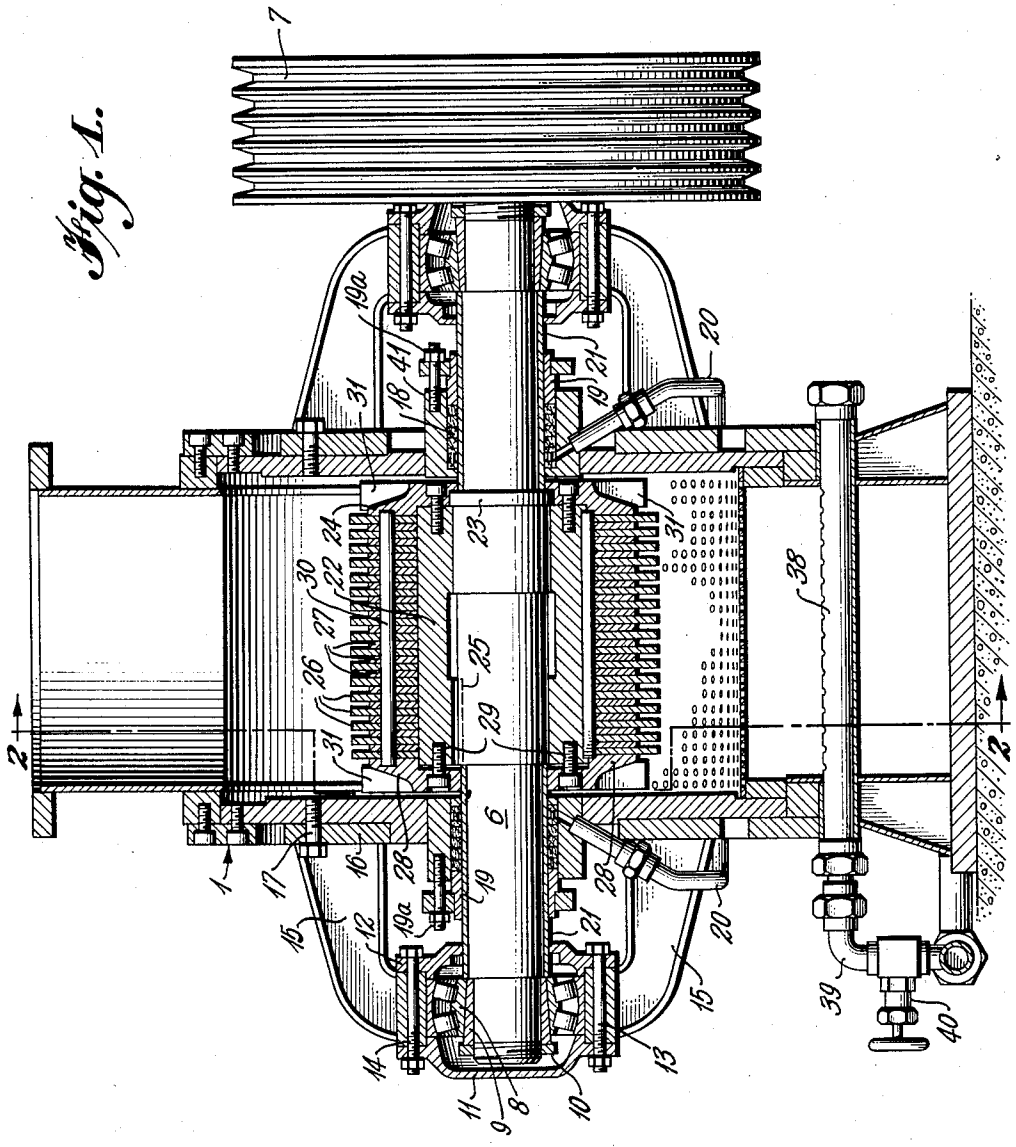
Nov. 24, 1959 O. A. HESTVIK ET AL 2,914,259

APPARATUS FOR DISINTEGRATION OF WOOD MATERIALS

Filed Dec. 26, 1956 3 Sheets-Sheet 1

Fig. 1.



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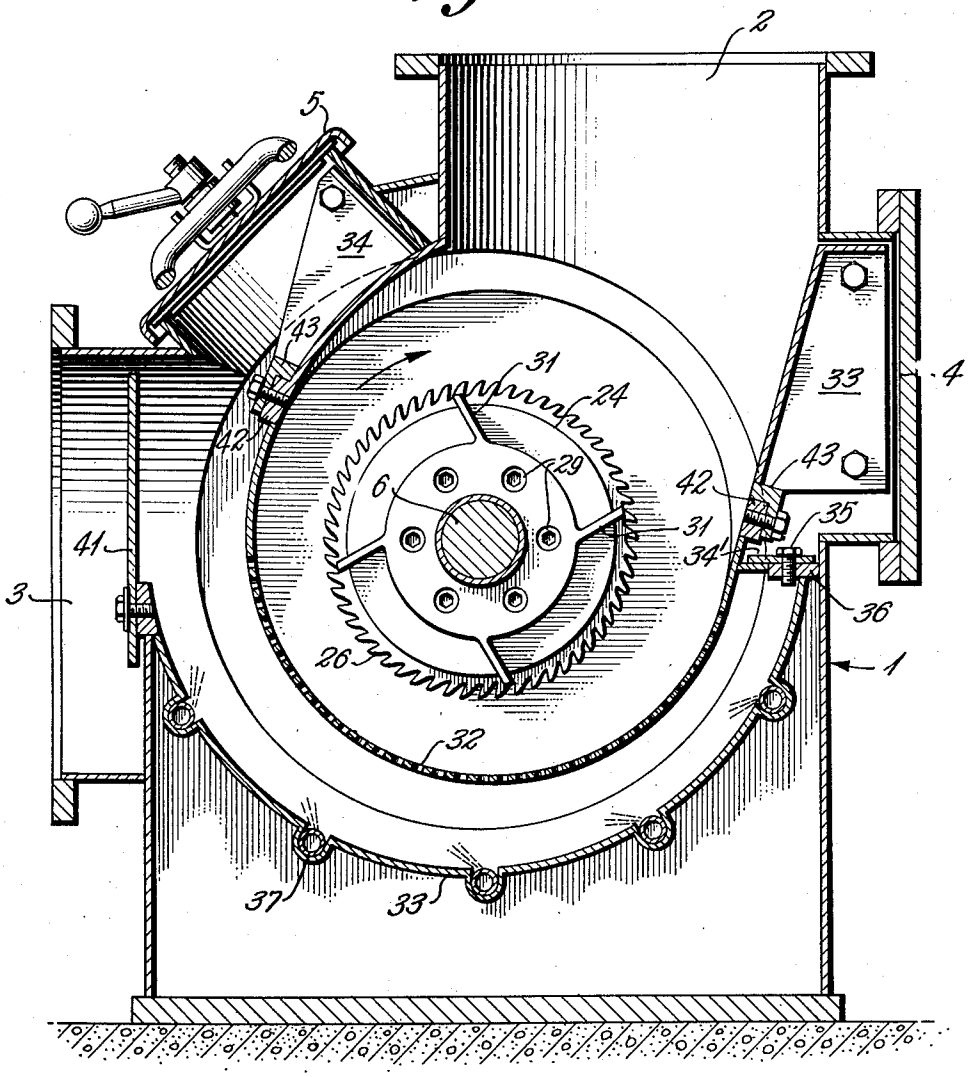
BY Stevens, Davis, Miller & Mosher
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Fig. 2.



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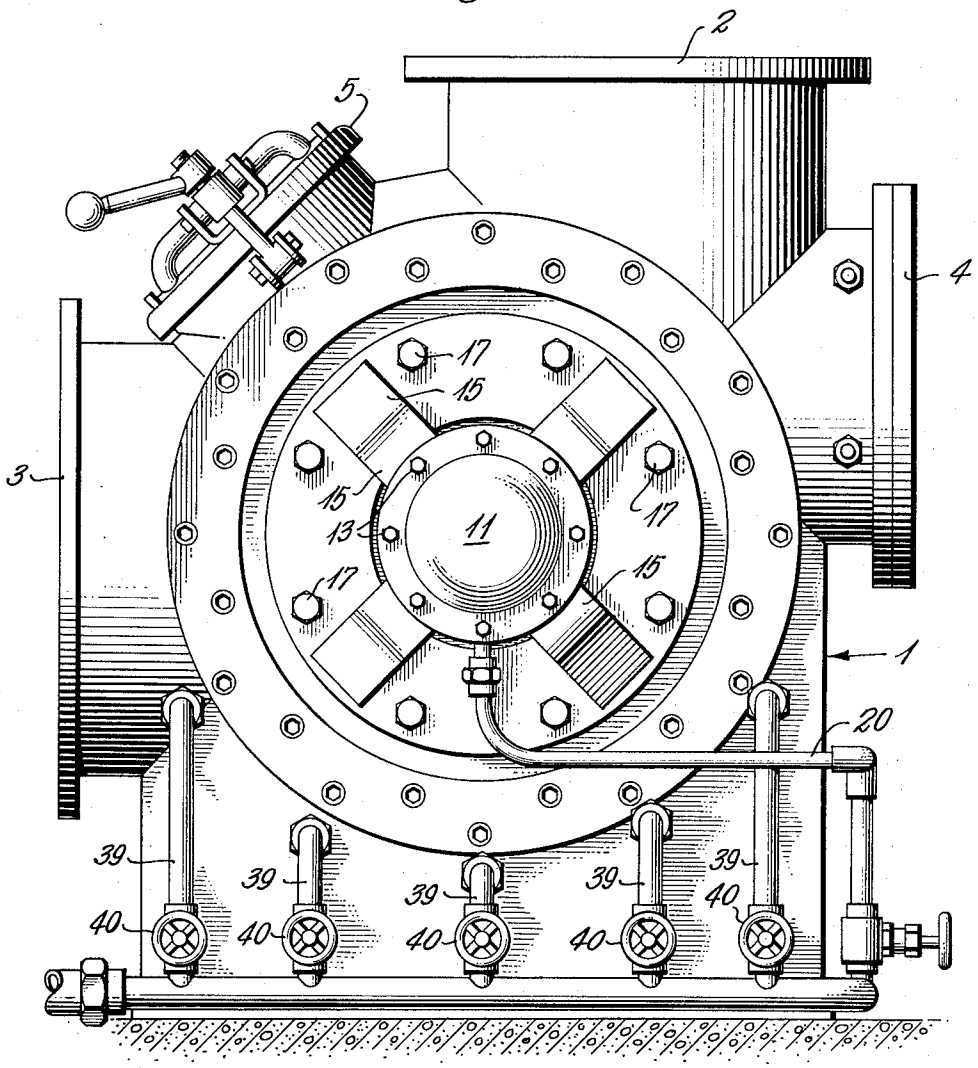
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APPARATUS FOR DISINTEGRATION OF WOOD MATERIALS

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Fig. 3.



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United States Patent Office 2,914,259
Patented Nov. 24, 1959

2,914,259

APPARATUS FOR DISINTEGRATION OF WOOD MATERIALS

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Application December 26, 1956, Serial No. 630,687

7 Claims. (Cl. 241—46)

This is a continuation-in-part of our application Serial No. 529,252, now abandoned, of August 18, 1955.

This invention relates to an improved method and apparatus for disintegration of wood and other lignocellulose-containing materials. By such materials, for instance, are principally meant coarse wastes from knife and friction disbarking of wood, wastes from cutting and planing of wood, screenings from sulphite, sulphate and semi-chemical processes, semichemical pulp and particularly screenings from stuff grinders.

At present large quantities of wood refuses, such as coarse screenings, bark and similar material, are not utilized in an economical way but are wasted and burnt in a very moist state. The mills (unravelling machines, finishing machines, refiners, roller mills etc.) used for disintegrating wood waste cannot treat other materials than rejects of a small particle size. A method of utilizing the splinters is to return them to the stuff grinder, but this step involves a very power-consuming process. Furthermore difficulties also appear when treating the wastes in the stuff grinder in that the load will vary according to the heterogeneous material which results in irregularities of the consistency of the pulp obtained. Charging the material into the stuff grinder will be accompanied with considerable difficulties compared with charging wood. In addition to this the stuff grinder is an expensive apparatus that when used in that way cannot be exploited to its full capacity and in a correct manner. The consumption of power also will be greater than that obtained in grinding wood owing to the varying and small grinding pressure.

Owing to said facts enormous economical values are now wasted. Only the coarsest splinters from the stuff grinders in a newspaper factory with an annual fabrication of 100,000 tons of paper represent a volume of about 5,000 m.^{3} annually.

The primary object of this invention is to provide a method as well as an apparatus for the production of a product from wood materials, such as coarse rejects or coarse screenings, which product may either be used in the form as obtained, if desired after a new screening step, or may be passed to a subsequent refiner for further treatment so as to have it converted into a pulp or further disintegrated product by means of other refiners such as disc refiners and conical refiners.

A second object of the invention is to provide a method as well as an apparatus, in which the disintegration of the materials of the above mentioned type can be carried out in a particularly economical way.

A third object is to provide a method as well as an apparatus, which are particularly economical in operation.

A fourth object is to provide a method as well as an apparatus, which can be operated during a considerable period of time without getting broken or requiring frequent substitution of movable or not movable parts.

A fifth object of the invention is to provide a method as well as an apparatus, which is not difficult to handle for inspection, cleaning or substitution of parts.

Previously there have appeared a number of suggestions to solve the problems above stated. None of these suggestions were, however, of such a kind as to be able to be used for the particular kind of wood materials, for which the present invention is intended, namely primarily coarse screenings and similar material. This depends on the fact that certain factors were not sufficiently considered, which have appeared to necessitate consideration in the construction of suitable apparatuses. It has previously been suggested to effect a disintegration of the coarse wood materials referred to by subjecting said wood materials to a treatment with saw teeth in a gap or passage provided in the space between a screen plate and a rotating toothed surface. This device and method could not be used because of the fact that it was impossible to operate the apparatus for any longer time without substituting the screen plate, since the latter was easily broken due to the crushing action effected in the gap by the coarser wood pieces. To avoid this drawback deriving from the crushing action of wood pieces the inventors understood that it was necessary to modify the construction and the operation of the screen plate in order to avoid the crushing action of the coarser pieces of the raw material.

The method for dispersing coarse rejects or screenings or similar cellulose-containing materials consists in that said material is subjected to a disintegration treatment carried out by rotating member rolling about an essentially horizontal shaft, the rotating surface of said member being toothed. A mixture of said material and water is introduced into a gap or passage between the rotating surface of the rotating member and a screen plate, which latter at least surrounds the lower part of said surface in spaced relationship to said surface, thus proving a gap or passage. The liquid level of the mixture in the apparatus is kept at such a height as to keep at least the whole rotating surface covered, as well as, the space between the rotating surface and the screen plate filled with aqueous medium, that is a suspension of wood fibres and fragments in water. Due to the action of the toothed rotating surface, as well as, impelling means arranged on the rotating shaft the mixture is subjected to circulation around said rotating surface as well as along the internal surface of the screen plate in the rotating direction of the rotating member whereby a further disintegration is effected due to the action of the teeth.

In the following the invention is to be described with reference to the enclosed drawings, on which Figure 1 is a sectional view in longitudinal direction through the device; Figure 2 is a cross-section according to line II—II of Figure 1. Figure 3 is a side-view of the device.

The apparatus comprises an external housing **1**. Said housing **1** is supported by a base plate, which is in turn arranged on a firm support. The housing is provided with an inlet **2** for charging the material to be treated. Said inlet is situated in the upper part of the apparatus. The housing is furthermore provided with an outlet **3** for discharged treated material. The external housing has moreover two inspection doors **4**, **5** respectively. Said doors are removable so that they may be rapidly removed, if an inspection is necessary or desirable to carry out.

The external housing described has two plane end walls, in which there are taken out holes or orifices for a rotatable shaft **6**. Said shaft **6** is driven by rope driving over a driving pulley **7**, to which power is transmitted from an electric motor (not shown). The pulley is attached to one end of the rotatable shaft **6**. Said rotatable shaft **6** is supported at its opposite ends by two

rolling bearings respectively, both of which are of a known construction. The inner running ring 8 of the rolling bearing is kept in position by means of a wedge-shaped or conical sleeve 9. Said sleeve 9 is in turn kept in position by means of stop ring 10, which is threaded onto the shaft 6. The whole bearing construction is housed by two bearing house parts 11, 12, which are kept together by bolts 13, 14.

Said bolts 13, 14 also keep the bearing house attached to two spiders or arm crosses 15, the ends of which are attached to a ring shaped plate 16, which is in turn moveably secured to the end walls of the external housing 1 by means of bolts 17. The support and bearing of the shaft has been described in detail with reference to the left side but it ought to be understood that corresponding support and bearing of the shaft also may be provided as to the other side of the shaft 6. The construction has appeared to be necessary to compensate the rather strong stresses, to which the shaft 6 is subjected in the operation of the whole disintegration apparatus. The shaft is passed through the openings of the end walls of the housing 1 and tightened at these places by means of pack boxes of known construction. To the end wall there is welded a sleeve 41, in which pack rings 18 are arranged. The pack rings 18 are pressed together and tighten against the shaft by means of the gland 19 and the pin bolt 19*a* with associated screw nut. The tightening is completed by introduction of liquid or water through a duct 20, which is passed through the pack box sleeve 41 and ends in the tightening space. The water supplied effects that materials cannot be driven or pressed out along the shaft at the tightening places. In order to protect the surface of the shaft from corrosion and abrasion at the parts which are in contact with liquid from the housing 1, there is provided a lining 21, which is fastened to the surface of shaft.

Within the housing 1 the rotatable shaft 6 has a rotating member 22 attached thereto. Said member is prevented from displacement on the shaft in that within said member there is a part 23 of the shaft which is turned out with a little larger diameter than the remaining part of the shaft, and the rotating member is pressed against said part 23 by means of a flange-like ring 24, which is prevented from displacement in a direction, which is opposite that of the rotating member by means of bolts which pass through holes in the flange-like ring 24 and are threaded onto the rotating member 22. The rotating member is secured by a wedge 25 to the shaft 6 so as to prevent slipping of said rotating member relative to said shaft.

On the rotating member there are mounted a great number of circular shaped blades 26 arranged in spaced relationship to each other by means of distance discs 27. Thereby spaces of some millimeters are provided between the saw blades, said spaces being of advantage in so far as due to said spaces the saw teeth can be kept clean or free from disintegrated materials in a more effective way. The saw blades 26 with the distance discs are kept pressed together by the flange-like rings 24, 28, the pressing action being effected by the bolts 29, which are threaded into the rotating member 22. In order to prevent mutual displacement of the saw blades relative to the distance discs six rods 30 are carried through by holes or orifices in said saw blades and distance discs, which rods 30 are prevented from displacement sidewardly by the flange-like rings 24, 28 with recesses arranged therein.

The flange-like rings 24, 28 have impeller-like wings or blades 31 attached thereto as integral parts, the purpose of which is to effect a vigorous agitation of the fibre suspension formed or the material mixture. The direction of the teeth of the saw blades 26 is preferably the same as the rotation direction of the rotating member. However, the direction of the saw teeth may also be opposite to the direction of the rotating member or the teeth may be triangular-shaped depending upon the properties of the wood materials to be disintegrated in said apparatus. Different kinds of saw blades may be used according to the properties of the materials. For coarse rejects or coarse screenings deriving from a wood grinder the tooth shape shown on the drawing in Figure 2 has appeared to be particularly suitable.

Partially surrounding the toothed surface of the rotating member and spaced relative to said member a screen plate 32 is provided, which is tightly secured at the internal surface of the end walls of the housing 1. The inlet 2 is elongated downwardly and is a little enlarged in cross-section. The enlarged part of the inlet 2 is supported by supporting means 33, 34, which are connected by bolts to the internal surface of the housing 1. The screen plate 32 is cylinder-shaped and is attached to the elongation of the inlet 2 by means of bolts, adjacent edges of said elements being reinforced by means of a rigid strip 42 secured to the screen plate 32 and a rigid strip 43, right angled in cross-section, secured to the elongation of the inlet. The screen plate is provided with holes or perforations arranged spaced relative each other, the distance between the holes or perforations as well as the diameter of the holes being chosen according to the materials to be treated for disintegration. In the device shown on the drawing the holes are of the diameter 10 millimeters and said holes are arranged at a space of about 50 millimeters. The toothed rotating surface and the internal surface of the screen plate define a passage or gap, which is rectangular-shaped in cross-section, the width of said cross-section being uniform so as to prevent or decrease any risk that the material to be disintegrated be subjected to any crushing action between the metallic surfaces of the rotating member and the screen plate. The width has to be as wide as to allow the material to be treated to circulate in liquid suspension in a zone around the toothed surface of the rotor.

The screen plate 32 is substantially or to a large part surrounded by a trough 33 semicircularly shaped in cross-section. Said trough 33 is tightly secured to the end walls of the housing for example by welding. The space between the external surface of the screen plate 32 and the internal surface of the trough 33 is confined towards the inspection door 4 by means of the tightening strip 34' which is attached by bolts 35 to a plate rod 36 welded to the internal surface of the housing. The upper edge of the trough 33 is welded to the firm plate rod 36. To the underside of the trough 33 there are a number of pockets 37 secured, which are open inwardly and serve to contain dispersion tubes 38 for water. The water is supplied from the ducts 39 with the control valve 40, and is spread out in such a direction as to increase or facilitate the transport of the treated material which passes through the screen plate 32, away from the space. At the upper edge of the open end of the trough 33 there is a controllable vertical overflow baffle 41 arranged, which is secured to the trough by means of bolts. This overflow baffle serves to keep the liquid level of the apparatus at such a level that the rotor is wholly or essentially wholly immersed in liquid aqueous suspension or mixture containing disintegrated wood.

By keeping the clearance between the screen plate 32 and the toothed rotation surface sufficiently wide, the advantage is effected that the water being in said passage or the gap will retard the movement of the material being treated in so far as the coarser particles will not beat against the screen plate to too large an extent.

The apparatus functions in such a manner that the material to be disintegrated or dispersed in water, i.a. coarse rejects, is charged through the inlet 2 of the external housing 1 with water. Due to the forcing action of the rotor and the saw blades as well as the wings there is effected a circulation of material mixture around the toothed surface of the rotor, in which the teeth tend to

cut the chips or the pieces and abrade fibres or smaller fragments away from the larger wood pieces. Said smaller fragments are sludged or dispersed in the circulating aqueous mixture. The holes or the orifices of the screen plate **32** are so placed as to allow said smaller fragments to pass through after having been dispersed or disintegrated to a certain desired particle size.

The particles passing through said orifices are collected in the trough **33**, and the sludge or the dispersion formed is discharged from said trough over the overflow baffle **41**, arriving in the container confined by the external housing, from which said sludge is discharged through the outlet **3**. As mentioned above it is of importance that the upper edge of the overflow baffle is at such a level as to allow the whole toothed rotating surface of being immersed in the aqueous mixture. Only by this measure the screen plate may be spared from the action of the coarse material treated in order to effect the desired disintegration. The action is thus not a friction treatment as involved in a pulp engine nor can it be characterized as grinding.

The gap or passage between the toothed rotating surface of the rotor or roller and the internal surface of the screen plate is shown on the drawing to have the same width in cross section from the point where the material is fed into the passage. It is to be understood that said width may also be varied. In such a case the rotor is provided with a means which allows displacement of the shaft with rotor sidewardly, e.g. to the right in Figure 2. Hereby the circulation speed of the fibrous dispersion may be varied along the rotation surface of the roller, which may be of value in certain cases.

The ratio of the radius of the circular shaped saw blades and the radius of the cylindrical part of the screen plate is about 1:1.5 in the apparatus shown on the drawing. It is, however, to be understood that other ratios may be used according to the special conditions in each particular case, such as 1:1.1, 1:1.2, 1:1.3, 1:1.4, 1:1.6. The speed of the rotating member is kept at 1450 r.p.m., but it ought to be understood that the one skilled in the art may use any suitable number of revolutions per minute depending on whether he desires a rapid disintegration to occur or a slow disintegration to be achieved. In the apparatus shown on the figure the average consumption of power when the apparatus was operated over a whole day was 34 H.P. for the production of 3 tons disintegrated product per day.

It can be mentioned that after a further slight treatment in a roll mill the disintegrated material passing through screen holes of about 10 millimeters in the apparatus described could be used for cardboard manufacturing without further treatment. This good result must be considered to be very surprising and represents a distinct progress not expected.

In the embodiment shown on the drawing and described above of the apparatus of the invention the rotating member is provided with spacers or spacing discs between the saw blades. This is, of course, not necessary, as on the other hand the teeth may extend continuously over the whole length of the rotating member. In the operation of the apparatus according to the invention the concentration may be kept at 0.3–0.6% of the discharged material suspension. However, it is to be understood that also other concentrations may be used, such as 1%, 1.5%, 1.7%, but preferably not more than 2.0%. The diameter of the rotating member is about 300 millimeters in the above mentioned case, but it ought to be understood that this figure is only an example of suitable dimension.

It is to be understood that the invention is not restricted to the embodiments described and shown on the drawings but may be varied within the scope of the following claims.

Having now particularly described and ascertained the nature of our said invention and in which manner the same is to be performed, we declare that what we claim is:

1. An apparatus for disintegration of coarse wastes of wood and similar lignocellulose containing materials while suspended in an aqueous medium comprising a perforated trough-shaped screen member, through which disintegrated material may pass together with the aqueous medium, walls enclosing both ends of said screen member, a toothed rotating member mounted on said end walls, the rotating toothed surface of which is spaced from said screen member, said screen member surrounding said rotating surface at least partially, a jacket surrounding said screen member and spaced therefrom, means for keeping the rotating member wholly immersed in liquid during operation and means attached to said rotating member to assist in subjecting the mixture of not disintegrated wood pieces and aqueous medium to a violent circulation around said toothed surface.

2. An apparatus as claimed in claim 1 in which said means for keeping the rotating member wholly immersed in liquid medium comprises an overflow baffle means for discharged mixture, the upper edge of which is at a substantially higher level than that of the upper part of the rotating member.

3. An apparatus as claimed in claim 2 in which the overflow baffle means is arranged as a part of the jacket surrounding the trough-shaped screen member.

4. An apparatus for disintegration of coarse wastes of wood and simlar lignocellulose containing materials while suspended in aqueous medium comprising a perforated trough-shaped screen member, through which disintegrated material together with the aqueous medium may pass, walls enclosing both ends of said screen member, a toothed rotating member mounted on said end walls, the rotating toothed surface of which is spaced from said screen member, said screen member surrounding said rotating surface at least partially, a jacket surrounding said screen member and spaced therefrom, means for keeping the rotating member wholly immersed in liquid during operation, said rotating member comprising toothed blades mounted radially to the axis of rotation and means attached to said rotating member at the ends of said rotating member near the end walls to assist in subjecting the mixture of wood pieces and aqueous medium to a violent circulation around said toothed surface.

5. An apparatus for disintegration of coarse wastes of wood and similar lignocellulose containing materials while suspended in aqueous medium comprising a perforated trough-shaped screen member, through which disintegrated material together with the aqueous medium may pass, walls enclosing both ends of said screen member, a toothed rotating member mounted on said end walls, the rotating toothed surface of which is spaced from said screen member, said screen member surrounding said rotating surface at least partially, a jacket surrounding said screen member and spaced therefrom, means for keeping the rotating member wholly immersed in liquid during operation, and means attached to said rotating member near the end walls to assist in subjecting the mixture of wood pieces and aqueous medium to a violent circulation around said toothed surface.

6. An apparatus for disintegration of coarse wastes of wood and similar lignocellulose-containing materials while suspended in an aqueous medium comprising a perforated trough-shaped screen member, through which disintegrated material may pass together with the aqueous medium, walls enclosing both ends of said screen member, a toothed rotating member mounted on said end walls, the rotating toothed surface of which is spaced from said screen member, said screen member surrounding said rotating surface at least partially, a jacket surrounding said screen member and spaced therefrom, means for keeping the rotating member wholly immersed in liquid during operation, and means attached to said rotating

member to assist in subjecting the mixture and undisintegrated wood and aqueous medium to a violent circulation around said toothed surface, said rotating member being composed of a plurality of toothed wheels arranged in spaced relationship to each other with respect to the longitudinal direction of the rotor so as to provide spaces between at least the toothed section of said wheels through which spaces disintegrated wood may pass during operation.

7. An apparatus as claimed in claim 6, in which said rotating member is composed of a plurality of toothed wheels arranged on a rotating shaft, said space being provided by distance wheels arranged between said toothed wheels.

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