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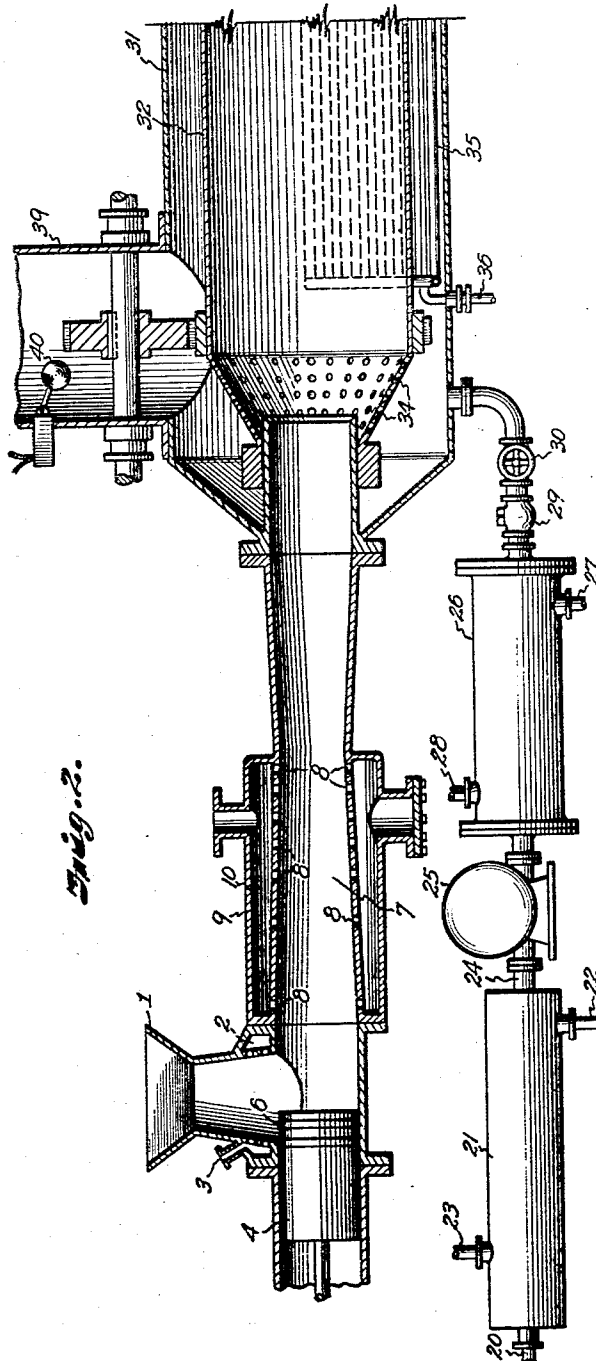
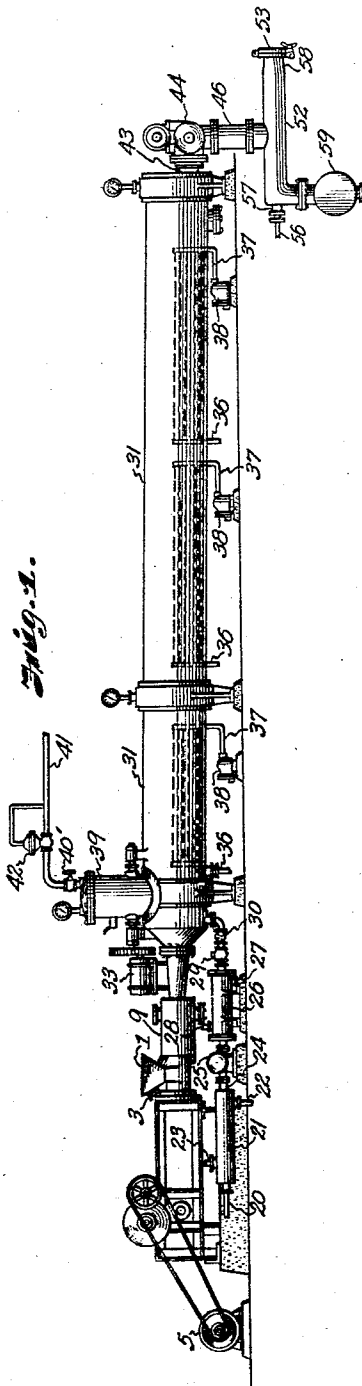
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**2,159,258**

# METHOD AND APPARATUS FOR DIGESTING FIBROUS OR CELLULAR MATERIAL

Filed May 28, 1934

2 Sheets-Sheet 1



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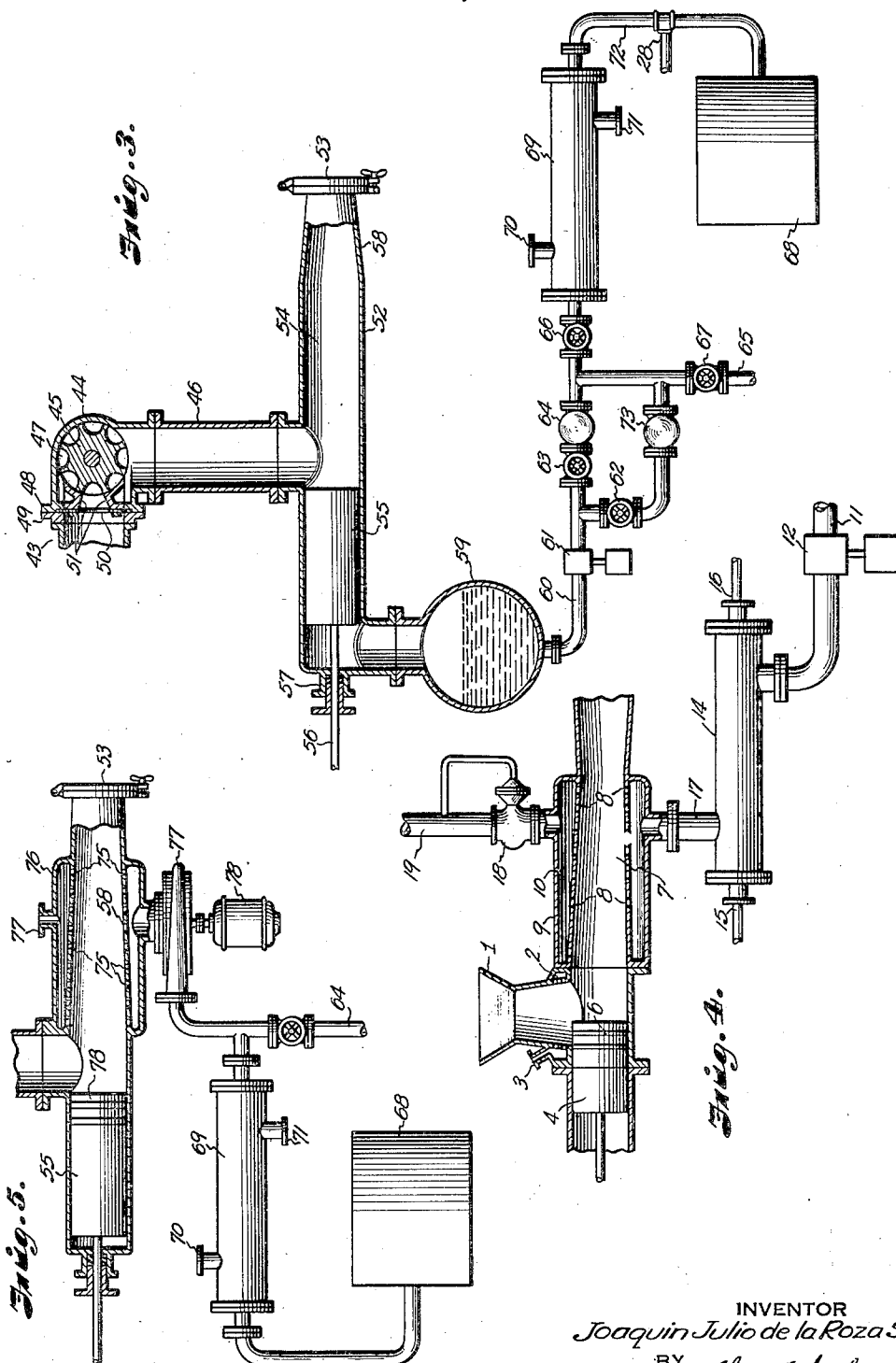
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METHOD AND APPARATUS FOR DIGESTING FIBROUS OR CELLULAR MATERIAL

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2 Sheets-Sheet 2



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## UNITED STATES PATENT OFFICE

2,159,258

METHOD AND APPARATUS FOR DIGESTING  
FIBROUS OR CELLULAR MATERIAL

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Application May 28, 1934, Serial No. 727,878

20 Claims. (Cl. 92—7)

My invention relates to a method and apparatus for digesting fibrous or cellular material, and more particularly, to a method and apparatus for continuously digesting fibrous or cellular material by which occluded oxygen or air carried by the material being fed to the digester is removed before the digesting process proper takes place.

In my co-pending applications, Serial No. 581,636 filed December 17, 1931 now Patent No. 1,991,243 issued February 12, 1935 and its divisional application Serial No. 705,210 filed January 4, 1934 now Patent No. 1,991,245 issued February 12, 1935, I disclose a process and apparatus for continuously digesting fibrous or cellular material at high density in which the material is fed to the digester in the form of a compressed cork or plug adapted of itself to withstand the pressure existing in the digester.

In my co-pending application Serial No. 690,406 filed September 21, 1933 now Patent No. 1,991,244 issued February 12, 1935 which forms a continuation-in-part of application Serial No. 581,636 now Patent No. 1,991,243 issued February 12, 1935 I disclose a process and apparatus for continuously digesting fibrous or cellular material at high density in which the digestion is similarly carried on within a perforated container rotatably supported in a stationary vessel. This vessel is provided with devices for controlling the rate of input and output of the digesting material as well as with suitably arranged heat exchange means for maintaining the desired temperature gradient of the liquor within and around the perforated container.

I have found that substantially completely removal of oxygen or air from the material to be digested before its introduction to the digesting chamber is of material advantage in the operation of my process.

In the pulp industry it has been the general practice in the operation of the sulphite process to add to the sulphite liquor a base or a compound containing a base which will serve to neutralize sulphuric and other acids formed during the process of digestion. Failure to provide for the neutralization of these acids results in a burned cook. It has generally been assumed that the chemical reaction of the sulphite process is substantially as follows:

$\text{Ca}(\text{HSO}_3)_2 + \text{H}_2\text{SO}_3 + \text{incrusting matter} = \text{calcium salts of lignosulfonic acids} + \text{H}_2\text{SO}_3$

If the cooking is carried out improperly this reaction is believed to be  $\text{Ca}(\text{HSO}_3)_2 + \text{H}_2\text{SO}_3 + \text{decomposed incrusting matter} = \text{lignosulfonic acids} + \text{H}_2\text{SO}_4$ .

I have found from a careful investigation of this subject that contrary to all of the above, the sulphuric acid is formed simply from the combination of sulphurous acid and oxygen obtained from the air contained within the wood chips. From this determination the chemical reaction would then be as follows:

$\text{Ca}(\text{HSO}_3)_2 + \text{H}_2\text{SO}_3 + 2\text{O}_2 + \text{incrusting matter} = \text{Ca}(\text{HSO}_4)_2 + 2\text{H}_2\text{SO}_4 + \text{hydrolyzed incrusting matter}$

This explains why wet chips give higher yields of better pulp than dry chips and why very slow cooking or preimpregnating of the chips increases the yield and quality of the pulp. It is all due to the elimination of the oxygen contained in the air within the chips.

As it is now, commercially, a digester is filled with chips and liquor which traps much oxygen within the chips. A calcium bisulphite liquor is then run in. The sulphurous acid displaces the air about the chips. This air is released and the acid then penetrates the interior of the chips more rapidly than the calcium base and forms sulphuric acid with the occluded oxygen. Shortly thereafter the calcium base also penetrates the chips and neutralizes the sulphuric acid. Obviously then, if no free oxygen existed in the interior of the chips, no sulphuric acid would be formed and no base would be required to neutralize acid not found. Thus, the yield, quality and economy of the entire process would be considerably improved.

It is, therefore, an object of my invention to provide a process and apparatus for removing oxygen or air from within fibrous or cellular material before it is subjected to a digesting operation.

It is a further object of my invention to provide a process and apparatus for removing occluded oxygen or air from fibrous or cellular material being fed to a continuous digester in the form of a compressed cork or plug by impregnating the material before digestion with a neutralizing base under a pressure sufficient to cause penetration of the interstices of the material forming the plug or cork and displacement of the occluded oxygen or air.

It is another object of my invention to provide a process and apparatus for recovering in an economic and commercially practical manner volatiles such as sulphur dioxide, turpentine, furfural and/or other vapors or gases continuously evolved during the digesting operation.

It is a further object of my invention to provide a process and apparatus for handling the

digested pulp which will permit extraction from the pulp of the digesting liquor with its potentially useful high heat content and also avoid the usual dilution of the pulp for pumping and handling.

It is a still further object of my invention to provide a process and apparatus for recovering chemicals from the digesting liquor separated from the pulp to thereby provide a substantial saving in the cost of operation of the digesting process.

It is a further object of my invention to provide a novel and efficient arrangement of heat exchange means in my digester for maintaining a desired temperature gradient within the digesting apparatus during the process.

In the accompanying drawings which form part of the instant specification and which are to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in the various views;

Figure 1 is a view in elevation of a digester embodying one mode of carrying out my invention.

Figure 2 is a sectional view of the inlet end of my digester.

Figure 3 is a view partly in section of the discharge mechanism and recovery system of my invention.

Figure 4 is a view partly in section of a modification of the inlet end of my digester.

Figure 5 is a view partly in section of a modification of the discharge mechanism and recovery system of my invention.

In general, fibrous or cellular material such as, for example, bagasse, corn stalks, cotton linters, cotton stocks, flax stocks or waste, grasses, canes; or any of the suitable undergrowth woods; or bamboo, straw, jute, hemp, sisal, manilla, and the like; or cellulose bearing woods such as, for example, spruce, pine, chestnut, hemlock, fir, oak or poplar are comminuted and fed to a compacting and impregnating zone. A liquid may be utilized for wetting the comminuted or chip-like material and this may be water or water containing a wetting compound such as Turkey red oil for breaking down the surface tension of the liquid to enable it to more readily penetrate the cells of the material to be digested. Preferably, however, I find it desirable to utilize a solution of calcium oxide in water, or other suitable base, as the wetting and impregnating substance in order to neutralize sulphuric and other acids which may be formed unavoidably by the sulphite liquor during the digestion proper.

The wetted material is compacted and impregnated by means of a reciprocating piston, provided with sealing rings, which forces the wetted material within a restricted inlet which is tapered and in part first converges and then diverges in the direction of the material feed, or the inlet may be a plain tubular inlet offering sufficient resistance due to friction to form a cork or plug. The walls of the converging portion of this inlet are perforated throughout their length, the number of perforations increasing in the direction of the material feed. As a result of the compacting and impregnating of the material the occluded air or oxygen which is within the cellular structure of the chips or fibres is displaced by the incompressible impregnating liquid such as the lime water previously referred to which is forced into the cellular material. The maximum amount of air or oxygen will be displaced at the throat of the inlet where the pressure is greatest and will escape

through the small orifices provided in greatest number at this section. This converging portion of the inlet is provided with a jacket serving to collect the expressed oxygen, air or excess liquid expressed and remove it from the vicinity. The compacted impregnated material will be of a density in the neighborhood of 25 to 35 or more pounds of fibrous material per cubic foot dry basis.

As a result of the intermittent action of the reciprocating piston the substantially air-free material will be advanced into the diverging portion of the inlet as a compressed cork or plug adapted of itself to withstand the pressure existing within the digesting zone proper. The density of the material in this portion of the inlet will be at least 20 pounds of fibrous material per cubic foot dry basis, although I prefer to have it in the neighborhood of 30 or more pounds of fibrous material per cubic foot dry basis to prevent blow-backs. The compressed column emerges from the diverging portion into the conical portion of a cylinder rotatably supported within and by a stationary vessel. The material on entering will expand to an average density of 20 to 18 pounds or less per cubic foot of dry fibrous material. I prefer, however, that the digestion of the material in the container be carried out at an average density which is in excess of 12 pounds per cubic foot of dry fibrous material.

More particularly referring now to the drawings, the fibrous or cellular material to be digested is fed to hopper 1. It is to be understood that the fibrous material may be dehydrated if desired, in order to remove the excess of water. This may be done when the chips have a high moisture content in order that the proper liquor ratio may be secured in the digester. A wetting liquid such as a base solution of calcium oxide and water referred to is pumped into manifold 2, through line 3, which is connected to a suitable pump and reservoir (not shown). The wetted material is compacted and impregnated with the liquid by reciprocating piston 4 which is driven by any suitable means actuated by motor 5. The piston is provided with piston rings 6 and is adapted to compress the material to be digested into a converging passageway 7 having perforations 8 which can readily be seen by reference to Figure 2. A jacket 9, having a jacket space 10, surrounds the converging passageway 7. The jacket space is adapted to receive the air and excess liquid forced from the material which is being compressed.

In the modification shown in Figure 4, a feed line 11 communicates with a source of gas such as ammonia or nitrogen, or a chemical in a powder form, as for example calcium oxide or a solution of calcium oxide in water or the like or, if desired, hot water. Pump 12 is interposed in line 11 and is adapted to pump the gas, powder, or liquid through heat exchanger 14 in which the fluid being pumped is adapted to be heated by heating medium entering through line 15 and passing out through line 16. The fluid passes from heat exchanger 14 through line 17 and enters the jacket space 10 and passes through the perforations 8 to the material being compacted. The material to be digested, which may be dry or preferably initially wetted by means of the wetting fluid being pumped through line 3 as described above, will have itself collected air containing oxygen which is displaced by the fluid being pumped into the jacket space 10. A predetermined back pressure is kept upon jacket

space 10 by means of pressure control valve 18, the displaced gas passing through valve 18 and out through line 19.

The liquor to be used in the digesting operation, as for example sulphite liquor or the like, is supplied to line 20 which leads to heat exchanger 21. Hot, spent liquor recovered from the digester pulp, or any other suitable heating medium, is passed to line 22, through the heat exchanger in heat exchange relation with the incoming digesting liquor and is withdrawn through line 23. The preheated fresh liquor is withdrawn from the heat exchanger through line 24 and is pumped by pump 25 through a second heat exchanger 26 (to which a heating medium is supplied through line 27 and passes out through line 28), through check valve 29, through valve 30, to the digesting vessel 31 at the desired digesting temperature. By my process, little or no sulphuric acid is formed by the union of hot sulphurous acid liquor and such oxygen as may remain occluded in the chips after the impregnation of the fibrous or cellular material being fed to the digester as has been pointed out hereinabove.

The digesting vessel 31 houses a rotatably mounted container 32 which is driven in any suitable manner, as for example by motor 33 through suitable mechanical connections. The material to be digested is discharged into the rotating container as can readily be seen by reference to the drawings. The inlet end of the rotating container is provided with perforations 34 to permit the digesting liquor being fed to the vessel 31 to thoroughly admix with the material to be digested. The liquor ratio can readily be controlled by means of valve 30 and should not be much in excess of five parts of liquor to one part of bone dry material. I prefer, however, that the liquor ratio be approximately two and one half parts of liquor to one part of bone dry material. It will be understood, of course, that the ratio will vary depending upon the material to be digested, the temperatures employed, and the concentration and type of the digesting liquor. Within the vessel 31 I provide a number of heating coils 35 which extend throughout the length of the digester in the space formed by rotating container 32 and the digesting vessel shell 31. Any suitable heating medium may be passed through the coils. The coils may be arranged in parallel or in series. A suitable medium is steam which is supplied through pipes 36. The heating coils are provided with discharge lines 37 having suitable steam traps 38. By means of my heating arrangement I am enabled to control the temperature existing within any portion of my digesting vessel.

Adjacent the inlet portion of the vessel I provide a vapor dome 39 similar to that shown and described in my co-pending application, Serial No. 690,406, filed September 21, 1933 now Patent No. 1,991,244 issued February 12, 1935. My digesting vessel is fitted with the control shown in the above entitled application by means of which a single float 40 within the dome 39, through suitable control means, coordinates the rate of operation of the feeding mechanism, the rotation of the container, the rotation of the unloader valve and the speed of the feed. The dome 39 is provided with a vapor draw off line 41 having a shut off valve 40' and a pressure control valve 42. The withdrawal line 41 leads to a recovery plant (not shown). Attempts have been made

digestion from a batch process. These attempts have uniformly met with failure. The rate of evolution of gas and vapors in a batch process is so rapid that it is commercially impossible and impractical to collect these gases and permit economical recovery of the constituents to be made. In a continuous process of digestion, such as I have disclosed, the greatest portion of gaseous materials such as for example sulphur dioxide, turpentine, furfural, and the like, are released during the first third of the travel of the digesting materials through the digester. The rate of evolution of gases and vapors in my process, therefore, is relatively slow and I have found it feasible and economical to collect these gases and deliver them to a recovery plant. The recovery plant forms no part of my invention, except in so far as it is in combination with a digesting process. It may be any well known system of rectification or fractionation of gases or vapors such as by means of fractional condensation or the like, as used in the petroleum industry, Blau gas industry, fatty acid industry, alcohol industry, and associated arts.

It is of importance in my invention that the digesting cylinder 32 be rotated at a speed which is a function of the rate of input of material to be digested and/or the rate of output of digested material. If the speed of rotation is not properly governed, a secondary plug of material of high density will be formed within the container. This will tend to hinder and impede the travel and movement of the material along the digesting vessel and accordingly, proper digestion will not take place. The rotation not only admixes the digesting liquor and the material to be digested thoroughly but also carries the digesting material away from the inlet end of the digester as rapidly as it is fed therinto.

On the other hand, if the rate of rotation be too high, a rapid movement of the digesting material through the digesting vessel will take place. This will result in unsatisfactory cooking and a piling up of the digested material at the outlet end of the digester. The speed of rotation, as can be readily understood, will vary with the material being treated, the temperatures employed, the particular digesting liquor and the concentration thereof. The operator can adjust the speed of rotation by observation. It is an advantage of my process and its associated control mechanism that, once the operation has been adjusted to give proper digestion that remarkably uniform and constant results take place. The digested material is withdrawn through pipe 43, which leads to unloader valve casing 44. Within the unloader valve casing 44 is mounted a rotating volumetric unloader valve 45 or any other suitable design of discharge valve.

The discharge end of vessel 31 may be readily removed for cleaning, inspection, and repair. The volumetric discharge valve 45 discharges into discharge conduit 46, which extends at substantially right angles to pipe 43, through which digested material from the digester passes to the volumetric valve 45. The valve 45 may be of any suitable design, as for example a cylinder provided with buckets or recesses 47. Supported between flanges 48 and 49 is a diaphragm 50 of great strength and flexibility. This diaphragm may be made of chrome nickel steel or the like. Attached to the diaphragm in any suitable manner are saddle members 51 which ride the rotary valve 45 to effectively seal the valve at the input side. The saddle is held loosely in place by

the diaphragm and guide members so that it is free to move in the direction of flexing of the diaphragm but not endwise or sidewise. The saddle members 51 may, for the alkaline process of digestion, be made of either nickel or cast iron, which materials are not too hard and are, at the same time, resistant to the action of the chemicals used. The pulp is forced from the digester through pipe 43 until the buckets, in rotating, shear off a portion of the mass and discharge the same after rotation of 90 degrees into discharge conduit 46. The valve shown in Figure 3 will rotate in a counterclockwise direction. The material in each of the buckets 47 contains entrapped steam. Further steam is formed when the bucket approaches the alignment with the discharge conduit 46. The steam in each bucket tends to exert pressure, forcing the mass of pulp from the bucket at the outlet side. It will be observed, by reference to Figure 3, that there is a considerable increase in volumetric capacity from a bucket placed in the discharge conduit 46. The liquor contained in the pulp discharged by valve 45 will be in the neighborhood of 170° C. in the alkaline process and in the neighborhood of 150° C. in the acid process. This liquor is under a pressure of from 25 to 125 pounds per square inch or greater. It will be readily understood that, in passing from the small bucket space to the large space in the discharge conduit, that the liquor will undergo flash vaporization with the evolution of considerable quantities of steam. An enlarged space, therefore, in the form of an appendix 52 is provided. The appendix is closed by means of a flap valve closure 53. Supported for reciprocating movement within the space 54 of the appendix 52 is a loosely fitting piston 55 which is reciprocated by any suitable means (not shown) through connecting rod 56, which works through stuffing box 57. The pulp containing liquor which is not vaporized in the flash chamber is delivered to chamber 54 and forced by the piston 55 through the tapered end 58 of the appendix 52.

A substantial amount of the liquor will be pressed from the pulp by virtue of the compacting of the pulp through the converging passageway 58. The expressed liquor will flow into surge tank 59. This hot liquor is withdrawn from tank 59 through line 60 by means of pump 61. The valve 62 being closed and valve 63 being opened, the hot liquor will be pumped through filter 64 from which it may be passed through line 65, if valve 66 is closed and valve 67 is opened. Line 65 leads to line 27. It will be observed that the hot liquor will then be passed through heat exchanger 26 in heat exchange relation with the incoming fresh liquor. Line 28, leading from heat exchanger 26, passes to a recovery plant, indicated as 68, in which certain constituents of the spent liquor such as carbohydrate materials, alkaline bases, tannins, waxes, and the like, which may have been extracted by the liquor from the material being digested, may be recovered by any of the well known processes for the recovery of these materials from digested liquors. If desired, valve 67 may be closed and valve 66 may be opened and the hot spent liquor pass through heat exchanger 69 in which it is cooled by cooling medium entering through line 70 and passing out through line 71. The cool, spent liquor then passes to the recovery plant 68 through line 72. Filter 64 serves to remove minor amounts of pulp from which may have been entrained in the liquor from the pressing operation. When

it is necessary to clean filter 64, valve 63 is closed, valve 62 is opened, and filter 73 then filters the spent hot liquor. The flap valve 53 at the outlet of the converging portion of the appendix 52 will be closed at the commencement of operations to permit the formation of the plug or cork. As soon as the plug has been formed, the flap valve is opened and the pulp, substantially free of digesting liquor, is permitted to discharge to the repulper (not shown).

In the modification shown in Figure 5, the converging portion of the appendix 58 is provided with perforations 74 and a jacket 76. A centrifugal pump 77, driven by a motor 78 is adapted to pump the hot liquor expressed during the pressing operation by piston 55. Vapors from jacket 76 pass out through flanged port 77 through a suitable conduit (not shown) to a condenser or recovery system. Pipe 65 goes to heat exchanger 26 as before and heat exchanger 69 is similar to that shown in the arrangement in Figure 3. If desired, the perforations 76 may be more closely spaced at the narrow end of the converging passageway, inasmuch as the maximum expressing of liquor will occur at this point, since it is the point of greatest pressure. The piston 55 in the modification shown in Figure 5, may be fitted with piston rings 78 to prevent the escape of liquor into the cylinder housing the piston 55 at the beginning of its stroke.

It will be observed that I have accomplished the objects of my invention. I have provided a process for the digesting of fibrous or cellular material in which the formation of corrosive sulphuric and other acids is obviated. A novel and efficient continuous digesting process is disclosed permitting the economical recovery of volatiles such as sulphur dioxide, turpentine, furfural, and the like. A system which is thermally efficient has been devised. A uniform product of surprising quality is produced.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of my claims. It is further obvious that various changes may be made in details within the scope of my claims without departing from the spirit of my invention. It is, therefore, to be understood that my invention is not to be limited to the specific details shown and described.

Having thus described my invention, what I claim is:

1. A process for continuously digesting fibrous or cellular material in a digestion zone comprising wetting the material with an alkaline liquid, compacting the wetted material in a compression zone so as to displace occluded air and substantially impregnate the material with an alkaline liquid, removing the air from the compression zone, passing the material from the compression zone to a digestion zone and there digesting the material with an acidic cooking liquid.

2. In a process for continuously digesting fibrous or cellular material in a digestion zone at an elevated temperature and pressure, the improvement comprising the steps of discharging the digested material into a zone of reduced pressure, separating the pulp from the heated liquor, removing the pulp from the system and passing the heated liquor in heat exchange relationship with cooler liquor being delivered to the digestion process.

3. In the art of making pulp from fibrous or

cellular material by a continuous digestion process, the improvement comprising the steps of removing the pulp from a digestion zone, introducing the pulp to a separating zone and there extracting substantially all of the liquor, passing the extracted liquor in heat exchange relationship with incoming cool liquor and subjecting the extracted liquid to a chemical recovery operation.

10 4. A process for continuously digesting fibrous or cellular material comprising wetting the material with a wetting fluid, subjecting the wetted material to pressure in a compacting zone to form a compacted body of material, express occluded air from and impregnate the material with wetting fluid, removing the expressed air from the compacting zone, intermittently advancing the impregnated material into a digesting zone, subjecting the material in the digesting zone to heat under pressure and to the action of digesting liquor being injected into the digesting zone, removing the hot digested material from the digesting zone into a zone of reduced pressure, compressing the hot digested material to a density sufficient to express the greater portion of the digesting liquor from the material and removing the compressed material from the system.

5 5. A process for continuously digesting fibrous or cellular material comprising wetting the material, subjecting the wetted material in a compacting zone to a sufficient pressure to form a compacted body of the material, express occluded air from and impregnate the material with the wetting liquid, removing the expressed air from the compacting zone, advancing the body of impregnated material into a digesting zone, subjecting impregnated material in the digesting zone to the action of a digesting liquor being injected into said zone, continuously removing from the digesting zone volatiles evolved during the digesting operation, discharging digested material from the digesting zone into a compressing zone, compressing the material in said compressing zone to a density sufficient to express the greater portion of the digesting liquor from the material and discharging from the compressing zone material from which liquor has been expressed.

10 6. A process for continuously digesting fibrous or cellular material comprising wetting the material, subjecting the wetted material in a compacting zone to a sufficient pressure to form a compacted body of the material, express occluded air from and impregnate the material with the wetting liquid, removing expressed air from the compacting zone, advancing the body of impregnated material into a digesting zone, subjecting impregnated material in the digesting zone to the action of a digesting liquor being injected into said zone, discharging digested material from the digesting zone into a compressing zone, compressing the material in said compressing zone to a density sufficient to express the greater portion of the digesting liquor from the material, passing the expressed liquor in heat exchange relationship with the liquor being injected into the digestion zone and discharging from the compressing zone material from which liquor has been expressed.

7. A continuous digester comprising a pressure digesting chamber, means forming a tubular inlet to said digesting chamber, a piston adapted to cooperate with said inlet means to compact in said inlet material to be digested into a digesting

pressure retaining plug supported only by said inlet means, said inlet means being provided with a plurality of gas escape orifices.

8. A continuous digester comprising a pressure digesting chamber, means forming a tubular inlet to said digesting chamber, a piston adapted to cooperate with said inlet means to compact in said inlet material to be digested into a digesting pressure retaining plug supported only by said inlet means, said inlet means being provided with orifices, and external means associated with said inlet means for passing a fluid through said orifices and said plug.

9. In a continuous digester of the rotary type, means forming an inlet to said digester, the walls of said inlet first converging and then diverging to the digester, a plurality of openings formed in said converging walls and a jacket surrounding said inlet means.

10. A continuous digester comprising a rotary digesting vessel, means forming a tubular perforated inlet to said digester, means adapted to cooperate with said inlet means to compact in said inlet material to be digested into a digester pressure retaining plug supported only by said inlet means, and external means associated with said inlet means for passing fluid through said inlet means and the material compacted therein effecting the removal of occluded oxygen or air from material being compacted in said inlet means.

11. Apparatus for digesting fibrous or cellular material comprising in combination a stationary vessel, a rotatable digesting chamber in said vessel, means forming an inlet to said digesting chamber, means associated with said inlet means for effecting the removal of occluded air from material passing through said inlet means, means for removing digested material from said chamber and separating mechanism associated with said last named means for extracting liquid from said digested material.

12. Apparatus for continuously digesting fibrous or cellular material including a discharge member, an unloader valve in said member, a liquor expressing device for receiving digested material discharged through said member, and material transferring means connecting said expressing device and said discharge member.

13. Apparatus for continuously digesting fibrous or cellular material including in combination means forming a discharge member from said digesting apparatus, an unloader valve in said discharge member, means forming an outlet adapted to compact the digested material and express the liquid contained therein connected to said discharge member, means for removing expressed liquid from said outlet forming means, means for delivering the removed liquid to a recovery plant and a bypass line connected to said delivery means for returning a portion of said liquid to a desired point in the digester.

14. Apparatus for continuously digesting fibrous or cellular material including in combination means for introducing material to be digested to said digester in the form of a compressed plug or cork, means associated with said introducing means for removing occluded air from said material in said introducing means, a liquor input line connected to said digester, heat exchange means associated with said input line, a discharge member connected to said digester, an unloader valve in said discharge member, mechanism associated with said discharge member for expressing liquid from the unloaded material,

means for removing the expressed liquid connected to said mechanism, a line connecting said removal means with a recovery plant, and means connected to said line for bypassing a portion of said liquid to said liquid input heat exchange means.

15. A process for continuously digesting fibrous or cellular material comprising wetting the material with a wetting fluid, subjecting the wetted material to pressure in a compacting zone to form a compacted body of material, express occluded air from and impregnate the material with wetting fluid, removing the expressed air from the compacting zone, advancing the body of material from the compacting zone into a digesting zone, introducing into the digesting zone a digesting fluid different than the wetting fluid, heating the material in the digesting zone and subjecting it under pressure to the digesting action of the digesting fluid, discharging the hot digested material from the digesting zone into a compressing zone, compressing the hot digested material in said zone to a density sufficient to express the greater portion of the contained fluids from the material and separately discharging the compressed material and the expressed fluids from the compression zone.

16. A process for the manufacture of pulp from fibrous or cellulose bearing material comprising, wetting the material with a solution containing a base, uniformly impregnating the material with the solution by pressing the material to a high density and then digesting the base impregnated material by an acid cooking process to produce pulp.

17. A process for the manufacture of pulp from

fibrous or cellulose bearing material comprising, wetting the material with a solution containing a base, applying a compressing force to the wetted material while confining the body of material to a uni-directional restricted movement into a digesting chamber, said force having an applied intensity sufficient in conjunction with the restrictive force to uniformly impregnate the material with the solution containing a base and form a material body of high density, and digesting the impregnated material under pressure in the digesting chamber with an acid cooking liquor to produce pulp.

18. The process of claim 17 including the step of withdrawing from the zone of impregnation the liquid in excess of that required to uniformly impregnate the material.

19. The process of claim 17, said confined body of base impregnated material forming an internally unreinforced plug of a density sufficiently high to withstand the pressure existing within the digesting chamber.

20. A process for the manufacture of pulp from fibrous or cellulose bearing material comprising, adding a solution of lime and water to the material, applying a compressing force to the wetted material while confining the body of material to a uni-directional restricted movement into a digesting chamber, said force having an applied intensity sufficient in connection with the restrictive force to uniformly impregnate the material with the milk of lime solution and digesting the impregnated material under pressure in the digestion chamber with sulphurous acid.

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