United States Patent [19]

Cumpston, Jr.

[11] **3,771,732**

[45] **Nov. 13, 1973**

[54] **PULPER**

[76] Inventor: **Edward H. Cumpston, Jr.**, 43 Monument Ave., Old Bennington, Vt. 05201

[22] Filed: **July 19, 1972**

[21] Appl. No.: **273,135**

[52] **U.S. Cl.** **241/46.11**, 241/97

[51] **Int. Cl.** **B02c 13/18**

[58] **Field of Search** 241/46.06, 46.11, 241/46.17, 97

[56] **References Cited**

UNITED STATES PATENTS

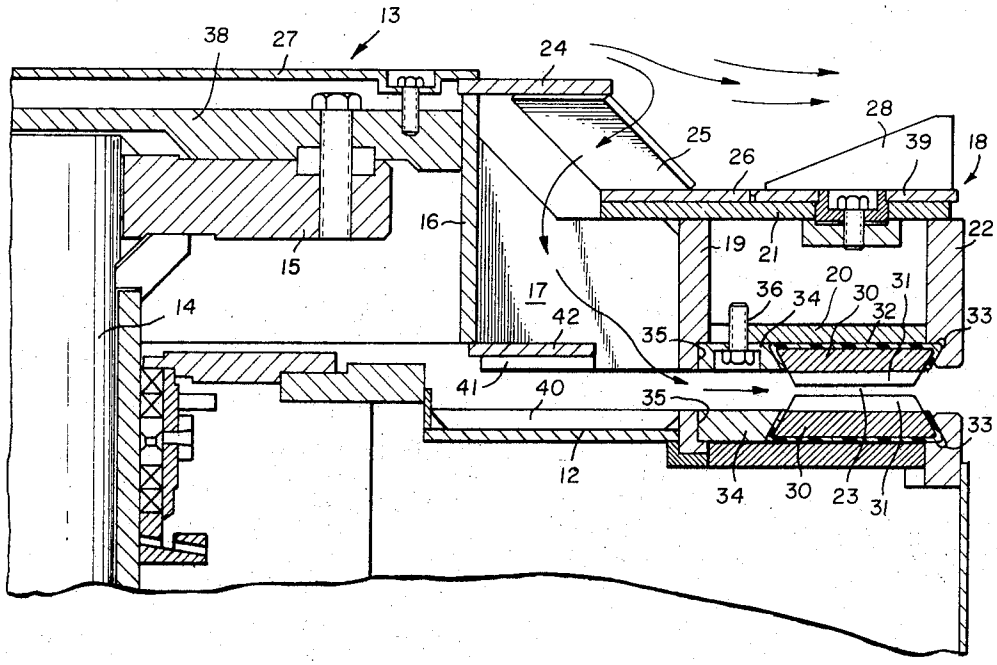
2,129,789	9/1938	Seaborne	241/97
3,380,669	4/1968	Hatton	241/97 X
3,428,261	2/1969	Moulton	241/97 X
3,506,202	4/1970	Cumpston	241/97
3,713,595	1/1973	Craig et al.	241/46.11

Primary Examiner—Granville Y. Custer, Jr.
Attorney—Cumpston, Shaw & Stephens

[57] **ABSTRACT**

A pulper uses a stator having a ridged peripheral surface and a rotor adjacent the stator and having a peripheral rim with a ridged surface confronting the ridged surface of the stator. Spokes extend from the rotor's central region to support the rim and provide a substantially open, annular region radially inward from the rim. A cleaner is spaced over the open region and preferably includes cleaning vanes allowing only clean pulp to enter the open region between the spokes to be pumped out through the ridged surfaces of the rotor and stator.

36 Claims, 5 Drawing Figures



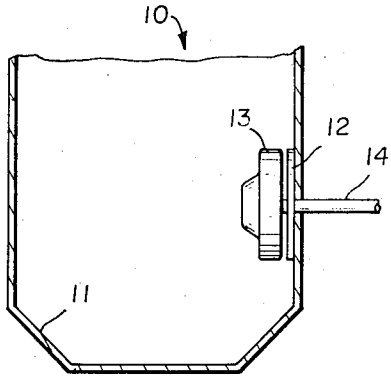


FIG. 1

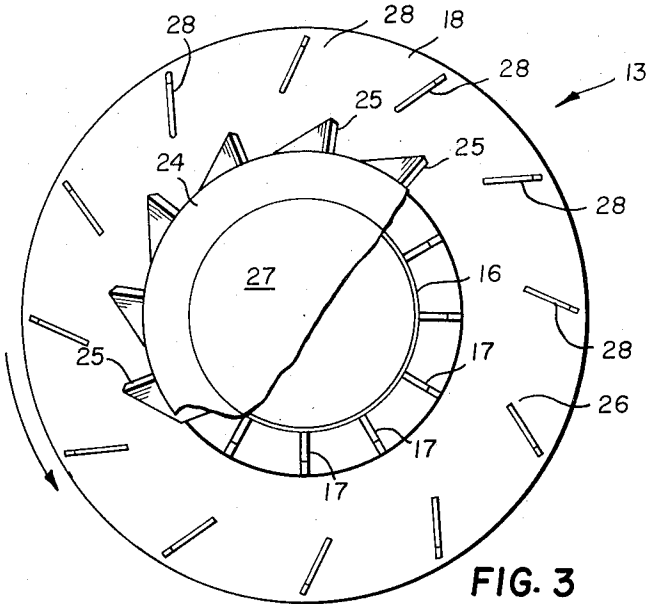


FIG. 3

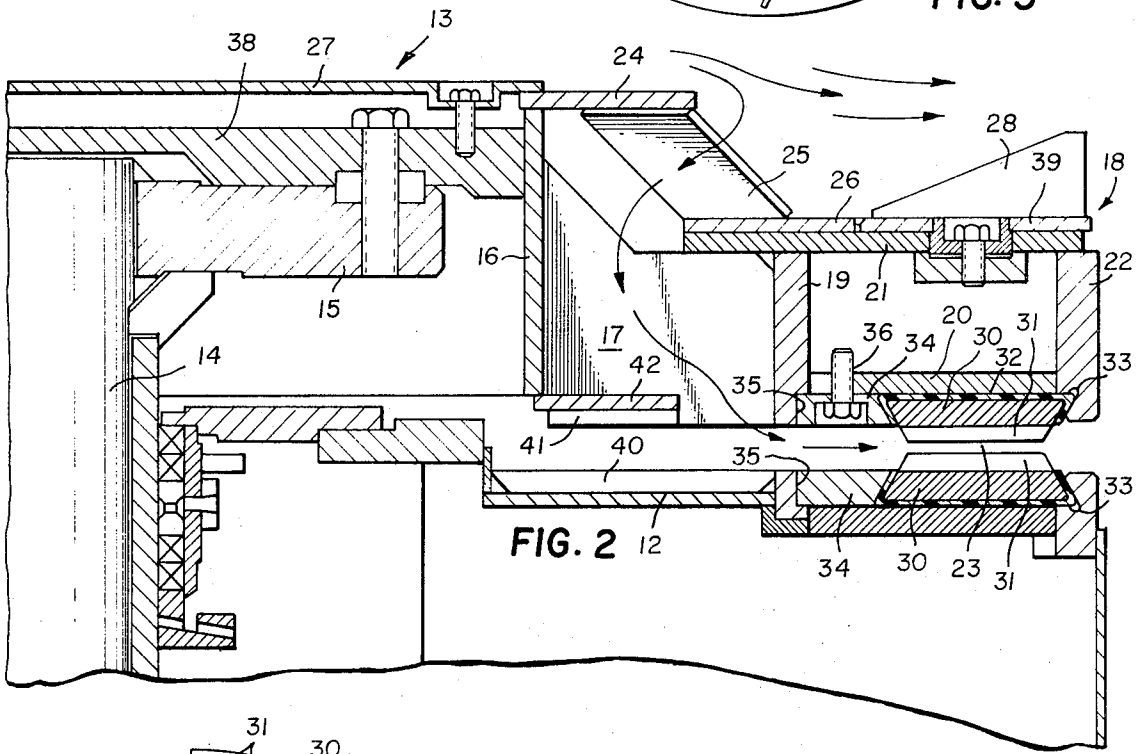


FIG. 2

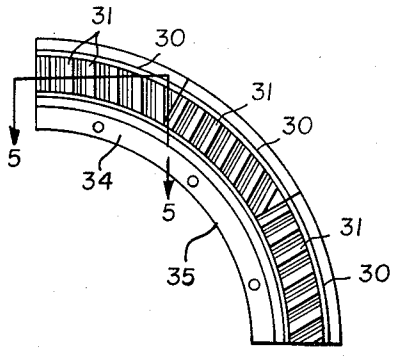


FIG. 4

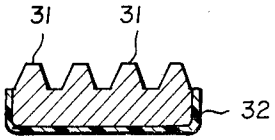


FIG. 5

PULPER

THE INVENTIVE IMPROVEMENTS

This invention is an evolutionary advance from the pulper shown in U.S. Pat. No. 3,506,202. The invention involves discovery of several problems and inadequacies of the previous pulser, and a realization that these problems and inadequacies can be solved by a different construction leading to a different operational mode and providing faster and more efficient pulping. The improved pulper of this invention aims at efficiency, reliability, economy, and safety, and it improves on the previous pulper in achieving better cleaning of the pulp admitted to the rotor, faster and more efficient pulping, improved defibering of pulp, and more economical and reliable construction.

SUMMARY OF THE INVENTION

The inventive pulper uses a stator having a ridged surface on a peripheral annular region and a rotor adjacent the stator. The rotor has a peripheral rim supported by spokes to provide a substantially open annular region radially inward from the rim. A ridged surface on the rim confronts the ridged surface of the stator, and a cleaner is spaced over the open region.

BACKGROUND OF THE INVENTION

The pulper described in U.S. Pat. No. 3,506,202 was not very successful, but its deficiencies inspired this invention. For example, the pulp outlet formed as holes in the stator was inoperable because of the high vacuum created by the pumping action between the rotor and the stator. When the outlet valve was opened, air rushed into the pulper rather than pulp flowing outward. Also, the holes in the stator refining surface greatly reduced its efficiency.

The inlet holes in the rotor quickly plugged up when foreign matter was present in the pulp, and modifications attempting to overcome this were expensive and complex and involved cleaning vanes and shrouds arranged around the bonnet and having different configurations depending upon their position relative to the inlet holes through the rotor.

The original intention in the previous pulper was that since cleaning of the pulp to keep foreign objects out of the rotor inlet could not be complete and reliable, the inlet openings should be spaced as closely as possible to the attrition zone of the pulper so that any foreign material such as ropes or strings entering the rotor inlet openings would be quickly chewed up in the attrition ridges and not allowed to hang up in the rotor and clog its intake openings. This consideration involved design limitations that created many problems making the prior pulper a poor compromise.

After experience with cleaning techniques for a rotor, it was discovered that a very reliable cleaner could be made that would keep foreign objects out of the rotor inlet. Also, the need was recognized for opening up and expanding the rotor inlet to accommodate a greater volume and make the inlet less susceptible to clogging. Pumping was found to occur mostly around the peripheral region of the attrition zone, so it was important to keep the peripherally outer ridges uninterrupted.

After much work on these discoveries, an inventive concept was derived to form the rotor as a rim supported by radial spokes to allow a large, open inlet

through the rotor. For strength the spokes extend axially of the rotor a considerable distance, and this spaced the inlet cleaner a long way from the attrition zone under the annular box used as a rotor rim. This would normally be undesirable and would invite hanging up of foreign material in such a long passageway, but a better cleaner was devised for those installations where dirty pulp is encountered so that the rotor inlet could be kept clean.

In addition, a better way was devised for forming the ridged attrition surfaces of the rotor and stator, and the entire construction was simplified and strengthened. For example, the earlier pulper used a two and one half inch thick, stainless steel disk which was heavy, unwieldy, and expensive, while the inventive pulper uses a stronger but simpler and lighter construction.

Finally, the inventive improvements were found to make the pulper run cleaner and safer, to do a better job of defibering the pulp, and to run at a greatly increased capacity for more efficient operation.

DRAWINGS

FIG. 1 is a partially schematic, cut-away, side elevational view of a preferred embodiment of the inventive pulper;

FIG. 2 is a cross-sectional view of the pulper of FIG. 1;

FIG. 3 is a partially cut-away, plan view of the pulper of FIG. 1 with the bonnet removed from one-half of the rotor;

FIG. 4 is a plan view of an attrition surface for the pulper of FIG. 1; and

FIG. 5 is a cross-sectional view of one of the attrition blocks from FIG. 4 taken along the line 5 — 5 thereof.

DETAILED DESCRIPTION

Pulper **10** of FIG. **1** includes a tank **11** having a stator **12** and a rotor **13** turned by drive shaft **14** all as generally known. Rotor **13** and stator **12** can be in the side wall of tank **11** as illustrated, or can be mounted in the bottom of tank **11.** Also, more than one rotor **13** can be operated in a single tank **11** if desired.

The improvement in the inventive pulper lies chiefly in the construction of the rotor and stator so that these cooperate in an improved fashion for a more efficient and satisfactory pulping. A preferred construction of the rotor and stator is best shown in FIGS. **2 – 5.**

As best shown in FIGS. **2** and **3,** a hub **15** is secured to shaft **14** to support rotor **13** which has a central region constructed of a disk **38** secured to hub **15** and carrying a cylinder **16.** Radial spokes **17** formed as axially oriented plates extend radially outward from cylinder **16,** and an annular rim **18** is supported on spokes **17.** Rim **18** is formed of an inner cylinder **19** secured to spokes **17,** an axially inner annular plate **20,** an axially outer annular plate **21,** and an outer cylinder **22** joined together to form an annular box supported by spokes **17.** The box formed by plates **20** and **21** and cylinders **19** and **22** is preferably closed and its strong and strudy but relatively lightweight.

Stator **12** and rotor **13** each have ridged, peripheral surfaces described more fully below to form an attrition zone **23** through which pulp is radially pumped for defibering. Since stator **12** and rotor **13** have a fairly large diameter of, for example, four to five feet, pumping is very forceful through attrition zone **23** and creates a high vacuum between rotor **13** and stator **12.** This

tends to draw rotor **13** toward stator **12** and to bend or deform rotor **13** slightly in an umbrella fashion. Rotor **13** is preferably strong and rigid to resist such a deforming force, and its strength lies in a strong central region using disk **38** and cylinder **16**, sturdy spokes **17**, and a strong annular rim **18** formed as a closed box. Spokes **17** extend axially for a sufficient depth to support rim **18** rigidly, and the minimum axial dimension of spokes **17** is preferably at least 6 percent of the outside diameter of rotor **13.** The spaces between spokes **17** then afford a generally open and unobstructed passageway through rotor **13** radially inward from rim **18** without a sacrifice in rotor strength.

A cleaner formed of an annular cover plate **24**, spaced-apart cleaning vanes **25**, and an annular rim plate **26** is arranged over spokes **17** for keeping foreign matter out of the inlet through rotor **13** in the spaces between spokes **17.** Vanes **25** are preferably welded between rim plate **26** and cover **24** to form a cleaner assembly that is clamped down under center plate **27.** Cover **24** preferably extends radially outward beyond the inner perimeter of rim plate **26** so that pulp material entering between spokes **17** must flow radially inward against the outward pumping force of rotor **13.** This tends to keep foreign objects out of the rotor inlet to keep the pulper clean and protect the attrition zone **23**, and for some installations where relatively clean pulp is used, cover **24** is sufficient protection for the rotor inlet.

In many circumstances, foreign matter such as rope, string, and debris gets into pulper **10** and must be kept out of attrition zone **23** if possible. Whenever such foreign matter is expected, the whole cleaner assembly including cover **24**, cleaning vane plates **25**, and rim plate **26** is preferably clamped in place under plate **27** to guard the rotor inlet opening. An outer rim plate **39** carries mixing vanes **28** for pumping and mixing pulp, and inner rim plate **26** preferably interlocks with outer rim plate **39** to help secure the cleaner in place. Each of the cleaning vanes **25** is preferably formed as a flat, parallelogram plate, and since cover **24** and rim plate **26** are parallel, a plurality of identical cleaning vane plates **25** can be conveniently welded between cover **24** and plate **26.**

Cleaning vane plates **25** are preferably angled at about 45° to the radius of rotor **13** and about 45° to the axis of rotor **13** as illustrated, and are oriented to have outwardly trailing edges relative to the direction of rotation of rotor **13,** as best shown in FIG. **3.** Vanes **25** then pump outwardly as rotor **13** rotates, and pulp drawn into the inlet spaces between spokes **17** in response to the pumping force through attrition zone **23** must move inwardly around cleaning vanes **25** which are very successful in keeping foreign objects out of the rotor inlet and admitting only clean pulp. This keeps the inlet clear and unclogged, and prevents any damage to the attrition zone **23.** It also leaves foreign objects whole and unbroken so that they can be removed from tank **11** rather than chewed up to contaminate the pulp.

The space between rim plate **26** and cover **24** can range from 1 inch – 6 inches, and cleaning vane plates **25** are preferably spaced from 3 to 12 per foot of outside diameter of rotor **13,** depending in part on the expected cleanliness of the pulp to be worked in pulper **10.** The cleaning effect of cover **24** and cleaning vanes **25** is good enough to keep the rotor inlet unclogged, even though there is a considerable distance between cleaning vanes **25** and attrition zone **23.** At the same time, the generally open and unobstructed spaces between spokes **17** allow a high volume intake through rotor **13** to meet the high volume and forceful pumping through attrition zone **23.** The result is not only a faster and more efficient pulper, but a pulper that keeps itself clean and safe and does not clog up, damage itself, or shred contaminants into the pulp.

As added insurance that foreign material does not plug up rotor **13** or lodge in the space between rotor **13** and stator **12,** stator **12** has a few radial bars **40** confronting rotor **13,** and rotor **13** has a few radial bars **41** arranged under annular plate **42** to confront stator bars **40.** The relative motion between rotor **13** and stator **12** moves bars **40** and **41** across each other to break up any foreign material and keep it from lodging in place.

Attrition zone **23** is formed in an improved way of sector plates **30** as best shown in FIGS. **2, 4** and **5.** Sector plates **30** are preferably equal, angular portions of the annular attrition zone **23,** and are preferably identical for both stator **12** and rotor **13.** Each sector plate **30** has generally radial ridges **31** oriented to pump radially outwardly, and sector plates **30** are preferably cast of hard, metallic material. The bases of sector plates **30** preferably have a potted coating **32,** formed of a plastic or moldable material such as epoxy. Potted coating **32** is preferably applied to each of the sector plates **30** in a single mold so that the bases of each sector plate are identical for uniform and firm clamping of sector plates **30** in place.

The outer rim of both the rotor and stator has a peripheral abutment surface formed as a groove **33** that is dove-tailed in shape to fit the dove-tail shape of the potted coating **32** of sector plates **30.** Grooves **33** provide a firm abutment surface holding sector plates **30** against centrifugal force. The radially inward edges of sector plates **30** are also dove-tailed, and are held in place by clamp rings **34** that have a matching dove-tail and are wedged in place between sector plates **30** and cylindrical ridges **35** and held tight by screws **36.** Clamp rings **34** wedge down the inner edges of sector plates **30** tightly and hold sector plates firmly between the dove-tail of groove **33** and the dove-tail of clamp ring **34.** This arrangement also facilitates changing or replacing sector plates **30** if they are worn or damaged, and it allows the entire attrition zone **23** to be formed of a number of identical plates that are readily molded and provided with potted base coatings **32.**

The inventive pulper solves the problems encountered by the pulper described in U.S. Pat. No. 3,506,202, and is also far more efficient and economical. It forces pulp through its attrition zone at a much higher rate, partly because its attrition zone is uninterrupted, its intake is open and commodious, and its intake cleaner is efficient and reliable. Also, its construction is stronger, lighter, and less expensive. Hence, it is cheaper to build, more reliable in operation, and does a faster and better job. It is also easier to service and maintain, and more versatile in the pulp it can work. It does a better and faster job of defibering pulp, and it does not choke or clog on contaminants or chew them into bits disbursed into the pulp.

Persons wishing to practice the invention should remember that other embodiments and variations can be adapted to particular circumstances. Even though one point of view is necessarily chosen in describing and de-

fining the invention, this should not inhibit broader or related embodiments going beyond the semantic orientation of this application but falling within the spirit of the invention. For example, those skilled in the art will appreciate the many sizes, shapes and constructions possible to adapt the inventive pulper to various circumstances.

I claim:

1. An improved pulper comprising:

a. a stator having a ridged surface on a peripheral annular region;

b. a rotor adjacent said stator;

c. a shaft for driving said rotor;

d. means for supporting the central region of said rotor on said shaft;

e. said rotor having a peripheral rim;

f. spokes supporting said rim on said central region to provide a substantially open, annular region radially inward from said rim;

g. a ridged surface of said rim confronting said ridged surface of said stator; and

h. a cleaner spaced over said open region.

2. The pulper of claim **1** wherein said spokes are plates extending radially and axially of said rotor.

3. The pulper of claim **2** wherein said spokes extend for an axial distance of at least 6 percent of the outside diameter of said rotor.

4. The pulper of claim **2** wherein said cleaner and said ridged surface of said rotor are spaced axially on opposite sides of said spokes.

5. The pulper of claim **1** wherein said cleaner includes vanes.

6. The pulper of claim **5** wherein said vanes are inclined approximately 45° to the axis of said rotor and approximately 45° to the radius of said rotor and oriented to have outwardly trailing edges relative to the direction of rotation of said rotor.

7. The pulper of claim **5** wherein said cleaner includes a cover extending radially outward beyond the inner periphery of said rim.

8. The pulper of claim **7** wherein said cover is a flat, annular plate parallel with the axially outer surface of said rim.

9. The pulper of claim **8** wherein said cleaning vanes are substantially identical plates.

10. The pulper of claim **9** wherein said cleaning vane plates are parallelograms extending between said rim and said cover and inclined approximately 45° to the axis of said rotor and approximately 45° to the radius of said rotor and oriented to have outwardly trailing edges relative to the direction of rotation of said rotor.

11. THe pulper of claim **1** wherein a cylinder extends around said central region, said spokes are axially oriented plates extending radially outward from said cylinder, and said rim is formed as an annular box supported by said spokes.

12. The pulper of claim **11** wherein said annular box is formed of radially inner and outer cylinders, an axially inner, annular plate supporting said ridged surface of said rotor, and an axially outer, annular plate.

13. The pulper of claim **12** including mixing vanes around the axially outer periphery of said rotor.

14. The pulper of claim **1** wherein said ridged surfaces are formed of a plurality of ridged sector plates clamped in place on said rotor and stator.

15. The pulper of claim **14** wherein said sector plates have generally radial grooves oriented to pump radially outwardly.

16. The pulper of claim **14** wherein said sector plates have potted bases.

17. The pulper of claim **14** wherein said rotor and stator have peripheral abutment surfaces for engaging the radially outer edges of said sector plates and a clamp ring to secure the radially inner edges of said sector plates in place.

18. The pulper of claim **17** wherein said rotor and stator have a cylindrical ridge for engaging the radially inner edge of said clamp ring.

19. The pulper of claim **18** wherein said inner and outer edges of said sector plates are dove-tailed, and said abutment surfaces and said clamp rings have corresponding dove-tails to hold said sector plates in place.

20. The pulper of claim **1** wherein said cleaner includes spaced-apart vanes and said spokes are plates extending radially and axially of said rotor.

21. The pulper of claim **20** wherein said cleaner includea a cover extending radially outward beyond the inner periphery of said rim and said cleaning vanes extend between said rim and said cover and are inclined approximately 45° to the axis of said rotor and approximately 45° to the radius of said rotor and oriented to have outwardly trailing edges relative to the rotational direction of said rotor.

22. The pulper of claim **21** wherein said cover is a flat, annular plate parallel with the axially outer surface of said rim, and said cleaning vanes are substantially identical plates formed as parallelograms.

23. The pulper of claim **20** wherein said spokes extend for an axial distance of at least 6 percent of the outside diameter of said rotor, and said cleaner and said ridged surface of said rotor are spaced axially on opposite sides of said spokes.

24. The pulper of claim **23** wherein said cleaner includes a cover extending radially outward beyond the inner periphery of said rim, and said cleaning vanes extend between said rim and said cover and are inclined approximately 45° to the axis of said rotor and approximately 45° to the radius of said rotor and oriented to have outwardly trailing edges relative to the rotational direction of said rotor.

25. The pulper of claim **24** wherein said cover is a flat annular plate parallel with the axially outer surface of said rim, and said cleaning vanes are substantially identical plates formed as parallelograms.

26. The pulper of claim **1** wherein a cylinder extends around said central region, said spokes are plates extending anxially of said rotor and extending radially outward from said cylinder, said rim is formed as an annular box supported by said spokes, and said cleaner includes spaced-apart cleaning vanes.

27. The pulper of claim **26** wherein said annular box is formed of radially inner and outer cylinders, an axially inner, annular plate supporting said ridged surface of said rotor, and an axially outer, annular plate.

28. The pulper of claim **27** wherein said cleaner includes a cover extending radially outward beyond the inner periphery of said rim, and said cleaning vanes extend between said rim and said cover and are inclined approximately 45° to the axis of said rotor and approximately 45° to the radius of said rotor and oriented to

have outwardly trailing edges relative to the rotational direction of said rotor.

29. The pulper of claim **28** wherein said cover is a flat, annular plate parallel with the axially outer surface of said rim, and said cleaning vanes are substantially identical plates formed as parallelograms.

30. The pulper of claim **1** wherein said cleaner includes spaced-apart vanes, said spokes are plates extending radially and axially of said rotor, and said ridged surfaces are formed of a plurality of ridged sector plates clamped in place on said rotor and stator.

31. The pulper of claim **30** wherein said sector plates have generally radial grooves oriented to pump outwardly, said rotor and stator have peripheral abutment surfaces to engage the radially outer edges of said sector plates, and a clamp ring secures the radially inner edges of said sector plates in place.

32. The pulper of claim **30** wherein said sector plates have potted bases.

33. The pulper of claim **32** wherein said sector plates have generally radial grooves oriented to pump outwardly, said rotor and stator have peripheral abutment surfaces to engage the radially outer edges of said sector plates, a clamp ring secures the radially inner edges of said sector plates in place, said rotor and stator have a cylindrical ridge engaging the radially inner edge of said clamp ring, said inner and outer edges of said sector plates are dove-tailed, and said abutment surfaces and said clamp rings have corresponding dove-tails to hold said sector plates in place.

34. The pulper of claim **30** wherein a cylinder extends around said central region, said spokes are axially oriented plates extending radially outward from said cylinder, and said rim is formed as an annular box supported by said spokes.

35. The pulper of claim **34** wherein said cleaner includes a cover extending radially outward beyond the inner periphery of said rim, and said cleaning vanes extend between said rim and said cover and are inclined approximately 45° to the axis of said rotor and approximately 45° to the radius of said rotor and oriented to have outwardly trailing edges relative to the rotational direction of said rotor.

36. The pulper of claim **35** wherein said cover is a flat, annular plate parallel with the axially outer surface of said rim, and said cleaning vanes are substantially identical plates formed as parallelograms.

* * * * *