CHIPS

1. REFINER

2. REFINER

3. SCREEN

4. HYDROCYCLONE

    PULP

    REJECTS TO WASTE

    Fig. 1

CHIPS

5. PRESSURE VESSEL

6. LIVE BOTTOM BIN & DRAINER

7. INTERMITTENT PRESSURE SCREW PRESS

1. REFINER

2. REFINER

3. SCREEN

4. HYDROCYCLONE

    PULP

    REJECTS TO WASTE

    Fig. 2

Fig. 3

PULP

REJECTS TO WASTE

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Jan. 9, 1962 C. K. TEXTOR 3,016,324

METHOD AND APPARATUS FOR PRODUCING WOOD PULP

Filed March 7, 1957

CHIPS

8 - ATTRITION MILL

5 - PRESSURE VESSEL

6 - LIVE BOTTOM BIN AND DRAINER

7 - INTERMITTENT PRESSURE SCREW PRESS

2 - REFINER

3 - SCREEN

4 - HYDROCYCLONE

PULP

REJECTS

UNHEATED CHEMICAL ADDED

CHEMICAL ADDED

REJECTS TO WASTE

REJECTS

REJECTS TO WASTE

Fig. 4

Fig. 5
This invention relates to the production of wood pulp, and more particularly to the making of a wood pulp like ground wood produced by mechanical and chemi-mechanical methods from wood chips.

The invention provides improvements in the art of wood pulp making by means of wood chips of mixed species to be reduced to pulp of uniform good color and quality. It also provides an improved system and method for reducing wood chips, utilizing known machinery, whereby the reduction can be carried out selectively on a mechanical or chemi-mechanical basis.

The object of the invention is to simplify the method of producing wood pulp whereby such method may not only be economically carried on, but will be more efficient and satisfactory in use, and adaptable to a wide variety of raw woods.

It is a further object of the invention to produce wood pulp from raw wood chips by an all mechanical method involving only the steps of disc refining, screening, and cleaning.

Another object of the invention is to present a method of the kind described which may readily be varied by the addition of or omission of certain steps and equipment to obtain wood pulp of the desired quality.

A further object of the invention is to enable a wood pulp to be produced from mixtures of wood species.

Still another object of the invention is to produce a lightly colored wood pulp from raw wood chips.

A still further object of the invention is to make a selective use of chemicals in connection with the mechanical working of the wood chips to assist in obtaining a pulp of the desired color and quality.

A further object of the invention is to provide a method of the kind described which is inherently more efficient and satisfactory in use, and adaptable to a wide variety of raw woods.

With the above and other incidental objects in view as well as the more fully appearing in the specification, the invention intended to be protected by Letters Patent consists of the following steps:

1. The features of construction, the parts and combinations thereof, and the mode of operation as hereinbefore described or illustrated in the accompanying drawings, or their equivalents.

2. Referring to the accompanying drawings wherein is shown one but obviously not necessarily the only form of embodiment of the invention.

3. A flow chart of a chemi-mechanical form of the invention.

4. A flow chart similar to FIG. 2, but disclosing a method in which one refining step is omitted.

5. A flow chart similar to FIG. 3 in which the method of FIG. 3 is modified by the addition of an attrition mill.

6. A flow chart showing another chemi-mechanical form of the invention; and

7. A diagram showing an actual installation of apparatus arranged for the practice of a method of the present invention.
by a need for a pulp of different quality or by the use of different wood species. Thus, the minimum equipment as described may suffice to produce a pulp of good quality in the working of soft woods, whereas an additional, for example a pretreatment with chemicals, may be desirable to produce a pulp of comparable quality from hard wood chips.

In the flow diagram of FIG. 2, there has been added to the equipment of FIG. 1 a pressure vessel 5, a drainer 6, and an intermittent pressure screw press 7. In the method of FIG. 2, the raw wood chips are first introduced into a pressure vessel 5 of a kind that can be closed and sealed and which is adapted for rapid loading and unloading. After the chips are in the vessel, it is pumped full of a chemical solution, in the presence instance sodium sulphite. According to the instant invention concept the chemical solution is unheated. Hydrostatic pressure at about one hundred pounds per square inch is applied within the pressure chamber for a few minutes, then the liquid in the vessel is drained off, and the chips discharged therefore into a live bottom bin and drainer 6. The live bottom bin is a receptacle, the entire bottom of which is formed with or of screw conveyors arranged in such manner that any or all of them can be rotated. Such live bottom bin is a draining device having a perforated metal bottom with the conveyors moving the chips across the perforated bottom. The result is to drain off the liquid while leaving chips that are saturated or impregnated with the chemical, the combination of pressure and chemical action resulting in a weakening of the cohesive qualities of the fibers of the individual chips, as well as a softening of the natural substances which normally surround and permeate the fibers of a wood.

After draining, the chips are put into and passed through an intermittent pressure screw press 7 which extracts additional liquor and natural wood fluids from the chips and partly refines them into their fibrous components. The particular press used herein involves a succession of pressure applications and releases during traversal of the wood material through the press. The material being processed is compressed by the rotation of a helical feed screw and gradually advanced through a restricted area. As the material passes the restricted area it is permitted to expand at the point where the pressure is released. As the pressure is released, the feed screw again picks up the material and again applies pressure, and so on in the advancement of the material past a further restricted area. During the pressing of the wood it is subjected not only to pressure but also to a twisting or shearing action due to the rotary motion of the feed screw. The material within the press is accordingly subjected simultaneously to a squeezing and shearing action and to the successive application and release of relatively high pressures. Such treatment of the material extracts therefrom the greater part of the moisture and in addition there to some of the natural wood fluids such as sap, rosin, and other chemicals normally present in the wood. The lignin and other wood sugars are also softened during this processing operation.

The material discharged from the screw press 7 then is directed successively through a pair of refiners 1 and 2 and a screen 3 and cleaner 4, all of these latter elements being of the same equipment and arranged in the same manner as the parts 1 through 4 in the flow diagram of FIG. 1. The pulp material, as finally accepted by the cleaner 4, is clean, light colored and has characteristics equal to or superior to commercial ground wood.

As an alternative in the foregoing method, sodium peroxide may be used instead of sodium sulphite, together with additives such as sodium silicate, epsom salts etc. This has a bleaching effect and tends to produce an even lighter color pulp.

An alternative, as regards equipment, is illustrated in FIG. 3 wherein the refining stage is accomplished in a single refiner instead of two. Thus, in the method as proposed in FIG. 3, the wood chips are introduced into a pressure vessel 5 and there subjected to pressure in the presence of chemicals as before described. The impregnated wood chips are introduced into a live bottom bin and drainer 6, forced through the screw press 7 and then put through the single refining stage in a refiner 2. Finally, the pulp material is screened in the rotary screen 3 and cleaned in the hydrocyclone 4.

In FIG. 4 the proposed method is the same as that of FIG. 1 except that an attrition mill 8 is added. In this method, the raw wood chips are put first into the mill 8 and there reduced in size before entering a pressure vessel 5 and passing through the remaining equipment 6, 7, 2, 3, and 4 corresponding to the similar equipment of FIG. 3. Being of smaller size, the chips are more readily penetrated, within the pressure vessel, by the chemical solution therein.

Returning to a consideration of the continuous screw press, this press causes a break down of the chipped material and an opening up of the fibrous structure thereof. A high degree of fiberizing and maceration is achieved by the successive application and release of pressure combined with the squeezing and shearing effects obtained. The material, as it is discharged from the press, is in excellent condition for further refining or treatment to produce a ground wood type of pulp by conventional refiners. Also, the discharged material is very dry and porous and presents itself in a favorable condition for the absorption of moisture.

Advantage is taken of the latter condition in the embodiment illustrated by the flow diagram of FIG. 5. In this instance a chemi-mechanical pulp is produced without the use of the pressure vessel 5 characterizing the embodiments of FIGS. 2 to 4. The raw wood chips are fed directly into a screw press 7. As the macerated chip material emerges from the press, in its dry, expanding condition as described, it is sprayed with a sodium peroxide solution. In this manner, the chip material may be thoroughly impregnated with a liquid chemical without the use of a pressure vessel. After impregnation, the progress of the chip material through the equipment is to a live bottom bin and drainer 6, to a refiner 2, to a screen 3, and thence to a cleaner 4.

A certain degree of heat is developed in the screw press which materially assists in the processing of the wood and the satisfactory extraction of natural fluid compounds within the wood. The heat developed is not comparable to that of a cooking operation as is generally used in the processing of fibers for pulp purposes, but is helpful, in connection with the compressing and delignifying of the material in preparing it more readily and completely to absorb a chemical liquid spray as the material is released from the final applied pressure within the press.

In the practice of the present invention, both the all mechanical and chemi-mechanical methods have been used to produce a pulp from a mixture of wood species. In all instances, the pulps so prepared have had qualities at least as satisfactory as the average results obtained from the pulping of the individual component species.

The practice of the invention further has indicated that any species of wood that is currently being ground successfully with conventional stone grinders may be economically converted to a pulp by the instant proposals for converting raw wood chips. The physical qualities of the produced pulp are readily controllable by operators who by adjustment of a feed regulating device may alter and regulate the rate of movement of the pulp material from the grinder to the refiners. A considerable yield equal mullen or tensile strength up to 50% greater strength as compared with pulp prepared by grinders from the same lot of wood. The tear factor is generally 25% to 50% higher. The brightness and opacity of the process pulps as here contemplated are at least as good as that of pulps prepared by conventional
grinding of the same wood. There is no discoloration. In the matter of economic considerations, a wood pulp-
ing installation as proposed by the present invention is operated in a largely automatic manner requiring but slight attendance by operators, the space requirements are low and capital investment is substantially less than that required for an efficient conventional ground wood mill. Power requirements are no greater than those for stone grinders and the system is flexible, for example a mill design to produce chem-mechanical pulp from hard wood can, without change, be used for soft wood mechanical pulp, for semi-chemical pulp or for fully cooked fiber.

FIG. 6 illustrates in diagrammatic form an actual installation for the production of ground wood like pulp from chips, the apparatus and the procedure involved being essentially those of FIG. 2. Referring thereto, hard-woods, for example birch, beech and maple species are reduced to chip form and the chips stored in a bin 32. A suitable unloader removes chips from the bin to a belt conveyor 33 delivering to a chip metering hopper 34. The capacity of the latter is approximately equal to one "charge" of a pressure vessel 35 to which pass the chips from the hopper. Delivery of the chips to the metering hopper and the loading of the vessel 35 with-are automatic operations, the former under the control of quantity level indicating devices and the latter occurring in response to the unloading from the pressure vessel of a previous charge.

A charge from the hopper 34 substantially fills the vessel 35 with wood chips, after which a chemical liquor is added from a storage tank 36 until the contained chips are completely covered. The pressure within the vessel then is raised in a suitable manner to an impregnation value, as on the order of 100-150 p.s.i., and maintained for an interval of the order of fifteen to twenty minutes.

The non-absorbed chemical liquor is then returned to storage and the impregnated chips discharged from the vessel. The latter may be a quick acting operation effected under pressure, as by introducing air under pressure into the vessel while opening an outlet in the bottom thereof.

The use of sodium peroxide as the basis of the chemical liquor is thought to be broadly new in the chemical impregnating of woods. It supplies a softening influence upon the wood material and at the same time bleaches. The discoloration resulting from conventional impregnating liquors is avoided, as is the need for bleaching as an operation separate and distinct from impregnation. Sodium sulphite is a more effective softener, where this is necessary or desirable, and the liquor might also be a caustic solution or merely water. The chips as supplied to the pressure vessel are relatively smaller than conventional kraft or sulphite chips, and in the method as described are adequately generated by the liquors from tank 36 even though such liquors are unheated.

The impregnated chips are blown from the vessel 35 to a live bottom bin 37 which in effect retains the chips for a predetermined time to permit more thorough softening by the absorbed chemical. A continuous removal of chips from the bin 37 takes place, however, by way of a feed screw 38 delivering to a screw press 39. The latter, as previously noted, extracts spent liquor from the chips and also subjects them to an initial defibering.

From the press 39, the now visibly dry and partly defibered chips are conveyed by screw means 41 to a double disc refiner 42, material fed in excess to that which can be accepted by the refiner being returned to the live bottom bin 37. The chip material emerges from the refiner 42 in a more completely defibered condition and passes a second double disc refiner 43, with material fed in excess returned to the live bottom bin. The output of the second refiner is directed to a stock chest 44 where it is diluted to a consistency for pumping and then directed by means which may include a consistency reg-
ulator 45 to a screen 46. The rejects of the screen 46 are returned to the live bottom bin over a drain pan con-
voyer 47. The material accepted by the screen passes into a box 48 and then is pumped to series arranged centrifugal cleaners 49. Material rejected by the secondary cleaner 49 is sent to waste.

The pulp accepted by the cleaners may be considered to be in a finished form, although any one or all of its qualities of brightness, strength and freedom may be made greater by further processing. In the illustrated example of FIG. 6, the pulp accepted by the cleaners is delivered to and thickened on two Oliver vacuum deckers 51 and 52. The thickened pulp is raised by a bucket elevator 53 to a conveyor 54 which delivers it to a mixer 55. In the Cozier, which may be a single disc mill, the pulp material is mixed with a sodium hypochlorite bleach liquor. The chemically treated pulp drops into a tower 56 where it is permitted to remain for a period of one to one and a half hours while the bleaching action con-
tinues.

Whether the bleaching action is accomplished in a single stage, as shown, or in multiple stages, the resulting material flows by gravity to a vacuum thickener 57. The thickened, bleached stock is regulated as to consistency in a device 58 and pumped to and through a refiner 59. The outlet of the latter is closely controlled and regulated as desired, affecting final selected strength development and freedom reduction.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is suscept-
ible of modification in its form, proportions, detail con-
struction and arrangement of parts without departing from the principle involved or sacrificing any of its ad-
vantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise but one of several modes of putting the invention into effect, and the invention is therefore claimed in any of its forms or modifications within the legit-
imate and valid scope of the appended claims.

What is claimed is:

1. A method of making wood pulp including the steps of chipsipping the raw wood, defibering the wood chips by successive compressing and shearing action, impregnating the defibered chips with a chemical solution immediately as the compressing and shearing action is completed to further weaken the cohesive quality of the chip fibers, further defibering the defibered wood chips, screening the resultant material, returning the rejected material for fur-
ther defibering and passing acceptable material through a centrifugal cleaner.

2. A method of making wood pulp including the steps of chipsipping the raw wood, passing the chips through a press and applying successive compressing and shearing forces thereto to defiber the chips, spraying a softening chemical solution on the chips at the point of and at the time of release of the compressive force of the press and impreg-
inating the defibered chips thereby, further defiber-
ing the impregnated defibered chips, and screening and cleaning the resultant pulp product, unsatisfactory material being separated in the process.

3. A method of making wood pulp including the steps of producing chips from raw wood, feeding such chips through a press wherein successive compressing and shearing forces are applied to defiber the chips, impreg-
inating the defibered chips with a bleaching chemical as they emerge from the press draining the chips, pass-
ing the drained defibered chips through a refiner for fur-
ther defibering, and screening and cleaning the so-de-
A method of making wood pulp including the steps of producing chips from raw wood, defibering the chips in an attrition mill, introducing the defibered chips into a pressure chamber, adding an unheated chemical solution in the pressure chamber and raising the pressure therein to a value on the order of a hundred pounds per square inch, thereby impregnating the defibered chips with the chemical solution for softening and bleaching thereof, passing the impregnated material from the pressure chamber after a predetermined interval, draining the excess liquid therefrom, applying successive compressing and shearing forces to the defibered impregnated chips in a press, further defibering the material as it emerges from the press and screening and cleaning the so defibered material.

5. A method of making wood pulp including the steps of supplying wood chips to a continuously acting press, subjecting the chips to alternating shearing and squeezing operation in the press and defibering the chips thereby to cause the defibered chips to emerge from the press in a dry highly absorbent condition with additional fibers exposed, spraying the emerging defibered chips with a liquid chemical softening and bleaching solution and then subjecting the defibered impregnated chips to a further defibering and cleaning operation.

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