

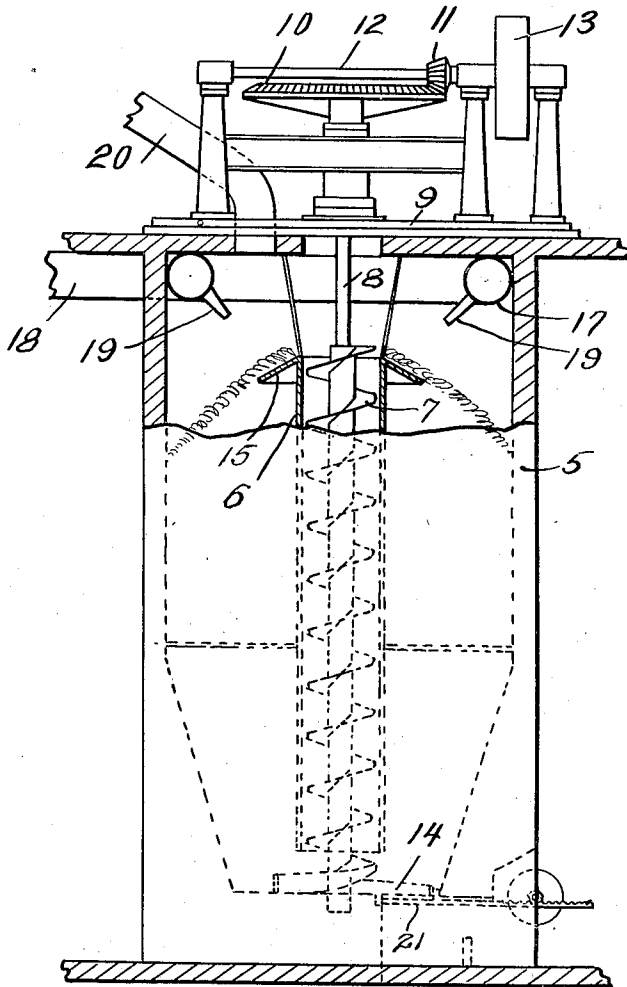
March 9, 1926.

1,576,018

R. B. WOLF

CONTROLLING BLEACHING OPERATIONS

Filed July 28, 1925



INVENTOR
Robert B. Wolf
BY
Percie Davis Mason & Edwards
his ATTORNEYS

UNITED STATES PATENT OFFICE.

ROBERT B. WOLF, OF NEW YORK, N. Y.

CONTROLLING BLEACHING OPERATIONS.

Application filed July 28, 1925. Serial No. 46,533.

To all whom it may concern:

Be it known that I, ROBERT B. WOLF, a citizen of the United States, residing at New York city, in the county of New York, State of New York, have invented certain new and useful Improvements in Controlling Bleaching Operations; 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 for paper stock, and particularly to an apparatus and method permitting the more accurate control of the bleaching operation. The invention is adapted especially for use in connection with the bleaching of relatively thick stock, that is to say, pulp containing preferably more than 10% of fibre and constituting a relatively non-fluid mass. In U. S. Letters Patent No. 1,433,865 I have described a method of bleaching pulp at such relatively high concentration. The method can be conducted in various types of apparatus, both horizontal and vertical. It depends upon the circulation of the relatively non-fluid mass of pulp and bleach liquor. Owing to the high concentration of the pulp the proportion of bleach in the bleach liquor may be considerably greater than is usual in ordinary bleaching operations and the time required to accomplish the satisfactory bleaching of the material is considerably accelerated. It is essential, however, that the temperature of the mass be maintained at a relatively low point to avoid overbleaching, the temperature being preferably in the neighborhood of 80° F. and not exceeding 90° F.

In conducting bleaching operations it is possible usually to maintain the required low temperature. Conditions arise, however, in certain cases in which the temperature of the materials entering the bleacher is already so high that the heat generated by the bleaching reaction is not eliminated with sufficient rapidity. Consequently there is a tendency for the temperature of the mass to rise above the maximum indicated. This rise in temperature accelerates the bleaching action so that a portion of the fibre becomes overbleached and is thereby weakened.

It is the object of the present invention to provide for the satisfactory control of the bleaching operation so that overbleaching is avoided. This is accomplished by the re-

moval of the surplus heat as rapidly as it is generated so that the temperature of the mass is maintained constantly at substantially the desired point.

I have discovered that the essential control can be accomplished by the introduction of air to the bleacher in sufficient volume and particularly with sufficient velocity to ensure the removal of the heat. A certain proportion of the heat can be removed as sensible heat, that is to say, by transfer to the air at a lower temperature. To increase the heat transfer the air may be cooled before it is introduced to the bleacher. It is not practicable always to cool the air and its temperature is often very close to that of the mass undergoing bleaching. It is possible, nevertheless, to remove the heat as latent heat, and in the preferred mode of operation the major portion of the heat which is withdrawn from the mass is carried off as latent heat by evaporation of a portion of the moisture content by the entering air. This evaporation is accelerated by introducing the air under a sufficient velocity and under conditions which cause it to permeate the pulp. The cooling of the pulp is thus accomplished by a combination of the withdrawal of heat as sensible and as latent heat, maximum advantage being taken of both of these methods of cooling. As the result of the application of air as indicated to the pulp, the tendency to overbleach is avoided. Notwithstanding this reduction in temperature, I have found that the bleaching action is actually accelerated because of the action of the air which sweeps the gaseous products of the bleaching reaction from the pulp so that the time required to finish the bleaching of a given quantity of pulp is reduced without danger of weakening the fibre.

By directing the air so that it impinges against the fibres of a continuously moving surface layer of the pulp, it rebounds from the surface and carries away a considerable portion of the products of decomposition directly after they are formed during the bleaching operation.

In the preferred method of conducting the bleaching operation a vertical type bleacher is used, the bleacher being provided with means to cause a circulation of the concentrated and substantially non-fluid pulp. This circulation may be accomplished by the provision of a vertical tube within the bleacher enclosing a screw conveyer which

lifts the pulp and discharges it at the top of the tube. From the top of the tube the pulp is distributed by an apron provided for that purpose and descends therefrom by gravity until it is again picked up by the conveyer. In such an apparatus the pulp which has been previously dewatered to a concentration of approximately 25 to 40%, is mixed with a suitable proportion of the bleaching agent which may contain, for example, from 20 to 30 grams of available chlorine per liter. The amount of bleach in the bleaching liquor so added will vary with the character of the pulp. The amount of bleaching liquor to be added will depend upon the concentration of the pulp and should be such as to produce a pulp mass containing preferably more than approximately 12% of pulp. The bleach is most effective when the pulp mass has a concentration of from 18 to 25% although it is possible to treat the pulp at even higher concentrations.

The mixture of pulp and bleaching liquor is caused to circulate in the bleacher by being lifted continually and discharged into the space surrounding the conveyer. During this operation the temperature of the mass should be maintained preferably at about 80° to 85° F., and in any event at not materially exceeding 90° F. So long as the bleaching liquor and pulp enter the bleach at a sufficiently low temperature no difficulty will be experienced in avoiding high temperatures. If, however, the bleaching liquor and pulp enter at temperatures of from 85 to 90° F. the temperature of the pulp mass will tend to rise and it may reach a temperature of 105° F. or higher. Such a rise in temperature is accompanied by overbleaching of the fibre and weakening thereof.

To avoid overbleaching air is introduced to the bleacher preferably at the top thereof and is caused to impinge at a relatively high velocity upon the pulp as it is discharged from the conveyer. This is accomplished readily by providing a pipe of suitable size to convey the required volume of air with nozzles directed upon the pulp as it flows over the apron at the top of the conveyer. The entire exposed surface of pulp from the conveyor tube to the side of the tank constitutes a relatively thin layer of fibrous lumps. This surface layer is continuously being renewed as the additional pulp is discharged from the tube. The newly discharged pulp spreads out, as a new surface layer, while that portion of the pulp formerly constituting layers is permitted to descend in circulation. The amount of air is calculated with reference to its temperature and relative humidity as it enters the bleacher and the required drop in temperature therein. Thus in a bleacher of 4 tons capacity with the materials centering at

about 85° F., it is desirable to introduce air at a velocity of approximately 4000 feet per minute through about thirty nozzles having a diameter of approximately 3 inches at their outward ends. This requires an air pipe of about 16 inches in diameter and a source of air under a sufficient pressure to maintain the delivery of air to the pulp at the indicated velocity. If the air enters the bleacher at a relative humidity of approximately 50%, it will be discharged with a humidity of about 80%, indicating thus the evaporation of moisture in the pulp. This evaporation of the moisture is accompanied by a drop in temperature of approximately 15° F. and the pulp is thus maintained at a temperature sufficiently low to avoid the effect of overbleaching. The amount of heat to be withdrawn in any case will depend, of course, upon the particular conditions existing in the bleacher and these in turn are affected by the temperatures of the materials entering the bleacher. In conducting the operation, therefore, it is necessary to consider the conditions in each specific case and to so regulate the flow of air to the bleacher as to ensure the desired reduction of temperature therein and the maintenance of the pulp at a substantially uniform temperature which is adapted to permit the most effective bleaching without loss of fibre strength. The air entering the bleacher must, of course, be withdrawn and for that purpose it is sufficient to provide an outlet pipe of suitable size, for example, approximately 22 inches in diameter so that it can pass freely therethrough to the atmosphere.

Since the major portion of the heat is withdrawn by the evaporation of moisture and the conversion of heat into latent heat of vaporization, it is essential to the efficient operation of the method that the air be directed upon the pulp at a sufficient velocity and under such conditions that the surface lumps of pulp are blown apart and the air is permitted to circulate in contact with the fibers thereof. The contact of the air with the fibers permits maximum evaporation and ensures the utmost efficiency in the removal of moisture from the pulp, and a consequent maximum reduction in temperature. This is accomplished most satisfactorily in the apparatus hereinafter described embodying features which have been mentioned. In this apparatus the air nozzles are directed upon the apron in close proximity thereto and as the pulp flows over the apron it is thoroughly aerated, all of the fibre being subjected more or less to contact with the streams of air impinging thereon.

The enormous evaporating and cooling area presented by the fibers which protrude from the surface lumps of pulp enable the impinging streams of air to not only absorb moisture with great rapidity, but also

to sweep off from the fiber surface considerable of the volatile decomposition products which are formed during the bleaching operation. It is the presence of these decomposition products which slows down the bleaching action, particularly at the last end of the period when the bleaching agent is nearly exhausted, and I have discovered that their removal by the impingement of a large quantity of rapidly moving air so hastens the bleaching action that it is entirely unnecessary to apply heat to obtain a bright colored pulp.

The accompanying drawing is a cross-sectional view of one form of apparatus adapted for the practice of the invention. Other types of apparatus may be employed, the invention being applicable in the manner hereinbefore indicated wherever it is essential to control bleaching, and particularly to reduce the temperature to which the pulp tends to rise during the bleaching operation.

Referring to the drawing, 5 indicates a vertical tank preferably constructed of concrete or other suitable material adapted to withstand the action of the bleaching liquor. A tube 6 is supported within the tank and encloses a screw conveyor 7 which is supported on a shaft 8 mounted in suitable bearings on a cover 9 of the bleacher. The shaft is adapted to be driven through a bevel gear 10 and bevel pinion 11, the latter being supported on a shaft 12 having a pulley 13 or other means of transmitting power. A scraper 14 is disposed at the bottom of the tank 5 to draw the material into the tube 6 and thus to permit lifting thereof through the tube to the upper end thereof. An apron 15 is supported at the upper end of the tube and the pulp is discharged thereon and flows therefrom into the mass which is maintained in the bleacher and which circulates constantly under the action of the conveyor.

A circular pipe 17 is disposed in the top of the bleacher and is adapted to be supplied with air under suitable pressure through an inlet 18. A plurality of nozzles 19 are directed from the pipe 17 toward the apron 15. These nozzles are preferably of slightly smaller diameter at their outlets so as to increase the velocity of the air flowing therefrom. A discharge pipe 20 passes through the top 9 of the bleacher to deliver the air after it has absorbed moisture to the atmosphere. A discharge valve 21 is also provided at the bottom of the bleacher for the removal of the pulp after it has been sufficiently bleached.

In the apparatus as described the constantly circulating pulp containing the bleaching liquor is discharged over the apron. During its passage through the bleacher heat is generated by the action of the chlorine and the temperature of the mass tends to rise. If the temperature is

already somewhat high the increase in temperature will cause a too violent bleaching action and consequent weakening of the fibre. This effect is avoided, however, by the action of the air flowing from the nozzles and impinging upon the pulp as it passes over the apron. The air brushes out the fibre on the apron and in contacting therewith evaporates a portion of the moisture content, the water vapor being absorbed by the air and passing therewith through the discharge pipe. The evaporation of the moisture absorbs heat from the mass and the temperature is reduced materially. If the air entering the bleacher is lower in temperature than the pulp in the bleacher, it will absorb heat in its passage there-through causing a reduction in temperature of the pulp mass. This reduction, due to withdrawal of sensible heat, can be augmented if desired by cooling the entering air. The most effective cooling is, however, accomplished by the withdrawal of heat as latent heat of vaporization and this is controlled by the velocity of the air as it impinges upon the pulp. By increasing or decreasing the velocity of the air the amount of cooling can be varied to meet the required condition and to maintain a substantially constant temperature within the bleacher. This ensures the maximum effectiveness of the bleaching operation.

It is customary at the time when the bleacher is being filled with pulp, to add the bleach liquor, and during this filling period this mixture of pulp and bleach liquor passes over the apron, as a result of which it falls off the edge of the apron into the main body of the pulp below. As the mixture showers off of the apron in fibrous lumps, the air from the nozzles strikes these lumps, causing rapid evaporation. The velocity of the air being approximately 4,000 feet per minute, the entering air, because of the nozzle effect, is carried down with the pulp and finally escapes from the bleacher through the vent pipe, after having absorbed both moisture and volatile decomposition products.

It should be noted that as a large part of the bleaching action takes place immediately after the bleaching agent is added to the pulp, it is therefore quite advantageous to impinge air upon the pulp as it showers from the apron of the conveyor tube. In this way, most of the heat of chemical combination generated during the filling period is removed. As pointed out in my previous patent referred to above, it is especially desirable to keep down the temperatures during the early part of the bleaching operation.

During the filling operation and also after the bleacher is filled, a portion of the air containing free oxygen is trapped in

the spaces between the lumps of pulp, and because of the non-fluid character of the pulp mass this air cannot escape; consequently it is carried downward due to the movement of the pulp where it finally comes under the influence of the scraper. These entrapped bubbles of air being under pressure because of the weight of the overlying mass of pulp, are brought into intimate contact with the fibers at this stage of the bleaching cycle when the bleaching action is being augmented by the mechanical action of the scraper. These bubbles of air, saturated with moisture and decomposition products, are continuously being carried up the conveyor tube and discharged from the top thereof, after which they escape through the vent pipe.

Various changes may be made in the details of operation including the method of applying the air to the pulp as well as in the apparatus employed for the purpose without departing from the invention or sacrificing any of the advantages thereof.

I claim:

1. The method of controlling the bleaching of paper pulp, which comprises subjecting the mixture of pulp and bleaching agent to the action of cooled air.
2. The method of controlling the bleaching of paper pulp, which comprises causing streams of air substantially free from the gaseous decomposition products of the bleaching reaction to impinge upon the mixture of pulp and bleaching agent.
3. The method of controlling the bleaching of paper pulp, which comprises causing the mixture of pulp and bleaching agent to pass in a relatively thin layer in contact with a directed current of air substantially free from the gaseous decomposition products of the bleaching reaction.
4. The method of controlling the bleaching of paper pulp, which comprises causing the mixture of pulp and bleaching agent to pass in a relatively thin layer in contact with air substantially free from the gaseous decomposition products of the bleaching reaction directed thereon in streams.
5. The method of controlling the bleaching of paper pulp, which comprises directing streams of air upon a flowing layer of the mixture of pulp and bleaching agent, the velocity of the air being sufficient to cause substantial evaporation of the moisture content of the pulp.
6. The method of controlling the bleaching of paper pulp, which comprises reducing the temperature of the mixture of pulp and bleaching agent by causing a thin layer thereof to be subjected to a controlled air current substantially free from the gaseous decomposition products of the bleaching reaction, for transferring heat to the air.
7. The method of controlling the bleaching of paper pulp, which comprises reducing the temperature of the mixture of pulp and bleaching agent by transfer of heat to air substantially free from the gaseous decomposition products of the bleaching reaction directed thereon as latent heat of vaporization.
8. The method of bleaching which comprises directing streams of air upon a relatively non-fluid mass of a mixture of pulp and bleaching agent containing not less than ten percent pulp for reducing the temperature of the mixture.
9. The method of controlling the bleaching of paper pulp, which comprises reducing the temperature of the mixture of pulp and bleaching agent by the action of streams of cooled air impinging thereon.
10. The method of controlling the bleaching of paper pulp, which comprises reducing the temperature of the mixture of pulp and bleaching agent by transfer of heat to cooled air in contact therewith.
11. The method of controlling the bleaching of paper pulp, which comprises reducing the temperature of the mixture of pulp and bleaching agent by transfer of heat as latent heat of evaporation from relatively thin layers thereof to air substantially free from the gaseous decomposition products of the bleaching reaction in contact therewith.
12. The method of controlling the bleaching of paper pulp, which comprises reducing the temperature of the mixture of pulp and bleaching agent by transfer of heat as latent heat of vaporization to streams of air substantially free from the gaseous decomposition products of the bleaching reaction impinging thereon.
13. The method of controlling the bleaching of paper pulp, which comprises reducing the temperature of the mixture of pulp and bleaching agent by transfer of heat as latent heat of vaporization to streams of air substantially free from the gaseous decomposition products of the bleaching reaction impinging upon a relatively thin layer of the pulp.
14. The method of controlling the bleaching of paper pulp, which comprises circulating the mixture of pulp and bleaching agent and causing a relatively thin layer of the mixture to be moved into a current of air substantially free from the gaseous decomposition products of the bleaching reaction.
15. The method of controlling the bleaching of paper pulp, which comprises circulating the mixture of pulp and bleaching agent, and causing a relatively thin layer of the mixture to be moved into the path of a current of air substantially free from the gaseous decomposition products of the bleaching reaction, which impinges thereon.
16. The method of controlling the bleaching

ing of paper pulp, which comprises circulating a relatively nonfluid mass of pulp and bleaching agent containing not less than ten percent of pulp, to a position in which it is subjected to a controlled air current.

17. The method of controlling the bleaching of paper pulp, which comprises circulating a relatively nonfluid mass of pulp and bleaching agent containing not less than ten percent of pulp, to a position in which a controlled air current impinges thereon.

18. The method of controlling the bleaching of paper pulp, which comprises circulating a relatively nonfluid mass of pulp and bleaching agent containing not less than ten percent of pulp, to a position in which a controlled air current impinges upon a relatively thin layer thereof.

19. The method of controlling the bleaching of paper pulp, which comprises circulating the mixture of pulp and bleaching agent by lifting it, permitting it to descend by gravity, and subjecting it to a current of air at the stage of the cycle between its highest point and the point where it begins to ascend.

20. The method of controlling the bleaching of paper pulp, which comprises circulating the mixture of pulp and bleaching agent by lifting it, permitting it to descend by gravity, and subjecting it to air impinged thereon in streams between its highest point and the point where it begins to ascend.

21. The method of controlling the bleaching of paper pulp, which comprises circulating the mixture of pulp and bleaching agent by lifting it, permitting it to descend by gravity, and subjecting a relatively thin layer thereof to directed air currents at the stage of the cycle between its highest point and the point where it begins to ascend.

22. The method of bleaching, which comprises introducing air to a descending relatively non-fluid mass of a mixture of the pulp and bleaching agent containing not less than ten percent pulp whereby the air is trapped and carried downward with the pulp.

23. The method of bleaching, which comprises introducing air to a descending relatively non-fluid mass of a mixture of the pulp and bleaching agent containing not less than ten percent of pulp whereby the air is trapped and carried downward with the

pulp, and subjecting the mass containing entrapped air to agitation.

24. The method of bleaching, which comprises introducing air to a descending relatively non-fluid mass of a mixture of the pulp and bleaching agent containing not less than ten per cent of pulp whereby the air is trapped and carried downward with the pulp, and subjecting the mass containing entrapped air to agitation while the air is under compression.

25. In an apparatus for bleaching paper pulp, the combination with a bleaching chamber, of means to elevate the pulp within the chamber, means through which a portion constituting the upper surface is permitted to assume a lower level, and means for directing a gas upon the surface of the pulp at a time during its passage from the upper to the lower level.

26. In an apparatus for bleaching paper pulp, the combination of bleaching chamber, a substantially vertically arranged conduit through which the pulp is adapted to be elevated and overflow therefrom, an elevator within the conduit for causing an upward movement of the pulp therein, and means for directing a gas upon the pulp as it overflows from the upper end of the conduit.

27. In an apparatus for bleaching paper pulp, the combination of a bleaching chamber, an elevator therein to lift the mixture of pulp and bleaching agent, an apron at the top of the elevator over which the pulp is discharged and means for directing gas upon the pulp as it passes over the apron.

28. In an apparatus for bleaching paper pulp, the combination of a bleaching chamber, an elevator therein to lift the mixture of pulp and bleaching agent, an apron at the top of the elevator over which the pulp is discharged and means for directing streams of gas upon the pulp as it passes over the apron.

29. In an apparatus for bleaching paper pulp, the combination of a bleaching chamber, an elevator therein to lift the mixture of pulp and bleaching agent, an apron at the top of the elevator over which the pulp is discharged, a pipe in the bleaching chamber and nozzles connected thereto to direct streams of gas upon the pulp as it passes over the apron.

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