Nov. 11, 1952 W. K. KOLB ET AL 2,617,334

PULPER FOR PAPER STOCK

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Fig. 1.

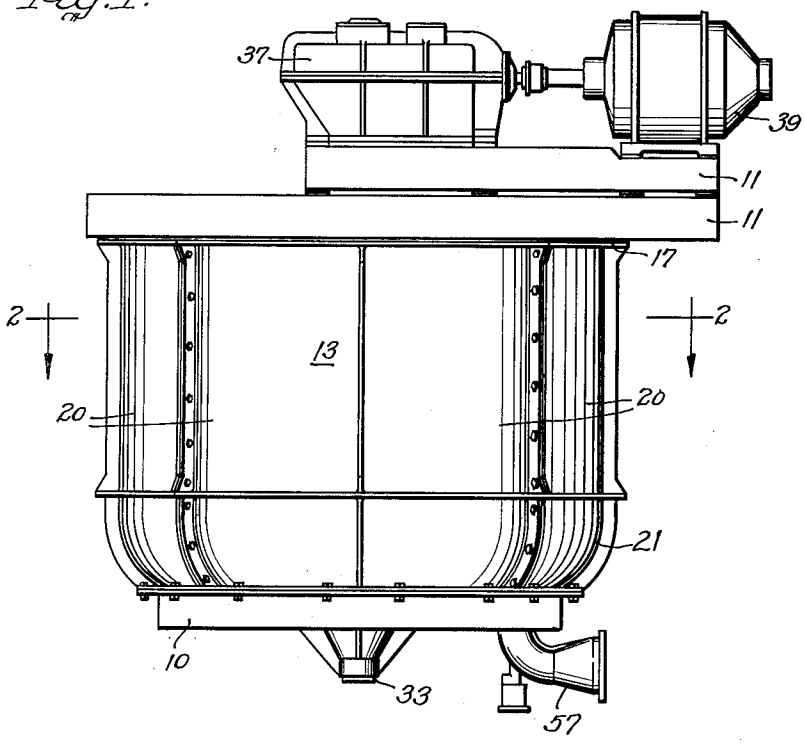
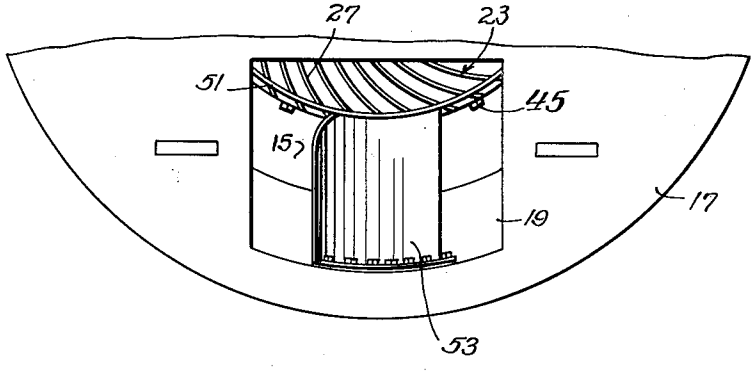



Fig. 5.




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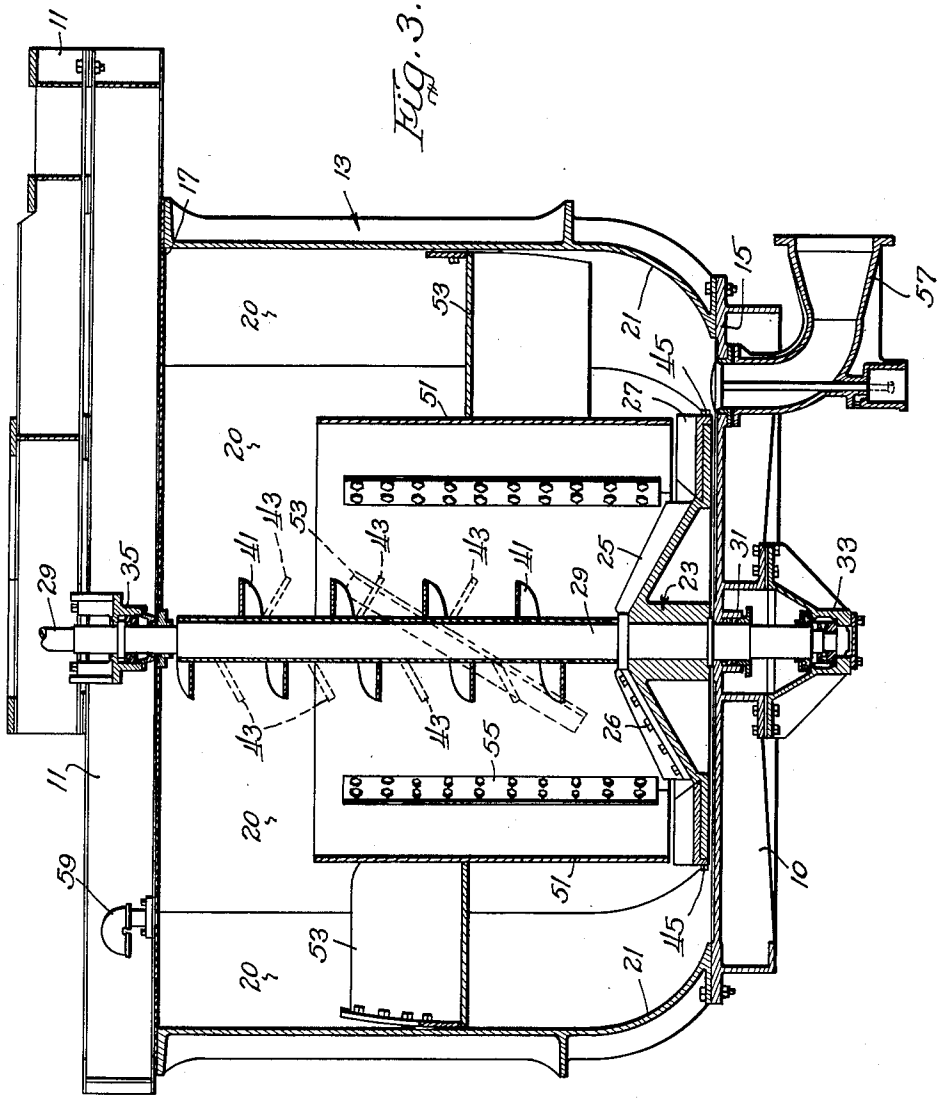
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Fig. 3.




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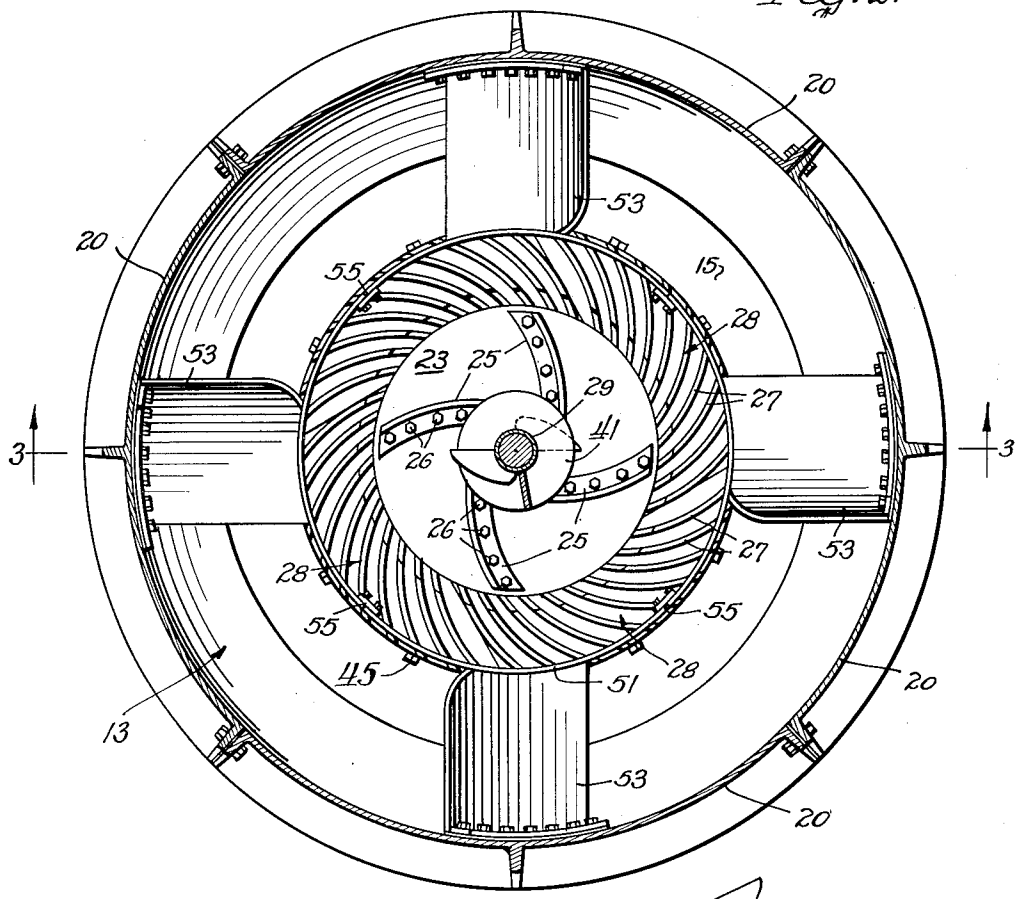
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PULPER FOR PAPER STOCK

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Fig. 2.



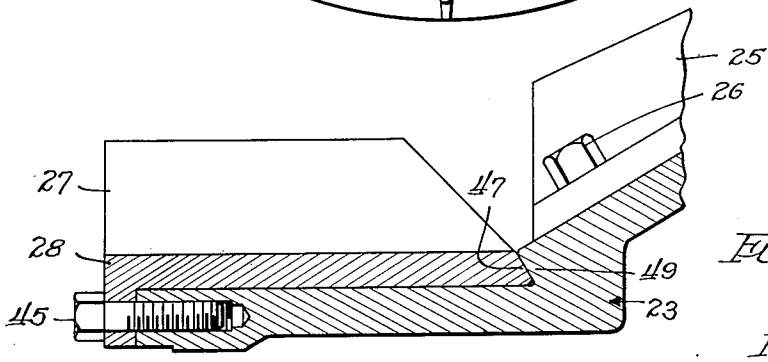




Fig. 4.

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# UNITED STATES PATENT OFFICE

2,617,334

## PULPER FOR PAPER STOCK

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Application April 19, 1947, Serial No. 742,648

2 Claims. (Cl. 92—26)

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The present invention relates to a pulper for paper stock.

In papermaking, a pulper is used to accomplish the preliminary breaking-up of pulp stocks or broke, so as to effect the mechanical separation and suspension of the fibers before they are put into the beater for intermediate or final refining. A pulper, in contrast to a beater, desirably accomplishes mere breaking-up or the mechanical separation of the cellulosic fibers, while a beater besides separating the fibers, subjects them to a rubbing and shearing action. This rubbing and shearing action results in the production of hydrated or partially hydrated cellulosic fibers which may be of substantially equal lengths, and which tend to curl so as to form a paper having good felting qualities when deposited on the wire of the Fourdrinier papermaking machine.

The degree of hydration of the cellulosic fibers is very important in controlling the "freeness" of the final sheet. To obtain uniform hydration, it is desirable to effect the primary separation of the fibers rapidly in a pulper, which minimizes local hydration and results in fewer control difficulties in the beating step.

Heretofore, several types of pulpers have been devised, but, so far as we know, none has proven entirely satisfactory, due, it is believed, to the failure of these devices to provide means for positively controlling the circulation of the stock in the pulper, so as to effect rapid and uniform separation of the fibers. The provision of pulping apparatus wherein the circulation of the stock is positively controlled during the pulping operation is, therefore, the principal object of the present invention. The pulper of the present invention is, in certain of its features, a modification of the Seaborne beater which is fully described in U. S. Patents Nos. 1,691,308 and 2,129,789, and during its operation produces a very uniform furnish, which is adapted to be fed to a beater or other refining machine or, in some instances, even directly to a papermaking machine. Other objects and advantages of the invention will be apparent by reference to the following description and the accompanying drawings of one preferred embodiment of the invention.

In the drawings:

Fig. 1 is a side elevational view of a pulper embodying the features of my invention;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken on line 3—3 in Fig. 2;

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Fig. 4 is a fragmentary, elevational view, partially in section, showing a preferred method of mounting knife blades on the rotor which constitutes a part of the apparatus illustrated in the other figures of the drawings; and

Fig. 5 is a fragmentary, plan view of the cover section of the pulper showing the pulp feeding opening.

The pulper illustrated in the drawings generally comprises a supporting frame, a large, closed container or tank, which is supported on the frame, rotor means for circulating and breaking up the pulp stock, and includes baffles and a feed screw means for positively controlling the recirculation of the pulp stock so as to insure numerous contacts of undisintegrated pulp with the rotor.

The supporting frame 10 includes a number of rigid structural members which are fastened together by welding, riveting, or the like. The frame 10 supports a closed tank or container 13, which is generally cylindrical in shape. The bottom of the tank 13 is permanently closed by means of a metallic plate 15, as is the top by a similar plate 17 having a pulp charging opening 19 which is desirably of large enough size to give access to the interior of the apparatus for cleaning and maintenance operations. The tank 13 may be made, as shown in the drawings, from fabricated steel sections 20 which are bolted together, or may be constructed from concrete, tile, castings, or any of the other materials that are commonly used in the paper art. The bottom corners of the tank are suitably well-rounded, as shown in the drawings at 21, so as to prevent excessive friction losses as the stock is circulated in the tank.

A rotor 23, having a plurality of impeller blades 25 and pulping knife blades 27, is supported for free rotation on a vertically extending shaft 29. The shaft 29 extends through a suitable packing gland 31 at the base of the tank 13, and is supported at its lower end by a suitable thrust bearing 33 attached to the supporting frame 10. The upper end of the shaft 29 is journaled in a suitable bearing 35 supported upon an upper frame 11 above the cover 17 of the tank 13. The upper end of the shaft 29 is extended so as to be operatively connected to a gear box 37, which is adapted to be powered from a suitable source, such as the electric motor shown at 39.

The section of the shaft 29 which is intermediate the rotor 23 and the cover plate 17 includes a worm conveyor section 41, which is adapted to force material, upon rotation, downwardly into

contact with the rotor 23. The shaft may also be provided with a series of breaker bars 43 which, when the shaft 29 is rotated, tend to break up large masses of pulp material. The breaker bars 43 may not conveniently be used with materials which contain an appreciable amount of string, wire, etc., as they present projections upon which such materials may wind.

The rotor 23 is of generally convex, plate-disc shape, as is shown in the drawings. A plurality of impeller blades 25 are attached to the raised central portion of the rotor 23 by means of bolts 26 or other suitable connecting means. Four impeller blades 25 are illustrated, but any number may be used if they are evenly arranged so that a dynamically-balanced structure results. The impeller blades 25 are back-curved, as illustrated, to increase the radial thrust which is exerted on the paper stock, thus improving the positive recirculation. A plurality of pulping knife blades 27 are evenly placed around the periphery of the depressed portion of the rotor 23 so as to provide a balanced unit. The rotor 23 is of substantially smaller diameter than the outer tank 13.

A convenient method of mounting the knife blades 27 is shown in Figs. 3 and 4, where segments 28 having generally concentric arcuate edges and each containing a plurality of knives are attached to the rotor 23 by means of machine screws 45. This attaching means provides for easy removal of the segments 28 when sharpening and replacement is necessary. In order to insure a rigid knife structure, the inner edges of the segments 28 are machined, as shown in the drawings at 47, so as to be fitted into an undercut groove 49 which extends around the rotor structure. In order to increase the radial thrust on the stock, the knife blades 27 are back-curved in a manner similar to the impeller blades 25.

The baffle means, used to provide positive control of the recirculation of the paper stock, includes a vertically extending cylindrical baffle or draft tube 51, which is supported from the walls of the tank 13 by means of a plurality of director vanes or flow control baffles 53. The diameter of the cylindrical draft tube 51 is equal to, or slightly smaller than, the diameter of the rotor 23. The knife blades 27 which extend to the rim of the rotor 23 desirably extend slightly beyond the outer defining surface of the draft tube 51; this is of some importance in obtaining the maximum possible flow rate of the material being pulped. The draft tube 51 may be fabricated from heavy, steel plate or suitable material and the sections are preferably joined on the inner side by reinforcing members 55 which serve an added function as abrading members. The baffle cylinder 51 is supported in close proximity with the upper edge of the knife blades 27 by the flow control vanes 53. The clearance between the knife blades 27 and the lower edge of the cylinder 51 may be adjustable; it is desirably set at about $\frac{1}{8}$ of an inch for ordinary kraft pulp lap and kraft broke, when working at normal concentrations. The lower edge of the draft tube 51 is desirably smooth surfaced so as to minimize the hydration of the broken up pulp and to also reduce the shearing action in the area between the tube 51 and the pulping knives 27.

The flow control baffles or vanes 53 are fabricated from suitable sheet steel, and are of relatively massive construction in order that they may be strong enough to support the draft tube 51. It is desirable that the vanes 53 shall not have any projections which may impede the free circulation of the paper stock. In the illustrated apparatus, the baffles 53 are inclined about 30 to 45 degrees from the vertical, in the direction of rotation of the rotor 23. Maximum efficiency of the flow directing baffles 53 is interrelated with the concentration of the paper stock. Our investigations have shown that the less concentrated the furnish, the greater should be the variation of the angle from the vertical. However, under widely varying conditions, a thirty-degree inclined vane is a good average structure; but, if the machine is required to constantly pulp either extremely attenuated or extremely concentrated paper stocks, these conditions should be allowed for in the installation of the machine. Even vertical vanes can be used advantageously in certain instances, as where high furnish concentrations are encountered.

In order to facilitate quick dumping of the pulped stock, a quick acting valve is provided in the bottom of the tank, as is illustrated at 57. It is also desired that a suitable source of water be provided so that the tank may be rapidly charged on initial operation, and the concentration of the paper stock may be easily controlled. A vent pipe 59 should be provided to eliminate the possibility of an air lock when rapidly dumping the stock.

In a particularly satisfactory embodiment of the invention, designed for pulping hard kraft stock in batches of 2,000 pounds at a concentration of 5.6 percent, the rotor has a diameter of 76 inches and is rotated in a tank 11 feet in diameter. The rotor carries 40 evenly spaced knives about 3½ inches high, and the clearance between the top of the knives and the lower surface of the draft tube is about $\frac{1}{16}$ of an inch. The worm conveyor in this machine has a diameter of about 16 inches and a length of 78 inches. The depth of the tank is approximately 96 inches, and the draft tube is 75 inches in diameter, and is positioned with its lower end about 7 inches from the bottom of the tank. The draft tube in this structure is supported by four flow directing vanes substantially as illustrated in the drawings.

During operation, the tank 13 is filled with water to the level of about the top of the cylindrical draft tube 51. The drive motor 39 is energized and the rotor 23 is turned until a speed of about 100 R. P. M. is reached. Due to the pressure differential created by the rotor 23, the water within the draft tube 51 will drop and that in the annular space between the outer tank and the tube will tend to move slowly in the direction of rotation of the rotor structure 23. The water is guided, however, along an upward and somewhat spiral path by means of the flow control baffles 53 which are disposed so as to cause the rotating motion of the mass of liquid to be resolved into a vertical component which adds to the pressure differential created by the rotor.

The charge is dumped into the pulper through the charging opening 19 in the top covering 17 of the tank 13, and is carried by the flowing liquid into the cylindrical draft tube or baffle 51. The bundles of pulp laps, etc. are forced onto the rotor 23 and also broken up by action of the vertical worm conveyor 41 and the breaker bars 43 if they are used. The impeller blades 25 force the material outwardly until it is engaged by the draft tube 51 and the knife blades 27 which tear apart the large pieces until they are small

enough to be forced through the space between the rapidly rotating knife blades **27**. The resulting circulating effect produced by the cooperating action of the draft tube **51** and the flow directing baffles **53**, as previously described, causes the particles which have been broken up to rise with the liquid, to go over the top of the draft tube **51**, downwardly through the tube, and to again pass through the area of the rotor. The rotor thus acts both as a disintegrating means and as a pump.

In a trial installation of the previously described pulper, wherein the rotor was rotated at a speed of about 100 R. P. M., the hard pulp laps were fed into the tank at a rate of about 600 pounds per minute, without overloading the machine. The pulping operation to produce a 5.6 percent paper stock required only about 12 minutes at the same speed.

The worm conveyor aids materially in effecting the submergence of the larger, unpulped portions of the lap or other material which is charged into the apparatus, with resultant decrease in the time required to effect complete pulping. This is especially true when pulping at stock concentrations of about 5 percent or over, in which range most of the present pulpers become inefficient, apparently due to poor circulation of the paper stock. The breaker bars, when their use is possible, are also of value in increasing the efficiency of operation of the pulper by decreasing the time required for complete pulping of the charge.

The features of the invention that are believed to be new are expressly set forth in the appended claims.

We claim:

1. In a machine for pulping paper stock, a tank, a vertically disposed, cylindrical draft tube, which is fabricated of rigid plate material and which has a smooth bottom edge, supported in a central position within said tank by means of a plurality of generally vertically extending, radially disposed, spaced-apart, plate members, which extend across the space between the tank and the draft tube, said plate members also serving as baffles for controlling the flow of material being pulped in said machine in the space between said draft tube and said tank, a disc-shaped rotor disposed within said tank and supported for rotation in a generally horizontal plane at the lower end of said draft tube, said rotor having a plurality of generally radially extending pulping knives supported on the upper surface thereof, said knives having inner portions aligned with the space enclosed by said tube and outer portions in position to cooperate with the bottom edge of said draft tube, and means for rotating said rotor.



2. In a machine for pulping paper stock, a tank, a vertically extending, cylindrical draft tube, which is fabricated of rigid plate material and which has a smooth surface on the lower edge, supported centrally within said tank, a plurality of equally spaced, generally vertically extending flow control baffles disposed in the space between said draft tube and said tank, a rotatably supported, vertically extending worm conveyor disposed within said draft tube, a rotor having a diameter greater than that of the draft tube, said rotor being supported within said tank for rotatable movement adjacent the bottom of said tank, said rotor having a plurality of back-curved, pulping knives supported in close proximity to the lower edge of said draft tube for cooperating therewith, and a plurality of back-curved impeller blades for cooperating with said worm conveyor, and means for rotating said rotor and said worm conveyor.

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