April 8, 1930. R. B. WOLF ET AL 1,753,228

METHOD OF AND APPARATUS FOR BLEACHING PAPER PULP

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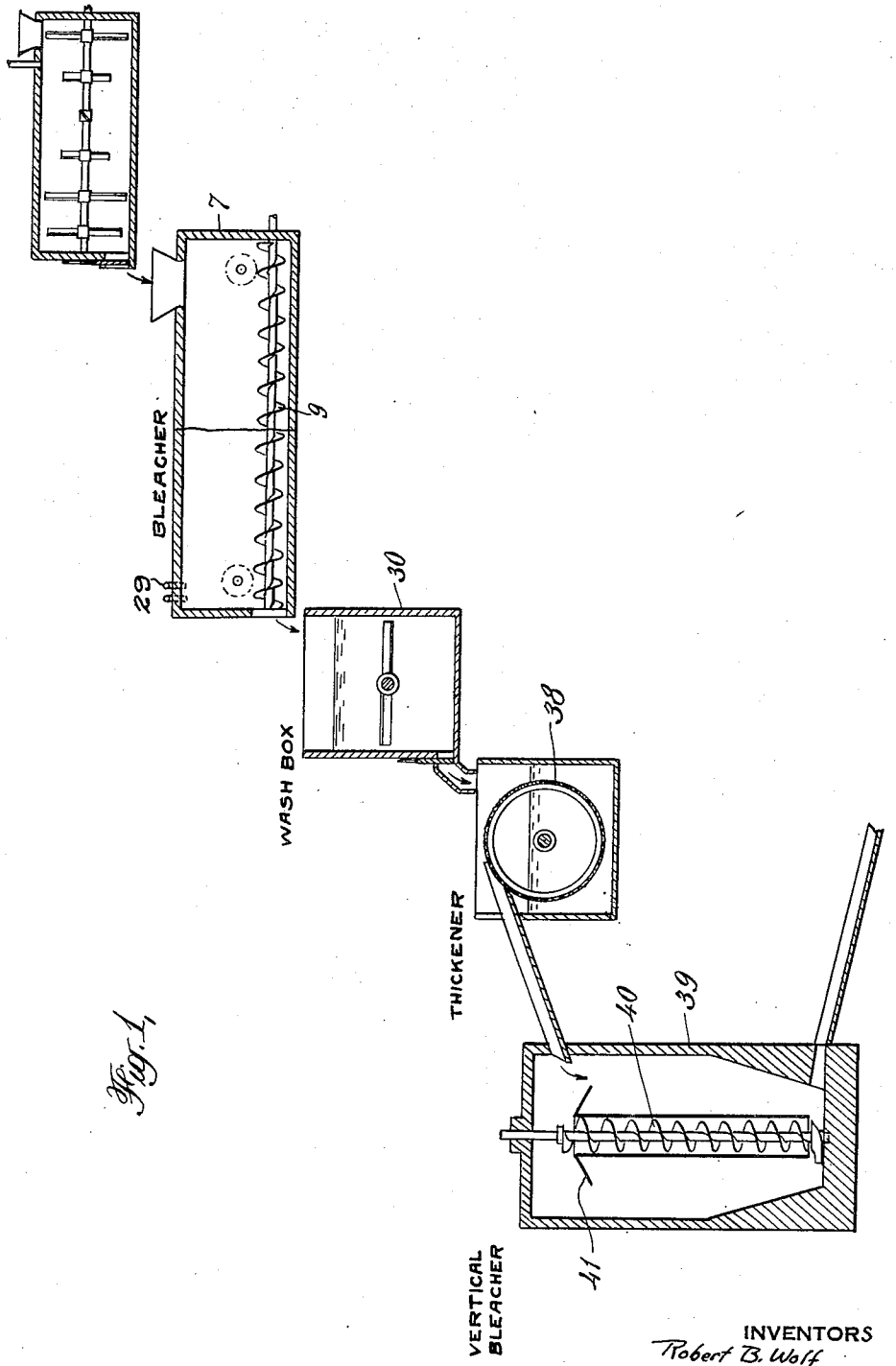


Fig. 1.

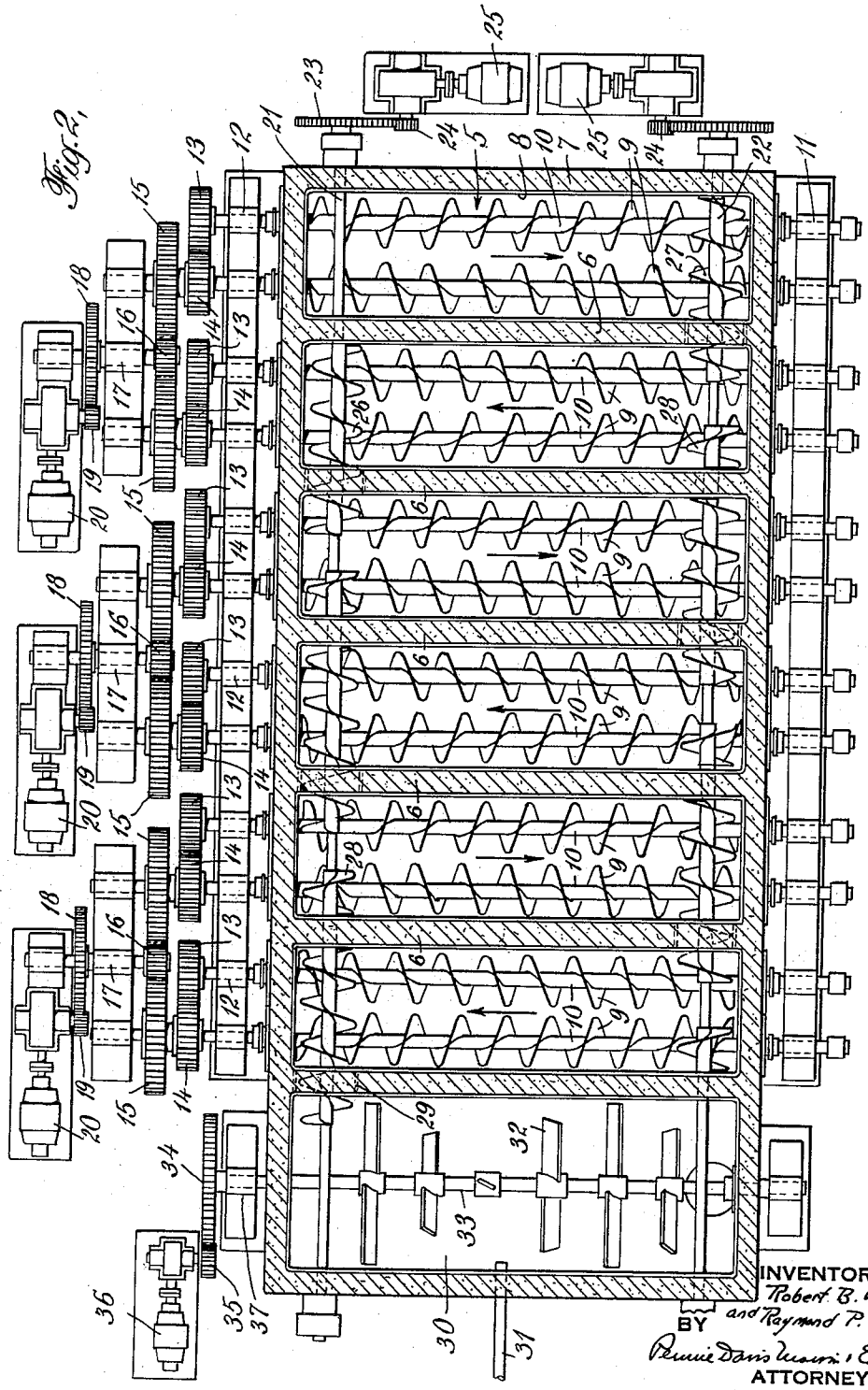
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Fig. 2.



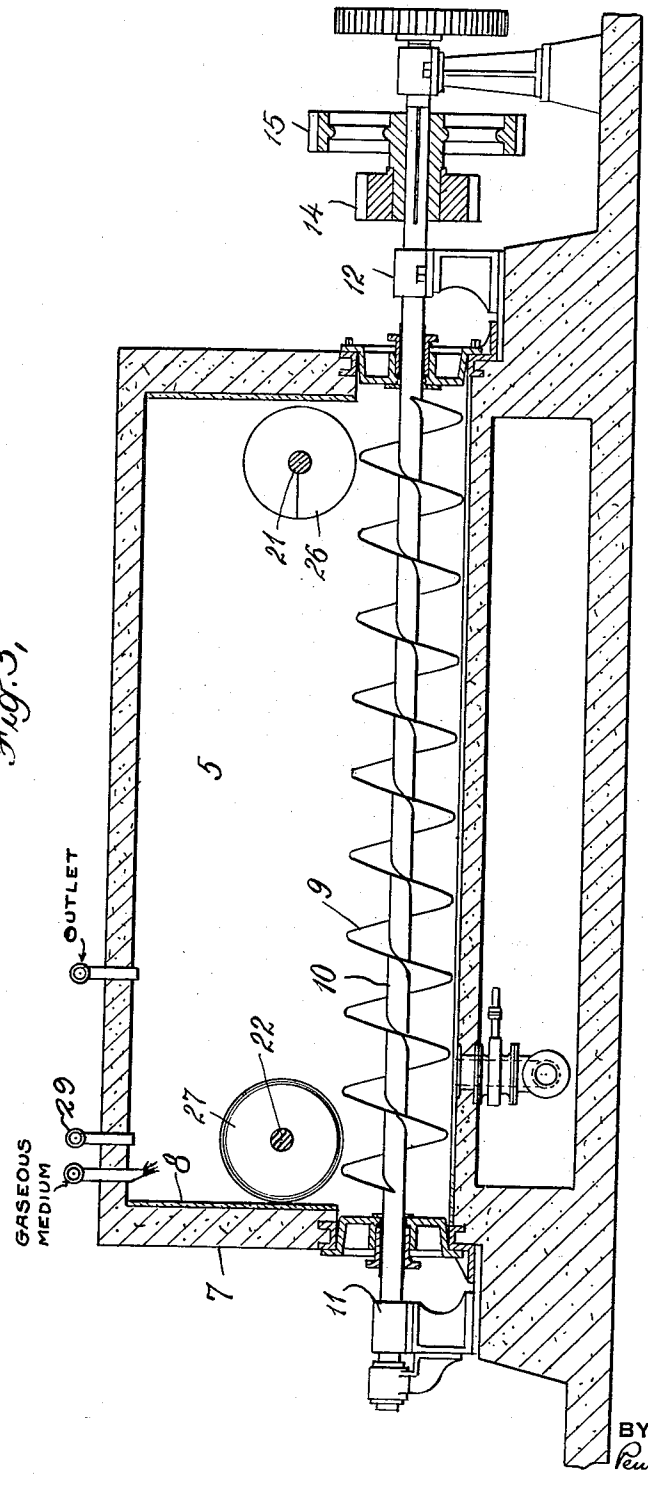
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Fig. 3.



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UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR BLEACHING PAPER PULP

Application filed October 23, 1928. Serial No. 314,439.

This invention relates to the bleaching of pulp or paper stock, and particularly to a method and apparatus for treating such material to accomplish the desired bleaching more effectively.

The invention relates especially to the continuous treatment of paper pulp at high concentrations, i. e. above 10% and preferably upward to 30% or even higher. At such concentrations the bleaching action is rapid because of the high strength of the bleaching solution. Consequently it is difficult to secure uniform action of the bleaching reagent and to produce pulp of standard color throughout without overbleaching portions of the pulp. This difficulty is met particularly when the amount of bleaching reagent sufficient to complete the bleaching action is added initially to the pulp which is thereafter caused to travel substantially without agitation through the bleaching apparatus. The pulp thus treated is usually non-uniform in color or is overbleached and thereby weakened.

It is the object of the present invention to provide an improved method and apparatus wherein concentrated pulp may be bleached continuously, rapidly and uniformly with a minimum expenditure of power and of the bleaching reagent, thus ensuring economical and satisfactory bleaching of the pulp.

A further object of the invention is to ensure intimate mingling of the bleaching reagent with the pulp and particularly to effect periodic kneading of the fibres, which we have found to be particularly advantageous in accomplishing uniform and satisfactory bleaching.

Another object of the invention is the provision of a method and apparatus wherein the bleaching action is controlled more readily to permit the production of bleached pulp of uniform and predetermined color.

Another object of the invention is the provision of a method and apparatus in which the initial bleaching of the pulp is effected continuously, the final bleaching being accomplished in a separate stage after removal of reaction products from the pulp by washing or otherwise.

The invention depends upon the continuous movement of a mixture of the pulp with the bleaching reagent, the mixture being supplied continuously and the bleached pulp being discharged similarly when the bleaching reaction is completed. It involves advancing a substantially quiescent body of the pulp and bleaching reagent through the bleaching apparatus with periodic agitation to effect the kneading of the fibres and the intimate mingling of the bleaching reagent with the pulp. The total amount of bleaching reagent required to effect either complete or partial bleaching of the pulp may be mixed with the latter before the bleaching action is initiated. Alternatively the bleaching reagent may be added in separate portions as the pulp advances at any convenient point, and preferably during one or more of the periods of agitation. The addition of portions of the bleaching reagent at intermediate stages of the bleaching reaction is desirable, particularly to permit control of the bleaching action. The operation may be further improved by the introduction of a neutral gaseous medium such as air to the mixture of pulp and bleaching reagent during the periods of agitation, the gaseous medium being caused to impinge upon the pulp for the purpose of removing gaseous reaction products from the fibre whereby a maximum bleaching effect of the reagent is ensured.

In carrying out the invention, we provide a suitable apparatus which may be embodied in various forms but which essentially includes a plurality of bleaching chambers or units through which the pulp is permitted to pass without substantial agitation. The thick pulp, being previously concentrated by any suitable apparatus to a density of, for example, 20 to 30%, may be advanced by gravity through the successive bleaching chambers. Preferably, however, these chambers are provided with suitable conveying means such as screws which cause the pulp to advance without substantial agitation. The bleaching reagent is mingled with the pulp which is introduced continuously at one end of the system to the first bleaching chamber. When the pulp reaches the opposite end of

that chamber it is picked up by a suitable conveyor which carries it into the next succeeding chamber, subjecting it meanwhile to relatively vigorous agitation to effect the desired kneading of the pulp. At the end of the second unit through which the pulp travels in a substantially quiescent state, it is again subjected to agitation and kneading. The operation may be repeated successively until the pulp has passed through any desired number of units intended and adapted to accomplish the desired bleaching effect.

In the manner described, the pulp with the bleaching reagent mingled therewith is subjected to successive periods of travel in a substantially quiescent condition, that is to say, without relative movement between the fibres constituting the mass. Such a condition is favorable to effective and rapid bleaching. It is not desirable, however, to leave the pulp in such condition for an extended period of time because of the tendency of the bleaching reagent to react non-uniformly and overbleach portions of the pulp. To correct this tendency the pulp is subjected periodically to agitation and resultant kneading of the fibres, which redistributes the bleaching reagent in the mass and facilitates the separation of gaseous reaction products which may be removed as hereinbefore indicated by the action of a gaseous medium impinging on the fibre. Following the agitation and kneading of the pulp it is again permitted to travel in a quiescent state to permit further action of the bleaching reagent after which it is again subjected to agitation. We have found that the successive periods of quiescent travel with periodic agitation ensure the maximum and most uniform effect of the bleaching reagent, and hence the economical treatment of the pulp.

It is desirable under some conditions to introduce successive portions of the bleaching reagent to the pulp while it is undergoing agitation to ensure intimate distribution of the bleaching reagent through the pulp and particularly to permit control of the reaction. The bleaching reagent may be added during all or during only selected periods of agitation. In any case, the amount of bleaching reagent initially added will be reduced in proportion to the amount which is introduced during the later stages of the bleaching operation. Thus a part of the bleaching reagent necessary to accomplish the desired bleaching effect may be introduced initially, and the remaining portion or portions may be supplied to the pulp at any stage of its travel, and particularly while the pulp is undergoing agitation following any period of quiescent travel thereof. Since the movement of the pulp is continuous, the bleaching reagent may be fed continuously at selected points in the travel thereof, or the reagent may be introduced intermittently, depending upon the observed conditions of the pulp, to correct any inequality of bleaching thereof.

We have also discovered that the bleaching action may be improved and that more uniform action can be secured by subjecting the pulp undergoing bleaching periodically to the action of a suitable gas such as air, which may be caused to impinge upon the pulp in such a way as to blow the fibres apart and to remove therefrom the products of the bleaching reaction which tend to accumulate on the fibres and to retard further bleaching. The introduction of the gas is effected most satisfactorily at the ends of the successive bleaching units, so that the pulp, while being agitated by suitable mechanical means such as a screw or beater arms, is simultaneously subjected to the scouring action of the gas which carries away the gaseous reaction products and leaves the pulp in condition to react most favorably with the bleaching reagent. The introduction of the gas has a further advantage in that it tends to reduce the temperature of the pulp in case of any tendency to overheat, so that the pulp may be maintained readily at a temperature preferably not exceeding 90° F., at which temperature it is practicable to effect the desired bleaching. It is desirable to avoid overheating because of the destructive effect upon the fibre.

The pulp, either wholly or partially bleached in accordance with the invention, is discharged continuously from the last bleaching unit and may be diluted immediately with a sufficient quantity of water to reduce the concentration materially, for example to about 2%. The pulp may be agitated with the water for the purpose of washing products of the bleaching reaction therefrom, whereupon the pulp may be concentrated again in an ordinary thickener, for example of the cylinder type. If the pulp has been completely bleached, it may be delivered to the machines in which it is utilized. Otherwise it may be subjected, at concentrations either above or below 10%, to further bleaching action in suitable apparatus to effect the final bleaching. We have found that in many cases the final bleaching is best accomplished in this manner, and particularly in a batch operation which is more readily controlled to produce a pulp having the desired color. At low concentration the pulp may be treated, for example, in an ordinary Belmer bleacher. At higher concentrations it may be subjected to treatment in vertical or horizontal bleaching units, and to the action of a further quantity of the bleaching reagent while the pulp is circulated in a closed path and subjected preferably to the action of a gas such as air to remove gaseous reaction products.

In the operation as hereinbefore described, it is possible to secure rapid and uniform partial bleaching of the pulp in a relatively short

time. Thus the apparatus may be so designed that the pulp will travel through each successive unit in a period of approximately 6 minutes, and if 6 units are provided, the bleaching is completed by the passage of the pulp through the bleacher in a period of between 30 and 45 minutes. In this operation two-thirds of the total quantity of bleaching reagent required to bleach the pulp completely is delivered initially or in successive portions to the pulp in the several units as hereinbefore described and intimately mingled with the pulp, thus assuring uniformity of the bleaching action. If complete bleaching is desired, the additional quantity of the bleaching reagent necessary for that purpose is added as described to the pulp, the bleacher being operated so as to allow sufficient time to complete the reaction before the pulp is discharged therefrom.

In addition to the advantages hereinbefore enumerated, the operation as described affords a pulp of maximum strength. The operation is, moreover, readily controlled to accomplish the desired bleaching effect. Thus, where only partial bleaching is required it is possible to regulate the action of the bleaching reagent in such a manner as to discharge continuously pulp of the desired color which need not be subjected to any further bleaching action to maintain a uniform color characteristic of the product.

As hereinbefore indicated, the apparatus employed in the practice of the invention may differ in form and arrangement. It may depend upon gravity for the major movement of the pulp, although preferably suitable conveyors are employed. Screw conveyors are admirably adapted for the purpose. The units in the event that conveyors are used are preferably horizontal, although vertical conveyors may be employed. Horizontal units may be arranged in vertical tiers, or they may be placed side by side. In either case provision is made between the several units to effect the agitation and kneading of the pulp during the addition of the bleaching reagent and the transfer of the pulp from one unit to the succeeding unit. Screws are used preferably to transfer the pulp but other feeding means may be employed, and suitable beating arms may be introduced to open the pulp and to mingle the bleaching reagent therewith.

The preferred form of apparatus is illustrated in the accompanying drawing in which—

Fig. 1 is a diagrammatic view illustrating the succeeding steps of a bleaching operation conducted in separate stages with intermediate washing of the pulp;

Fig. 2 is a plan view of the preferred form of bleacher; and

Fig. 3 is a transverse section through the bleacher as illustrated in Fig. 1.

Referring to Figs. 2 and 3, the bleacher may comprise a plurality of units 5, each in the form of a compartment, the units being separated by division walls 6 of a tank 7. The tank and the division walls are constructed of any suitable material, preferably concrete, and the separate units are lined with acid-resisting material such as tile 8. Each unit is provided with two worms 9 supported on suitable shafts 10 which are mounted in bearings 11 and 12 outside the bleacher. Suitable stuffing boxes are provided where the shafts pass through the walls of the bleacher to prevent leakage therefrom. The shafts are driven by gears 13, 14 and 15, a pinion 16 on a shaft 17. The latter is driven through a gear 18 from a pinion 19 which is actuated by a motor 20. Three motors are preferably provided, each driving the shafts in two of the units of which six are embodied in the structure illustrated in the drawing. It will be understood that the worms 9 in each unit are designed to convey the pulp in one direction therethrough, and that the worms in the succeeding units convey the pulp respectively in opposite directions, so that the pulp may be fed continuously through the chambers.

To effect the transfer of the pulp from each unit to the succeeding unit, shafts 21 and 22 extend through the opposite ends of the units and are adapted to be driven by gears 23 from pinions 24 which are connected to motors 25. The shafts 21 and 22 carry worms 26 and 27 which, as will be noted, are not continuous. The worms 26 and 27 operate at a relatively high speed, say 50 revolutions per minute, and are adapted to convey the pulp from the discharge end of each unit into the opposite end of the succeeding unit. Propellers 28 with shafts 21 and 22 prevent the pulp from piling up against the wall of the bleaching unit and ensure delivery thereof uniformly to the worms 9 for transfer through the unit. The rapidly revolving worms at the ends of the units violently agitate the pulp as it is delivered by the worms 9, open up the fibres and permit the intimate distribution of the bleaching reagent in the pulp. The bleaching reagent is added to the pulp in successive portions as it enters the first bleaching unit, and thereafter as the pulp is transferred to each succeeding unit, through pipes 29 provided for that purpose. It will be understood that since the movement of the pulp is continuous, the bleaching reagent must likewise flow continuously into the bleacher in an amount regulated to effect the mixing of the required proportion of the reagent with the pulp. The bleaching reagent may be of any suitable concentration, for example 20 to 30 grams of available chlorine per liter, and the flow may be regulated by any suitable device to ensure the introduction of the required quantity to each unit. The amount

of the bleaching reagent employed will depend necessarily upon the character of the pulp and the amount of bleaching to be accomplished and will be determined by the usual methods before the operation is started. Thereafter bleaching is continuous, and if the character of the pulp is unchanged no further adjustment is normally required.

The wholly or partially bleached pulp is discharged from the final unit into a wash box 30 in which the pulp is mingled with water supplied through a pipe 31 and subjected to the action of arms 32 on a shaft 33 which is driven by a gear 34 from a pinion 35. The latter pinion is actuated by a motor 36. It will be understood that the shaft 33 extends through the walls of the wash box and is supported in suitable bearings 37 with stuffing boxes to avoid leakage. The pulp is diluted in the wash box to a suitable concentration and is thereafter delivered to a thickener 38 in which the pulp may be again concentrated to any desired density.

If further bleaching is to be effected, the pulp may be delivered to a second bleaching unit, for example a vertical bleacher 39, preferably cylindrical in form and having an elevator 40 which raises the pulp from the bottom of the bleacher and discharges it over an apron 41 at the top thereof. The pulp then falls by gravity to the bottom of the bleacher and is again elevated. The amount of bleaching reagent required for the final bleaching may be introduced to the pulp as it enters the bleacher. The operation in such a bleacher is a batch operation, and the amount of bleaching reagent can be carefully proportioned, therefore, to effect the final bleaching to the desired color. A gas such as air may be introduced at the top of the bleacher and directed upon the fibres as they pass over the apron to remove gaseous products of the bleaching reaction. When the bleaching operation is completed, the pulp may be discharged, subjected to further washing and thickening and then utilized for its intended purpose.

It will be understood that other types of bleachers operating with pulp at high or low densities may be utilized for the final bleaching step, and that this step may be omitted in the event that bleaching is completed in the continuous operation hereinbefore described or if complete bleaching is not required. In either case the advantages of the invention are secured by effecting the bleaching in a continuous manner with intermittent quiescence and agitation of the pulp and the introduction of a portion of the bleaching reagent during agitation.

Various changes may be made in the details of operation and in the construction and arrangement of the apparatus employed without departing from the invention or sacrificing any of the advantages thereof.

We claim:

1. The method of bleaching paper pulp which comprises advancing a substantially non-fluid and quiescent mass of pulp and bleaching reagent and agitating the mass periodically, and discharging the bleached pulp continuously.

2. The method of bleaching paper pulp which comprises continuously advancing a substantially non-fluid and quiescent mass of pulp and bleaching reagent, agitating the mass periodically, and mingling portions of the bleaching reagent with the mass during the periods of agitation.

3. The method of bleaching paper pulp which comprises adding the bleaching reagent to the pulp in successive portions, mingling the bleaching reagent with the pulp and advancing the pulp after each successive addition of the bleaching reagent in a substantially quiescent state.

4. The method of bleaching paper pulp which comprises adding the bleaching reagent to the pulp in successive portions, mingling the bleaching reagent with the pulp and advancing the pulp after each successive addition of the bleaching reagent in a substantially quiescent state, each portion of the bleaching reagent being such as to be consumed substantially before the successive portion is added.

5. The method of bleaching paper pulp which comprises advancing the pulp continuously through successive relatively quiescent stages and mingling portions of the bleaching reagent with the pulp at intervals while the pulp is advancing.

6. The method of bleaching paper pulp which comprises advancing the pulp continuously through successive relatively quiescent stages and mingling portions of the bleaching reagent with the pulp at intervals while the pulp is advancing, each portion of the bleaching agent being such as to be consumed substantially before the successive portion is added.

7. The method of bleaching paper pulp which comprises advancing the pulp continuously through successive relatively quiescent stages, mingling portions of the bleaching reagent with the pulp at intervals while the pulp is advancing, and simultaneously subjecting the pulp to the action of a gaseous medium.

8. The method of bleaching paper pulp which comprises advancing the pulp continuously through successive relatively quiescent stages, mingling portions of the bleaching reagent with the pulp at intervals while the pulp is advancing, each portion of the bleaching agent being such as to be consumed substantially before the successive portion is added, and simultaneously subjecting the pulp to the action of a gaseous medium.

9. The method of bleaching paper pulp

which comprises mechanically conveying the pulp continuously through successive relatively quiescent stages, mingling portions of the bleaching reagent with the pulp at intervals while the pulp is advancing, and simultaneously subjecting the pulp to the action of a gaseous medium.

10. The method of bleaching paper pulp which comprises mechanically conveying the pulp continuously through successive relatively quiescent stages, mingling portions of the bleaching reagent with the pulp at intervals while the pulp is advancing, each portion of the bleaching agent being such as to be consumed substantially before the successive portions is added, and simultaneously subjecting the pulp to the action of a gaseous medium.

11. The method of bleaching paper pulp which comprises advancing the pulp continuously through successive relatively quiescent stages, mingling portions of the bleaching reagent with the pulp at intervals while the pulp is advancing, washing the pulp and subjecting it to a final bleaching operation.

12. The method of bleaching paper pulp which comprises advancing the pulp continuously through successive relatively quiescent stages, mingling portions of the bleaching reagent with the pulp at intervals while the pulp is advancing, each portion of the bleaching reagent being such as to be consumed substantially before the successive portion is added, washing the pulp and subjecting it to a final bleaching operation.

13. The method of bleaching paper pulp which comprises advancing the pulp continuously through successive relatively quiescent stages, mingling portions of the bleaching reagent with the pulp at intervals while the pulp is advancing, simultaneously subjecting the pulp to the action of a gaseous medium, washing the pulp, and subjecting it to a final bleaching operation.

14. Apparatus for bleaching pulp comprising a plurality of bleaching chambers, means in each chamber to convey the pulp bodily therethrough, and means at the end of each chamber to transfer the pulp to the succeeding chamber and simultaneously to agitate the pulp.

15. Apparatus for bleaching pulp comprising a plurality of bleaching chambers, means in each chamber to convey the pulp bodily therethrough, means at the end of each chamber to transfer the pulp to the succeeding chamber and simultaneously to agitate the pulp, and means to introduce successive portions of a bleaching reagent to the pulp.

16. Apparatus for bleaching pulp comprising a plurality of bleaching chambers, means in each chamber to convey the pulp bodily therethrough, means at the end of each chamber to transfer the pulp to the succeeding chamber and simultaneously to agitate the pulp, means to introduce successive portions of a bleaching reagent to the pulp, and means to supply a gaseous medium to the pulp simultaneously with the transfer thereof

17. Apparatus for bleaching pulp comprising a plurality of bleaching chambers, means in each chamber to convey the pulp bodily therethrough, means at the end of each chamber to transfer the pulp to the succeeding chamber and simultaneously to agitate the pulp, means to introduce successive portions of a bleaching reagent to the pulp, and means to wash the products of the bleaching reaction from the pulp after it leaves the final chamber.

18. Apparatus for bleaching pulp comprising a plurality of bleaching chambers, means in each chamber to convey the pulp bodily therethrough, means at the end of each chamber to transfer the pulp to the succeeding chamber and simultaneously to agitate the pulp, means to introduce successive portions of a bleaching reagent to the pulp, means to wash the products of the bleaching reaction from the pulp after it leaves the final chamber, and means for subjecting the pulp to further bleaching.

19. Apparatus for bleaching pulp comprising a plurality of bleaching chambers, mechanically actuated means in each chamber to convey the pulp bodily therethrough, and means at the end of each chamber to transfer the pulp to the succeeding chamber and simultaneously to agitate the pulp.

In testimony whereof we affix our signatures.

ROBERT B. WOLF.
RAYMOND P. HILL.