July 31, 1928. 1,679,336

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METHOD AND APPARATUS FOR CONTINUOUS COOKING OF FIBROUS MATERIAL

Filed Oct. 25, 1926 2 Sheets-Sheet 1

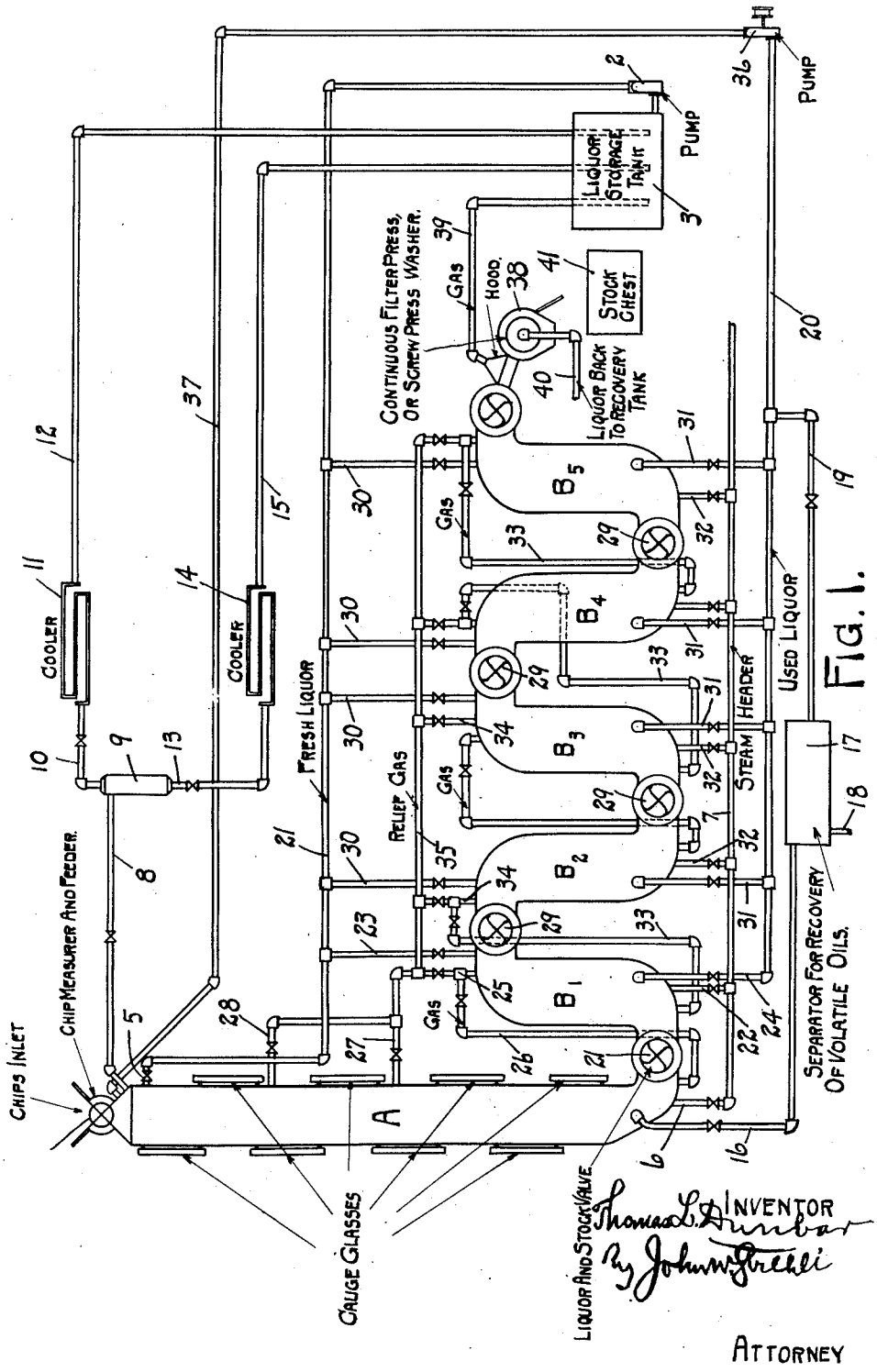


FIG. 1.

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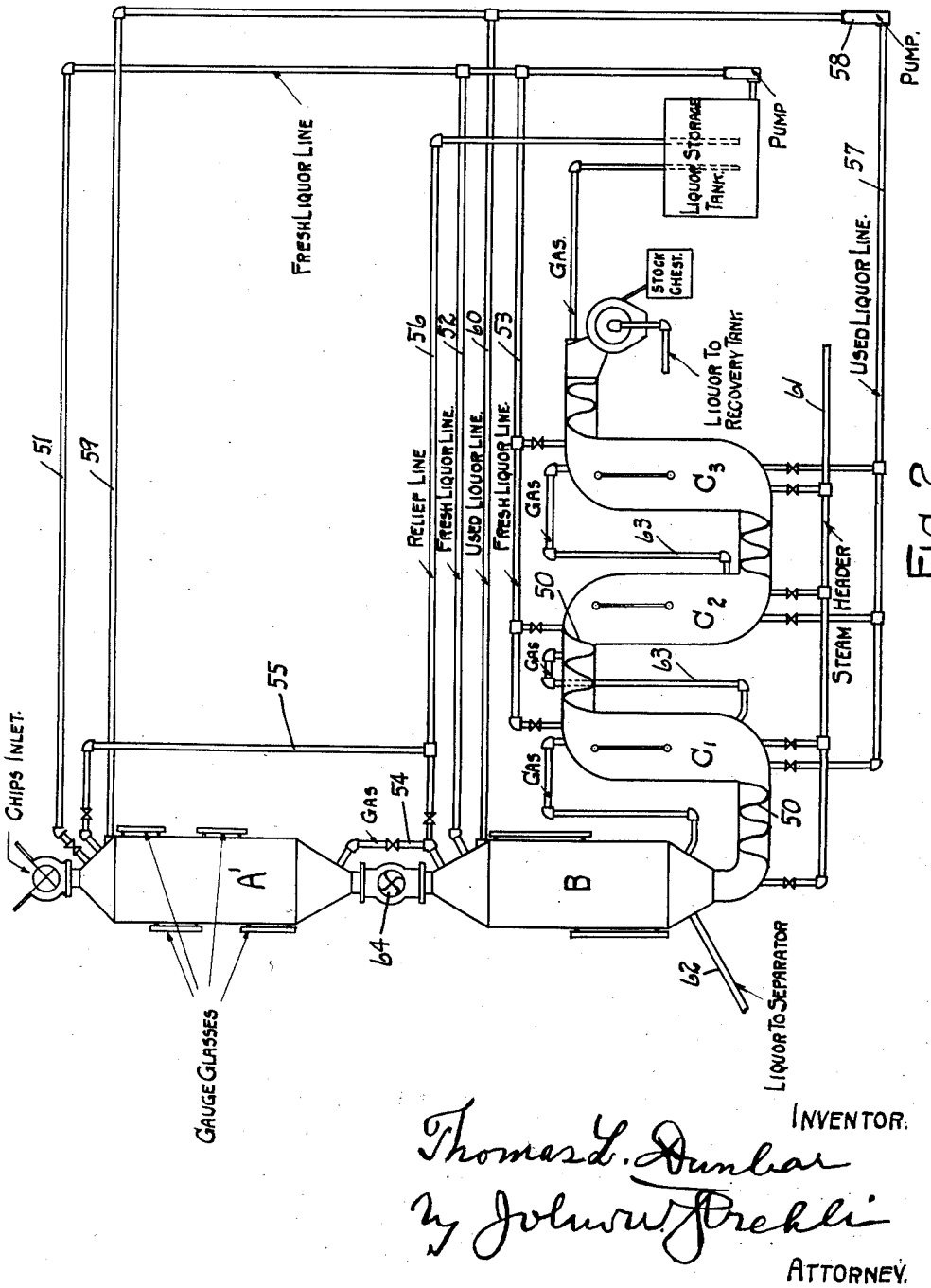


FIG. 2.

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Patented July 31, 1928. 1,679,336

UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR CONTINUOUS COOKING OF FIBROUS MATERIAL.

Application filed October 25, 1926. Serial No. 143,993.

This invention relates to a method and apparatus for use in the continuous cooking of fibrous materials and more particularly to a continuous method and apparatus for use in digesting wood pulp.

One of the objects of the invention is to provide a method and apparatus in which wood chips or the like, in measured quantities are continuously fed into a pre-cooking chamber, the chips being continuously fed through this chamber and subjected therein to acid and heat treatment. From this chamber, the pre-cooked chips are continuously fed successively through a series of digesting chambers, in which the heat and pressure is progressively raised from the first to the last chamber of the series.

A further object of the invention is to feed either fresh acid liquor or a mixture of fresh acid liquor and used acid liquor into the pre-cooking chamber, or either or all of the chambers of the series of digesters, so that this liquor, heated by steam introduced into the chambers, will properly digest the pulp.

A still further object is to provide the pre-cooking chamber and each of the digesting chambers with a gas outlet, the gas outlet being connected to proper points in the system, to insure absorption of the gas, and to utilize the gas for heating the acid liquor.

With the foregoing objects outlined and with other objects in view which will appear as the description proceeds, the invention consists in the novel features hereinafter described in detail, illustrated in the accompanying drawings, and more particularly pointed out in the appended claims.

Referring to the drawings,

Fig. 1 is a diagrammatic view of one form of my improved apparatus in which the process may be carried out.

Fig. 2 is a similar view of another form of the apparatus.

In the embodiment of the invention illustrated in Fig. 1, the chips to be digested are continuously fed in measured quantities through a drum valve 1 or the like, into the upper end of the pre-cooking tower A. The valve 1 is of such construction as to feed the chips into the tower without materially affecting the pressure maintained in the tower. The tower is filled with fresh acid liquor which may be forced by a pump 2 from the storage tank 3, through the pipe 4 to the top of the tower. The pipe 4 has a suitable valve 5 for controlling the passage of the liquor through the pipe. When the tower is filled with acid, a hydrostatic pressure will be created equal to the vertical depth of acid surrounding the chips in the tower.

Steam is admitted into the bottom of the tower through a valved pipe 6 from a steam header 7, creating a predetermined temperature, whereby through the chemical action of the heat and acid, the chips receive a pre-cooking treatment. During this pre-cooking, SO_2 gas will be released from the top of the tower through a valved pipe 8 connected to a separator 9.

In the part 9, a separation will take place between liquor and gas, the gas passing off by way of a valved pipe 10 through a cooler 11 into the pipe 12, and the liquid passing off by way of valved pipe 13 through a cooler 14, into a pipe 15. The pipes 12 and 15 extend into the lower portion of the liquor storage tank 3, so that the gas and liquid passing through pipes 12 and 15 will be absorbed by the fresh acid liquor in tank 3.

At the bottom of the tower A, I provide an outlet pipe 16 for draining liquor to the separator 17. Under certain temperature conditions, the volatile oils are distilled from the chips and partially mixed with the partially spent liquor in the tower A. I drain this mixture through the pipe 16 into the separator 17, which separates therefrom the volatile oils and gummy substances which pass off by way of pipe 18. The purified acid liquor passes from separator 17, through pipe 19 and enters a used liquor pipe 20, from which it may be used for pre-cooking in combination with fresh liquor. My invention provides for a continuous cooking method with a closed cycle and the return of spent liquor and gases into fresh liquors for the purpose of reclamation. This method and apparatus is applicable to the production of any kind of chemical pulp.

After the chips have been pre-cooked in the tower A, they pass through a rotatable drum valve 21 which feeds them into the digesting chamber B′ which is the first of the series. In this chamber additional steam is contacted with the chips and liquor which have passed from tower A, and this steam

is introduced through a valved pipe 22. Fresh liquor may be fed into the top of this chamber from the pipe 4 by means of the valved pipe 23 and the spent liquor may be discharged from the lower end of this chamber into the pipe 20, through valved conduit 24. Gas may be discharged from this chamber through valved pipe 25, from which it may be led by way of pipe 26 into the bottom of the tower A, or through valved pipes 27 and 28 into intermediate portions of the tower. In either instance, the gas will be absorbed by the liquor, so that a conservation of heat is provided in this way.

The digesting chambers, B^2, B^3, B^4 and B^5, communicate with each other but the points of communication are closed by valves 29. These valves and the valve 21 functioning to continuously feed the chips moistened by acid liquor from one chamber to the next without materially affecting the pressures maintained in the various chambers. Each of the chambers B′ to B^5 inclusive, is connected to the fresh liquor pipe by means of valved conduits 30, and the lower end of each of these chambers is connected to the used liquor pipe 20 by means of valved conduits 31. The lower portion of each of these chambers is also connected to the steam header 7 by way of valved pipes 32. Furthermore, the top of each of these chambers is connected to the preceding chamber by a valved pipe 33 so that gas evolved in one chamber may be fed into the liquor in the preceding chamber for the purpose of absorbing the gas and imparting its heat to the liquor in the preceding chamber. The upper end of each of the digesting chambers B^2 and B^5 is also connected by a pipe 34 to a relief gas pipe 35 that connects with the pipes 27 and 28. At the end point of cooking, all of the gases which have been evaporated are carried by the pipes 35 and 25 back into the upper portion of the tower A, meeting a counter current flow of fresh acid liquor from the pipe 4, so that the tower not only acts as a pre-cooker but also as a reclaimer and gas absorption tower.

The used liquor entering the pipe 20 may be forced by a pump 36 through a pipe 37 into the top of the tower A, where it is mixed with the fresh liquor and is utilized in precooking.

From the last chamber B^5 of the digester series, the moistened pulp is discharged through a filter press or screw press washer 38, which tends to squeeze the liquor out of the pulp. From the part 38, the gas passes off by way of pipe 39 to the tank 3 where it is absorbed by the fresh acid liquor, giving up its heat to the liquor during such absorption. The liquor pressed out of the pulp is discharged by way of pipe 40 while the squeezed digested pulp is fed into the stock chest 41.

From the foregoing, it will be appreciated that I have devised a novel continuous system for digesting pulp, in which heat is economized to the maximum degree, and in which all useful spent matter is reclaimed and reused wherever possible.

In the embodiment of the invention illustrated in Fig. 2, the pre-cooking tower is formed of two similar parts A′ and B, and the chamber B communicates with a series of digesting chambers C′, C^2 and C^3. Instead of using drum valves between the precooking chamber B and between the varying digesting chambers, I use screw conveyors 50 which also function to continuously feed the moistened chips and part of the liquor without materially affecting the pressure maintained in the chambers.

In this construction, the fresh liquor from the storage tank is pumped by way of pipes 51, 52 and 53 into the chambers A′, B, C′, C^2 and C^3. The gas released from the chamber B may be by-passed through the valved pipe 54, into the lower part of the chamber A′, or the gas from the upper portions of the chambers A′ and B may be conveyed by pipes 55 and 56 to the fresh liquor storage tank to be absorbed by the liquor therein. The used liquor from the digesting chambers can be fed through a pipe 57 and pump 58, back to the tops of the chambers A′ and B by way of pipes 59 and 60. Steam is fed into the lower portion of the chambers B, C′, C^2 and C^3, by pipe 61, and the pipe 62 functions to discharge liquor from the lower end of the chamber B to a separator, similar to that shown at 17 in Fig. 1. Gases from the chambers C′, C^2, and C^3 are fed to the preceding chambers by pipes 63.

The apparatus disclosed in Fig. 2 is used in substantially the same manner as that shown in Fig. 1, but the pre-heating is carried out in two chambers instead of one, the pulp and liquor being continuously fed from one chamber to the other by means of the drum valve 64.

In either form of the apparatus, it is to be understood that an additional amount of steam is added each time the pulp passes from one chamber to a following chamber, and a portion of the partially spent liquor is drained off from the bottom of each of the digesting chambers and pumped back into the pre-heating tower at any desired point, thus carrying with it, heat units and acid in sufficient amount to cause a partial pre-cooking of the chips by means of the spent liquor. This method is continued through a sufficient number of the digesting chambers until the ligneous matters in the chips have been dissolved, leaving a raw cellulose ready for treatment for the purpose of making paper products or textiles.

From the above description, it is believed

that those skilled in the art may readily understand my improved process and novel apparatus, and I am aware that changes may be made in the details disclosed without departing from the spirit of the invention as expressed in the claims.

What I claim and desire to secure by Letters Patent is:

1. A method for the continuous cooking of fibrous material, consisting in feeding the material through a series of cooking chambers arranged end to end, cooking the material in each of said chambers by means of a heated chemical cooking liquor, subjecting the material in the first chamber of the series to hydrostatic pressure, and subjecting the material in succeeding chambers of the series to a higher temperature and superatmospheric pressure.

2. A method for the continuous cooking of fibrous material, consisting in continuously moving such fibrous material through a series of chambers, maintaining the temperature and pressure conditions in certain of the chambers different from that maintained in another one of the chambers, precooking such material in the first one of said chambers by the use of heated cooking liquor and under hydrostatic pressure, withdrawing a mixture of cooking liquor and volatile oils from said precooking chamber, separating the cooking liquor from said oils, and then feeding the cooking liquor thus separated, back into one of said chambers.

3. A method for the continuous cooking of fibrous material, consisting in continuously feeding such material through a series of cooking chambers, precooking the material in the first one of said chambers by the use of heated acid, cooking the material in the succeeding chambers under higher temperature and pressure, and utilizing a mixture of fresh acid liquor and used acid liquor for the cooking in said first chamber.

4. A method for the continuous cooking of fibrous material, consisting in continuously feeding the material through a series of cooking chambers, utilizing heated acid liquor for cooking in the various chambers and increasing the temperature and pressure in certain of said chambers, and passing acid gas from the top of one chamber to a preceding chamber at a lower point while the material is passing through the latter chamber.

5. A method for the continuous cooking of fibrous material, consisting in continuously feeding the material through a series of cooking chambers, introducing steam into each of said chambers, introducing cooking liquor into each of said chambers, maintaining the last chambers of the series under superatmospheric pressure and at a higher temperature than that existing in the first chamber of the series, and withdrawing used liquor from one of said chambers and reintroducing it into another one of said chambers while the material is passing through the latter chamber.

6. A method for the continuous cooking of fibrous material, consisting in continuously feeding the material through a series of chambers containing heated cooking liquor, maintaining certain of said chambers of the series under superatmospheric pressure and at a higher temperature than that existing in the first chamber of the series, withdrawing used liquor from one of said chambers, and feeding the withdrawn liquor into another one of said chambers.

7. A process for the continuous cooking of fibrous material, consisting in feeding said material through a series of cooking chambers arranged end to end, cooking the fibrous material in each of said chambers by means of a heated cooking liquor, maintaining certain chambers of the series under superatmospheric pressure and at a higher temperature than that existing in the first chamber of the series, withdrawing gas from the top of one of said chambers, and feeding the withdrawn gas into a preceding chamber at a lower point.

8. A method for the continuous cooking of fibrous material, consisting in feeding such material through a series of cooking chambers arranged end to end, precooking the material in the first one of said chambers by the use of heated cooking liquor, cooking said material in each of the succeeding chambers by the use of heated cooking liquor under a higher temperature and while under superatmospheric pressure, and withdrawing used liquor from one of the last mentioned chambers and feeding it into the precooking chamber.

9. A method for the continuous cooking of fibrous material, consisting in feeding the material through a series of cooking chambers arranged end to end, cooking the material in each of said chambers by the use of heated cooking liquor, maintaining certain chambers of the series under superatmospheric pressure and at a higher temperature than that existing in the first chamber of the series, feeding fresh cooking liquor into the upper portion of the first chamber of the series, and passing gas from other chambers of the series into the upper portion of the first chamber where it is absorbed by the fresh liquor and its heat is imparted to the fresh liquor.

10. A method for the continuous cooking of fibrous material, consisting in feeding the material through a series of cooking chambers arranged end to end, cooking the material in each of said chambers by means of heated acid liquor, feeding fresh acid liquor into the upper portions of each of said chambers, withdrawing used acid liquor from the lower portion of certain of said

chambers, cooking the material in the last chambers of the series under higher temperature and pressure than that existing in the first chamber of the series, and feeding the withdrawn acid liquor in a heated condition into the upper portion of the first chamber of the series.

11. A method for the continuous cooking of wood chips, consisting in feeding said chips through a series of cooking chambers arranged end to end, cooking the chips in said chambers by the use of heated cooking liquor, subjecting the chips in the first chamber to predetermined temperature condition and to hydrostatic pressure, subjecting the chips in succeeding chambers to higher temperature and to superatmospheric pressure, feeding fresh cooking liquor into the upper portion of each of said chambers, withdrawing used liquor from the lower portion of certain of said chambers, feeding this withdrawn liquor in heated condition into the upper portion of another chamber of the series, and passing gas from the upper portion of one of said chambers into a preceding one of said chambers.

12. A method for continuously cooking fibrous material, consisting in moving said material through a series of closed chambers arranged end to end, and precooking such material in the first of said chambers by the use of heated chemical liquor, while progressively submerging the material to increasing depths in a pool of said liquor.

13. In a method for the continuous cooking of wood chips, moving said chips downwardly through a relatively deep confined pool of heated chemical liquor, whereby the chips are subjected to gradually increasing hydrostatic pressure while undergoing precooking, and withdrawing said chips in precooked condition from the bottom of said pool.

14. A method for use in the cooking of fibrous material consisting in feeding the material successively through a series of digesting chambers containing heated cooking liquor, while progressively raising the temperature from the first to the last chamber of the series and maintaining the pressure above atmosphere.

15. A method for the continuous cooking of fibrous material consisting in moving such material downwardly through a relatively deep confined pool of heated cooking liquor while subjecting the material to gradually increasing hydrostatic pressure and for the purpose of precooking such material, discharging the precooked material from the bottom of said pool, then feeding the precooked material through a series of digesting chambers, arranged end to end, feeding cooking liquor to and discharging cooking liquor from said chambers while the material is passing therethrough, introducing steam into the chambers while the material is undergoing treatment in the latter, maintaining the material in the digesting chambers under higher temperature than that existing in the pool, and maintaining certain of the digesting chambers under superatmospheric pressure and at a higher pressure than that existing on the pool.

16. A method as claimed in claim 15 in which gas is withdrawn from at least one of the digesting chambers and introduced into said pool.

17. An apparatus for cooking fibrous material, comprising a series of chambers arranged end to end and forming a circuitous passageway, valve means arranged between each pair of chambers for use in feeding fibrous material from one chamber to another without affecting the relative pressure in each of said chambers, means for feeding fresh acid liquor into the upper portion of each of said chambers, means for withdrawing used acid liquor from the lower portion of certain of said chambers, and means for feeding this withdrawn liquor into the first chamber of the series.

18. An apparatus for use in cooking fibrous material, comprising a series of chambers arranged end to end, valve means arranged between each pair of chambers for use in feeding fibrous material from one chamber to another without affecting the relative pressure in each of the chambers, means for feeding cooking liquor into each of said chambers, means for introducing steam into each of said chambers, means for withdrawing used cooking liquor from the lower portion of certain of said chambers, and means for feeding this withdrawn liquor into other chambers of the series.

19. An apparatus for use in cooking fibrous material, comprising a series of cooking chambers arranged end to end, the first chamber of the series, consisting of a relatively tall column adapted to contain a relatively deep pool of cooking liquor, valves separating the chambers and capable of feeding the material from one chamber to the next without affecting the relative pressure in each of the chambers, one of said valves being located in the bottom of the first chamber of the series, a fresh cooking liquor storage tank, means for feeding fresh cooking liquor from said tank into each of said chambers, means for introducing steam into each of said chambers, means for withdrawing used cooking liquor from the lower portion of certain of said chambers, and means for feeding this withdrawn liquor into the upper portion of another chamber of the series.

20. An apparatus as claimed in claim 19, including a gas release pipe connecting the

upper portion of the first chamber of the series to the storage tank, as and for the purpose described.

21. An apparatus as claimed in claim 19, including conduits for passing gas from the top of each chamber to the lower portion of a preceding chamber.

22. An apparatus as claimed in claim 19, including means for passing gas from the upper portion of several of said chambers into the first chamber of the series.

23. An apparatus as claimed in claim 19 including a conduit for withdrawing a mixture of acid liquor and volatile oils from the bottom of the first chamber of the series, a separator connected to said conduit and adapted to separate the acid liquor from the volatile oils, and means for feeding said separated liquor into one of said chambers.

24. An apparatus as claimed in claim 19, including a pipe for releasing gas from the top of the first chamber of the series, a separator connected to said pipe, conduits connected to the separator and coolers interposed in said conduits.

In testimony whereof, I affix my signature at Watertown, New York, this 18th day of October, 1926.

THOS. L. DUNBAR.