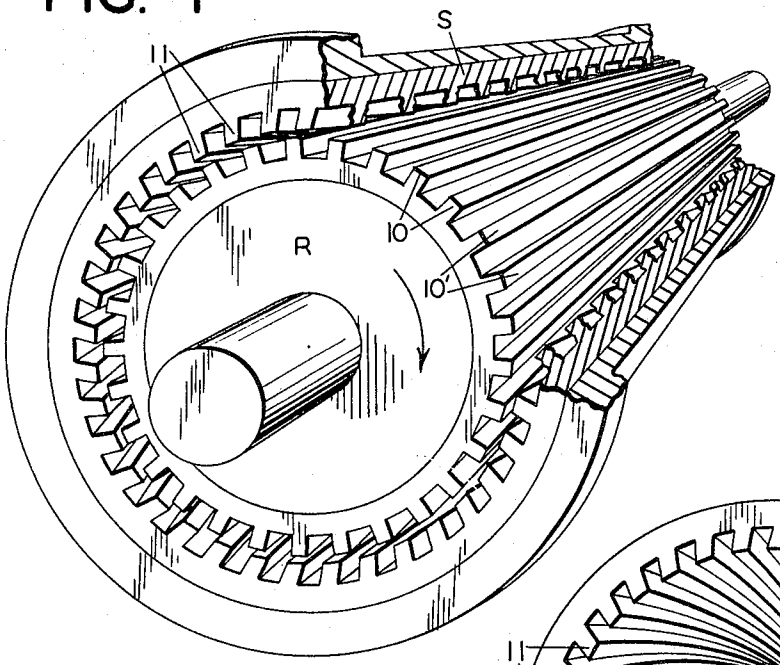
Feb. 21, 1967 R. B. MORDEN 3,305,183

MACHINE FOR TREATING PULP MATERIAL

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FIG. 1



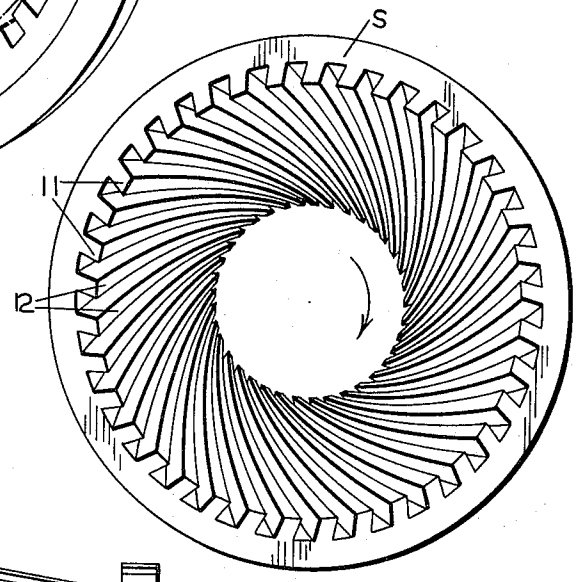


FIG. 3

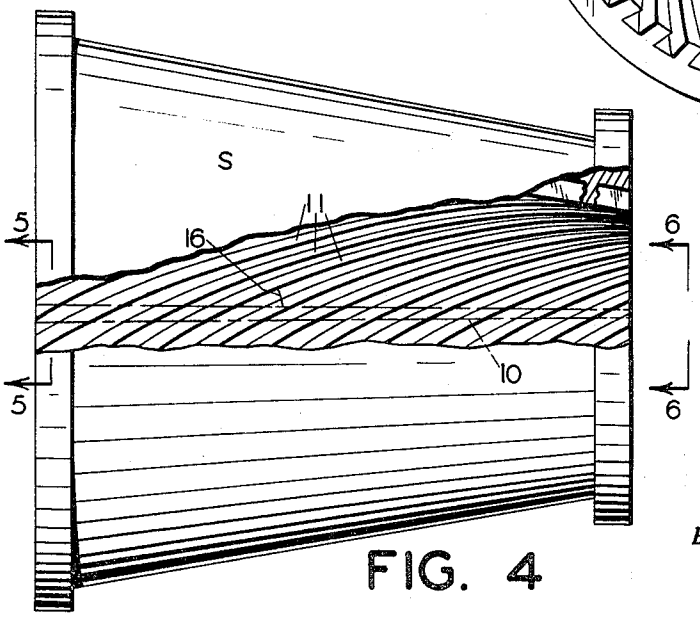


FIG. 4

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MACHINE FOR TREATING PULP MATERIAL

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FIG. 2

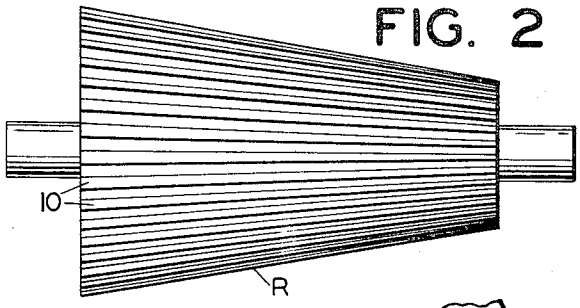
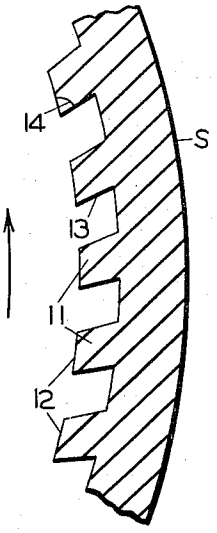


FIG. 5



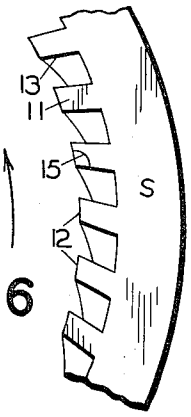


FIG. 6

FIG. 7

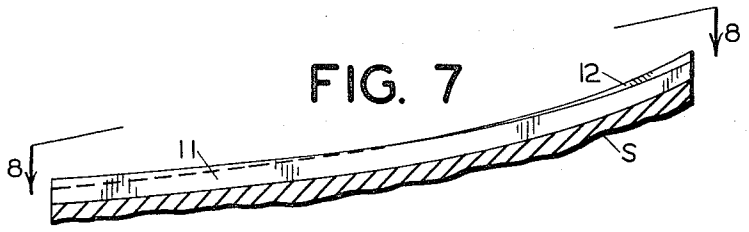




FIG. 8

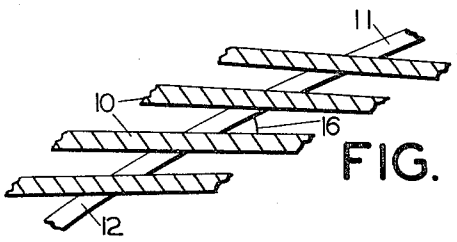


FIG. 9

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3,305,183

MACHINE FOR TREATING PULP MATERIAL

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Filed June 15, 1964, Ser. No. 375,094
5 Claims. (Cl. 241—260)

The present invention relates in general to the treating and refining of pulp material used primarily in the manufacture of paper and paper products, and, more specifically, to the general class of machines employed for subjecting the individual fibers in such pulp materials to the mechanical treatment necessary for obtaining the proper refining of the pulp.

In general, the mechanical treatment to which the fibers are subjected may be described mainly as a combination of fiber cutting, or transverse severing of the fiber, and of fiber brushing or roughening of the fiber surface. In the refining of pulp in which fiber length retention is important and in which excessive cutting of the individual fibers is undesirable the mechanical treatment for optimum results should, if possible, be so regulated as to have a proportionately greater amount of fiber brushing action and less cutting action on the fibers take place.

The various types of machines for treating fibers or pulp materials employ a rotating member having an external attritioning surface and a nonrotating member presenting a cooperating internal attritioning surface, the refining of the material or the treatment given the individual fibers taking place as the material is caused to pass along between the two attritioning surfaces. A typical pulp treating and refining machine includes a frusto-conical rotating member or rotor and a surrounding nonrotating frusto-conical member often referred to as a shell. The exterior attritioning surface of the rotor and the cooperating interior attritioning surface of the shell are provided with ridges or bars, of one type or another, extending in a more or less longitudinal direction on the respective surfaces, the rotor bars moving over the shell bars with a slight clearance and causing the fibers as they are forced to pass between the opposed bars to be subjected to a cutting action and to a brushing action as well as to other treatment intermediate between actual cutting and surface roughening.

There are two familiar problems encountered with such customary pulp treating machines. One is the amount of vibration and noise produced by the operation of the machine, emanating from the high frequency impulses generated by the encounter of the individual bars of one attritioning surface with those of the other. The other problem is to obtain less cutting action and proportionately more brushing action on the fibers by the encounter of the opposed attritioning bars when, as in most cases, improved fiber length retention is desirable.

An object of the present invention is to provide an improved pulp treating machine, the operation of which will be performed with greatly reduced noise and vibration, but without any reduction of speed in operation or reduction of output.

Since, as might be expected, a considerable reduction in vibration and noise of operation, without reduction in speed of operation, would indicate a more efficient use of power, a related secondary object is to provide an improved machine which will operate successfully with more efficient power consumption.

Another object of this invention is to provide an improved machine of the type indicated for treating pulp material with which it will be possible to obtain proportionately less actual cutting of the fibers and proportionately greater fiber brushing and other mechanical action on the fibers during the same period of treatment.

A further and related object is to provide an improved pulp treating machine in which the moving area of contact between the individual opposed attritioning bars of rotor and shell will be maintained over a relatively longer period without increasing the width of the bars or reducing the spacing between them.

An additional object is to provide an improvement in an attritioning surface of a pulp treating machine which will accomplish the above objects without involving any particular manufacturing problem or adding materially to the cost of manufacturing.

These objects and incidental advantages I have succeeded in attaining by substituting special attritioning bars mounted in novel arrangement on one of the attritioning surfaces in such a pulp treating machine. The manner in which such bars are arranged and the improved way in which they function, and the manner in which the above indicated objects consequently are attained, will be briefly described and explained with reference to the accompanying drawings.

In the following explanation the special attritioning bars and their special novel arrangement embodying the invention are illustrated and described as located on the attritioning surface of a frusto-conical, nonrotating shell member of a familiar type of pulp treating machine, the making of such change in the attritioning surface of the shell alone being considered the most practical and the preferred manner of carrying out the invention, although the invention could also be carried out by making such change in the attritioning surface of the rotor member or on the attritioning surfaces of both rotor and shell members, as well as in machines in which the rotor and shell members are not frusto-conical. Accordingly the rotor member is described herein as a frusto-conical rotor having the customary arrangement of attritioning bars extending longitudinally from one end of the rotor to the other and extending substantially in radial planes intersecting along the rotor axis.

In the drawings:

FIG. 1 is an assembly in perspective, showing the rotor and shell members in their relative positions in a machine of the type described, the attritioning bars of the shell member being shaped and mounted in accordance with the present invention, a portion of the shell member being shown broken away for clarity;

FIG. 2 is a side elevation of the rotor member by itself;

FIG. 3 is a perspective view looking into the frusto-conical shell from the large diameter end towards the small diameter end;

FIG. 4 is a side elevation of the shell member with a portion of the wall on the near side broken away to show part of the attritioning surface on the opposite side of the interior;

FIG. 5 is a fragmentary transverse section taken on the line indicated at 5—5 of FIG. 4 looking in the direction indicated by the arrow and showing an end portion of some of the bars on the attritioning surface of the shell;

FIG. 6 is a fragmentary transverse section taken on the line indicated at 6—6 of FIG. 4 looking in the same direction as in FIG. 5 and showing the opposite end portions of some of the bars on the attritioning surface of the shell;

FIG. 7 is a side elevation of one of the shell bars;

FIG. 8 is a top plan view of the same bar taken on line 8—8 of FIG. 7; and

FIG. 9 is a schematic fragmentary developed section illustrating the relative position of each shell bar with respect to the associated rotor bars during any given moment.

Referring first to FIGS. 1 and 2, the rotor and shell are indicated in general by reference characters R and S re-

spectively. The attritioning surface of the rotor is provided with the customary attritioning bars **10**, the longitudinal center lines of which extend in radial planes intersecting along the rotor axis. The outer or working faces **10'** of these rotor bars are curved transversely into convex curvature to correspond to the curvature of the adjacent portions of the surface of the rotor, the outer faces of these bars thus extending in a co-axial frusto-conical surface as is customary.

For the purpose of this description it is assumed that the pump material to be treated passes between the attritioning surfaces of the rotor and shell from the large diameter end of these members to the small diameter end and also that the rotation of the rotor, as viewed in FIG. 1, is clockwise.

The interior frusto-conical surface of the shell S is provided also with a plurality of identical, equally-spaced bars **11**, but the longitudinal center lines of these bars (see FIGS. 7 and 8 as well as FIGS. 3 and 4), extend in planes which intersect at a point on the common axis of the rotor and shell. Thus the longitudinal center line of each shell bar **11** extends in a single plane and these planes have the same angularity at corresponding points along the bars with respect to the intersected bars on the rotor.

Due to the fact that the shell bars **11** extend obliquely across the interior of a frusto-conical surface, each bar, although extending in a single plane, is also bowed or curved longitudinally. The outer or working face **12**, of each shell bar **11** is curved transversely to conform to the curvature of the adjacent portions of the shell surface, thus having concave curvatures, and these working faces extend in a frusto-conical surface co-axial with and having a slight clearance with the frusto-conical surface determined by the opposed working faces of the rotor bars **10**. In effect therefore the working faces of the shell bars are spirals extending obliquely from one end of the shell surface to the other.

However, also due to the fact that these shell bars extend in planes oblique to the common axis and thus extend obliquely across the curved interior or frusto-conical surface of the shell, the angularity which the plane of the longitudinal center line of each shell bar **11** makes with the portion of the shell surface adjacent the base of the bar will vary from one end of the bar to the other. In other words, the inclination of a side face of a bar with respect to the adjacent shell surface at one end of the shell will be different from the inclination with respect to the adjacent shell surface at the opposite end of the shell. This feature is illustrated best in FIGS. 5 and 6, the ends of some of the shell bars **11** at the large diameter of the shell being shown in FIG. 5 as sloping in a direction opposed to the (clockwise) direction in which the rotor blades are indicated as moving, while the opposite ends of some of the shell bars **11** are shown in FIG. 6 as sloping oppositely with respect to the adjacent portion of that end of the shell interior surface. While the longitudinal center line of each bar remains in the same plane throughout the extent of the bar the slope of the surface over which the bar extends changes gradually from a slope in one direction to another. Correspondingly the working face **12** of each shell bar **11**, which of necessity must correspond to the surface of the shell immediately adjacent the base of the bar, gradually changes from a slope in one direction to another. Thus the intersection of the working face **12** with the side face **13** of the bar, for example, which is shown as being the side face facing against the direction towards which the rotor is rotating, is indicated in FIG. 5 as forming an acute angle **14** at this large diameter end of the shell, but the same side **13** of the same bar intersects the working face **12** of the bar at the opposite end of the bar with a greater angle and thus, in the device as illustrated, is shown forming the obtuse angle **15** at this end of the bar as indicated in FIG. 6.

This difference in the relative slope of each bar at opposite ends of the shell will be referred to again later.

Referring now particularly to FIGS. 4 and 9, since the longitudinal center lines of the shell bars **11** all extend in planes which intersect at a point on the common axis of rotation of the rotor and shell, while the longitudinal center lines of the rotor bars extend in radial planes, intersecting along the common axis of rotor and shell, the working faces of the shell bars and of the rotor bars have a definite angularity with respect to each other. In other words, each rotor bar **10** will be in working relationship with a plurality of shell bars at all times, each bar of the rotating rotor passing along over a plurality of shell bars from one end to the other of each bar.

The resulting effect on the operating vibration and noise arising from the relative movement between the two opposed attritioning surfaces can be readily understood by comparing two imaginary situations, one in which the shell bars as well as the rotor bars all extend in radial planes intersecting along the common axis, under which condition there would be a maximum amount of vibration and noise from the resulting impulses; and the other in which the shell bars would extend in planes each perpendicular to the common axis of the rotor and shell with the rotor bars remaining in radial planes intersecting along the common axis. Thus the shell bars would constitute co-axial rings surrounding the rotor. Obviously in this latter situation there would be an absence of impulses causing vibration and noise. However, in this case also there would be no passage of the pulp material through the attritioning surfaces and consequently such an arrangement in the machine would not function.

In the carrying out of the present invention it has been found that most satisfactory results are obtained, from the standpoint of desired extensive reduction of vibration and noise of operation, from the standpoint of machine output and efficient power consumption, and from the standpoint of controlled fiber treatment, if the angularity between the shell bars and the rotor bars at the points where the working faces of the rotor bars move across the faces of the shell bars is at least 18° and not more than 38°. A machine of standard size with the rotor bars and shell bars arranged as indicated has given highly satisfactory performance from all the above mentioned standpoints with the angularity at which the shell bars are crossed by the moving rotor bars reaching a minimum of approximately 24° and a maximum of approximately 36° at corresponding points of intersection, (as indicated by the angle **16** in FIGS. 4 and 9), and consequently this is regarded as the preferred arrangement for the carrying out of the invention in the manner described. In this particular machine the attritioning bars of both members were more or less of standard width with the spacing between them also more or less standard for such machines, but each rotor bar constantly extended over approximately 20% of the shell bars.

From FIGS. 4 and 9 it will be apparent that the moving areas of contact between the opposed bars are maintained over a relatively longer period than with the heretofore customary arrangement in which the opposed attritioning bars more closely approach parallelism, and proportionately greater brushing treatment is received by the fibers since they tend to be moved over the working faces of the bars to a less degree in a transverse direction and to a greater degree in a longitudinal direction with respect to the bars.

Referring again to FIGS. 5 and 6, in which the direction of rotation is indicated by the arrows, it will be noted that there will be a greater tendency for cutting of the fibers to take place when the moving rotor bars thrust the fibers against an acute angle edge of the shell bar, as illustrated in FIG. 5, than when the fibers are thrust against an edge which has an angle which is less acute and preferably obtuse, as illustrated in FIG. 6. Thus in the example illustrated, proportionately more cutting of the fibers

takes place at the start or large diameter end of the attritioning surfaces but the proportionate cutting action decreases while the proportionate brushing action increases towards the smaller diameter end. Thus, with a predetermined positioning of the shell bars, and by having the planes determined by the longitudinal center lines of these bars given a predetermined inclination with respect to the adjacent shell surface at a given location, it is possible to achieve proportionately less cutting action and proportionately greater brushing action, and this is in addition to the important feature of achieving a substantial reduction in the vibration and noise of operation of the pulp treating machine.

Various modifications will be possible in the details of a machine capable of carrying out the invention, and, as previously indicated, the machine herein described is given as a preferred example only. In the drawings both rotor bars and shell bars are indicated as being formed integral with the body portion of the rotor and shell respectively. It has been found very practical in machines of this type to form the attritioning surfaces on each member by casting. However, since the shell bars as well as the rotor bars each have their longitudinal center lines extending in a single plane and the shell bars are identical while the rotor bars also are identical, the bars on both members may also be made separately and mounted in combination with suitable fillers placed in the intervening spaces as has also been customary in such machines.

Also while the machine described is shown with the rotor rotating in clockwise direction, as viewed from the large diameter end, and with the shell bars extending forwardly and obliquely in the same direction, obviously it would be possible to have the machine arranged to accommodate rotation in either direction and the same desired objectives achieved. Further modifications would be possible similarly without departing from the scope and principle of the invention.

I claim:

1. In a machine for treating pulp material, a rotor member having an exterior attritioning surface, a non-rotating shell member co-axial with and surrounding said rotor member and having an interior cooperating attritioning surface, a plurality of attritioning bars on the attritioning surface of one of said members, each of said bars extending in a single plane, a plurality of attritioning bars on the attritioning surface of the other of said members, each of said latter mentioned bars extending in a single plane and arranged at the same relative angularity of between 18° and 38° with said first mentioned bars at corresponding crossing points, whereby every bar on the attritioning surface of one of said members will be in working relationship with and in angularity with a plurality of cooperating bars on the attritioning surface of the other of said members at all times, thereby minimizing the noise and vibration produced by the operation of the machine, the working faces of said bars on said attritioning surfaces extending in a pair of surfaces having a slight clearance therebetween, the side faces of each of said bars on one of said attritioning surfaces having a different inclination with respect to the adjacent surface on the latter mentioned attritioning surface at one end of said latter mentioned surface than with respect to the adjacent surface at the opposite end of said latter mentioned surface.

2. In a machine for treating pulp material, a rotor member having an exterior attritioning surface, a non-rotating shell member co-axial with and surrounding said rotor member and having an interior cooperating attritioning surface, a plurality of attritioning bars on the attritioning surface of one of said members, the longitudinal center lines of said bars extending in radial planes intersecting along the common axis of said members, a plurality of attritioning bars on the attritioning surface of the other of said members, the longitudinal center lines of said second mentioned bars extending in planes intersecting at a point on the common axis of said members, whereby every bar on the attritioning surface of one of said members will be in working relationship with and in angularity with a plurality of cooperating bars on the attritioning surface of the other of said members at all times, thereby minimizing the noise and vibration produced by the operation of the machine, the side faces of each of said second mentioned bars inclined in one direction relative to the adjacent portion of the attritioning surface at the base of such bar at one end of said bar and inclined in the opposite direction relative to the adjacent portion of such surface at the opposite end of said bar, the side faces of said first mentioned bars having the same angularity with respect to the adjacent attritioning surface of said first mentioned member throughout their entire extent, whereby the fibers of the pulp material passing between said attritioning surfaces with the rotation of said rotary member will be subjected to combined cutting and brushing actions with the proportionate amount of cutting action being greatest at one end of said attritioning surfaces and the proportionate amount of brushing action being greatest at the opposite end of said attritioning surfaces.

3. In a machine for treating pulp material, a rotor member having an exterior attritioning surface, a non-rotating shell member co-axial with and surrounding said rotor member and having an interior cooperating attritioning surface, the attritioning surfaces of said members being frusto-conical, a plurality of attritioning bars on the attritioning surface of said rotor member, the longitudinal center lines of each of said bars extending in a single plane, a plurality of attritioning bars on the attritioning surface of said shell member, the longitudinal center lines of said shell member bars extending in planes intersecting at a point on the common axis of said members, said shell member bars so arranged that each of said shell member bars will be in working relationship with and in angularity with a plurality of cooperating bars on said rotor attritioning surface at all times, thereby minimizing the noise and vibration produced by the operation of the machine, the working faces of said shell bars constituting in effect spirals extending forwardly in the direction of the flow of material between said attritioning surfaces, and the side faces of said shell bars inclined in one direction relative to the adjacent shell surface at one end of said shell and inclined in the opposite direction relative to the adjacent shell surface in the opposite end of said shell.

4. In a machine for treating pulp, a rotor member having an exterior attritioning surface, a non-rotating shell member co-axial with and surrounding said rotor member and having an interior cooperating attritioning surface, the attritioning surfaces of said members being frusto-conical, a plurality of attritioning bars on the attritioning surface of said rotor member, the longitudinal center lines of said bars extending in radial planes intersecting along the common axis of said members, a plurality of attritioning bars on the attritioning surface of said shell member, the longitudinal center lines of said shell bars extending in planes intersecting at a point on the common axis of said members, the working faces of said shell bars constituting in effect spirals extending forwardly in the direction of the flow of material between said attritioning surfaces and in the direction of rotation of said rotor member, whereby every bar on the attritioning surface of one of said members will be in working relationship with and in angularity with a plurality of cooperating bars on the attritioning surface of the other of said members at all times, thereby minimizing the noise and vibration produced by the operation of the machine, the working faces of the bars on said attritioning surfaces extending in a pair of co-axial frusto-conical surfaces having a slight clearance therebetween, the side faces of each of said shell bars having a different angularity with respect to the adjacent surface on said shell member at

one end of said shell member than with respect to the adjacent surface on said shell at the opposite end of said shell member, whereby the fibers of the pulp material passing between said attritioning surfaces with the rotation of said rotor member will be subjected to combined cutting and brushing actions, with the proportionate amount of cutting action being greatest at one end of said attritioning surfaces and the proportionate amount of brushing action being greatest at the opposite end of said attritioning surfaces.

5. In a machine for treating pulp material, a rotor member having an exterior attritioning surface, a non-rotating shell member co-axial with and surrounding said rotor member and having an interior cooperating attritioning surface, the attritioning surfaces of said members being frusto-conical, the machine and said members so arranged that the pulp material being treated will pass from the larger diameter ends of said attritioning surfaces out through the smaller diameter ends, a plurality of similar equally-spaced attritioning bars on the attritioning surface of said rotor member, the longitudinal center lines of said bars extending in radial planes intersecting along the common axis of said members, a plurality of identical, equally-spaced attritioning bars on the attritioning surface of said shell member, the longitudinal center lines of said shell bars extending in planes intersecting at a point on the common axis of said members, the working faces of said shell bars constituting in effect spirals extending forwardly in the direction of the flow of material between said attritioning surfaces and in the direction of rotation of said rotor member, whereby every bar on the attritioning surface of one of said members will be in working relationship with and in angularity with a plurality of co-operating bars on the attritioning surface of the other of said members at all times, thereby minimizing the noise and vibration produced by the operation of the machine, the angularity between the opposed bars at corresponding crossing points being between 18° and 38°, the working faces of the bars on said attritioning surfaces extending in a pair of co-axial frusto-conical surfaces having a slight clearance therebetween, the side faces of each of said shell bars at the larger diameter end of said shell inclined relative to the adjacent portion of the shell surface in the direction opposed to the direction of rotation of said rotor member and oppositely inclined relative to the adjacent portion of the shell surface at the smaller diameter end of said shell member, whereby the fibers of the pulp material passing between said attritioning surfaces with the rotation of said rotor member will be subjected to combined cutting and brushing actions, with the proportionate amount of cutting action being greatest at the larger diameter intake end of said attritioning surfaces and the proportionate amount of brushing action being greatest at the smaller diameter end of said attritioning surfaces.

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