May 13, 1952 C. W. MORDEN 2,596,586

MACHINE FOR TREATING FIBROUS MATERIAL

Filed June 19, 1947 3 Sheets-Sheet 1

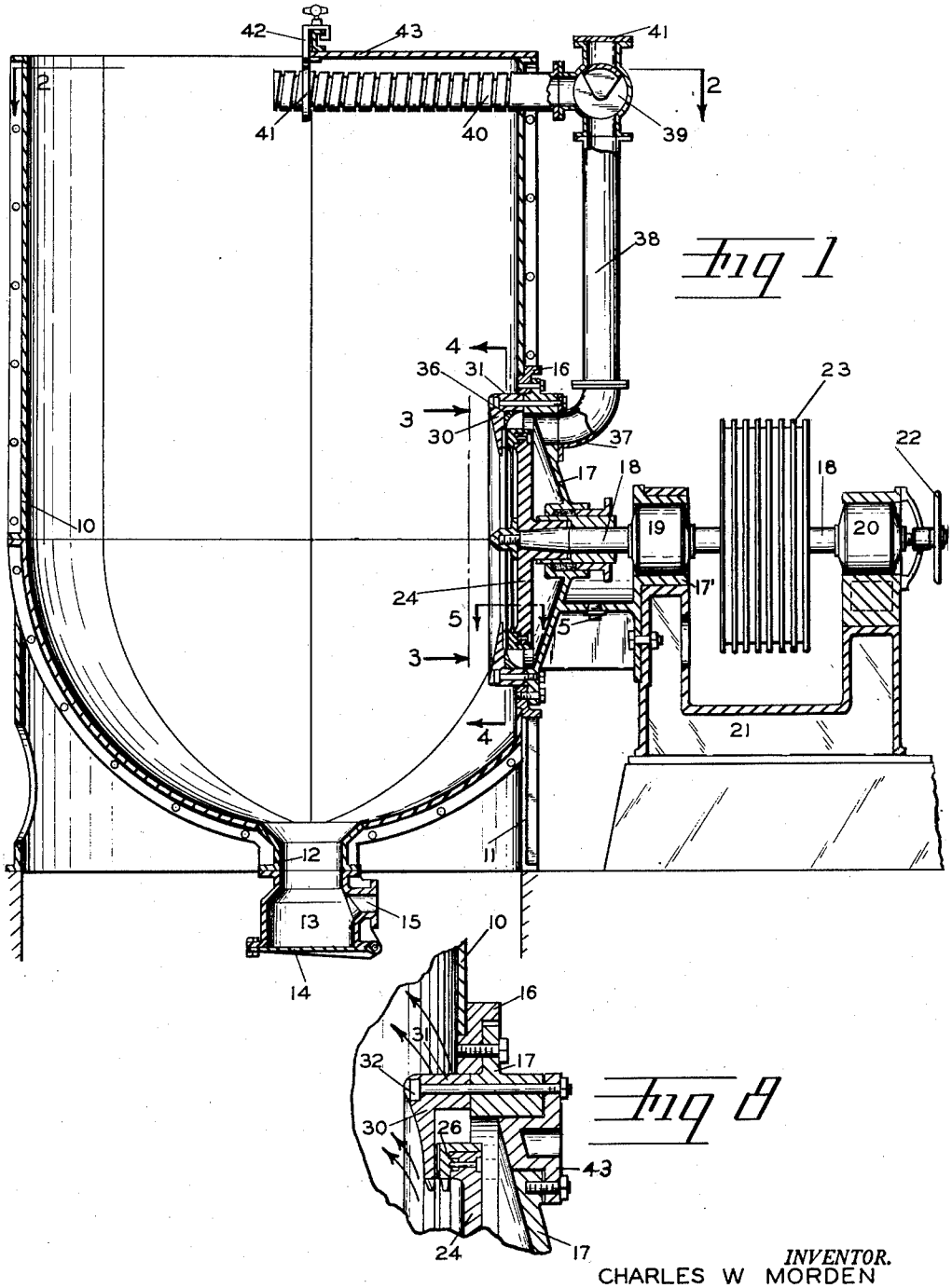


Fig 1

Fig 8

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Fig 2

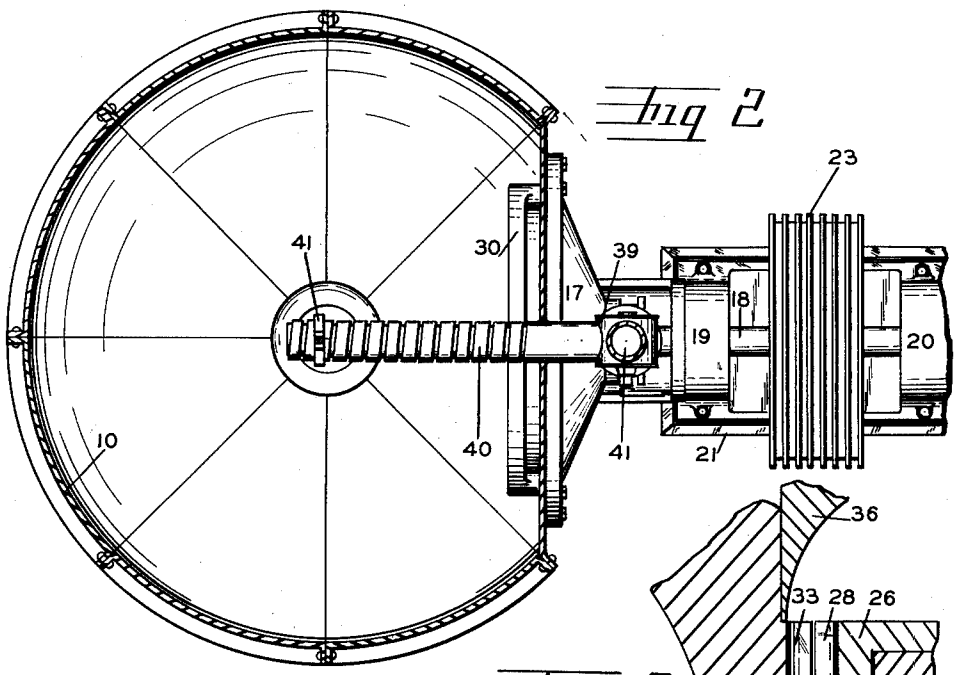
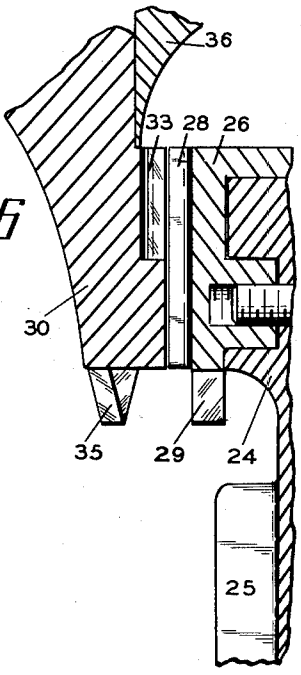


Fig 6



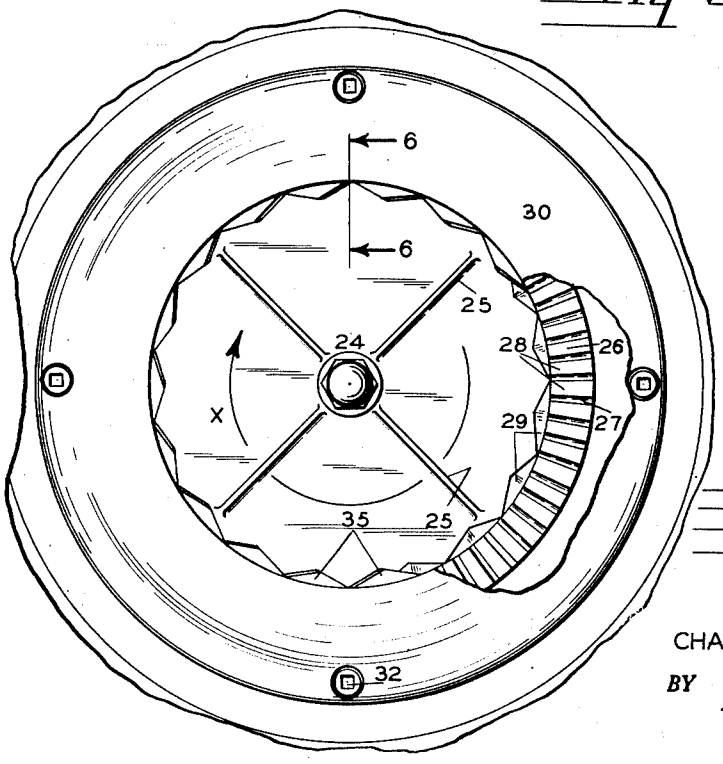


Fig 3

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Fig 4

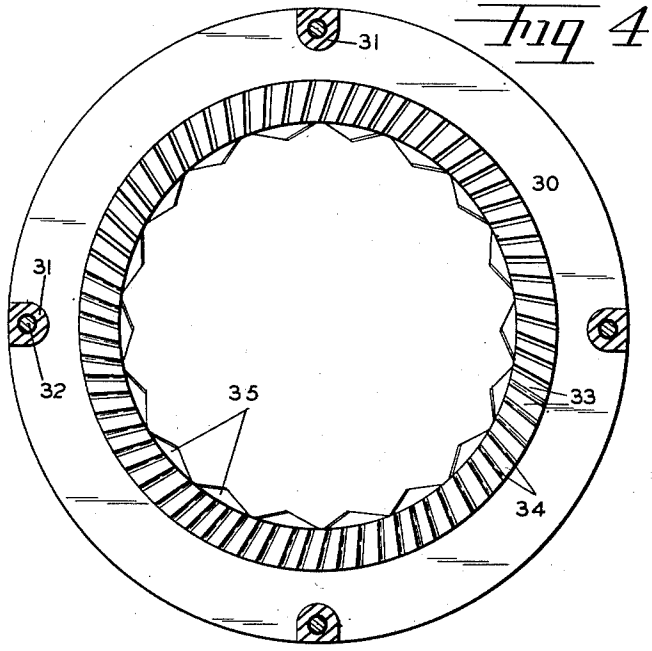


Fig 7



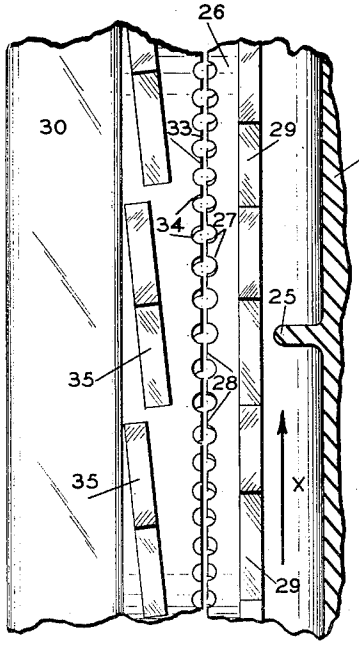


Fig 5

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UNITED STATES PATENT OFFICE

2,596,586

MACHINE FOR TREATING FIBROUS MATERIAL

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Application June 19, 1947, Serial No. 755,581

10 Claims. (Cl. 92—26)

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The present invention relates in general to machines employed for treating fibrous material, particularly such material as pulp sheets, old paper stock, etc., when such material is delivered in dry form and is required to be broken up, shredded, slushed and refined.

More specifically, this invention relates to a machine in which pulp or paper stock is also to be given a special controlled and regulated treatment including shredding, classifying and refining of the pulp fibers.

One of the objects of the invention is to provide an improved device which will serve the dual purpose of shredding, slushing, and mixing the pulp and of performing a controllable refining action on the pulp as required.

Another object of this invention is to provide a machine, of the nature above indicated, for treating fibrous material, which will function to classify the material and permit that portion of the material which has received sufficient, predetermined treatment to be withdrawn, as and if desired, and the residue to be recirculated and given further treatment.

An additional object of the invention is to provide a machine which can be used either for continuous operation or for batch operation.

A further object is to provide an improved machine of relatively simple construction and easy maintenance in which various and variable types of pulp treatment can be selectively carried out in an efficient and definite manner and in which relatively little adjustment will be necessary for meeting different requirements.

The objects above indicated and other advantages, as will hereinafter appear, I am able to attain in my improved machine by providing therein a revolving disk of special design and construction, associated with a stationary ring, also of special design and construction, with teeth in novel arrangement and of novel design preferably on both disk and ring for shredding the pulp or other material, with means including attritioning elements provided on the disk and on the ring for performing a controllable brushing and refining action; and with cooperating elements and adjustable means as hereinafter briefly described.

In the following description reference is made to the accompanying drawings in which:

Fig. 1 is a vertical longitudinal section taken approximately along the center line of the device;

Fig. 2 is a plan section taken on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary side elevation taken on line 3—3 of Fig. 1, but drawn to a larger scale,

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showing in elevation the stationary ring and the inner face of the disk beyond the ring, with portion of the ring broken away to show the attritioning surface and shredding teeth on the flanged rim attached to the disk;

Fig. 4 is a sectional elevation taken on line 4—4 of Fig. 1, drawn to the same scale as Fig. 3 and showing the opposite face of the ring member with its attritioning surface;

Fig. 5 is a fragmentary plan section taken on line 5—5 of Fig. 1, but drawn to a still larger scale and giving a plan view of the shredding teeth and attritioning grooved surfaces of the lower portion of both disk and stationary ring;

Fig. 6 is an enlarged fragmentary section through the ring and disk taken on line 6—6 of Fig. 3;

Fig. 7 is a vertical transverse section taken diametrically through an annular flow-directing member which is employed when the device is arranged as shown in Fig. 1; and

Fig. 8 is an enlarged fragmentary vertical section of the upper portion of the disk and stationary ring showing optional means by which the treated pulp can be directed through another course.

In the embodiment of my invention as illustrated by the pulp treating machine shown in the accompanying drawings, a pulp tank (Figs. 1 and 2) indicated in general by the reference character 10, comprises a substantially cylindrical upper portion, with a flat section on one side, which upper portion is joined to a substantially semi-spherical tank base. Preferably this stock tank is made in flanged sections as a practical convenience suitable for being bolted, riveted or otherwise secured together in place when the tank is set up. As shown in Fig. 1 a suitable cylindrical skirt or support 11 serves as the support or mounting for the tank.

A centrally located bottom discharge passageway 12 connects with a lower chamber 13 which extends preferably down below the floor. The chamber 13 has an outlet port 15, adapted to be connected to a suitable outlet pipe (not shown), through which the contents of the tank can be discharged into a suitable receiving vessel or storage tank located in the floor below, if desired. The bottom of the chamber 13 is closed by a hinged cover plate 14, which is locked or bolted in closed position, but which may be opened from time to time when necessary for the purpose of removing dirt, "tramp metal," or other foreign particles which will collect in the bottom of chamber 13.

The flattened side wall section of the tank 10 (Figs. 1 and 2) is formed with a large circular opening. A flanged rim 16 (Figs. 1 and 8), secured to the tank wall, extends around the border of this opening and an exterior cover plate 17, the major portion of which is slightly conical in shape, is secured to the rim 16 by bolts. This cover plate 17 is formed with a central boss which supports a packing gland (as shown in Fig. 1) around a horizontal rotating shaft 18. The cover plate is also formed with an extension 17' in which is mounted a journal box 19 for the shaft 18.

The shaft 18 is mounted in the pair of journal boxes 19 and 20. The journal box 20 is carried on a suitable bearing stand 21 which is attached to the cover plate extension 17' and thus to the tank 10. The journal boxes 19 and 20 contain suitable anti-friction bearings, the bearing in journal box 20 being a thrust type bearing. The two journal boxes are so mounted that they may be given a slight sliding movement in their supports, and thus the position of the shaft 18 may be adjusted longitudinally with respect to the tank wall. The reason for this will be explained later. This longitudinal adjustment of the position of the shaft 18 is accomplished by means of a hand wheel 22 (Fig. 1) attached to the outer end of a positioning screw. The inner end of the positioning screw is threaded into a plate attached to journal box 20. A pulley 23, keyed on the shaft 18, is arranged so as to be connected by suitable belt or belts (not shown) to a motor, so that operation of the motor will produce rotation of shaft 18.

On the inner end of shaft 18 a disk 24 is secured. The design of this disk is one of the features of the invention. The side of this disk 24 which faces the tank is slightly dished and carries radial vanes 25 (Figs. 3 and 6) at its center portion, the purpose of which is to cause the stock in the tank, when coming into contact with the vanes of the rotating disk 24 to be moved to the outer perimeter of the disk. An annular or flanged rim 26, shown most clearly in Figs. 6, 8 and 3, is mounted on the disk 24.

Equally spaced radial grooves 27 in the vertical face of this annular rim 26 cause the intervening portions of the face of this rim to constitute a series of radially-arranged attritioning bars 28 (see Figs. 3, 5 and 6). The inner periphery of the disk rim 26 is formed with a continuous succession of peaked teeth 29, all extending in a plane perpendicular to the axis of rotation of the disk 24.

On the inside of the tank 10, coaxial with the circular opening and with the disk 24 and cover plate 17, is a stationary ring member 30 (shown in all the figures). The face of this stationary ring member towards the interior of the tank is dished or concave, as shown in Figs. 1, 6 and 8. Bosses 31 (Figs. 1, 4 and 8) extend from the opposite face of the stationary ring member so as to cause the ring member to be mounted in a position slightly spaced inside the tank wall. The ring member 30 is secured in place by bolts 32 extending through the ring and its bosses and through the cover plate 17. The outer face of the ring member, that is to say, the face opposed to the disk rim 26 is formed into a series of attritioning bars 33 (Figs. 4 and 5) by grooves 34 similar to the grooves 27 in the disk rim 26. However the grooves 34 unlike the grooves 27 do not extend radially but are arranged so as to be at an angle with the radius of the ring at each point. This

difference in the arrangement of the attritioning bars on the opposed faces of the stationary ring member 30 and the disk ring 26 cause the pulp which is required to pass between these opposed faces during the rotation of the disk 24 and disk rim 26 to have its fibers subjected to a shearing action as part of the refining action. Thus these two opposed attritioning surfaces perform a multiple attritioning action on the pulp fibers passing between them, which action will be governed or controlled to considerable extent by the position of the rotating disk rim 26 with respect to the stationary ring member 30. This position, as apparent from Fig. 1 and the previous description, is adjustable by the hand wheel 22.

The inner periphery of the stationary ring member 30 is formed with a series of peaked teeth 35, similar to the teeth 29 on the inner periphery of the disk rim 26, but, as shown in Figs. 5 and 6, the teeth 35, unlike the teeth 29, are obliquely disposed in planes which are not parallel to the plane of rotation of the disk 24 and thus are not parallel to the vertical plane in which the teeth 29 extend. These oblique teeth 35, as best shown in Fig. 5, are inclined toward the teeth 29 in opposition to the direction of rotation of the teeth 29, that is, in opposition to the arrow x in Fig. 5, so as to split the impinged fibrous material and direct part of it laterally while the remainder is centrifugally forced radially between the opposed attrition surfaces on the rim 26 and ring member 30.

The two sets of teeth 29 and 35, their shape and arrangement, constitute further important features of my machine. If the pulp is brought into contact with these two sets of teeth, one set rotating while the other set remains stationary, the pulp is subjected to a new type of shredding action. Following this shredding action, a portion of the pulp will then be passed between the attritioning surfaces of the stationary ring member 30 and the rotating disk rim 26 and subjected to the special and controlled attritioning action already described.

The fact that the two sets of teeth 29 and 35 do not extend in parallel rows will furthermore, due to the manner in which the teeth 35 are positioned, (see Fig. 5), exert a force tending to pull the pulp apart and at the same time the moving of the pulp against and past the teeth will increase this pulling apart to what might be termed a "splitting" action as the pulp stream is actually "split" upon its impingement against the teeth of the ring member 30. Thus, as the disk 24 rotates in the direction indicated by the arrow x in Fig. 5, the pulp will be subjected in part to a lateral pull by the teeth 35 which are not parallel to the plane of rotation of the disk 24, which pull changes to more of a splitting and severing action as the pulp is drawn and forced against and along the teeth 35. The peaked form of the shredding teeth also has a further feature in that it causes pieces of "tramp metal," or any other particles heavier than the pulp, to be thrown out from the teeth, and thus thrown back into the tank 10. In the arrangement of the machine which I have shown in the drawings tramp metal and other foreign particles will tend to settle in the tank bottom, being of heavier specific gravity than the pulp itself, and, due to the shape of the tank bottom, such foreign material will finally collect in the chamber 13 from which it may readily be removed from time to time.

Although the stationary ring member 30 is positioned inside the tank wall by its integral bosses

31, as previously explained, in the arrangement of my machine illustrated by Figs. 1, 2 and 6 passage of pulp between the stationary ring member and the adjacent tank wall and past the bosses 31 is blocked by an annular flow-directing member or ring 36 (shown also separately in Fig. 7) which is purposely set in behind the stationary ring member 30 and held in place by the bosses 31 and the cover plate 17. Since the stock which is passed between the attritioning surfaces of the stationary ring member 30 and the disk rim is prevented by the member 36 from passing directly back into the tank, it fills the space within the cover plate 17 around the rotating disk and builds up pressure. The cover plate 17 is formed with an outlet port in the upper portion, and an elbow fitting 37 (Fig. 1) is secured to the cover plate at this outlet port. A vertical pipe 38 is connected to the upper end of this elbow fitting and in turn is connected to a three-way valve 39 of well known construction. The valve 39 and associated pipe joints are so arranged that the pulp, passing up through pipe 38, can be caused either to pass through a pipe or nozzle 40, or can be delivered through a top outlet 41 (which top outlet can be connected to a pipe line extending to the floor above and thence delivering the pulp wherever desired for further stages in the paper manufacture in the mill), or the passage of the pulp from pipe 38 can be shut off altogether.

When the valve 39 is in the position indicated in Fig. 1, the treated pulp will pass upwardly through pipe 38 and thence through the pipe or nozzle 40 and will be delivered again into tank 10 for further mixing with the pulp in the tank and for further treatment in combination with the other tank pulp. Preferably the pipe or nozzle 40 through which this pulp is discharged back into the tank is made flexible so that the position of the discharging end of the pipe or nozzle can be adjusted. The reason for this is that a stream of pulp discharged from the pipe or nozzle 40 into the tank 10 will influence the current or submergence of the stock within the tank. The pulp from nozzle 40 could be discharged, for example, at the side of the tank opposite the disk 24. For improved submerging, mixing and circulating of the pulp sheets and paper stock in the tank it may sometimes be advantageous to direct the stream of treated pulp, discharged from the pipe or nozzle 40, to a particular section of the pulp in the tank. As one means of enabling this possibility to be made use of, when treated pulp is being returned to the tank, I provide the flexible pipe or nozzle 40 as illustrated in Figs. 1 and 2. The discharging end of the pipe or nozzle 40 rests in a loop support 44 attached at its upper end to a suitable clamp bracket 42 which slides on the edge of a top plate 43 extending part way over the top of the tank 10. A clamping screw holds the bracket and therewith the discharging end of the pipe or nozzle 40 at a preferred location with respect to the tank wall and with respect to the vertical movement of the pulp within the tank.

After the pulling apart and "splitting" of the pulp delivered from vanes of the rotating disk 24 that portion of the pulp which passes between the attritioning surfaces of the stationary ring member 30 and the rotating disk rim 26 will be given a controllable, desired, predetermined treatment, and, as a result, the pulp passing into the pipe 38 becomes classified by such treatment and thus distinguished from the pulp in the tank 10 which has still to receive attritioning treatment or classifying action.

Instead of having the treated pulp pass through pipe 38 and thence delivered either back into the tank through the pipe or nozzle 40 or delivered elsewhere through the upper outlet 41, the treated pulp can be returned directly to the tank by removing the flow-directing member 36 and by preventing discharge of the pulp from the port in the cover plate 17. When it is desired to have all the treated pulp returned directly to the tank, as for example in special batching operations, I remove the fitting 37 (Fig. 1) and secure a plug 45 (Fig. 8), in the cover plate port. That portion of the pulp which passes between the attritioning surfaces of the disk rim 26 and stationary ring member 30 then is delivered directly back into the tank, following the course indicated by the upper arrows in Fig. 8, while the balance of the pulp, split off by the teeth on the stationary ring member 30, follows the vortical course indicated by the lower arrows in Fig. 8.

When my machine is set up in this manner for batching operations primary consideration can be given, if desired, to obtaining a controllable shredding action, with or without accompanying refining action. While the possibility of adjustment of the position of the disk 24 with respect to the stationary ring 30 heretofore has been referred to only as a means of controlling the attritioning treatment accorded by the two opposed attritioning surfaces of the ring 30 and disk rim 26, such adjustment can also serve primarily in influencing the shredding action desired to be obtained through the medium of the two sets of shredding teeth. For example, in starting a special batch operation it may be desirable to concentrate on the shredding and slushing of the pulp. By increasing the spacing between the disk rim 26 and stationary ring 30 the attritioning treatment can be minimized or even rendered negligible. However in such case the shredding would be enhanced by the more rapid passage of the pulp past and between the two sets of shredding teeth as an increased amount of the pulp is drawn between rim 26 and ring 30 with less interference. Thus the adjustment of the relative position of the disk and ring has a separate and novel and important function in my invention in connection with the shredding action as distinguished from the more common attritioning treatment.

In batch operations the pulp, after completion of whatever treatment is to be performed, can then be discharged through the outlet port 15 in the bottom chamber 13 (Fig. 1), as previously mentioned.

In the embodiment of my invention which I have described and illustrated, the rotating disk and associated members are positioned at the side of the tank. It would of course be possible to have more than one disk in my machine, thus, for example, a pair of disk assemblies could be placed opposite each other, located in opposite sides of a large tank, with each disk assembly functioning substantially in the manner described. It would also be possible to have the disk assembly located at the bottom of the tank instead of at the side. While I have illustrated and described what I consider to be the preferred arrangement in my machine, it is not my intention to restrict myself to the specific construction or arrangement described or to limit my invention otherwise than as set forth in the claims, since other and various minor modifica-

tions would be possible within the scope of this invention.

I claim:

1. A machine for treating fibrous material, comprising a stationary ring member, shredding teeth on the inner periphery of said ring member, the free ends of said teeth extending inwardly of said ring member and towards the center thereof, a rotatable element coaxial with said ring member, an annular rim supported by said rotatable element in closely spaced parallel relation to said ring member, the inner peripheries of said ring member and said rim being of substantially the same diameter, shredding teeth on the inner periphery of said rim, the free ends of said latter teeth extending inwardly of said rim towards the axis of rotation thereof for cooperation with the shredding teeth on said ring member in tearing or shredding of fibrous material and means on said rotatable element for causing fibrous material to be delivered to and impinged against the two sets of shredding teeth when said element is rotated.

2. A machine as defined in claim 1 wherein the two sets of said shredding teeth are respectively disposed in substantially parallel planes and the teeth of at least one of said sets are each disposed obliquely to the plane of said set, said oblique teeth being inclined toward the other set of teeth in opposition to the relative rotation between said ring member and rim element to split the impinged fibrous material and direct part of the material laterally while the remainder of the material is forced radially between the adjacent sides of said ring member and rim element.

3. A machine as defined in claim 2 wherein the adjacent sides of said ring member and rim element comprise attrition means which cooperatively act upon the fibrous material which is forced therebetween.

4. A machine for treating fibrous material, comprising a tank, a stationary ring member mounted within said tank adjacent one side thereof, a set of shredding teeth on the inner periphery of said ring member, the free ends of said teeth extending inwardly of said ring member and towards the center thereof, a rotatable disk journalled in said tank coaxially with said ring member and between said ring member and the adjacent side of said tank, an annular rim supported by said disk in closely spaced parallel relation to said ring member, the inner peripheries of said ring member and said rim being coaxial and of substantially the same diameter, a set of shredding teeth on the inner periphery of said rim, the free ends of said latter teeth extending inwardly of said rim towards the axis of rotation thereof for cooperation with the shredding teeth on said ring member in tearing or shredding fibrous material, said sets of shredding teeth being respectively disposed in parallel planes, and means on said disk for causing fibrous material to be delivered to and impinged against the two sets of shredding teeth and between said attrition surfaces when said disk is rotated, the teeth of said ring member set being respectively disposed obliquely to the plane of said set and being inclined toward and in opposition to the direction of rotation of said rim teeth to split the impinged fibrous material and direct part of it laterally toward the middle of the tank.

5. A machine for treating fibrous material, comprising a rotatable dished disk, vanes extending from the central portion of said disk, a stationary ring member coaxial with said disk, an annular attritioning surface on the outer face of said stationary ring member, an annular rim on said disk, a cooperating annular attritioning surface on said annular rim opposite said attritioning surface on said annular rim opposite said attritioning surface of said stationary ring, a set of shredding teeth located around the inner periphery of said stationary ring member, the free ends of said teeth extending inwardly towards the center of said ring member, and a similar set of shredding teeth around the inner periphery of said disk rim, the free ends of said latter teeth extending inwardly of said rim towards the axis of rotation thereof for cooperation with the shredding teeth on said ring member in tearing or shredding fibrous material, the inner periphery of said ring member and the inner periphery of said disk rim being of substantially the same diameter in alignment with each other.

6. A machine for treating fibrous material, comprising a tank, a stationary ring member, means supporting said ring member within said tank in spaced relation to a wall of the tank and defining a passage therebetween, shredding teeth on the inner periphery of said ring member, the free ends of said teeth extending inwardly of said ring member and towards the center thereof, a rotatable element journalled in said tank coaxially with said ring member and between said member and said tank wall, an annular rim supported by said rotatable element in closely spaced parallel relation to said ring member, opposed attrition surfaces on the adjacent sides of said ring member and said rim, the inner peripheries of said ring member and said rim being coaxial and of substantially the same diameter, shredding teeth on the inner periphery of said rim, the free ends of said latter teeth extending inwardly of said rim towards the axis of rotation thereof for cooperation with the shredding teeth on said ring member in tearing or shredding fibrous material, and means on said rotatable element and operative when said element is rotated to cause fibrous material to be delivered to and impinged against the two sets of shredding teeth and force part of the material between said attrition surfaces and through said support means passage back to the tank proper.

7. A machine as defined in claim 6 wherein said rotatable element comprises a disk, said disk being spaced from said tank wall, an annular flow-directing element mounted between said ring member and said tank wall closing said support means passage and surrounding the periphery of said disk to define a chamber between said disk and tank wall, and a discharge opening in said tank wall in communication with said chamber for discharging material passed between said attrition surfaces and directed by said flow-element into said chamber.

8. A machine for treating fibrous material, comprising a tank, a stationary ring member within said tank in spaced relation to a wall of said tank, a set of shredding teeth on the inner periphery of said ring member, the free ends of said teeth extending inwardly of said ring member and towards the center thereof, a rotatable disk journalled in said tank coaxially with said ring member and between said ring member and said tank wall and spaced from said wall to define a discharge chamber therebetween, an annular rim supported by said disk in closely spaced parallel relation to said ring member, opposed

attrition surfaces on the adjacent sides of said ring member and said rim, the inner peripheries of said ring member and said rim being coaxial and of substantially the same diameter, a set of shredding teeth on the inner periphery of said rim, the free ends of said latter teeth extending inwardly of said rim towards the axis of rotation thereof for cooperation with the shredding teeth on said ring member in tearing or shredding fibrous material, means on said disk for causing fibrous material to be delivered to and impinged against the two sets of shredding teeth and between said attrition surfaces when said disk is rotated, a flow-directing element between said ring member and said tank wall and surrounding said disk to direct the material passed between said attrition surfaces into said discharge chamber, a discharge passage in communication with said discharge chamber and extending to the top of said tank and having a discharge into said tank, and a control valve in said discharge passage.

9. A machine for treating fibrous material, comprising a tank, a stationary ring member within said tank in spaced relation to a wall of said tank, a set of shredding teeth on the inner periphery of said ring member, the free ends of said teeth extending inwardly of said ring member and towards the center thereof, a rotatable disk journalled in said tank coaxially with said ring member and between said ring member and said tank wall and spaced from said wall to define a discharge chamber therebetween, an annular rim supported by said disk in closely spaced parallel relation to said ring member, opposed attrition surfaces on the adjacent sides of said ring member and said rim, the inner peripheries of said ring member and said rim being coaxial and of substantially the same diameter, a set of shredding teeth on the inner

periphery of said rim, the free ends of said latter teeth extending inwardly of said rim towards the axis of rotation thereof for cooperation with the shredding teeth on said ring member in tearing or shredding fibrous material, said sets of shredding teeth being respectively disposed in parallel planes, the teeth of one of said sets being respectively disposed obliquely to the plane of said set, means on said disk for causing fibrous material to be delivered to and impinged against the two sets of shredding teeth and between said attrition surfaces when said disk is rotated, a flow-directing element between said ring member and said tank wall and surrounding said disk to direct the material passed between said attrition surfaces into said discharge chamber, a discharge passage in communication with said discharge chamber and extending to the top of said tank, a control valve in said discharge passage, an adjustable branch pipe extending from said control valve to discharge into said tank, and means for selectively positioning said pipe relative to said tank.

10. A machine as defined in claim 9 wherein said branch pipe is flexible, and said positioning means comprises a bracket movably supported by said tank and supporting the end of said pipe.

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