Sept. 13, 1955 C. L. CLARK ET AL 2,717,536

CONDITIONING PAPER-MAKING STOCK

Filed July 22, 1953 2 Sheets-Sheet 1

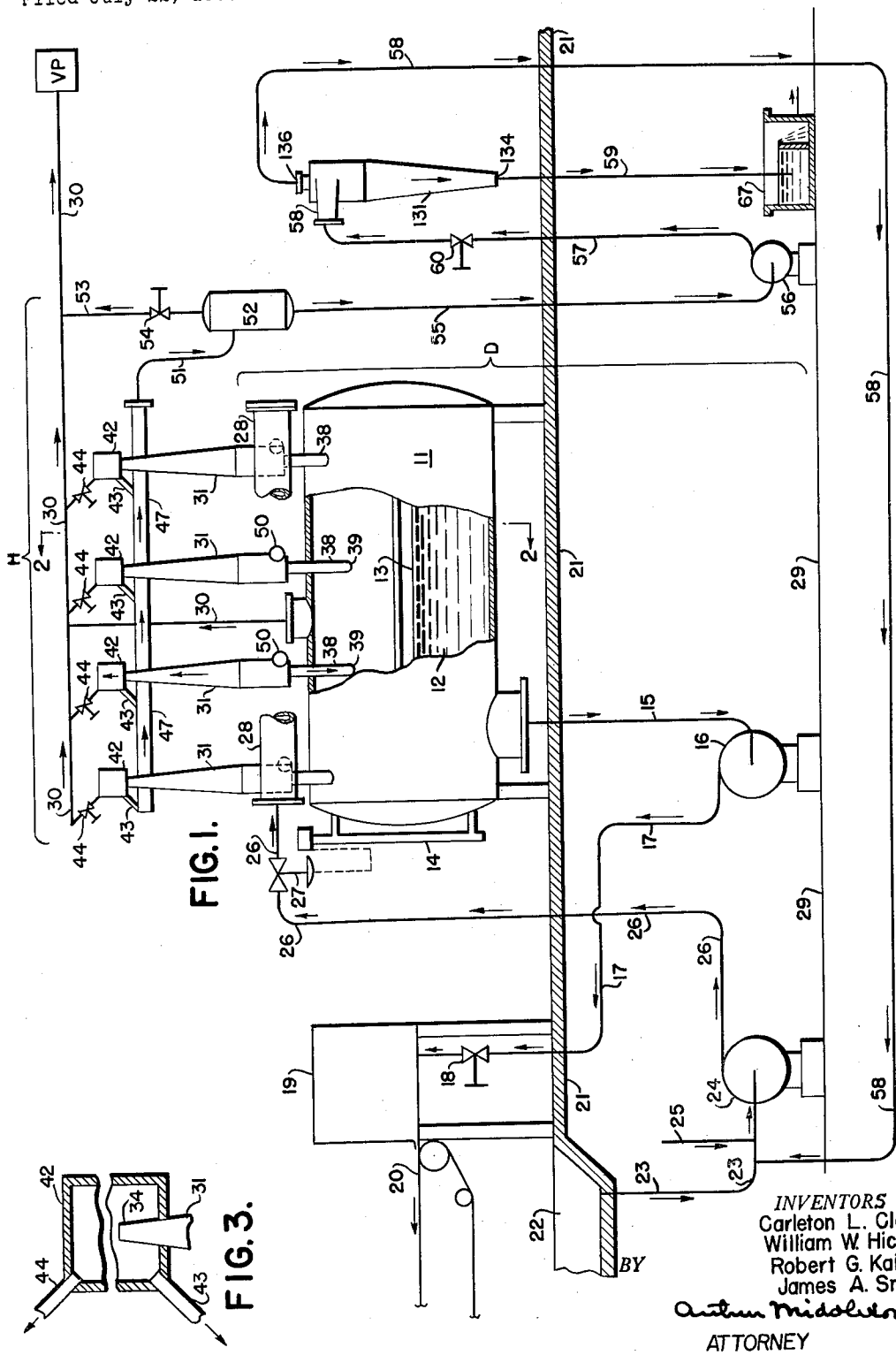

FIG. 1.

FIG. 3.

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Filed July 22, 1953 2 Sheets-Sheet 2

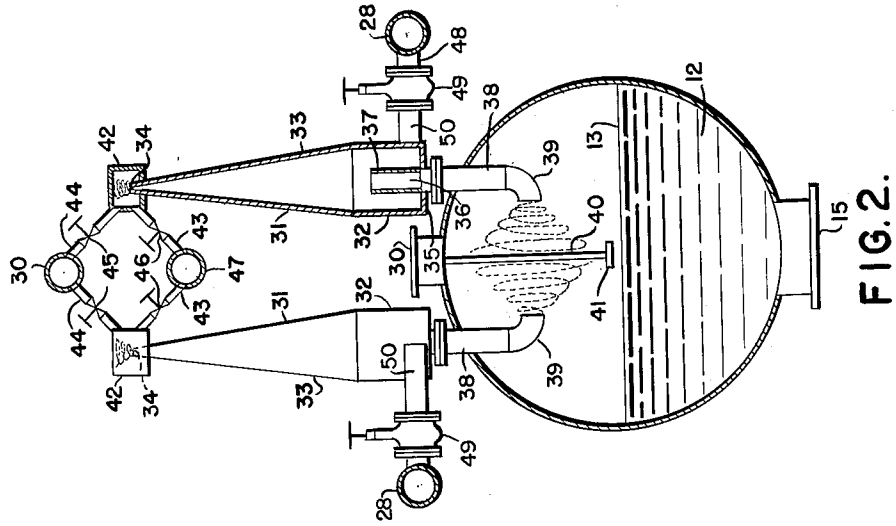

FIG. 2.

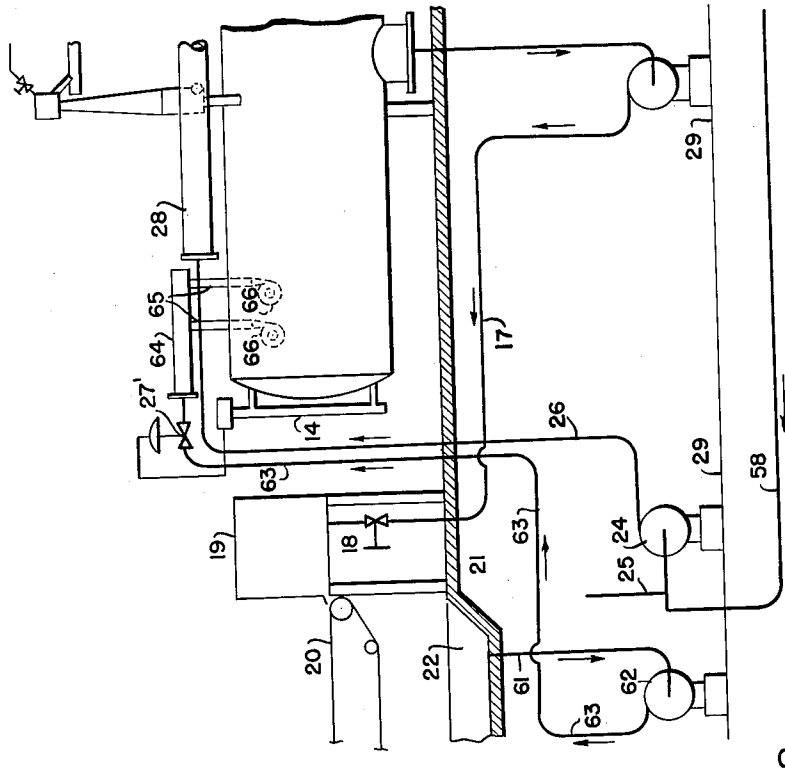

FIG. 4.

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2,717,536

CONDITIONING PAPER-MAKING STOCK

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Application July 22, 1953, Serial No. 369,614

13 Claims. (Cl. 92—28)

This invention relates to the removal of gas and dirt from paper-making stock to ready it for the paper-making machine. It has heretofore been proposed to improve its handleability by de-aerating it, sometimes referred to as de gasifying it. This is accomplished by atomizing the pumpably fluid stock into a receiver while subject to the influence of substantial vacuum, collecting a pond of de-aerated stock while still under the influence of vacuum, and then conducting it to the paper-making machine. Such a proposal has been patented in the patent to De Cew—No. 2,571,219, patented October 16, 1951. It has also been proposed to clean or to de-dirt the stock prior to supplying it to the paper-making machine. This proposal has been carried out by treating the stock centrifugal separating or segregating devices to divide the stock into fractions of which one is substantially dirt-free, or at least dirt-poor, and thus acceptably clean stock, while the other has the dirt concentrated in it or is dirt-rich, so it may be referred to as rejectably dirty stock. One such proposal has been patented in the patent to Samson et al., No. 2,377,524, patented June 5, 1945, while another such proposal has been patented in the patent to Freeman—No. 2,312,706, patented March 2, 1943. The devices of these two patents, by way of example, both comprise a hydrocyclone characterized in that as a result of pressure on a tangential feed thereto, vortices are said to be set up therein. The liquid body therein is given a vortically spinning movement with inner and outer layers, in which outer layers are segregated coarser or faster settling solids, while in the inner layers are segregated the fine or slower settling solids. The segregated coarse solids discharge through the apex of the conical part of the hydrocyclone of those patents and is called underflow, while the segregated fine solids vortex discharge through a vortex finder in the base of the hydrocyclone of those patents and is called overflow. A dirt-poor acceptable fraction of slower settling solids is discharged as overflow while a dirt-rich rejected fraction of faster settling solids is discharged as underflow. However, these terms overflow and underflow do not mean that the hydrocyclone has to be vertical or that the overflow is from the top of the hydrocyclone or that the underflow is from the bottom of the hydrocyclone. Sufficiently high feed pressure is used in feeding the stock tangentially of the cylindrical part of the hydrocyclone so that the liquid in the hydrocyclone is swirled centrifugally with a force significantly in excess of gravity, whereby a hydrocyclone can function horizontally as well as vertically and, indeed, upside-down. These two patented hydrocyclones have been selected by way of example because their discharges are emitted under pressure and in the form of liquid in discontinuous phase, namely as a spray. So this is the important factor made use of by this invention when it uses a centrifugal separator, of which a hydrocyclone is the preferred form because of its unobstructed interior. And referring again to the patent to De Cew, in that device the stock requires sufficiently high feed

pressure to atomizing spray nozzles in the receiver that is under the influence of vacuum for emitting the stock into that receiver as an atomized spray, fog, or mist.

So it is an object of this invention to put these two types of treatment stations together while modifying each to co-operate conjointly with the other to improve the results including reducing the costs of installation and of operation. Another object is to combine the centrifugal separators with a stock de-aerator to pass the stock to the de-aerator through hydrocyclones instead of the spray nozzles per se, so that only one set of feed pressures is used instead of two, and yet the stock sprayed into the de-aerating receiver has already been de-dirted. Hydrocyclones usually have an air core extending axially therethrough, and this air core tends to aerate, or inject air into, liquid suspensions being treated in the hydrocyclone, but since it is the main purpose of this invention both to de-dirt and to de-gasify the stock, it is another object of this invention to combine the hydrocyclones with the de-gasifier or de-aerator under conditions that the normal aerating function of the hydrocyclones is eliminated therefrom. In a stock de-aerator of the type of the De Cew patent, all the stock to be de-aerated is usually passed through the atomizing spray nozzles of the vacuum treatment receiver. So it is another object of this invention to pass through the de-dirting centrifugal separator only a part of the total volume of the stock going to the paper-making machine. In the de-aerator of the type of the De Cew patent, it takes considerable feed pressure on the stock to force it through the atomizing spray nozzles of that patent. It is yet another object of this invention to reduce substantially the normal amount of that infeed pressure. Another object of this invention is to treat the dirt-rich fraction discharged from the centrifugal separators to reclaim some of that rejected stock by further or secondarily de-dirting it while maintaining it in de-aerated condition.

Some of the features of this invention contributing to the realization of these objects include the means whereby the accepted or de-dirted fraction from the centrifugal separator station is atomizingly sprayed directly into the de-aeration station or vacuum receiver, making unnecessary the use of spray nozzles as such; the means whereby relatively thick or high consistency stock can be passed to the de-aeration station through the centrifugal separator station while stock-diluting liquid can be supplied to that de-aeration station directly, thus by-passing the centrifugal separator station; the means for using the vacuum in the de-aeration receiver or station to help create the differential in pressure normally required to pump stock through the hydrocyclones; the means for eliminating air-bleed by maintaining the effect of vacuum on the rejected fraction of stock; and the means for re-claiming some of the stock in the primary rejected dirt-rich fraction underflowing from the hydrocyclone station.

The objects of this invention, and perhaps others that appear as this specification proceeds, are realizable in one embodiment of this invention having an enclosed receiver tank provided with means for subjecting the tank to vacuum-induced significantly reduced pressure, into the atmosphere of which tank are atomizingly sprayed pumpable de-dirted paper-making components flowing from the outlet in the base end of hydrocyclones of the centrifugal separator station, which overflow outlets lie within the influence of the vacuum in the tank of the de-aeration station. That is, the stock supplied to the centrifugal station is fractionated into an acceptable de-dirted or dirt-poor fraction and a rejectable dirt-rich fraction. As the terminal outlets from the hydrocyclones are connected to the tank, the acceptable fraction is sprayed thereinto. The rejectable dirt-rich fraction is underflowingly discharged

from the centrifugal separator station outside of the de-aeration tank and preferably into a header that conducts the rejected fraction to further treatment. The dirt-poor fraction sprayed into the de-aeration tank and collected therein as a pond of de-dirted de-aerated stock is conducted to the head-box of the paper-making machine. New incoming paper-making stock of rather high consistency can be so fractionated and sprayed from the hydrocyclones into the de-aerating tank, and diluting liquid, such as white-water, can by-pass the hydrocyclone station to be sprayed directly thereinto to collect in the pond in the de-aeration tank, there to make up the proper dilution of the de-dirted and de-aerated stock going to the feed end of the paper-making machine. Primary rejected dirt-rich stock in the hydrocyclone-rejected fraction is or can be treated in a primary separator station that is a tank maintained under the influence of vacuum, by being sprayed therein. The vacuum sucks vapors from the top of the tank, and a pump returns sprayed stock from the separator tank back to be re-treated in the de-aeration station while still under the influence of vacuum through a secondary hydrocyclone station which again fractionates this stock into an acceptable de-dirted fraction ultimately sprayed into the de-aeration station wherein it falls into the pond in which it commingles with the acceptable stock fraction sprayed from the primary hydrocyclone station. From the secondary hydrocyclone station there is also emitted a rejectable dirt-rich fraction conducted from the underflow of the secondary hydrocyclone station and thereupon is conducted to discard through a barometric drop leg.

The preferred embodiments of this invention are illustrated in the accompanying drawings, in which Fig. 1 shows a flow-sheet of the ways and means for removing dirt and gas from paper-making solids, as practiced by this invention. In the flow-sheet, some of the devices are illustrated by their contours and indeed some by broken-away views thereof. Fig. 2 is a vertical sectional transverse view, with parts in section, along the lines 2—2 in Fig. 1. Fig. 3 is a vertical sectional view through the expansion chamber 42 in Fig. 2. Fig. 4 is a partial view like that of Fig. 1, of a modification.

In the drawings, 11 indicates an enclosed vacuum-influenced de-aerating or de-gasifying tank, in which a suspension of paper-making solids is to be atomizingly sprayed to de-aerate or de-gasify it, wherein there is adapted to be collected a pond or pool 12 of de-aerated stock whose liquid-level 13 is maintained constant under the control of a standard level transmitter device 14. De-aerated stock is conducted from the tank 11, sometimes referred to as the receiver, while air is substantially excluded therefrom, through a pipe-line or conduit 15, by means such as the fan pump or centrifugal pump 16, from whence it is conducted through pipe-line 17 having a headbox control valve 18 therein, to a headbox 19 of a paper-making machine. From the headbox, stock therefrom is delivered to the usual wire 20. 21 represents the usual machine room floor in a paper mill, and 22 the wire pit of the papermaking machine.

White water is drawn from the wire pit 22 through conduit 23 by centrifugal mixing pump 24, usually on the basement floor 29, which also draws up new paper-making stock through pipe 25 to mix it with white water from pipe 23, forces the so-diluted stock through conduit 26, through automatic flow-control valve 27 that is influenced or controlled by the level-transmitter 14 to maintain a constant liquid-level 13 on the pond of de-aerated stock in the tank 11. Conduit 26 delivers the stock to be treated into a stock header pipe 28 that is adapted to supply the stock of paper-making solids in suspension, to a de-dirting centrifugal segregator or separator station indicated generally by H, while the de-aeration station is indicated generally by D. The de-aerating tank or receiver 11 is maintained under the influence or effect of vacuum by means of the vacuum-line or header 30 that is connected with a suitable vacuum-producer VP, which vacuum-line is also effective on the centrifugal segregator station H as will be described later.

Station H is made up of a plurality of such segregators whose function is to receive the stock or suspension of papermaking solids and centrifugally to segregate into fractions of that stock one fraction that is dirt-poor or de-dirted, and one fraction that is dirt-rich, namely in which most of the dirt is concentrated, but under conditions whereby at least the dirt-poor fraction is forcefully sprayed from its outlet in the segregator in significantly discontinuous liquid phase. This seems to involve vortical spinning of the liquid within the segregator to set up therein centrifugal action having a force much greater than gravity whereby the faster settling solids are segregated in the outer layers while the slower settling solids are segregated in the inner layers. Thus the dirt-rich fraction is in the outer layers while the dirt-poor fraction is in the inner layers. The dirt-poor fraction issues through one outlet from the segregator, usually an axial outlet, while the dirt-rich fraction issues through another outlet. Stock going to the segregator is fed thereto tangentially with a pressure sufficient to swirl the liquid body within the casing vortically to accomplish the desired separation and segregation. A general type of such device is now known as a hydrocyclone, and this type is exemplified by the patents to Samson et al. No. 2,377,524, and to Freeman, No. 2,312,706, of which the hydrocyclone of the Samson patent is at present the preferred one in which to practice the de-dirting part of this invention. A typical hydrocyclone of this type is shown in Fig. 2, wherein one of the hydrocyclones of the hydrocyclone station H is shown in vertical section, whereas its twin is not. Each hydrocyclone selected as illustrative of the centrifugal segregation used in the practice of this invention such as 31 comprises a cylindrical part or section 32 subtended by a conical part of section 33, having an apex outlet 34. The cylindrical section is closed by a base 35 having a base-outlet 36 through which passes a pipe 37, usually called a vortex-finder. 38 indicates a pipe that is a continuation of the vortex-finder that may or may not terminate in an elbow 39. If the latter is used, it is for the purpose of emitting the centrifugally and forcefully sprayed discharge from the hydrocyclone at an angle thereto of less than 180°. In the instance shown, the spray is emitted at a right angle to the axis of the hydrocyclone 31. The centrifugally sprayed base discharge from the hydrocyclone 31 containing the acceptable dirt-poor fraction, is sprayed against an impingement plate 40 supported within the receiver tank 11 and extending at substantially right angles to the axis of the emitted spray. The impingement plate preferably has a reinforcing bottom flange 41. The emitted spray from the elbow 39 is a forcefully whirling spiralling mass of discontinuous liquid phase droplets ejected from the elbow at velocity high enough to impinge them with considerable impact against the plate for further comminuting the droplets so that the liquid so projected into the tank 11 is in the form of an atomized spray much like a fog or mist. The discharge through the apex 34 contains the rejectable dirt-rich fraction and it is sprayingly emitted into an expansion chamber or box 42. The sprayed liquid suspension falls to the bottom portion of the chamber from whence it is flowed away through a pipe 43 while from the upper section of the chamber is a pipe 44 through which vapors flow since it is connected to vacuum header or line 30 leading to the source of vacuum or vacuum producer VP. The pipe 44 is valved at 45 for regulating the vacuum effective on the chamber 42 and the apex 34 of the hydrocyclone. The liquid outlet pipe 43 is also valved, at 46, for regulating the outflow of liquid therefrom. Pipe 43 connects with rejects header or pipe 47, leading the rejected dirt-rich fraction to further treatment. The expansion chamber

or box 42 is designed so that the liquid is taken off through pipe 43 below the apex outlet of the hydrocyclone in order to keep that outlet from becoming submerged in its own emitted liquid.

Stock from the feed header 28 is drawn off through pipe 48 valved at 49, to control the feed of stock therethrough to the tangential inlet pipe 50 inletting to the cylindrical section 32 of the hydrocyclone 31. Stock to be de-dirted is forced through the tangential feed pipe 50 with sufficient pressure to set up in the liquid body of stock within the hydrocyclone 31 a vortical spinning of that body by a centrifugal force greater than gravity for the dual purpose of maintaining centrifugal segregating effects (1) to yield the dirt-rich fraction in the outer vortex and the dirt-poor fraction in the inner vortex, and (2) to make it possible to use the hydrocyclone in an upside-down position. The infeed pressure on the stock entering the tangential feed pipe 50 from the stock header 28 comes from pump 24 through stock-line pipe 26. Normally such pressure supplied by the pump 24 would be of the order of 40 p. s. i. g. but it is to be noticed that in this case both outlets from the hydrocyclone 31 are under the influence of vacuum. Therefore, only about 27 to 29 p. s. i. g. pressure or less has to be used to get the same centrifugal segregating effect as it would if these outlets were open to the atmosphere. The degree of vacuum acting within the de-aerating receiver or tank 11, is normally in accordance with the teaching of the patent to Clark et al., No. 2,614,656, namely, such that the partial pressure of the gas in the de-aerating tank 11 is equal to less than 0.3 inch of mercury, if more than 90% of the air or gas is to be removed from the stock. Otherwise, a lesser degree of vacuum can be used.

Turning now to the rejected dirt-rich fraction of the paper-making stock in rejects header 47, they are conducted through pipe 51 and sprayed into a primary separator tank 52, whose top is connected with line 53, valved at 54, with main vacuum line 30, while its bottom is connected by pipe 55 to a primary rejects fan or centrifugal pump 56 that pumps the rejects up pipe 57, valved at 60, through the tangential feed inlet pipe 58 of a secondary hydrocyclone station indicated generally by the numeral 131 functioning like the other hydrocyclone station. The segregated dirt-poor fraction is discharged through base outlet 136 through pipe 58 to be returned to conduit 23 in which is the incoming stock to be initially treated, so this secondary accepted dirt-poor fraction from the secondary hydrocyclone station 131 is mingled with the incoming new stock by the mix pump 24, and goes again to the primary dual treatment of de-dirting and de-aerating. The dirt-rich fraction segregated in the secondary hydrocyclone 131 passes out through apex outlet 134 and passes through a drop-leg 59 to be discharged to the atmosphere through a seal-box 67. The rejects flowing through pipe 51 into the primary separator 52 are under the influence of vacuum so the rejects are in effect sucked into the separator 52 as a spray.

Under some conditions, it is not necessary to put all of the paper-making stock through the de-dirting and de-aerating treatment zone. This makes for quite a saving in size of equipment and in pumping costs. To that end, it is proposed by this invention to pass only a high-consistency fraction of the incoming new stock of the de-dirting and de-aerating treatment, and then dilute the de-dirted and de-aerated thick new stock while it is in the pond thereof in the de-aerating receiver tank 11, with diluting white water, or other water, so that the treated stock drawn from the pond 12 is properly diluted, but the mass of diluting water has not been de-dirted but only de-aerated. To that end, the arrangement of Fig. 4, is shown that is a modification of the showing of Fig. 1, in that the white water in pipe 23 is not mixed with incoming raw feed stock from pipe 25, by mixing pump 24. Instead, this mixing pump 24 mixes only incoming

thick raw stock from pipe 25 and recirculating secondary acceptable stock from pipe 58, which mixture is then supplied through pipe 26 to de-dirting and de-aerating treatment through stock feed header 28 and the primary hydrocyclone station H. Diluting water, either as such, or a very dilute suspension of paper-making solids, such as white water from the wire pit 22, is supplied through pipe 61, to a fan or centrifugal pump 62, which pumps it through pipe 63 to diluting water header 64 through control valve 27' that is controlled by the level-transmitter 14 for maintaining constant the liquid-level 13 in the tank 11. The level-transmitter 14 may control either or both of the automatic control valve 27 in the stock flow conduit 26 in Fig. 1, or the automatic control valve 27' in the diluting water pipe 63 in Fig. 4. From diluting water header 64, the water is fed through pipes 65 into the tank 11 where each terminates in an atomizing spray nozzle 66 that sprays the water as mist into the atmosphere of the tank 11 so that it is de-aerated, whereupon it falls to collect in the pond 12 of de-dirted and de-aerated thick stock, in which pond the thicker stock is thus diluted with de-aerated diluting water that has not been passed through the de-dirting hydrocyclone station.

Operation

New stock to be made into paper, or other such sheeted material, comes in for treatment through pipe 25, to be mixed in pump 24 with diluting white-water coming from the wire pit 22 through pipe 23. This dilute suspension of paper-making solids is forced through pipe 26 and stock feed header 28 to enter the hydrocyclone station H and its centrifugal segregators or hydrocyclones 31 through the latter's tangential feed pipes 50 with sufficient pressure to give the liquid body of suspension in the hydrocyclones a vortically spinning or spiralling movement with inner and outer layers in which outer layers are segregated coarser or faster settling solids into a dirt-rich fraction of the suspension, while in the inner layers are segregated slower or fine settling solids into a dirt-poor fraction of the suspension. The dirt-rich or rejectable fraction of the suspension is sprayed out through the apex outlet 34 of the hydrocyclone while under the influence of vacuum through pipe 44 from the line 30, into an expansion chamber or box 42 from whence it passes through pipe 43 to further treatment.

The acceptable dirt-poor fraction of the suspension is then forced from the base outlet 36 of the hydrocyclone 33 by the centrifugal action in the hydrocyclone, to pass through pipe 38 and elbow 39 to be spirally and atomizingly sprayed into the de-aeration tank 11, preferably against an impingement plate 40 for further atomizing the fraction entering the de-aeration tank 11, since in order to get good de-aeration the entering suspension must be finely divided like a fog or mist. This tank is under the influence of vacuum through line 30 leading to a vacuum-producer VP, and it has a pond 12 of de-aerated de-dirted stock in it whose liquid-level 13 is maintained constant by operation of a level-transmitter mechanism 14 that influences automatic valve 27 that controls the quantity of stock fed through pipe 26 and header 28 to the hydrocyclones. The sprayed stock from which first dirt and then gas has been removed falls or rains to collect in the pond 12 thereof from whence such stock is drawn through pipe 15 by pump 16 and conducted through pipe 17 to the feed end of a paper-making machine, such as the headbox 19.

The rejectable dirt-rich fraction segregated in the hydrocyclone station H, in the individual hydrocyclones 31, is discharged from the apex outlets 34 thereof into the expansion chambers 42 while under the influence of vacuum from line 30 and pipes 44 so that both discharges from the hydrocyclones are thus under the effect of vacuum so that the usual air core formed in and by such hydrocyclones is absent. This is important in this case because that air core has an aerating effect, and one of the functions of this invention is to de-aerate the paper-

making stock. The expansion chamber or box 42 is tall enough, and the apex 34 of the hydrocyclone enters it sufficiently, so that the apex is not normally submerged by the emitted suspension. That is why the suspension take-off pipe 43 is shown to be from the bottom portion of the chamber and again, it preferably inclines downwardly. Vapors are sucked from the emitted suspension in the chamber 42, as a result of vacuum being effective thereon through the pipe 44 leading to the vacuum line 30. The rejected, dirt-rich fraction discharge through the apex of the hydrocyclones is collected in reject header 47 and conducted through pipe 51 to a primary separator tank 52 which also is under the effect of vacuum through valve-controlled pipe 53 leading to the main vacuum line 30. The rejected fraction of stock is sucked into the tank by means of that vacuum coupled with the centrifugally swirling impulse the fraction gets as it is discharged from the apex 34 of the hydrocyclone into the expansion chamber 42. Valves such as 45 and 54 are shown to enable this relationship to be effected by proper adjustment. Vapors are sucked from the top of the separator tank 52, and the fluid suspension falls down pipe 55 to encounter pump 56 that feeds it to tangential inlet pipe 58 of the secondary hydrocyclone station 131, wherein the suspension so tangentially fed is further fractionated into a secondary dirt-rich fraction and a secondary dirt-poor fraction. The secondary acceptable dirt-poor fraction passes out through the base outlet 136 of the secondary hydrocyclone to be conducted through pipe 58 to be mixed with the incoming new stock in mixing pump 24 to be thus recycled to the de-aerating tank 11. The secondary rejectable fraction passes out through the apex outlet 134 of the secondary hydrocyclone and then through drop-leg 59 and seal-box 67 passes to discharge to the atmosphere.

The operation of the modification shown in Fig. 4, differs from the foregoing mainly in that undiluted rather thick or high consistency new stock only is supplied to the pump 24 and is passed to fractionating treatment in the hydrocyclone station H on its way into the de-aerating tank 11. Water necessary for diluting that thicker stock de-dirted in the hydrocyclones and then de-aerated in the tank 11, does not need to be de-dirted so it by-passes that station and is sprayed directly into the tank by means of pump 62, pipe 63, header 64, pipes 65, and atomizing spray nozzles 66. Under certain conditions the pump 62 may not be necessary as the vacuum in the tank 11 is sufficient to suck the stock to the nozzles to discharge therefrom.

A major feature of this invention is spraying into the paper-stock de-aerating station of the type shown and described in the patent to Clark et al, No. 2,614,656, directly from a suspended solids fractionating centrifugal segregator and while subject to the effect of vacuum during such segregation, the segregated dirt-poor fraction in discontinuous liquid phase with such centrifugally swirled force that that fraction is in substantially atomized condition or that is so atomized upon impinging on an impingement plate. In this connection, there is substantial advantage accruing from the use of the vacuum as part of the differential in pressure normally required to pump the suspended solids through a hydrocyclone. In other words, the same pressure drop between infeed and outlet in the hydrocyclone is maintained, but since the outlets are under vacuum, the infeed pressure can be significantly reduced over normal. Another feature is that since a thicker or high solids consistency stock can be so fractionated than is normal when passing stock through an atomizing spray nozzle, only thick new stock needs to be so de-dirted, while diluting water, that does not require de-dirting, can by-pass that de-dirting station, and be sprayed directly into the de-aerating tank wherein the thicker de-dirted and de-aerated stock is diluted to the desired consistency. Another feature is the reclaiming of some of the rejected dirt-rich fraction so the reclaimed part can be recirculated to the primary treatment stations.

Whereas, in the foregoing, the treatment has been described as applied to paper-making stock of the type used on a Fourdrinier machine, the invention is capable of being applied to the treatment of higher consistency wood or other pulps of the type that may not go onto a Fourdrinier machine but be used in other types of sheeted material including boards. Also, whereas a hydrocyclone has been referred to, by this is meant any centrifugal segregator whose dirt-poor fraction is emitted in discontinuous liquid phase which when impinged on or against an impingement surface becomes an atomized spray of the nature of a fog or mist.

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, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and 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.

One such modification is that the vacuum-line or header 30, instead of going directly to the vacuum-producer VP, will go to the primary separator tank 52 in the same way that the primary rejects pipe 51 does, whereupon the vapors will all flow to the vacuum-producer VP through the pipe 53.

We claim:

1. The continuous process for simultaneously segregating a liquid suspension of paper-making solids into one primary rejectable dirt-rich fraction and one primary acceptable dirt-poor de-aerated fraction, which comprises maintaining a main enclosed zone under the influence of vacuum, collecting as a pond therein a quantity of the acceptable dirt-poor de-aerated fraction, conducting such fraction to a paper-making operation maintaining a plurality of centrifugal suspended-solids segregating casings each with two outlets, force-feeding tangentially into the casings a treatable suspension of paper-making solids to form therein a vortically spinning body thereof to segregate a coarse-solids fraction in the outer layers and a fine-solids fraction in the inner layers, passing a different centrifugally segregated discharge through the outlets of each casing of which the finer-fraction is dirt-poor and the coarse fraction is dirt-rich, conducting both fractions from their casing under substantially air-excluding conditions, conducting the dirt-poor fraction to the enclosed vacuum zone where it is de-aerated, regulating the degree of vacuum on the zone correlated with the degree of air removal desired, and based upon the degree of vacuum used regulating the degree of vortical spin of the body to spin with sufficient force to effect said segregation into inner and outer fractions as well as to discharge the conducted dirt-poor fraction into the enclosed vacuum zone as an atomized spray.

2. The process according to claim 1, with the addition of atomizingly spraying into the vacuum zone a dilute suspension of paper-making solids for diluting the pond of accepted de-aerated fraction in the vacuum zone.

3. The process according to claim 1, wherein the primary rejected fraction from the apex outlets of the hydrocyclones is conducted to a first separator including an enclosed zone under the effect of vacuum, and spraying that fraction thereinto for further de-aerating it, controllably recycling such further de-aerated fraction to the main vacuum zone through a rejected fraction-treating hydrocyclone, discharging from the apex outlet thereof a secondary rejected dirt-rich fraction under substantially air-excluding conditions, and atomizingly spraying a secondary accepted dirt-poor fraction from the base outlet of that hydrocyclone into the vacuum zone wherein it is de-aerated.

4. The process according to claim 3, wherein the de-

gree of vacuum in the first separator is sufficiently powerful to suck the rejected fraction thereinto in an atomizingly sprayed manner.

5. The continuous process for simultaneously segregating a liquid suspension of paper-making solids into one primary rejectable dirt-rich fraction and one primary acceptable dirt-poor de-aerated fraction, which comprises regulatably maintaining a main enclosed zone under the effect of de-aerating vacuum, collecting as a pond therein a quantity of the acceptable dirt-poor de-aerated fraction, conducting such fraction from the pond to a paper-making machine, maintaining a plurality of hydrocyclone casings each having a cylindrical base section subtending a conical section with two aligned axial outlets, passing a different hydrocyclone-discharge through the outlets of each casing of which one is in the apex while the other is in the base with the discharge through the base outlet being within the enclosed zone and under the influence of vacuum therein, conducting the discharge from the apex under substantially air-excluding conditions, feeding the treatable suspension tangentially into the cylindrical section of the hydrocyclones, and based upon the degree of vacuum used in the vacuum zone regulatably swirling the suspension with sufficient pressure to swirl the suspension with a centrifugal force significantly greater than gravity thus effecting in the hydrocyclones two oppositely directed suspended-solids fractionated discharges of which one comprises the rejectable dirt-rich fraction while the other comprises the acceptable dirt-poor fraction and also sufficient for atomizingly spraying the dirt-poor fraction while under the effect of vacuum into the enclosed zone wherein it is de-areated.

6. Apparatus for continuously producing a de-dirted and de-aerated suspension of paper-making solids, having a stock receiving and de-aerating tank adapted to hold therein a pond of such suspension; vacuum-producing means for applying the effect of vacuum to the tank; means for removing treated stock from the pond thereof in the tank; and means for supplying de-dirted stock while under vacuum into the tank to be de-aerated therein which comprises means for centrifugally segregating dirt-bearing and air-bearing suspended paper-making solids into a discharging dirt-poor fraction and a discharging dirt-rich fraction, means connected with the vacuum-producer for maintaining the effect of vacuum on both discharging fractions, means for feeding said suspended paper-making solids to the centrifugal means, means for conducting the dirt-rich fraction from the centrifugal means, and means for atomizingly spraying the vacuum-influenced dirt-poor fraction into the atmosphere of the vacuum-influenced de-aerating tank.

7. Apparatus according to claim 6, wherein the centrifugal means comprises a hydrocyclone having a base section with an axial outlet and a conical section with an apex outlet, and a conduit leading from the base outlet into the tank and from the terminal end of which conduit the dirt-poor fraction is sprayed.

8. Apparatus according to claim 7, with the addition of impingement plate means against which the discharging atomizing sprays are impinged.

9. Apparatus of the class described having in combination an enclosed de-aerating vacuum-influenced tank, means for conducting treated paper-making stock therefrom under substantially air-excluding conditions, a vacuum producer, a plurality of hydrocyclones associated therewith each having an apex outlet and a base outlet with the base outlets communicating with the interior of the vacuum-influenced tank while the apex outlets communicate with the vacuum producer, and means for pressure-feeding treatable paper-making stock tangentially into the hydrocyclones to atomizingly spray a dirt-poor fraction of paper-making stock from the base outlets and a dirt-rich fraction from the apex outlets.

10. Apparatus according to claim 9, with the addition of a conduit connecting the base outlets with the vacuum-influenced tank and terminating at an angle less than 180° from the apex outlet.

11. Apparatus according to claim 9, with the addition of an expansion chamber around the apex outlet, and a pipe leading from the lower section thereof to the vacuum producer.

12. Apparatus for simultaneously segregating a liquid suspension of paper-making solids into one primary rejectable dirt-rich fraction and one primary acceptable dirt-poor de-aerated fraction, which comprises an enclosed de-aerating tank, means for maintaining the tank under the effect of de-aerating vacuum, means for discharging from the tank a primary acceptable dirt-poor de-aerated fraction of paper-making suspension, a hydrocyclone station having a plurality of hydrocyclones each having a casing with a cylindrical base section subtending a conical section and two aligned axial outlets passing hydrocyclone-discharge through the casing of which one is through the apex and one is through the base with the discharge through the base outlet being within the tank and under the influence of vacuum therein, means for passing discharge through the apex outlet under substantially air-excluding conditions, means for conducting treatable suspension into the cylindrical section tangentially, means for spinning such suspension with sufficient pressure to swirl the suspension with a centrifugal force significantly greater than gravity thus effecting in the hydrocyclones two oppositely directed suspended-solids fractionated discharges of which one is dirt-rich and one is dirt-poor, said force being great enough to emit the dirt-poor fraction from the base outlet as an atomized spray.

13. Apparatus for continuously producing a stock of de-dirted and de-aerated suspension of paper-making solids comprising a de-aerating tank adapted to hold a pond of such suspension; vacuum-producing means for applying the effect of vacuum to the tank; means for removing treated stock from the pond thereof in the tank; means for centrifugally segregating dirt-bearing and air-bearing suspended paper-making solids into a discharging dirt-poor fraction and a discharging dirt-rich fraction, means connected with the vacuum-producing means for maintaining the effect of vacuum on both discharging fractions; means for feeding said suspended paper-making solids to the centrifugal means; means for conveying the segregated dirt-rich fraction from the centrifugal means; means for flowing the segregated dirt-poor fraction from the centrifugal means while under the influence of vacuum; and means connected with the latter for atomizingly spraying the segregated dirt-poor fraction into the atmosphere of the vacuum-influenced tank.

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