

Jan. 22, 1963

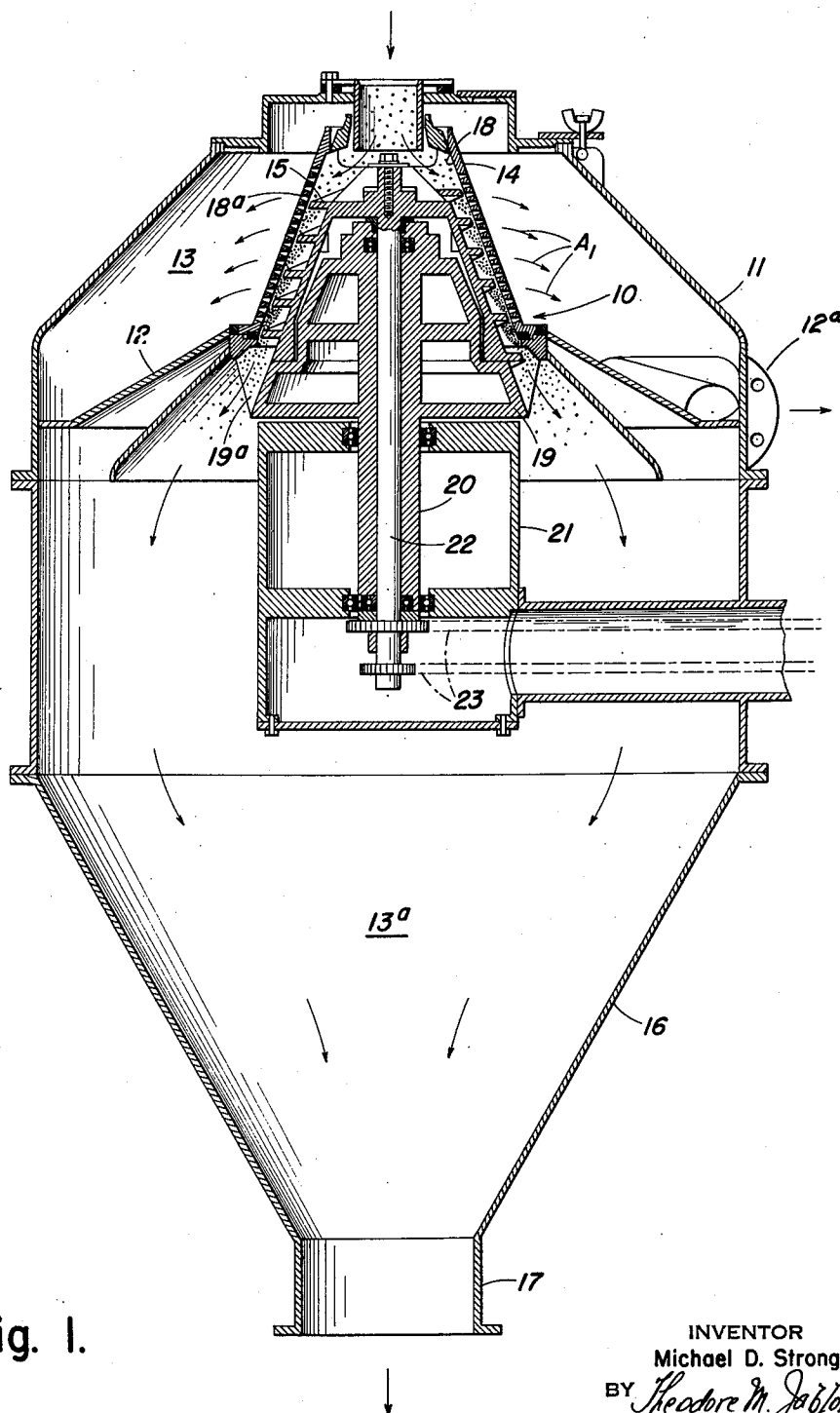
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3,074,842

TREATMENT OF UNBLEACHED CELLULOSE PULPS

Filed July 24, 1959

4 Sheets-Sheet 1



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Fig. 4.

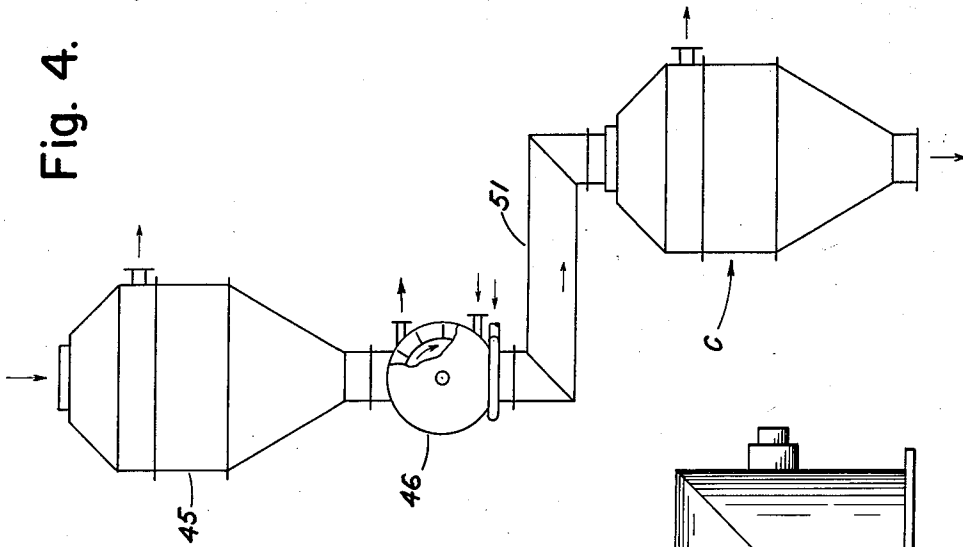
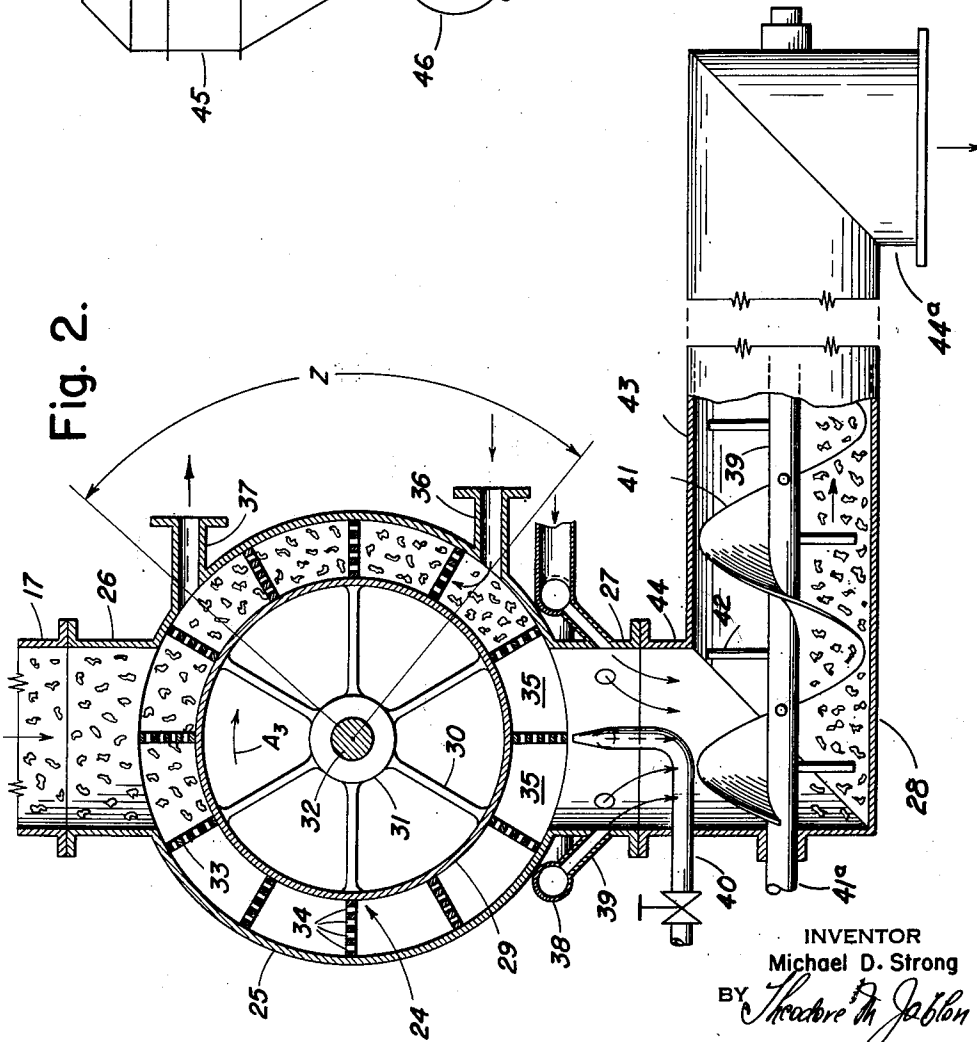


Fig. 2.



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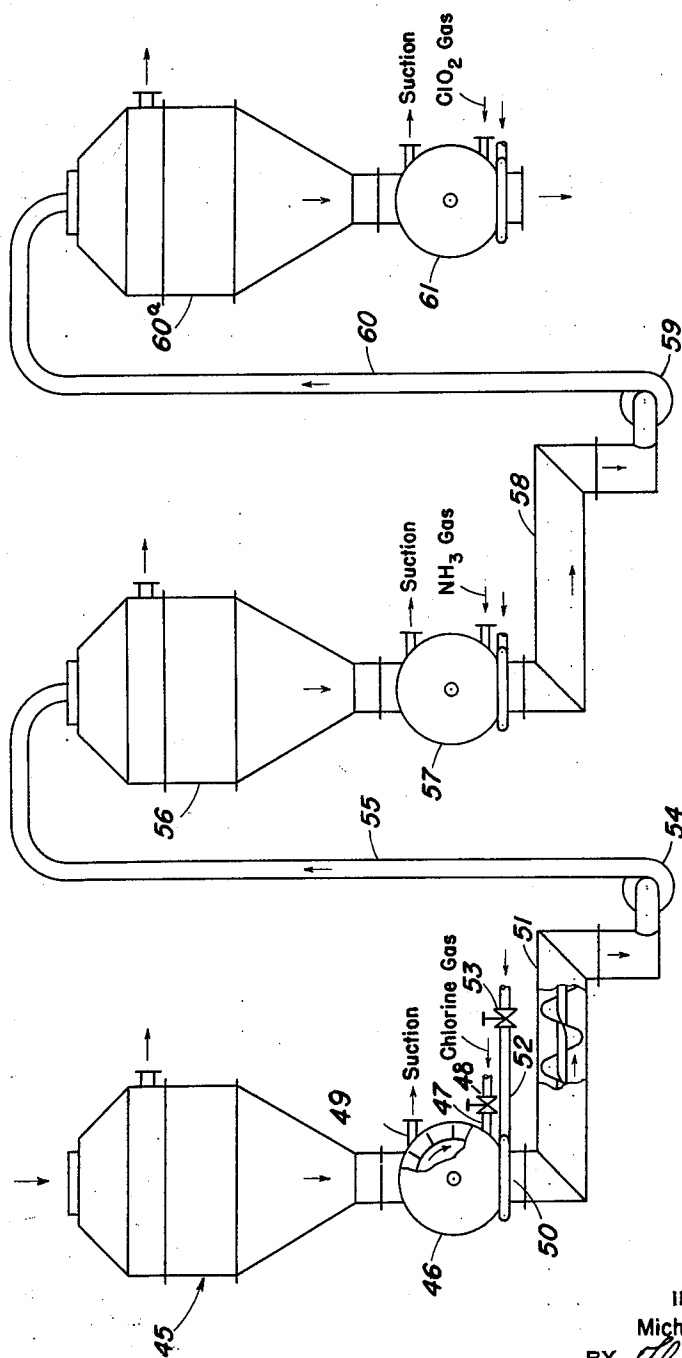


Fig. 3.

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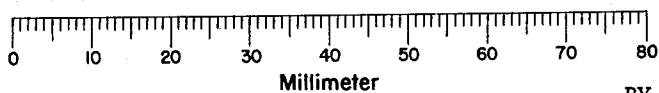
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FIG. 6



FIG. 5



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1

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TREATMENT OF UNBLEACHED CELLULOSE PULPS

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Filed July 24, 1959, Ser. No. 829,284
17 Claims. (Cl. 162-66)

This invention relates to the purification and bleaching treatment of cellulose pulps produced from wood chips by various initial treatment processes. For example, this may be so-called brown stock which is the result of chemical digestion of wood chips in a cooker, or stock which has resulted from semi-chemical treatment of the chips such as the neutral sulfite semi-chemical process involving a combination of chemical and mechanical effects, or stock which may have been obtained from mechanical pulping treatment alone. For the purposes of this invention, all these pulps are herein collectively termed unbleached pulps. If this pulp has undergone additional partial treatment, it will herein be termed partially bleached stock.

Such unbleached pulps contain the separated wood fibers or fiber bundles still burdened or coated with non-cellulosic binding substances which must be removed with as little mechanical damage or chemical degradation as possible inflicted upon the fibers themselves, to the end of obtaining clean bleached fibers with a minimum of debris as a basis for producing high grade strong and flawless paper.

As distinct from the conventional treatment of such dilute pulps in reaction towers, this invention revolves around the discovery that by special treatment in a novel manner such pulp can be dewatered and converted into spongy units or flocs physically so conditioned that gaseous reagents such as chlorine in its gaseous state can be effectively employed. The desired reaction of the gas with the non-cellulosic matter on the fibers is then almost instantaneous with substantially no more than the theoretical amount of gas required, while mechanical destruction and chemical degradation of the fibers are reduced to an insignificant amount or practically eliminated.

Conventional treatment of unbleached pulps is a slow and cumbersome process inasmuch as it requires very large expensive treatment towers provided with built-in propeller type agitators and an expensive non-corrosive inner lining, along with washing filters, heaters, pumps and instrumentation such as sensing instruments and the like. The pulp in a relatively dilute state containing the dissolved treatment agent at great dilution is required to undergo the desired reaction while passing relatively slowly through this treatment tower during a period of detention which may be hours.

With these treatment towers, the lower the consistency of the pulp, the greater is the detention time required for consummating the reaction. On the other hand, increases in consistency may render the reaction difficult to control, inasmuch as excessive degradation of the cellulose fibers may occur incident to the reaction at these higher consistencies and at greater concentration of the reagents and of the reaction products. The relatively low consistency at which the pulp must therefore undergo reaction in the treatment towers makes for large tower size requiring high capital outlays, maintenance as well as space.

Conventionally, as an example of a complete treatment brown stock having a consistency of only 3½% and containing the chlorine in solution passes through the first treatment tower preferably in upflow fashion requiring a detention time of about one hour which allows most of the lignins on the fibers to react with chlorine, the reaction producing chloro-lignins. The solubility of these chloro-

2

lignins depends upon the molecular weight, in the sense that the low molecular weight chloro-lignins are rendered soluble by chlorination only whereas the higher molecular weight chloro-lignins are solubilized by a certain amount of oxidation and forming soluble compounds such as sodium salt. Among other dissolved chlorine reaction products is HCl which latter is potentially destructive to fibers but appears at sufficiently low concentration. Hence, the chlorine-reacted pulp usually overflowing from the top end of the tower is then washed free of the HCl and other reaction products as on a washing filter. This chlorination operation produces a shrinkage due to removal of undesirable material which is in the order of 5%. The chlorine-reacted washed filter cake must be repulped so that it may be subjected to the next treatment step called alkaline extraction conventionally by hot weak NaOH solution in another tower treatment. This will solubilize the high molecular weight chloro-lignins, yet with an attendant shrinkage due to removal of undesirable material of about 2½% with the stock concentration in the tower being kept as of a suitable 12% and also with the concentration of the caustic such as to minimize fiber degradation. The resulting reaction products again must be washed out as in a washing filter operation, the washed filter cake to be repulped for still another tower treatment step. The pulp having been freed by the preceding two successive tower treatments from most of its lignins as well as other non-cellulosic matter, may be subjected for example in a third or last tower treatment step to the action of bleaching agent such as calcium or sodium hypochlorite with the stock consistency kept at a suitable 12% to 16%. This treatment not only bleaches the fibers but also oxidizes and removes residual lignins from the fibers but with a shrinkage due to removal of undesirable material to the extent of about 2½%. Here the detention time which may be from 1 to 6 hours, must be long enough to allow the oxidized lignins to diffuse out from the fibers so they can again be washed out in a final washing filter operation.

This invention makes it possible to have bulky and expensive treatment towers as well as various other equipment partly or entirely eliminated, and the respective reaction or reactions themselves speeded up enormously, even while avoiding fiber degradation as by any of the reaction products or otherwise. Such radical improvements are accomplished by way of subjecting the unbleached pulp to a dewatering operation increasing the pulp consistency at least to a degree which may be 20% to 30% consistency where the fibrous elements rather than the liquid control the physical characteristics of the fibrous mass, and the pulp is rendered directly in the form of fibrous clusters or fluffed up flocs. This centrifugal treatment is such that the fibers remain substantially undamaged or unbroken even while retaining their natural springiness, so that each such cluster represents a spongy structure that is resiliently compressible and can be readily and instantaneously penetrated by a treatment gas adapted to react instantaneously with the respective non-cellulosic matter on the fibers.

For example, if chlorine is initially applied in its gaseous state to a pulp that has been prepared in the manner of this invention, chlorine reaction with the non-cellulosic matter in the flocs is consummated within a contact time that may be in the order of mere fractions of a second as compared with hours of conventional tower treatment. Any appreciable chemical degradation of the fibers therefore has no chance to manifest itself especially if the reaction is promptly followed by a wash. The physical characteristics of the prepared stock or pulp are such as to permit instantaneous penetration of the clusters also by the washing and repulping liquid.

The fibrous product having the particular qualifications

above set forth, is obtainable according to one embodiment by subjecting a starting pulp, for instance brown stock of flowable consistency, to centrifugal separating forces by feeding a continuous supply of pulp into the inlet end of a centrifugal screen device. Thus, there is initially formed upon the inside of the inlet end a blanket of fibers from which the liquid is centrifugally drained through the screen. While under the influence of these centrifugal forces, suitable slow-acting impelling means within the screen disrupt the initially formed blanket subdividing the same into the aforementioned discrete clusters or spongy fibrous structures even while moving the same continuously and gently towards the discharge end of the rotary screen for delivery therefrom as a dewatered and prepared stock which may have a consistency of from 20% to 30%. Meanwhile, the separated liquid discharges along another path from this machine.

The method of treating the prepared stock with the gas according to one embodiment, comprises maintaining in a treatment chamber a flow of the treatment gas, continuously feeding to the chamber a controlled quantity of the unbleached pulp or stock, continuously moving the stock through the chamber preferably counter-current to the flow of treatment gas, and accordingly discharging the treated stock from the chamber still in the form of clusters for repulping and for washing. Thus, untreated clusters of prepared stock may enter the chamber at one end thereof, while gas-treated clusters discharge from the other end. The controls may be such that substantially all of the gaseous reagent is absorbed in the reaction.

According to one feature, a slight vacuum is applied to the contents of the chamber under conditions so controlled that highly efficient as well as rapid reaction between the gas and the non-cellulosic matter may be obtained.

Other features lie in employing gaseous reagents in treatment steps following chlorination thereby similarly eliminating conventional treatment towers and accessory equipment, with gassing treatment advantages similar to those set forth above.

Apparatus for practicing the foregoing method of reacting material with the gas, features combined metering and conveying means wherein an endless sequence of spaced gas-permeable partitions move through a reaction chamber. In a preferred form, the apparatus resembles a star feeder mechanism altered for the purposes of this invention, which may be combined directly with the centrifugal screening device so as to constitute therewith a compact operating unit replacing not only the reaction towers but also cumbersome washing filter and repulping installations.

Features of the apparatus relate to washing and repulping means compactly arranged in direct association with the gas reactor.

Still other features and advantages will hereinafter appear.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof will be best understood from the following description of specific embodiment when read in connection with the accompanying drawings, in which:

FIG. 1 is a vertical sectional view of a centrifugal screen for dewatering and preparing the stock in accordance with the requirements of this invention;

FIG. 2 is a vertical sectional view of apparatus in a preferred form for effecting the reaction between pulp and gas in a continuous counter-current fashion, directly combined with washing and repulping means;

FIG. 3 illustrates, in a preferred arrangement, the application of this invention to a sequence of cooperating

treatment steps each involving the treatment of the specially prepared stock with a gas;

FIG. 4 completes the arrangement of FIG. 3 by the addition of a final centrifugal dewatering and pulp conditioning stage;

FIG. 5 is a somewhat enlarged photographic view of the fibrous product delivered by the screening centrifuge, and having the special physical characteristics called for by this invention; and

FIG. 6 is a microscopic view of the cellulose fibers after repulping of the fibrous product illustrating the absence of short fibers or debris in the preservation of the fibers.

Since the invention revolves around the problem of specially conditioning the unbleached pulp, for example brown stock, for treatment with a gaseous reagent, reference may first be had to the prepared pulp material as shown in the photograph in FIG. 5. This shows the fluffed up flocs or clusters presenting fibrous spongy structures which according to the invention result when the unbleached stock is subjected to the dewatering treatment in a centrifugal screen device an example of which is shown in FIG. 1.

According to the invention, the fibrous product thus obtained is ideally suited for treatment with a gaseous reagent such as chlorine as well as other gases as will be furthermore explained. Even though with about 70% moisture left in it, and thus at a consistency of 30%, this fibrous product presents a fluffed-up dry appearance. In bulk, it appears as a mass of individual clusters or rolls in each of which the fibers are substantially contained in an undamaged state having retained their natural springiness so that it is one of the physical characteristics of this product that these clusters or fibrous units in fact are resiliently compressible. Each such cluster or roll is an average of $\frac{3}{8}$ " or 10 mm. long, more or less. This fibrous product as a mass can be readily handled and bagged or put up in suitable containers to be shipped for treatment as in a different locality. However, in a preferred form of operation, this material can be delivered continuously from the centrifugal screen device directly into the reactor for treatment counter-current with the gaseous reagent.

The centrifugal screen device for so dewatering and specially conditioning the stock into the illustrated fluffed up flocs of FIG. 5 may be of a suitable known design or type such as exemplified in FIG. 1.

In such a machine the centrifugal screen mechanism proper is enclosed in housing 11 which has a transverse dividing wall 12 which together with the screen mechanism 10 defines an upper volute chamber 13 surrounding the screen to receive the centrifugally separated liquid for discharge through an outlet neck 12a, and a lower chamber 13a into which discharge the solids retained by the screen in the form above indicated and illustrated. In this example, the feed suspension or pulp enters the narrow end of the conically shaped screen construction 14 at once to be subjected therein to the centrifugal forces which drain the liquid through the screen into the surrounding volute chamber as indicated by arrows A₁ while a conical screw member 15 shaped to conform to the inner conical face of the screen and rotating at a slightly higher speed continuously transports the solids on the screen towards the wide end thereof for discharge into the lower chamber 13a formed with a hopper-shaped bottom 16 having a downward discharge neck 17. More specifically, the screen construction 14 in the machine herein exemplified comprises a conical screen element 18 proper mounted within a correspondingly shaped, perforated backing member 18a for rotation therewith, which backing member in turn is carried by a hub member 19 through ribs 19a unitary with a hollow shaft 20 mounted for rotation in supporting structure 21 which in turn is supported in the lower chamber 13a of the housing. The conically shaped

5

screw member 15 is fixed to a quill shaft 22 which is mounted for rotation concentric within the hollow shaft 20 that rotates the screen. Drive means 23 are indicated for imparting to both screen 18 and the co-operating screw member 15 the required differentiated speeds.

While the physical characteristics of the prepared fibrous product as obtained from the centrifugal screening is such that it may readily be put up in bulk and transported to another locality for treatment with a gaseous reagent, preferably the material is delivered directly from the screening device into a reactor which, like the screening device, may operate continuously and one form of which is illustrated in FIG. 2.

In this reactor, the prepared stock is moved through a reaction chamber counter-current to the flow of gas, under conditions so arranged as to prevent the gas escaping through the inlet or through the outlet passages through which the material respectively enters and discharges from this reaction chamber. According to the invention, the effect of the gas may be confined to a reaction zone located between a gas inlet where slight pressure is maintained and a gas outlet to which a slight vacuum is applied, with the bulk of the material present in the reaction zone accounting for the pressure differential between the gas inlet and the gas outlet means. An endless sequence of gas-pervious partitions spaced equally from one another move through the reaction zone forming with the walls of the reaction chamber a corresponding sequence of compartments containing substantially equal amounts of the material, thus moving the material through the reaction zone.

With these features in view, the reactor exemplified in FIG. 2 is constructed as a compact treatment unit resembling a star feeder device altered and adapted to the purposes of this invention.

Accordingly, this reactor comprises a star wheel 24 mounted for rotation about a horizontal axis in the end walls of a cylindrical housing 25 which at the top is formed with a flanged inlet 26 connected directly to the discharge neck of the centrifugal screening device above. The flanged outlet 27 discharges gas-treated material from the reactor into a repulper 28 preferably connected directly to the outlet 27 of the reactor.

The star wheel 24 has a cylindrical rim portion 29, rigidly connected by spokes 30 to a hub 31 which in turn is fixed upon a shaft 32 rotatable in the end walls of the housing 25. The rim portion 29 has radially extending gas-pervious partitions 33 angularly spaced from one another equal distances defining a sequence of compartments and provided with perforations 34 or the like indicating passages through which the gas may pass from one compartment 35 to the next in counter-current to the material carried in the compartments through the reaction zone.

Adjacent to the discharge outlet 27 the housing has a gas inlet 36, whereas adjacent to the inlet 26 for the prepared material there is a gas outlet 37. Rotation of the star wheel 24 as by a motor drive not shown in the direction indicated by arrow A_3 , will cause the gas-pervious partitions to move corresponding quantities of the material continuously into and through the reaction zone located within the angle Z between the inlet and outlet for the gas. As the material moves through this reaction zone, the slight suction maintained at the gas outlet 37 at least partially removes air from the interstices of the prepared stock thereby relatively increasing the effectiveness of the gaseous reagent. A very high degree of effectiveness in terms of reaction speed and a very high degree of efficiency in terms of gas utilization are thus obtainable if the speed of rotation of the wheel 24 governing the rate of movement of the material through the reaction zone, and the supply of gas, are so controlled with respect to each other that substantially all the gas will have been utilized during passage of the material through the reaction zone. With such control it becomes

6

possible in fact to carry out the reaction with only the theoretical amount of gaseous reagent required and within a space of time within this zone which as in the case of chlorine is in the order of fractions of a second. Hence, under such conditions practically none of the treatment gas itself would reach the gas outlet 37.

With the treated material from the reactor discharging substantially in same physical condition as the prepared product which was supplied to the reactor, into the repulper 28, repulping wash water is at once added so as to block degradation such as the reaction products might potentially exert towards the degradation of the fibers. For that purpose there is shown a ring shaped supply header 38 surrounding the outlet 27, provided with inwardly directed radial branch connections 39 for delivering water into the transfer passage between the reactor and the repulper. Additionally, a valved supply pipe 40 is provided terminating in this passage area for directing a jet of wash water upwardly into respective compartments 35 as they move past the outlet 27, insuring that all of the material be flushed out thoroughly from the compartments, thus conditioning them for refill in their cyclic path of movement.

The repulper 28 according to a preferred example comprises a horizontal conveyor screw 41 which has a shaft 41a provided with supplementary radial agitating arms 42, and journaled for rotation in the end walls of a closed horizontal elongated casing 43 having at one end thereof a flanged inlet 44 whereby the repulper is preferably connected directly to the reactor outlet 27. This repulper casing has a flanged outlet 44a which may be connected to a pump for transferring the treated and repulped material to a subsequent treatment station, or as illustrated in FIG. 4 directly to another centrifugal screen device C for dewatering and conditioning preparatory to further treatment or preparatory to shipment of the product or else the repulper may discharge into a storage bin or the like.

In the purification treatment of unbleached pulp, the invention may be applied to one or more of a sequence of treatment steps. However, in the example of a complete treatment shown in FIG. 3 the invention is utilized in each one of a combination of steps comprising in sequence the chlorination, the alkaline extraction, and the oxidation bleaching stage. Yet, it will be understood that the invention is in no way limited to these treatment steps either relative to kind or relative to sequence or relative to the number of treatment steps.

According to the example of a complete treatment shown in FIG. 3, the initial unbleached stock which may be brown stock, is fed at a pumpable consistency range to a first centrifugal screening device 45 which may be one in FIG. 2, whereby it is dewatered and possibly washed and which converts the pulp into the relatively dry prepared product herein described and illustrated. The thus prepared material discharges directly into a first reactor 46 to which chlorine gas is fed at 47 via a control means or valve 48 to react with the stock, while suction is applied at 49. In the case of chlorine, a reaction time of about $\frac{9}{10}$ of a second was found to be sufficient for the reaction to be completed under the conditions provided for by this invention as set forth. From this reactor, the chlorinated stock drops into a first repulper 51 which may be the one shown in FIG. 2, while repulping water is added through pipe 52 in an amount regulated as by a valve 53 or the like. From the repulper the stock is then transferred as by a first pump 54 and a conduit 55, into a second centrifugal screening device 56 operating substantially in the same manner as the one in the first treatment stage and delivering a fibrous product of similar physical characteristics prepared and suited for treatment with another gas. FIG. 4 illustrates an alternative arrangement wherein the prepared stock from the repulper 51 may be discharged into a next following centrifugal screening device designated by the let-

ter C. In this stage, according to the invention, gaseous NH_3 may be applied in the reactor for the purposes of alkaline extraction in a second reactor 57 which may be similar to the one in the first treatment stage. Again, the resulting treated stock is at once rediluted and repulped in a second repulper 58 resembling the one of the first treatment stage. From this repulper 58 a second pump 59 with conduit 60 may transfer the repulped stock to a third centrifugal screening device 60a which prepares the pulp in the manner of the preceding stages for treatment with gaseous oxidizing bleaching agent. In this last treatment stage, the bleaching treatment according to the invention may be carried out for example by means of ClO_2 in its gaseous state in a third reactor 61 which may resemble those in the preceding treatment stages. Suitably, since pure ClO_2 is explosive, it is supplied adequately diluted with an inert gas preferably so that the partial pressure of the ClO_2 is at all times below 200 mm. Hg. In this last reactor 61, the detention time will be long enough, in the order of 15 minutes, if the ClO_2 gas suitably diluted is to be absorbed substantially completely by the prepared material, whereupon the material instead of going directly to a repulper may be conveyed to a storage chest or other storage facilities without dilution there to allow for a period of time suitable for completing reaction with the absorbed ClO_2 . Wash water may be added in each of the centrifugal screening stages of the operation. Yet, other gaseous oxidizing bleaching agents may be used of which ozone is an example, ozone by its nature being a highly effective bleaching agent.

In each one of the treatment stages just described in connection with the example of FIG. 3, the manner of centrifugally preparing the stock renders the same in the form of physical condition substantially as above described and as illustrated in FIG. 5, and thereby eminently suited for effective treatment with respective gaseous reagents without inflicting any significant mechanical damage to the fibers due to the absence of any mechanical squeezing or compressing action. The metric scale shown in FIG. 5 in millimeters provides an indication of the actual size of the clusters of fibrous flocs produced by the centrifugal operation. Yet, the condition of the prepared stock is equally favorable with respect to the repulping operation, in that the fibers will readily separate from one another and in fact have been observed to float apart in the diluting water without damage to the fibers. This is in accordance with the micro-photograph of FIG. 6 representing an unbleached pulp in a state of redilution after it had been prepared in a centrifugal screening device in a manner herein set forth.

From the foregoing, it will be seen that the discovery underlying this invention makes it possible to convert fibrous cellulose pulp rapidly from a dilute condition into a relatively dry product that readily lends itself for almost instantaneous penetration by a treatment gas, as distinct from tower treatment with solutions, thereby affording immediate contact and substantially instantaneous reaction of the gas with non-cellulosic matter on the fibers. In this way, inasmuch as one or more of the conventional reaction towers as well as other expensive apparatus may be eliminated by this invention, the installed cost as well as the space requirements of apparatus embodying the invention is startlingly reduced. At the same time, an equally startling reduction in reaction time as well as minimum requirements in reagent chemical are achieved along with practically no degradation of the fibers chemically or mechanically. A high-grade final fibrous product can thus be provided which in turn makes for a high-strength, high-quality paper product.

For example, the invention may be applied to any one or more of a series of required treatment steps. Therefore, the invention may be applied to a partially bleached stock.

Also, the treatment may be terminated after any one stage wherein the stock has been treated in accordance with the teachings of this invention, namely by contacting the specially prepared stock with a gaseous reagent.

It will also be understood that the term gaseous reagent may herein include any suitable mixture of gases.

With respect to the sequential treatment steps illustrated in FIG. 3 or any similar arrangement, it will be understood that the transfer pumps between the stage may be eliminated by arranging the respective treatment steps for direct gravitational discharge of the prepared pulp from one stage to the next, that is from any one repulper directly into the next following centrifugal screening unit.

Moreover, the term "continuous" as herein used with respect to practicing the method or running the apparatus, includes not only an uninterrupted flow but also an intermittent flow at such frequencies that the effect is that of a substantially continuous flow for the purposes of this invention.

I claim:

1. Apparatus for the continuous treatment of fibrous stock with a gaseous reagent, comprising a reaction chamber provided with stock inlet and outlet means for passing therethrough the stock which has been dewatered so as to be rendered in a relatively dry condition, said chamber also having gas inlet and outlet means arranged in counter-current relationship to said stock inlet and outlet means; and combined metering and conveying means for passing said stock through said chamber in such a manner as to cause said gaseous reagent to penetrate the material to react with non-cellulosic constituents thereof while passing counter-currently therethrough, said combined means comprising an endless sequence of gas-permeable partitions movable at a controlled rate through said reaction chamber and defining between them and with the walls of the chamber a corresponding sequence of compartments adapted to contain a sequence of confined volumes of said stock while moving through said chamber counter-current to said gaseous reagent, so that incident to the movement of said endless sequence of partitions a sequence of filled compartments moves from said stock inlet to said stock outlet means while emptied compartments move from said stock outlet to said stock inlet means.

2. The apparatus according to claim 1, with the addition of a suction connection provided in the region of said stock inlet means to effect air evacuation for improving the subsequent penetration by the gas into the stock.

3. Apparatus for the continuous treatment of fibrous stock with a gaseous reagent, comprising a cylindrical casing having a peripheral wall and transverse end walls, provided with a stock inlet and a stock outlet connection on said peripheral wall for passing therethrough unbleached stock which has been dewatered so as to be rendered in a relatively dry condition, said casing also having gas inlet and outlet means arranged in counter-current relationship to said stock inlet and outlet connections; and combined metering and conveying means for passing said stock through said chamber in such a manner as to cause said gaseous reagent to penetrate the material to react with non-cellulosic constituents thereof while passing counter-current therethrough, said combined means comprising a rotary transporting member turnable at a controllable rate in said casing co-axial therewith, and having gas-pervious partitions extending radially therefrom angularly substantially equally spaced from one another and co-operative with the walls of the casing to constitute an endless sequence of compartments adapted to carry stock from said stock inlet connection to said stock outlet connection, so that incident to the rotation of said transporting member a sequence of filled compartments moves from said inlet to said outlet while emptied compartments move from said outlet to said inlet connection for re-filling.

4. The apparatus according to claim 3, with the addition of means directly associated with said stock outlet connection for introducing wash water into the treated stock during its discharge from said compartments.

5. The apparatus according to claim 3, with the addition of means directly associated with said stock outlet connection for introducing wash water into the treated stock during its discharge from said compartments, comprising upwardly directed nozzle means located within the passage area of said connection.

6. The apparatus according to claim 3, with the addition of a repulping device connected to said stock outlet connection so that treated stock will discharge directly into said repulping device by gravity, said repulping device comprising a horizontal conveyor screw, and means for introducing wash water into the treated stock for repulping.

7. The apparatus according to claim 3, with the addition of a vertically disposed centrifugal screen unit having a housing providing a reservoir having a bottom discharge neck connected to said stock inlet connection for gravitationally delivering thereto said dewatered stock.

8. Apparatus for the continuous treatment of fibrous stock with a gaseous reagent, comprising a reaction chamber provided with stock inlet means and outlet means for passing therethrough the stock which has been dewatered so as to be rendered in a relatively dry condition, said chamber also having gas inlet and outlet means arranged in countercurrent relationship to said stock and outlet means; combined metering and conveying means for passing said stock through said chamber in such a manner as to cause said gaseous reagent to penetrate the material to react with non-cellulosic constituents thereof while passing countercurrently therethrough, said combined means comprising an endless sequence of gas-permeable partitions movable at a controllable rate through said reaction chamber and defining between them and with the walls of the chamber a corresponding sequence of compartments adapted to contain a sequence of confined volumes of said stock while moving through said chamber countercurrent to said gaseous reagent, so that incident to the movement of said endless sequence of partitions a sequence of filled compartments moves from said stock inlet to said outlet while emptied compartments move from said outlet to said inlet connections for re-filling; and a vertically disposed centrifugal screen unit having a housing providing a reservoir having a bottom discharge neck connected to said inlet connection for delivering thereto said prepared stock.

9. The apparatus according to claim 8, with the addition of a repulping device connected to said stock outlet connection of said reaction chamber so that treated stock will discharge directly into said repulping device by gravity, said repulping device comprising a horizontal conveyor screw, and means for introducing wash water into the treated stock for repulping.

10. The apparatus according to claim 8, with the addition of a repulping device connected to said stock outlet connection of said reaction chamber so that treated stock will discharge directly into said repulping device by gravity, said repulping device having a downward discharge neck, means for introducing wash water into the treated stock for repulping, and another vertically disposed centrifugal screen unit having its top end connected to said downward discharge neck to receive repulped treated stock for centrifugal dewatering.

11. The method of treating fibrous cellulosic stock with a gaseous treating agent, which comprises continuously dewatering the stock by passage through a continuously operating centrifugal screen provided with helical discharge screw to a consistency where the fibrous elements of the stock rather than the liquid control the physical shape of the fibrous mass, with the helical screw cooperating with the screen effective to continuously discharge the dewatered material in the form of discrete clusters

of fibrous elements constituting spongy structures wherein the fibers have retained their natural resiliency, and which clusters are therefore subject to uniform gas penetration; continuously supplying such clusters to a gas reaction chamber through which is kept passing a continuous flow of treatment gas; continuously moving said clusters through said chamber at a substantially uniform controlled speed in counter-current to said flow of gas reacting uniformly therewith because of said uniform penetration; and subjecting gas-treated clusters to repulping and to washing.

12. The method according to claim 11, wherein said treatment gas is from a group comprising chlorine, chlorine dioxide, and NH_3 .

13. The method according to claim 11, wherein air is evacuated from the voids in said clusters by maintaining a vacuum in said chamber in the region of the entrance of said clusters into said chamber to facilitate the subsequent penetration of said clusters by said gaseous reagent.

14. The method of continuously treating fibrous stock with a gaseous reagent, which comprises providing a supply of said stock dewatered by continuous centrifugal screening effects to a consistency where the fibrous elements of the stock rather than the liquid control and physical shape of the fibrous mass, so that the material is in the form of discrete clusters of fibrous elements, constituting spongy structures wherein the fibers have retained their natural resiliency, and which clusters are therefore subject to uniform gas penetration; and subjecting said clusters to reaction with said gaseous reagent in a gas treatment zone effecting uniform reaction because of said uniform gas penetration of the clusters, said gas treatment comprising continuously supplying said clusters to a gas reaction chamber through which is passing a continuous flow of treatment gas, continuously moving said clusters through said chamber at a substantially uniform controlled speed in counter-current to said flow of gas; and repulping and washing the gas treated clusters.

15. The method of continuously treating fibrous stock with a gaseous reagent, which comprises providing a supply of said stock dewatered by continuous centrifugal screening effects to a consistency where the fibrous elements of the stock rather than the liquid control the physical shape of the fibrous mass, so that the material is in the form of discrete clusters of fibrous elements, constituting spongy structures wherein the fibers have retained their natural resiliency, and which clusters are therefore subject to uniform gas penetration; and subjecting said clusters to reaction with said gaseous reagent in a gas treatment zone effecting uniform reaction because of said uniform gas penetration, said gas treatment comprising continuously supplying such clusters to a gas treatment chamber through which is passing a continuous flow of treatment gas, continuously moving through said chamber a sequence of confined metered quantities of said clusters in counter-current to said flow of gas passing sequentially through said quantities within the bounds of their confinements, whereby said gas will penetrate the spongy structures of the fibrous clusters even when substantially at rest with respect to one another; and repulping and washing said gas treated clusters.

16. The method of treating fibrous stock with a gaseous bleaching reagent, which comprises providing a supply of said stock prepared for the reaction by passing said stock through a continuously operating centrifugal screen provided with a discharge screw concentric with said screen for dewatering the stock to a consistency where the fibrous elements of the stock rather than the liquid control the physical shape of the fibrous mass, so that the material delivered by the screen is in the form of discrete clusters of fibrous elements formed simultaneously with the centrifugal dewatering operation by the coaction of the discharge screw and the screen, the resulting clusters constituting spongy structures wherein the fibers have retained their natural resiliency and which clusters are therefore

11

readily and uniformly penetrable by said gaseous reagent; maintaining said prepared stock in said chamber exposed to said gaseous reagent for a length of time sufficient to attain uniform reaction between the fibers and the gaseous reagent as a result of said uniform gas penetration into the voids of the clusters whereby inadequate reaction of the fibers in the interior portion as well as excessive destructive reaction of the peripheral portion of the clusters is avoided when subjected to said penetration; and repulping and washing the reacted stock.

17. The method according to claim 16, wherein air is

12

evacuated from the voids in said clusters sufficiently to facilitate subsequent penetration thereof by said gaseous reagent.

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