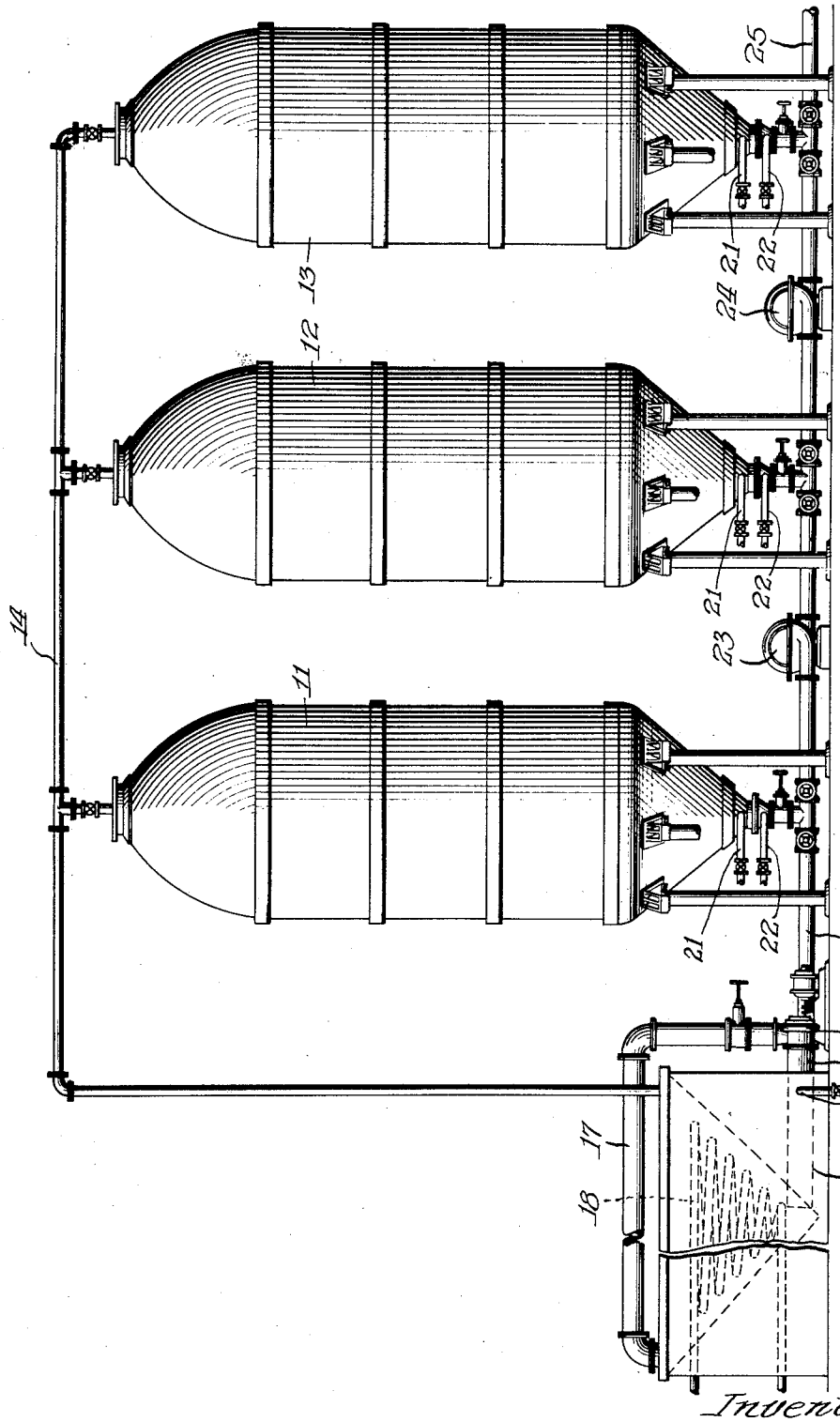
June 16, 1931. P. E. HODGDON 1,810,398

METHOD OF AND APPARATUS FOR DIGESTING WOOD

Filed May 27, 1929



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Patented June 16, 1931 1,810,398

UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR DIGESTING WOOD

Application filed May 27, 1929. Serial No. 366,215.

My invention relates to paper pulp production and particularly to improvements in the direct, or Ritter-Kellner process as used in the manufacture of sulphite pulp.

As is well known, the purpose of the cooking or digesting process is to dissolve the lignin, sugars and resins of the wood, thereby separating the cellulose from the cementing materials with as little damage as possible to the cellulose. The cellulose constitutes the useful element for paper making. Among the numerous processes heretofore suggested many are objectionable either as to quality of pulp or the time and cost of production.

The temperature and pressure maintained in the digester has a direct relation to the time required for the operation, temperature being the most important. The poorer quality of pulp is commonly cooked in from 8 to 12 hours by the use of a high temperature. The pulp produced under these operating conditions is not of high grade due to the physical and chemical conditions under which the material is treated. The wood is supplied to the digesters in the form of chips and, due to the high temperatures, the exterior portions of the chips are frequently treated to excess while the interior portions are insufficiently treated.

After the chips have been charged into the digester, a period of from two to three hours is usually required for heating the mixture of acid and chips and it has been found that during this period the temperature must not exceed 110° C. to prevent the chips from becoming case-hardened; that is, where the chips are subjected to a temperature in excess of 110° C. an insoluble lignin compound is formed which renders such chips inert to the acid action, regardless of the length of time or temperature employed in subsequent cooking. Where a digester is filled with cold chips and an attempt is made to raise the temperature quickly, there is danger of local over-heating and burning at the steam inlet.

I have conceived the thought that sulphite pulp may be produced by a continuous process using preferably four containers, three of which would be in many particulars, identical with digesters now in use and the fourth in the form of a penetrator or pre-saturator into which the chips would be charged.

Inasmuch as the speed of production of pulp is dependent to a large extent upon the extent of penetration of the acid into the chips, and as thorough agitation is an essential to effective penetration, I have provided for mechanical circulation of the contents of the presaturator preferably employing indirect heat if necessary to supplement the heat supplied by hot acid and by discharging the relief gases from the digesters into the presaturator. I can, therefore, obtain effective results in the penetrator by employing an acid having a low free SO_2. This is possible because more time can be taken in the presaturator for penetrating than is practical to take in a commercial digester. The temperature can accurately be controlled at the point most desirable for penetration. By thoroughly agitating and circulating the contents of the presaturator, I am able to effect the proper preparation of the chips for the cooking process in the digesters. After the chips have been thoroughly penetrated, the contents of the vessel may be pumped or blown into the first digester where a proper cooking temperature is quickly obtained due to the fact that the material is received already penetrated and at a temperature of approximately 100° C. A short treatment in the first digester under ideal cooking temperatures, which can be more rapid than under the present conditions owing to the fact that the chips are already penetrated, is followed by the removal of the contents through a disintegrating pump into the second digester where the cooking is continued with a further rise in temperature. From this digester, the materials are similarly discharged into a third digester where cooking is finished at a still further increase in temperature. Thus with approximately 1½ hours in each of the four vessels, I am able to produce a highly satisfactory pulp, the total time for the combination of the processes being approximately six hours. This will also be accomplished with a much lower maximum temperature than is used at present which will insure a much stronger and better product.

The invention will be more readily understood by reference to the accompanying drawing in which the figure is a side elevation of a series of tanks and piping connections arranged in accordance with my invention.

In the drawing, I have illustrated somewhat diagrammatically a presaturating tank 10 and digesters 11—12—13. A relief line 14 has a valved connection to each of the digesters and leads into the presaturator.

A circulating system for the presaturator consisting of a pump 15, an inlet pipe 16 connected to the bottom of the tank at one end, and a discharge pipe 17 connected to discharge material into the opposite end of the tank. A coil 18 is indicated with the tank to indirectly heat the contents if necessary. An acid inlet pipe is indicated at 19 by means of which hot or cold acid may be supplied to the presaturator at the start of operations.

A pipe 20 leads from the presaturator through suitable valves to the first digester 11. A steam supply pipe 21 and an acid supply pipe 22 are shown and as each of the digesters is of duplicate construction, no further specific description thereof will be given. They may, however, be considered to be of standard form and having the usual linings.

After the chips have been cooked for a desired length of time in the first digester, the valves are manipulated and the disintegrating pump 23 is started. The action of this pump which may be of the ship propeller or screw type, together with the pressure accumulated in the first digester will serve to quickly transfer the material into the second digester, where the cooking is continued with a gradual rise in temperature. Similarly, the materials will be transferred from the second digester into the third digester, by a similar pump 24. In each of the digesters, the pressure is raised to the proper point by the admission of hot acid as required and by utilizing steam to a limited extent both for effecting circulation and for maintaining the temperature. The admission of hot and new strong acid between the different stages will further hasten the cooking and insure a purer product.

Preferably the chips in the saturator will be treated under ideal conditions of acid and temperature and constantly agitated, care being taken never to reach over a maximum temperature of approximately 105° C. The material will therefore be received into the first digester at a temperature of approximately 100° C. and it will not be difficult to raise the temperature and pressure to the required point. Preferably, the cooking in the first digester will be carried on for approximately 1½ hours at a pressure of 80 pounds. When the materials are received in the second digester, the temperature will continue to be high and cooking will be continued at approximately 70 pounds pressure. The transfer of the contents from the second digester to the third will be made at a high temperature and the cooking will be continued in the third and last digester at approximately 60 pounds pressure. From the third digester, the materials will be discharged through the pipe 25 to the blowing pits. Meanwhile, the other batches of material have been received in the presaturator and passed on to the digesters. As already stated, if necessary the pressure in each digester can be the same by pumping new hot acid into the different digesters.

By the use of the process and apparatus described a substantial saving in heat is effected due to the reduction of time of treatment and to the more efficient handling of the materials. A further advantage is that the penetration may be carried on with a weak acid, because effected under low temperature. For each condition of pressure or temperature in a digester, there can be only one concentration of gas, or in other words, sulphurous or free acid. Consequently if the penetration is effected before the chips are received in the digester, the same degree of penetration can be obtained with a weak acid as could be obtained with a strong one in the digester. Furthermore, by carrying on the preliminary steps of penetration under ideal conditions, there is a higher yield of cellulose due to the absence of local overheating of the chips around the steam inlet such as occurs when the penetration takes place in the digester.

The use of mechanical devices such as the disintegrating pumps that act on the chips in their passage from one to another of the digesters serves to accelerate the breaking down of the wood structure and to expose greater areas of the chips to the action of the solvent. It will be understood that the cellulose is not inert to the acid but merely more resistant than the lignin and other constituents. Consequently if subjected to the action of the reagent under extreme conditions of molecular activity incident to high heat for an extended period, the cellulose will be attacked and, if not carried into solution, will be low in yield of the desirable beta and gamma fibers. Thus, by mechanically subdividing the wood pieces, the attack of the acid on the soluble constituents is facilitated and this avoids the overcooking of parts of the fiber during the effort of the acid to reach the inner parts of the wood chips. A higher yield of pulp having better bleaching ability and being lower in alpha cellulose will therefore result. Those advantages together with a reduction of the cost of production render the described process particularly desirable.

I claim:

1. The method of digesting wood which consists in charging the wood chips into a presaturating tank, supplying acid to the tank

and maintaining the temperature of the contents of the tank at approximately 105 degrees Cent. until the chips are saturated, then pumping the contents of the tank into a digester without materially reducing the temperature, then raising the temperature in the digester to proper cooking temperature and allowing cooking to proceed for a period less than that required to complete the cooking, then withdrawing the contents of the first digester, mechanically disintegrating the solids and delivering the material into a second digester for further cooking.

2. The method of digesting wood which consists in subjecting the wood chips to the action of acid while maintaining the temperature at approximately 105 degrees Cent. by indirectly applied heat, then transferring the chips and acid to a digester without material loss of heat and cooking the chips in the digester at a higher temperature.

3. The method of digesting wood which consists in subjecting the wood chips to the action of acid while maintaining the temperature at approximately 105 degrees Cent. by indirectly applied heat, then transferring the chips and acid to a digester without material loss of heat and cooking the chips in the digester at a higher temperature, then removing the chips and acid from the digester and charging them into a second digester where cooking is continued at a different temperature.

4. The method of digesting wood chips which consists in charging the chips into a container supplying acid thereto, raising the temperature of the contents of the container to approximately 105 degrees Cent. by indirectly applied heat and by utilizing relief gas from a digester maintaining said temperature substantially constant for a period sufficient to effect penetration of the chips by the acid, then transferring the chips and acid to a digester and cooking the chips at a higher temperature.

5. The method of digesting wood chips which consists in charging the chips into a container supplying acid thereto, raising the temperature of the contents of the container to approximately 105 degrees Cent. by indirectly applied heat and by utilizing relief gas from a digester maintaining said temperature substantially constant for a period sufficient to effect penetration of the chips by the acid, then transferring the chips and acid to a digester without material loss of heat and cooking the chips at a higher temperature.

6. The method of digesting wood chips which consists in charging the chips into a container supplying acid thereto, raising the temperature of the contents of the container to approximately 105 degrees Cent. by indirectly applied heat and by utilizing relief gas from a digester maintaining said temperature substantially constant for a period sufficient to effect penetration of the chips by the acid, then transferring the chips and acid to a digester without material loss of heat and cooking the chips at a higher temperature, then transferring the contents of the first digester to a second digester and continuing cooking at a different temperature.

7. The method of digesting wood chips which consists in charging the chips into a container supplying acid thereto, raising the temperature of the contents of the container to approximately 105 degrees Cent. by indirectly applied heat and by utilizing relief gas from a digester maintaining said temperature substantially constant for a period sufficient to effect penetration of the chips by the acid, then transferring the chips and acid to a digester without material loss of heat and cooking the chips at a higher temperature, then transferring the contents of the first digester to a second digester and continuing cooking at a different temperature, and mechanically disintegrating the chips in the process of transferring the same to the second digester.

8. The process of digesting wood, which consists in placing wood chips and acid in a container, maintaining the temperature of the contents of the container at approximately 105 degrees Cent., mechanically agitating the contents by circulation, then transferring the contents to a digester and cooking the chips at a higher temperature.

9. The process of digesting wood, which consists in placing wood chips and acid in a container, maintaining the temperature of the contents of the container at approximately 105 degrees Cent. for approximately one and one-half hours, continuously mechanically agitating the contents by circulation, then transferring the contents to a digester and cooking the chips at a higher temperature.

10. The process of digesting wood, which consists in placing wood chips and acid in a container, maintaining the temperature of the contents of the container at approximately 105 degrees Cent. mechanically agitating the contents by circulation, then transferring the contents to a digester and cooking the chips at a higher temperature, then transferring the contents of the digester to a second digester and continuing cooking at a different temperature.

11. The process of digesting wood, which consists in placing wood chips and acid in a container, maintaining the temperature of the contents of the container at approximately 105 degrees Cent. for approximately one and one-half hours, continuously agitating the contents by circulation, then transferring the contents to a digester and cooking the chips at a higher temperature, then removing the contents of the digester, agitating the same to assist in disintegrating the

chips, and placing the contents in a second digester for further cooking.

12. The process of digesting wood, which consists in placing wood chips and acid in a container, maintaining the temperature of the contents of the container at approximately 105 degrees Cent. for approximately one and one-half hours, continuously mechanically agitating the contents by circulation, then transferring the contents to a digester and cooking the chips at a higher temperature for approximately one and one-half hours then transferring the contents of the digester while mechanically agitating said contents, to a second digester for further treatment.

13. The process of digesting wood, which consists in placing wood chips and acid in a container, maintaining the temperature of the contents of the container at approximately 105 degrees Cent. for approximately one and one-half hours, continuously mechanically agitating the contents by circulation, then transferring the contents to a digester and cooking the chips at a higher temperature for approximately one and one-half hours then transferring the contents to a second digester for further treatment at a different temperature.

14. The process of digesting wood, which consists in placing wood chips and acid in a container, maintaining the temperature of the contents of the container at approximately 105 degrees Cent. for approximately one and one-half hours, continuously mechanically agitating the contents by circulation, then transferring the contents to a digester and cooking the chips at a higher temperature for approximately one and one-half hours then transferring the contents to a second digester for further treatment for approximately one and one-half hours at a different temperature.

15. The method of digesting wood in a series of steps in different containers which consists in presaturating wood chips in a container under theoretically correct conditions of temperature and acid strength, then transferring the chips and acid to a digester for further treatment at a different temperature.

16. The method of digestering wood in a series of steps in different containers which consists in presaturating wood chips in a container under theoretically correct conditions of temperature and acid strength while continuously mechanically agitating the contents of the container, then transferring the chips and acid to a digester for further treatment at a different temperature.

17. The method of digesting wood in a series of steps in different containers which consists in presaturating wood chips in a container under theoretically correct conditions of temperature and acid strength, then transferring the chips and acid to a digester for further treatment at a different temperature and then transferring the contents of the digester to a second digester for treatment under different temperature conditions.

18. The method of digesting wood in a series of steps in different containers which consists in presaturating wood chips in a container under theoretically correct conditions of temperature and acid strength, then transferring the chips and acid to a digester for further treatment at a different temperature and then transferring the contents of the digester to a second digester for treatment under different temperature conditions and disintegrating the chips in the process of transferring the material from the first to the second digesters.

19. In means of the class described, the combination of a presaturating tank, means for indirectly heating the contents of the tank, a plurality of digesters, and means for transferring chips and acid from the presaturator to the first digester and from the first to an adjacent digester to progressively treat the chips under different conditions of temperature and acid strength.

20. In means of the class described, the combination of a presaturating tank, means for indirectly heating the contents of the tank, means for continuously mechanically circulating the contents of the tank, a plurality of digesters, and means for transferring chips and acid from the presaturator to the first digester and from the first to an adjacent digester to progressively treat the chips under different conditions of temperature and acid strength.

21. The method of digesting wood in a series of steps in different containers which consists in presaturating wood chips in a container under theoretically correct conditions of temperature and acid strength, then transferring the chips and acid to a second container for further treatment at a different temperature and then transferring the contents of the said second container to a third container for treatment under different temperature conditions.

22. The method of digesting wood in a series of steps in different containers which consists in presaturating wood chips in a container under theoretically correct conditions of temperature and acid strength, then transferring the chips and acid to a second container for further treatment at a different temperature and then transferring the contents of the said second container to a third container for treatment under different temperature conditions and disintegrating the chips in the process of transferring the material from one to another of the containers.

In testimony whereof I have affixed my signature.

PAUL E. HODGDON.