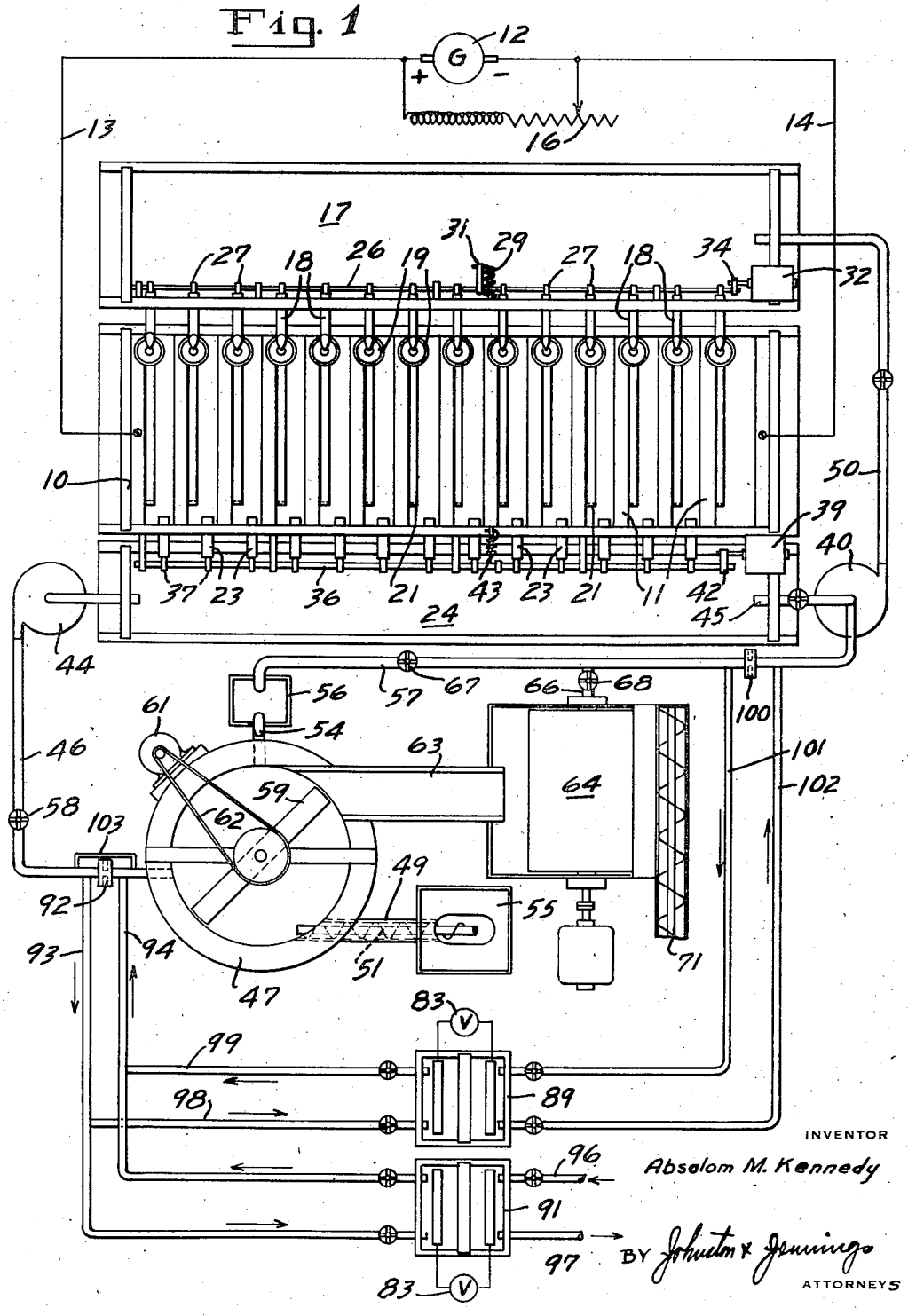
Jan. 5, 1943. A. M. KENNEDY 2,307,137

PROCESS FOR BLEACHING WOOD PULP

Filed Jan. 23, 1939 3 Sheets-Sheet 1

Fig. 1



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Jan. 5, 1943. A. M. KENNEDY 2,307,137

PROCESS FOR BLEACHING WOOD PULP

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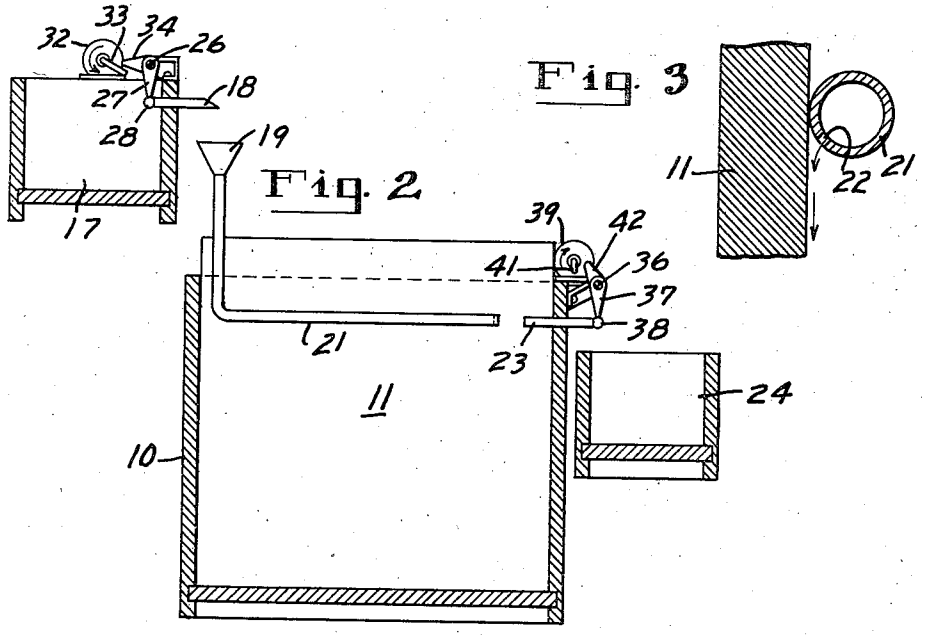
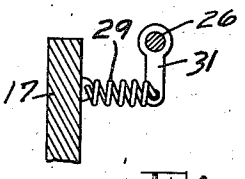


Fig. 2

Fig. 3

Fig. 4



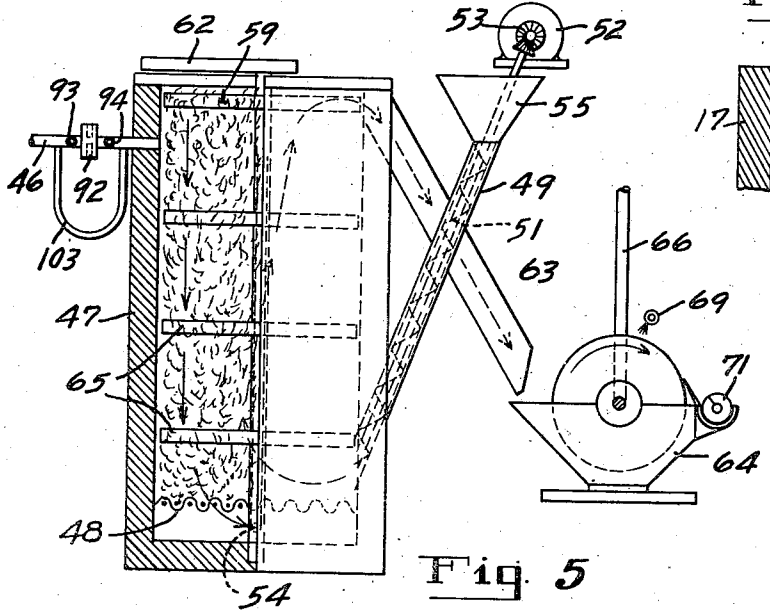
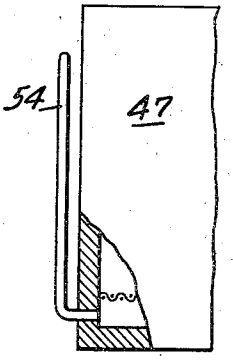


Fig. 5

Fig. 6



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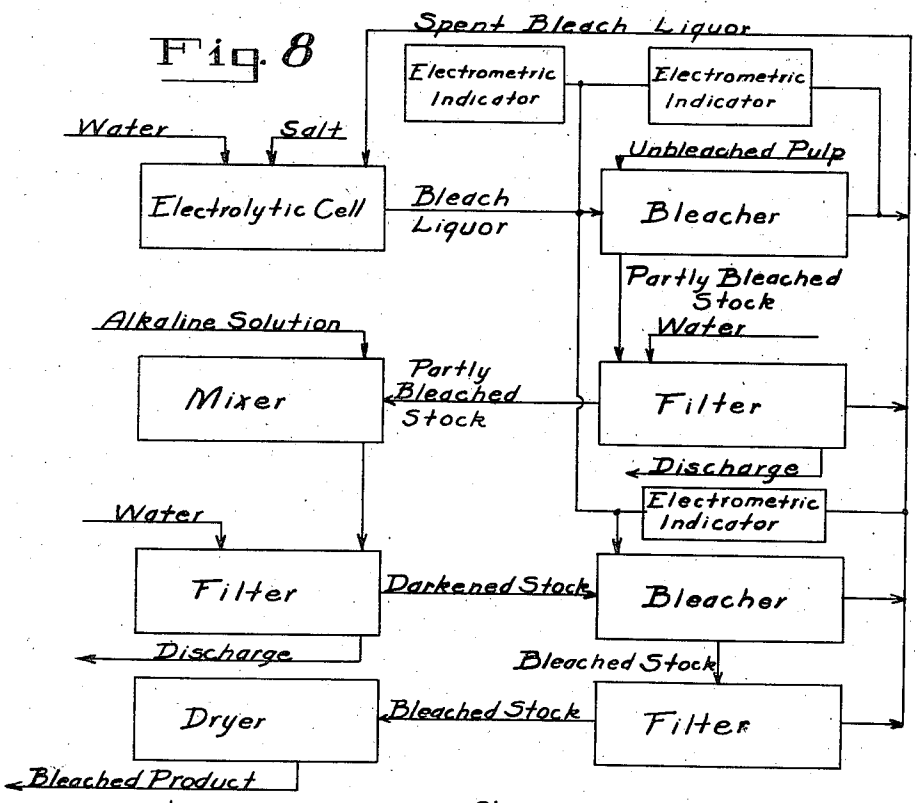
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Jan. 5, 1943. A. M. KENNEDY 2,307,137

PROCESS FOR BLEACHING WOOD PULP

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Fig. 8



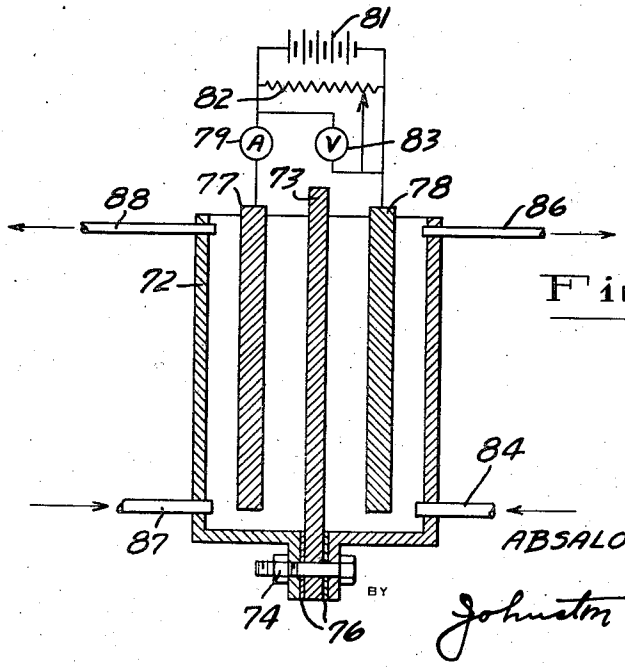


Fig. 7

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Patented Jan. 5, 1943 2,307,137

UNITED STATES PATENT OFFICE

2,307,137

PROCESS FOR BLEACHING WOOD PULP

Absalom M. Kennedy, University, Ala., assignor of one-half to Stewart J. Lloyd, University, Ala.

Application January 23, 1939, Serial No. 252,344

8 Claims. (Cl. 8—105)

This invention relates to the bleaching of cellulose materials, and particularly to the bleaching of wood pulp used in the production of paper, rayon, cellulose esters or ethers, etc., and has for its object a method by which such materials may be bleached in a simple and economical manner.

Another object is to provide a method for bleaching cellulose materials rapidly so that a large output is produced and small floor space required by the apparatus.

A further object is to provide a method whereby waste of chemicals is avoided by the use of the cyclic production and utilization of the bleach liquor.

A still further object is to provide a method for bleaching cellulose materials wherein the rate at which the bleaching takes place and the extent of the bleaching are readily and accurately controlled so that a uniform product may be obtained.

Another object of my invention is to provide an improved apparatus for the continuous bleaching of cellulose materials in which the hypochlorite employed in bleaching is continuously regenerated electrolytically and maintained at a uniform strength.

A further object of my invention is to provide continuous electrolytic bleaching apparatus embodying a cell having a plurality of bipolar electrodes dividing the cell into separate non-communicating chambers, with means to circulate the liquor through the chambers so as to prevent short circuiting of the electric current.

A still further object of my invention is to provide electrolytic bleaching apparatus embodying a cell having a plurality of bipolar electrodes dividing the cell into separate non-communicating chambers, with means to provide a circulation of the electrolyte over the surfaces of the electrodes in each chamber.

Krafts or sulphate pulp, and particularly that produced from quick growing slash pine in the Southeastern States, is difficult to bleach as compared with soda or sulphite pulp made from spruce. It is now bleached by a chlorination process which, in its simplest form, includes the following steps:

(1) The pulp is treated with chlorine in the presence of water. The excess acid liquid is removed and the pulp is washed.

(2) The product is next treated with an alkali, such as a solution of sodium hydroxide, to neutralize the hydrochloric acid produced in (1) and to dissolve certain products (chlorolignins) which are not soluble in the acid solution of (1). The pulp is then separated from the liquid and washed.

(3) The resulting straw-colored mass is bleached to its final color with a hypochlorite, as calcium hypochlorite, and the product is thoroughly washed.

In addition to these absolutely necessary operations, the process is frequently modified by a repetition of one or more of these steps to reduce the consumption of chlorine or to secure a whiter product so that in practice usually five or more steps are employed. See Rue, "Recent developments in the bleaching of kraft", Paper Trade Journal, vol. 104, No. 25, pages 19–25 (1937).

When chlorine is used in this way the actual bleaching agent is not the chlorine itself but the hypochlorite (known in bleaching practice as "available" chlorine), such as hypochlorous acid, obtained by the reaction between chlorine and water ($Cl_2+H_2O=HCl+HClO$.)

It will be noted that only one-half the chlorine is utilized in the production of the useful hypochlorite bleaching agent, the remainder producing hydrochloric acid which is not only useless as a bleach but wastes that portion of the alkali necessary to neutralize it in step (2) above. See Hansen, "The chlorination of wood pulp," Paper Trade Journal, vol. 95, No. 3, pages 30–32 (1932).

Experimental work has shown that the chlorine in the above process may be replaced by sodium hypochlorite, which may be electrolytically regenerated. If the bleaching is done with such electrolytic bleach liquor kept practically neutral with respect to acidity, that is at a pH value between 6.5 and 8, such replacement results in a number of advantages. For example, corrosion is eliminated and the cost of construction and operation of a bleach plant may be materially reduced; the use of alkali to neutralize the hydrochloric acid of the chlorine process is eliminated; the process is speeded up so that for a given output apparatus of smaller size and less floor space is required; and by the method of control described, a product of any degree of whiteness and strength or softness within the limits of the raw pulp used, may be obtained with continuous operation.

It is well known that a hypochlorite may be produced by the electrolysis of a solution of a soluble chloride (C. Watta, Br. Pat. 13,755/1851). The preparation of bleach liquor by electrolysis has been suggested a number of times (Mellor, Br. Pat. 2,236/1866; Barlow, Br. Pat. 5,160/1883; Nation, Br. Pat. 8,808/1866; Hermite, U. S. Patent 392,159/1886; Andreoli, Br. Pat. 8,161/1888, etc.) as has the production of bleach liquor in an electrolytic cell and its utilization in a separate vessel and the return of the spent liquor to the electrolytic cell. (Barlow, Br. Pat. 2,899/1881; Lindberg, Sw. Pat. 7,281/1896; Blackman, U. S. Pat. 541,147/1895).

This invention particularly contemplates the employment of an electrolytic cell for the production of bleach liquor containing a predeter-

mined concentration of available chlorine, maintaining the solution in a practically neutral condition with respect to acidity; employing the solution thus obtained in the bleaching operation with the removal of a predetermined portion of its original chlorine content; the return of the partially spent liquor to the electrolytic cell for the renewal of its available chlorine content; and the use of a system of control whereby these conditions are maintained.

Apparatus embodying features of my invention and in which my improved process may be carried out is illustrated in the accompanying drawings forming a part of this application, in which

Fig. 1 is a plan view, in part diagrammatic, of a bleaching plant constructed according to my invention;

Fig. 2 is a transverse sectional view through the electrolytic cell employed with my invention;

Fig. 3 is a detail sectional view through one of the electrodes of the cell;

Fig. 4 is a detail view showing means for operating the liquor supply and discharge valves of the electrolytic cell;

Fig. 5 is a view of a preferred form of bleaching apparatus employed with my invention;

Fig. 6 is a fragmentary sectional elevation of the bleacher taken at a right angle to Fig. 5;

Fig. 7 is a detail sectional view of an electrometric device employed with my invention; and

Fig. 8 is a flow sheet explanatory of the process employed.

Referring to the drawings, particularly Figs. 1 to 4 inclusive, I show an electrolytic cell 10 provided with a multiplicity of insoluble electrodes 11, made of such material as carbon or graphite, extending transversely thereof, and dividing the cell into a corresponding number of non-communicating chambers. Direct current is supplied to the end electrodes of the cell from a generator 12 through conductors 13 and 14, the electromotive force provided being regulated by an adjustable rheostat 16. The intermediate electrodes 11 thus form bipolar electrodes, as will appear more clearly hereinafter.

Extending along one side of the cell 10 is a vessel or reservoir 17, in which is received electrolyte made up from sodium chloride and water, and through which the spent bleach liquor is circulated. Separate spouts 18, corresponding in number to the number of separate chambers in the cell 10, extend outwardly of the vessel 17 to deliver electrolyte into funnels 19 which connect to pipes 21 made of insoluble non-conducting material, each of which extends alongside the anode surface of its associated electrode 11. Each of the pipes 21 is slitted or provided with a multiplicity of small openings 22 near the anode surface of its associated electrode 11, whereby the electrolyte is discharged downwardly along the anode surface, as may be seen more clearly in Fig. 3 of the drawings. The fresh electrolyte thus flows downwardly over the anode surface of each compartment of the cell and upwardly over the cathode surface. Hydrogen is liberated from the cathode surface and the escape of this gas also aids in effecting a movement of the electrolyte upwardly along the cathode surface. The descent of fresh electrolyte along the anode surface of the electrodes, and the ascent of the electrolyte along the cathode surface of the electrode thus effect a circulation of the electrolyte in each compartment and prevent the accumulation of hypochlorous acid on the anode surfaces and serves to convert this acid into the more stable sodium hypochlorite by constantly bringing fresh sodium hydroxide solution from the cathode into contact with it.

The solution is discharged from the cell 10 through a multiplicity of pipes 23 into a vessel 24 extending along the other side of the cell 10 from the vessel 17, one of the pipes being connected to each of the separate compartments of the cell 10. The flow of the liquor from the vessel 17 to the cell 10 and from the cell 10 to the vessel 24, should be so regulated that there is no possibility of short circuiting the generator 12 through the vessel 17 or the vessel 24, as would be the case if there was a constant stream of liquor flowing from any or all of the spouts 18 or 23. I accordingly show a conventional means by which the liquor may be delivered in separate drops or masses from the vessel 17 to the cell 10, and from the cell 10 to the vessel 24.

Extending along one side of the vessel 17 is a shaft 26 having suitably mounted thereon downwardly depending arms 27 opposite each of the pipes 18, and which may be formed of insulating material or be insulated from the shaft 26. On the lower end of each of the arms 27 is a ball valve 28 made of relatively soft resilient material, such as rubber, and which is adapted to close the inner end of the pipe 18. The ball valve 28 is normally held against the end of the pipe 18 to close it by means of a spring 29 connected to a lower depending arm 31 and to the wall of the vessel 17. A motor 32 has operatively connected thereto a crank 33 adapted to engage an arm 34 on the end of the shaft 26 and raise said arm to open periodically each of the valves 28, allowing a mass of liquor in the vessel 17 to pass through each of the pipes 18 to the separate compartments in the cell 10. A similar shaft 36 extends alongside the cell 10 and has mounted thereon a plurality of depending arms 37 carrying at their lower ends ball valves 38 which control the flow of liquor from the discharge tubes 23 into the vessel 24. The valves 38 are tripped periodically by means of a motor 39 having operatively connected thereto a crank 41 which strikes an arm 42 mounted on the shaft 36 and opens the ball valves 38 to permit the discharge of liquor in separate masses from the cell 10, as shown in Fig. 2. The valves 38 are normally held on their seats by means of a spring 43 which is connected similarly and operates in a manner similar to the spring 29 already described.

There being no flow of liquor from one compartment of the cell 10 to another, there is no possibility of a short circuit through the liquor in the cell 10 or in either of the vessels 17 and 24. This feature is important in view of the fact that it is contemplated that a high voltage, that is, from 500 to 700 volts, will be employed in the electrolytic circuit at an amperage of around 400. It will be obvious that with such an E. M. F., if measures such as just described were not taken, the electric current would flow in part directly through the liquor and not serve to dissociate it and form the bleaching solution sought.

The bleaching solution may be recirculated through the vessel 17, the cell 10, and the vessel 24, by means of a pump 40, the inlet side of which is connected to the vessel 24 by a conduit 45, and which discharges through a conduit 50 to the vessel 17. The solution may thus be raised

to any desired available chlorine concentration before use.

The bleaching solution formed in the cell 10 is transferred from the vessel 24 by a pump 44 through a conduit 46 to a bleacher 47. The bleacher 47 is preferably in the form of a tower, or cylindrical vessel, having a perforate bottom 48. Pulp to be bleached is supplied to the tower just above the perforate bottom 48 through a conduit 49 having a hopper 55 on the upper end thereof. The pulp is fed downwardly by means of a conveyor mechanism 51 driven by any suitable means, such as by a motor 52, and suitable gearing 53, as shown in Fig. 5. The pipe 46 discharges bleaching solution into the upper end of the bleacher 47 and the solution flows downwardly through the pulp and through the perforate bottom 48 to overflow through a pipe 54, the elevation of which determines the level of the bleaching liquor in the bleacher 47. The pipe 54 discharges into a vessel 56 which has connected thereto a pipe 57 leading to the inlet side of the pump 40 which returns the liquor through the pipe 50 to the vessel 17, from whence it may reenter the cell 10 and have its hypochlorite concentration restored.

As is well known, the specific gravity of water-saturated cellulosic fiber is very near that of water, so that the pulp would not naturally rise in water in the bleacher 47. As the hypochlorite in the solution reacts with the coloring matter in the fiber, however, the specific gravity of the fiber is decreased so that it moves upwardly in the bleacher and floats on top of the liquor therein. The movement of the liquor downwardly through the bleacher and the pulp upwardly through the bleacher, rising as it is bleached, brings about a countercurrent movement of the pulp and the bleach liquor. By changing the rate of feed of the pulp into the bleacher 47 or by varying the rate at which the bleach liquor is supplied to the bleacher 47, which may be done by the valve 58 shown in the line 46, it will be seen that the time the pulp is in contact with the bleach liquor and the amount of available chlorine removed from the bleach liquor by the pulp in its passage through the bleacher, may be varied between wide limits.

The bleached, or partially bleached, pulp is removed from the top of the bleacher 47 by means of a rotary rake 59, which may be driven by means of a motor 61 through a transmission means 62, and which discharges the pulp through a chute 63 downwardly to a liquor extracting mechanism, such as a rotary filter 64. Stirring blades 65 are provided on the shaft of the rake 59 in the bleacher 47 whereby to maintain the pulp in agitation in the bleach liquor. The showing of the filter 64 is intended as being purely conventional, as any suitable liquor extracting apparatus known in the art may be employed. The liquor is extracted from the pulp on the filter 64, and is returned through a pipe 66 and the pipe 57, through the pump 40 and pipe 50 into the vessel 17. Suitable valves 67 and 68 in the pipes 57 and 66 respectively regulate the flow of the liquor. The pulp should be washed while on the filter 64, as by means of sprays 69, and the first, or richer wash water may be returned with the strong liquor separated from the pulp to the vessel 17 in a manner well understood. In the vessel 17 salt and more water may be added to make up for the chlorine in the water absorbed in the bleaching operation. In the bleaching of cellulose material as heretofore practiced by the chlorine process or by the use of alkaline hypochlorites, to avoid waste of chlorine, it has been necessary to exhaust practically all of the available chlorine in the bleach liquor as the spent liquor is not further employed.

From the filter 64 the washed and de-watered pulp is delivered by means of a screw conveyor 71 and may be further treated, as will be hereinafter described.

The rate at which bleaching takes place depends on the concentration of the available chlorine in the bleach liquor. It is rapid at first and slows down as the available chlorine concentration of the liquor diminishes, and may apparently be represented by the equation $dC/dT=KC$ where C represents the hypochlorite ion concentration, T the time required for bleaching, and K a constant depending on the original concentration of hypochlorite ion, the temperature of the bath, the kind of wood from which the pulp is made, and its treatment in the pulp plant.

While the concentration of available chlorine employed must necessarily vary with the type of pulp being bleached, and will vary with the personal inclinations of the operator, the following, by way of example, represents the time consumed in a typical bleaching operation. Assuming a concentration of available chlorine in the liquor entering the bleacher of 5 grams per liter and sulphate pulp of average "hardness," the pulp should stay in the bleaching liquor for from one to one and one-half hours during the first bleaching step, and from ten to twenty minutes during the second bleaching step. During the first bleaching step, the pulp will consume about one half of the available chlorine in the liquor which will be regenerated in the electrolytic cell. During the second step only a very small percentage is consumed. Inasmuch as the available chlorine is regenerated in each cycle, the time required for bleaching is considerably less than with a process in which the hypochlorite ion content of the bleach liquor must be practically exhausted in the bleaching operation.

Bleached cellulose is usually converted into products such as paper, rayon, plastics, lacquers, and adhesives. To secure a uniform product it is necessary that the bleached cellulose be as uniform as possible in whiteness, strength, texture and other required properties. To secure this uniformity careful control must be exercised of the bleaching conditions, such as the temperature, the hydrogen ion concentration of the bath and of the original hypochlorite concentration of the bleach liquor, as well as the amount of available chlorine absorbed or utilized by the pulp in bleaching.

Instruments for the indication or control of the first two above mentioned conditions may be readily procured. The latter conditions are usually indicated by chemical or volumetric analysis, which is a relatively slow procedure, so that a change of hypochlorite ion concentration may be detected and steps taken to restore the desired concentration only some time after such change, and the consequent damage to the uniformity of the product, has occurred.

Referring particularly to Fig. 7, I show in detail an electrometric device which I may employ to determine the available chlorine content of the bleach liquor entering the bleacher 47, and also the amount of available chlorine used up by the pulp in its passage through the bleacher. The device comprises a cell 72 divided by a po-

rous diaphragm 73 into two separate chambers which are held together by bolts and nuts 74, suitable gaskets 76 being provided between the halves of the cell to prevent leakage. Two electrodes 77 and 78, made of similar material, insoluble in the electrolyte, such as carbon, platinum, tungsten, or other suitable material, are provided in the separate chambers of the cell and are connected to a milliammeter 79, a battery 81, a variable resistance 82, and a voltmeter 83 to form the usual potentiometer circuit, as shown. Liquors, the concentration of which is to be compared, may be circulated through the two halves of the cell in contact respectively with the electrodes 78 and 77. For example, liquor of a known concentration may enter the side of the cell to contact the electrode 78 at the bottom of the cell through a conduit 84 and leave that side of the cell through a conduit 86 near the top. The liquor to be compared with that of the known concentration may enter the other side of the cell to contact the electrode 77 through a conduit 87 and leave the cell near the top through a conduit 88. With this arrangement, a difference in hypochlorite ion concentration in contact with the electrodes 78 and 77 will cause a difference in electromotive force between these two electrodes. The resistance 82 is adjusted so that the ammeter 79 shows no current passing between the electrodes. The voltmeter 83 then indicates the true E. M. F. between the electrode 78 and the electrode 77, or the E. M. F. unaffected by polarization.

If sufficiently large electrodes 77 and 78 are employed, and there is a continuous flow of liquor through the halves of the cell, and with a sensitive or high resistance voltmeter 83, the potentiometer circuit may be eliminated and the voltmeter 83 connected directly to the electrodes 77 and 78, serving thus to indicate directly the difference in the concentration of the hypochlorite ion in the liquor flowing through the two parts of the vessel.

Referring again particularly to Fig. 1, I show two electrometric devices 89 and 91, such as just described, which may be employed in connection with my improved process and apparatus. In the conduit 46 I provide a restricted orifice 92 and connect on the upstream and downstream sides respectively of said orifices, conduits 93 and 94 which lead to one side of the electrometric device 91, and provide a constant flow of bleaching liquor through that side of the device, the liquor being of the concentration entering the bleacher 47. In the other side of the electrometric device 91, through conduits 96 and 97, I provide a constant flow of a bleaching solution of a known hypochlorite ion concentration. The voltmeter 83 of the device 91 thus indicates constantly the relative hypochlorite ion concentrations of the solutions passing through the two halves of the cell.

I likewise make connections from the conduits 93 and 94 through branch conduits 98 and 99 respectively, to one side of the electrometric device 89 so as to provide a constant flow of bleach liquor through that side of the device, which will correspond in concentration with the liquor entering the bleacher 47. In the return conduit 57 for the used bleaching liquor I provide another restricted orifice 100, and connect to the upstream and downstream sides respectively of said orifice conduits 101 and 102 which lead to the other side of the electrometric device 89. The voltmeter 83 of the electrometric device 89 will thus indicate the comparative hypochlorite ion concentration of the solution as it enters and as it leaves the bleacher 47.

Should the hypochlorite ion concentration of the bleach liquor being supplied to the bleacher 47 vary from that of the standard liquor solution in cell 91, the voltmeter 83 will indicate the fact, the pointer resting on one side of zero if the hypochlorite ion concentration of the bleaching liquor is greater, and on the other side of zero, if less than that of the standard solution liquor in the cell 91. It is evident that this concentration of the bleach liquor may be brought to the same as that of the standard liquor solution, by varying the current supplied by the generator 12, or by suitably regulating the adjustable resistance 16.

The voltmeter 83 associated with the cell 89 may be calibrated in terms of differential hypochlorite ion concentration, as in grams per liter or ounces per cubic foot. The product of this value by the rate of flow of bleach liquor will show the rate at which the hypochlorite ion is being absorbed or utilized by the pulp in the bleacher 47. The rate of flow of bleach liquor to the bleacher 47 may be determined by a manometer 103 having its two sides connected respectively to the upstream and downstream sides of the restricted orifice 92. The rate of flow of the bleach liquor, the passage of pulp through the bleacher 47, and the electromotive force supplied to the electrolytic cell, are all adjusted in accordance with the readings of the voltmeters 83 to afford the required bleaching action on the pulp being treated.

Referring now to the flow sheet shown in Fig. 8, the steps in my improved process will be explained in further detail. In starting the bleaching operation, a sodium chloride solution of suitable strength, say 20% NaCl, is provided and is passed through the electrolytic cell and re-circulated until the desired hypochlorite ion concentration is attained. The electrolyte is then passed to the bleacher where it encounters the unbleached cellulosic material, flowing downwardly through it, as hereinbefore described, the relation of liquor to pulp being such that it may readily be handled and there be a predetermined excess of hypochlorite ion present to bleach stock to the desired degree within the limits of time during which the pulp is in the bleacher. The proportions of 97 parts liquor to 3 parts of dry stock by weight of cellulosic material provide for ready handling, while a concentration of 5 to 10 grams of available chlorine per liter will be found to provide the requisite strength of bleaching solution. After the bleach liquor has passed through the bleacher, it is returned to the electrolytic cell, as already described. The pulp is then separated from the bleach liquor remaining with it by suitable apparatus, such as a filter, and the bleach liquor thus separated, together with the stronger part of the wash water, is returned to the electrolytic cell. The partly bleached stock is then passed to a mixer where it is digested with an alkaline solution, such as caustic soda, soda ash, lime water, or white liquor as used in sulphate process pulp mills. In this washing step, the bleaching solution being neutral, consumes no alkali in the neutralization of hydrochloric acid which would otherwise be left in the stock.

In the bleaching of kraft stock from mills employing the sulphate or soda processes, more than one bleaching step is ordinarily required. The

washed pulp may accordingly be filtered and the darkened stock, which is now approximately of a tan color, is sent to a second bleacher where it is again mixed with bleach liquor and the treatment already described is repeated. It will be found that the bleaching will be completed in a very short period of time, whereupon it is again filtered, the excess bleach liquor being returned to the electrolytic cell and the washed, bleached stock being sent to a drier or other suitable disposal made of it. If the bleached pulp is to be used shortly, as for the making of paper, it may be stored as wet pulp and the drying step omitted.

Pulp is ordinarily cooked "hard" or 'soft"; that is, it is subjected to the action of the alkaline liquor in the digester for different lengths of time and under different conditions. The soft cooked pulp requires less chlorine for bleaching than does the hard cooked pulp. The amount of hypochlorite ion required for any particular batch is determined in advance by finding the amount of potassium permanganate required to bleach a given sample. This is known as the "permanganate number." For the low permanganate number the hypochlorite ion consumption will be low, and as the number increases the consumption of hypochlorite ion increases. It is contemplated, in accordance with my process, that the flow of bleaching liquor, its initial concentration, the E. M. F. supplied to the electrolytic cell, and the feed of the pulp, will all be regulated to afford the necessary hypochlorite ion for bleaching any given batch.

From the foregoing it will be apparent that I have devised an improved process and apparatus for the bleaching of cellulosic material which is simple and economical of operation, and which is effective to afford adequate bleaching of the cellulosic material with a minimum expenditure of power and material.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. The method of bleaching wood pulp in which there is continuously circulated and regenerated a solution of sodium chloride-sodium hypochlorite of an original substantially constant predetermined hypochlorite concentration, comprising continuously floating pulp upwardly and countercurrently as it is bleached through the said solution, continuously withdrawing pulp from the upper surface of the solution as it acquires the requisite bleach and floats to the top of the solution, and controlling the rate of bleaching by controlling the original $C10^-$ concentration of the bleaching solution.

2. A continuous method of bleaching wood pulp which comprises circulating an initially substantially neutral sodium hypochlorite solution downwardly in a confined path, bleaching the pulp in said downwardly moving solution, removing pulp as it floats to the top of the solution, continuously introducing fresh material to be bleached into the lower part of the solution, withdrawing the solution from the bottom of the mass, and regenerating the solution to its original hypochlorite concentration.

3. A continuous method for the bleaching of wood pulp which comprises circulating continuously a descending body of a solution containing initially a substantially constant predetermined concentration of sodium hypochlorite, continuously bleaching a mass of the pulp in said solution and allowing it to float upwardly through said descending body of said hypcchlorite solution as it is bleached, continuously removing pulp as it floats to the top of the solution and withdrawing hypochlorite solution from the bottom thereof, and regenerating the solution to its original hypochlorite concentration.

4. A continuous method for the bleaching of wood pulp which comprises circulating continuously a descending body of a solution containing sodium hypochlorite, continuously bleaching the pulp and allowing it to float upwardly through said descending body of said hypochlorite solution as it is bleached, continuously removing pulp as it floats to the top of said solution, withdrawing solution from the bottom thereof, and regenerating the solution to its original hypochlorite concentration.

5. A continuous method for the bleaching of wood pulp which comprises circulating continuously a descending body of a solution containing initially a substantially constant predetermined sodium hypochlorite concentration greater than that required for bleaching, continuously floating the pulp upwardly through said descending body of said hypochlorite solution, continuously removing pulp from the top and withdrawing used solution from the bottom of said hypochlorite solution, and regenerating the solution to its original hypochlorite concentration.

6. A continuous method for the bleaching of wood pulp which comprises continuously circulating downwardly a solution containing an initial substantially constant predetermined concentration of sodium hypochlorite, said concentration being greater than that required for bleaching, continuously floating the pulp upwardly through the descending hypochlorite solution, continuously removing pulp from the top and withdrawing used solution from the bottom of said hypochlorite solution, and regenerating the solution to its original hypochlorite concentration.

7. The method of bleaching wood pulp which comprises continuously circulating downwardly a solution of sodium chloride-sodium hypochlorite, continuously floating pulp upwardly as it is bleached through the said solution, continuously withdrawing pulp from the solution as it acquires the requisite bleach and floats to the top of the solution, and continuously regenerating the solution to provide hypochlorite for bleaching.

8. The method of bleaching wood pulp which comprises circulating continuously downwardly a solution of sodium chloride-sodium hypochlorite having initially a predetermined substantially constant concentration, maintaining the solution substantially neutral with respect to acidity, floating pulp upwardly as it is bleached through the said solution as it absorbs a part of the original available chlorine content of the solution, and continuously regenerating the solution to its initial concentration.

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