driven from any suitable source of power through bevel gears 11 and 12 or other power-transmitting means. Preferably a cone 13 surrounds the shaft 9 at the top of the conveyer tube 8, and the material as it is delivered by the worm 10 is forced between the cone and the upper edge of the tube, thus giving the brushing action which serves to agitate and mingle the constituents of the mass. The shaft 9 is preferably rotated at approximately fifty revolutions per minute although the speed may vary, depending upon the conditions such as the concentration of the pulp and the time in which it is desired to complete the bleaching operation.

A shaft 13' is supported on a step bearing 14 and extends through a stuffing box 15 in the bottom of the tank 5. The shaft 13' is driven from any source of power through bevel gears 16 and 17 or other power-transmitting means. A plurality of arms 18 are mounted preferably as a single casting upon the end of the shaft 13 within the tank and carry upwardly-extending ploughs 19 arranged at such an angle and in

such relation that upon the rotation of the shaft 13 the material within the tank will be moved inwardly and delivered to the mouth of the conveyer tube 8 where it is picked up by the worm 10. Preferably the ploughs 19 increase in height as they approach the shaft 13. They may, however, be uniform in size. It will be noted that the arrangement of the ploughs is such that their action is coextensive with the area of the bottom of the tank so that substantially all of the material falling to the bottom will be uniformly drawn toward the center and delivered to the conveyer. Consequently all of the material in the tank is circulated and uniformity of action is assured. The shaft 13 is rotated at the rate of approximately two revolutions per minute although this speed may vary, depending upon the conditions of operation. It is important, however, that the shaft 13 should rotate at a relatively slow speed in order that the power consumed may not be excessive. If the speeds assumed for the shafts 9 and 13 are maintained, the material will be effectively circulated without interruption, and consequently the maximum efficiency both as to time and uniformity of treatment will be accomplished.

The bleaching tank herein described is not to be confused with tanks having conical or semi-conical bottoms. In such tanks an obstruction would be offered to the descent of thick pulp, and owing to its concentration the pulp would wedge and "hang," thus rendering the apparatus inoperative at the desirable high densities. It is essential to the present invention that the thick pulp be permitted to descend freely without obstruction such as the constriction of the tank would afford. In a tank having a substantially vertical wall extending to the bottom or a wall which flares outwardly in the downward direction, the pulp will descend freely, and consequently the continuous operation of the apparatus and the bleaching process may be maintained therein.

From the foregoing it will be observed that I have provided a bleaching tank which is capable of handling the thick pulp and that the tank, owing to its form, requires the minimum of space. Various changes may be made in the details and arrangement of the parts without departing from the invention or sacrificing any of the advantages thereof.

I claim:—

1. In an apparatus for bleaching paper pulp, the combination of a tank and means to elevate the pulp in the tank and to discharge it at the top thereof, the space between the elevating means and the wall of said tank being greater in cross section at the bottom, whereby wedging action of the pulp as it moves downwardly in the space

surrounding the elevating means is prevented.

2. In an apparatus for bleaching paper pulp, the combination of a tank, an elevator to lift the pulp in the tank and to discharge it at the top thereof, the space between the elevator and the wall of said tank being greater in cross section at the bottom, and means at the bottom of the tank to feed the pulp to said elevator.

3. In an apparatus for bleaching paper pulp, the combination of a tank, an elevator to lift the pulp in the tank and to discharge it at the top thereof, the space between the elevator and the wall of said tank being greater in cross section at the bottom, and means at the bottom of the tank to feed the pulp to the elevator and means for actuating the elevator and feeding means.

4. In an apparatus for bleaching paper pulp, the combination of a tank, an elevator to lift the pulp in the tank and to discharge it at the top thereof, the space between the elevator and the wall of said tank being greater in cross section at the bottom, and means at the bottom of the tank to feed the pulp to the elevator and means for independently actuating the elevator and feeding means.

5. In an apparatus for bleaching paper pulp, the combination of a tank having a substantially horizontal bottom, an elevator to lift the pulp in the tank and to discharge it at the top thereof, means at the bottom of the tank to feed the pulp to the elevator, and means for independently actuating the elevator and feeding means.

6. In an apparatus for bleaching paper pulp, the combination of a tank having a substantially horizontal bottom, means to elevate the pulp consisting of a tube in the tank with a worm therein to lift the pulp and discharge it at the top of the tank, the elevating tube having a substantially uniform outward flare from the bottom upwardly, whereby wedging action of the pulp as it moves downwardly in the space surrounding the tube is prevented.

7. In an apparatus for bleaching paper pulp, the combination of a tank, an elevator to lift the pulp in the tank and to discharge it at the top thereof, the wall of the tank having an outward flare in the downward direction to the bottom thereof whereby the pulp is permitted to settle freely by gravity, and means for feeding the pulp to the elevator.

8. In an apparatus for bleaching paper pulp, the combination of a tank, an elevator to lift the pulp in the tank and to discharge it at the top thereof, the wall of the tank having an outward flare in the downward direction to the bottom thereof whereby the pulp is permitted to settle freely by gravity, means for feeding the pulp to the elevator

and independent means for actuating the elevator and feeding means.

9. In an apparatus for bleaching paper pulp, the combination of a tank, means to
5 elevate the pulp in the tank and to discharge it at the top thereof, the space between the elevating means and the wall of said tank being greater in cross section at the bottom, and means at the top of the tank to cause
10 commingling of the pulp with the agent with which it is treated.

10. In an apparatus for bleaching paper pulp, the combination of a tank, means to
15 elevate the pulp in the tank and to discharge it at the top thereof, the space between the elevating means and the wall of said tank being greater in cross section at the bottom, and a cone at the top of the tank to cause commingling of the pulp with the agent
20 with which it is treated.

11. In an apparatus for bleaching paper pulp, the combination of a tank, an elevator disposed in the tank with a worm therein to lift the pulp and to discharge it at
25 the top of the tank, a plow member at the bottom of the tank arranged between the elevator and the wall of the tank to feed material to the elevator, and driving connections extending through the top and bottom
30 of the tank to drive the worm and feeding means respectively.

12. In an apparatus for bleaching paper pulp, the combination of a tank, an elevator disposed in the tank with a worm therein
35 to lift the pulp and to discharge it at the top of the tank, means at the bottom of the tank to feed material to the elevator including a plurality of arms each carrying a number of angularly disposed ploughs, and
40 driving connections extending through the top and bottom of the tank to drive the worm and feeding means respectively.

13. In an apparatus for bleaching paper pulp, the combination of a tank and an elevator including a tube disposed in the tank
45 with a worm therein to lift the pulp and to discharge it at the top of the tank, the ele-

vator tube having an outward flare from the bottom upward whereby the pulp is permitted to settle freely by gravity, and means
50 at the bottom of the tank to feed material to the elevator consisting of a plurality of arms each carrying a number of angularly disposed plows in the space surrounding the tube.

14. In an apparatus for bleaching paper pulp, the combination of a tank and an elevator including a tube disposed in the tank with a worm therein to lift the pulp and to discharge it at the top of the tank, the
60 elevator tube having an outward flare from the bottom upward whereby the pulp is permitted to settle freely by gravity in the space surrounding the tube, and means at the bottom of the tank to feed material to the
65 elevator.

15. In an apparatus for bleaching paper pulp, the combination of a tank and an elevator including a tube disposed in the tank with a worm therein to lift the pulp and to
70 discharge it at the top of the tank, the elevator tube having an outward flare from the bottom upward whereby the pulp is permitted to settle freely by gravity in the space surrounding the tube, means at the bottom of
75 the tank to feed material to the elevator and means for independently actuating the worm and feeding means.

16. In an apparatus for bleaching paper pulp, the combination of a tank and means
80 to elevate the pulp in the tank and to discharge it at the top thereof, the space between the elevating means and the wall of the tank being greater in cross section adjacent the bottom, and a plow-member operating through the space between the elevating
85 means and the wall of the tank at the lower end of the elevating means to feed material to the elevating means from substantially the entire space between the lower
90 end of the elevating means and the wall of the tank.

In testimony whereof I affix my signature.
ROBERT B. WOLF.