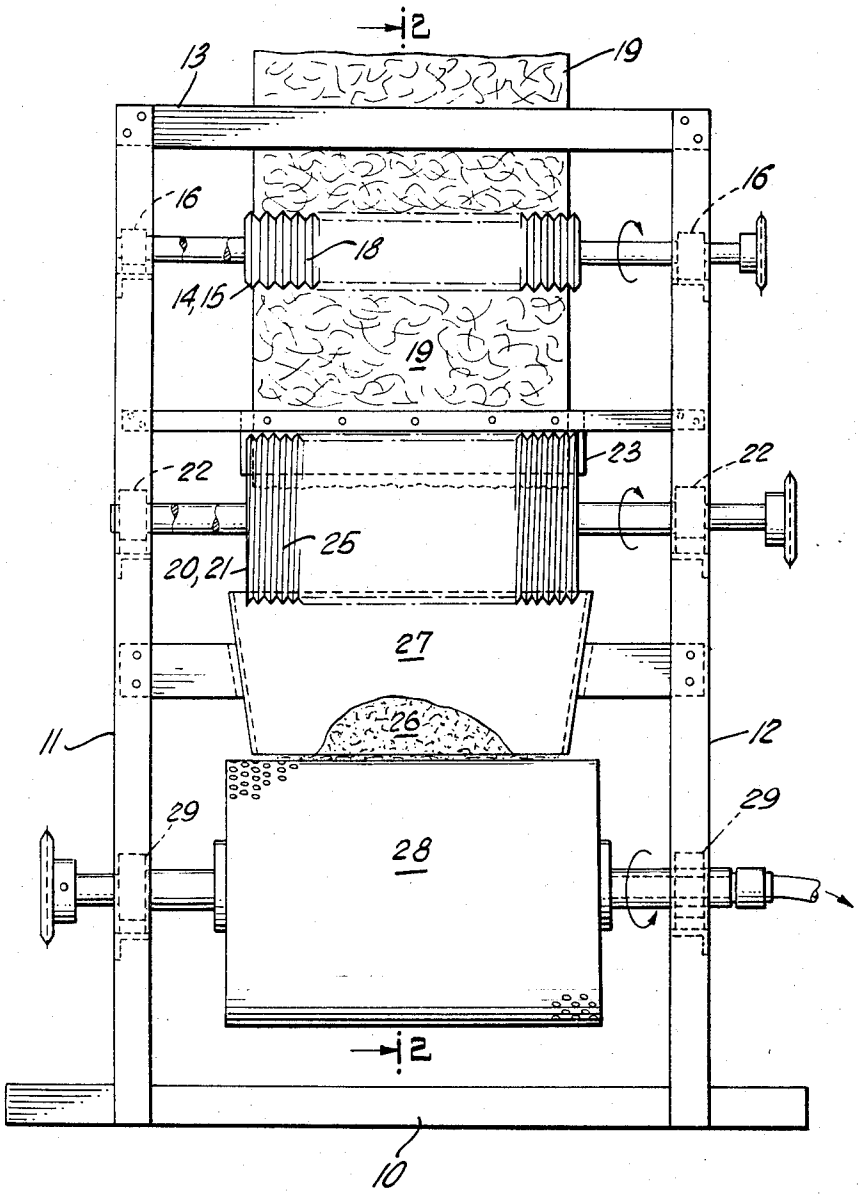
May 28, 1968 F. KALWAITES 3,385,531

METHOD AND APPARATUS FOR GRINDING AND DISTRIBUTING PULPBOARD

Filed June 2, 1965 2 Sheets-Sheet 1

Fig. 1.




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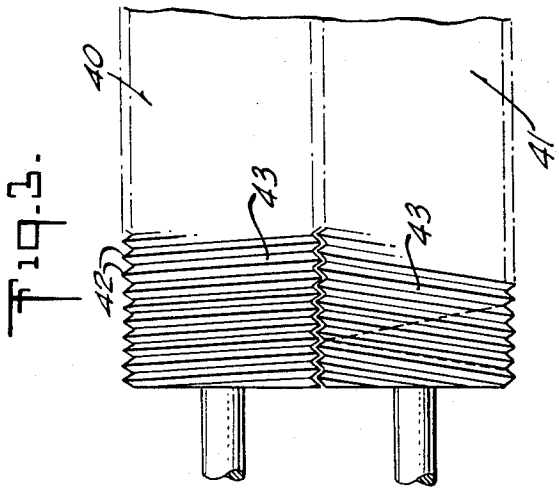



Fig. 3.

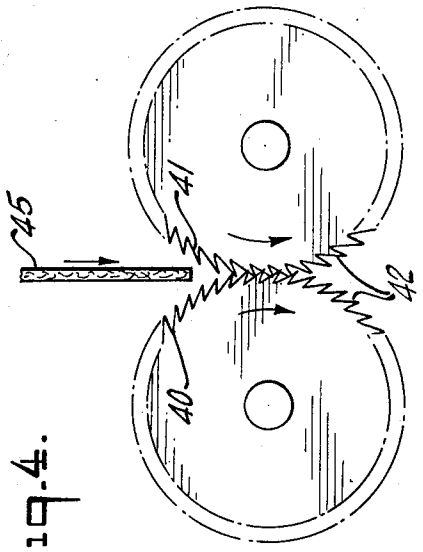



Fig. 4.

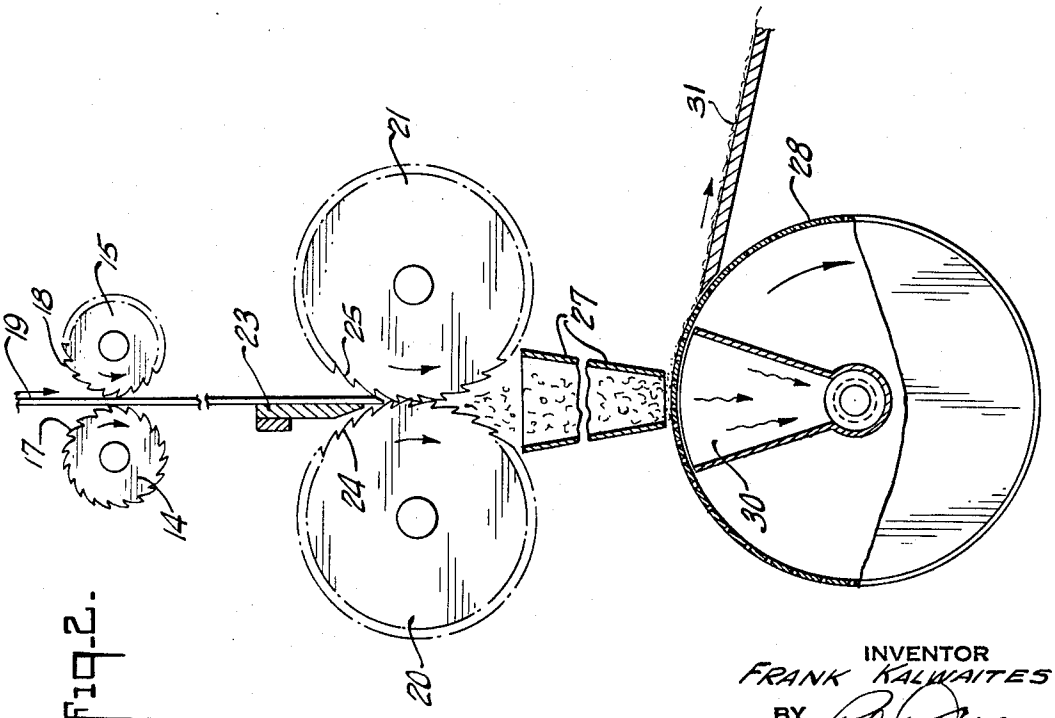



Fig. 2.

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3,385,531

# METHOD AND APPARATUS FOR GRINDING AND DISTRIBUTING PULPBOARD

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## ABSTRACT OF THE DISCLOSURE

Apparatus for grinding wood pulp comprising a pair of toothed rolls rotating in opposite directions and with their teeth intermeshing. The teeth of the rolls have a positive rake of at least 5 degrees. The maximum surface linear speed of either of the rolls being 10,000 feet per minute. Wood pulpboard fed to the nip of the toothed rolls is ground into individualized wood pulp fiber.

This invention relates to methods and apparatus for grinding and distributing pulpboard. More particularly, this invention relates to methods and apparatus for taking pressed wood pulpboard and shredding and disintegrating it into loose wood pulp fibers and then distributing and collecting these fibers in the form of a layer of loose wood pulp fibers.

Wood pulp fibers are a very low cost, highly efficient absorbent material. In many absorbent products the primary absorbing media is a layer of such wood pulp fibers. In making such layers it is important that the fibers be individualized, rather than in agglomerates and that they be uniformly distributed throughout the layer. Generally, these layers of wood pulp fibers are made from pressed pulpboard which is shredded or disintegrated into layers of individualized fibers. There are many different apparatus for shredding the pressed pulpboard; however, all of these apparatus having their shortcomings in that they do allow agglomerates of wood pulp to be formed and also distribution of pulp fibers is not uniform.

In the method and apparatus of the present invention the wood pulpboard is shredded and disintegrated and reduced to individualized fibers with extremely few agglomerates, and this is done in a uniform manner. Furthermore, these individualized fibers are uniformly distrubuted and collected in the form of a layer with said layer having substantially uniform density throughout its thickness and area making an efficient absorbent media.

In accordance with the present invention, pulpboard is ground and distributed by feeding the board to disintegrating means and applying a positive shredding action to the leading edge of the pulpboard while simultaneously applying a shearing action to the same leading edge. This combination of shredding and shearing action uniformly disintegrates the board into wood pulp fibers. The pulp fibers may then be placed in an air stream and collected on collecting means by separating the fibers from the air stream into the form of a layer of loose wood pulp fibers.

The pulpboard is ground and distributed by holding the pulpboard while feeding the leading edge to a pair of toothed rolls positioned in close proximity to the means for holding the pulpboard and only allowing the leading edge to slowly meet the toothed rolls. The teeth of the rolls intermesh and are closely spaced to apply both a grinding action and a shearing action to the leading edge of the plupboard. It is preferred that the teeth have a positive rake to aid the grinding and shredding action. The toothed rolls rotate in opposite directions and the



maximum speed of either of these rolls is approximately 10,000 feet per minute.

If desired, on the outlet side of these toothed rolls there is positioned a chute for directing the flow of the individualized fibers as they leave the toothed rolls. These individualized fibers are then collected in the form of a loose wood pulp fiber layer.

The invention will be further described in conjunction with the accompanying drawings wherein:

FIGURE 1 is an elevation of the machine embodying the present invention;

FIGURE 2 is a cross-sectional elevation of part of the machine taken along line 2—2 of FIGURE 1;

FIGURE 3 shows in detail a pair of toothed grinding rolls in top elevation;

FIGURE 4 shows in detail the toothed rolls in cross or side elevation.

Referring to the drawings, in FIGURES 1 and 2 there is shown an apparatus for carrying out the present invention. The apparatus comprises a bottom frame **10**, two sides frames **11** and **12** and a top frame **13**. Mounted at the top of the frames are a pair of feed rolls **14** and **15**. The feed rolls are mounted for rotation in bearings **16** mounted in the side frames. The feed rolls as shown have a dull toothed surface **17** and **18**; however, other surfaces may also be used such as a sand-blasted, knurled, or fluted surface or virtually any surface which will grip the wood pulpboard and prevent it from passing too quickly to the grinding rolls. The wood pulpboard **19** is fed to the nip of these feed rolls and through this nip to a pair of grinding or disintegrating rolls **20** an **21** mounted for rotation in bearings **22** mounted in the side frames. Mounted also from the frame and just above the nip of the grinding rolls is a feed plate **23**. This feed plate is positioned so as to force the wood pulpboard first onto one of the grinding rolls and let this grinding roll proceed to take the leading edge of the wood pulpboard into the nip of the grinding rolls. However, the feed plate may be eliminated or positioned to direct the pulpboard into the nip of the grinding rolls as desired. The grinding rolls have intermashing teeth **24** and **25** and grind and disintegrate the wood pulp into individualized fibers **26** which pass down a chute **27** onto a perforated drum **28**. The drum is mounted for rotation in bearings **29** mounted in the side frames. Within the drum, suction **30** is placed and air removed and the fibers allowed to collect on the surface of the drum which are conveyed away in the form of a loose layer **31** of wood pulp fibers. Various other collecting means may be substituted for the perforated drum, such as conveyor belts, or similar collecting mechanisms.

In FIGURES 3 and 4 there are shown enlarged views of suitable grinding and disintegrating rolls **40** and **41** for use in the apparatus shown in FIGURES 1 and 2. Each roll is covered over its entire surface with teeth **42**. The grinding rolls may have from about 8 teeth per square inch of surface area to about 250 teeth per square inch of surface area. The teeth of both rolls are aligned in rows **43** preferably at a slight angle which intermesh with each other so that the outermost point of the teeth of one roll almost touch the innermost surface area of the other roll. It is preferred that these teeth intermesh to at least one-half of their depth and preferably even more. However, the teeth may just intermesh or intermesh to the point where they almost touch the surface of the opposing roll. In so doing the intermeshing teeth not only shred the wood pulp **45**, which is fed directly to the nip of the rolls, by the direct action of a tooth but also shear the pulp between the intermeshing teeth of the two rolls and by this combined action prevent fiber agglomerations from passing through the grinding rolls. It is preferred that the teeth

of both rolls have a positive rake to impart shredding action to the wood pulp fiber as it is being fed to the grinding rolls. The positive rake shreds individual fibers from the pulpboard. A positive rake of approximately 5 degrees has been found most suitable; however, rakes from about a negative 45 degrees to about a positive 60 degrees are suitable in accordance with the present invention. The term "rake" means the angle the leading edge of the tooth makes with a line drawn from the center of the roll to the point of the tooth. If the leading edge is directed towards the trailing edge of the tooth, the rake is a positive rake and if the leading edge is directed away from the trailing edge of the tooth, the rake is a negative rake.

The rolls rotate in opposite directions as shown by the arrows and though they may rotate at the same speed, it is preferred that they rotate at different speeds. Ratio of speeds between the two rolls of from about 1:1 to 10:1 or even higher have been found suitable. It is important that neither of the rolls rotate at a greater surface linear speed than approximately 10,000 feet per minute. It has been found that higher speeds will scorch or burn the fibers and of course the lower speeds reduce the capacity of shredding or disintegrating.

When different speeds are used in the two grinding rolls, the rows of teeth must be wrapped on pitches in accordance with the speed ratio to provide for intermeshing at all times. For example the teeth on the faster roll may be wrapped on a pitch of one, that is, for one complete circle of teeth about the perimeter of the roll the teeth move across the width of the roll the distance between the center lines of adjacent teeth. If the other roll rotates at one quarter the speed of the faster roll the teeth on the slower roll are wrapped on a pitch of four, that is, for one complete circle of teeth about the perimeter of the roll the teeth move across the width of the roll the distance between the center lines of four teeth. The pitch on the rolls are disposed in opposite directions, i.e., one roll will have a right hand wrap and the other roll a left hand wrap. The angle wrap of the teeth virtually insures that no fiber agglomerations will pass between the grinding rolls and the relative pitches provide for intermeshing of teeth at all times.

In operation pressed pulpboard is fed by means of the feed rolls down past the feed plate and on to the surface of one of the grinding rolls. The feed rolls control the rate at which the pulpboard is fed to the grinding rolls. The intermeshing grinding rolls shred the leading edge of the pressed pulpboard while simultaneously placing shearing forces on this leading edge by means of the intermeshing teeth. The individualized wood pulp fibers are discharged from the outlet side of the grinding rolls passed through a chute to the collecting means. At the collecting means the air is separated from the wood pulp fibers, and the fibers collected in the form of a layer of loose wood pulp fibers.

The invention will be further illustrated in greater detail by the following specific examples. The percentages indicated are by weight unless specifically stated otherwise.

*Example I*

Alpha-M wood pulpboard approximately 10 inches wide and 1/32 inch thick is fed to apparatus similar to that shown in FIGURES 1 and 2 of the drawings. The pulpboard is fed by the feed rolls down past the feed plate to a pair of grinding rolls. The grinding rolls are 6 inches in diameter and are covered with metallic wire. Both rolls are wrapped at 10 threads per inch and have 90 teeth per square inch of surface area and the rolls are wrapped on the same pitch. The rolls rotate in opposite directions, and both rolls rotate at a surface linear speed of about 9,000 feet per minute. The teeth on both rolls have a 5 degree positive rake. The pulpboard is fed at a rate of approximately 15 feet per minute by the feed rolls so that approximately 130 pounds per hour of wood pulp fiber is produced. The individualized fibers pass down a chute and are collected on a rotating perforated drum in the form of a 16 inch wide layer of fibers which is continually removed from the perforated drum. The layer is of uniform density and contains no fiber agglomerates.

*Example II*

Natchez wood pulpboard approximately 10 inches wide and 1/32 inch thick is fed to apparatus similar to that shown in FIGURES 1 and 2 of the drawings with the feed plate **23** removed. The pulpboard is fed by the feed rolls to a pair of grinding rolls at a rate of 15 feet per minute. The grinding rolls are 6 inches in diameter and are covered with metallic wire. Both rolls are wrapped at 14 threads per inch and have approximately 150 teeth per square inch of surface area. One roll is wrapped on a pitch of one and the other roll is wrapped on a pitch of four. The rolls rotate in opposite directions. The roll wrapped on a pitch of one has a surface linear speed of about 6,000 feet per minute and the roll wrapped on a pitch of four has a surface linear speed of about 1,500 feet per minute. The teeth on both rolls have a negative rake of approximately 10 degrees. The apparatus grinds and shreds about 100 pounds per hour of pulpboard into wood pulp fibers which pass down a chute and are collected as described in Example I. The layer formed is of uniform density and contains no fiber agglomerates.

Although several specific examples of the inventive concept have been described, the same should not be construed as limited thereby nor to the specific embodiments shown, but to include various other equivalent embodiments as set forth in the claims appended hereto. It is understood that any suitable changes, modifications and variations may be made without departing from the spirit and scope of the invention.

It should also be understood that various standard parts have been omitted from the description and the drawings such as driving pulleys and belts, speed ratio mechanisms, frames, etc. These are all standard and are well known in the art and have only been omitted for purposes of clarity in both the drawings and the description.

What is claimed is:

**1.** Apparatus for grinding and distributing wood pulp comprising: feed means for holding and feeding wood pulpboard, a pair of toothed rolls positioned in close proximity to said feed means, each roll having from about 8 teeth to about 250 teeth per square inch of surface area, the teeth of said rolls intermeshing, said teeth having a positive rake of at least 5 degrees, said toothed rolls rotating in opposite directions, the maximum surface linear speed of either roll being about 10,000 feet per minute for individualizing wood pulp fiber from said pulpboard.

**2.** Apparatus for grinding and distributing wood pulp comprising: feed means for holding and feeding wood pulpboard, a pair of toothed rolls positioned in close proximity to said feed means, each roll having about 8 teeth to about 250 teeth per square inch of surface area, the teeth of said rolls intermeshing at least to ½ their depth, said teeth having a positive rake of at least 5 degrees, said toothed rolls rotating in opposite directions, the maximum surface linear speed of either roll being about 10,000 feet per minute for individualizing wood pulp fiber from said pulpboard.

**3.** Apparatus for grinding and distributing wood pulp comprising: feed means for holding and feeding wood pulpboard, a pair of toothed rolls positioned in close proximity to said feed means, each roll having about 8 teeth to about 250 teeth per square inch of surface area, the teeth of said rolls intermeshing at least to ½ their depth, said teeth having a positive rake of at least 5 degrees, said toothed rolls rotating in opposite directions and at a speed ratio of about 1:1 to about 10:1, the teeth of said rolls being wrapped on a pitch about the circumference of the roll, the pitch ration between said

rolls being the same as the speed ratio with the slower moving roll having the greater pitch, the pitch on one roll being disposed opposite the pitch on the other roll, the maximum surface linear speed of either roll being about 10,000 feet per minute for individualizing wood pulp fiber from said pulpboard, a chute positioned at the outlet side of said toothed rolls for directing the flow of the individualized fibers as they leave the toothed rolls and collecting means for collecting the fiber in the form of a layer of loose wood pulp fiber.

4. Apparatus for grinding and distributing wood pulp comprising: feed means for holding and feeding wood pulpboard, a pair of toothed rolls positioned in close proximity to said feed means, the teeth of said rolls being wrapped on a pitch about the circumference of the roll, the pitch on one roll being disposed opposite the pitch on the other roll, each roll having about 8 teeth to about 250 teeth per square inch of surface area, the teeth of said rolls intermeshing, said teeth having a positive rake of at least 5 degrees, said toothed rolls rotating in opposite directions, the maximum surface linear speed of either roll being about 10,000 feet per minute for individualizing wood pulp fiber from said pulpboard.

5. Apparatus for grinding and distributing wood pulp comprising: feed means for holding and feeding wood pulpboard, a pair of toothed rolls positioned in close proximity to said feed means, the teeth of said rolls intermeshing, said teeth having a positive rake of at least 5 degrees, said toothed rolls rotating in opposite directions, the teeth of said rolls being wrapped on a pitch about the circumference of the roll, the pitch ration between said rolls being the same as said speed ratio with the slower moving roll having the greater pitch, the pitch on one roll being disposed opposite the pitch on the other roll, the maximum surface linear speed of either roll being about 10,000 feet per minute for individualizing wood pulp fiber from said pulpboard.

6. Apparatus for grinding and distributing wood pulp comprising: feed means for holding and feeding wood pulpboard, a pair of toothed rolls positioned in close proximity to said feed means, each roll having about 8 teeth to about 250 teeth per square inch of surface area, the teeth of said rolls intermeshing at least to ½ their depth, said teeth having a positive rake of at least 5 degrees, said toothed rolls rotating in opposite directions and at a speed ratio of about 1:1 to about 10:1, the maximum surface linear speed of either roll being about 10,000 feet per minute for individualizing wood pulp fiber from said pulpboard, a chute positioned at the outlet side of said toothed rolls for directing the flow of the individualized fibers as they leave the toothed rolls and collecting means for collecting the fiber in the form of a layer of loose wood pulp fiber.

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