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PRODUCTION OF WOOD AND FIBER MASS

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Fig. 1.

Fig. 2.

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The present invention relates to a method and a device to decompose wood or waste-timber or waste like so as to obtain a fiber mass which, in a manner known per se, may be used in the production of plates or other bodies of different shapes. To make the plates sufficiently strong, it is necessary that the fibers constituting the finished mass are as long as possible, i.e., the wood must pass the disintegration process without the fibers being broken or torn to any considerable degree.

In hitherto known grinding mills used for this purpose it has been found that a plurality of roller sets are necessary to bring about an adequate decomposition. In this thorough grinding process the fibers are, however, destroyed thereby in turn the final product in the form of plates or the like will show a reduced mechanical resistivity.

To eliminate said inconvenience it has been previously proposed to introduce the wood in a pressure vessel and subject it to an explosive steam pressure whereupon the material is expelled out of the vessel and then allowed to explode. Said method certainly results in a mass containing long fibers but that necessary plant requires big capital outlays and a very circumstantial attention on account of the excessive pressures used.

The present invention has for its object to eliminate said incompatibilities and to bring about a simple and power-saving method. The invention is substantially characterized in that wood cut into small chips is introduced between two bodies of rotation, having frictional operative surfaces and being nearly tangent to each other along a generatrix. By a suitable mutual movement of said bodies, the material particles are then subjected to both normal and tangential forces resulting in a combined crushing and tearing of said particles.

According to an embodiment of the invention the one of two simultaneously rotating rollers in a roller set has a peripheral velocity which is at least seventy-five times greater than that of the other roller.

As a result of the extensive experimental researches, upon which the present invention is based, it has been found that in grinding, as it is usually carried out, the material is dragged in between the rollers at a too high speed to allow the material to be completely disintegrated. For this reason the grinding procedure must be repeated in a plurality of roller sets disposed behind each other which arrangement, however, has the inconvenience that, as above mentioned, the fibers are easily destroyed. If, on the other hand, the one roller is allowed, according to the invention, to operate as a feeding roller which only slowly introduces the material, and the converging operative surfaces of the rollers, there will be ample time to carry out the grinding process completely. When the material then passes outwards through the narrow gap between the rollers it is practically completely disintegrated and any further mechanical treatment is in most cases unnecessary. On account of the great difference between the peripheral velocities of the rollers, the particles in the operative zone are subjected to a powerful tearing action simultaneously with the crushing and the pressing action. By adjusting said actions in relation to each other in a suitable manner the unexpected result is obtained that the fibers pass between the rollers practically uninjured during a complete disintegration of the material. The most favourable ratio between the peripheral velocities of the rollers appears to fall between two hundred and three hundred.

It is preferred, although not necessary, that the operative surfaces of the rollers move in the same direction through the operative zone. If it is desired to regulate the output of the roller set this takes place in the most simple manner by varying the absolute values of the rotation speeds while maintaining substantially the same ratio between the peripheral velocities.

It has been found suitable to supply liquid, preferably water in abundant quantities to the operative zone in order to facilitate the treatment and to limit the temperature rise in the operative zone. The material mass is thereby brought to a thinly liquid state and stopping of the rollers by a wedging action of the material between the rollers is prevented. The water further acts as a lubricant which facilitates a grinding uninteresting for the fibers.

It may be suitable to supply the liquid in such quantities that a liquid level is formed between the rollers above the operative zone for which purpose closely fitting walls may be disposed at the roller ends. Thereby a suitable quantity of liquid mass may always remain standing in the operating zone.

Evidently the angle of engagement between the converging roller surfaces in the operative zone is of importance for the operation of the arrangement. If, by way of example, both rollers have
very large diameters the roller surfaces will evidently be nearly parallel in the operative zone which fact may result in a locking of the rollers by the material. If, on the other hand, the diameter of the rollers are too small the feeding in of the material becomes difficult. A practical rule in dimensioning the rollers is that the sum of the radii of the rollers should fall within the range of 0.5 to 1.5 meters. The rollers may then, of course, be of different sizes if only said value of the sum of the radii is observed. The distance between the centers of the rollers falls within said limits.

In selecting the rotation velocities of the rollers, it may be assumed that the roller having the highest speed has a peripheral velocity of ten to fifteen meters per second.

The invention is of course not restricted to the case of the rollers being cylindrical. It is also conceivable that the rollers may advantageously be made conical or in the shape of any other body of rotation. Also the one roller may be adapted to cooperate with the inside of a larger hollow roller without receding from the idea of the invention.

The invention is illustrated in the accompanying drawing, showing a machine according to the invention for the decomposition of wood. Figure 1 shows the arrangement in vertical section. Figure 2 shows a disintegrating set from above.

The roller set shown in Figure 1 comprises two substantially cylindrical rollers 3, 4 rotatably disposed on horizontal, mutually parallel shafts 1, 2 and preferably made of stone, such as granite. The cylindrical surface of said rollers is preferably rough so that it offers a powerful frictional engagement for the material to be treated by the rollers. The rollers may of course also be made of steel or other material. They are adapted to be driven by, for example, by means of pulleys 5, 6 disposed on the shaft so that they rotate in the directions indicated by the arrows in Figure 1, the peripheral velocities being then so selected that the portions of the operative surfaces facing each other displace in tangential direction in relation to each other, the roller 3 then preferably rotating with a higher peripheral velocity than the roller 4. If the rollers have nearly the same diameter, by way of example 1.2 meters, the rollers 3 may, by way of example, rotate with a velocity of 300 revolutions per minute and the roller 4 with a velocity of one to 1.5 revolutions per minute. The minimum distance between the peripheral surfaces of the rollers may be quite insignificant and may, by way of example, be one or two millimeters.

The necessary water is supplied through a perforated pipe 11, disposed above the rollers. Adjacent to the ends of the rollers, plates 12, 13 are disposed which have for their purpose to dam up the water flowing from the pipe 11. Said water is preferably supplied in such quantities that a liquid level 14 remains standing between the rollers.

The material to be treated is supplied to the rollers from a feeding funnel 9 through the intermediate portion of a belt conveyor 10 or the like so that the material is continuously fed in between the rollers, the rollers being then so arranged that the material falls down upon the roller 4 which rotates at a lower peripheral speed. Any kind of wood, waste timber or the like may be used if it can be ground, preferably in the shape of chips.

The material thus introduced between the rollers 3, 4 will on account of the rotation of the rollers be compressed between the rollers so that it is brought into a powerful frictional engagement with the operative surfaces of the rollers. The material particles will then, on account of the different peripheral velocities of the rollers, be subjected to the normal and tangential forces which results in that the particles, on the one hand, are crushed and, on the other, torn by shearing action. It has been found that said treatment produces a mass which to a considerable extent contains comparatively long fibers.

It has further been found that the mass is not allowed to pack together in the wedge-shaped interspace between the rollers as would be the case if the material were supplied to the decompositon set from a feeding funnel disposed immediately above the rollers. According to the invention, the material is thus supplied to the rollers by means of a conveyer the velocity of which is adjusted in relation to the peripheral velocities of the rollers so that during continuous operation only a small, substantially constant quantity of material is lying between the rollers.

An improved efficiency may be obtained by giving the one or both rollers an axial reciprocating motion in such a manner that the operative surfaces of the rollers displace axially in relation to each other, simultaneously with their rotation. Such an arrangement is shown in Figure 2. According to this embodiment, the shaft 10 is provided with a tooth wheel 15 which engages another pinion 17 disposed on the shaft 16 which latter over conical tooth wheels 18, 19 drives a shaft 21 provided with an axially disposed stud 20. Upon the rotation of the shaft the stud 20 will transmit a reciprocating motion to the shaft 2 through the intermediate of a connecting rod 22. The amplitude of the axial motion may vary and may be, by way of example, 25 millimeters.

I claim:

1. A method in producing fiber mass, comprising the steps of rotating a feeding roll, simultaneously rotating a tearing and crushing roll at a peripheral speed on the times greater than that of the feeding roll, supplying water to the space between the rolls to form a liquid surface freely communicating with the atmosphere and confined by the roll sides, freely introducing wood chips into said space to form a liquid mixture, and letting the wateray wood chips contact with the feeding roll and be brought thereby into the bite between the two rolls.

2. A method in producing fiber mass, comprising the steps of rotating a feeding roll, simultaneously rotating a tearing and crushing roll at a peripheral speed more than twenty-five times greater than that of the feeding roll, supplying water to the space between the rolls to form a liquid surface freely communicating with the atmosphere and confined by the roll sides, freely introducing wood chips into said space to form a liquid mixture, and letting the wateray wood chips contact with the feeding roll and be brought thereby into the bite between the two rolls.

3. A method in producing fiber mass, comprising the steps of rotating a feeding roll, simultaneously rotating a tearing and crushing roll at a peripheral speed on the times greater than and less than three hundred times greater than that of the feeding roll, supplying water to the space between the rolls to form a liquid surface
freely communicating with the atmosphere and confined by the roll sides, freely introducing wood chips into said space to form together with the water therein a freely movable liquid mixture and letting the watery wood chips contact with the feeding roll and be brought thereby into the bite between the two rolls.

4. A method in producing fiber mass, comprising the steps of rotating a feeding roll, simultaneously rotating a tearing and crushing roll at a peripheral speed more than two hundred times and less than three hundred times greater than that of the feeding roll, supplying water to the space between the rolls to form a liquid surface freely communicating with the atmosphere and confined by the roll sides dropping non-treated wood chips to said feeding roll to form together with the water in said space a freely movable liquid mixture and letting the watery wood chips contact with the feeding roll and be brought thereby into the bite between the two rolls.

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