April 14, 1970 E. H. CUMPSTON, JR 3,506,202

PULPER

Filed March 31, 1967 3 Sheets-Sheet 1

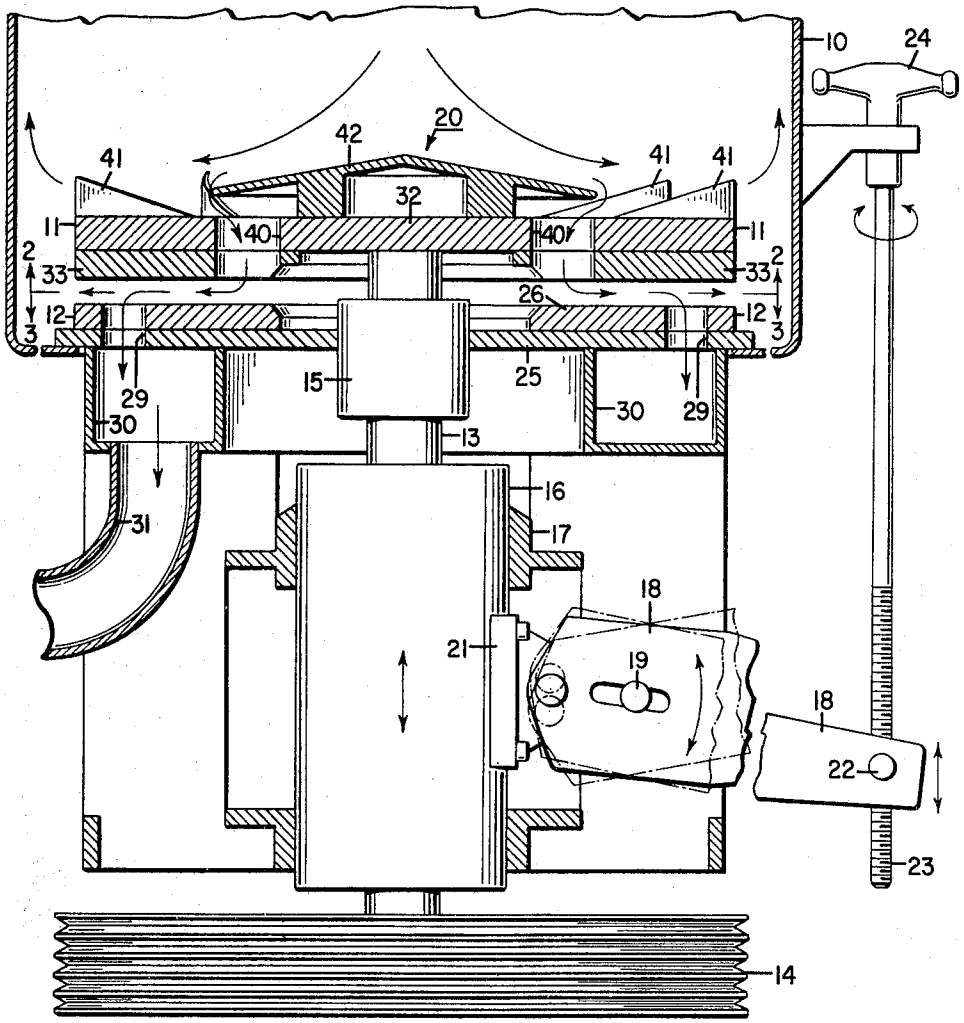


FIG. 1

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PULPER

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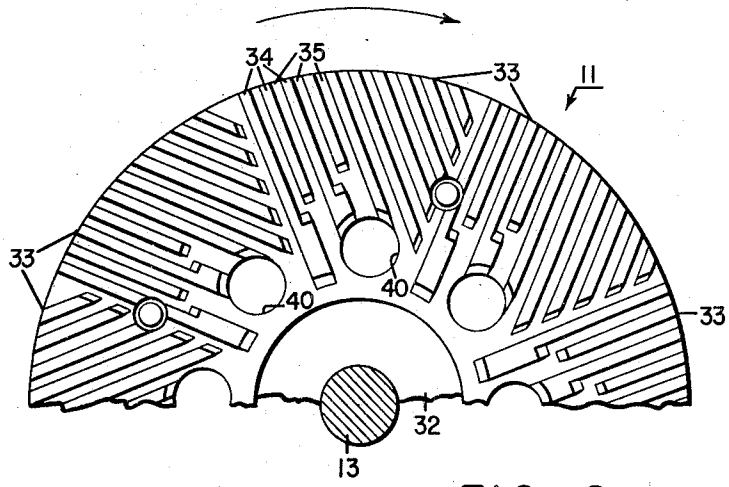


FIG. 2

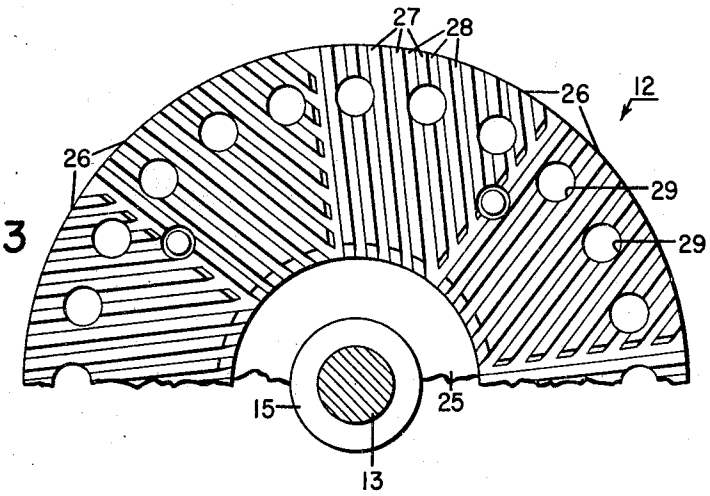


FIG. 3

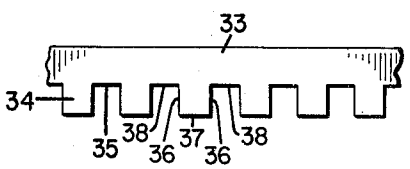
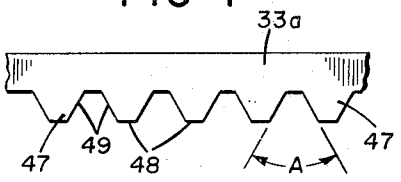


FIG. 4

FIG. 7



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PULPER

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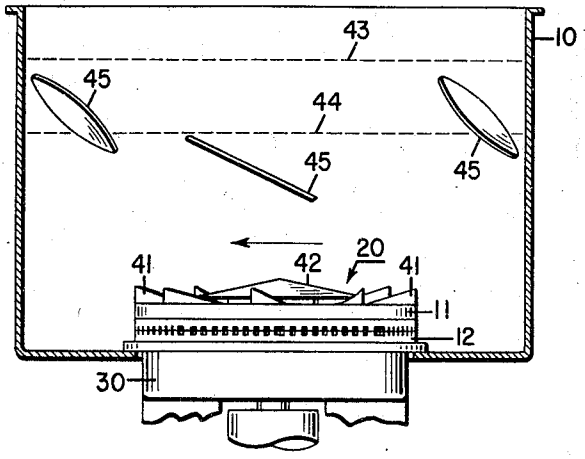


FIG. 5

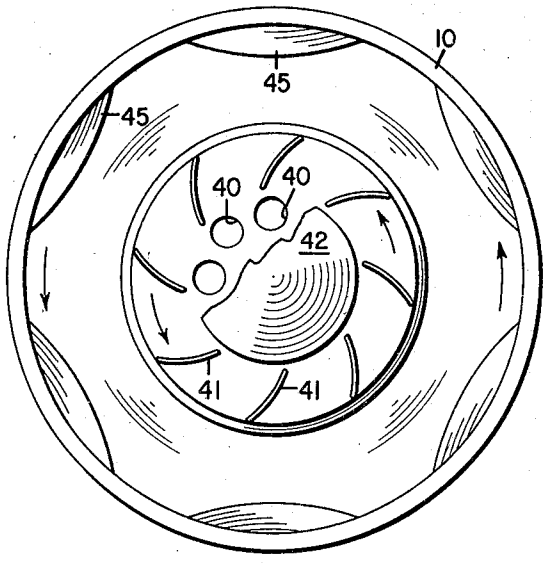


FIG. 6

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3,506,202

PULPER

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Int. Cl. B02c 7/08, 7/12, 18/12
U.S. Cl. 241—97 26 Claims

ABSTRACT OF THE DISCLOSURE

An improved pulper uses a relatively large refiner or defibering unit with ridged confronting faces on its stator and rotor, and the inlet openings to the refining passageway are arranged around the center of the rotor and protected by a shield to admit only clean pulp to the refiner. An outlet opening for refined pulp is arranged around the periphery of the stator. The defibering unit is at least one half the tank diameter to provide a large refining area and considerable pumping force on the pulp material. Vanes mounted on top of the rotor break up and swirl the pulp material to create a centrifugal force augmenting the pumping force of the refiner to drive pulp radially outward away from the refiner and thus speed up circulation through the refiner. Tank walls are smooth and unbaffled to facilitate such swirling, and deflector vanes are mounted on the tank wall just below the working surface to limit the height of the swirl and to turn over the pulp material at its peripheral surface to speed up recirculation of material through the refiner.

The invention comprises improved apparatus for pulping processes in which dry paper making material is reduced to individual fibers in a water suspension. Pulping as known in the prior art is accomplished in a tank filled with water and into which dry paper making material is introduced. One or more refining or defibering units are driven by electric motors to mechanically reduce the pulp material to individual fibers in either a batch or continuous process. The process is used on both fresh fibrous material and "broke" or fibrous waste material that is repulped. The latter often includes foreign objects such as bits of metal, glass, or other materials that cannot be defibered. Such foreign materials must be cleaned out of the pulper, and can damage or clog the refiner if they enter it. Hence, it is important to keep foreign materials out of the refiner, and it is easier to separate such materials from the pulp material if they have not been broken into small bits by passing through the refiner. Prior art equipment has suffered serious shortcomings in not successfully keeping foreign materials out of the refiner, and in general inefficiency and unreliability.

The objects of the invention include, without limitation, the following:

(a) Overcoming the deficiencies of prior art pulping equipment;

(b) Keeping foreign material out of a pulping refiner;

(c) Improved efficiency and reliability in a pulper;

(d) A pulping refiner that is rugged and simple, easily adjustable, reliable, and long-lived;

(e) Reducing the power consumption and improving the performance of a pulper;

(f) Providing continuous adjustment between the working surfaces of a pulp refiner's rotor and stator to keep the shearing forces adjusted to an optimum;

(g) Speeding up the circulation of pulp material in a pulper for faster defibering and greater efficiency;

(h) Facilitating the removal of contaminants and foreign objects from pulping equipment; and

(i) Allowing continuous removal of defibered material from a pulper without removing under-refined material or over-working sufficiently defibered material.

These and other objects of the invention will be apparent hereinafter from the specification which describes the invention, its use, operation, and preferred embodiments, from the drawings, which constitute a part of the disclosure, and from the subject matter claimed.

Generally, improved defibering efficiency for a pulper is accomplished according to the invention with a relatively large refiner formed either as a single rotor or a combined rotor and stator having large, flat, annular surfaces each provided with many ridges that confront to form a refining passageway. Preferably, the refiner is arranged at the center of the bottom of a generally cylindrical tank and is about ½ the diameter of the tank. Such a relatively large refiner exerts considerable pumping force to drive material radially outward from the refiner and draw material into the refiner for rapid circulation. This is augmented by vanes on top of the rotor that break up and swirl the pulp to drive it radially outward by centrifugal force. The lower half of the tank is smooth-walled and unbaffled to facilitate such swirling, and deflector vanes are arranged around the tank wall just below the working surface to limit swirl height and to turn over surface pulp to speed its reentry into the refiner region. The refiner can also be used in other locations such as a tank wall or in a pipeline. Apertures near the center of the rotor disk admit fibrous material to the radially inward edge of the refining passageway, the ridges subject it to severe mechanical shear for breaking the material into individual fibers.

Improved ability to keep foreign material and debris out of the refiner is generally accomplished by two improvements. First, the inlet to the refining passageway is formed by apertures near the center of the rotor disk. The moving apertures in their radially inward position admit fibers of light mass to the refining passageway, but larger masses and denser foreign materials are urged outward by the pumping effect of the rotor and do not ordinarily enter the rotating inlet apertures. Second, the inlet apertures are preferably covered by an adjustable shield arranged so that material must turn over the periphery of the shield and travel radially inward to be drawn into the inlet apertures. Foreign material and debris of generally greater density and larger size is driven outward by the centrifugal flow of pulp at the periphery of the shield, and cannot turn radially inward to enter the inlet apertures as can the relatively lighter fibrous material.

For continuous pulping, an outlet for defibered pulp is preferably arranged near the periphery of the stator to insure that only properly refined material of relatively small size is withdrawn against the centrifugal flow which tends to carry larger, incompletely refined material out into the tank for recirculation through the refiner.

In the drawings:

FIG. 1 is a partially sectioned, partially elevational, and partially cut-away, side view of a pulper according to the invention;

FIG. 2 is a plan view of a refining surface for the rotor of the pulper of FIG. 1;

FIG. 3 is a plan view of the refining surface of the stator of the pulper of FIG. 1;

FIG. 4 is an enlarged fragmentary elevation of the rotor of FIG. 2;

FIG. 5 shows a partially cut-away side elevation of the pulper of FIG. 1;

FIG. 6 shows a partially cut-away plan view of the pulper of FIG. 1; and

FIG. 7 shows an enlarged, fragmentary elevation of an alternative rotor and stator ridge configuration.

Throughout the drawings, corresponding parts are identified by the same reference numerals. Although the inventive pulper improvement can be used in a variety of pulping equipment, the invention will be described relative to the illustrated preferred embodiment.

Referring particularly to FIG. 1, the inventive pulper comprises defibering or refining unit **20** preferably mounted in the center of the bottom of pulping tank **10**, which is partially cut-away for convenience of illustration. Defibering unit **20** generally comprises stator **12** mounted on the bottom of tank **10**, and rotor **11** mounted on drive shaft **13** driven by a conventional sheave **14** with belts and a motor (not shown). Packing gland **15** seals the opening in the bottom of tank **10** for shaft **13**, and shaft **13** is mounted in bearings in a known way in quill **16** which is movable axially in frame **17**. Arm **18** mounted for pivotal motion on pin **19** is connected to bracket **21** on quill **16** for sliding quill **16** axially in frame **17** to position rotor **11** axially relative to stator **12**. Arm **18** is positioned vertically by screw **23** extending through nut **22** at the outer end of arm **18**, and adjusted by hand wheel **24**. Of course, power adjusting means such as an hydraulic cylinder or an electric gear motor can be used for positioning quill **16**. By such adjusting means rotor **11** can be positioned axially to adjust its clearance from stator **12** even during operation of the pulper.

Stator **12** is formed generally of a base plate **25** secured to the bottom of tank **10**, and refining plates **26** screwed to the upper surface of base plate **25** (as best shown in FIGS. 1 and 3). Refining plates **26** are preferably formed as identical sectors of an annular area around the periphery of base plate **25** rather than forming the entire stator refining surface of one large integral piece. The advantages include more economical manufacture, especially of a large stator, and easy replacement of worn or defective plates **26**. Plates **26** are preferably formed of a hard material such as hardened steel, and are provided with ridges **27** separated by grooves **28**. Ridges **27** extend generally radially of stator **12** as illustrated in FIG. 3, and are formed with generally parallel and upright sides and flat top portions similar to rotor ridges illustrated in FIG. 4 and described below. A preferred alternative form of refining ridges having sloping side walls are illustrated in FIG. 7 and described below. With either configuration, ridges **27** provide a multitude of abrupt surfaces for mechanically shearing and defibering pulp in the refining passageway between stator **12** and rotor **11**.

Outlet or extraction holes **29** are formed around the periphery of stator **12** to extract refined pulp from tank **10**. An extraction channel or conduit **30** is arranged beneath outlet openings **29**, and conduit **30** connects with an outlet pipe **31** which is normally connected to a pump (not shown). Extraction of refined pulp through outlet openings **29** near the periphery of stator **12** at a point in the refining passageway at which pulp is subjected to generally centrifugal outward flow, insures that only refined and relatively small fibers are drawn down through outlet openings **29** against the centrifugal flow tending to force any heavier and incompletely refined particles out to the periphery of stator **12**. Outlet conduit **30** can also be arranged to open into the bottom of tank **10** around the periphery of stator **12** to the same general effect. This also avoids holes **29** in stator **12** and increases the working area of stator **12**.

As best shown in FIGS. 1, 2, and 4, rotor **11** is formed of a generally closed disk or plate **32** secured to drive shaft **13** with several refining surface sector plates **33** screwed to the underside of disk **32**. Sector plates **33** are each formed with a plurality of generally radial ridges **34** and grooves **35**, and are preferably formed of a hard, corrosion-resistant material. As best illustrated in FIG. 4, each ridge **34** is formed with generally vertical side walls **36** communicating with a top wall **37**, and each of the ridges **34** is connected by a grooved bottom **38**.

An alternative preferred embodiment of ridges for rotor **11** is illustrated in FIG. 7. Ridges **47** on sector plate **33***a* have generally flat tops **48** and sloping side walls **49** which tend to prevent the grooves between ridges **47** from clogging with pulp material. Corresponding sloping sided ridges are preferred for stator **12** so that the refining surfaces of both the rotor and stator are made self cleaning. The angle A between confronting sloping surfaces **49** can be any of a variety of angles preferably from between 60° to 120°. In one preferred embodiment of the invention angle A is formed at 60° as illustrated for the rotor and at 90° for the stator ridges, but many different angles are possible within the spirit of the invention. The sides and edges of such ridges provides a multitude of shearing surfaces for defibering pulp as rotor **11** is driven relative to stator **12**.

As best shown in FIGS. 1, 5, and 6, rotor **11** has a plurality of vanes **41** arranged around its upper periphery. As rotor **11** is driven in the indicated direction, vanes **41** drive pulp material outward in a pumping action from the periphery of rotor **11** and circulate pulp material through tank **10** in a swirling motion as indicated by arrows. Vanes **41** also serve to break up pulp material into flake size for the refiner **20**, and vanes **41** on rotor **11** can successfully accomplish pulping without stator **12** or any refining passageway.

Although refiner **20** is illustrated as arranged on the bottom of tank **10**, it is possible to use the inventive refiner in other environments. For example, refiner **20** could be positioned in an enlarged space in a pipe line, or could be located on the vertical wall of a tank. In circumstances in which it is not essential for refiner **20** to impart a swirling motion to material to be pulped, and in which such material is fed to refiner **20** in flake size suitable for defibering, vanes **41** can be omitted.

Inlet openings **40** are formed through disk **32** and sector plates **33** to admit material from tank **10** to the radially inward edge of the refining passageway formed by ridges on rotor **11** and stator **12**. Pulp material drawn into the refining passageway through openings **40** is pumped radially outward between rotor **11** and stator **12**.

Inlet openings **40** in rotor **11** are preferably covered by shield **42** mounted at the center of disk **32**. Shield **42** is spaced above disk **32** to allow material from tank **10** to pass around the periphery of shield **42** into openings **40**. To force material to turn radially inward around the periphery of shield **42** in entering into openings **40**, shield **42** preferably extends at least to the centers of openings **40** which are preferably equidistant from the axis of rotor **11**. The diameter of shield **42** and its clearance from disk **32** are related in creating conditions keeping overly large or foreign materials from turning radially inward into rotor openings **40**.

Shield **42** is convex as shown in FIG. 1 with its center extending up into tank **10** slightly more than its periphery to guide the flow of pulp material downward and outward at the upper surface of rotor **11**. However, a flat topped shield works quite satisfactorily and is less expensive than convex shield **42**. Also shield **42** is preferably axially adjustable relative to disk **32** to adjust the clearance between disk **32** and shield **42** over inlet openings **40**. Such axial adjustment can be accomplished by shims or other known means, or by replacing shield **42** with another shield having greater or less clearance over disk **32** as desired.

The preferred relative size and positions of tank **10** and refiner **20** are best shown in FIGS. 5 and 6. Tank **10** is preferably an upright, right circular cylinder, and refiner **20** is preferably mounted in the center of the bottom of tank **10**. The bottom of tank **10** is preferably flat as illustrated or slightly sloping or concave to allow draining of tank **10**. The working levels of pulp material in tank **10** range from the normal level indicated by dashed line **43**, to a low level indicated by dashed line **44**. The inside of tank **10** is preferably smooth-walled, and at least the lower half of tank **10** is unbaffled as shown in FIG. 5.

The relatively large size of refiner **20** not only provides a large refining area for pulp material, but exerts a substantial pumping force driving material radially outward. The unobstructed bottom of tank **10** allows the pulp to

move rapidly away from refiner **20** toward the vertical walls of tank **10** so that refiner **20** can draw in pulp material at a high rate of circulation. At the same time, the unbaffled lower half of tank **10** allows free swirling of material to create a centrifugal force augmenting the pumping action of refiner **20**.

The pumping and centrifugal force from refiner **20** not only draws pulp material rapidly through refiner **20** and drives pulp radially outward from refiner **20**, but such forces make the pulp material swirl and rise around the periphery of tank **10**, return toward the center of tank **10** across the upper surface of the liquid, and be drawn downward through the center of tank **10** to refiner **20** in a rapid circulation. Such free swirling of pulp material in a tank is contrary to the usual procedure of baffling the tank to restrict swirling motion and increase the speed of the rotor relative to the pulp material.

A plurality of small, streamlined deflector vanes **45** are arranged on the inside wall of tank **10** just below the intended working surface. Vanes **45** are preferably set approximately 45° to the vertical and are oriented to the normal swirling motion of pulp material to give an uplift to such material at its peripheral working surface to hasten the turnover and return of pulp material to the central portion of the tank and down to the region of refiner **20**. Vanes **45** are preferably streamlined as illustrated in FIGS. 5 and 6 for minimum obstructing of normal swirling motion of the slurry in tank **10**, and as best shown in FIG. 5, vanes **45** are positioned at different elevations to insure that some vanes are positioned just below either normal working surface **43** or low working surface **44**. The uplift and turnover force imparted to the swirling slurry by deflector vanes **45**, speeds up the circulation of pulp material through refiner **20** and prevents pulp from swirling in stratified bundles of fibers tending to collect at the periphery of the tank. Vanes **45** tend to lift and turn over such bundles of fibers to force them toward the center of the tank for submerging toward refiner **20**. Vanes **45** are not numerous enough or large enough to substantially baffle the swirling motion of pulp material in tank **10**, but vanes **45** are arranged in sufficient numbers and sizes to limit the height of swirling pulp material next to the walls of tank **10**.

The inventive refiner and tank arrangement has been found to increase the rate of pulping over conventional tanks and pulping equipment by from 25% to 50% with no increase in power. At the same time the solid material in the liquid can be increased from the prior art level of about 3% to about 6% in the inventive pulper. This effects a substantial economy in addition to the improved efficiency of refiner **20** over previously known pulp defibering units.

Refiner **20** is preferably at least ½ the diameter of tank **10** to take advantage of the power economy of moving a large volume of slurry at a low velocity rather than moving a small volume at high velocity. Circulation of slurry follows the conservation of momentum law, holding circulation C equal to velocity V times mass moved M or $C=VM$. The power P required to move a mass M of slurry follows the conservation of energy law and is equal to $\frac{1}{2}MV^2$. ($P=\frac{1}{2}MV^2$.)

Increasing the diameter of refiner **20** not only greatly reduces the power required to circulate slurry in the tank, but increases the working area of the refining passageway of refiner **20** by a power of 2. For example doubling the diameter of a relatively small refiner increases its working area A by 4 times.

The mass moved by a refiner is equal to its working area A times its velocity V. ($M=AV$.) This proportion exists because mass is related to the discharge circumference of the refiner and the thickness of the moving layer in the refining passageway, both of which increase as disk size increases. For example, if the diameter of a relatively small refiner ($M_1=AV$, and $C_1=VM_1$) is doubled and its velocity is halved, the new mass M_2 of moved slurry will be $M_2=4A\times\frac{1}{2}V=2M_1$, and the new circulation will be $C_2=M_2\times\frac{1}{2}V=2M_1\times\frac{1}{2}V=M_1V$, or the same as with the smaller disk diameter. However, the power for the larger refiner [$P_2=\frac{1}{2}M_2\times(\frac{1}{2}V)^2$] will be $P_2=\frac{1}{2}\times2M_1(\frac{1}{2}V)^2=\frac{1}{4}M_1V^2$, which is only ½ the $\frac{1}{2}M_1V^2$ required by the smaller disk to produce the same rate of circulation. This example demonstrates the importance of a relatively large diameter for refiner **20**. Of course, an optimum diameter for refiner **20** is limited by the diameter of tank **10**, the manufacturing costs of a larger refiner, and fluid flow considerations between the circumference of the refiner and the vertical tank wall. From experience, I have found that an optimum refiner diameter is ½ the tank diameter or slightly larger.

In operation, tank **10** is filled with water, and fibrous material to be pulped is furnished into the tank. Rotor **12** is driven to rapidly circulate the pulp material into contact with vanes **41** which easily tear the material into small flakes. As the size of these flakes diminish, they become more and more resistant to defibering shear from vanes **41**, but the pumping action between rotor **11** and stator **12** draws sufficiently small and light flakes over the periphery of shield **42** and radially inward into inlet openings **40** to enter the refining passageway between rotor **11** and stator **12**. The ridges on the refining surfaces of the rotor and stator subject the flakes to severe hydraulic and mechanical shearing action to defiber them. Defibered material is either drawn continuously into outlet conduit **30** and outlet pipe **31**, or the pulper can be operated on a batch basis with delivery of defibered material from the periphery of refiner **20** back into tank **10**.

Shield **42** prevents foreign material, debris, or oversized material from entering inlet openings **40**, since larger objects of greater mass are more subject to the centrifugally outward pumping force of refiner **20**, and cannot turn radially inward under shield **42** before they are swept radially outward by the main flow of slurry over vanes **41**. As a further cleaning effect, shield **42** is positioned relatively closely over the top of the rotor to guard inlet openings **40** from foreign matter and contaminants by size as well as by mass. Objects larger than the clearance of shield **42** over disk **32** cannot enter openings **40** even if they were light enough to turn radially inward against the centrifugal forces at the periphery shield **42**. Such cleaning action of shield **42** and rotating inlet openings **40** in rotor **11** prevents damage to the refining surfaces of the rotor and stator from any foreign matter.

Foreign matter and contaminants are removed from tank **10** by known methods of settling into a trap or being caught by trailing wire. Foreign matter that has not been broken down by passage through refiner **20** is easier to remove from the inventive pulper than broken or finely divided contaminants which are difficult to separate from the usuable fibers.

It will thus be seen that the inventive pulper accomplishes the objects set out above. Other features, advantages, and other specific embodiments of this invention will be apparent to those exercising ordinary skill in the pertinent art after considering the foregoing disclosure. In this regard, while a specific preferred embodiment has been described in detail, such disclosure is intended as illustrative, rather than limiting, and other embodiments, variations, and modifications can be effected within the scope and spirit of the invention as disclosed and claimed. Furthermore, the following claimed subject matter is intended to cover fully all the aspects of the disclosed invention that are unobvious over prior art, including all equivalent embodiments.

I claim:

1. An improved pulping machine comprising:

(a) a tank having a generally cylindrical vertical wall and an unobstructed bottom, at least the bottom half of said tank being substantially smooth-walled and

unbaffled and said tank being arranged for containing material to be pulped;

(b) a refiner arranged on said bottom and including a flat rotor overlying a refining passageway and disposed for substantial, radial pumping through said passageway;

(c) a plurality of vanes arranged on the upper periphery of said rotor to impart swirling motion to said material in said tank; and

(d) said refiner being at least one half the diameter of said tank.

2. The pulping machine of claim **1** including a plurality of streamlined deflector vanes arranged on said vertical wall in the upper half of said tank below and near the working surface for said tank, said deflector vanes being oriented generally in the direction of said swirling motion and tilted to turn over said material at the periphery of said working surface to hasten the reentry of said material into the region of said refiner.

3. The pulping machine of claim **1** wherein said diameter of said tank is approximately 1.5 times the distance from said bottom to said working surface for said tank.

4. The pulping machine of claim **1** wherein said refiner is concentric with said bottom and said bottom is substantially flat.

5. The pulping machine of claim **1** wherein said refiner comprises:

(a) a stator comprising a generally planar, annular, refining surface facing into said tank and formed with a plurality of generally radial ridges;

(b) a rotor comprising a generally closed disk overlying and extending to the periphery of said stator, the face of said disk confronting said stator, having a generally planar, annular refining surface formed with a plurality of generally radial ridges extending into proximity with said stator refining surface to form said refining passageway between said stator and said rotor;

(c) said plurality of vanes being arranged on said rotor disk around the periphery of said rotor disk on the tank side of said rotor disk; and

(d) said rotor disk being formed with a plurality of apertures through said disk and disposed radially inward of said vanes adjacent a radially inward portion of said refining passageway to admit material from said tank through said apertures to said inward portion of said passageway for a refining pass radially outward through said passageway toward the periphery of said stator and rotor.

6. The pulping machine of claim **5** including means for axially adjusting said rotor disk relative to said stator for varying the spacing between said rotor disk and said stator.

7. The pulping machine of claim **6** wherein said refiner is concentric with said bottom and said bottom is substantially flat.

8. The pulping machine of claim **6** wherein said adjusting means comprises an axially movable drive shaft for said rotor disk, a quill supporting said drive shaft, a pivoted lever for moving said quill axially to position said drive shaft and said rotor disk, and means for adjusting said lever.

9. The pulping machine of claim **5** wherein a liquid tight shield is arranged in spaced relation to said rotor disk over the central portion of said rotor disk on the tank side thereof, and said shield extends radially outward at least to the center of said apertures in said rotor disk.

10. The pulping machine of claim **9** wherein said apertures in said rotor disk are equidistant from the axis of said disk.

11. The pulping machine of claim **5** wherein an outlet opening is formed in the region of the periphery of said stator and including conduit means communicating with said outlet opening for extracting refined material from said tank through said outlet opening.

12. The pulping machine of claim **11** including a plurality of streamlined deflector vanes arranged on said vertical wall in the upper half of said tank below and near the working surface for said tank, said deflector vanes being oriented generally in the direction of said swirling motion and tilted to turn over said material at the periphery of said working surface to hasten the reentry of said material into the region of said refiner.

13. The pulping machine of claim **5** wherein said diameter of said tank is approximately 1.5 times the distance from said bottom to said working surface for said tank.

14. In a pulping machine having a stator, a rotor, and means for driving said rotor in rotary motion relative to said stator, the improvement comprising:

(a) said stator comprising a generally planar, annular, refining surface formed with a plurality of generally radial ridges;

(b) said rotor comprising a generally closed disk overlying and extending to the periphery of said stator, the face of said disk confronting said stator having a generally planar, annular refining surface formed with a plurality of generally radial ridges extending into proximity with said stator refining surface to form a refining passageway between said stator and said rotor; and

(c) said rotor disk being formed with a plurality of apertures through said disk spaced substantially inward from the periphery of said disk and disposed adjacent a radially inward portion of said refining passageway to admit material to said inward portion of said passageway, for a refining pass radially outward through said passageway toward the periphery of said stator and rotor.

15. The pulping machine of claim **14** including means for axially adjusting said rotor disk relative to said stator for varying the spacing between said rotor disk and said stator.

16. The pulping machine of claim **15** wherein said adjusting means comprises an axially movable drive shaft for said rotor disk, a quill supporting said drive shaft, a pivoted lever for moving said quill axially to position said drive shaft and said rotor disk, and means for adjusting said lever.

17. The pulping machine of claim **14** wherein a liquid tight shield is arranged in spaced relation to said rotor disk over the central portion of said rotor disk on the tank side thereof, and said shield extends radially outward at least to the center of said apertures in said rotor disk.

18. The pulping machine of claim **17** wherein said apertures in said rotor disk are equidistant from the axis of said disk.

19. The pulping machine of claim **17** wherein the central portion of said shield extends into said tank at least as far as the peripheral portion of said shield, and said peripheral portion of said shield is spaced from said rotor by at least .25 inch.

20. The pulping machine of claim **14** wherein an outlet opening is formed in the region of the periphery of said stator and including conduit means communicating with said outlet opening.

21. The pulping machine of claim **14** wherein said ridges on said refining surfaces of said rotor and said stator each comprise generally sloping side surfaces communicating with a flat top surface.

22. The pulping machine of claim **14** wherein said stator and said rotor disk are disposed in a tank and a plurality of vanes are arranged on said rotor disk around the periphery of said rotor disk on the tank side of said rotor disk.

23. The pulping machine of claim **22** wherein said tank has a generally cylindrical vertical wall and a substantially flat bottom and said stator and said rotor disk are concentric with said tank bottom.

24. The pulping machine of claim **14** including a tank

and wherein said rotor is arranged over the bottom of said tank and is at least ½ the diameter of said tank.

25. The pulping machine of claim **1** wherein said rotor is arranged over the bottom of said tank and is up to 1 inch thick.

26. The pulping machine of claim **25** wherein said rotor is spaced at least 3 inches above said bottom of said tank.

References Cited

UNITED STATES PATENTS

2,706,621	4/1955	Laird	241—46.17 X
2,776,800	1/1957	Uschmann	241—296
2,968,444	1/1961	Jones	241—260 X
3,049,307	8/1962	Dalzell	241—260 X
3,073,535	1/1963	Vokes	241—46.11
3,243,129	3/1966	Jones	241—152 X
3,314,617	4/1967	Sargood	241—260
3,342,425	9/1967	Morton	241—46.11

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U.S. Cl. X.R.

241—46.4, 90, 134, 188, 259