

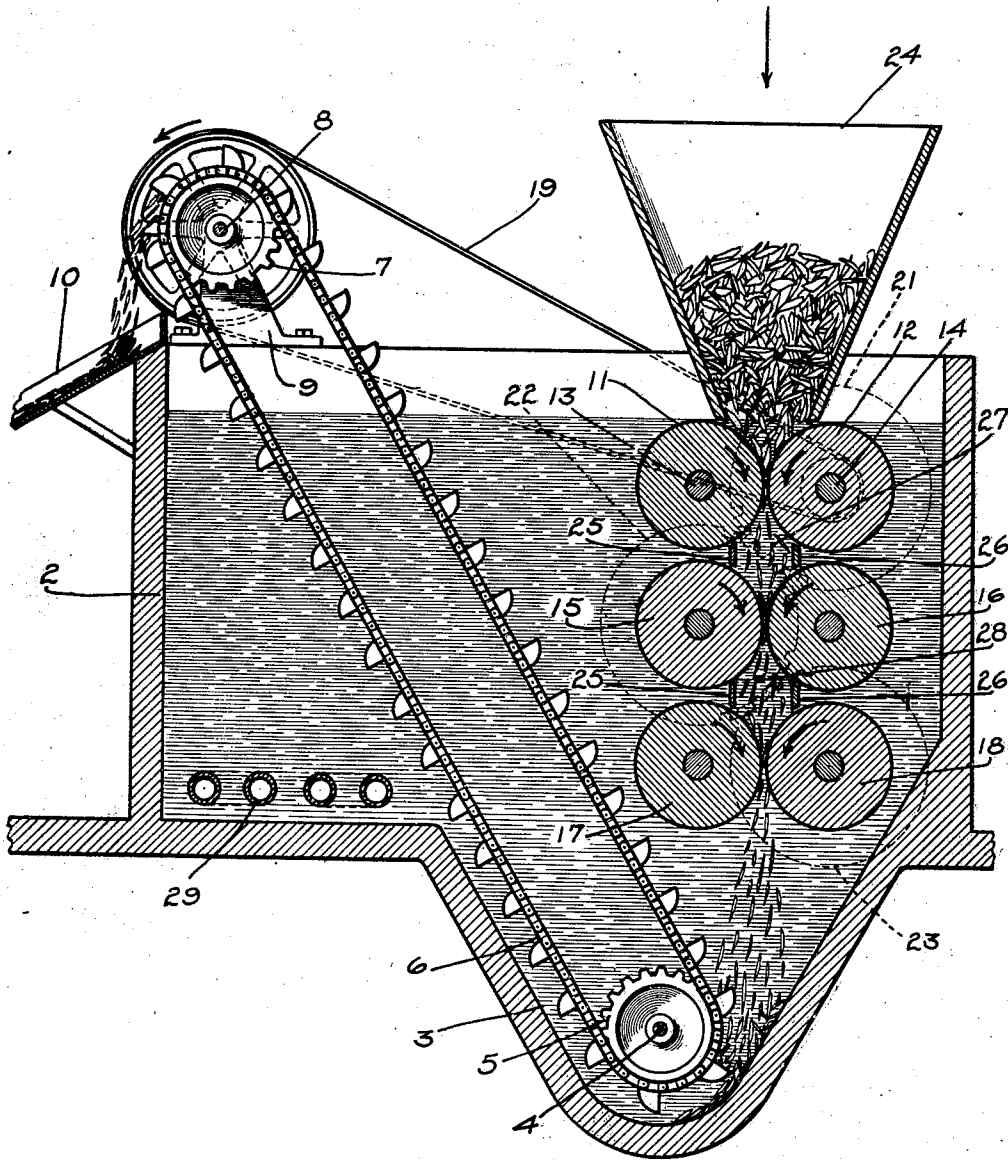
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G. H. ELLIS

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PROCESS AND APPARATUS FOR DISINTEGRATING WOOD

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INVENTOR
GEORGE H. ELLIS
By *Paul, Paul, Moore*
ATTORNEYS

UNITED STATES PATENT OFFICE

GEORGE H. ELLIS, OF ST. PAUL, MINNESOTA, ASSIGNOR TO THE INSULITE COMPANY,
OF MINNEAPOLIS, MINNESOTA, A CORPORATION OF MINNESOTA

PROCESS AND APPARATUS FOR DISINTEGRATING WOOD

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This invention relates to an improved process and apparatus for disintegrating wood chips or separating wood fibers in preparing them for use in the making of wood pulp stock, such as is used in the manufacture of paper, insulating material, and various other products.

An object of the invention is to provide an improved process which consists in alternately compressing the chips and allowing them to absorb water until the fibers are loosened from one another or are separated into integrant parts.

A further object is to provide an improved process for disintegrating wood chips which consists in passing the chips between a pair of submerged rollers to squeeze or force the air and water out of the wood, then allowing the squeezed chips to expand and absorb water and repeating the operation until the chips are disintegrated.

A further object is to provide an apparatus for disintegrating wood chips comprising a fluid tank having means therein for heating the fluid, and further having a plurality of rollers mounted therein and arranged in pairs, one pair over another, and a series of water chambers alternating with said rollers, and through which the wood chips are progressively passed to cause the fibers thereof to become separated into integrant parts.

Broadly, the process consists in first passing air dried wood chips between a pair of submerged rollers and compressing them to remove the air from the wood; then discharging the wood chips into a confined water chamber and allowing them to expand and absorb water, after which the compressing and expanding operations are repeated until the fibers become separated. By thus compressing the chips and allowing them to expand under water, preferably hot water, the water is drawn into the cells or interstices between the fibers of the chips. In taking the water into the interstices of the chips, the lignin and resin are more or less softened, and, when the water soaked chips are compressed, the water, being noncompressible, is forced out very rap-

idly and, in so doing, tears the chips asunder and shreds them into small long bundles of fiber, after which the wood fibers may readily be separated and mixed with a suitable fluid, such as is used in the preparation of fibrous pulp stock.

The particular object of the invention therefore is to provide an improved process and apparatus for disintegrating wood.

Other objects of the invention will appear from the following description and accompanying drawings and will be pointed out in the annexed claims.

In the accompanying drawings, there has been disclosed a structure designed to carry out the various objects of the invention but it is to be understood that the invention is not confined to the exact features shown, as various changes may be made within the scope of the claims which follow.

The accompanying drawing illustrates an apparatus adapted for use in connection with my improved process.

In the accompanying drawing, there is illustrated an apparatus adapted for use in connection with my improved process for disintegrating wood chips. This apparatus comprises a fluid tank 2, preferably having a depressed portion 3, wherein a shaft 4 is mounted, and upon which sprocket wheels 5 are secured which function to support the lower portion of an endless conveyer belt 6, as shown. The upper portion of the conveyer is supported by means of sprockets 7 secured to a shaft 8, mounted in brackets 9, preferably secured to the upper portions of the walls of the tank. A chute 10 is provided to receive the disintegrated wood chips, as they are discharged from the bucket conveyer 6.

An important feature of this apparatus resides in the means provided for squeezing or pressing the wood chips, as they are passed therethrough. A pair of rollers 11 and 12 are mounted adjacent the upper portion of the tank 2 and normally are submerged in the fluid contained in the tank, as shown. These rollers are secured respectively to shafts 13 and 14, and are geared together for simultaneous movement in the direction indi-

cated by the arrows. A second pair of rollers 15 and 16 are mounted below the rollers 11 and 12, and are similarly geared together for simultaneous movement. Similar rollers 17 and 18 are preferably mounted below the rollers 15 and 16 and are likewise geared together for simultaneous movement.

The conveyer 6 may be operated by a suitable belt drive 19, operatively connecting the shaft 8 with the roller shaft 14. The rollers 15—16 and 17—18 are also preferably driven from the shaft 14 by means of suitable gears 21, 22, and 23, indicated in dotted lines. The gears connecting together each pair of rollers are of ordinary, well-known construction and it is therefore thought unnecessary to show same in the drawing, it being understood that the rollers are rotated in the direction indicated by the arrows.

A hopper 24 is suitably supported upon the walls of the tank and provides means for feeding the wood chips between the upper pair of pressure rollers 11 and 12.

Referring to the drawing, it will be noted that a substantially closed water chamber is provided between each pair of rollers. These water chambers are defined by the peripheries of the rollers and the spaced wall portions 25 and 26, having their end suitably secured to the side walls of the tank.

In the operation of this novel apparatus, the wood, after having been passed through a chopper or cutter and reduced into comparatively small chips or pieces, is delivered into the hopper 24, after which the chips are fed downwardly between the upper pair of rollers and into the upper water chamber 27. As the chips pass between the rollers 11 and 12, the air contained therein, as a result of the chips being substantially dry, is squeezed out of the chips. As soon as the squeezed chips are discharged into the water chamber 27, they immediately begin to expand or tend to assume their natural shape, thereby drawing water into the interstices between the fibers thereof. These water-soaked chips are then passed between the second pair of rollers 15 and 16, thereby subjecting them to a second rapid compressing operation which rapidly forces the water out of the chips with the result that the fibers are partially loosened or torn asunder before being discharged into the second water chamber 28, where they again tend to expand and thus absorb or fill with water. The chips are then passed through the lower pair of rollers where the water is again quickly forced out of the chips with the resultant loosening or separating of the wood fibers into separate integrant parts. By the time the wood chips have progressively and alternately passed through the series of pressure rollers and water chambers, all of the air has been removed therefrom so that the disintegrated chips no longer tend to rise or float in the water, but sink to the

bottom of the depression 3, where they are intercepted by or received in the buckets of the conveyer 6 and are discharged onto the chute 10, as shown on the drawing.

The buckets of the conveyer 6 are preferably perforated so as to permit the water to drain back into the tank 2. A steam pipe or coil 29 is also preferably mounted in the lower portion of the tank to provide means for heating the fluid. It has been found that by using hot water, the lignin and resin in the wood chips becomes more or less softened after which the fibers are more readily separated.

In actual practice, it has been found that by alternately passing wood chips through a series of pressure rollers and water chambers, such as above described, that the fibers of the chips become loosened or freed from one another so that the chips, after being discharged from the lower set of rollers, appear very much like bundles of fibers, as each chip will be substantially intact but the fibers thereof will be loosened from one another so that they may readily be separated.

It has also been found that three sets of pressure rollers and two water chambers, arranged substantially as shown on the accompanying drawing, is sufficient to thoroughly disintegrate the chips when passed there-through. It is to be understood, however, that for certain grades of wood, it may be necessary to use a greater number of pairs of rollers, or, it may be necessary to dispense with one pair and use only four rollers. The process of disintegrating the chips, however, remains the same. It may also be necessary, when disintegrating certain kinds of wood, particularly the fatty grades, such as yellow pine and tamarack, to use a solvent such as alkali, or sulphate liquor, in order to obtain the desired degree of disintegration. If the water in the chambers in which the chips are allowed to expand, is alkaline or acid, this alkali or acid will be drawn into the interstices of the chips and will therefore act upon the resins, gum and lignin, which will tend to hasten disintegration and will impart to the chips a softness which tends to free the fibers, after which the fibers will have the characteristics of fibers which have been treated in a digester with the same chemicals. By the employment of this novel process and apparatus, the operation of disintegrating wood chips in preparing them for fibrous pulp stock is greatly simplified and expedited, as compared with usual methods wherein the chips are disintegrated in a digester or cooker. The apparatus is also comparatively small, thus taking up very little floor space, and the results obtained are substantially equal to that obtained from the usual digesters or apparatus now in use, which are very large in size and require a great deal of floor space and room, and are therefore objection-

able, especially where the question of room is of any importance.

A very important feature of the present invention relates to the process for dividing wood for producing pulp board or analogous products, particularly production from certain classes of woods, including woods having the bark thereon, not heretofore usable in the manufacture of pulp products. The present process permits the use of waste products of the saw mill called "slab wood" containing bark, as well as certain other "waste woods", the texture, or chemical composition, of which has heretofore made them unusable. One of the important steps in the process is compression and release in water or in a chemical solution, by means of which, as the result of what may be termed pumping action, the water or the solution is sucked or brought into the interstices of the wood. The idea of taking advantage of that mechanical function of the wood by which the fibers tend to resume their original expanded condition after compression, and as a result of which chemical material can be sucked within, to assist in separating the bundled and cemented fibers, is believed broadly new. By continued experiment, it has been found that fibers of various soft woods can be successfully separated, without destroying their binding properties for the use in hand. For example, it has been heretofore considered unprofitable to attempt to utilize waste cedar, cut from the butt ends of cedar poles and posts. Mechanical processes have been failures due, it is believed, to the frangible, silk-like fiber in the cedar, and due to persistent cementation of the fibers. The abrasive action of the grindstone completely destroys this fiber, making it unsuitable for any use. Cooking processes have been attempted, but these are unprofitable. Another wood which is usable, when subjected to the present process is balm of Gilead, which has an excellent long fine fiber, but has not been used for paper making or for lumber, and is generally left to decay. Neither grindstone nor chemical treatment has made this wood usable commercially.

The slab wood above mentioned contains a large percentage of bark and heretofore this wood has not been usable because there is no profitable method for removing the bark from the slabs. The present process has made it possible to use this wood for mechanical pulp or chemical pulp, and has made it possible to remove and dispose of the bark economically.

As before stated, these waste woods as well as other woods may be properly conditioned for the purpose in hand by being chipped into pieces of a size ordinarily used for chemical pulping, and then pressed, (to drive out the air and put the fibers under tension) and subsequently allowed to expand,

preferably in some fluid medium, or in a chemical solution, for instance, in an alkaline solution, which will act to neutralize wood acids, allowing the fibers of the wood bundles to be separated without such corresponding breaking up of the fibers as will destroy their binding qualities. If a chip becomes soft as the result of softening of cementing materials therein, the rapidity with which the fluid is driven out of the chip may be increased so that the outgoing fluid, or chemical medium will shred or split the chip into small bundles or into separate fibers. If the water is hot, the action is quicker. It has been found that by varying the amount of alkali, that the cementing materials are softened to a greater degree than with hot water alone and remain soft for a longer period. In other words, if cold water is used the action is very slow and the resultant fiber is shorter than if hot water is used. If a hot solution of alkali, or of an acid which will neutralize the cementing materials, these materials are softened in less time, with less injury to the fiber. This reduction of time, and pulling apart of the fiber without undue disintegration or breaking, are important features of the invention and of the process.

The following woods have been successfully reduced to fiber in such a manner that pulp is very satisfactorily produced for building material, including insulation material, and also wrapping paper; cedar, balm of Gilead, poplar, jack pine, tamarack, white pine slabs and a mixture of slab wood from the saw mill containing white pine, birch, spruce, all of the slab wood containing the bark.

The process of pressing, or putting the resilient fibres under tension and releasing them, and thus obtaining what may be considered a pumping of the fluid into the chips, (in the case of unbarked slab wood) disintegrates the bark which is more tender than the fiber, and, it is believed that at least a certain portion of the bark is held as an emulsion, or in suspension or solution in a finely divided state. After the cementing materials are sufficiently softened and the chip reduced to shreds or to small bundles of fiber, it is passed to the pulping machine. It is apparent that the attritional or rubbing action which takes place, further reduces the bark which is thus separated from the fiber.

The pulp produced by the present process can be washed in any of the well known devices used in paper making, and a large percentage of bark is removed in the washing process. It has been found that the water first leaving, has a dark brown appearance and contains bark. Of course, it is evident that with this process, it is unnecessary to debark the wood, and in this way the entire tree can be converted into pulp. This is an accomplishment at present unknown.

The important steps in the present process are compression, release and expansion of the batch in the presence of chemical substance such as water or a chemical solution of a nature to soften and assist in disintegrating the fibers. To recapitulate: the slab wood or waste wood containing considerable wood cementing material and having bark is first chipped to a suitable size. The chipped or sized material is then introduced into an alkaline solution, or water, or a suitable chemical solution, or a suitable absorbable chemical material of any kind, and the sized material is compressed while within this solution or chemical material. The wood is then released, and in an attempt to expand to its normal condition, the chemical substance is sucked inwardly, and apparently an intimate mixture, resulting in chemical change, takes place to soften and separate the fibers, without that disintegration, which often, in the old processes, unfitted the material for further use. The separated, neutralized batch is then ground to a suitable fineness, and the mass is then washed to remove the bark which apparently goes into solution and is drawn off with the wash liquid.

I claim as my invention:

1. A process of disintegrating wood chips which consists in passing the chips between a pair of rollers submerged in liquid within a suitable receptacle, to force the air out of the wood, then allowing the squeezed chips to expand and absorb the liquid, and immediately subjecting the liquid-soaked chips to a second pressing operation to quickly force the liquid out of the chips to separate the fibers.

2. In an apparatus for disintegrating wood chips, the combination of a fluid tank having means therein for heating the fluid, rollers mounted in pairs in said tank, means for feeding wood chips between the first pair of rollers, and a series of confined water chambers alternating with said pairs of rollers through which chambers, said chips are progressively passed to absorb the fluid therein.

3. In an apparatus for disintegrating wood chips, the combination of a fluid tank having means therein for heating the fluid, pairs of rollers mounted therein, in superposed relation and normally submerged in the fluid, a hopper for feeding wood chips between the top pair of rollers, a series of confined water chambers alternating with said pairs of rollers and through which chambers, said chips are progressively passed and allowed to absorb fluid, and means for removing the disintegrated wood fibers from said tank.

4. In an apparatus for disintegrating wood chips, the combination of a fluid tank, a pair of rollers mounted therein and submerged in the fluid, means for feeding wood chips between said rollers to squeeze the air there-

from, beneath the surface of the fluid, a submerged chamber beneath said rollers adapted to receive the squeezed chips and wherein said chips will expand and partially fill with fluid, a second pair of rollers arranged to receive said fluid-soaked chips from said chamber and functioning to forcibly squeeze the fluid therefrom, a similar chamber arranged beneath the second pair of rollers through which the squeezed chips are passed and allowed to again absorb water, and means beneath said last mentioned chamber for subjecting the chips to another squeezing operation to forcibly squeeze the fluid therefrom and whereby the wood fibers are separated into integral parts.

5. An apparatus for disintegrating wood, comprising a suitable tank having a liquid therein, a plurality of pressure means mounted in said tank and substantially submerged in the liquid therein, and a closed chamber between said pressure means adapted to be traversed by the wood.

6. An apparatus for disintegrating wood, comprising a suitable tank having a liquid therein, a plurality of pressure means mounted in said tank, and through which the wood is progressively passed, there being confined areas between said pressure means containing liquid into and beneath the surface of which the partially disintegrated wood is discharged from said pressure means and allowed to absorb liquid.

7. An apparatus for separating wood fibers, comprising a tank adapted to contain a suitable liquid, pairs of rollers mounted in said tank, means for feeding wood chips between said pairs of rollers, there being confined areas between adjacent pairs of rollers adapted to contain liquid into and beneath the surface of which the partially disintegrated wood chips are discharged from said rollers and allowed to expand and absorb liquid, as the chips are passed from one pair of rollers to the next.

8. A process for disintegrating wood which consists in passing the wood between oppositely rotating members while the wood is substantially submerged in a fluid medium to force the air out of the wood, then allowing the squeezed wood to expand and absorb fluid, and subsequently subjecting the fluid-soaked chips to a second pressing operation to quickly force the fluid out of the wood to separate the fibers, the second pressing operation following immediately after the first.

9. A process of disintegrating pieces of wood which consists in squeezing the pieces while submerged in a suitable fluid, to force air out of the pieces, then allowing the pieces to expand and absorb the fluid, and subsequently squeezing the pieces a second time to eject the fluid from the pores and thereby separate the wood fibers, the second squeez-

ing operation following immediately after the first.

10. An apparatus for disintegrating wood, comprising a suitable tank having a fluid therein, spaced-apart pressure means mounted
5 in said tank, there being a substantially closed chamber between said pressure means adapted to be traversed by the wood as it passes from one pressure means to the next.

11. An apparatus for disintegrating pieces of wood, comprising means for squeezing the pieces to eject air from the pores thereof, said apparatus having a substantially closed liquid-containing area adapted to receive the
15 squeezed wood pieces and allow the pores in the wood to fill with liquid, and means for expelling the liquid from the pieces to separate the fibers thereof.

12. A process of disintegrating wood
20 which consists in compressing the wood between rotating members while under water to remove air therefrom, then allowing the wood to expand and absorb water, and immediately subjecting the water-soaked wood
25 to a second pressing and expanding operation whereby the fibers are separated.

13. In an apparatus for disintegrating wood chips, a fluid tank, a pair of rollers mounted therein, means for feeding the wood
30 chips between said rollers, a second pair of rollers spaced from said first mentioned rollers, there being a substantially confined area between said pairs of rollers provided with a liquid into and beneath the surface of which
35 the squeezed chips are discharged from the first pair of rollers, whereby the air-exhausted pores of the chips will absorb liquid, after which said liquid-soaked chips will pass between the second pair of rollers and the liquid
40 again squeezed therefrom, thereby causing the fibers to separate.

14. A process of disintegrating fibrous material which consists in subjecting the material to a series of compressions one following
45 immediately after the other, and subjecting the material to moisture between compressions.

15. An apparatus for disintegrating wood chips, comprising a receptacle adapted to
50 contain liquid, chip-compressing means arranged to successively squeeze the chips, means for feeding the chips to said compressing means to expel the air from the pores of the chips, there being areas provided in the
55 liquid between the compressing means to receive the chips following each compression thereof, whereby the air-exhausted pores of the chips will absorb moisture following each squeezing operation.

60 In witness whereof, I have hereunto set my hand this 25th day of June, 1927.

GEORGE H. ELLIS.