

Nov. 10, 1931.

W. H. SWANSON ET AL

1,831,206

DIGESTER SYSTEM

Filed March 6, 1931

2 Sheets-Sheet 1

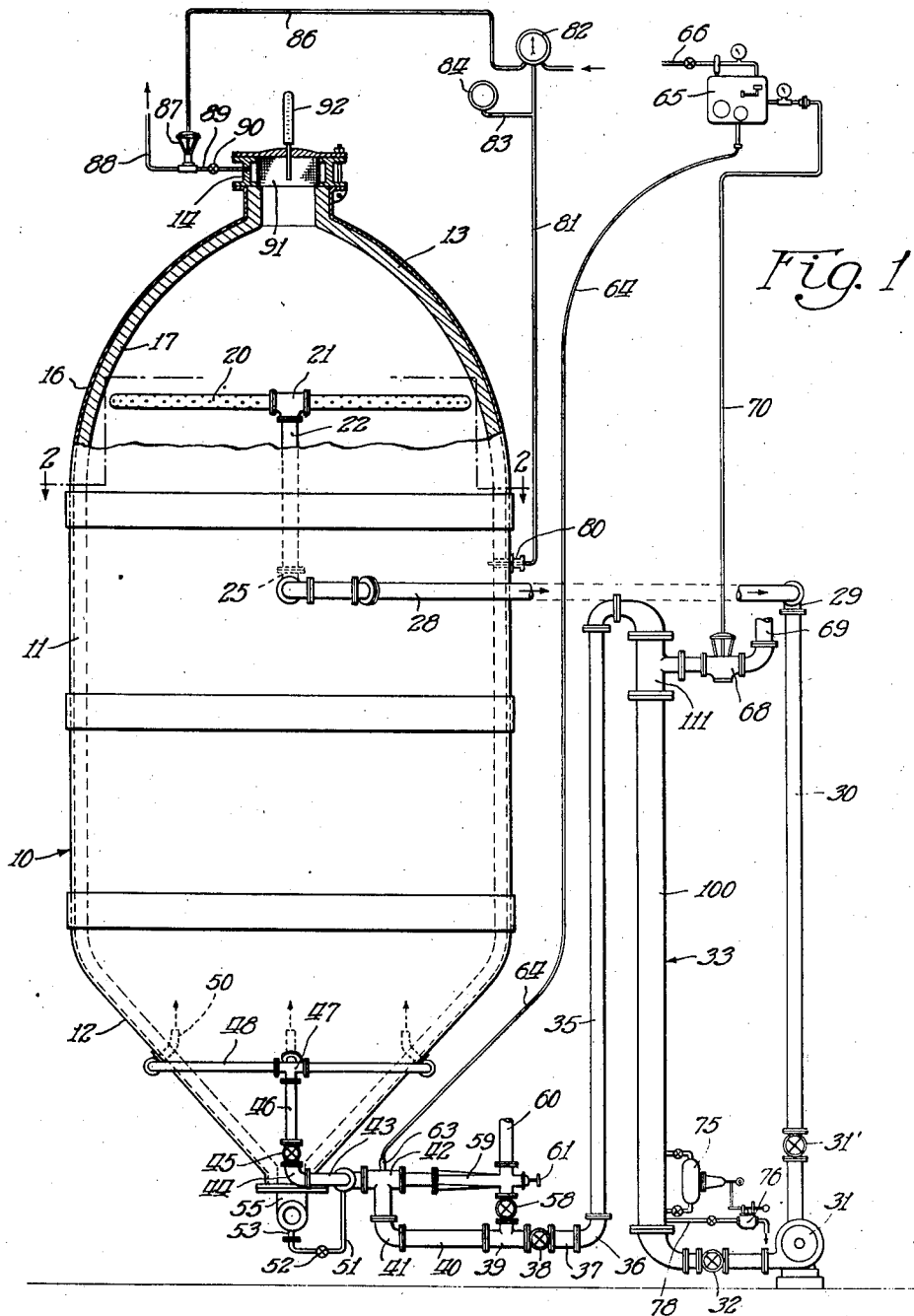


Fig. 1

Inventors
Walter H. Swanson
Lloyd Lang
By Fisher, Clapp,
Hoans & Bond Attys

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2 Sheets-Sheet 2

Fig. 2

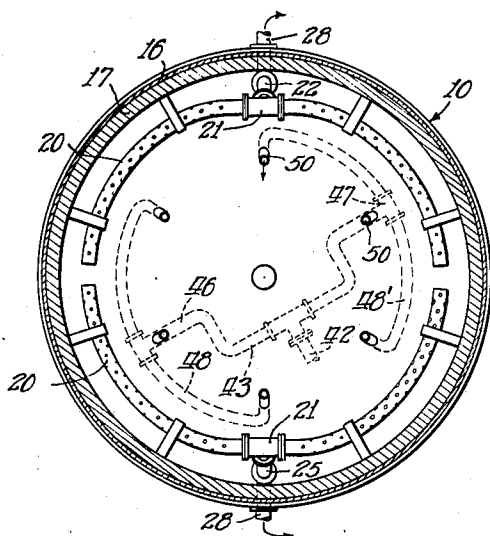


Fig. 3

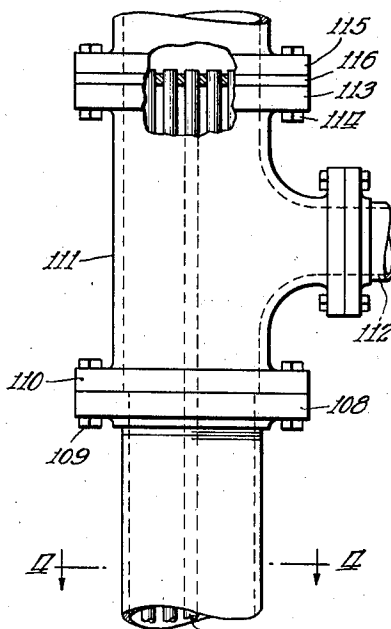
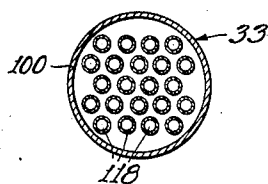
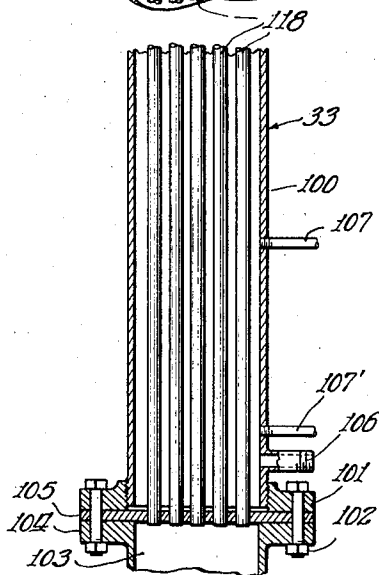


Fig. 4



Inventors
Walter H. Swanson
Lloyd Lang
By Fisher, Clapp, Soans & Bond, Attys

UNITED STATES PATENT OFFICE

WALTER H. SWANSON, OF MENASHA, AND LLOYD LANG, OF KIMBERLY, WISCONSIN, ASSIGNORS TO PAPER PATENTS COMPANY, OF NEENAH, WISCONSIN, A CORPORATION OF WISCONSIN

DIGESTER SYSTEM

Application filed March 6, 1931. Serial No. 520,625.

Our invention relates broadly to the digestion of wood pulp for the manufacture of paper and the like and has to do more particularly with improved apparatus and method for the circulation of digesting liquor and the maintenance of substantially uniform temperatures thereof at all points in the digester. Our invention contemplates the use of an auxiliary heater for the liquor outside of the digester, means for continuously circulating the hot liquor through the heater and digester, and means for automatically maintaining the temperature thereof.

According to the ordinary system for operating digesters, there may exist widely variant temperatures at various points in the digester at any given time. Inasmuch as temperature is the most important factor governing the quality of sulphite pulp, it is obvious that lack of temperature control can result only in extreme non-uniformity in the character of the pulp produced in any cook. Thus, portions may be over-cooked, other portions properly cooked and still other portions under-cooked. Furthermore, uniformity of the product from one cook to another is difficult to maintain inasmuch as these temperature variations are not reproducible in consecutive cooks.

A principal object of our invention, therefore, is to eliminate the conditions above referred to and to substitute temperature control whereby the liquor will be of substantially uniform temperature at all points in the digester at any time, and the quality of the product will be substantially uniform from one cook to another, inasmuch as the temperature conditions may be reproduced at will.

Another object of our invention is to provide a new method and apparatus for accomplishing the results outlined above.

The principal results which are achieved by our invention are:

1. Uniformity of pulp quality within an individual cook.

2. Uniformity of pulp quality from cook to cook because of ease of repetition of cooking conditions. This latter is made still more possible because automatic means for controlling temperature can be utilized, as will be shown below. This naturally eliminates the human element in cooking.

3. Improved quality of pulp because of elimination of overcooked and undercooked portions of the pulp, which have a deleterious effect on the finished pulp taken as a whole.

4. Higher pulp yields because of elimination of overcooked portions of the pulp, which are sufficiently low in yield to more than balance the increased yield from the undercooked portions of the pulp.

5. Increased yield per digester because of the ability to more completely fill it with chips, thus utilizing as much as possible of the cooking space. Of course, more complete filling of the digester can be employed with the normal cooking system, but in general pulp quality suffers and operating difficulties arise through this practice. These are not experienced with the new system.

Turning now to the drawings illustrating preferred apparatus for carrying out our invention:—

Fig. 1 shows an elevational view partly in section of a digester, heat exchanger, and auxiliary parts comprising our improved system.

Fig. 2 is a section taken on line 2—2 of Figure 1.

Fig. 3 is a view, partly in elevation and partly in section, of the improved heater; and

Fig. 4 is a section taken on line 4—4 of Figure 3.

The numeral 10 represents a digester which comprises a cylindrical portion 11, an inverted cone-shaped base portion 12, and a

substantially spherical dome portion 13. A removable air tight top closure 14 of any suitable type is provided. The digester is formed with an outer metallic casing 16 and an inner lining 17 of acid-proof ceramic material or the like.

In the upper portion of the digester and spaced slightly above the base of the dome portion 13 is disposed an annular strainer 20 formed of perforated pipe. This strainer may be of any suitable design but in our present embodiment comprises six inch pipe perforated at one inch centers with one-fourth inch holes. Such a design is desirable for the following reasons:—

In this form, the strainers cover a large portion of the digester content, resulting in uniform removal of liquor from all parts and thus reducing channeling tendencies. Furthermore, using a large number of strainer holes causes the linear velocity of the liquor passing through any one hole to be very low. Hence, there is no tendency for the liquor to draw small chips or fibers into these holes and clogging them. As shown in Figure 2, the strainer may be in two parts.

Disposed in the strainer 20 is a pair of T fittings 21, which may be oppositely disposed on the circumference and which communicate with pipe sections 22. The latter sections are connected in turn to elbows 25 which, by means of suitable fittings, extend through the wall of the digester. It will thus be seen that the strainer 20 is supported by means of the oppositely disposed vertical pipe sections 22 (only one of which is shown in Figure 1). The elbows 25 communicate by means of various other pipe fittings, which need not be described here, with a pipe 28, which is connected by means of an elbow 29 to a vertical pipe 30, which leads to a pump 31, a valve 31' being disposed in pipe 30. The pump 31 need not be described here in detail.

The pump 31 discharges through a valve 32 to a heat exchanger indicated generally at 33. Condensed steam is removed from the heat exchanger by means of a liquid level controller 75 attached to a balanced valve 76 in condensate line 78 from the heat exchanger 33. This liquid level controller permits of continuous removal of the condensate by actuating the balance valve. The condensate, being pure water and containing considerable heat, is returned to the boiler house to be used as make-up water, which effects appreciable economy in steam cost.

The liquor is forced by the pump 31 upwardly through the heat exchanger and thence by suitable fittings through a down pipe 35. This pipe is connected to an elbow 36, nipple 37, valve 38 and T 39, thence to a pipe section 40, elbow 41 and T 42. The T fitting 42 is connected to a pipe section 43 which in turn is connected to an elbow 44 which leads upwardly through a valve 45 to a

distributing header 48. This header is connected to fitting 47 from which distributing pipes 48' and 48'' diverge, these distributors carrying a plurality of nozzles 50. It will be noted that these nozzles are directed upwardly into the digester and have their outlets at points spaced inwardly from the wall of the cylindrical portion 12 thereof. In the preferred embodiment six nozzles 50, equally spaced about the periphery of the digester, are provided.

In order to insure digestion of chips in the extreme lower portion of the cone 13 of the digester, a by-pass is provided comprising a pipe 51 tapping the main feed pipe 43, having a valve 52 therein and connected by means of a nipple 53 to the bottom T 55 of the digester. It will thus be seen that each increment of liquor is forced by displacement upward through the chip mass and is substantially evenly distributed from the header, thus providing substantially equal temperatures throughout the digester.

While the dimensions of the digester may vary within wide limits, the one under consideration has a maximum diameter of 14 feet and is about 35 feet in length from the bottom of the cone to the top of the dome and has a volume inside of the lining of about 3051 cubic feet. The capacity of the digester in pulp is approximately 5.75 tons of spruce, 5.75 tons of balsam and 5.25 tons of hemlock.

In carrying out the process embodying our invention, the digester is filled with wood chips of the usual form and with cooking acid. The entering acid may vary in temperature from 30 degrees C. to 50 degrees C., and is made up of a solution of bisulphite salt, usually a bisulphite of calcium or dolomitic lime, and free sulphur dioxide in excess. A common analysis is as follows:

Total SO_2 , 5.5%; free SO_2 , 4.25%; combined SO_2 , 1.25% (computed as monosulphite).

Having completely filled the digester with both chips and acid, it is prepared for cooking by bolting on the top cover and closing all valves. The valves 31', 32 and 38 are then opened and the pump 31 is started, whereupon the liquor is caused to circulate.

Considering at this point the main circulatory system of the liquor, it will be seen that the liquor in the upper portion of the digester flows into the annular pipe 20 and thence downwardly through the pipes 22, 28 and 30 to the pump 31 whence it is forced up through the heat exchanger 33, where it absorbs heat. The liquor is then forced down through the pipe 35 through the various fittings 36, 37, 38, 39, 40, 41, 42, 43, 44 and 45 to the header 46, thence to the distributing pipes 48 and 48', whence it is projected through the nozzles 50 up into the digester.

Naturally, in the passage of the liquor through the chip mass, the latter becomes

saturated with the acid liquor, which also gives up some of its heat to the chip mass, thus raising its temperature to the cooking range, causing the digestion reaction to proceed so as to disintegrate the wood into its ultimate fibers.

It is a well known fact that wood, particularly when quite dry, containing 40% moisture or less, will absorb a considerable quantity of acid. Inasmuch as the system just described involves heating of the acid liquor by indirect means (in contra-distinction to the usual system wherein steam is introduced directly into the digester contents and condenses there) this results in a lowering of the acid level in the digester when using dry wood. It sometimes drops to a point wherein a considerable portion of the chipped mass in the top dome of the digester becomes uncovered by liquor. This is undesirable for the reason that these chips heated out of contact with the acid are likely to become brown or charred, resulting in the rejection of an appreciable portion of the digester content as screenings or tailings; also some of these chips break up in the process of refining, causing brown specks or shives in the resultant pulp and thus lowering its quality.

In order to avoid this situation, we provide certain optional features which comprise a valve 58 communicating with the T fitting 39, whereby a portion of the heated liquor coming from the heat exchanger may be diverted. The valve 58 communicates with a continuous heater represented at 59, which receives live steam from a steam pipe, 60 controlled by means of a valve 61. The liquor is here intimately mixed in the heater 59 with the live steam which is condensed therein, resulting in an increased liquor volume. This bypassed liquor rejoins the liquor of the main line in the T fitting 42.

In cooking wood for pulp production a predetermined rate of temperature increase of the digester content is required, which will give the pulp the desired quality in the time allotted for cooking. In our process for cooking the preferred time is from 9 to 10 hours. We have found that a temperature schedule somewhat as follows for the digester content, yields a pulp of the desired quality.

1. A rate of increase of temperature of 40° C. per hour from the starting temperature, which is usually around 50 degrees centigrade, to 110 degrees centigrade. This requires a one and one-half hour time interval for this preliminary heating period.

2. A rate of increase of temperature of 7 degrees per hour for the next six hours from 110 degrees C. to 152 degrees C. This is the main cooking period.

3. A holding period of two hours when the digester contents are maintained at the maximum temperature of 152 degrees C. This is the finishing period of the pulping

process. This schedule makes a cooking time of nine and one-half hours and contains two periods when the temperature rises at different rates and one when it is maintained constant.

We accordingly provide the following means for producing the temperature schedule outlined above.

A thermometer bulb 63 of the vapor tension type is inserted in the cross portion of the T fitting 42. This thermometer communicates by means of flexible tubing 64 with a conventional time-temperature control 65 which is preferably disposed on the digester charging floor (not shown). A compressed air inlet 66 leads through a valve mechanism in the controller (which is actuated by the vapor tension in thermometer 63) to a motor diaphragm steam valve 68 disposed in the main steam line 69, by way of tubing 70.

In the time-temperature controller 65 a cam is provided for giving the above mentioned temperature schedule to the liquor from the heat exchanger. A rider in the instrument rests on the cam which is turned by a clock mechanism and is attached to the air valve in the instrument. This air valve controls the compressed air flow to the motor diaphragm steam valve 68. (The parts just referred to are all more or less conventional and hence are not shown in detail.) Also, attached to the air valve just referred to is the vapor tension thermometer 63. The cam is so designed so that at any desired point in the cook the air is actuated by the cam so as to permit the flow of air to the motor diaphragm valve, whereby the opening of the latter is adjusted to permit steam to pass through it and into the heat exchanger at such a rate that the liquor passing through the heat exchanger is heated to the desired temperature. The thermometer is an important feature inasmuch as it measures the temperature of the liquor, and if it is higher or lower than that desired, it automatically makes the adjustments in the air valve, which in turn makes the proper correction to the motor diaphragm valve.

In this system, the pressure of the steam used for heating is maintained substantially constant in the steam main 69 by means of a pressure reducing valve (not shown) of a conventional or other suitable type. The steam pressure is preferably held at about 80 lbs. gauge, which gives a saturated steam temperature of about 323° F.

Obviously, other temperature schedules than that given above may be used and the time temperature controller may be caused to function according to any desired schedule by providing a cam of proper design.

Another method of temperature control which we have successfully employed is as follows:

A pressure regulating valve is attached to

the heat exchanger and actuates a balanced valve in the steam main. For any given rate of temperature rise of the liquor, a predetermined steam pressure is maintained on the steam side of the heat exchanger by setting the valve accordingly. To change the rate of temperature rise, the regulating valve 58 is adjusted. While this system works satisfactorily, it requires more attention from the operators than is desirable.

Pressure control

Inasmuch as the digester contents are heated within a closed vessel, the pressure therein increases, due to the vapor pressure of the liquid and the dissolved gases. Inasmuch as it is not permitted to operate the digesters above a certain pressure, it is necessary to release the excess gases in order to maintain a predetermined minimum. In the preferred system embodying our invention, the maximum pressure is usually held at between 75 to 85 lbs. gauge. In order to control this, an automatic system is used, as follows:

Mounted in the upper wall of the cylindrical portion 11 of the digester is a small outlet fitting 80, which may be referred to as a pressure plug. This plug is connected by means of tubing 81 to release controlling mechanism 82 and by means of a tube 83 to a pressure recorder 84. Inasmuch as the recorder 84 records the pressure and does not enter into its control, it may be neglected in the description which follows.

A pressure pipe 81 is connected to an air valve (not shown) disposed in the controller 82, which valve controls the flow of compressed air through the instrument from the tubing 66 to the line 86, the latter being connected to a diaphragm motor valve 87 and a relief line 88 which communicates with the upper portion of the digester through the conduit 89 in which is a valve 90.

It will be noted that the conduit 89 is tapped into the closure member 14, the latter seating a strainer 91 which serves to prevent the passage of pulp out of the digester into the conduit 89. A visual thermometer 92 may be disposed in the upper portion of the closure member 14.

The operation of the apparatus just described is as follows:

As the digester contents heat up, the resulting pressure is transmitted to the air valve in the controller 82 through pipe 81. Inasmuch as the controller will have been previously set to operate at, say, 75 lbs. pressure, the instrument does not function until this pressure has been attained. Shortly previous to this, the operator will open hand valve 90 in the relief line 89. When the maximum pressure is attained, the air valve in the controller is automatically opened, permitting the compressed air to flow through it and the line 86 into the motor diaphragm

valve 87. The compressed air opens this valve and permits gases in the digester to pass out into the line 88 to the reclaiming tank (not shown), where they are recovered for further use. The venting of the gases from the digester causes the pressure therein to drop, which drop in pressure is transmitted to the controller which actuates the air supply to the motor diaphragm valve, closing the latter. This action continues so long as the setting of the controller is not changed.

It is customary in the practice of sulphite pulping preparation to materially reduce the pressure of the digester contents near the end of the cook, in order to recover the excess of sulphur dioxide which remains in the cooking acid after the pulping process is completed. To accomplish this recovery by means of our pressure controlling means just described, it is only necessary to set the controller at a new and lower pressure point, say about 50 pounds gauge. This resetting permits the diaphragm motor valve to open wide and remain so until the gases vented from the digester have been sufficient to drop its pressure to the new setting. At this point, the controller again becomes operative, tending to maintain the pressure there. However, the digester contents are customarily blown out at this time.

Heat exchanger

We consider the heat exchanger an important part of our improved system, inasmuch as it has been especially designed to meet the particular demands thereof. Referring to Figures 3 and 4 which show the heat exchanger 33 in detail, this device comprises a pipe member 100, which may be secured as by screw-threading or the like to an annular collar 101. This collar may be secured as by bolts 102 or the like to a similar pipe section 103, the latter having an annular flange 104 through which the bolts extend, an apertured disk-like header 105 being interposed between the flange 104 and the collar 101. The pipe 100 may be tapped at a plurality of places adjacent its lower portion to provide openings for a condensate outlet 106 and for pipes 107 and 107', communicating with the liquid level controller 75. The pipe 100 may be screw-threaded or otherwise secured to a collar 108, which may be secured as by bolts 109 or the like to an annular flange 110 of a T-fitting 111, which communicates with the steam line as by means of a nipple 112 or the like. The T 111 is flanged at 113 and is thus secured by bolts 114 or the like to a collar 115, a perforated header disk 116 being secured between the collar 115 and the flange 113. A plurality of tubes 118 are secured in the headers 105 and 116 in the usual manner and serve to convey liquor through the heater, it being understood that the steam which enters the heater through the nipple 112 cir-

culates around the tubes and is drained off at 106.

The particular design of the heat exchanger is considered important. The main features thereof are as follows: The number of tubes was chosen at 22 because with the size shown, 1" diameter, this number gives an area sufficient to permit of a linear velocity of the liquor through them of 10 feet per second. This velocity results when a rate of circulation of liquor through the system of 550 gallons per minute is used. Preliminary experiments in a small scale heater showed that there was no appreciable tendency for the surface of the tubes to scale with gypsum or calcium and magnesium sulphite from the acid at velocities above 8 feet per second; therefore, a velocity of 10 feet per second was chosen for the preferred installation and the heater designed accordingly. This is an important factor in the indirect heating of sulphite cooking acid successfully. Further, the material in the tubes consists of 18 per cent chromium—8 per cent nickel alloy iron, commonly called KA₂. This was used not only because of its resistance to corrosion by sulphite acid, but also because it had very little tendency to scale when liquor velocity past its surface is 8' or more per second, as before pointed out. Copper, the other commonly used metal in sulphite practice, scales rapidly, even when the acid is passed over its surface at high velocity.

The length of the tubes was set at 18' 5 1/4" because with 22 tubes 1" in diameter of this length, sufficient heat-transferring surface is presented between the steam and the circulating liquor to permit of heating the digester contents at the fastest rate usually employed in cooking practice; namely, 50° C. per hour.

The pump is placed at a low point to permit of the liquor being forced in at the bottom of the heat exchanger, where the steam is at its lowest temperature, and passing out at the top, where the live steam is introduced.

The continuous heater 59, used in this installation for introduction of direct steam into the acid when necessary, should be of the injector type. Steam might be introduced directly into the acid line, but this causes such a violent hammer that it is impossible to keep the piping tight. It also might be introduced directly into the digester in the conventional manner, but this leads to local overheating and channeling of the acid, which is the factor which this system is designed to overcome. Therefore, the principle followed in this whole scheme has been to heat the liquor externally and then pass it through the digester.

It will be noted that in our improved system the liquor circulates from the bottom to the top of the digester rather than from the top to the bottom, as is the usual practice.

This method of circulation was chosen because of the nature of the liquor. As previously stated, the liquor is a solution of bisulphite and sulphur dioxide in water. The solubility of the sulphur dioxide in water depends at any particular temperature on the pressure at which the solution is maintained. The higher the pressure, the higher will be the concentration of free sulphur dioxide in the solution. At the top of the digester, the solution is under a pressure of 75 pounds, for example, during the major portion of the cook. At the bottom, it is at this pressure plus the hydrostatic pressure due to the weight of the liquid in the digester, or approximately 90 pounds total pressure in our preferred installation. Now, if the acid were removed from the bottom of the digester, passed through the heater and released at the top, it would have passed from a condition of one temperature and pressure to a new condition of a lower pressure but a higher temperature, due to its being heated. This would cause some of the dissolved gas to flash out of solution and pass out through the relief lines prematurely, thus decreasing the acid strength more rapidly than is necessary. It is desirable to maintain as high a free sulphur dioxide content in the cooking acid as long as possible during the cooking process. Therefore, it is preferred to take the acid from a region of lower pressure, which is from the top zone of the digester, heat it up, and deliver the heated acid into the region of higher pressure, which is the bottom of the digester. This prolongs appreciably the maintenance of a high sulphur dioxide content.

A multiplicity of entry points for the acid—seven in this system—is in some cases, of some advantage in order to obtain even distribution of the circulating acid over the whole of the digester contents. It seems desirable to have the temperature of the digester contents uniform across any horizontal plane. This is the objective sought in introducing the liquor as shown. However, such temperature uniformity may be achieved by admitting the acid at a single point, if the digester is uniformly packed with chips.

The fact that digester temperatures can be maintained uniform by this system makes possible the application of an automatic time-temperature instrument for controlling the temperature during the cooking cycle. The advantage is obvious, namely, the elimination of the human element, with resultant uniformity of product from cook to cook.

The automatic pressure control device is used as a matter of convenience, lightening the task of the operator.

Another feature which has developed in the use of this system is the desirability of uniformly distributing the chips throughout the digester during the filling period. With

normal practice the chips drop down into the digester along the center line, building up a continuously rising column of chips having as its top a cone with sides according to the angle of repose of this material. This causes uneven pressure zones in the chip mass and leads to channeling of the circulating acid at times. Further, by this method some valuable space is left unfilled in the upper portion of the digester because of the cone formation already mentioned. Naturally, this means a loss of productive capacity. Mechanical devices are on the market which distribute chips uniformly throughout the digester during its filling, eliminating the coning effect and increasing the quantity of chips charred into the digester. The uniformity of distribution is very desirable in that it eliminates uneven pressures on the chip mass and consequently is a very material aid in preventing channeling of the circulating liquor. It is a very desirable feature to incorporate in this system. These chip distributors have not been particularly successful with the conventional system of cooking because they lead to undercooking in the lower portions of the digester, with consequent hanging up of this raw stock when the digester contents are blown out. This difficulty is not experienced when our improved circulating system is employed for cooking and a chip filling device is used.

Throughout the installation we prefer to use alloy steel containing about 18 per cent chromium and 8 per cent nickel, commonly called KA₂, in all pipings and fittings which come in contact with the cooking liquor. This material is used because of its very high corrosive resistance and is highly preferable to copper and bronze.

Various modifications, variations and improvements coming within the spirit of our invention will doubtless occur to those skilled in the art. Hence, we do not wish to be limited to the specific form shown or uses mentioned except as set forth in the appended claims, which are to be interpreted as broadly as the state of the art will permit.

We claim as our invention:

1. A process of digesting wood or the like, comprising introducing digesting liquor in a plurality of jets into the lower portion of a digester containing pulp, removing said liquor from the upper portion thereof, heating said liquor, and returning it to the lower portion of said digester to repeat the cycle.

2. A process of digesting wood or the like, comprising introducing digesting liquor in a plurality of jets into the lower portion of a digester containing pulp, removing said liquor from the upper portion thereof, passing said liquor upwardly through an indirect heater, and thence conducting said liquor to the lower portion of said digester for repeating the cycle.

3. In a system for digesting wood or the

like, a digester, means for jetting liquor into the lower portion of said digester, means for withdrawing liquor from adjacent the upper portion thereof, a vertical indirect heat exchanger, means for conducting liquor to the lower portion of said heat exchanger, means for withdrawing liquor from the upper portion thereof and returning it to the lower portion of said digester, and means for circulating a heating fluid through said heat exchanger.

4. In a system for digesting wood or the like, a digester, means for jetting liquor into the lower portion of said digester, said means comprising a plurality of upwardly extending nozzles, means for withdrawing liquor from adjacent the upper portion thereof, a vertical indirect heat exchanger, means for conducting liquor to the lower portion of said heat exchanger, means for withdrawing liquor from the upper portion thereof and returning it to the lower portion of said digester for recirculation, and means for circulating a heating fluid through said heat exchanger.

5. In a system for digesting wood or the like, a digester, means for jetting liquor into the lower portion of said digester, said means comprising a plurality of upwardly extending nozzles, means for withdrawing liquor from adjacent the upper portion thereof, a vertical indirect heat exchanger, means for conducting liquor to the lower portion of said heat exchanger, means for withdrawing liquor from the upper portion thereof and returning it to the lower portion of said digester for recirculation, means for circulating a heating fluid through said heat exchanger, and means adjacent the liquor inlet of said heat exchanger for circulating said liquor.

6. In combination with a liquor circulating system, a heater, means for introducing heating fluid into said heater, means for controlling said fluid introducing means for maintaining a predetermined time-temperature schedule, and means controlled by the temperature of liquor in said system and acting as a check on said time-temperature controller, whereby the temperature of liquor in said system is automatically maintained within predetermined limits.

7. In a digester system, a container for wood or the like, an indirect heater for digesting liquor, means for circulating liquor from said digester to said heater and back to said digester, and means for automatically controlling the flow of heating fluid to said heater according to a predetermined time-temperature schedule.

8. In combination with a system as defined in claim 7, temperature controlled means disposed in said system adjacent the inlet of liquor to said digester for maintain-

ing the temperature of said liquor within predetermined limits.

9. In a device of the class described, and in combination, a container for wood pulp or the like having a substantially conical base portion, means for introducing digesting liquor into said digester comprising a plurality of upwardly extending nozzles having their outlets disposed above the vertex of said cone, and means extending into the vertex of said cone for injecting liquor into the extreme lower portion of said digester.

10. In a process of digesting wood or the like, the method of circulating digesting liquor through a system including a digester, an indirect heater, and conduits connecting said digester and heater, and maintaining a substantially constant level of liquor in said digester by introducing heated fluid into a portion of the liquor line outside of said digester.

11. In a digester system, a container for wood pulp or the like, an indirect heater, means for circulating digesting liquor from said digester to said heater and back to said digester, and means for maintaining a substantially constant level of liquor in said digester, said means comprising an injector for heated fluid disposed in the liquor line outside of said digester.

12. In a digester system, a container for wood pulp or the like, an indirect heater, means for circulating digesting liquor from said digester to said heater and back to said digester, means for maintaining a substantially constant level of liquor in said digester, said last-named means comprising an injector for heated fluid disposed in the liquor line outside of said digester, a valve controlling the flow of heating fluid to said heater, and means controlled by the temperature of liquor adjacent the liquor inlet of said digester for controlling said valve and thus maintaining the temperature of said liquor within predetermined limits.

13. A process of digesting cellulosic material, comprising cooking said fibers in the digesting liquor according to a schedule wherein the temperature is raised approximately 40° C. per hour from about 50° C. to about 110° C., then increasing the temperature at approximately the rate of 7° C. per hour until a temperature of about 152° C. is attained, and holding the temperature of about 152° C. for a period of about two hours.

14. A process of digesting cellulosic fibers wherein there is used a digesting liquor containing a gaseous digesting agent in solution, comprising introducing liquor into the lower portion of a digester, withdrawing the liquor adjacent the upper portion thereof, and conveying the same to the lower portion of an indirect heat exchanger, withdrawing the liquor from the upper portion of said heat

exchanger, and returning it to the lower portion of said digester for re-circulation.

15. A system as defined in claim 6, wherein said means which acts as a check on the time-temperature controller is controlled by the temperature of liquor adjacent the liquor inlet of said digester.

WALTER H. SWANSON.
LLOYD LANG.

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