

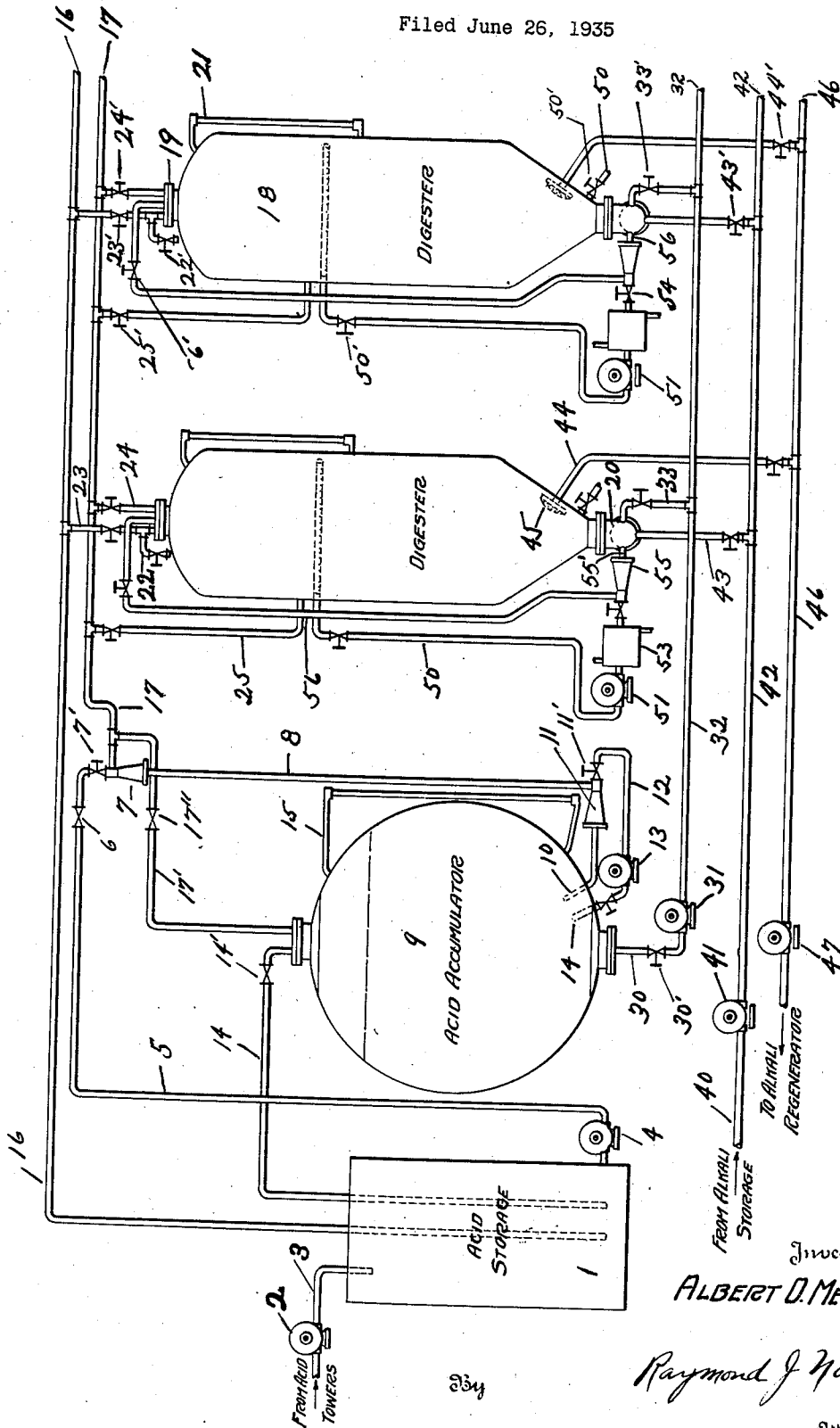
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METHOD FOR TREATING CELLULOSIC MATERIAL

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METHOD FOR TREATING CELLULOSIC MATERIAL

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This invention relates to an improved method of and apparatus for treating cellulosic material for the production of pulp.

A major object of the present invention is to provide a modified sulphite pulp.

A further object is to provide a modified sulphite process by reason of which the characteristics of the final pulp may be relatively widely varied.

Yet another object is to provide a process of producing pulp in which differential reagents are employed and the time of treatment materially lessened.

An additional object is to provide a method of producing pulp in which a high yield of pulp is secured and which readily may be modified to produce pulps of different characteristics.

With these and other equally important and related objects in view the invention comprehends the concept of subjecting ligno cellulosic material to a series of specially correlated steps or treatments with differential reagents for the purpose of producing a high quality of pulp by a diminished time of treatment; the steps and reagents being susceptible to modification to produce pulps of differential characteristics.

In a typical method of digesting wood by the quick-cook sulphite process, a relatively long period of time was expended in slowly bringing the contents of the digester up to cooking temperatures. This was thought to be necessary in order to insure penetration of the cooking liquor into the interior of the chips. Hence in a typical mill practice the mass within the digester was brought up to about 115° C. in a period of between two and seven hours.

It was found subsequently, as disclosed in the U. S. patent to T. L. Dunbar 1,859,384, that major advantages could be secured by impregnating the chips with hot acid under a high hydrostatic pressure.

It developed furthermore, as disclosed in the U. S. patent to T. L. Dunbar 1,901,706, that an improved quality of sulphite pulp could be produced by first soaking the chips with hot acid, for a predetermined period of time, and then after draining such acid to cook for a limited period of time in hot bisulphite liquor and then to subject the material to an alkaline cook. This method, utilizing differential reagents, permitted not only a considerable flexibility in respect of the manipulative steps but also a range of differential products having specifically different strength and folding characteristics.

The present invention is of the general type

described in Patent 1,901,706 but presents many advantages thereover, particularly in respect of the time of treatment and character of the final product.

In order to enable a more ready comprehension of the present invention, an apparatus suitable for effectuating the present process is shown in the single figure of the accompanying drawing, certain well-known parts being omitted for simplicity and clarity.

One of the major features of the present process comprehends the concept of subjecting cellulosic material to a plurality of treatments with differential reagents, such treatments being so devised as not only to diminish the time of treatment but also to secure a selective action upon the constituents of the cellulosic material and thus to control the character of the final pulp within a wide permissive range.

Thus one improved method of procedure, according to the present invention, is to precondition and preheat the chips by subjecting them to a special treatment in an alkaline medium and then to digest the preconditioned material, under conditions insuring accelerated reactions, with an acid liquor such as a typical bisulphite liquor.

According to one method of procedure the starting material, such as wood chips, is subjected to a preliminary soak in a heated alkaline liquor. During this period the liquor is maintained at elevated but below drastic reaction temperatures, at high hydrostatic pressure, and is recirculated to and from the digester. In these circumstances the chips are penetrated with liquor and certain of the constituents are taken up in the alkaline solution, thus softening and establishing interstitial voids or spaces in the chips. Preferably the concentration and temperature of the soaking liquor is controlled to prevent any drastic type of reaction which would result in degradation of the cellulose content of the chips. Thereafter the liquor is drained and hot preconditioned bisulphite is added. In the preferred procedure a high hydrostatic pressure is built up on the acid liquor and this is recirculated to and from the digester so as to homogeneously distribute the acid through the mass. Refinements of this type of process may include the introduction of sulphur dioxide gas or such gas in solution (sulphurous acid) in regulated amounts, prior to the introduction of the bisulphite solution. The preconditioned chips are then digested in the acid liquor under conditions of elevated temperatures and pressures.

More specifically such a process may include

charging a digester with chips and then admitting preheated alkaline liquor to the bottom of the digester and utilizing the upwardly moving volume of liquor to displace and expel air from the digester by manipulating a valve at the top. After the digester is filled or substantially filled with the liquor the top valve may be closed and additional quantities of liquor forced in to build up a high hydrostatic pressure on the liquor. This may be done by utilizing any suitable means such as a centrifugal pump. The pressure may, for example, be from two to five or more atmospheres. As noted above, preferably the temperature and concentration of the alkaline liquor is so controlled as to preclude any drastic reaction upon the cellulose content of the wood. This preliminary treatment, as will be appreciated, depends upon the solvent power of an alkaline solution, such for example as caustic soda, for certain constituents of the wood.

In the preferred process alkaline solutions, such as sodium, calcium or ammonium hydroxide and the like, or typical sulphate or soda solutions may be employed. Thus in lieu of sodium or calcium hydroxide, a typical soda solution, i. e. a mixture of caustic soda with sodium carbonate, may be utilized. Similarly a solution of sodium hydroxide and sodium sulphate may be employed. Preferably, during the preconditioning treatment the temperatures should be maintained below about 50° C., the preferred range being approximately from 40 to 50° C. The concentration may be lower than that used in typical soda or sulphate cooks, although it is to be distinctly understood that relatively high strength solutions may be employed. Ordinarily a solution of from about 6° to 10° Bé. (at 60° C.) may be utilized. In carrying out this preconditioning treatment it is preferable to control the time of soaking, concentration and temperature so as to limit the consumption of caustic to a relatively low degree so as to avoid any undesirable reaction upon the cellulose. It will be appreciated that the characteristics of the alkaline soaking liquor and the time of treatment may be varied, depending upon the type of wood. Thus deciduous woods will require a shorter period of treatment than the coniferous woods. After the termination of the soaking period the liquor may be drained off, preferably through the bottom of the digester, and sent to a recovery plant to be treated in a manner well known in the art for the recovery of the caustic. In these circumstances, particularly when the top of the digester is sealed, the draining of the alkaline liquor from the chips will establish a reduced pressure or vacuum in the digester which greatly facilitates the subsequent introduction of the acid liquor. After draining, the hot preconditioned bisulphite, or equivalent, such as hot sulphurous acid, is then admitted and cooking carried on in a manner well known to those skilled in the art.

It will be appreciated that this type of treatment presents many advantages. In the first place the alkaline liquor has greater penetrating power than sulphite and thus the chips may be more quickly penetrated for any given pressure and temperature conditions. By carrying out the soaking under conditions of relatively high temperature and pressure, coupled with recirculation, not only is actual penetration quickly initiated but selective dissolution of certain of the non-cellulosic constituents is accelerated. Even at the relatively low temperatures employed the

alkaline liquor dissolves an appreciable portion of the non-cellulosic constituents, thus chemically and physically preconditioning the material prior to treatment with the bisulphite. This pretreatment results in steam and acid liquor economies and further shortens the period of time requisite for the acid cook.

The process preferably is carried out in apparatus of the character shown in the accompanying drawing. In these 1 is an acid storage tank of any suitable design and construction. This is supplied with acid from the acid towers through pump 2 and line 3. Acid liquor may be withdrawn from the tank by the pump 4 and forced through pipe 5, check valve 6 and eductor 7 to the drop leg 8. This drop leg is in connection with the accumulator 9 through the branch pipe 10. Interposed in the branch pipe is a second eductor 11. This eductor is connected through the line 12, pump 13 and branch 14 to the accumulator. The branch 14 is provided with a control valve 14' and eductors 7 and 11 are provided with valves 7' and 11' respectively for the purpose of regulating the quantity of the respective materials flowing therethrough. It will be appreciated that by opening the valve 14' and operating pump 13, liquor may be withdrawn from the acid accumulator, forced through the line 12 and eductor 11 back into the accumulator. During this passage such liquor is mixed with fluids flowing down through the drop leg 8 and serves to condense and absorb gases contained in such fluids.

If desired a heater (not shown) may be interposed in this accumulator recycle line so as to maintain the temperature of the acid in the accumulator at any predetermined elevated value. Such heater may be an indirect heat exchange of which the heating medium may be steam, spent liquor or waste gases from the digestion process, or hot side relief liquor. The flow of the hot medium through such heater may be controlled by a valve associated with a suitable thermostatic element responsive to the temperature within the accumulator.

The pressure within the accumulator may likewise be controlled within any desired range. As shown, a vent line 14 having a pressure regulating valve 14' leads from the vapor space of the accumulator to the acid storage tank. The regulating valve 14' may be set at any desired value, usually about 30 pounds, so that when pressures are developed in the accumulator in excess of this, gases are automatically vented through the line 14 and are absorbed in the liquor in the acid storage tank 1.

When it is desired the concentration of the acid within the accumulator may be controlled by associating therewith any suitable type of electrolytically actuated control. Such control may be used to operate a valve so as to admit acid gas to build up the acid concentration to the desired extent. Such valves, operating upon differential conductivity due to differences in acid concentration are well known in the art and need no full description.

As shown, the accumulator is preferably spherical in shape and is provided with a gauge 15. It will be understood that the accumulator may also be provided with liquid level indicating and/or recording instruments (not shown).

The acid storage tank 1 and accumulator 9 are in connection with the digester system through the low pressure header 16 and high pressure header 17 respectively. The high pres-

sure header 17 is connected with eductor 7. In a manner well known to those skilled in the art, hot fluids evolved during the digestion period may be caused to flow through header 17 and are then contacted, condensed and absorbed by the relatively cool acid flowing into the eductor from the acid storage tank by way of pipe 5. Such eductor functions in this manner to establish a relatively low pressure in header 17 and thus facilitates the evolution and/or withdrawal of gases from the digestion zone. This reduction in pressure is further accentuated or augmented by the action of the eductor 11 connected in series with eductor 7.

The digestion system itself includes a series of digesters 18 (two being shown). These are each provided with a removable manhole cover 19 and a blowoff elbow 20. Each digester is likewise provided with a gauge glass 21 and with the usual temperature, pressure and liquid level indicating or recording instruments (not shown).

Each digester is provided with a vent line 22, controlled by valve 22'. This line is shown discharging to the atmosphere but it will be appreciated that it may be connected in the low pressure header 16 so as to recover and absorb low pressure gases. The upper part of the digester may be placed in communication with the low pressure header 16 through the line 23 controlled by valve 23'. Similarly the digester may be placed in communication with the high pressure header through the overhead line 24, controlled by valve 24'.

The digester may be placed in communication with header 17 through the side relief line 25 having control valve 25'. This side relief terminates within the digester at a point well below the liquid level and, as will be appreciated, is provided with a strainer to prevent clogging of the line with pulp.

Means are provided to place the digesters in communication with a hot acid storage (accumulator 9). As shown, such communication may comprise the line 30, controlled by the valve 30', leading from the lower section of the accumulator to the suction side of pump 31. The pump 31 discharges into line 32 which is connected to the digester, preferably through the blowoff elbow, by the branch line 33. Flow of acid from the accumulator to any particular digester is controlled by the valves 33'.

Similarly the digesters are connected in circuit with a hot alkali storage receptacle (not shown). Hot alkaline liquor may be withdrawn from such storage through the line 40, by means of pump 41, and forced through the line 42 through the branches 43 to any one digester of the battery. Flow of the alkaline liquor into the digester may be controlled by proper manipulation of valves 43'.

In accordance with the principles of the invention heretofore expressed, at the termination of the preconditioning treatment the alkaline liquor may be withdrawn from the digester prior to the introduction of the acid liquor. This may be done by utilizing the drawoff lines 44 controlled by the valves 44'. The drawoff lines, as will be understood, are provided with a suitable strainer fitting 45, to retain the pulp within the digester during the removal or drainage of the liquor. The branch lines 44 from each digester may connect into a header 46 through which the soaking liquor is conducted either to the alkali make-up tank or to the regenerator. The drainage of the alkaline liquor may be speeded

up by interposing a pump 47 in the drainage line.

As indicated hereinbefore there is associated with each digester a recirculation circuit which may be utilized, during the preconditioning or soaking period, to recirculate the soaking liquor and/or during the digestion or cooking period to recirculate the cooking liquor. Such circuit may comprise the line 50, having control valve 50', which terminates within the digester in the form of a perforated section. Such line connects with the suction side of recirculation pump 51. The discharge side of the pump is connected through the line 52 to the indirect heater 53. As described above, any suitable heating medium may be utilized in the heater, and such heater may be thermostatically controlled by utilizing a conventional thermostatic element responsive to the temperature condition of the liquor in the digester. Recycle liquor passed through line 50, pump 51 and heater 53 may be discharged through valve 54 to the liquid inlet of eductor 55. The eductor 55 discharges through line 55' into the blowoff elbow or any other suitable connection into the digester. The eductor 55 may be placed in communication, through the line 56, controlled by the valve 56', with the upper or vapor space of the digester. As will be noted hereinafter, during the cooking period, or in some circumstances during the soaking period, gases evolved from the liquor may be withdrawn from the upper section of the digester, mixed with the recycle liquor and reinjected into the digester. Such gas recycle line may, as will be appreciated, be cut out by bypassing the recycle liquid directly from the heater 53 to the bottom of the digester through a bypass line not shown. Similarly a bypass may be provided directly from the pressure side of pump 51 to the digester, thus cutting out the heater 53.

In order more accurately to control the pressure conditions in the accumulator a branch 17' is connected with header 17. Interposed in this line is a pressure regulating valve 17'' which operates automatically to vent fluids from header 17 directly to the accumulator, whenever the pressure within the latter drops below a predetermined point.

Steam may be supplied to the digesters from a header (not shown) through the inlets 51 controlled by valves 51'. While the steam inlets are shown as communicating with the bottom of the digester, it will be understood that branch steam lines may be connected with the blowoff elbow, acid feed line 32 and/or the liquid recycle line.

The operation of the process will have been appreciated from the foregoing description. In starting operations the cover of one of the digesters is removed and such digester is packed with chips to the desired level. The manhole cover is then bolted on, valve 22' is opened and valves 23', 24', 25', 50' and 33' are closed. Valve 43' is opened and pump 41 started. Hot alkali liquor at an elevated temperature of from 40° to 50° C. more or less is then forced through line 42 and branch 43 into the digester. As the liquid level raises the air within the digester is progressively displaced and is allowed to escape through open vent line 22. When the air is largely or completely expelled, the valve 22' is closed and the pump 41 preferably continued in operation until a high hydrostatic pressure is built up on the liquor. This pressure may vary over a relatively wide range and is preferably

correlated with the temperature and concentration of the alkali.

When the alkali liquor from the alkali storage tank is at relatively low temperature, heat units may be imparted to it in transit to the digester. Thus when desired or advantageous, direct steam may be injected into the feed line 42-43 preferably by way of an injector. In this manner the temperature of the liquor is increased and charging of the liquor to the digester accelerated. In lieu of, or in conjunction with, the steam injector, an indirect heater may be employed.

The character and composition of the alkaline liquor may widely be varied, depending upon the character of the raw material employed and the ultimate product desired. Thus, as noted hereinbefore, the preconditioning liquor may be an alkali or alkaline earth hydroxide or ammonium hydroxide. Again such liquor may comprise a soda or sulphate liquor. The concentration, temperature and time of the preconditioning treatment should be so controlled as to limit the action preferentially to the non-cellulosic constituents. When a rigorous preconditioning action is desired, a soda or sulphate liquor is preferred, i. e. a liquor having a component which will take up the acidic products resulting from the action of the caustic on the non-cellulose organic matter of the wood. By controlling the factors noted the extent of the preferential or selective action may be governed.

When the digester has been charged with the preconditioning reagent under the desired hydrostatic pressure, the valve 33' is closed and valve 50' is opened. The pump 51 is then started and the alkaline liquor recirculated from the top to the bottom of the digester. While such a line has not been shown, it will be understood that the present invention contemplates a reversed recirculation, i. e., from bottom to the top of the digester or a combination of the two.

The recirculation of the alkaline liquor is maintained for a period of time sufficient to equalize the temperature throughout the mass of chips and to secure the desired solubilizing action. While, as will be appreciated, this may vary considerably in different treatments, it is found that in most circumstances the desired action is obtained with a recirculation period of from about one to two hours. During the treatment heat units may be added to the recycle stream in its passage through the heater 53 in an amount sufficient to maintain the reagent at the optimum temperature.

In some circumstances, as when the alkaline soaking liquor contains a volatile component, such as ammonia, the gas recycle line 56 is coupled into the liquor recycle line 50 through the medium of the eductor 55. In these circumstances gases evolved are withdrawn through line 56 and valve 56' and are contacted, condensed and/or absorbed in the eductor by the stream of liquor. Thus the concentration of the liquor is substantially maintained and the heat units of the gas recuperated.

When the gas recycle line is not employed, the recycle liquor may flow directly from the heater to the digester through a line (not shown) which bypasses the eductor.

It will be understood that the invention also contemplates a plural soaking treatment utilizing different alkaline liquors. Thus chips may be subjected to a short soaking treatment with caustic followed by a soaking treatment in am-

monium hydroxide or other ammonium derivative.

In accordance with the principles outlined at the end of the alkaline soak the excess liquor is removed from the digester. At such time the recycle line is closed off, by manipulating valves 50' and 56' and valve 44' is opened. The alkaline liquor then discharges from the digester through lines 44 and 46 to the alkaline storage to be mixed with fresh alkali or to the regenerator where, in the known manner, the caustic is recovered. The discharge of the soaking liquor may be accelerated by operating the pump 47.

During this period the valves in the upper section of the digester are still closed. As a result withdrawal of the liquor sets up a partial vacuum within the digester, thus facilitating subsequent introduction of the acid soaking and/or digestion liquor.

When the digester has been drained, in the manner described, valve 43' is closed, pump 41 is stopped and then valves 30' and 33' are opened, thus placing the digester in communication with the accumulator. Since a high pressure exists in the accumulator and a partial vacuum in the digester, the hot preconditioned acid may initially be forced into the digester without operating the pump. When such flow is diminished below a predetermined point the pump 31 may be started. If desired, of course the pump 31 may be operated initially and the differential pressure conditions mentioned supplement the action of the pump.

Since the hot preconditioned bisulphite liquor at a temperature of 70° to 80° C. or more passes from a zone of high pressure to a zone of low pressure, some evolution of SO₂ takes place. The amount of this will of course depend on the temperature, and free acid content of the liquor and the pressure differential. Such evolved gas however is largely reabsorbed by the soaked chips and combines with the alkali. Any excess which is not so combined may be recovered by opening the valve 23' and passing it to the acid storage tank 1.

When the digester is largely or completely filled with the hot acid, the valve 23' may be closed and the pump 31 continued in operation until a hydrostatic pressure of the desired value is built up on the acid. Such pressure may vary from one to five or more atmospheres.

Thereafter the valve 33' is closed, valves 56' and 50' are opened and recirculating pump 51 started. The hot acid is then recycled through the mass of chips, becoming uniformly dispersed in the interior of the chips and equalizing the temperature throughout. It will be appreciated that as a result of the preliminary soaking in alkali a substantial amount of the original mass of the woody material is dissolved or leached out, thus increasing the porosity of the chips. The subsequent soaking in acid liquor at high pressure therefore effects very rapid penetration and combination with residual alkali and insures a uniform condition of the chips not only with respect to temperature but also the quantity and concentration of the reagent.

It will be appreciated that during such acid liquor soaking or saturating period heat units may be added to the mass, by means of heater 53 or controlled introduction of direct steam to gradually increase the temperature. Such impregnating period, due to the conditions noted, is of relatively short duration and in most cir-

cumstances requires only a period of an hour or more. Thereafter steam is admitted through lines 51 and cooking instituted in the known manner.

It will be understood that while it is preferred to recycle the acid liquor through the chips while maintaining the liquor below reaction temperatures, such a step is not essential and the present improvement is not limited to it. Such a step presents the advantages resulting from a uniform impregnation with hot acid before cooking is initiated. If desired, as noted above, heat units may be added to the liquor all during the recycle period to raise the temperature up to 115° C. or more. In this circumstance there is no sharp line of demarcation between the acid impregnating and cooking steps. A more uniform quality and a better yield of pulp however is secured if the liquor is recycled, below reaction temperatures, for a period sufficiently long to insure uniform permeation with acid before cooking.

It is particularly to be observed that due to the preliminary treatment with alkali and the consequent removal of a large quantity of the non-cellulose constituents, the quantity of acid liquor required for digestion is commensurately reduced. This diminution in the requisite quantity of the digestion liquor, coupled with the preheating of chips with alkali and the high starting temperature of the acid liquor effects very decided economies in steam consumption. Since under the preferred method the chips are saturated with acid liquor at a high temperature, the time required to bring the mass up to cooking temperature is likewise shortened. Similarly the reduction in the amount of steam employed correspondingly diminishes the quantity of side relief liquor required to be withdrawn.

After admission of the steam the valve 24' may be opened, venting fluids from the digester to the header 17. These fluids passing into eductor 7 contact with cooler acid flowing there-through from line 5 and are absorbed and condensed.

After a given period, which as known may vary depending upon conditions of a particular treatment, the valve 24' may be closed and valve 25' in the side relief line opened to withdraw relief fluids.

The continued admission of steam increases the volume of liquor in direct proportion to the amount of steam condensation, the volume at all times being indicated by the gauge glass 21 or other liquid level indicator. By the proper manipulation of valves 24' and 25', as is understood by those skilled in the art, the level may be maintained at any desired height.

During the cooking period the relief fluids passing through header 17 are contacted with cold acid in eductor 7 and after passing down through drop leg 8 are contacted and admixed with the accumulator recirculating stream passing through the circuit 14-13-12-11 and 10. By thus employing two eductors in series, the pressure in the accumulator may be maintained considerably higher than in header 17.

As the reactions proceed an increased amount of gas is evolved which should be relieved to prevent an excess raise in pressure. Such gases may be vented through line 23 and header 16 and absorbed in the cooler liquor in storage tank 1.

As noted above, the employment of bypass line 17' and vent line 14 enables the optimum pressure to be carried on the accumulator. Near the ter-

mination of the cook the gases are relieved through header 16 and this relief is continued until the pressure is reduced from the cooking pressure, usually about seventy-five pounds, down to about twenty pounds more or less. After such diminution of pressure the materials may be discharged through the blowoff pipe to the pit. Prior to such discharge, however, the pulp may be given a preliminary washing in the digester.

It will now be appreciated that the methods described herein insure improved results. Not only is the preferential action of the alkaline materials on certain non-cellulose constituents utilized, but at the same time the greater penetrability of such compounds, as compared to bisulphite, is advantageously used. The chips are not only extracted of certain undesired constituents, but at the same time they are uniformly preheated. The preferred method, as noted, not only insures decided economies in steam and acid liquor consumption, but also presents optimum flexibility of operation and a wide permissive range of final products. The present process permits a wide choice of reagents for the preliminary extraction and soaking period. Thus, as noted, this may comprise any suitable alkaline medium having a preferential solubilizing action on certain of the constituents. The treatment also comprehends a plural stage alkaline soak. It will likewise be appreciated that in some circumstances, as in the preparation of a modified kraft, the soaking liquor may comprise a mixture of fresh and spent liquors. It is also to be understood that the present apparatus is particularly amenable to carrying out a treatment involving a preliminary soak in a hot alkali or hot acid liquor, followed by a second soak or a cook in ammonia or an ammonium derivative.

Therefore, while preferred methods and reagents have been described, it is to be understood that these are given as illustrative of the underlying principles of the invention and not as the exclusive means of effectuating such principles.

I claim:

1. A method of treating fibrous materials which comprises charging a digester with the material, soaking the material with preheated alkaline liquor at a temperature of between substantially 40° C. and 50° C. while recirculating the liquor to and from the digester under a high hydrostatic pressure, maintaining the liquor in contact with the material for a period of time of from 1 to 2 hours to solublize some of the non-cellulose constituents, then draining the liquor from the digester and introducing preheated acid liquor and digesting the material in the acid liquor.

2. A method of treating fibrous materials which comprises charging a digester with the material, soaking the material with hot recirculating alkaline liquor of substantially 10° Bé maintained at elevated, but below reaction temperatures, and under a high hydrostatic pressure, draining the alkaline liquor and admitting hot preconditioned bisulphite liquor, soaking the material in the bisulphite liquor for a predetermined period while maintaining the liquor below reaction temperatures and then raising the liquor to cooking temperature.

3. A method of treating fibrous material which comprises soaking the material in hot alkaline liquor maintained at a temperature of approximately 50° C. under high hydrostatic pressure, draining the alkaline liquor from the material; soaking the material in hot acid liquor maintained under high hydrostatic pressure but below

reaction temperatures for a predetermined time and then reducing the pressure and raising the acid liquor to reaction temperature.

4. A method of treating fibrous material which comprises soaking the material in a recirculating mass of hot alkaline liquor; then draining the excess liquor and soaking the material in a recirculating mass of acid liquor maintained at elevated but below reaction temperatures and then raising the temperature and cooking the material in said acid liquor.

5. A method of treating fibrous materials which comprises soaking the material in hot alkaline liquor maintained under high hydrostatic pressure while recirculating the liquor to and from a mass of the material; draining the excess alkaline liquor; soaking the material in hot preconditioned acid liquor maintained at elevated but below reaction temperature and under high hydrostatic pressure, recirculating the acid liquor to and from the mass of material during such soaking period, while maintaining the liquor at elevated but below reaction temperatures and then digesting the material by raising the acid liquor to reaction temperatures.

6. A method of treating fibrous material which comprises charging a digester with fibrous material, soaking the material therein in hot alkaline liquor, draining the excess liquor, then admitting hot acid liquor to the digester, building up a high hydrostatic pressure on the acid, soaking the material in the hot acid while maintaining it below reaction temperature recirculating the acid to and from the digester, then raising the liquor to reaction temperature.

7. A method of treating fibrous materials which comprises charging a digester with fibrous material, admitting hot alkaline liquor to the digester while venting air therefrom, sealing the digester and forcing in additional alkaline liquor to establish a high hydrostatic pressure on the liquor, recirculating the liquor to and from the digester for a period of from 1 to 2 or more hours, while maintaining the liquor at a temperature of from substantially 40° C. to substantially 50° C. to extract some of the non-cellulose constituents while maintaining the liquor cooking temperatures, then draining the digester, admitting hot preconditioned acid liquor and digesting the material in the acid liquor.

8. A method of treating fibrous materials which comprises charging a digester with fibrous material, admitting preheated alkaline liquor to the digester while venting air therefrom, sealing the digester and forcing in additional alkaline liquor to establish a high hydrostatic pressure on the liquor; maintaining liquor in contact with the material for a period of time sufficient to uniformly preheat the material and solubilize certain of the non-cellulosic constituents without effecting the formation of any substantial amount of alkali cellulose, then draining the digester and admitting hot preconditioned acid liquor thereto, maintaining the acid at elevated but below reaction temperatures building up a

high hydrostatic pressure on the acid liquor and recirculating the liquor to and from the digester, then raising the mass to reaction temperature and digesting the material in said acid liquor.

9. A process of producing pulp which comprises charging fibrous material to a digester, admitting hot alkali liquor to the digester in an amount sufficient to build up a high hydrostatic pressure on the liquor, recirculating the liquor while under such pressure to and from the digester while adding heat thereto, then draining the liquor and admitting hot preconditioned bisulphite liquor to the digester, building up a high hydrostatic pressure on such liquor, recirculating the liquor to and from the digester while maintaining it below reaction temperature for a period of time sufficient to saturate the material with the acid liquor, and then digesting the material in the acid liquor.

10. A process of producing cellulose pulp which comprises charging fibrous material to a digester, admitting a hot ammoniacal solution to the digester, building up a high hydrostatic pressure on the solution, recirculating the hot liquor to and from the digester and utilizing the recirculating stream to withdraw ammonia gas from the top of the digester and reabsorb the gas in the solution.

11. A method of producing pulp which comprises saturating fibrous material with hot caustic soda maintained under high hydrostatic pressure at a temperature of approximately 50° C. for a period of from approximately 1 to approximately 2 hours to uniformly preheat the material and extract certain of the non-cellulose constituents of the material; then draining the excess caustic, contacting the material with hot bisulphite liquor maintained at high hydrostatic pressure but below reaction temperature for a predetermined period of time and then digesting the material in the said acid liquor.

12. A process of producing cellulose pulp which comprises charging fibrous materials to a digester, admitting an ammoniacal solution to the digester, building up a high hydrostatic pressure on the solution, recirculating the solution to and from the digester and utilizing the recirculating stream to withdraw ammonia gas from the top of the digester and reabsorb the gas in the solution, and subsequently digesting the fibrous material in hot bisulphite liquor.

13. A process of producing cellulose pulp which comprises charging fibrous material to a digester, admitting ammoniacal solutions to the digester, building up a high hydrostatic pressure on the solution, recirculating the solution to and from the digester and utilizing the recirculating stream to withdraw ammonia gas from the top of the digester and reabsorb the gas in the solution, withdrawing the ammoniacal solution from the bottom of the digester, admitting preconditioned bisulphite liquor to the digester and digesting the fibrous material in said liquor.

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