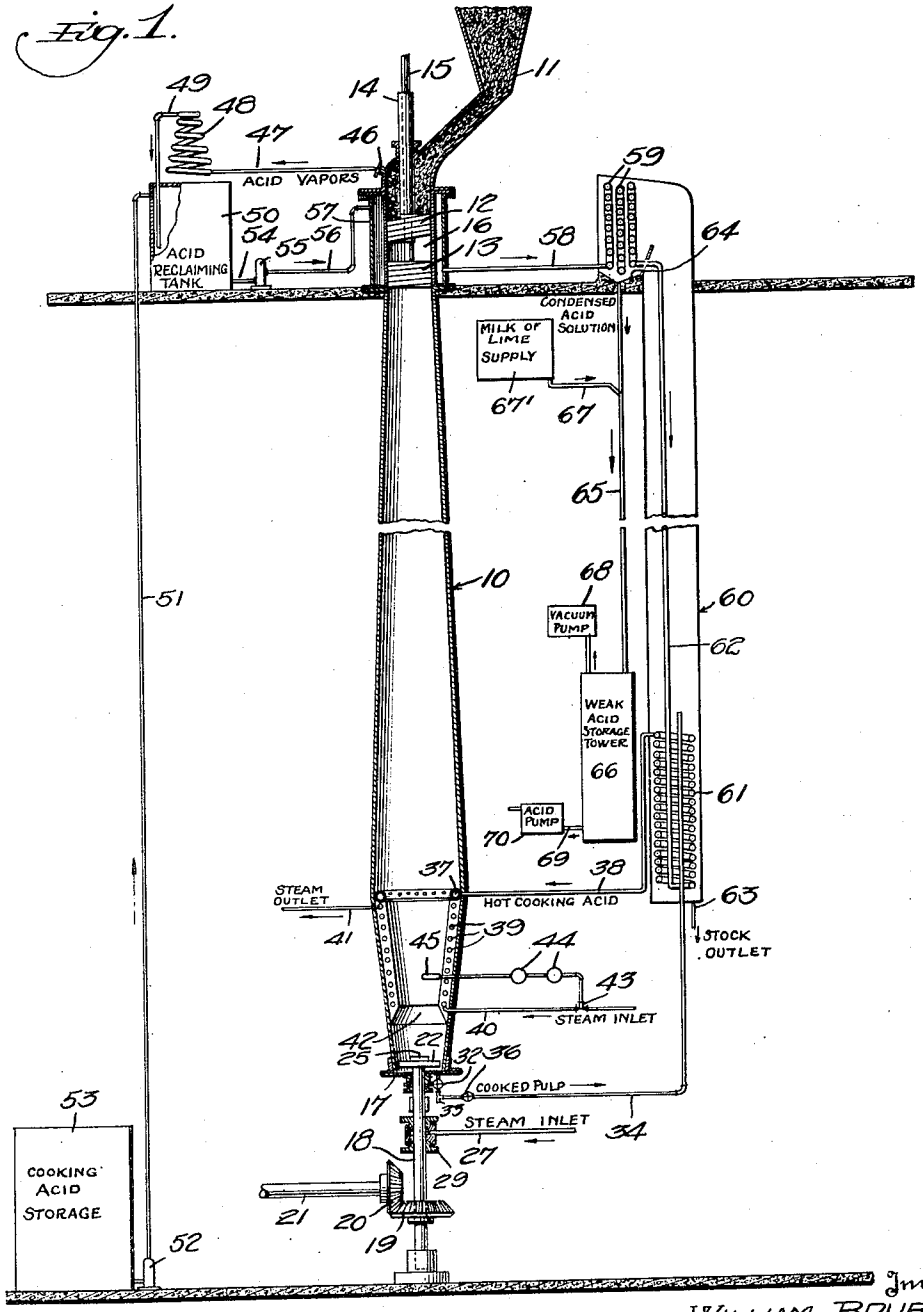
July 16, 1935. W. BRUBACHER 2,008,635

PROCESS OF AND APPARATUS FOR PRODUCING PULP

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Fig. 1.



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Fig. 2.

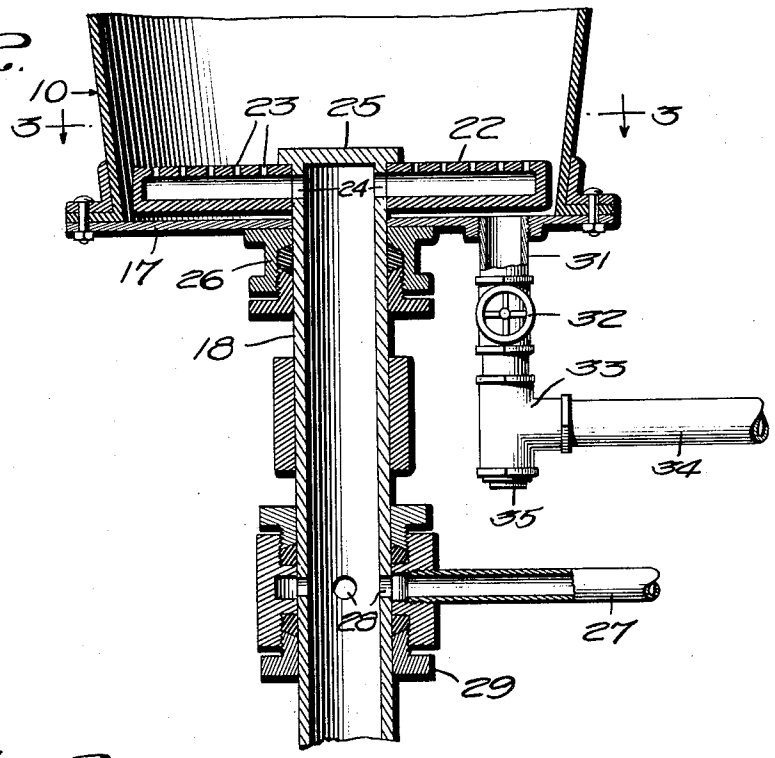
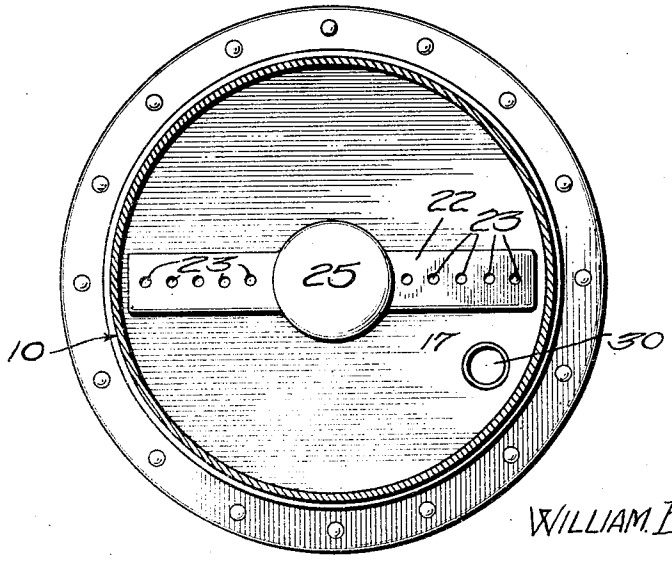


Fig. 3.



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2,008,635

PROCESS OF AND APPARATUS FOR PRODUCING PULP

William Brubacher, Kapuskasing, Ontario, Canada

Application May 5, 1932, Serial No. 609,519

18 Claims. (Cl. 92—7)

This invention relates to the production of pulp from fibrous material, such as wood chips, saw dust, rags, old paper, straw hemp and the like, and more particularly to an improved process of and apparatus for the continuous cooking of such fibrous material to provide for the continuous production of pulp therefrom.

The principal object of this invention is to provide an efficient, economical, and commercially practical process of producing pulp continuously wherein the cooking of the fibrous material may be carried out in a single cooking tower or digester.

An important object of the invention is to provide a process of producing pulp wherein the cooking of fibrous material is more effectively and rapidly accomplished than in similar processes heretofore employed.

Another object of the invention is to provide a process of producing pulp wherein the cooking of the fibrous material is effected with less waste of steam, chemicals, and raw materials than in processes heretofore employed.

A further object of the invention is to provide an efficient and commercially practical apparatus for carrying out the process above referred to.

Other objects and advantages of the invention will become apparent during the course of the following description.

While there have heretofore been proposed processes for the continuous digesting of fibrous material, such as by the use of a plurality of interconnected digesters, the customary methods of digesting fibrous material all involve batch treatment. Batch digesting is a relatively slow procedure, involves an unnecessary amount of handling of materials, and requires a battery of expensive digesters for a practical commercial plant. Moreover, in general practice, the materials to be employed are brought in contact with each other in a digester at temperatures much below the boiling point of the cooking liquor, thus requiring a considerable additional amount of heat in order to bring the mass in the digester to the elevated temperature necessary for effective cooking of the fibrous material. In most instances this heat is supplied by injecting steam directly into the cooking vessel, with the result that considerable dilution of the cooking liquor takes place, thereby reducing its efficiency. This direct heating must be done slowly in order to prevent boring of the chips or other fibrous material, but even under these conditions, a considerable escaping of sulfur dioxide and precipitation of monosulfite on account of local overheating cannot be avoided. In other instances, the cooking liquor is preheated before entering the cooking vessel, and steam is then introduced directly into the vessel resulting in the above mentioned disadvantage. In some processes steam coils inside the vessel are employed for heating indirectly the mass to be cooked, and in other processes heat exchangers located outside the cooking vessel are employed whereby the cooking liquor is circulated through the heat exchangers and is heated indirectly, while at the same time steam is injected directly into the vessel in order to bring the mass up to boiling.

As will be apparent from the foregoing, in all of the processes heretofore generally employed the fibrous material and cooking liquor are brought in contact with each other at the beginning of the process before either has reached the boiling temperature of the cooking liquor. Hence, it is readily apparent that in these prior processes considerable time and a substantial amount of steam are employed before the actual cooking stage of the process begins. In addition to the amount of time which is thus practically wasted, the introduction of the large amount of steam employed to bring the mass to a boiling temperature results in the reduction of strength of the cooking liquor and attendant disadvantages, viz. reduced yield and lower strength of product.

In addition to the foregoing disadvantages, the majority of prior processes have not provided best commercial practice with respect to the recovery of waste heat and chemicals. For example, the cold cooking acid employed in these processes is ordinarily preheated in the acid supply tank with a resulting separation of gas and a consequent weakening of cooking liquor which is very undesirable. In other words, the full initial concentration of the cooking liquor is not preserved for the actual cooking operation. Moreover, in prior processes the raw material to be treated is brought to the cooking temperature by added heat while in contact with the cooking liquor, thereby necessitating the introduction of sufficient steam not only to bring the cooking liquor to a boiling temperature but also to heat a large mass of fibrous material. This involves an input of steam which is in excess of the amount which I have found is necessary if the mass of fibrous material is gradually brought to the necessary temperature by the hot gases discharged from the zone of actual cooking of the material.

In an effort to overcome the above mentioned

disadvantages, I have devised a process in which the undesirable features of prior processes are not present. This process is particularly adapted for use in the production of sulfite pulp and the process will be described in connection with the production of this type of pulp. However, it will be apparent to those skilled in the art that the process is not limited to the sulfite method.

In the accompanying drawings I have shown a form of apparatus particularly suitable for use in the practice of my process. In this showing,

Figure 1 is a diagrammatic view of the assembly of apparatus preferably employed,

Figure 2 is a central vertical section of the assembly of the lower portion of the digester employed, parts being shown in elevation, and

Figure 3 is a horizontal section taken substantially on line 3—3 of Figure 2.

Referring to the accompanying drawings, the reference numeral 10 designates the digester or cooking vessel which is relatively elongated. In commercial practice, this digester may conveniently be approximately one hundred feet in length. As shown in the drawings, the digester 10 gradually tapers outwardly from the top to a point below the center thereof and, from such point tapers more sharply inwardly toward the bottom, the extreme lower portion of the digester thus being of frustro-conical shape. As will be apparent, the walls of the digester 10 should be of suitable conventional construction to withstand the reactions resulting from the cooking of fibrous material therein.

The upper end of the digester 10 is provided with a hopper 11 of conventional design by which wood chips or other fibrous material are fed to the digester. The supply of fibrous material introduced into the digester is controlled by two worms 12 and 13 which are independently driven by telescoping shafts 14 and 15 from suitable sources of power (not shown). The two worms are spaced a substantial distance from each other providing a chamber or space 16 therebetween. As shown in Figure 1, the upper worm 12 has a sharper pitch than the lower worm 13.

The extreme lower portion of the digester 10 is provided with a removable bottom 17 which has a central opening through which extends a hollow shaft 18 supported in suitable bearings and adapted to be rotated by means of the gear 19 meshing with the gear 20 driven by the shaft 21 connected with a suitable source of power (not shown). The upper end of the hollow shaft 18 carries a hollow scraping member 22 which is provided on the upper face thereof with steam discharge openings 23. The interior of the scraper arm 22 communicates with the interior of the hollow shaft 18 through openings 24. The upper end of the shaft 18 is closed by means of a suitable cap 25. Packing members 26 are arranged around the hollow shaft 18 adjacent the bottom 17. The interior of the shaft 18 is adapted to receive steam from a steam inlet pipe 27 through openings 28, the steam inlet pipe 27 and the shaft 18 being provided with suitable connections and packing members 29 at their junction point.

The removable bottom plate 17 of the digester 10 is provided at one side thereof with a discharge opening 30 which communicates with a pulp discharge pipe 31 provided with a control valve 32 and connecting through the T 33 with the pipe 34. The T 33 is provided with a clean-out plug 35. As shown in Figure 1, the pipe 34 is provided with a control valve 36 adjacent the T 33.

The lower frustro-conical portion of the digester 10 is provided on the interior thereof with a perforated liquid distributor ring 37 which is connected to the pipe 38. Below the ring 37 are arranged steam coils 39 connected to a steam inlet pipe 40 and a steam outlet pipe 41. The coils 39 are covered by a shield 42 to prevent the lodging of pulp thereon. The pipe 40 is provided with an automatic valve 43 which is operated by a conventional thermostatic control device 44 connected to a heat responsive member 45 arranged within the interior of the digester 10 near the bottom thereof.

The extreme upper portion of the digester 10 is provided with a conventional gas collector 46 which is connected by the pipe 47 with cooling coils 48. From the coils 48, liquid passing therethrough is adapted to be delivered by the pipe 49 to an acid reclaiming tank 50. The upper portion of the tank 50 is connected by the pipe 51 with a liquid pump 52 which is connected with the acid storage tank 53. The lower portion of the tank 50 is connected by a pipe 54 with a liquid pump 55 which is adapted to force liquid through the pipe 56 into the interior of a heat interchanger 57 surrounding the extreme upper portion of the digester 10. The heat interchanger 57 is connected by a pipe 58 with condensing coils 59 arranged in the extreme upper portion of an elongated, preferably round, pulp receiver designated generally by the numeral 60.

The mass of material treated in the digester 10 is discharged continuously through the opening 30 and conveyed to the receiver 60 by the pipe 34 which extends into the interior of the receiver and terminates at a substantial distance from the bottom thereof. As shown in Figure 1, within the lower portion of the receiver 60 is arranged a heat exchanging coil 61 which has an inlet pipe 62 connecting it with the coils 59 and which is connected with the liquid distributing ring 37 in the digester through the pipe 38. The bottom of the receiver 60 is provided with a stock outlet pipe 63 which delivers the treated stock to conventional washing and deckering apparatus (not shown) customarily employed for producing finished pulp.

As shown in the drawings, the condensing coils 59 are arranged above a sump 64 which is adapted to deliver liquid into the pipe 65 which is connected with the weak acid storage tower 66. Intermediate its ends, the pipe 65 is connected through the pipe 67 with a supply tank 67'. The weak acid storage tower 66 and the receiver 60 are adapted to be maintained under vacuum by means of a vacuum pump 68. The lower portion of the tower 66 is connected by the pipe 69 to a liquor pump 70.

In the practice of my process, wood chips or other fibrous material are fed from the hopper 11 to the screw 12 which delivers the material into the space 16 from which it is discharged into the digester 10 by means of the screw 13. The pitches of the screws 12 and 13 are so proportioned as to permit compressing of the fibrous material in the space 16 to provide a seal for the upper end of the digester 10. In practice, the two screws are separately and independently driven through the shafts 14 and 15 in such a manner as to force the fibrous material into the digester at the desired rate and at the same time to control the compression of material in the space 16 so as not to jam the lower screw and

prevent the creation of a wholly air-tight seal. It has been found that the material in the space 16 may be compressed to such a degree as to permit the use of pressures in the digester 10 somewhat higher than atmospheric pressure and at the same time to permit some discharge of gases from the digester to prevent the creation of a stagnant condition therein. The gases which escape are collected by the device 46 and carried by the pipe 47 to the condensing coils 48 which deliver the condensed acid solution through the pipe 49 to the acid reclaiming tank 50. The principal supply of acid in the tank 50 is received from the cooking acid storage 53. In order to prevent excessive pressure of gases and vapors at the top of the digester 10, the cold acid solution (about 25° C.) from the tank 50 is delivered by the pump 55 to the heat interchanger 57 thereby maintaining the upper end of the digester 10 relatively cool whereby a substantial proportion of gases and vapors reaching the upper end of the digester are condensed.

The fibrous material under treatment in the digester 10 passes slowly from the top to the bottom depending upon the rate at which the treated material is removed from the bottom thereof. As will be apparent, due to the outward taper of the digester 10, the material therein moves more slowly as it approaches the actual cooking zone which is adjacent the lower end of the digester. At this point, the fresh cooking liquor introduced into the digester from the liquid distributor 37 is brought into contact with the fibrous material. However, it will be apparent that the fresh cooking liquor, which is introduced at approximately boiling temperature as hereinafter explained, will be vaporized to a certain extent due to the heating action of the steam coils 39, and the resulting gases will pass upwardly, together with steam from the scraper arm 22, counter-current to the flow of fibrous material. The result is that the hot gases tend to heat the downwardly moving body of fibrous material so that at its point of contact with the fresh cooking liquor it is at approximately the temperature of such liquor whereby the essential chemical reactions take place most speedily and with the greatest efficiency. Moreover, as the gases and steam pass upwardly they are absorbed in part by the fibrous material. This is doubly advantageous in that it reduces the volume of gases discharged from the digester and also serves to impregnate the fibrous material with the cooking acid so that when the material reaches the point of direct contact with the fresh cooking acid, the acid concentration of the fibrous material approaches the concentration of the fresh acid with the result that the cooking is completed in a relatively short time.

The time required for treating a given amount of fibrous material, and also the particular temperature of treatment to be employed, will depend upon the particular material to be disintegrated. The temperature is maintained and controlled by the steam coils 39, the control being effected automatically in a conventional manner by the thermostatic device 44 which controls the valve 43 in the steam inlet pipe 40. Ordinarily, in a commercial digester of approximately one hundred feet in length the cooking cycle normally requires about nine hours from the time the fibrous material enters the digester until the pulp is discharged from the bottom. As indicated above, the temperature within the digester will be the lowest at the top thereof and will gradually increase toward the bottom. The introduction of steam from the hollow scraper arm 22 serves to bring the temperature of the mass to its maximum point although the major proportion of heat input is from the steam coils 39. The following table indicates an approximate temperature schedule inside the cooking vessel in a typical operation of the process:

0 ft. (top)	30° C.
10 "	40° C.
20 "	65° C.
30 "	85° C.
40 "	100° C.
50 "	110° C.
60 "	120° C.
70 "	125° C.
80 "	128° C.
90 "	132° C.
100 " (bottom)	140° C.

The cooked pulp is continuously removed from the digester 10 through the opening 30 in the bottom plate 17, the rotating scraper arm 22 facilitating the discharging of the pulp from the digester. The mass containing the pulp is delivered through the pipe 34 to the receiver 60. As pointed out above, a relatively high vacuum is maintained within the receiver 60 with the result that when the cooked pulp is discharged into the receiver from the pipe 34 the cellulose fibers thereof will expand suddenly. The cavities of the cellulose fibers will be filled with steam when the pulp leaves the bottom of the digester 10 and the fiber walls themselves are tender as a result of the cooking action and, hence, when the pulp is transferred from the high temperature and high pressure cooking condition, as it exists in the digester, into the receiver 60, the fibers will be subjected to a relatively high vacuum and will expand suddenly. The resulting fraying effect upon the fibers has been found to be particularly beneficial for the manufacture of certain paper products.

The blowing off of the cooked pulp mass in the receiver 60 results in the conversion of a large portion of the cooking acid solution into vapor phase and the resulting acid gases pass upwardly into contact with the condensing coils 59 which are maintained relatively cool by the passage therethrough of fresh acid solution from the acid reclaiming tank 50. The resulting condensate is collected by the sump 64 and delivered therefrom by the pipe 65 to the storage tower 66. As pointed out above, the vacuum pump 68 which is connected to the tower 66 which, in turn, is connected to the receiver 60, maintains the tower and the receiver under relatively high vacuum. Hence, not only does the liquid condensed by the coils 59 pass into the tower 66, but also the gases released in the receiver 60 and, that are not condensed, are drawn through the pipe 65 into the body of acid solution in the tower 66 and are substantially completely absorbed therein. Obviously, a sufficient head of acid solution is maintained in the tower 66 in order to assure proper absorption. The recovery of acid is further aided by introducing a milk of lime solution, as is generally employed in the manufacture of bisulfite liquor, through the pipe 67 into the pipe 65 where it will combine with the sulfur dioxid while passing to the storage tower 66. The weak acid from the tower 66 may be pumped by the pump 70 to any of the main acid making apparatus (not shown).

As will be apparent from the foregoing, the loss of acid is reduced to a practical minimum by the use of the preferred form of apparatus shown in

the drawings. Moreover, the use of this apparatus reduces heat losses to a practical minimum. For example, the cold acid from the tank **50** is slightly preheated while passing through the heat interchanger **57** and its temperature is increased to a marked degree as it passes through the condensing coils **59**, a substantial proportion of the heat from the gases passing over the coils being exchanged thereto. However, it is by the passage of the acid through the coils **61** that the solution is brought to boiling temperature, at which temperature it is delivered to the digester through the distributor **37**. As will be apparent, a substantial head of the cooked pulp mass should be maintained in the lower portion of the receiver **60** in order that there may be a maximum exchange of heat therefrom to the acid solution passing through the coils **61**. Accordingly, the rate of discharge of the stock from the receiver **60** through the stock outlet **63** should be controlled so that the head of cooked pulp mass will be sufficient to substantially completely cover the coils **61**.

As will be readily apparent to those skilled in the art, the use of my process and apparatus results in numerous practical advantages not possessed by systems heretofore employed. In the first place, continuous production of pulp is provided with a single digester. In the second place, the fibrous material and cooking liquor are brought together when both are at a temperature favorable to rapid and efficient cooking. In addition, the time of operation and effort in handling materials are greatly reduced. Moreover, because of the efficient heat recovery the requirements for heat input are materially reduced. Finally, there is practically no loss of waste acid gases, thereby effecting a saving in chemicals. In addition to these advantages in operation, my invention possesses the important advantage that the pulp produced is of particularly high quality and can therefore be marketed at a premium.

While I have described in detail the preferred practice of my process and the preferred form of apparatus to be employed therewith, it is to be understood that the details of procedure in practicing the process and the size, form, and arrangement of parts of the apparatus may be considerably modified without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. A continuous process of cooking pulp which comprises introducing into a digester fibrous material to be converted into pulp, such fibrous material being introduced substantially free from pulp cooking chemicals, moving a body of said fibrous material in said digester toward a pulp cooking zone, elevating the temperature of said fibrous material in said digester during its movement toward said cooking zone, maintaining a pulp cooking temperature in said cooking zone, mixing with said body of fibrous material as it approaches said cooking zone cooking liquor at an elevated temperature and in substantially unspent condition, passing the fibrous material in contact with said cooking liquor through said cooking zone, and moving the resulting cooked pulp away from said cooking zone and out of said digester.

2. A continuous process of cooking pulp which comprises introducing into a digester fibrous material to be converted into pulp, said fibrous material being introduced at substantially atmospheric temperature and substantially free from pulp cooking chemicals, moving a body of said fibrous material in said digester toward a pulp cooking zone, elevating the temperature of said fibrous material in said digester during its movement toward said cooking zone, maintaining a pulp cooking temperature in said cooking zone, mixing with said body of fibrous material as it approaches said cooking zone cooking liquor at approximately boiling temperature and in substantially unspent condition, passing the fibrous material in contact with said cooking liquor through said cooking zone, and moving the resulting cooked pulp away from said cooking zone and out of said digester.

3. A continuous process of cooking pulp which comprises introducing into a digester fibrous material to be converted into pulp, said fibrous material introduced into said digester being substantially free from pulp cooking chemicals and at a temperature substantially below pulp cooking temperature, moving a body of said fibrous material in said digester toward a pulp cooking zone in which a pulp cooking temperature is maintained, elevating the temperature of said fibrous material as it moves toward said pulp cooking zone by means of heat discharged from said zone, mixing with said body of fibrous material as it approaches said cooking zone cooking liquor at an elevated temperature and in substantially unspent condition, passing the fibrous material in contact with said cooking liquor through said cooking zone, and moving the resulting cooked pulp away from said cooking zone and out of said digester.

4. A continuous process of cooking pulp which comprises introducing into a digester fibrous material to be converted into pulp, said fibrous material introduced into said digester being substantially free from pulp cooking chemicals and at a temperature below pulp cooking temperature, moving a body of said fibrous material downwardly in said digester toward a pulp cooking zone in which a pulp cooking temperature is maintained, elevating the temperature of said fibrous material as it moves toward said pulp cooking zone by means of hot gases and vapors moving upwardly from said pulp cooking zone, mixing with said fibrous material as it approaches said cooking zone cooking liquor at approximately boiling temperature and in substantially unspent condition, passing the fibrous material in contact with said cooking liquor through said cooking zone, and moving the resulting cooked pulp and spent cooking liquor away from said cooking zone and out of said digester.

5. In a process of cooking pulp wherein fibrous material to be converted into pulp is introduced into a digester, mixed with substantially unspent cooking liquor at an elevated temperature, and the mixture of fibrous material and cooking liquor is passed through a cooking zone, the improvement which comprises introducing said fibrous material into said digester at a temperature below pulp cooking temperature and substantially free from pulp cooking chemicals, and elevating the temperature of said fibrous material in said digester prior to mixing it with said pulp cooking liquor.

6. In a continuous process of cooking pulp wherein fibrous material to be converted into pulp is introduced into a digester, mixed with cooking liquor at approximately boiling temperature and in substantially unspent condition, and the mixture of said fibrous material and cooking liquor is passed through a pulp cooking zone in said digester, the improvement which comprises introducing said fibrous material into said digester at

a temperature below pulp cooking temperature and substantially free from pulp cooking chemicals, and elevating the temperature of said fibrous material in said digester by means of hot gases and vapors from said pulp cooking zone to heat said fibrous material to approximately pulp cooking temperature prior to contacting the same with said cooking liquor.

7. A continuous process of cooking pulp which comprises moving a current of fibrous material to be converted into pulp toward a pulp cooking zone in contact with a counter-current of steam and vapors from heated pulp cooking liquor, mixing cooking liquor at approximately pulp cooking temperature with said fibrous material as it approaches said cooking zone, maintaining a pulp cooking temperature in said cooking zone, passing the fibrous material in contact with said cooking liquor through said cooking zone, moving the resulting hot cooked pulp away from said cooking zone, and transferring heat from said hot cooked pulp to additional amounts of said cooking liquor prior to mixing the same with additional amounts of said fibrous material.

8. A continuous process of cooking pulp which comprises moving a body of fibrous material to be converted into pulp toward a pulp cooking zone, maintaining a pulp cooking temperature in said zone, mixing cooking liquor at approximately boiling temperature with said fibrous material as it approaches said cooking zone, passing the fibrous material in contact with said cooking liquor through said cooking zone, moving the resulting hot cooked pulp away from said cooking zone, and passing a current of said hot cooked pulp in indirect contact with a counter-current of additional amounts of said cooking liquor to transfer heat thereto prior to mixing said cooking liquor with additional amounts of said fibrous material.

9. A continuous process of cooking pulp which comprises moving a body of fibrous material to be converted into pulp toward a pulp cooking zone, maintaining a pulp cooking temperature in said zone, mixing cooking liquor at an elevated temperature with said fibrous material as it approaches said cooking zone, passing the fibrous material in contact with said cooking liquor through said cooking zone, moving the resulting mass of hot cooked pulp and cooking liquor away from said cooking zone, transferring heat from said mass to additional amounts of preheated cooking liquor prior to mixing the same with additional amounts of said fibrous material, and preheating said additional amounts of cooking liquor with hot gases and vapors discharged from said mass of hot cooked pulp and cooking liquor.

10. A continuous process of cooking pulp which comprises moving a body of fibrous material to be converted into pulp toward a pulp cooking zone, maintaining a pulp cooking temperature in said zone, mixing cooking liquor at approximately boiling temperature with said fibrous material as it approaches said cooking zone, passing the fibrous material in contact with said cooking liquor through said cooking zone, moving the resulting mass of hot cooked pulp and spent cooking liquor away from said cooking zone, and heating additional amounts of said cooking liquor by means of heat released from the hot cooked pulp and spent liquor removed from said cooking zone and the blow-off gases from said spent liquor.

11. A continuous process of cooking pulp which comprises continuously cooking pulp with cooking liquor in a pulp cooking zone maintained at a pulp cooking temperature, continuously withdrawing cooked pulp and spent liquor from said cooking zone, continuously supplying cooking liquor at approximately boiling temperature to be mixed with fibrous material to be converted into pulp, and continuously maintaining said cooking liquor at approximately boiling temperature by means of heat discharged from the cooked pulp and spent liquor removed from said cooking zone.

12. A pulp cooking apparatus which comprises an elongated digester, means for continuously supplying fibrous material to said digester, means for continuously withdrawing cooked pulp from said digester, heating means in said digester for providing an elevated temperature therein, and means adjacent said heating means for introducing cooking liquor into said digester.

13. A pulp cooking apparatus which comprises an elongated digester, means for continuously supplying fibrous material to said digester, means for continuously withdrawing cooked pulp from said digester, heating means in said digester for providing an elevated temperature therein, means adjacent said heating means for introducing cooking liquor into said digester, said heating means being connected to a source of a heating medium, automatic control means arranged between said source and said heating means for regulating the supply of said heating medium to said heating means, and temperature responsive means adjacent to said heating means and connected to said automatic control means for regulating the temperature in said digester.

14. A pulp cooking apparatus which comprises a pulp digester, means for continuously introducing fibrous material into said digester, means for continuously withdrawing cooked pulp from said digester, heating means for maintaining an elevated temperature within said digester, liquid supply means adjacent said heating means for introducing cooking liquor into said digester, and means for transferring heat from material withdrawn from said digester to the cooking liquor introduced into said digester by said liquid supply means.

15. In combination with a pulp digester having a walled inlet for introducing fibrous material into said digester, a plurality of spaced screws arranged in said inlet substantially in contact with the wall thereof, said screws being independently rotatable and adapted to compress fibrous material therebetween and in contact with the wall of said inlet, one of said screws being adapted to move fibrous material into the interior of said digester.

16. In combination with an elongated pulp digester and means for feeding fibrous material to said digester, a pair of spaced screws arranged in the inlet end of said digester substantially in contact with the walls thereof, the outer of said screws having a sharper pitch than the inner of said screws, said screws being independently rotatable and adapted to compress fibrous material therebetween and against the wall of said digester, the inner of said screws being adapted to feed fibrous material from the space between said screws into the interior of said digester.

17. A pulp cooking apparatus which comprises a pulp digester, cooking liquor supply means arranged in said pulp digester, a cooked pulp receiver, means for conducting cooked pulp from said digester to said receiver, a source of cooking liquor, means for preheating said cooking liquor by means of hot gases released in said receiver, means arranged in said receiver for transferring

heat to preheated cooking liquor from hot masses containing cooked pulp conducted to said receiver from said digester, and means for conducting thus heated cooking liquor to said cooking liquor supply means arranged in said digester.

18. A pulp cooking apparatus which comprises an elongated, vertically arranged pulp digester, a cooking liquor distributor arranged in said digester, a heat interchanger around said digester at the upper end thereof, an elongated, vertically arranged cooked pulp receiver, heat exchange means arranged in the upper portion of said receiver, heat exchange means arranged in the lower portion of said receiver, means for withdrawing a mass of hot cooked pulp and spent cooking liquor from said digester and delivering it to said receiver, a source of cooking liquor, connections for delivering fresh cooking liquor from said source thereof to said heat interchanger around the upper end of said digester, connections for delivering the cooking liquor from said last named heat interchanger to the heat exchange means arranged in the upper portion of said receiver, connections for delivering cooking liquor from said last named heat exchange means to the said heat exchange means arranged in the lower portion of said receiver, and means for delivering said cooking liquor from said last named heat exchange means to said cooking liquor distributor arranged in said digester.

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