March 23, 1965 H. L. CROSBY ETAL 3,174,313

TREATMENT TOWER FOR PAPER PULP

Filed Feb. 2, 1960 2 Sheets-Sheet 1

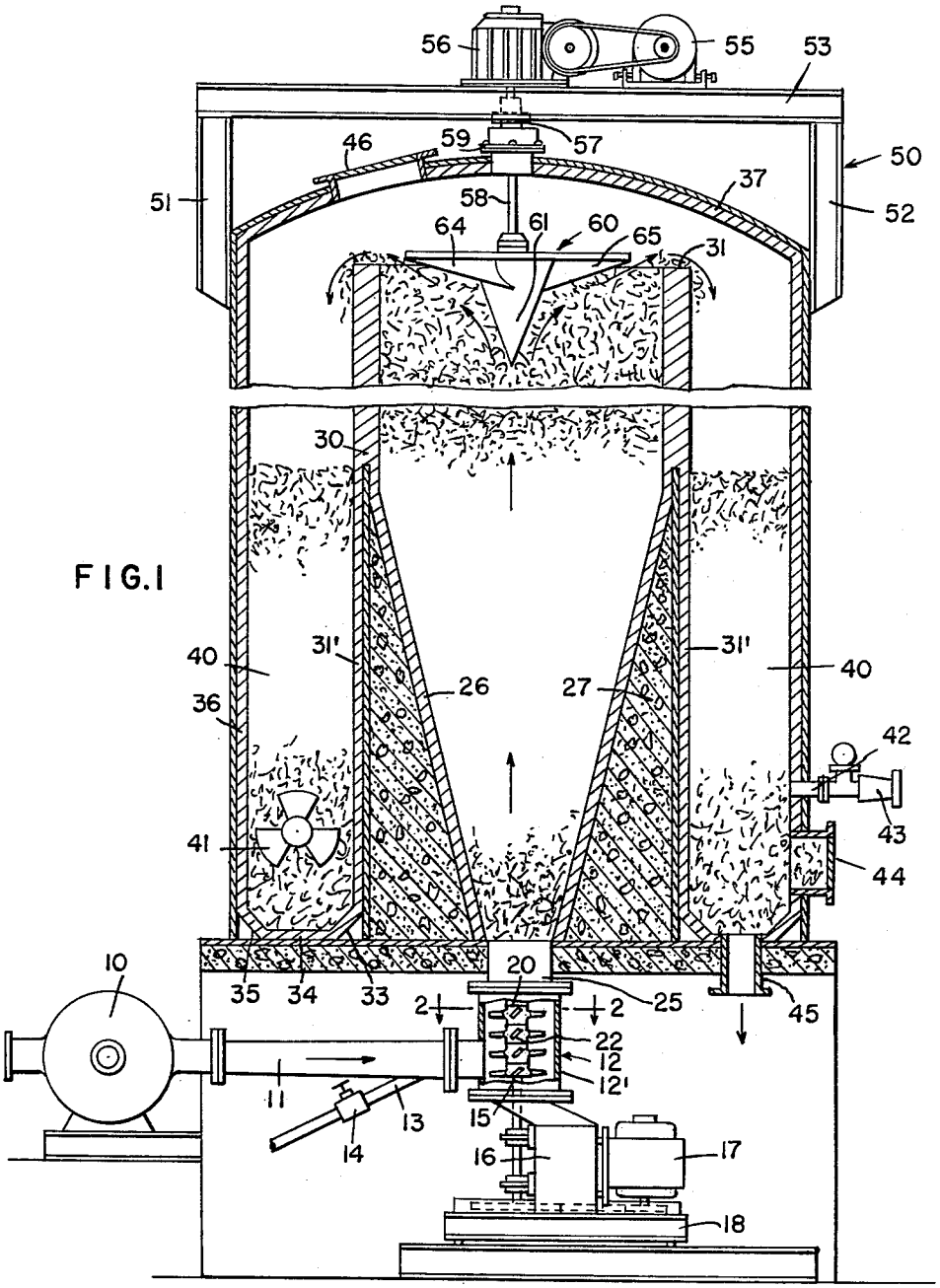


FIG. 1

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TREATMENT TOWER FOR PAPER PULP

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FIG.3

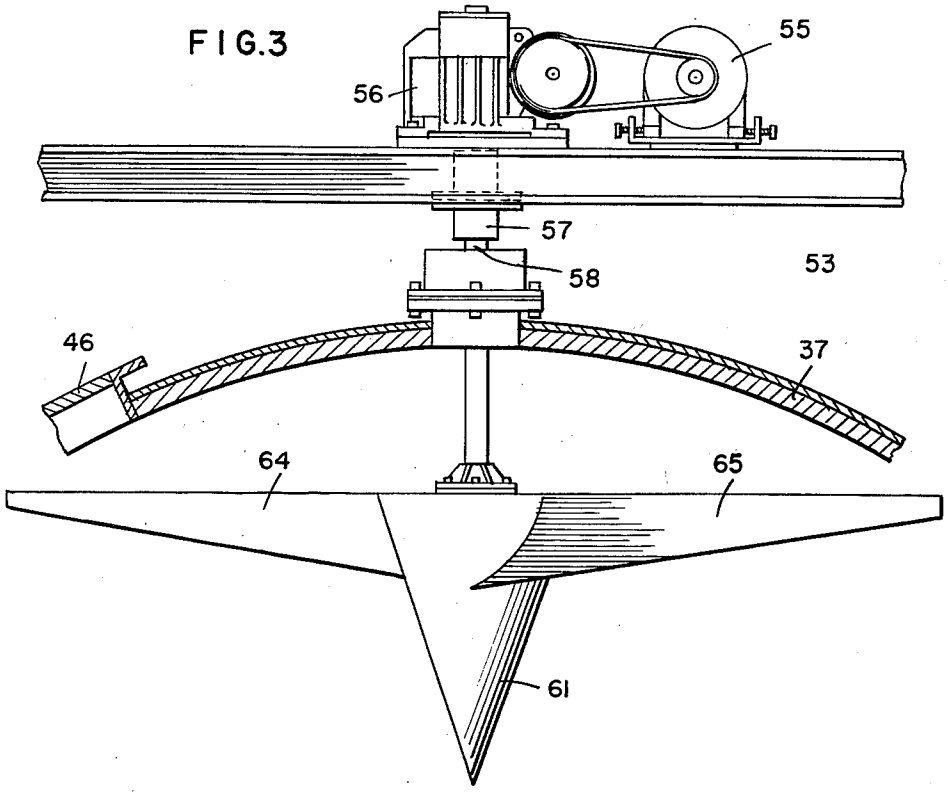


FIG.4

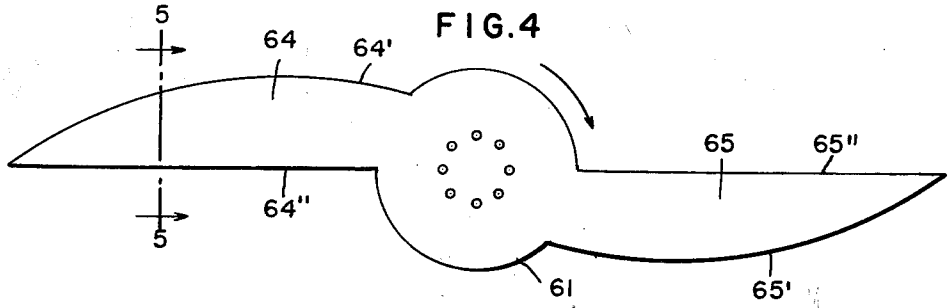
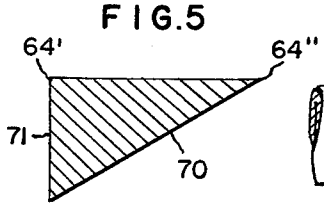


FIG.5



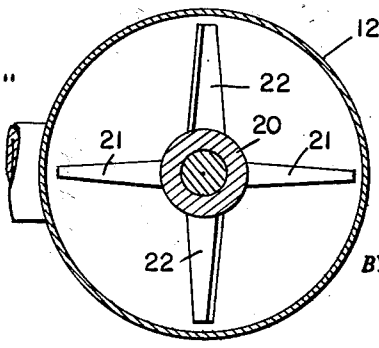


FIG.2

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3,174,313

TREATMENT TOWER FOR PAPER PULP

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Filed Feb. 2, 1960, Ser. No. 6,184
16 Claims. (Cl. 68—181)

The present invention relates to improvement in pulp treating apparatus in the paper industry, and more particularly to apparatus adapted for the treatment of high density pulp to effect purification and bleaching operations and the like in a treatment tower.

The apparatus of this invention may be advantageously employed in a bleaching operation where the high density pulp is treated in an upflow treatment stage, and for example where the bleaching agent is chlorine dioxide.

High density paper pulp, generally speaking, is one that has a concentration in excess of 7%, for example 10% to 15%. Among the advantages accruing from the use of such high density pulp are:

(*a*) Higher concentration of the treatment chemical providing shorter reaction time as well as more intensive purification;

(*b*) Less pulp water to be held in cases where elevated temperatures are required in the treatment tower, hence greater heat economy;

(*c*) A smaller tower volume required for a given throughput tonnage and detention time.

The present invention relates more particularly to the upflow type of treatment tower as distinct from the downflow type, each of which, however, has its advantages. It is among the objects of this invention to combine the advantages of both, yet substantially without incurring their disadvantages.

High density pulp operation for both upflow and downflow system has heretofore required the provision of water injection nozzles or the like to facilitate discharging the pulp from the end zone of the tower. But according to this invention, the need for such dilution is avoided in the top end pulp discharge from the tower, resulting in important advantages further to be set forth.

Upflow of high density pulp in the tower, for instance, insures effective initial absorption of the bleaching agent by the pulp. This is an important factor particularly when using vaporizable reagents having appreciable vapor pressure, such for example as $C10_2$ because of the explosiveness thereof when in a gaseous state. Upflow provides greater economy in chemical consumption as well as safety against explosion, since there will be little of the reagent left unreacted in the pulp reaching the top overflow end of the tower. The reagent as a rule is mixed into the pulp at the entrance thereof into the tower by a feeder device. However, there is a practical limit to the diameter of an upflow tower beyond which channelling or uneven upward flow will occur unless special distributing devices are installed in the tower inlet section. Thus, to provide the total required volume in a straight upflow tower will often necessitate a very high tower with attendant construction problems. A further disadvantage of a large completely upflow tower is the problem of emptying it on a grade change or shutdown. Normally the tower is flushed out with water resulting in a tower containing a large volume of water which may present a disposal problem.

Commonly stock discharged from a tower goes to a washing apparatus such as a rotary drum filter. Thorough repulping and dilution of the pulp is required and after neutralizing agents are added. With an upflow bleach tower this necessitates a separate agitated dilution chest between the tower and the filter.

Yet, a downflow tower provides effective control over

the detention time as is not attainable in straight upflow operation. Downflow also simplifies pulp distribution across the tower area due to the angle of reposal formed by the high-density material at the top, hence the tower diameter may be chosen relatively ample relative to the required height, yet not so great as to invite unbalancing of the high density pulp column supported by the bottom discharge dilution zone. Again, lower height and larger diameter require less high building accommodation, whereas a tower of more slender proportion, namely of greater height unless accommodated in a correspondingly tall building, may require expensive outdoor insulation. Moreover, the common procedure of discharging a downflow tower by dilution and agitation permits introduction of neutralizing chemicals and assures uniform repulping ahead of the washer with no additional apparatus. However, a disadvantage of the bottom dilution zone in the downflow system is due to the fact that this dilution zone being subjacent to the body of dense pulp above may unbalance the same even to the extent of causing the pulp column to turn upside down, thereby entirely vitiating the respective treatment operation, unless the ratio of height to diameter of the column is made great enough to prevent this phenomenon. In actual practice, however, the maximum permissible diameter for a conventional downflow tower which will provide reasonable assurance of no channelling is limited to 18–20 ft. regardless of height.

This invention combines the advantages of both the upflow- and the downflow-system, yet without incurring any of the drawbacks set forth above, by providing an inner upflow tower, concentric with respect to an outer downflow tower. This system therefore establishes a central high density upflow pulp column of constant volume and detention time, surrounded by an annular high-density downflow pulp column the volume and detention time of which are variable.

This concentric tower arrangement is preferably and advantageously combined with improved simple compact and efficient pulp feeding devices at the bottom of the inner tower, as well as improved simple and effective transfer means for moving high density stock without dilution from the top end of the inner tower outwardly into the surrounding annular downflow space.

In this concentric tower arrangement, where the internal tower represents only a portion of the total tower volume available for treatment and thus only a portion of the detention requirements, the effective cross-sectional area thereof may be suitably chosen to provide ideal upflow pulp distribution and treatment conditions with good initial utilization of the bulk of the ClO_2 or the like. Yet, the detention time in this arrangement is variable due to the transfer of the stock from the top end of the inner tower radially in all directions into the surrounding downflow receiving space beween the towers. Furthermore, the structural height of the tower as well as heat losses from the unit are minimized by reason of the novel concentric arrangement thereof. A further disadvatnage of prior art high density upflow towers is the utilization of air pressure feeders which, as is well known, cause surging of the pulp into the tower whereas the feed of the bleaching chemical is substantially constant thereby causing a continuous variance of the ratio of pulp to chemical which is undesirable. Furthermore, structures of this type generally employ a mechanical mixer means within the tower to provide a radial movement of stock outward in the tower to minimize channelling of the upflowing stock.

The present invention also relates to a treating tower wherein a distributor mechanism is employed in the upper portion thereof to produce a uniform discharge of the pulp without having to dilute the pulp in the discharge

zone, for discharging about the periphery of the top of the upflow tower portion. In prior art arrangements, it is not possible to mount heavy rigid rake means at the upper end of the tower, and accordingly this stock is diluted in order that the rake structure can handle the pulp as it reaches the top of the tower, without undue strain upon the mechanism. With respect to applying dilution in the discharge zone, it is to be noted that while this dilution stops the chemical reactions occurring while the pulp is being discharged, there is no assurance that dilution water will not penetrate the stock mass to some depth which is undesirable inasmuch as it detracts from the effective treatment volume of the tower itself. On the other hand, if it were desired to provide a sufficiently heavy rake structure as employed in the prior art, it would be necessary to provide some form of supporting bearing and guide structure submerged in the pulp which is not feasible from an engineering and economical standpoint.

The present invention overcomes the foregoing problems in a novel manner by providing a tower arrangement preferably in combination with a novel dual purpose mixer means for mixing the reagent with the pulp and feeding through the bottom of the inner tower, and further in combination with improved bladed rotary means useable for effecting transfer of high density pulp without dilution from the top end of the inner tower into the annular space surrounding it. The arrangement of the present invention includes an inner tower having an upper substantially cylindrical inner surface and a lower tapered conical surface. This conical surface serves to distribute the incoming pulp in a uniform manner and eliminates the necessity of providing mechanical distributor means to prevent channeling of the upflowing stock.

An outer tower means is disposed substantially concentric with the inner tower means and has a substantially cylindrical wall spaced from the outer wall of the inner tower member. Dilution nozzles and circulator means are provided at the lower portion of the outer tower to dilute and circulate the pulp in the annular space between the towers prior to discharge therefrom. Preferably, the cross-sectional area of the inner tower is in the order of from ¼ to ½ the cross-sectional area of the surrounding annular space. The concentric tower arrangement of this invention has important advantages in this type of high density pulp operation. Firstly, the retention time within the apparatus can be varied if desired, or on the other hand, a constant retention time may be maintained over a wide range of flow rates. For a given throughput tonnage and given pulp consistency the time in the inner upflow tower is constant, but the retention time in the outer downflow tower portion depends upon the depth of stock carried therein. Since the outside tower portion does not have to be maintained for the pulp, it is only necessary to lower the level in the outer tower portion to reduce the overall retention time of the pulp in the tower.

An important feature to note is the fact that whereas in a conventional downflow tower, it is necessary to maintain a depth of stock of at least 1½ to 2 times the tower diameter, in the invention it is not necessary to incorporate such a feature, since the inner tower will prevent the pulp from balling and turning upside down. Further, conventional downflow high density towers are limited to a maximum practical diameter of 18 to 20 feet in order to assure a relatively uniform downward movement and withdrawal of the stock. The concentric tower arrangement of this invention is not so limited and diameters up to 30 feet and even higher are practical, thus greatly reducing the overall height, as well as minimizing outside insulation requirements.

Furthermore, the concentric tower arrangement of this invention results in a substantial saving in space. It is not necessary to provide two separate towers connected by a long elbow, and in addition, the stock feed pump may be mounted adjacent to the foot end of the tower.

Another important advantage of the concentric tower

arrangement of this invention is the fact that the heat losses are minimized because of the outer zone occupying the annular space betwen the two concentric towers acting as an insulator for the inner tower. Bleaching operations, for instance, with chlorine dioxide, which has relatively high vapor pressure and is highly explosive in gaseous form, are generally carried out at a temperature in the range of 165 to 175 degrees F., and where prior art structures have been employed at such temperatures, heat losses become a serious problem. It is apparent, on the other hand, that with the concentric tower arrangement of this invention, the inner tower portion is surrounded by hot pulp in the outer tower portion and, accordingly, no heat losses will occur to the ambient air for at least the first hour of the total retention time, while the pulp is preferably detained in the central tower under operating conditions preferred in the circumstances. This results in a much more economical operation.

A further feature of the invention is the provision of a novel mixer device performing a dual function and that it serves not only to effectively mix the feed pulp with the chemical treating agent, but also provides a pulp feeding action adapted to overcome the line elbow friction of the high density pulp and thus to relieve the stock pump of part of its load, thereby affording a more economical operation as well as a reduction in maintenance costs. Furthermore, this novel mixing device featuring a bladed combination feeding and mixing element rotating about a vertical axis in the feed end of the inner tower, together with the conical bottom shape thereof provides a desirable uniform distribution of the high density pulp across the cross-sectional area of the tower inlet.

The novel rake arrangement according to the present invention employs a novel concept of top discharge mechanism featuring a novel manner of supporting a bladed rotary pulp engaging element by utilizing the high density of the pulp itself.

It has been common practice in the prior art to suspend such overhead pulp discharge mechanism from the top of the treating tower structure. When the rake mechanism is supported solely by the roof of the tower, it is normally not practical to rake high density stock due to unbalanced loads occasionally imposed on the rake arms and on the overhead bearings, and because of the impracticability of providing a mechanical bottom steadying bearing in the mass of pulp itself. However, with the present improved top discharge rake mechanism, it is possible to discharge high density pulp without dilution effectively, yet without imposing undue strains or unbalancing forces upon the arms and the vertical shaft thereof. According to the invention, the heavy duty rake mechanism having a central downwardly extending portion is actually supported and confined by the high density pulp rising within the tower to provide a water lubricated steady bearing in the mass of pulp itself, taking advantage of the high density character of the pulp itself, and thereby steadying the rake element against lateral unbalancing moment and at the same time tending to lift up the rake mechanism and to reduce the load on the bearings and on the speed reducer mechanism connected therewith. This improved arrangement enables the rake mechanism to be supported at the upper end of the inner tower portion without the necessity of providing a very heavy and complex supporting structure to compensate for the aforementioned unbalancing forces otherwise experienced with high density pulp.

The advantages of the present invention wherein the rake mechanism is steadied and partially supported by the high density pulp itself is apparent since when treating such stock, it is not necessary to dilute the stock as it reaches the top of the upflow tower. Therefore, it is important to note that the desired chemical reactions are allowed to continue uninterruptedly as the stock is transferred from the upflow into the downflow section in the annular receiving space between the concentric towers,

thus increasing the efficiency of operation of the apparatus.

A further feature of the rake mechanism is the fact that the novel conical central downward projection from the hub thereof aside from acting as a steadying means in the high density pulp serves to deflect the stock uniformly outwardly in all directions toward the peripheral overflow edge of the inner tower. Accordingly, the apparatus of this invention can be effectively employed with high density stock which, for example, may contain 10% to 16% solids by weight, without the need of interrupting the continuity of treatment between the inner tower and the surrounding annular treatment space by adding pulp dilution heretofore required at the top by prior art of discharge raking devices.

An object of the present invention is to provide a new and improved high density upflowing treating apparatus as used in bleach plants of the pulp and paper industry.

Another object is to provide a novel upflow pulp treating apparatus of great compactness and simplicity which prevents uneven feed distribution across the upflow tower area as by channeling.

A further object of the invention is to provide an upflow pulp treating apparatus wherein the retention time may be varied over a wide range, wherein the heat losses are substantially reduced as compared to prior art systems and wherein a substantial saving in space is achieved.

Yet another object of the invention is to provide an upflow pulp treating apparatus incorporating a novel mixing device which not only mixes the pulp effectively with a treating chemical, but also provides a pulp feeding and pumping action to assist overcoming line elbow friction with a high density pulp at the point of entrance at the base of the tower.

Still another object of the invention is to provide a heavy duty rake construction which does not require a heavy bearing support therefor, nor a bottom steady bearing means.

Still another object of the invention lies in the provision of a rake apparatus for top discharge purposes at the upper portion of the pulp treating tower which serves to divert the stock towards outside of the tower and to provide a uniform discharge from the tower, and it is not necessary to dilute high density pulps in order to obtain proper operation.

Further objects and many attendant advantages will become more apparent when considered with the specification and accompanying drawings wherein:

FIG. 1 is a view of an upflow pulp treating apparatus according to the present invention with parts thereof shown in section and other parts partly broken away;

FIG. 2 is a sectional view taken along line 2—2 of FIG. 1 looking in the direction of the arrows;

FIG. 3 is an enlarged view of a top portion of the apparatus shown in FIG. 1;

FIG. 4 is a top view of the rake mechanism shown in FIG. 3; and

FIG. 5 is a sectional view taken along line 5—5 of FIG. 4 looking in the direction of the arrows.

Referring now to the drawings wherein like reference characters designate corresponding parts throughout the several views, there is shown in FIG. 1, a conventional high density stock pump 10 which receives heated pulp coming from a conventional heater mixer (not shown). Stock pump 10 is connected by a conduit 11 with a mixer apparatus indicated generally by reference numeral 12. The chemical treating agent is introduced into conduit 11 through a conduit 13 having a valve 14 therein for controlling the flow therethrough. For example, chlorine dioxide may be injected into conduit 11 by means of conduit 13 when it is desired to perform a bleaching operation on pulp.

Mounted within the cylindrical wall portion 12' of mixer 12 is a central shaft 15 which extends downwardly from cylindrical portion 12' through an appropriate seal and is connected to a suitable drive means in the form of a gear reducing mechanism 16 operatively connected to a suitable drive motor 17, the speed reducing means and the motor being mounted on a suitable support platform 18. Fixed to shaft 15 are a plurality of hub members 20 shown as being four in number, each of the hub members carrying thereon as seen in FIG. 2 a pair of diametrically opposite tapered pin members 21 and a pair of diametrically opposite blade members 22 which are inclined to a horizontal plane as can be seen more clearly in FIG. 1. The operation of the mixer apparatus is such that a very effective mixing of the treating chemical is obtained due to the use of both the pins and blades within the mixer as it flows through the mixer, and at the same time the blade members 22 provide a thrust component to the pulp passing therethrough which aids in pushing the pulp upwardly within the inner tower portion. This upward thrust produced by blades 22 assists in moving the pulp through the apparatus.

The upper end of mixer 12 is in communication with a downwardly extending conduit 25 which in turn communicates with the lower wall portion 26 of the inner tower, wall portion 26 being substantially frusto-conical in configuration. While the ratio of the width to the height of the apparatus does not appear in FIG. 1 since it is broken away, it is noted that conical wall portion 26 may extend up the side wall of the inner tower portion. Some sort of filler such as cement indicated at 27 may be provided adjacent wall 26 for supporting it. Wall 26 fairs into a substantially cylindrical wall portion 30 which extends upwardly and has an open upper end defined by edge 31. Wall 30 also extends downwardly into portions indicated at 31' to provide a substantially cylindrical outer wall for the inner tower portion which has a substantially frusto-conical lower wall portion.

At the lower end of wall portions 31' outwardly extending wall portions 33, 34, and 35 are connected with one another and fair into an outer wall portion 36, outer wall portion 36 being substantially cylindrical in configuration and defining with domed top portion 37 a second tower portion which is substantially concentric with the inner tower portion and provides an annular space 40 therebetween.

A suitable circulator means in the form of a propeller or the like 41 extends inwardly through wall portion 36 for providing uniform mixing of the pulp and the dilution medium which is inserted through a conduit 42 in communication with the interior of annular cavity 40 and having a dilution nozzle 43 connected therein. A manhole 44 is provided at the lower portion of wall 36 for providing access to inspect the interior of the apparatus and a discharge pipe 45 carries the treated pulp away from the apparatus to a washing apparatus or any suitable collecting means (not shown).

A manhole 46 is also provided in the upper wall of the outer tower portion to provide access to the interior of the apparatus. A support means indicated generally by reference numeral 50 is mounted upon the upper part of the outer tower portion and may comprise a support platform indicated at 53 which is secured at its opposite ends to the upper ends of steel beams 51 and 52 or the like fixed to outer wall portion 36. Mounted upon platform 53 is a suitable electric motor or the like 55 connected to speed reducer mechanism 56. Speed reducer mechanism 56 is in turn connected with a coupling 57 which is in turn connected to a drive shaft 58 extending through a suitable sealing means 59 downwardly and interiorly within the outer tower portion. Supported at the lower end of drive shaft 58 is a rake mechanism indicated generally by reference numeral 60, rake mechanism 60 comprising a central portion 61 presenting an unbroken outer surface which is substantially conical in configuration. Portion 61 may either be solid or hollow as desired depending upon the specific operating conditions desired. As seen more clearly in FIGS. 3 and 4,

a pair of rake blades 64 and 65 extend substantially radially outwardly of the central portion 61 of the rake mechanism, these blades extending out to a point spaced from the inner wall 30 of the inner tower and also tapering upwardly and outwardly from the central portion 61. As seen in FIG. 4, arms 64 and 65 are provided with leading edges 64' and 65' which as seen in plan view are arcuate in configuration, whereas the trailing edges 64'' and 65'' respectively are aligned with one another and extend substantially radially from the central portion 61.

As seen in FIG. 5, the leading edge 64' extends substantially vertically downwardly, whereas the bottom surface 70 of each of blade members 64 and 65 tapers upwardly in a rearward direction from the lower end of the leading edge to the trailing edge of the respective blade thereby providing a sharp edge at the trailing edge and at the lower end of the leading edge while providing a substantially flat forward surface 71. It is apparent that rake arms 64 and 65 may be cast or fabricated integral with the central portion 61, or they may be formed as separate members and welded or otherwise suitably secured to the central portion.

In operation, the heated pulp normally passes into stock pump 10 from whence it passes into the mixer 12 while suitable treating chemicals are introduced into conduit 11 through conduit 13. After the pulp enters mixer 12 it is thoroughly mixed with the treating chemical by the use of the pins and blades 21 and 22 and an upward component is produced on the pulp by the action of inclined blades 22 to move the stock upwardly into the inlet pipe 25.

The use of mixer 12 is such that the pulp is very evenly distributed across inlet pipe 25 and as mentioned previously, the conical shape of the lower wall portion of the inner tower prevents channeling of the upflowing stock. The stock flows upwardly as indicated by the arrows and as seen in FIG. 1, when the tank is in operation, the rake mechanism 60 is supported by the action of the high density pulp against the frusto conically shaped outer surface of the rake mechanism. Actually, the shape of the rake mechanism is such that it serves several functions. The shape of the central portion 61 is such that it produces an upward component on the rake mechanism which tends to lift the rake mechanism and take the load off the bearings of the reducing mechanism supporting the rake. The shape of the central portion 61 also serves to divert the stock at the central portion of the tower gradually toward the upper outer edge of the tower as the pulp moves upwardly.

A further function is served in that as the pulp moves outwardly past the central portion 61 it is concentrated somewhat.

As the pulp continues to move upwardly along the outer surface of the central portion 61, it is engaged by the lower edge of the leading edge of blades 64 and 65, the tapered configuration of the blades providing a gradual movement of the pulp outwardly toward the outer wall of the inner tower. As the pulp moves still further upwardly, it finally overflows the top edge 31 of the inner tower and at this point, the pulp has been given an outward component of movement such that it flows over the upper edge and into the annular space 40 between the inner tower and the outer tower portion.

The pulp then flows downwardly in annular space 40 whereupon a suitable diluting substance is inserted through dilution nozzle 43 and conduit 42 in a well-known manner while the pulp in the lower portion of space 40 is circulated by the circulating means 41. The pulp then subsequently flows out of the discharge pipe 45.

It is apparent from the foregoing that there is provided a new and novel high density pulp upflow treating system such as used in bleach plants in the pulp and paper industry. The apparatus according to the present invention prevents channeling of the upflowing stock without the necessity of providing a mechanical mixer. The apparatus further provides an arrangement whereby the retention time may be effectively varied, the heat losses are maintained at a minimum, and furthermore, the device saves space as compared to prior art systems of this type.

A novel mixer is provided which produces not only an effective mixing, but also a pumping action on the pulp to assist in overcoming line and elbow friction in the system. The rake means of the present invention is of heavy duty construction and does not require any heavy steady bearing supporting means therefor. In addition, the rake mechanism is so constructed that it provides a uniform distribution about the upper edge of the inner tower portion and gradually diverts the stock toward the outer periphery of the inner tower wall.

A particular advantage of this arrangement is the fact that it is not necessary to dilute the stock when employing the invention rake as compared to prior art devices of this type. The apparatus is quite simple and inexpensive in construction and yet is compact and efficient in operation.

As this invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, and since the scope of the invention is defined by the appended claims, all changes that fall within the metes and bounds of the claims or that form their functional as well as conjointly cooperative equivalents are therefore intended to be embraced by those claims.

We claim:

1. A pulp treating apparatus comprising an inner tower means open at the top, pulp inlet means communicating with the lower end of said tower means to supply pulp for partial treatment thereof in an upflow treatment phase when rising through said inner tower means; an outer tower means surrounding and substantially concentric with respect to said inner tower means; an annular bottom connecting the periphery of the lower end of the inner tower means with the periphery of the lower end of the outer tower means to constitute with both said tower means an annular receiving chamber for further treatment of the pulp overflowing from the top end of said inner tower means, in a downflow treatment phase; outlet means communicating with the bottom zone of said annular receiving space for withdrawing treated pulp from said bottom zone; and separately actuated pulp engaging means mounted at the top end of the inner tower means and operable and effective to cause pulp from the top zone thereof to overflow into said annular receiving space in uniform distribution along the periphery of the top end of said inner tower means to insure the maintenance of a uniform pulp level in said annular receiving space below the top end of said inner tower means and variably maintainable by the control of said outlet means for varying the pulp treatment capacity and pulp treatment detention time of the apparatus.

2. The arrangement according to claim 1, wherein the cross-sectional area of the inner tower means is from about ¼ to about ½ of the cross-sectional area of the surrounding annular receiving chamber.

3. A pulp treating apparatus comprising an inner tower means open at the top, pulp inlet means communicating with the lower end of said tower means to supply pulp for partial treatment thereof in an upflow treatment phase when rising through said inner tower means; an outer tower means surrounding and substantially concentric with respect to said inner tower means; an annular bottom connecting the periphery of the lower end of the inner tower means with the periphery of the lower end of the outer tower means to constitute with both said tower means an annular receiving chamber for further treatment of the pulp overflowing from the top end of said inner tower means, in a downflow treatment phase; outlet means

communicating with the bottom zone of said annular receiving space for withdrawing treated pulp from said bottom zone; and overflow equalizing mechanism provided at the upper end of said inner tower means and arranged and constructed for effecting uniform distribution of overflowing pulp material along the periphery of the top end of said inner tower means to insure the maintenance of a uniform pulp level in said annular receiving space below the top end of said inner tower means and variably maintainable by the control of said outlet means for varying the pulp treatment capacity and pulp treatment detention time of the apparatus, said inner tower means having a lower wall end portion formed with an inner face of inverted frusto-conical configuration, said pulp inlet means comprising combined pulp feeding and reagent mixing mechanism comprising a tubular housing connected to said lower wall end portion at the narrow end of said frusto-conical face, a vertical shaft member mounted to rotate in said housing and having blade members extending radially from said shaft and having inclined pulp impelling faces to provide a combined reagent mixing and pulp impelling action cooperating with said frusto-conical face in aiding upward movement of the pulp material into and through said inner tower means with uniform flow rate distribution across the overflow area of the tower and thereby aiding the overflow distributing effect of said overflow equalizing mechanism.

4. A pulp treating apparatus comprising an inner tower means open at the top, pulp inlet means communicating with the lower end of said tower means to supply pulp for partial treatment thereof in an upflow treatment phase when rising through said inner tower means; an outer tower means surrounding and substantially concentric with respect to said inner tower means; an annular bottom connecting the periphery of the lower end of the inner tower means with the periphery of the lower end of the outer tower means to constitute with both said tower means an annular receiving chamber for further treatment of the pulp overflowing from the top end of said inner tower means, in a downflow treatment phase; outlet means communicating with the bottom zone of said annular receiving space for withdrawing treated pulp from said bottom zone; and overflow equalizing mechanism provided at the upper end of said inner tower means and arranged and constructed for effecting uniform distribution of overflowing pulp material along the periphery of the top end of said inner tower means to insure the maintenance of a uniform pulp level in said annular receiving space below the top end of said inner tower means and variably maintainable by the control of said outlet means for varying the pulp treatment capacity and pulp treatment detention time of the apparatus, said overflow equalizing mechanism comprising a bladed rotary construction adapted to engage the top strata of the pulp filling said upflow treatment tower.

5. For use with the upper open end of an upflow pulp treatment tower, pulp delivery mechanism mounted at the top of the tower, comprising a vertical shaft member, pulp spreader means connected to the free lower portion of said shaft member for engaging the top strata of pulp in said tower and adapted to deliver the pulp in substantially uniform distribution from the top end of the tower when said shaft member is rotated; and extension means rotating with said shaft member co-axially therewith and directed downwardly from the horizontal zone of pulp engagement of said spreader means into the mass of pulp below and effective therein to stabilize said free lower portion of the shaft member incident to its rotation.

6. The mechanism according to claim 5, wherein said extension means is of inverted conical shape.

7. For use with an upflow pulp treatment tower, flow equalizing mechanism for effecting uniform distribution of overflowing pulp material along the periphery of the tower comprising a vertical shaft member, a hub on said shaft member, at least a pair of opposedly arranged arms extending horizontally from said hub and shaped to effect radially outward movement of pulp towards said periphery when rotated, and an extension of said hub effective in the mass of pulp below said arms to stabilize the free end of the shaft member, wherein said arms have a vertically convexly curved leading face shaped to effect radially outward movement of the pulp towards said periphery, a trailing edge, and a bottom face extending from the bottom edge of said vertical face at an upward slope to said trailing edge, with the vertical dimension of said arm greater adjacent to said hub and tapering towards a lesser vertical dimension at the outer end thereof.

8. For use with an upflow pulp treatment tower, flow equalizing mechanism for effecting uniform distribution of overflowing pulp material along the periphery of the tower comprising a vertical shaft member, a hub on said shaft member, at least a pair of opposedly arranged arms extending horizontally from said hub and shaped to effect radially outward movement of pulp towards said periphery when rotated, and an extension of said hub effective in the mass of pulp below said arms to stabilize the free end of the shaft member, wherein said arms have the cross-sectional configuration of a substantially right-angled triangle defined by a vertical side representing a vertical convexly curved face shaped to effect radially outward movement of the pulp toward said periphery and by a horizontal side representing the top face of the arm and by the hypotenuse representing an inclined bottom face of the arm, with the vertical dimension of said arm greater adjacent to said hub and tapering towards a lesser vertical dimension at the outer end thereof.

9. For use with an upflow pulp treatment tower, flow equalizing mechanism for effecting uniform distribution of overflowing pulp material along the periphery at the top end of the tower, comprising a vertical shaft member, a hub on said shaft member, at least a pair of opposedly arranged arms extending horizontally from said hub and having a vertical convexly curved leading face shaped to effect radially outward movement of the pulp towards said periphery, a trailing edge, and a bottom face extending from the bottom edge of said vertical face at an upward slope to said trailing edge, with the vertical dimension of said arms greater adjacent to said hub and tapering towards a lesser vertical dimension at the outer end thereof.

10. A pulp treating apparatus comprising an inner tower means open at the top and having pulp inlet means communicating with the lower end thereof, to provide a first treatment phase for the pulp upflowing through said inner tower means; an outer tower means surrounding and substantially concentric with respect to said inner tower means and defining therewith an annular space for receiving pulp overflowing from the top end of said inner tower means for further treatment and having outlet means communicating with the bottom zone of said annular space; and flow equalizing means provided at the upper end of said inner tower means and arranged and constructed for effecting uniform distribution of overflowing pulp material along the periphery of said inner tower means in order to insure the maintenance of a uniform pulp level in said annular treatment space, said flow equalizing means comprising a vertical shaft member with overhead bearing means for rotatably supporting said shaft substantially coaxial with said inner tower means, a hub fixed upon the free lower end of said shaft member, at least a pair of spreader arms extending from said hub horizontally opposite from each other, and constructed and arranged to effect radially outward movement of upflowing pulp towards said periphery and into said annular treatment space incident to rotation of said shaft member, said hub portion having a downward extension below said spreader arms, effective to aid in stabilizing the lower free end of said shaft member operating in the pulp.

11. The apparatus according to claim 10, wherein said hub is of inverted conical configuration with said spreader

arms extending from the upper end portion of said hub, for aiding in the radial distribution of the pulp.

12. The apparatus according to claim 10, wherein said hub is of inverted conical configuration, and wherein each said arm has a vertical convexly curved leading face extending from the upper portion of the conical face of said hub and arranged to effect said radially outward movement of the pulp, said arm further having a trailing edge extending substantially radially from the upper end portion of said conical face and substantially level with the horizontal top edge of said convexly curved leading face, and having a bottom face extending at an upward slope from the bottom edge of said vertical leading face to said trailing edge, with the vertical dimension of said arm tapering from a maximum towards a lesser vertical dimension at the outer end thereof, whereby said inverted conical configuration and said upward slope of the arms cooperate in aiding the radial distribution of the pulp.

13. The apparatus according to claim 12, wherein said spreader arm has the cross-sectional configuration of a substantially right-angled triangle substantially at any point along the effective length thereof, said triangle being defined by a vertical side located in said convexly curved leading face, a horizontal side located in the top face of the arm, and the hypotenuse located in the inclined bottom face of the arm.

14. A pulp treating apparatus comprising an inner tower means open at the top, pulp inlet means communicating with the lower end of said tower means to supply pulp for partial treatment thereof when rising through said inner tower means; an outer tower means surrounding said inner tower means in substantially concentrically spaced relationship therewith and constituting therewith an annular receiving chamber closed at the bottom against said inner tower means for further treatment of the pulp passing downwardly through said chamber; outlet means communicating with the bottom zone of said annular receiving chamber for withdrawing treated pulp from said bottom zone; and pulp transfer delivery mechanism mounted at the upper end of said inner tower means, comprising a vertical shaft member, means for supporting said shaft member at the upper portion thereof for rotation about the vertical axis, pulp spreader means connected to the free lower portion of said shaft member for engaging the top strata of pulp in said inner tower means and effective to deliver the pulp from the top end of the inner tower means into said annular receiving chamber in substantially uniform distribution when said shaft member is rotated; means for rotating said shaft member; and extension means rotating with said shaft member co-axially therewith and directed downwardly from the horizontal zone of pulp engagement of said spreader means into the mass of pulp below and effective therein to stabilize said free lower portion of the shaft member incident to its rotation.

15. The arrangement according to claim 14, wherein said extension means is of inverted conical configuration adapted to aid in the radial distribution of the pulp.

16. Pulp treating apparatus comprising an upflow pulp treatment tower having an upper open end; and pulp delivery mechanism mounted at the top of said tower, comprising a vertical shaft member, means for supporting said shaft member at the upper portion thereof for rotation about the vertical axis, pulp spreader means connected to the free lower portion of said shaft member for engaging the top strata of pulp in said upflow treatment tower means and effective to deliver the pulp from the top end of the tower when said shaft member is rotated; means for rotating said shaft member; and extension means rotating with said shaft member co-axially therewith and directed downwardly from the horizontal zone of pulp engagement of said spreader means into the mass of pulp below and effective therein to stabilize said free lower portion of the shaft member incident to its rotation.

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