Sept. 4, 1962 L. E. EBERHARDT 3,052,592

PULP BLEACHING

Filed Oct. 15, 1958 2 Sheets-Sheet 1

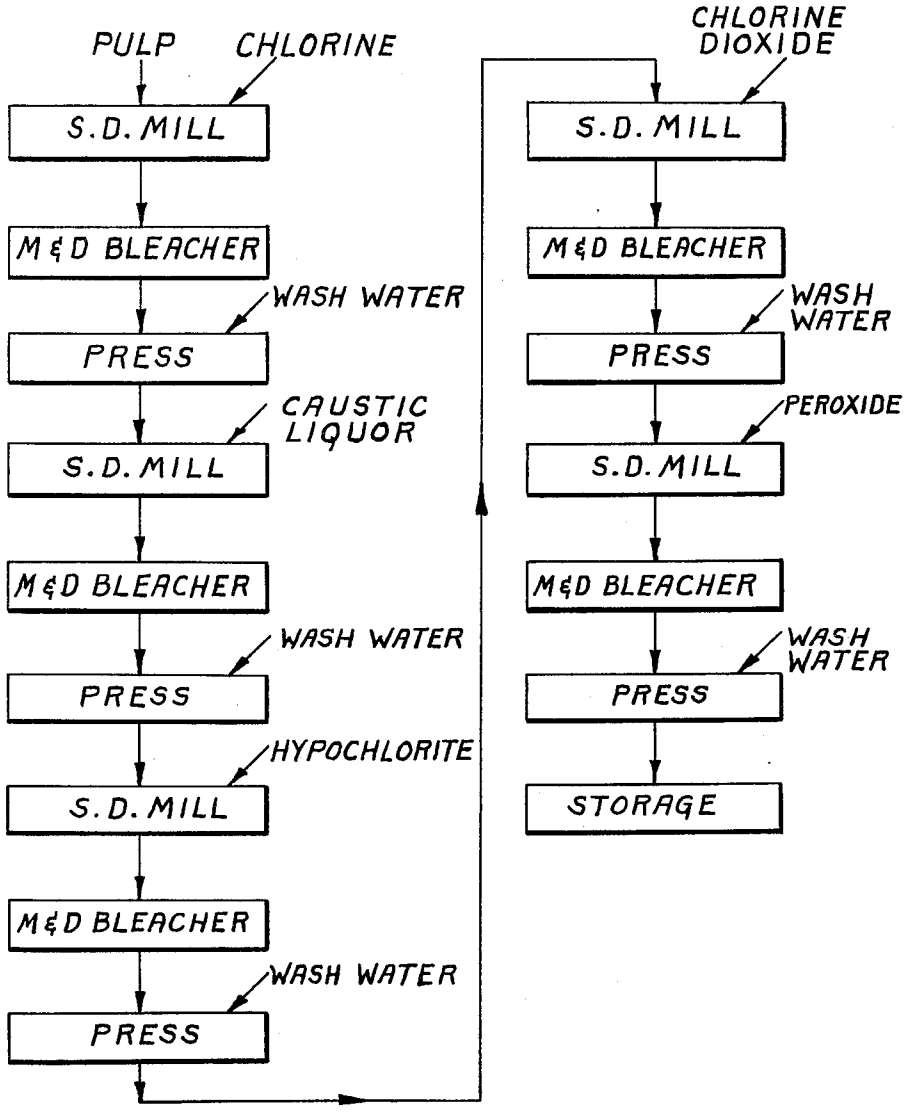


Fig. - 1

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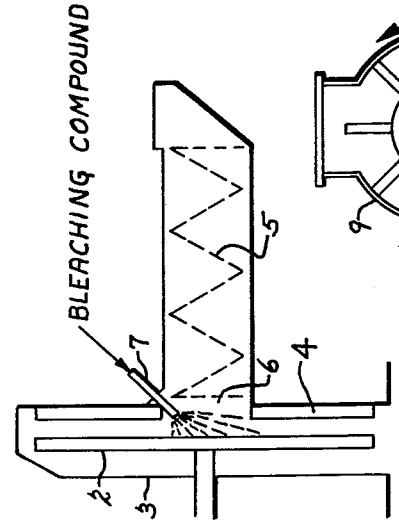


Fig.-3

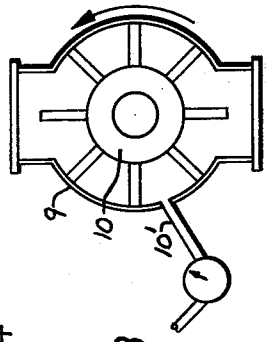


Fig.-4

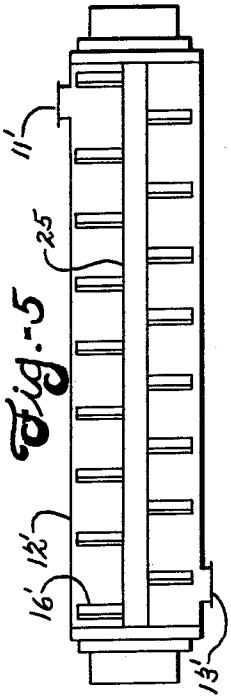


Fig.-5

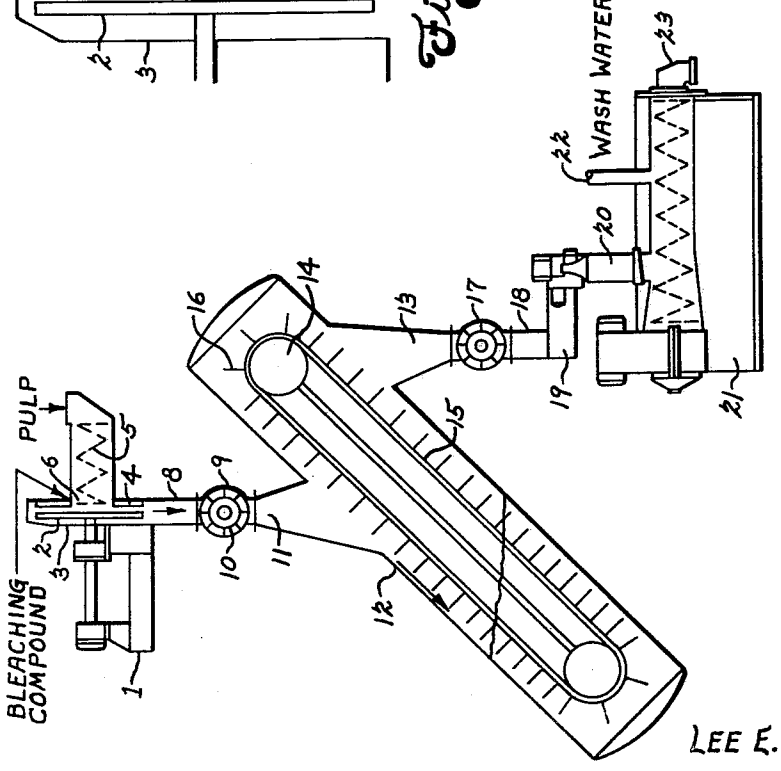


Fig.-2

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PULP BLEACHING

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16 Claims. (Cl. 162—17)

This invention relates to a bleaching process and more particularly to an improved system and method for bleaching wood pulp.

There has been a substantial increase in demand for pulp with higher brightness. With a greater degree of brightness there is more prestige to the pulp product and it can be used to fabricate prime quality end products which return greater profits.

Brightness is effected in the conventional pulp mill process by a bleach system involving a number of stages. A bleaching tower is employed in each stage. The pulp is retained for a considerable length of time in each tower and there subjected to bleaching agents and particular chemical reactions for increasing the pulp brightness. To obtain greater degrees of brightness more and more stages are added and each additional stage necessitates an additional bleach tower which is space consuming and expensive. A substantial tonnage of pulp stock is tied up in such a bleach system. Thus, bleach plants are generally high in operating cost and require substantial capital investment. Moreover, the conventional system is relatively inefficient in that it requires the reduction of the pulp to a low density for the bleaching process.

The present invention provides a simplification of the conventional bleach process leading to a substantial shortening of the bleaching cycle as well as a great reduction in capital requirement. The invention system provides a continuous positive displacement of pulp with a thorough intermixture of bleaching agents in transit so that the bleaching action actually takes place while the pulp is being continuously moved through successive stages. The invention process eliminates the need for bleaching towers, which are costly and space consuming, and avoids delay and tie up of stock for undue lengths of time. The bleaching action is not only swifter but more effective since a pressured system is employed. The system is economical in that it employs standard equipment while producing an entirely new idea in bleaching wood pulp. Moreover, the bleach reaction is effected at substantially higher temperatures and pressures than conventionally employed, which contributes to the speed and effectiveness of the bleaching action.

A primary object of the invention is to simplify pulp bleaching processes to render them more economical, more efficient and satisfactory in operation, extremely flexible and technically simple.

A further object of the invention is to provide improvements in systems for bleaching pulp effecting a substantial reduction in capital requirement for bleach plants.

Another object of the invention is to provide a continuous displacement pulp bleaching process.

An additional object of the invention is to substantially reduce the bleach cycle for wood pulp.

Another object of the invention is to provide improvements in methods for bleaching pulp eliminating the need for bleach towers and enabling the processing of the pulp at higher densities.

A further object of the invention is to provide an improved bleaching system possessing the advantageous structural features, the inherent meritorious characteristics and the mode of operation herein mentioned.

With the above and other incidental objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation as hereinafter described or illustrated in the accompanying drawings, or their equivalents.

Referring to the accompanying drawing wherein is shown one but obviously not necessarily the only form of embodiment of the invention,

FIG. 1 shows a flow chart illustrating the employment of the inventive bleaching process;

FIG. 2 schematically illustrates the associated equipment employed in each stage of the process shown in FIG. 1;

FIG. 3 is a schematic fragmentary detail view of the system shown in FIG. 2;

FIG. 4 is a schematic showing of the rotary valve unit employed in the invention system illustrated; and

FIG. 5 schematically shows an alternate continuous displacement chamber for use in modification of the system as illustrated in FIG. 2.

Like parts are indicated by similar characters of reference throughout the several views.

The invention can be best described with particular reference to the drawings. FIG. 1 shows a flow chart wherein a five stage bleaching process is illustrated. It will be readily apparent of course that the number of stages can be modified without departing from the inventive concepts presented herein, dependent on the pulp brightness desired.

The equipment employed shown in FIG. 2 of the drawings is identical in each stage and includes a single disc bleach mixer **1** having the single operating disc **2** thereof enclosed by a housing **3** in spaced relation thereto. Opposite the outer or operating face of the disc **2**, the housing **3** is provided with an aperture **6** defined by an annular plate **4** fixed to the inner wall of the housing in alignment with the disc **2**. A screw type conveyer **5** has its delivery end connected in sealing relation to housing **3** about the aperture **6**. It may be readily seen that pulp may be injected by the conveyer **5** against the operating face of the rotating disc **2**. At the juncture of the conveyor **5** and the housing **3** the discharge pipe **7** of a bleach dispenser, not shown, projects within the housing to discharge bleach in advance of the operating face of the disc **2** to thoroughly disperse the bleach through the fibrous pulp material from the conveyer and provide an intimate mixture thereof under the influence of the operating disc **2**.

Discharge tube **8** depending from the housing **3**, radially of the disc **2** conducts the intimate mixture of pulp fiber and bleaching agent to a rotary valve **9** which has a radial type plate assembly **10** positively moving the pulp mixture to the entrance **11** of a continuous positive displacement reaction chamber **12**. The valve **9** is provided with an outlet **10'** for evacuating air from the pulp mixture as it is moved from the duct **8** to the entrance **11** of the chamber **12**.

As illustrated, the chamber **12**, which is pressurized is angularly tipped to have its discharge end relatively elevated so its discharge conduit or duct **13** is generally vertically positioned. Mounted within the tank-like pressure chamber **12**, at its respective ends, are pulleys **14** jointly driven and jointly driving an endless belt **15** thereabout. Belt **15** has plates **16** fixed to projecting perpendicularly from its outer surface coextensive therewith. The plates or blades **16** are uniformly spaced.

The chamber **12** connects into a discharge valve **17** similar to the valve **9**. The valves **9** and **17** maintain a tight fit so that super atmospheric pressure and temperature may be effected and maintained in the operation of the chamber **12**. The intimately mixed pulp and bleach

are introduced through the duct **11** to be carried angularly downwardly by the blades **16** for continuous displacement thereof through the lower slanted end of chamber **12** which contains water, alkali or antichlor gas which quenches the bleaching action. The pulp is brought up to the outlet duct **13** and dropped through to the valve **17** which functions as valve **9**.

From the valve **17** a duct **18** contains the pulp as it is gravity fed to a conveyor unit **19** which discharges through a vertical duct **20** into a "Pressafiner" **21**. The "Pressafiner" **21** has a continuous screw type feed. A tube **22** is connected therein to introduce wash water for washing the pulp as it passes through the "Pressafiner" which presses and drains the remaining bleach liquids and water from the pulp as it delivers it through a discharge nozzle **23** for selective introduction to an identical sequence operation with variation only in the bleaching agent introduced and possibly the quenching agent utilized in the reaction chamber as will be described.

FIG. 5 of the drawings shows an alternate form of reaction chamber **12'** which can be substituted for the chamber **12**. The chamber **12'** is also a continuous displacement device but more of the agitation type being disposed horizontally and having an inlet at one end at the top identified by the numeral **11'** and an outlet at the other end to the bottom identified by numeral **13'**. A drive shaft **25** longitudinally of this chamber is driven by suitable means to rotate plate elements **16'** projecting therefrom at opposite sides, in offset relation, so as to agitate the pulp suspension as it is moved from the inlet to the outlet.

The above system constitutes a single stage in the invention bleaching process. Conventional equipment is generally employed, modified to suit the needs of the inventive method and incorporating improvements which enable efficiency and economy of operation.

With particular reference to the flow chart in FIG. 1 of the drawings, the following illustrates the improved method of the invention for bleaching pulp employing equipment as previously described for each single stage. The pulp is first delivered by the screw conveyer **5** at 15 to 45° consistency and injected in front of the disc **2**. Chlorine is simultaneously injected through the tube **7** ahead of the disc **2** to be completely dispersed through the fibrous pulp material and provide an intimate mixture therewith as acted upon by the single disc. The pulp and bleach mixture is discharged through the duct **8** and continuously displaced by the rotary valve **10** to the entrance **11** of the reaction chamber **12**. The reaction of the chlorine on the pulp takes approximately five minutes and occurs in transit between the single disc mixer and the reaction chamber where the bleaching reaction is completed. The reaction chamber is established preferably at super atmospheric pressure and elevated temperature between 30° and 200° C. The elevated temperature and pressure greatly accelerates the reaction. As the intimate mixture of chlorine and pulp is carried down to the lower angled end of the chamber **12** it is passed through an appropriate quenching fluid which quenches the chlorination reaction. The bleached pulp and reaction products are then discharged by the blades **16** through the outlets **13** to **17** which continuously displaces the pulp to conveyer **19**, which moves to the "Pressafiner" or washer where the chlorination products are removed and discharged. The cooling liquid used in preparing the pulp is also removed at this point in the process. The bleached and washed pulp is then delivered to the second stage conveyer **5**.

In the second stage caustic liquor is introduced through the bleaching injector tube to the single disc mill, being simultaneously intermixed with the pulp as it is injected in the mixer and discharged therefrom. As in the first stage the intimate mixture of pulp and caustic is displaced to the reaction chamber **12** which at this stage is maintained at a temperature above 100° C. The caustic extraction is completed in the reaction chamber in the manner previously described and the mixture of pulp and reaction products is discharged and continuously displaced through a rotary valve in the nature of the valve **17** to the "Pressafiner" or other press which removes the caustic liquor products resulting from reaction with the pulp.

The pulp so modified is then introduced once more through a conveyer **5** to the single disc mixer of an identical system as described previously where hypochlorite is now introduced to the rotating disc and delivered intimately intermixed to a valve such as **9**, positively displaced in the reaction chamber by blades continuously moving therein through a quenching agent and discharged through the outlet from the chamber. The pulp and the reaction products are then carried through as previously described to a press, preferably a "Pressafiner," to be continuously moved to the fourth stage where chlorine dioxide is introduced to the pulp. The sequence of operation is the same as in the system for the third stage, the temperature in the bleacher or reaction chamber being established above 100° C.

From the fourth stage washing unit the pulp is now introduced into a single disc mixer of a system as described and peroxide is simultaneously injected and intimately mixed with the pulp, moved as described to and through the reaction chamber where it is subjected to a quench to interrupt the bleaching action, employing appropriate agents, as described, at a temperature above 100° C. In this instance the pulp is squeezed out at the Pressafiner and washed. The pulp produce, now thoroughly bleached to a high degree of brightness, is delivered to a storage chamber.

The above described process is a preferred application of the inventive method and produces an optimum bleaching reaction and optimum brightness in the pulp product. There is a continuous positive displacement of the pulp in the entire process reducing the time interval for bleach process to an absolute minimum. There is no interruption of the bleaching action until the precise moment it is completed. An important feature of the invention is that the constant pressured continuous displacement of the pulp enables the introduction of pulp at densities of 15 to 45 percent and a complete and fluid movement thereof from the beginning to the end of the process. If desired, an evacuator may be introduced in the illustrated system ahead of the pulp feed to the bleach mixer but this feature is not essential to the present invention. It is merely additive. The use of super atmospheric high temperature reaction generally above 100° C. plays a substantial part in effecting the completion of the bleaching reaction within a relatively short period.

It is possible by the present invention to achieve a high degree of brightness at an economic cost level employing a continuous displacement high yield pulping system. This is in distinct contrast to the conventional high cost, space consuming multistaged conventional units which necessitate a high capital investment and operating cost. Irrespective of the number of stages necessary due to the nature of pulp and the degree of brightness required, there is the same proportional increase in efficiency and savings of money. The present invention enables means for producing high grade book and bond papers at reasonable cost and with a high degree of quality. The use of rotary valves enables optimum quality and the positive displacement and continuous movement of material through the reaction chamber insures uniformity of the bleach. It is possible by the employment of the present method to save in the area of 90 percent of the time employed for a similar bleaching process employing conventional equipment.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, de-

tail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise but one of several modes of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention I claim:

1. A bleaching system for wood pulp comprising housing means including a single rotating disc, pulp conveyor means connected to said housing for introducing the pulp to the operating face of said single disc to be centrifugally dispersed thereby, means connected to said housing for introducing bleach compound in advance of said single disc to be intimately mixed with the dispersed pulp under the influence of said disc, a conduit depending from said housing for free fall of the pulp and bleach mixture therefrom, a reaction chamber, pressure tight valve means connecting said discharge conduit and said reaction chamber including means for displacing the mixture to said reaction chamber, conveyor means in said reaction chamber for receiving the pulp, means for quenching the reaction between said pulp and bleach in said reaction chamber, said conveyor means being adapted to carry the pulp-bleach mixture through said quenching means, a discharge outlet from said reaction chamber, press means, valve means for receiving the bleached pulp from said discharge conduit of said reaction chamber and positively displacing it to said press means and means for introducing wash water to said press means to wash the products of the bleach reaction from the pulp prior to discharge therefrom.

2. A pulp bleach system including, a mixer having a single operating disc, conveyor means connected to said mixer for injecting pulp against the operating face of the disc in the mixer, bleach injector means connected to said mixer for injecting bleach in the pulp in advance of the operating face of the disc in the mixer, said mixer disc being operative to intimately intermix the pulp and bleach and immediately discharge it therefrom, a reaction chamber connected to said mixer, valve means intermediate said mixer and reaction chamber for receiving and continuously displacing the mixture from the mixer to the reaction chamber, agitating means in the reaction chamber for receiving and continuously displacing the mixture therethrough, a washing chamber, means connecting said reaction chamber and washing chamber for continuously displacing the mixture from the reaction chamber to the washing chamber and means in the washing chamber for squeezing and washing the pulp to provide a bleached pulp product having a high degree of brightness.

3. A bleach system for wood pulp comprising a single disc mixer including a housing in containing relation to the single disc thereof, a conveyor unit connected in sealed relation to said housing for delivering pulp to the operating face of said single disc, bleach injector means connected in advance of the single disc to spray bleach into said housing as the pulp is delivered thereto, said disc being operable to intimately mix and immediately disperse the pulp and bleach delivered thereto, means connected to said mixer providing for gravity discharge of the pulp and bleach immediately on dispersion thereof, a pressurized quenching chamber operatively connected to said gravity discharge means, said gravity discharge means providing for bleach of the pulp in transit to said chamber, means connected for continuously moving the bleached pulp from said gravity discharge means to said chamber, means disposed in said chamber to continuously displace the bleached pulp therethrough and quench the pulp in transit and means connected to said chamber to continuously remove the quenched pulp therefrom, the last named means having means connected for continuously displacing the pulp therefrom and removing the reaction products from the pulp in the process.

4. A method of bleaching wood pulp including the steps of subjecting pulp to a centrifugal dispersal from a mixing to a quench chamber and injecting a bleach compound in the pulp as it is centrifugally dispersed to provide an intimate mixture thereof, dispersing said mixture in continuous fashion to the quench chamber producing a bleaching of the pulp in transit, quenching in said chamber and then washing and squeezing the pulp at stations subsequent thereto and maintaining a continuous movement thereof throughout.

5. A method of bleaching wood pulp consisting of the steps of intimately mixing pulp and bleach compound by simultaneously impinging them on a rotating medium immediately, channeling the mixture in continuous fashion from said medium to a quench chamber effecting a bleaching of the pulp to the required degree in transit, then successively quenching, washing and squeezing the bleached pulp without interrupting its movement to provide a bleached pulp free of the products of the bleach reaction in a relatively short interval.

6. A method of bleaching wood pulp including the steps of intimately mixing the pulp and bleach compound by dispersing the pulp from a mixing to a quench chamber and simultaneously dispersing the bleach over the pulp as the pulp is discharged from the mixing chamber, channeling said mixture in a free fall to the quench chamber effecting bleach of the pulp in transit, quenching and washing and squeezing the pulp in succeeding chambers to produce a bleached pulp free of the products of the bleach reaction.

7. A bleach process for the wood pulp including the steps of simultaneously dispersing pulp and bleach in a free fall to effect an intimate contact therebetween and freely conveying the product to a quenching bath, the pulp being bleached in transit, passing the pulp through the bath while subjecting it to a temperature exceeding 100° C. to limit the bleaching action and then washing the pulp to eliminate undesirable products therefrom.

8. A bleach process for wood pulp employing a mixer, a quencher-reactor and a washer, characterized by the steps of intimately mixing pulp and bleach compound by simultaneous injection thereof and application of centrifugal dispersing means thereto in said mixer to immediately disperse the pulp and bleach therefrom in intimately mixed condition to said quencher-reactor, providing a bleaching of the pulp in transit, subjecting the pulp and bleach compound to super-atmospheric pressure and a temperature between 30° and 200° centigrade at said quencher-reactor and quenching to complete bleaching action and continuously displacing the pulp therefrom to the washer and washing the undesirable products of the bleaching reaction from the pulp.

9. A bleach process for wood pulp including the steps of intimately mixing pulp and bleach by effecting an immediate intermingling dispersion thereof on simultaneous injection thereof into a mixer and immediately conducting the intermingled pulp and bleach under the influence of gravity to a quencher, thereby producing a bleaching of the pulp in transit to the quencher, subjecting the bleached pulp to a completion of the bleach reaction by moving it through a quenching bath in said quencher at super-atmospheric pressure and elevated temperature and subsequently washing the pulp to remove the reaction products therefrom.

10. A bleach process for wood pulp employing a mixer, a reactor and a washer, characterized by the steps of simultaneously introducing pulp and bleach to said mixer, effecting a substantially immediate intimate intermixing and immediate discharge thereof from said mixer

to said reactor, effecting a bleach of the pulp in transit therebetween subjecting said mixture to elevated pressure and temperature and quenching in said reactor, and washing the pulp subsequent thereto in said washer to eliminate the undesirable products of the bleach reaction which has taken place prior thereto.

11. A method of bleaching wood pulp including the steps of conveying pulp at 15% to 45% consistency in uninterrupted fashion to a reduction device, intimately mixing bleach compound into the pulp in said reduction station and simultaneously discharging the mixture to a quencher, effecting bleaching of the pulp in transit to said quencher in a matter of minutes, subjecting the bleached pulp to continuous displacement under superatmospheric pressure in said quencher and quenching at a temperature exceeding 100° C. to complete the bleach reaction, and subsequently washing the pulp.

12. A method of bleaching wood pulp employing a mixer, a quencher, and a washer characterized by the steps of simultaneously injecting pulp and bleach into the mixer and effecting an immediate dispersion thereof to said quencher, effecting a bleaching of the pulp in transit, positively conveying the bleached pulp through said quencher and completing the bleach reaction in transit therethrough under conditions of superatmospheric pressure, delivering the resulting products to the washer for continuous positive displacement therethrough and washing and pressing the pulp in passage through washer to produce a pulp having the desired degree of brightness.

13. A method as characterized in claim 12 employing pulp at 15 to 45% consistency, the pulp being repetitively subjected to an identical sequence of operations in continuous successive stages, including simultaneously removing the liquor and bleaching products in the first stage washing chamber, and thereafter removing subsequently produced bleaching products in subsequent washing chambers.

14. A pulp bleach system comprising a mixer, a pressure type reactor, a washer, conveyor means connected to continuously deliver pulp to said mixer, bleach injector means connected to said mixer for simultaneously injecting bleach therein in a direct relation to the pulp delivered thereto, means connected in said mixer adjacent the delivery point of said bleach and pulp operative to intimately mix the bleach and pulp on receipt and immediately eject the mixture from the mixer to said reactor, providing for bleach of the pulp in transit, means in said pressure type reactor continuously displacing the bleached pulp therethrough and quenching in transit to complete the bleach reaction and means operatively connected to said reactor to deliver the pulp to and through said washer.

15. A system for bleaching wood pulp including, means for intimately mixing and centrifugally dispersing pulp and bleach compound on receipt thereof, means connected to said mixing means providing a gravity discharge of the pulp and bleach mixture on centrifugal dispersion thereof, a quencher connected to receive the pulp from said gravity discharge means, means in said quencher to receive the intimate mixture of pulp and bleach compound and continuously displace it therethrough for quenching in the process, a washer connected to said quencher to receive bleached pulp therefrom and means therein for positive displacement of the pulp therethrough squeezing and washing the pulp in passage.

16. A bleach system for wood pulp including, a mixer, a reactor, and a washer, characterized by means delivering pulp to said mixer, means in said mixer for substantially, immediately dispersing the pulp therefrom on receipt thereof, means to inject bleach in the pulp while in said mixer, means connecting said mixer and reactor for directly conveying said pulp and bleach to said reactor and providing for bleach of the pulp in transit, means in said reactor for receiving and continuously displacing the bleached pulp therethrough and quenching in transit and means connected to said reactor, to positively displace the quenched pulp therefrom to and through said washer.

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