July 4, 1961 E. R. BURLING 2,990,710

PULP BLEACHING APPARATUS

Filed Oct. 13, 1958 4 Sheets-Sheet 1

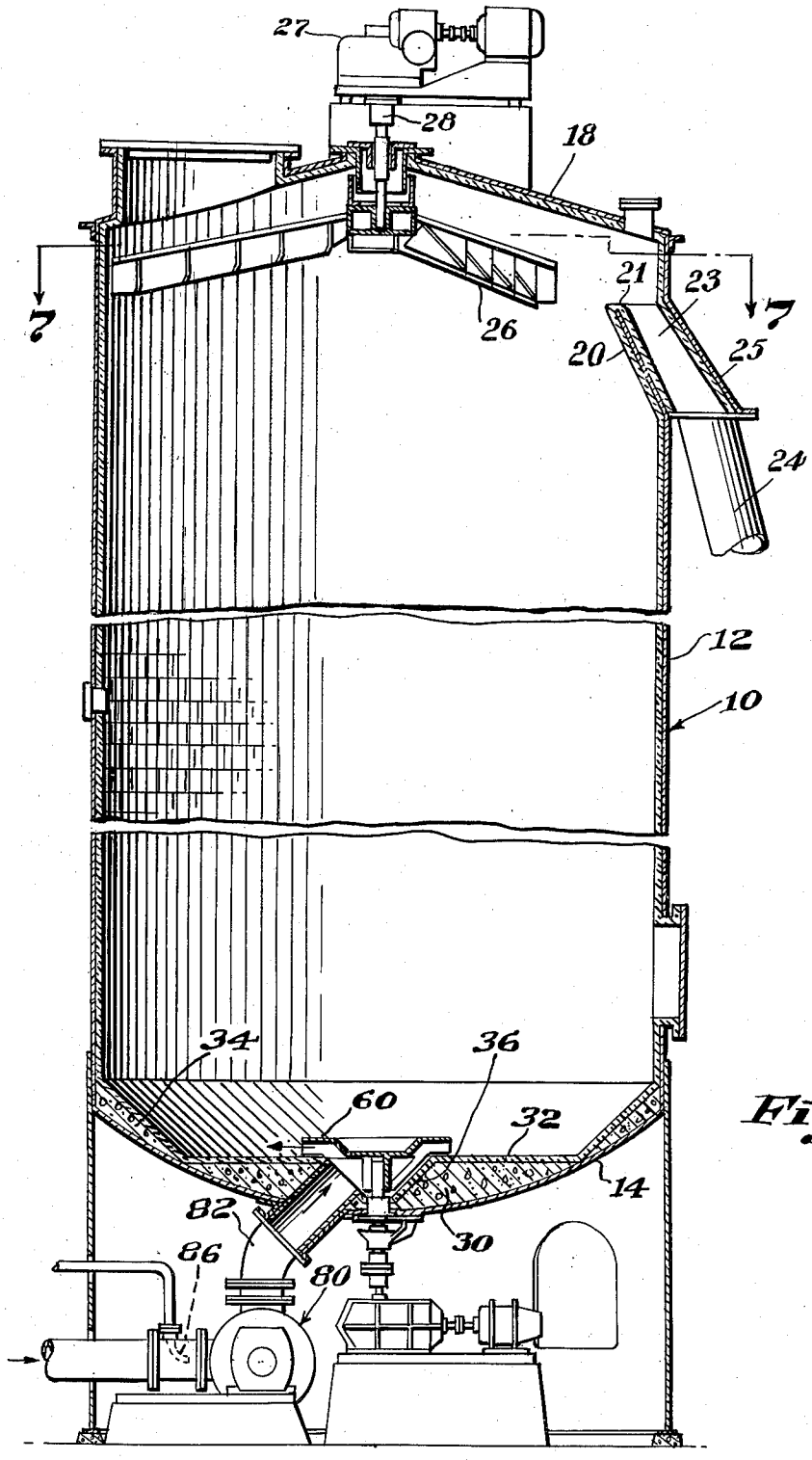


Fig. 1

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Fig. 3

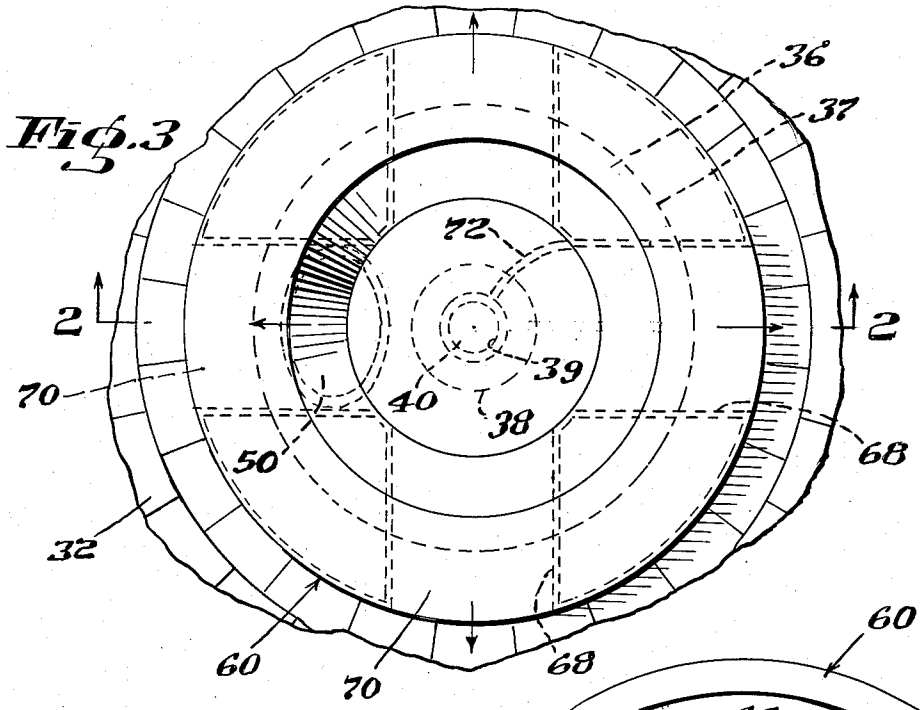


Fig. 4

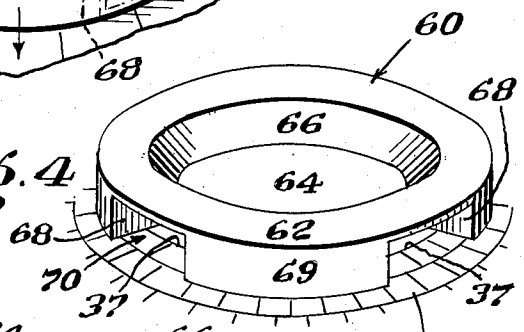
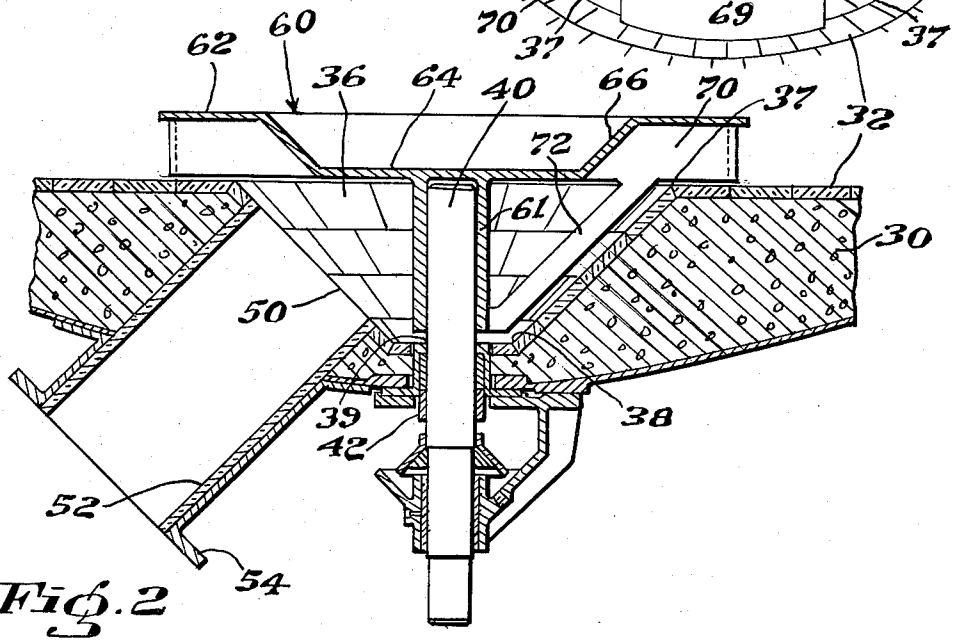


Fig. 2

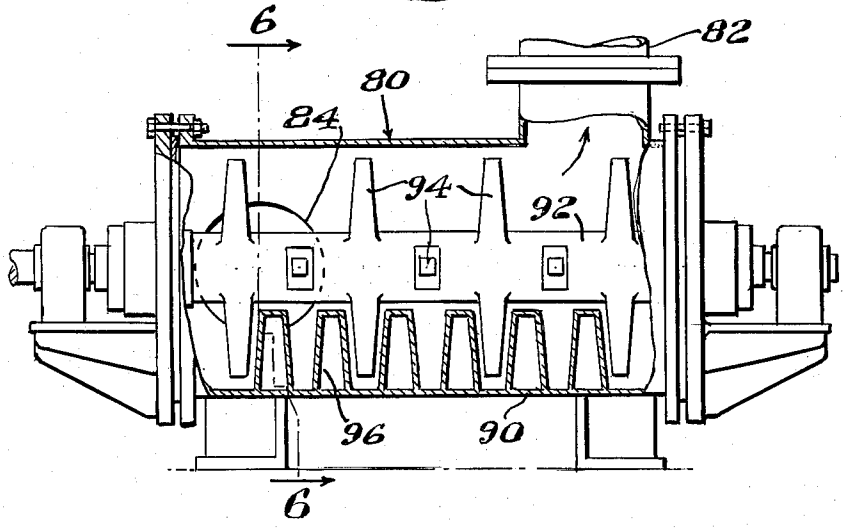


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Fig. 5



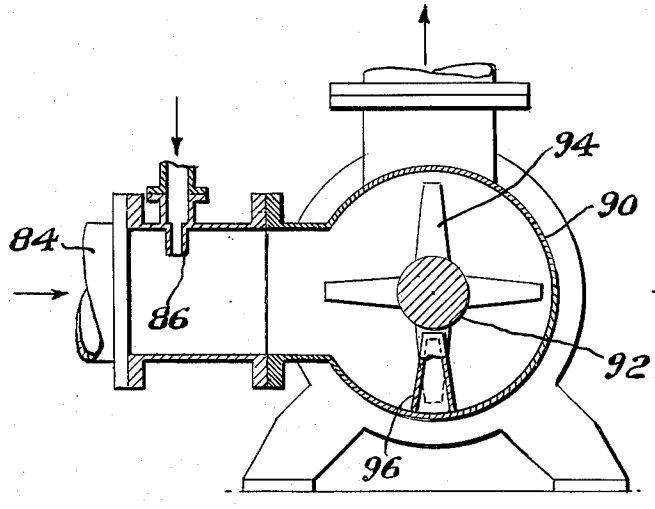


Fig. 6

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Fig. 7

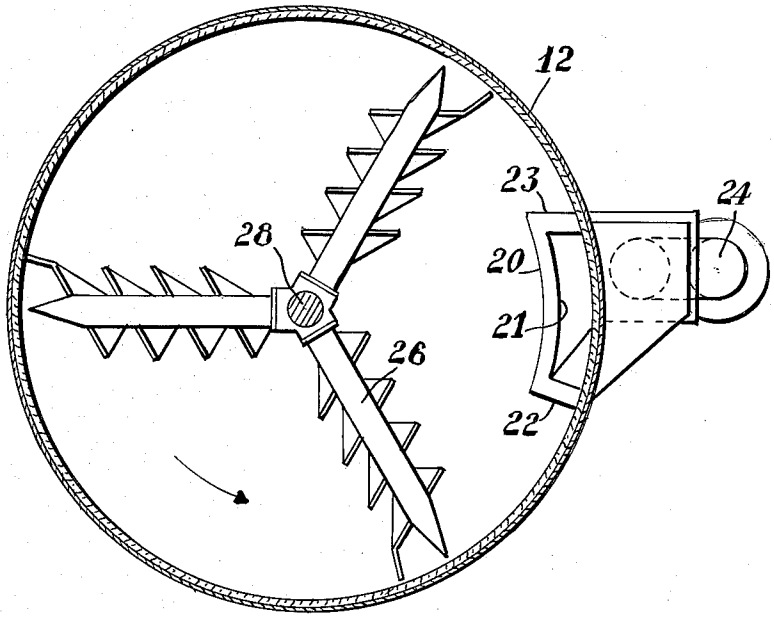
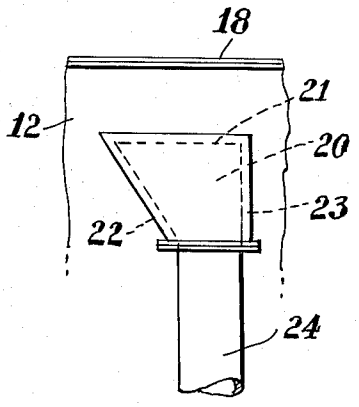


Fig. 8



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2,990,710

PULP BLEACHING APPARATUS

Elmer R. Burling, Nashua, N.H., assignor to Improved Machinery Inc., Nashua, N.H., a corporation of Maine

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10 Claims. (Cl. 68—181)

This invention relates to the bleaching of cellulosic materials, especially wood pulp utilizing chlorine dioxide as a bleaching agent, and more particularly to a novel upflow bleaching tower therefor.

In the bleaching of wood pulp, a suspension of about 5–10% wood pulp in water is treated by means of a bleaching agent, such as chlorine dioxide, mixed into the mass, the mixture being maintained for a period of about two to three hours to allow the bleaching reaction to be completed. Thus, in an upflow tower, for example, as set forth in Patent No. 2,706,673, the operation is carried out by introducing the mixture of wood pulp and chlorine dioxide into the bottom of the tower at a rate which will thoretically result in its movement throughout the length of the tower to establish a retention time equal to the desired reaction time, the head of liquid in the tower serving to reduce the relative vapor pressure of the chlorine dioxide in solution. In practice, however, large diameter upflow bleach towers, especially those having generally flat rather than V shaped bottoms, have always presented a problem of unequal flow distribution, so that a portion of the mixture passed through the tower in much less than the theoretical time and was accordingly under-bleached. One solution to the problem was to utilize a series of impeller blades spaced along the length of the tower and rotated slowly by a central shaft, the lower of such impeller blades in general serving to distribute outwardly pulp fed into the tower generally centrally thereof. This was effective in improving flow distribution, but was expensive to manufacture and install, and required a substantial amount of power for operation.

Accordingly, it is an object of the present invention to provide much simplified yet still effective bleaching towers for bleaching cellulose pulp, particularly in regard to novel means for ensuring the required intimate mixing of the chlorine dioxide bleaching chemical with the pulp suspension followed by control of the mixture in a manner to cause it to have a generally uniform time of flow upwardly through the bleach tower.

It is another object of the invention to utilize the structure of the tower itself as a portion of the flow control to reduce as much as possible the metallic elements which are subject to attack by bleaching chemicals, especially chlorine dioxide.

It is another object of the invention to provide means for continuously cleaning the flow controlling elements to avoid all possibility of build-up of pulp deposits thereon.

It is a still further object of the invention to provide novel means for discharging from the top of the tower the pulp after completion of the bleaching process.

In general, the above and other objects of the invention are carried out by providing a bleaching tower with a distribution means located generally centrally of its bottom providing a generally horizontally extending passageway for directing infed pulp outwardly along the bottom of the tower and so prevent flow directly upwardly through the center of the tower with resulting unequal time of retention in the tower. Furthermore, since an intimate and uniform mixture of chlorine dioxide or other bleaching chemical and pulp suspension is essential, the invention further contemplates that independent mixing means be provided externally to the tower so that such mixture is completed prior to the introduction of the pulp suspension to the tower distribution means. As a result, the distribution means acts solely to distribute the pulp outwardly across the tower bottom, and both it and the separate mixing means can hence be set up to operate independently at high efficiency. This is especially important because of the conflicting requirements of the mixing and the distributing means. Thus, the mixing means must provide a high degree of agitation, which is best accomplished by a rotary agitator of relatively small dimensions operating at high speed. In the distributing means, on the other hand, agitation is not desirable, rather it is desired to continuously and positively move stock outwardly along the bottom of the tower. This function is best accomplished by a rather large structure which is preferably moved at slow speed both to avoid agitation and high power consumption. Furthermore, such slow movement makes possible the use of scraper means suitable for continuously cleaning surfaces adjacent the distributing means to reduce the possibility of pulp build-ups which migh cause plugging.

In addition to the above described structure, the invention also provides novel and simplified discharge means at the top of the tower, comprising essentially a collecting opening adjacent to and within the cylindrical wall of the tower itself yet extending but a short distance therealong and having a sloping bottom to prevent clogging or other interference with the upward flow of pulp within the tower, arm means being provided to move the pulp at the top of the tower in a spiral path into the collecting opening.

By so providing separate infeed and discharge means according to the invention, the entire cross-sectional area of the tower therebetween is free from obstructions. This not only aids in maintaining uniform pulp flow, but enables each element to be run at its most efficient speed.

The above and other objects and features of the invention will be made clear from the following detailed description of a preferred embodiment thereof taken in connection with the annexed drawings in which:

FIG. 1 is a vertical cross section of a bleaching tower incorporating the present invention;

FIG. 2 is an enlarged vertical cross section of the distributing means of the tower of FIG. 1;

FIG. 3 is a plan of the distributing means of FIG. 2;

FIG. 4 is an isometric view of the distributing means of FIGS. 2 and 3;

FIG. 5 is an enlarged vertical side cross section of the mixing means of the tower of FIG. 1;

FIG. 6 is an enlarged vertical end cross section of the mixing means taken on the line 6—6 of FIG. 5;

FIG. 7 is a cross-sectional view taken on the line 7—7 of FIG. 1 and showing in plan the tower discharge means; and

FIG. 8 is a side elevation of a portion of the tower of FIG. 1 showing in elevation said discharge means.

FIG. 1 shows in partial section a bleaching tower and associated apparatus, the tower **10** of which may be of a diameter up to 20 feet and say 80 feet high. The tower **10** has an outer cylindrical steel shell **12**, a rounded bottom shell **14** and a cover **18**, and at the top has a discharge means including an outlet pipe **24** having a horizontal collecting opening hereinafter more fully described but in general defined by the inner surface of a portion of wall **12**, the upper edge **21** of collecting opening inner wall **20**, and the upper edges of radially extending collecting opening end walls **22** and **23**. A scraper **26** is provided to move pulp into the collecting opening for discharge from the tower **10**.

At the bottom of the tower **10** within bottom shell **14** is provided a concrete liner **30** faced with ceramic tile and preferably formed to provide a generally flat bottom portion **32** with an upwardly directed outer peripheral portion **34** and a circular central recess with a conical side wall **36**, although other configurations, even including rounded ones with an inner annular downwardly sloping

portion and outer upwardly sloping portion may be used under special circumstances. The upper edge **37** of said side wall terminates at the flat bottom portion **32** to provide a circular opening in the bottom wall, while the lower edge **38** of said wall terminates adjacent a bore **39** at the bottom of the recess for supporting the seal elements **42** of a shaft **40** driven by a suitable motor, which shaft extends axially of conical side wall **36** upwardly through the bottom of the tower and through the recess. A generally circular pulp inlet **50** is provided through the conical side wall **36** of the recess at one side thereof, said inlet having a pipe **52** extending through concrete liner **30** and terminating at a flange **54** for connection to the mixer means as hereinafter described.

A distributor, generally designated **60**, is mounted on the upper end of shaft **40** for rotation therewith by means of a downwardly extending tubular portion **61**. Said distributor has a raised rim portion **62** extending outwardly beyond edge **37**, spaced a limited distance above and overlying the annular flat bottom portion **32** to define a generally horizontally extending passageway between said bottom portion and said distributor to direct pulp outwardly along the bottom of the tower **10**. The inner portion **64** of distributor **60** is preferably depressed in relation to the rim portion generally in a plane with flat bottom portion **32** and is connected to rim portion **62** by a conical section **66** generally concentric with conical wall **36** to provide a faired transition for pulp flow from inlet **50** outwardly beyond rim **62**.

In order to establish the most desirable distribution of pulp passing from under rim **32** into the tower proper, by maintaining a strong flow of pulp radially outwardly, the distributor **60** is provided with a plurality of segmental walls of generally sector shape extending downwardly from rim **62** and conical section **66** to closely adjacent the flat bottom wall portion **32**, the point of said walls forming a 90° angle at the outer edge of circular portion **64** and extending outwardly with their downwardly extending connecting portion along the outer edge of rim **62**. These walls define a plurality of radially extending passageways **70** spaced from one another, herein shown as four in number and generally at right angles to one another extending from the central recess outwardly beneath the raised rim **62**. The pulp flow being so restricted results in the outward flow thereof in streams spaced from one another, so that the stock is evenly distributed from the center to the outside of the tower. The net effect is equalization, as between the center and the periphery, of the time required for the average fiber to travel the entire length of the tower. Furthermore, since the distributor **60** is rotated, the pulp streams therefrom also rotate to prevent channeling or build-ups, maintaining the uniform distribution of pulp throughout the entire bottom area of the tower.

More specifically, as to the distributor structure establishing passageways **70**, a pair of vertical walls **68** extend at right angles to one another and outwardly from each of four uniformly spaced points at the junction of conical section **66** and inner section **64**, the lower edge of said walls being generally in a plane with inner section **64**, and the outer ends of the walls of each said pair being connected by a peripheral wall **69** which extends downwardly from the outer edge of rim section **62**. Thus, the pulp emerging from the central recess defined by conical wall **36** is confined by walls **68** to the four passageways **70**, all at right angles to one another. Preferably, of the distributor rim periphery, the passageway openings and the spaces therebetween should be of about equal extent for best operation and distributor **60** should be rotated at about 10 r.p.m.

As it is desirable continuously to clean the walls of the recess, a scraper mounted on shaft **40** for rotation therewith is also provided, such scraper taking the form of a cleaning blade **72** mounted at its lower inboard end on tubular portion **61** and extending upwardly and outwardly therefrom closely adjacent to recess wall **36** to one of distributor walls **68**. Movement of said blade along said wall as disk **60** slowly rotates serves to provide a sure means of preventing pulp build-ups which might lead to plugging, yet requires little power since it runs at low speed and does not interfere with the flow of pulp outwardly through passageways **70**.

Referring now to FIGS. 5 and 6 as well as to FIG. 1, the mixer, generally designated **80** is mounted beneath the bottom shell **14** of the tower with its outlet **82** connected to inlet pipe flange **54** by a suitable length of pipe. At its inlet **84**, the mixer includes a means for introducing chlorine dioxide or other bleaching chemical into the pulp stream, such means herein being shown as a section of hollow tubing **86** passing through the wall of the mixer inlet **84**. Other means for introducing bleaching chemicals may also be used.

The mixer itself is well known in the art and includes a cylindrical housing **90** having rotatably mounted therein an axially extending shaft **92**, said shaft having a series of pegs **94** mounted thereon in axially spaced groups to cooperate with stationary pegs **96** in housing **90** upon rotation of shaft **92** by any suitable means to agitate the pulp and bleaching chemical mixture for uniform intermixing thereof prior to the time the mixture enters the tower inlet **50**. Other types of known mixers may be used as well, keeping in mind the necessity of achieving complete mixing prior to entry of the mixture into the distributor means in the tower, since such distribution means is essentially free of the agitation necessary for mixing.

Turning now to FIGS. 7 and 8 as well as to FIG. 1, the novel discharge means of the invention, mentioned briefly above, will now be described in detail with reference to such figures. The horizontal collecting opening inner wall **20** at its upper edge **21** is spaced inwardly from cylinder wall **12** for a distance equal to no more than about 5–10% of the tower diameter and slopes downwardly and outwardly to merge with cylinder wall **12**, preferably at an angle of about 30° to said cylinder wall so that pulp moving upwardly along wall **12** will not pile up against the inner collecting opening wall **20**. Also, further to avoid interference with upward movement of pulp within the tower, the generally triangular end walls **22** and **23** are spaced from one another no more than about 20% and preferably 10% of the tower circumference and preferably, too, the wall **22** at the leading side of said opening is sloped to provide a wider opening at the top for most efficient collection of pulp. The collecting opening communicates through tank wall **12** with a discharge pipe **24** which may be somewhat smaller than the collecting opening with opening walls **20**, **22** and **23** as well as outer wall **25** being sloped to provide a smooth transition for pulp flow. Pipe size is not critical, although it must be sufficiently large to accommodate the volume of pulp which must be continuously removed from the tower. To aid in such removal, a scraper **26** preferably having a plurality of arms is rotatably mounted at the top of the tower on a shaft **28** suitably driven by any suitable means **27** to rotate the arm **26** and scrape pulp outwardly in a spiral path so that it will be moved over the upper edges of and into the collecting opening. Such scrapers are generally well known in the art and may include a plurality of inclined blades urging the pulp both circumferentially and outwardly as the scraper is rotated to move the pulp into the collecting opening. For this type of bleaching tower, it is preferable to use a scraper with downwardly sloping arms such that the top of the mass of pulp is higher at the center than at the periphery, since such a configuration further reduces the tendency of the pulp to channel up the middle.

It is clear from the foregoing that the bleaching apparatus of the present invention, by operating to complete the necessary mixing of pulp suspension and bleaching

chemical prior to and independently of the distributing of the mixture in the tower itself, makes possible the use of a novel distributor structure capable of effecting radial transfer of pulp, without the use of the heretofore used central shaft and arms extending throughout the length of the tower. Furthermore, the structure makes use of inexpensive chemically resistant materials such as ceramic tile in combination with a novel tank bottom structure, so that only the disk itself, its shaft and the scraper need be of metallic material. In addition, the novel discharge means of the invention is much less complicated and expensive than those heretofore used, yet is entirely effective to perform its function without substantial interference to the operation of the bleaching tower and its associated apparatus.

Various modifications within the spirit of the invention and the scope of the appended claims will be apparent to those skilled in this art.

I claim:

1. Apparatus for bleaching cellulose pulp comprising a vertical upflow tower including a bottom having a circular recess with an upwardly diverging conical side wall and a pulp inlet opening through said side wall, agitating means positioned in advance of said inlet opening for introducing bleaching chemical into said pulp and for mixing said bleaching chemical with said pulp prior to its passage through said inlet opening, a rotatable shaft extending axially of said conical side wall upwardly through the bottom of said tower and through said recess, a rotatable distributor mounted on the upper end of said shaft, said distributor having a raised annular rim portion and a depressed circular central portion connected by a conical portion, and having at least its rim portion extending outwardly beyond said circular recess and spaced a limited distance above the bottom of said tower, said distribtuor providing a plurality of radially extending passageways spaced from one another about the peripheral rim of said distributor and providing substantially the sole communciation between said recess and said tower, and means for rotating said shaft with said distributor to direct pulp flowing outwardly through said passageways in a plurality of generally radial rotating streams.

2. Apparatus for bleaching cellulose pulp comprising a vertical generally cylindrical tile-lined upflow tower including a concrete bottom with a generally flat bottom portion having a circular central tile-lined recess with an upwardly diverging conical side wall and a generally circular pulp inlet opening through said side wall, agitating means positioned in advance of said inlet opening for introducing bleaching chemical into said pulp and for mixing said bleaching chemical with said pulp prior to its passage through said inlet opening including rotary agitating means, a rotatable shaft extending axially of said conical side wall upwardly through the bottom of said tower and through said recess, scraper means mounted on said shaft for movement along said conical sidewall closely-adjacent thereto, a rotatable distributor mounted on the upper end of said shaft having at least its rim portion extending outwardly beyond said circular recess and spaced a limited distance above the annular flat bottom portion of said tower, said distributor providing a plurality of radially extending passageways spaced from one another about the peripheral rim of said distributor and providing substantially the sole communication between said recess and said tower, and means for rotating said shaft with said scraper and distributor to direct pulp flowing outwardly through said passageways in a plurality of generally radial rotating streams.

3. Apparatus for bleaching cellulose pulp comprising a vertical generally cylindrical tile-lined upflow tower including a concrete bottom with a generally flat bottom portion having a circular central tile-lined recess with an upwardly diverging conical side wall and a pulp inlet opening through said side wall, a rotatable shaft extending axially of said conical side wall upwardly through the bottom of said tower and through said recess, a rotatable distributor mounted on the upper end of said shaft having at least its rim portion extending outwardly beyond said circular recess and spaced a limited distance above the annular flat bottom portion of said tower, said distributor providing a plurality of radially extending passageways spaced from one another about the peripheral rim of said distributor and providing substantially the sole communication between said recess and said tower, and means for rotating said shaft with said distributor to direct pulp flowing outwardly through said passageways in a plurality of generally radial rotating streams.

4. In a continuous upflow bleaching tower having a circular bottom recess with an upwardly diverging conical wall and a pulp inlet through said wall, a distributor rotatably mounted within said tower positioned closely adjacent said flat bottom portion outwardly beyond said recess, said distributor having a raised annular rim portion and a depressed circular central portion connected by a conical portion, with a plurality of segmental walls of generally sector shape extending downwardly from said rim portion and said conical portion providing a plurality of radial passages extending from said central recess outwardly beneath said raised rim portion, the outlets of said passageways being spaced from one another about the peripheral rim of said distributor and providing substantially the sole communication between said recess and said tower.

5. A distributor as claimed in claim 4 wherein said segmental walls are four in number and are of sector shape with their points adjacent said central portion and extending outwardly with a downwardly extending connecting portion adjacent the outer edge of said rim.

6. A distributor as claimed in claim 5 further including a cleaning blade mounted on one of said walls and extending downwardly and inwardly for cleaning the conical wall of said recess.

7. In a continuous upflow bleaching tower of generally cylindrical shape, discharge means comprising wall means defining a horizontal collecting opening within the outer cylindrical wall of said tower and extending downwardly and outwardly from said opening to merge with said wall, said tower wall having an opening therethrough for discharge of pulp collected in said collecting opening, and means for moving stock into said collecting opening.

8. Discharge means as claimed in claim 7 wherein said wall means includes an inner wall spaced inwardly from said tower wall by no more than about 10% of the diameter of said tower and end walls connecting said inner wall and said tower wall and spaced from one another no more than about 20% of the tower circumference.

9. Apparatus for bleaching cellulose pulp comprising a vertical generally cylindrical upflow tower including a bottom with a generally flat portion having a circular recess with an upwardly diverging conical side wall and a pulp inlet opening through said side wall, agitating means positioned in advance of said inlet opening for introducing bleaching chemical into said pulp and for mixing said bleaching chemical with said pulp prior to its passage through said inlet opening, a rotatable shaft extending axially of said conical side wall upwardly through the bottom of said tower and through said recess and terminating immediately thereabove, a rotatable distributor mounted on the upper end of said shaft having at least its rim portion extending outwardly beyond said circular recess and spaced a limited distance above the annular flat bottom portion of said tower, said distributor providing a plurality of radially extending passageways spaced from one another about the peripheral rim of said distributor and providing substantially the sole communication between said recess and said tower, and discharge means positioned at the top of said tower comprising wall means defining a horizontal collecting opening within the outer cylindrical wall of said tower and extending down-

wardly and outwardly from said opening to merge with said wall, said tower wall having an opening therethrough for discharge of pulp collected in said collecting opening, a rotatable upper shaft extending axially of said tower downwardly into said tower but terminating adjacent the top of said tower, scraper means mounted on the lower end of said upper shaft for moving stock into said collecting opening to discharge bleached pulp from said tower and means for rotating each of said shafts with said tower to direct pulp flowing outwardly through said passageways in a plurality of generally radial rotating streams to provide uniform exposure to said bleaching chemical as said pulp moves upwardly through said tower, the cross-sectional area of said tower between said distributor and said scraper being unobstructed to maintain uniform the upward flow of pulp until contacted by said scraper means for generally horizontal spiral movement into said collecting opening.

10. Apparatus for treating cellulose pulp including a vertical generally cylindrical upflow tower with a bottom having a pulp inlet opening and discharge means positioned at the top of said tower, said discharge means comprising wall means defining a horizontal collecting opening including an inner wall spaced inwardly from the tank wall by a limited distance with respect to the diameter of said tower and end walls connecting said inner wall and said tower wall and spaced from one another by a limited distance with respect to the tower circumference, with said inner wall extending downwardly and outwardly to said tower wall and said end walls extending generally vertically and radially of said tower within said tower wall, said tower wall having an opening defined by said collecting opening inner wall and end walls for discharge of pulp collected in said collecting opening, a rotatable upper shaft extending axially of said tower downwardly into said tower but terminating adjacent the top of said tower, scraper means mounted on the lower end of said shaft for moving stock into said collecting opening to discharge pulp from said tower with the outermost portion of said scraper means passing above said collecting opening during rotation, and means for rotating said shaft for generally horizontal spiral movement of pulp into said collecting opening.

References Cited in the file of this patent

UNITED STATES PATENTS

2,198,709	Tomlinson	Apr. 30, 1940
2,516,447	Burling	July 25, 1950
2,706,390	Johansen	Apr. 19, 1955
2,711,359	Johansen	June 21, 1955
2,764,011	Richter	Sept. 25, 1956
2,774,654	Reed	Dec. 18, 1956
2,873,600	Demaret	Feb. 17, 1959

FOREIGN PATENTS

529,983	Belgium	July 15, 1954