

July 16, 1940.

C. W. MORDEN

2,207,931

FIBROUS MATERIAL REFINING ENGINE

Filed Dec. 6, 1937

3 Sheets-Sheet 1

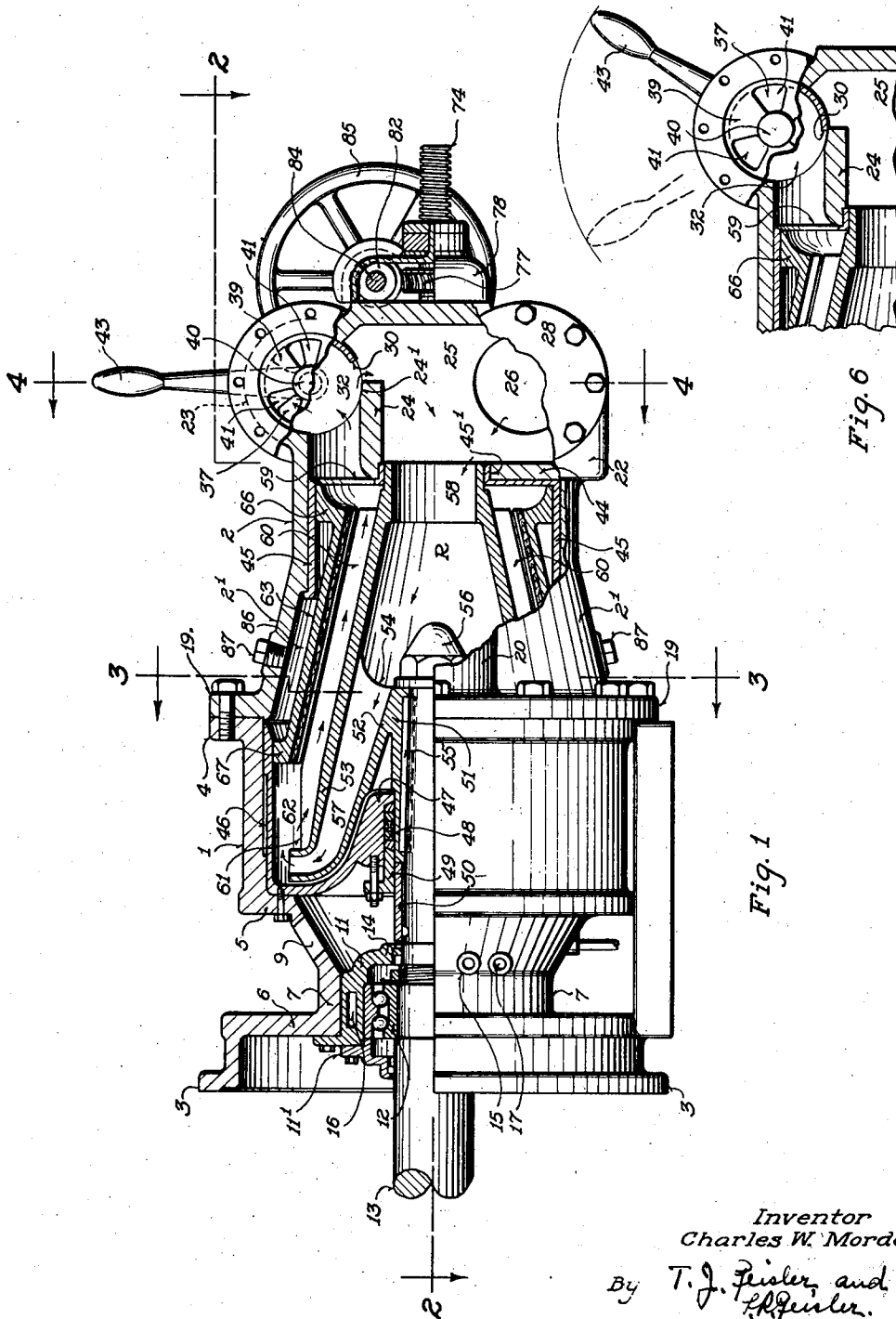


Fig. 1

Fig. 6

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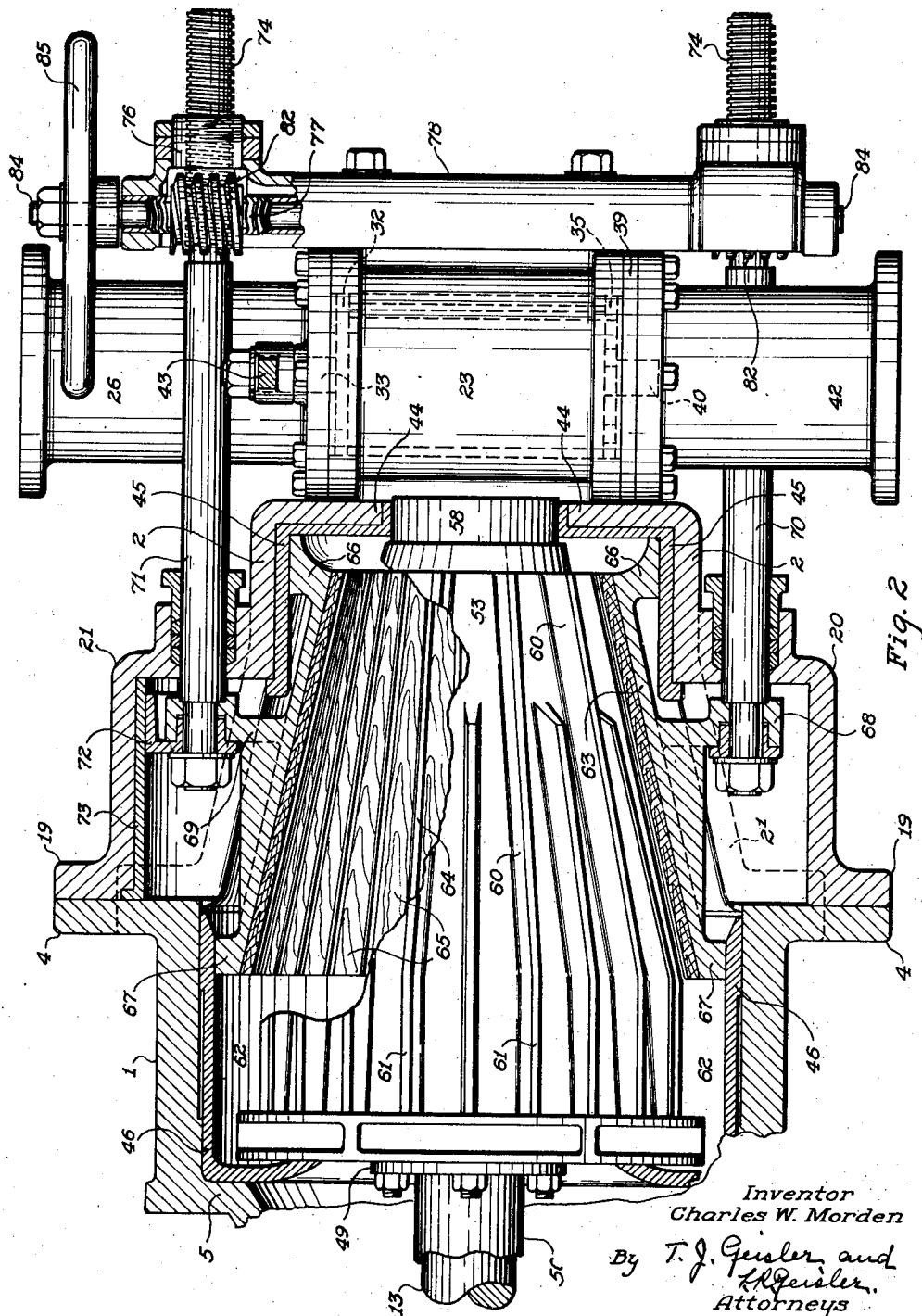
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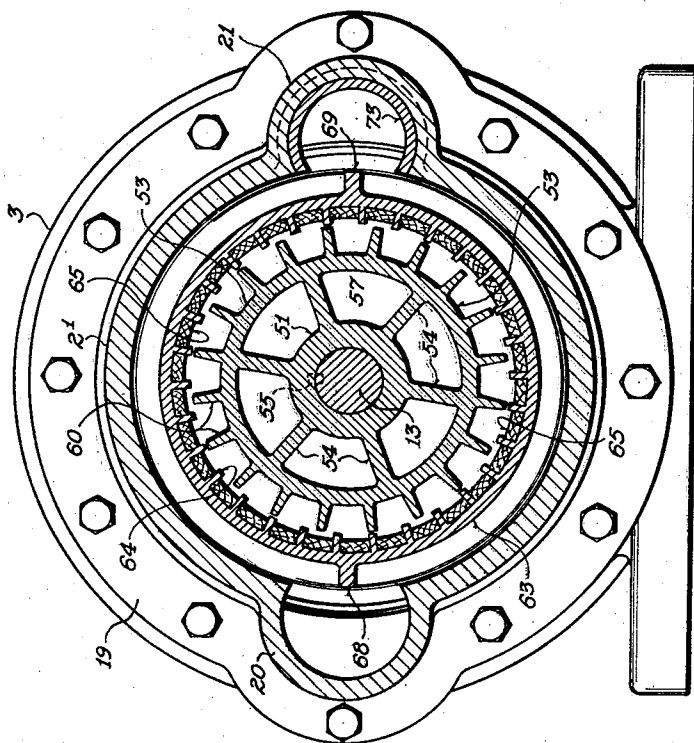


Fig. 3

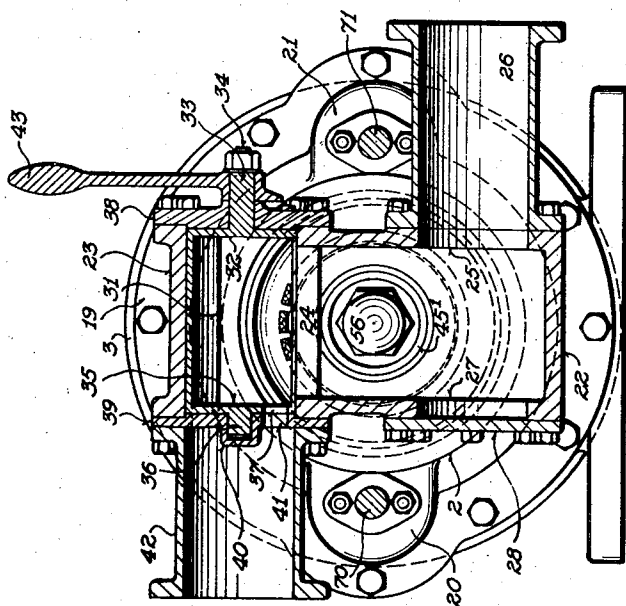


Fig. 4

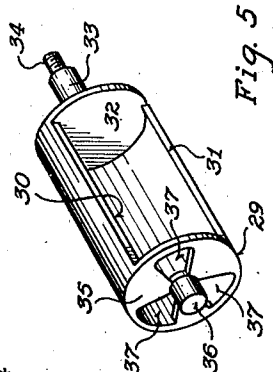


Fig. 5

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UNITED STATES PATENT OFFICE

2,207,931

FIBROUS MATERIAL REFINING ENGINE

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Application December 6, 1937, Serial No. 178,316

9 Claims. (Cl. 92—27)

My invention relates to a pulp treating machine for hydrating, brushing and otherwise mechanically treating and conditioning pulp and other materials such as are used in the production of paper and similar products.

The treatment given such material, by the machine embodied in my invention, is similar to that given by the Hollander type beater. In common with this type beater my machine employs the principle of recirculating the material that is being treated. However, the material may be treated in my machine without recirculating, depending upon the setting of a control valve. Also in certain of the details of the treating elements in the machine there is similarity to the Hollander beater.

My machine, however, in its general makeup, is entirely different in arrangement. My machine is primarily intended for continuous type treatment whereby pulp or other material to be treated is continuously admitted to and discharged from the machine. But my machine, when equipped with the necessary batching control equipment, may be used for automatic batch type treatment of the type set forth in United States Letters Patent No. 1,915,862, issued to me under date of June 27, 1933, to which reference is made.

An object of my present invention is to provide an improved machine adapted to replace or supplement the Hollander type beater.

Another object is to provide an improved machine so flexible in its treating action and mode of application that it is adapted to a wide variety of uses, such as the treatment of pulp screenings, the prehydrating of pulp ahead of its beater treatment, and as a paper stock conditioning unit, for which purpose, under certain conditions of operation, it will give to stock the mechanical treatment that is now given by the combination of the Hollander type beater and Jordan.

Another object is to provide a machine for either continuous treatment of the pulp, with or without recirculation of the pulp within the machine, or for the carrying out of automatically controlled batching type operation.

A further object of my invention is to provide a machine of the type described in which delivery of material to the treating surfaces and recirculation of material within the machine is caused by a pumping action which delivers the material to the treating surfaces of the machine.

A still further object of my invention is to arrange this delivery of material to the treating

surfaces in such manner that the material will enter the treating surfaces at their large diameter ends and under sufficient pressure to force the material between said treating surfaces in a direction contrary to that which the pumping action exerted by the members of the treating surfaces would normally cause it to flow.

These latter objects I attain by providing a rotor with an internal passageway extending from the small diameter to the large diameter end thereof thru which passageway material is delivered to the large diameter ends of the treating surfaces on the outside of and surrounding this rotor, and by providing means for delivering material thru such passageway to the treating surfaces, and, furthermore, by arranging my machine in such a way that when recirculation of material in the machine is desired the recirculated material will travel thru said interior passageway.

A further object of my invention is to subject the material, as it is recirculated in the machine during its treatment, to a pumping action, whereby the material will be subjected to high and low hydrostatic pressures alternately.

All these and incidental objects of my invention I attain by constructing my machine in the manner hereinafter described with reference to the accompanying drawings.

In the drawings, Fig. 1 is a side elevation, partly in vertical medial section, of the portion of a pulp treating machine in which my invention is embodied;

Fig. 2 is a horizontal section on the line 2—2 in Fig. 1, drawn to a larger scale than Fig. 1, and with part of the rotating member shown in full and with the part of such member broken away entirely to show a portion of the lower half of the surrounding bed-plate shell;

Fig. 3 is a vertical transverse section on the line 3—3 of Fig. 1 also drawn to a larger scale;

Fig. 4 is a vertical transverse section on the line 4—4 of Fig. 1 also drawn to a larger scale;

Fig. 5 is a view, in isometric perspective of the valve, such valve being shown in partial end elevation in Fig. 1 and in vertical section in Fig. 4; and

Fig. 6 is a fragmentary side elevation partly in vertical section, corresponding to Fig. 1 but showing the valve partly closed.

The machine as illustrated includes four principal elements, namely, a conical rotating member (hereinafter called the "rotor") driven by any suitable means (not shown); a laterally movable bed-plate encompassing the rotor with

bars on its inner surface cooperating with bars on the outer attritioning surface of the rotor to perform the mechanical treating operation; means for adjusting the position of the bed-plate member with respect to the outer surface of the rotor; and a means for controlling the passage and flow of the stock through the machine.

Referring first to Fig. 1, the housing of the machine is preferably composed of two sections of suitably shaped metal castings 1 and 2. Section 1 is formed with peripheral flanges 3 and 4 at each end, and is substantially cylindrical in outer form. An opening 9 is provided to allow access to the packing gland. The housing is provided with a suitable integral base which can be used for anchoring the machine in operative position. The cylindrical portion 7 is bored to receive a cored and flanged casting 11 fitted with an annular removable keeper flange 11', the cored casting 11 constitutes a housing for a radial thrust bearing 12 which is held against axial movement by the internal shoulders of the casting 11 and keeper 11'. Since the rotor shaft 13 is driven at relatively high speeds, it has been found advisable to provide an oil reservoir about said bearing and a water jacket 16 in the bearing housing. An oil tight compartment is formed by providing the flange 14 of the casing 11 and the keeper flange 11' with conventional oil-seal rings fitting tightly about the rotor shaft 13, the shell reservoir thus formed about the bearing 12 being filled with a lubricant thru a communicating pipe 15. The water jacket 16 of the casing 11 is supplied with cooling water by means of an inlet pipe connection 17.

The other half of the housing has a cylindrical middle section 2, which merges at its left hand end, as viewed in Fig. 1, into the part 2' of gradually increasing diameter and terminates in the peripheral flange 19. Flange 19 conforms to the similar flange 4 and the two flanges are secured together by suitable bolts. Two semi-cylindrical projections 20 and 21 are provided on opposite sides of this section 2' (see Figs. 2 and 3) for inclosing parts of an adjusting mechanism to be described later.

The other end of the middle section 2 merges into a box-like housing 22 which is substantially rectangular in vertical and horizontal cross-section, but which has a cylindrical valve housing top section 23 extending transversely, and an internal integral horizontal partition 24 dividing the interior into upper and lower communicating chambers. The lower part of the rear side wall 25 of the housing section 22, as viewed in Fig. 1, has a circular opening corresponding to the diameter of the inlet pipe 26 (see also Fig. 4) which is connected to the housing and through which the pulp enters the machine. The side wall 27 of the housing opposite the inlet pipe 26 is preferably provided with a similar opening, but this opening is covered with a detachable plate 28 which is made so that it may be removed in order to afford access to the interior of the housing for cleaning purposes, etc.

The upper portion of this section of the housing, located above the horizontal partition 24, houses a rotatable control valve 29. This valve is shown in perspective in Fig. 5. The valve 29 is cylindrical in form, but a substantial portion of the cylindrical wall is cut away between the edges 30 and 31. The end wall 32 of this cylindrical valve is formed with an integral, centrally located stub shaft 33 on its outer face, which stub shaft

terminates in a threaded extension 34. A correspondingly centrally located stub shaft 36 is provided on the outside of the other end wall 35 at the opposite end of this cylindrical valve 29. The end wall 35 is formed with a series of equally spaced openings or radial ports 37.

The upper portions of the side walls 25 and 27 of housing section 22 (see Figs. 4, 2, and 1) are provided with circular openings in horizontal axial alignment corresponding in size to the outside circumference of the cylindrical valve 29. A plate 38 (Figs. 4 and 2) is secured to the outside of the wall 25 and closes the circular opening at that side. This plate 38 has a central bore adapted to accommodate the stub shaft 33 of the cylindrical valve 29. A corresponding plate 39 is located on the outside of the opposite wall 27, which plate 39 has a central boss 40 accommodating the stub shaft 36 of the cylindrical valve 29. The plate 39 is provided with a series of equally spaced radial ports 41 (Figs. 1 and 4) similar in size and spacing to, and corresponding to the ports 37 of the cylindrical valve 29. An outlet pipe 42 is bolted to the housing wall 27 with the plate 39 interposed therebetween as shown in Fig. 4. Thus the cylindrical valve 29 is rotatably supported by the plates 38 and 39, and since the inner surface of the top portion of housing section conforms to the outside diameter of the cylindrical valve 29, and also since the edge 24' of the horizontal partition 24 is of the same curvature, the valve 29 is rotatable without interference from the housing or from the horizontal partition 24. The stub shaft 33 extends through the central bore in the plate 38, and a hand lever 43 is attached to the stub shaft and keyed thereto. The lever permits adjustment of the cylindrical valve 29 from the outside of the housing and the lever 43 is preferably provided with a pointer adapted to register with graduations on the outside of the plate 38 so as to indicate the position of the cylindrical valve and the valve ports 37.

The rotor element R is in the form of a hollow cone frustum and comprises an outer shell 53 connected by webs or vanes 54 to an inner shell 52 and hub 51 which is keyed to the tapered end of the shaft 13 by the key 55 and held in place thereon by the nut 56. Nut 56 is preferably dome-shaped, as shown in Fig. 1, to offer a minimum resistance to the passage of the pulp. Thus an interior passageway 57 is provided in the interior of the rotor extending from the small diameter end to the large diameter end of the rotor. The inner and outer shells 52 and 53 curve upwardly at the large diameter end of the rotor until they become substantially perpendicular to the axis of the rotor and of the shaft 13, thus causing the interior passageway 57 to curve outwardly at the large end of the rotor as shown in Fig. 1.

A series of equally spaced radial bars 60 are provided on the outer surfaces of the rotor. These bars may extend the full length of the rotor or alternate bars may terminate a distance from the small diameter end of the rotor, as illustrated in Fig. 2, to avoid the crowding of the bars too closely together at the smaller end. These bars have their outer surfaces at the large diameter end of the rotor formed parallel to the axis of the rotor, as shown at 61 in Figs. 1 and 2.

The bedplate 63 surrounding the rotor is also in the form of a cone frustum, and this bedplate is provided on its inner face with equally spaced bars 64. The bars 64, unlike the bars 60 of the rotor, do not lie in the same longitudinal

planes as the rotor axis, but are oblique thereto so as to produce a shearing action. In the space between the bars 64 wooden fillers 65 are placed so as to practically fill these spaces and thus to cause the material being treated to remain in contact with the treating faces of the bars 64 during its treatment. Peripheral flanges 66 and 67 are provided at the small and large diameter ends, respectively, of the bed-plate 63, the edges of these flanges being machined so as to permit the flanges to slide freely in the liners 45 and 46 of the housing.

Renewable inner linings 45 and 46 are preferably provided for these portions of the outer housing with which the material being treated comes in contact. The lining 46 is secured to the interior shoulder 5 of the housing 1 (see Fig. 1), and this lining curves inwardly at the shoulder 5 and forms a central boss 47. This boss 47 carries the packing rings 48 and packing retainer 49, the retainer 49 being removably attached to the boss by bolts or screws. Adjacent the retainer 49 is a wearing sleeve 50 keyed to the shaft 13.

An annular space 62 is provided around the large diameter end of the rotor and within the housing lining 46 so as to enable the material which is being delivered thru the interior passageway 57 of the rotor to pass back between the attritioning surfaces of the rotor R and the bed-plate 63, as indicated by the arrows in Fig. 1.

A transverse vertical wall 44 (see Figs. 1, 2 and 4) extends across the lower portion of the housing section 22 and joins the lower side of the horizontal partition 24. This wall has a circular opening in which is fitted the annular flange 45' of the housing lining 45, and the flange 45' in turn serves as a wearing ring for the small diameter end 58 of the rotor. A portion of the front wall of the lining 45 is cut away above the horizontal partition 24 to provide a segmental opening 59 thru which the treated material passes to the upper chamber of the housing section 22.

To provide means for varying the clearance between the bars 60 and 64 of the rotor and bed-plate, respectively, not only to compensate for the normal wear of these bars but also for controlling the treatment of the fibers of the pulp or other material, I provide mechanical means for moving the bed-plate 63 in either direction parallel to the axis of the rotor shaft 13. The bed-plate 63 is formed with a pair of integral lugs 68 and 69 on opposite sides of its outer face, as shown in Fig. 2. These lugs extend into the hollow, semi-cylindrical chambers formed by the projections 20 and 21 on opposite sides of the housing section 2'. Reduced diameter ends of the shafts 70 and 71 extend thru bores in the lugs 68 and 69, respectively, and are keyed to prevent rotation therein. The ends of these shafts are threaded and carry nuts which further secure the shafts to the lugs. A shoe 72 firmly secured to the lug 69 and adapted to slide freely in liner 73 (Figs. 2 and 3) in the housing 21, is incorporated in the construction to prevent rotation of the bed-plate 63.

The shafts 70 and 71 pass through suitable bores and packing glands disposed in the ends of the housings 20 and 21, and the shafts are longitudinally slidable therein. These shafts extend to a point at considerable distance beyond the housing section 22, and are parallel to the axis of the rotor shaft 13, as illustrated in

Fig. 2. The outer ends of these shafts are each provided with screw threads 74, which co-act with screw threads in the elongated hubs 76 of a pair of worm gears 77 journaled in a housing 78, which is mounted on the housing section 22. The worm gears 77 receive rotary motion from the cooperating worms 82 keyed on a transverse shaft 84 also journaled in the housing 78, one end of the shaft 84 carrying a hand wheel 85.

When the hand wheel 85 and therewith the shaft 84 and attached worms 82 are rotated, a rotary motion (at a considerably reduced rate) is imparted to the worm gears 77 which, through the media of the internally threaded hubs 76 and externally threaded shaft ends 74, causes axial movement of the shafts 70 and 71, and thereby of the bed-plate 63 to which the shafts 70 and 71 are attached in the manner described. Thus, by the turning of the hand wheel 85 the position of the bed-plate 63 can be adjusted so that the bars 64 are in the desired relation to the bars 60 of the rotor.

Instead of the shafts 70 and 71 and the gear mechanism just described and operated by the hand wheel 85, hydraulic means for controlling the position of the bed-plate 63 may be substituted by connecting the annular space 66 between the housing section 2' and the bed-plate 63 and bounded by the flanges 66 and 67, to an outside source of fluid under pressure (see Fig. 1). This space 66 may also be used as a cooling water jacket.

The operation of my machine and the method followed in the treatment of the material can now be described. The material to be treated enters the lower portion of housing section 22 thru the inlet pipe 26. Then it passes thru the opening in wall 44 into the small diameter end 58 of the interior of the rotor, as indicated by the arrows in Fig. 1. The rotor shaft 13 is driven at relatively high speed by any suitable means (not shown). The vanes 54 and the outwardly extending interior passageway 57 function in a manner similar to that of a centrifugal pump and produce a pumping action on the material passing thru the interior of the rotor. Due to this pumping action the material is discharged from the passageway 57 into the annular space 62 at high hydrostatic pressure, which pressure is sufficient to force the material then to pass between the outer surface of the rotor and the inner surface of the bed-plate. From the small diameter end of the rotor the material, which is passed between the attritioning surfaces of the rotor and bed-plate, then passes thru the segmental opening 59 into the chamber of housing section 22 above the horizontal partition 24. At this point the further course which the material follows is determined by the position of the cylindrical valve 29. Assuming that the cylindrical valve 29 is so positioned that the ports 37 are open, that is that the ports 37 are entirely in registration with the ports 41 of the plate 39, the material will then all pass into the outlet pipe 42, since the cylindrical valve 29 is so arranged that the edge 30 will contact the valve seat 24' on partition 24 and prevent the passage of the material back into the lower chamber of the housing section 22.

But when the valve 29 is turned to the position shown in Fig. 1, in which the ports 37 and 41 are partially closed, a portion of the material which has been treated is permitted to pass downwardly between the edge 30 and the edge of the horizontal partition 24 into the lower

chamber of the housing section 22, where this material is then mixed with incoming fresh material and caused to enter a second cycle of flow thru the rotor. Similarly, if the ports 37 and 41 are entirely closed, all the material will be forced to be recirculated thru the interior of the rotor and then back between the attritioning surfaces of the rotor and bed-plate. Thus the position of the valve 29 determines the percentage of the material which is recirculated and the percentage which is permitted to pass out thru the pipe 42. In other words, with proper manipulation of the valve 29, the material can be caused to recirculate in my machine as in an ordinary "beater," or it may pass thru my machine once and then out thru the discharge pipe, or part of the material may be recirculated in my machine and part allowed to pass out of the machine.

The material to be treated, when first entering the passageway thru the interior of the rotor, is subjected to a suction pump action, but, as it passes thru this passageway in the interior of the rotor, it is subjected to increasing hydrostatic pressure. Similarly, as this material passes from the annular space 62 between the attritioning surfaces of rotor and bed-plate, it is under high hydrostatic pressure, but as it again reaches the small diameter end of the rotor the hydrostatic pressure to which it is subjected has been considerably reduced. Thus, in being recirculated thru my machine, the material is subjected to low and high hydrostatic pressure alternately, which is one of the important objects of my invention, and this particular action on the fibers of the material is not unlike a squeezing and releasing action exerted on a sponge in causing a sponge to take up water.

While I have shown a rotor with conical outer surface and a similarly shaped surrounding bed-plate, it is not my intention to limit my invention to this specific construction, and various modifications may be made in the shape and construction of the rotor, and similarly, in the surrounding bed-plate, and still permit the carrying out of the principles of my invention. It is essential, however, that a suitable rotor be provided having an interior passageway, and that means be provided for moving the material thru such interior passageway and then between the attritioning surfaces of rotor and bed-plate, and with this means preferably so arranged as to subject the material to varying hydrostatic pressure, and, finally, to provide a suitable control for the recirculation of the material so that all or part of it, as may be desired, may be made to recirculate in the machine, or all of the material may be caused to pass directly through the machine without recirculating.

I claim:

1. In an engine of the character described, a rotor, said rotor provided with an interior passageway, pumping means in said interior passageway, said rotor provided with an exterior attritioning surface, a shell having an interior attritioning surface surrounding said rotor, said rotor's attritioning surface and said shell cooperating to produce a pumping force in partial opposition to the pumping action produced in said interior passageway, whereby said material, when being delivered from said interior passageway against the said pumping force will be subjected to high hydrostatic pressure, and, when discharged from said attritioning surfaces will be at lower hydrostatic pressure.

2. In an engine of the character described, a

conically shaped rotor, said rotor provided with an interior recirculating passageway extending from the small diameter end to the large diameter, end pumping means in said interior passageway, said rotor provided with an exterior attritioning surface, a shell having an interior attritioning surface surrounding said rotor, said rotor's attritioning surface and said shell cooperating to produce a pumping force in partial opposition to the pumping action produced in said interior passageway, and means for regulating the amount of treated material recirculated in said engine.

3. In an engine of the character described, a conically shaped rotor, said rotor provided with an interior passageway, said interior passageway so arranged as to cause the material being treated to be drawn thru said passageway by the action of centrifugal force, said rotor provided with an exterior attritioning surface, a shell having an interior attritioning surface surrounding said rotor, said rotor's attritioning surface and said shell cooperating to produce a pumping force in partial opposition to the pumping action produced in said interior passageway, whereby said material, when being delivered from said interior passageway against the said pumping force will be subjected to high hydrostatic pressure, and, when discharged from said attritioning surfaces will be at lower hydrostatic pressure.

4. In an engine of the character described, a rotor, said rotor provided with an exterior attritioning surface, said rotor provided with an interior recirculating passageway connecting the discharge end and inlet end of said attritioning surface, said interior passageway, due to the action of centrifugal force when said rotor is rotated, providing uniform circulation thru said passageway of the material being treated, means carried by said rotor for causing recirculation of the material being treated.

5. In an engine of the character described, a rotor, said rotor provided with an interior recirculating passageway, pumping means in said interior passageway, said rotor provided with an exterior attritioning surface, a non-revolving shell surrounding said rotor, said attritioning surface and shell constituting a second pumping means opposing said pumping means in said passageway, and means for regulating the proportionate amounts of treated material recirculated in or discharged from said engine.

6. In an engine of the character described, a conically shaped rotor, said rotor provided with an interior recirculating passageway, said interior passageway, due to the action of centrifugal force when said rotor is rotated, providing uniform circulation thru said passageway of the material being treated, said rotor provided with an exterior attritioning surface, a shell having an interior attritioning surface surrounding said rotor, said rotor's attritioning surface and said shell cooperating to produce a pumping force tending to reverse the flow of said material, whereby said material when recirculating in said engine will be subjected to high and low hydrostatic pressure alternately, and a valve located at the discharge end of said attritioning surface and shell, said valve having means for opening the outlet from said engine and related means controlling the passage of material into said recirculating passageway, whereby to govern the percentage of treated material recirculated.

7. In an engine of the character described, a rotor, said rotor provided with an interior re-

circulating passageway, pumping means in the interior of said rotor, said rotor provided with an exterior attritioning surface, the passage of said material over said attritioning surface and the recirculation of said material thru said rotor caused by said interior pumping means, and a control valve, said valve including means for restricting the discharge of treated material from said engine and means for restricting the circulation of treated material within said engine.

8. In an engine of the character described, a rotor, said rotor provided with an exterior attritioning surface, said rotor provided with an interior recirculating passageway connecting the discharge end and inlet end of said attritioning surface, a valve, said valve having means controlling the recirculation of treated material in said engine and related means controlling the outlet from said engine, said valve located at the discharge end of said attritioning surface and at the inlet end of said passageway, means in the interior of said rotor and means on the exterior

of said rotor causing the material being treated to be subjected to increasing hydrostatic pressure in its course through said interior passageway and to be subjected to decreasing hydrostatic pressure while receiving treatment on said attritioning surface.

9. In an engine of the character described, a rotor, an attritioning surface on said rotor, an interior recirculating passageway through the center of said rotor, pumping means associated with said interior passageway, and a non-revolving shell surrounding said rotor, said attritioning surface and shell constituting second pumping means associated with said attritioning surface, said pair of pumping means arranged to oppose each other, but one of said pumping means exerting a stronger force than the other, whereby the material being treated and recirculated in said machine will be subjected to varying hydrostatic pressures on said attritioning surface and in said interior passageway.

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