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METHOD OF WOOD DISINTEGRATION

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Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

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METHOD OF WOOD DISINTEGRATION

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This invention relates to a method of disintegrating wood in preparation for making paper, rayon, and similar products, and has for an object to provide a method of disintegrating wood in which the mechanical operation of grinding, shredding or chipping is not required, and therefore, the fibres are not injured or broken up.

It is also an object of the invention to provide a method by which large blocks or logs of wood may be disintegrated without chipping.

It is another object of the invention to provide a method of disintegrating wood in which a large proportion of the resinous materials of the wood is removed, so that in the digesting operation much less chemical is required and the time required for the digesting operation is greatly reduced, and still further the fibres are in such condition that they are more accessible and open for penetration of chemicals, and as the time required for the digesting operation is greatly reduced there is much less liability of injury to the fibres.

It is still another object of the invention to provide a method of disintegrating wood in which the mechanical operations are greatly reduced over those at present employed, the cost of disintegration is greatly reduced, and the fibres after disintegration are in much better condition for subsequent operations than in the present methods, thus giving a better quality of product as well as reducing the cost.

With the foregoing and other objects in view, the invention consists in certain novel steps and operations as will be more fully described in connection with the accompanying drawing. In this drawing,

Fig. 1 is a partial side elevation and partial section of the drum which may be employed to carry out my process.

Fig. 2 is a transverse section thereof substantially on line 2—2 of Fig. 1.

Fig. 3 is an end view looking from the right of Fig. 1, and

Fig. 4 is a view indicating the appearance of the wood after it is disintegrated.

Practically all processes used at the present time of which I am aware for disintegrating wood in preparing it for the manufacture of paper, rayon and the like require either the grinding of the wood, or shredding, or chipping. These are expensive operations and require frequent renewals of the cutters of the machines. I have devised a method of disintegrating wood in which the wood may be disintegrated without chipping, and it may be disintegrated in large blocks or even in logs. Generally speaking the method comprises subjecting the wood to a vacuum as high as can conveniently be secured for about two hours to withdraw air and moisture and volatilize and remove the lighter volatile constituents, and then heat it to from about 80° to 90° C., although it could be heated at a higher temperature so long as it is not sufficient to char the wood, to volatilize and remove the heavy resinous elements. The vacuum pump is then turned off permitting the vacuum to gradually drop, and then gas, such as air under pressure is forced into the container, gradually increasing the pressure. If the pressure is increased too rapidly, the gas, instead of entering the pores or cells of the wood, has a tendency to close the cells, thus preventing the entrance of the gases into the pores or cells of the wood. It is preferred to use air for this gas, and the wood is placed under pressure of about 150 pounds per square inch for about one-half hour, and then the pressure is gradually increased to about 600 pounds per square inch and maintained for about an hour. Then the pressure is suddenly released permitting the gas which has been forced into the cells of the wood, to suddenly expand and break down the walls of these cells.

A device for carrying out this method is shown somewhat diagrammatically in the drawing. It comprises a jacketed drum open at its opposite ends which may be closed by suitable clamps or closures. One end is closed by a closure 11 which is hinged to the drum at 12 and may be clamped over the end thereof by suitable clamps 13 to give a gas tight drum. This cover is opened for insertion of the blocks or logs of the wood in charging the container and for removal of the fibre after the wood is disintegrated.
The drum is surrounded by a jacket 14 for heating purposes, being provided with inlet and outlet pipes 15 and 16 controlled by valves 17 for entrance of steam, hot water or other heating medium, or a cooling medium if desired.

The interior of the drum is connected with a suitable vacuum pump and also a pressure pump. A longitudinally extending perforated pipe 18 is connected by a pipe 19 to a vacuum pump 20, while a perforated pipe 21 in the drum is connected by a pipe 22 to a pressure pump 23. Thus the interior of the drum may be subjected to a substantial vacuum or a high pressure, and these may be indicated by suitable gauges 24 and 25.

The opposite end of the drum is provided with means for quickly releasing the pressure within the drum. Various mechanisms may be provided for doing this, the one shown comprising a closure or cap 26 adapted to fit over the end of the drum and provided with means for entering in inclined grooves 28 in the outer wall of the drum and opening through the end thereof. The drum may be provided with flanges 29 and 30 carrying any suitable number of rods 31 slidable therein, and which also extend through circular slots 32 in the flange 33 of the cap 26, and the rods have heads 34 forming limit stops for the flange 33. Coiled springs 35 are mounted on these rods between the flange 29 and the opposite ends of the rods. An arm 36 secured to the cap is connected by a flexible connection 37, such as a chain, to a hand lever 38. By placing the lugs 27 in the inclined grooves 28 and turning the cap to the left or counterclockwise the cap will be clamped tightly against the end of the drum and may be rendered gas and moisture proof by any suitable packing 39. When the pressure is to be released, pulling of the lever 38 will rotate the cap to the right or clockwise permitting the lugs 27 to pass out the end of the grooves 28, and the pressure in the drum will force the cap away thus suddenly releasing this pressure. The flange 33 will engage the heads of the rods 31 and prevent the cap flying away from the drum, the springs 35 providing a cushioning effect.

In carrying out my method the wood is placed in the drum and may be left in the form of blocks or logs 40 either long or short. In other words the wood is in its natural state and no chipping is required, although the method may be carried out with chipped wood if desired, but the wood is preferably not chipped as this operation is unnecessary and undesirable. The drum is then sealed by the caps 11 and 26 and the vacuum pump 20 is started providing as high a vacuum as possible in the drum, the higher the vacuum the more rapid the process. This high vacuum is maintained for about two hours and this volatilizes and removes the moisture and the lighter volatile constituents as oils or resins in the wood. Ordinarily no heat should be applied during this first step as it is desirable to remove the lighter volatile constituents first before the heavier constituents to prevent clogging of the pores of the wood. The material in the drum is then heated by passing steam, hot water, oil or other heating medium through the jacket 14. It is preferable to heat this material to about 80° or 90° C. or below the normal boiling point of water, but it may be heated to a higher temperature if desired, although it should not be heated to a temperature which will char the wood. At the temperatures stated and with the greatly reduced pressure caused by the vacuum pump the heavy resins oils are distilled, though they boil ordinarily at about 200° or 300° C., but at these temperatures and reduced pressure these oils will be to a large extent distilled off and removed. To do this the heating is required for about one hour. The gases drawn off may be run through a scrubber or other apparatus and recovered. After this heating operation the vacuum pump is cut off for about a half hour permitting the vacuum within the drum to gradually reduce, during which time it will gradually drop from about 23 inches or more of mercury to about 9 or 10 inches by volatilization of various elements in the wood. The next step is the application of a gas pressure to the wood in the drum. I preferably use air although other gases may be employed if desired. The air compressor 23 forces air into the drum, raising the pressure to about 100 to 150 pounds per square inch, which is maintained for about half an hour. This pressure is then gradually increased to about 600 pounds per square inch which is maintained for about an hour. This method is pursued to maintain the cellular structure. If the pressure should be raised at once to 600 pounds or any similar high pressure, the cells would compress, thereby having a tendency to prevent the entrance of the gas into the pores or cells of the wood. Thus this air or gas under high pressure is forced into the wood and fills the cells. This gas readily enters the cells because the greater portion of the oils and resins has been removed under the vacuum and heat treatment, rendering the cell walls pervious to the gas. Then the pressure in the drum is suddenly released by disconnecting the cap 26 as above described, or the pressure may be suddenly released by any other suitable mechanical device. This sudden release of pressure in the drum permits the gas under pressure in the cells of the wood to quickly expand and rupture the walls of the cells so that the fibres of the cells are in separate bundles indicated at 41, Fig. 4. Each bundle appears to be the fibres of individual cells, and they
The material may be removed from the drum by removing the cap 11. It may be used in various processes for making rayon, paper or similar or other products.

It will be understood that the method is not confined to the exact pressures and temperatures stated or to the times mentioned as they vary considerably with different woods or with woods under different conditions of moisture and different quantities of resinous material. The fibres are not injured by this process, and the mechanical operation of chipping or shredding is wholly unnecessary.

The greater proportion of the resinous or other volatile constituents of the wood is removed thus opening up the cells so that the chemicals used in further processes can more easily penetrate the material, and as the greater proportion of these resinous materials has been removed much less chemical is required in the digesting operation and the time of digesting is greatly reduced over the old methods. Due to these facts the injury to the fibers in the digesting process is greatly reduced, giving a much better quality of fibre or cellulose. The washing operations are also much reduced and simplified.

It is very advantageous for either rayon or paper manufacture because the fibres are more intact, are not broken or injured, thus producing a much better quality of product. Although I prefer air for the medium of producing the high pressure I may use steam or other gases. This new method of disintegration produces a product of superior quality and greater strength on account of having removed empyreumatic compounds and other empyreumatic impurities, thus yielding and securing a higher percentage of the highest resistant cellulose (sometimes designated as alpha cellulose) than is produced by the ordinary process of chipping, grinding, shredding and otherwise treating as heretofore used.

Having thus set forth the nature of my invention, what I claim is:

1. The method of disintegrating wood comprising subjecting the wood to a partial vacuum to remove volatile constituents, then subjecting the wood to a relatively high gas pressure until the gas under pressure has entered the cells of the wood, and then suddenly reducing the pressure outside the wood.

2. The method of disintegrating wood comprising subjecting the wood in its natural shape as in a log or block to a pressure considerably below atmospheric pressure, to remove volatile constituents, then subjecting the wood to a relatively high gas pressure until the gas under pressure has entered the cells of the wood, and then suddenly reducing the pressure.

3. The method of disintegrating wood comprising subjecting the wood for some time to a relatively high vacuum, then heating the wood while still subjected to the vacuum, then applying a gas pressure, and then suddenly releasing the pressure.

4. The method of disintegrating wood comprising subjecting the wood to a relatively high vacuum for about two hours, then heating to a temperature about 80° to 90° C. for about one hour, then allowing the vacuum to gradually reduce, then applying an air pressure of from about 100 to 150 pounds per square inch for about one half hour, then gradually increasing the pressure to about 600 pounds per square inch for about an hour, and then suddenly releasing the pressure.

5. The method of disintegrating wood comprising subjecting the wood to a relatively high vacuum to remove the lighter volatile constituents, then heating while it is still subjected to the vacuum, then applying a relatively high gas pressure to fill the cells of the wood with this gas, and then suddenly releasing the pressure outside the wood.

6. The method of disintegrating wood comprising subjecting the wood to a partial vacuum to remove the lighter volatile constituents, then heating while still subjected to the vacuum to remove the heavier volatile constituents, then progressively applying a gas under pressure to the outside of the wood, and then suddenly releasing the pressure outside the wood.

7. The method of disintegrating wood comprising subjecting the wood to a relatively high vacuum to remove the lighter volatile constituents, then heating while subjected to said vacuum, then subjecting the wood to a gas under pressure, and then suddenly releasing the pressure.

8. The method of disintegrating wood comprising subjecting the wood to a relatively high vacuum to remove the lighter volatile constituents, then heating while subjected to said vacuum to volatilize the heavier oils and resins, then subjecting the wood to an air pressure of about 600 pounds per square inch to fill the cells with this gas under pressure, and then suddenly releasing this pressure.

9. The method of disintegrating wood comprising subjecting the wood to a relatively high vacuum to remove the lighter volatile constituents, then heating while subjected to said vacuum to volatilize the heavier oils and resins, then subjecting the wood to an air pressure of about 600 pounds per square inch to fill the cells with this gas under pressure, and then suddenly releasing this pressure.

10. The method of disintegrating wood comprising subjecting the wood to a relatively high vacuum for about two hours, then heat-
ing for about one hour while subjected to the vacuum to a temperature insufficient to char the wood, then allowing the vacuum to gradually decrease for about one-half hour, then applying an air pressure of about 100 to 150 pounds per square inch for about one-half hour, then increasing this air pressure gradually until it reaches about 600 pounds per square inch and maintaining it for about one hour, and then suddenly releasing this pressure.

11. A method of disintegrating wood comprising subjecting the wood to a pressure considerably below atmospheric pressure to remove volatile constituents, then subjecting the wood to a gradually increasing gas pressure so that the gas enters the cells of the wood, and then suddenly releasing the pressure.

12. A method of disintegrating wood comprising subjecting the wood to a pressure considerably below atmospheric pressure to remove volatile constituents, heating the wood while subjected to said reduced pressure to a temperature insufficient to char the wood, then subjecting the wood to a gradually increasing gas pressure so that the gas enters the cells of the wood, and then suddenly releasing the pressure.

13. A method of disintegrating wood comprising subjecting the wood to a pressure considerably below atmospheric pressure to remove volatile constituents, then subjecting the wood to a gas pressure insufficient to close the cells of the wood and gradually increasing this pressure to a relatively high pressure to fill the cells of the wood with gas at this pressure, and then suddenly reducing the pressure surrounding the wood.

14. A method of disintegrating wood comprising subjecting the wood to a pressure considerably below atmospheric pressure to remove volatile constituents, heating the wood while subjected to reduced pressure to a temperature insufficient to char the wood, then subjecting the wood to a gas pressure insufficient to close the cells of the wood and gradually increasing this pressure to a relatively high pressure to fill the cells of the wood with gas at this pressure, and then suddenly reducing the pressure surrounding the wood.

In testimony whereof I affix my signature.

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