

March 22, 1966

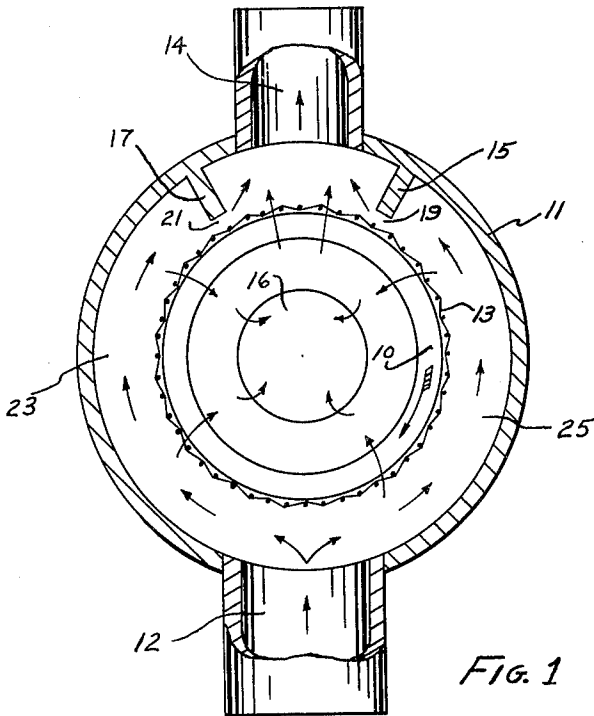
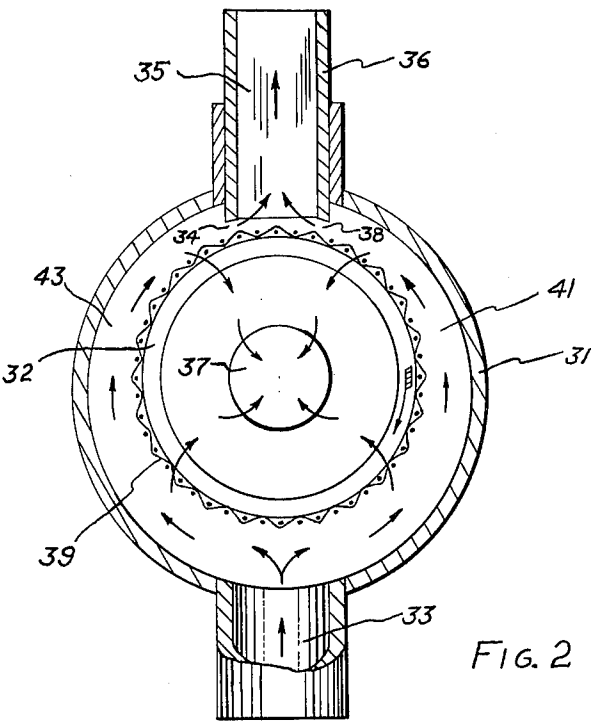
S. M. NEUVILLE ETAL

3,241,676

DEWATERING METHOD AND APPARATUS

Filed Aug. 9, 1962

3 Sheets-Sheet 1



March 22, 1966

S. M. NEUVILLE ETAL

3,241,676

DEWATERING METHOD AND APPARATUS

Filed Aug. 9, 1962

3 Sheets-Sheet 2

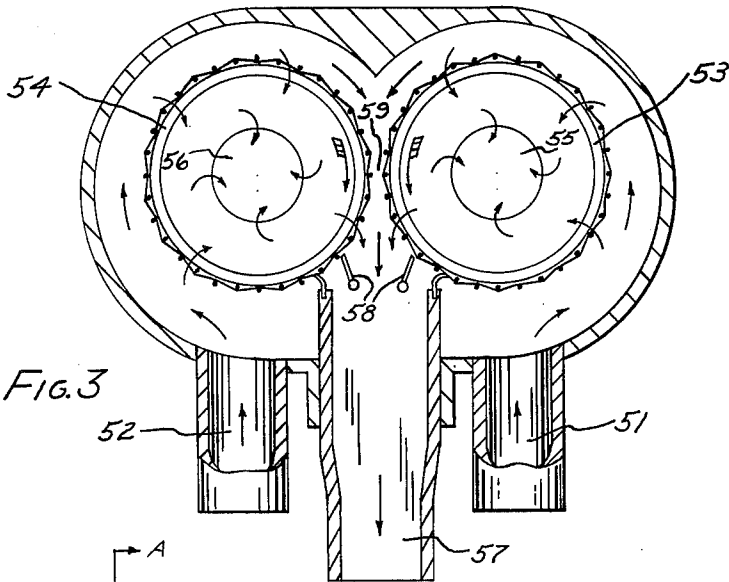
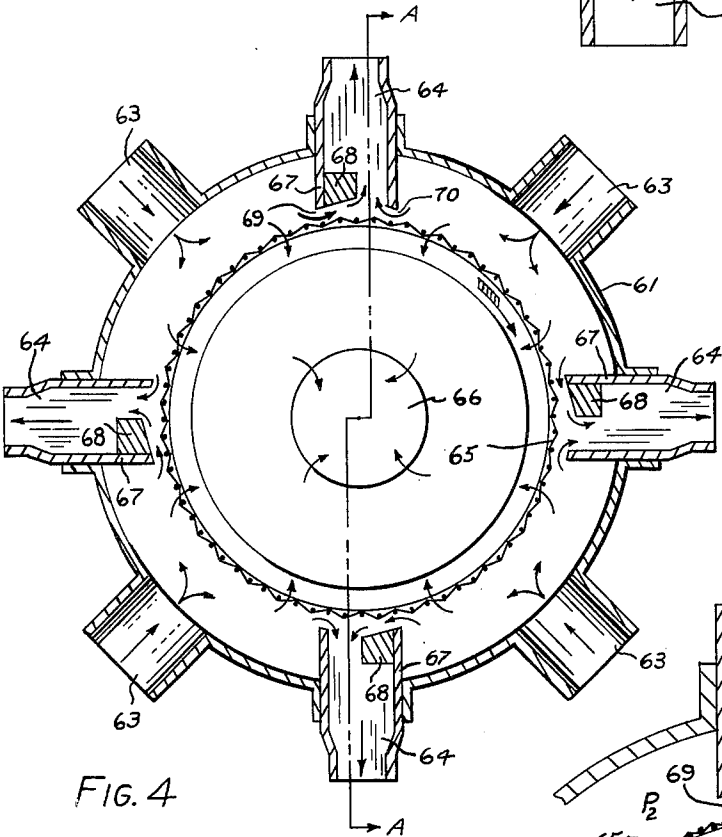
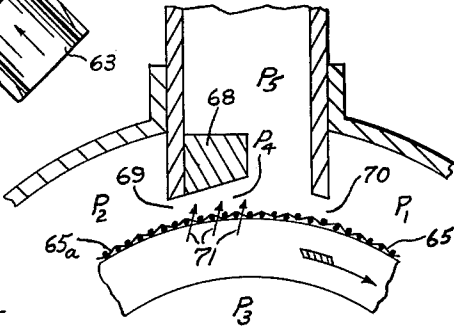


FIG. 5



March 22, 1966

S. M. NEUVILLE ETAL

3,241,676

DEWATERING METHOD AND APPARATUS

Filed Aug. 9, 1962

3 Sheets-Sheet 3

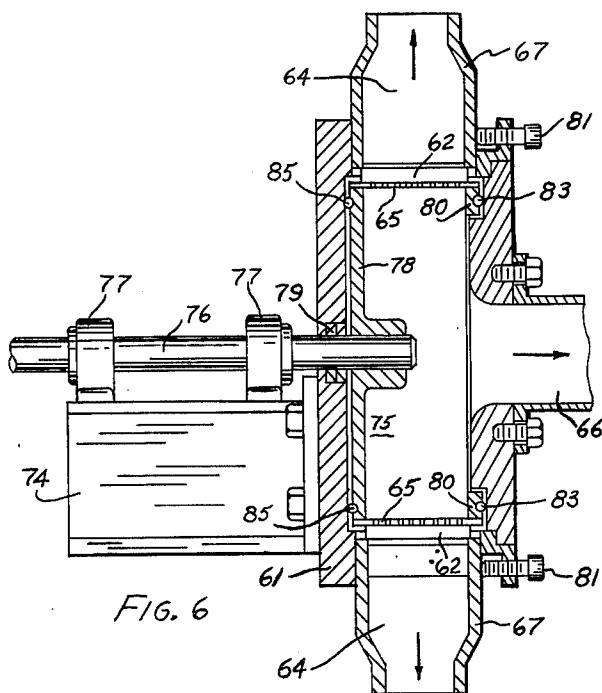


FIG. 6

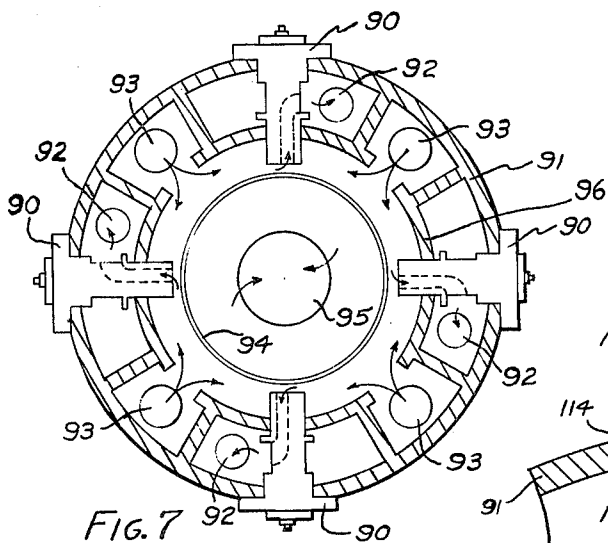


FIG. 7

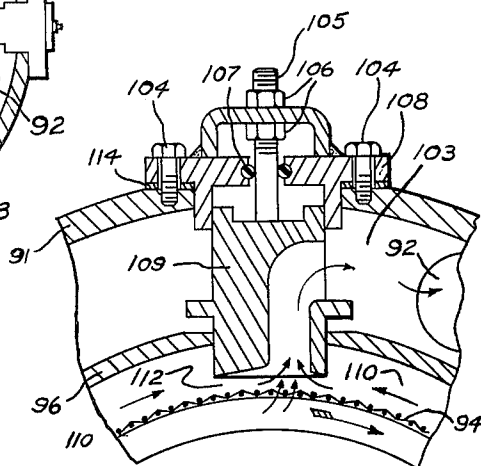


FIG. 8

1

3,241,676

DEWATERING METHOD AND APPARATUS

Stewart M. Neuville, Harrison, and Ira Caple, Robert W. Ellis, and Henry R. Cloots, Neenah, Wis., assignors to Kimberly-Clark Corporation, Neenah, Wis., a corporation of Delaware

Filed Aug. 9, 1962, Ser. No. 215,961

6 Claims. (Cl. 210—77)

This invention relates to a method and apparatus for continuously thickening an aqueous suspension of particulate material, including wood pulp fibers. More specifically, the invention is directed to increasing the consistency of a dilute aqueous suspension of pulp fibers in a continuous in-line operation with a minimum of fiber loss by means of an apparatus of improved efficiency and high capacity.

It is an object of this invention to provide a method and apparatus for continuously dewatering very dilute fibrous stock suspensions to raise their consistencies to a degree wherein the stock is in condition for subsequent processing at a suitable higher thickness.

A further object is to perform the thickening or dewatering operation continuously with an in-line apparatus of high capacity and increased efficiency to reduce both the initial capital investment and the actual operating costs.

Other objects and advantages will become apparent from the following detailed description and the accompanying drawings.

FIG. 1 is a diagrammatic cross section illustrating one embodiment of a suitable apparatus for carrying out the invention.

FIG. 2 is a diagrammatic cross section of another variation of suitable apparatus.

FIG. 3 is also a diagrammatic cross section of still another variation of a suitable apparatus.

FIG. 4 is a diagrammatic cross section of another embodiment of suitable apparatus employing multiple inlets and outlets.

FIG. 5 is an enlarged view of a typical outlet area such as is shown in FIG. 4.

FIG. 6 is a longitudinal section taken through line A—A of FIG. 4.

FIG. 7 is a diagrammatic cross section illustrating another arrangement of an apparatus employing multiple inlets and outlets.

FIG. 8 is an enlarged view of a typical outlet area such as is shown in FIG. 7.

In wood pulping operations, there are many places in the process where the aqueous pulp slurry, or stock, is treated at very low consistencies, i.e., in the neighborhood of 0.25% to 0.70% fibers by weight calculated on a bone dry basis. Such low consistencies are employed, for example, in screening and in centrifugal cleaning steps. Subsequent processing requires that the stock be re-thickened to render it more suitable for further treatment, or to reduce total stock volume and permit storage in smaller storage tanks.

Apparatus conventionally employed to effect thickening usually utilizes for this purpose a cylindrical member covered with a fine-mesh wire cloth which is slowly rotated partially submerged in a vat containing this stock as delivered from screens, centrifugal cleaners or the like. The pulp fibers collect and build up on the wire cloth surface, while excess water passes to the interior of the cylinder and flows out through suitable means at the ends of the cylinder and vat. The drained off water, or filtrate, is reused for thinning fresh stock or in the screening operation. The accumulated fibers are removed from the wire cloth by a doctor blade or a couch roll and discharged as thickened pulp. Such thickeners also are frequently employed for simultaneous washing.

2

As would be expected, the capacity of conventional thickeners varies with the diameter and length of the cylinder, mesh of cylinder cover, speed of cylinder rotation, depth of stock in the vat, and initial consistency of stock. However, to handle the large volumes required in modern pulp mills such thickeners are of necessity quite large in size, occupying valuable floor space, and require considerable power inputs. The present invention accomplishes thickening in much less cubic area per ton of product and reduces space requirements sufficiently to represent substantial savings in capital expenditures for both equipment and buildings. Increased efficiency of operation also reduces overall power requirements.

Because conventional thickeners operate with the cylinder screen only partly submerged and require that a filter mat be built up on such screens, they operate without utilizing the full potential of the available screening area. This condition is satisfactory where the initial supply of stock is relatively thick and discharged at a substantially higher thickness, i.e. up to as high as 15% consistency, but the process is inherently slow and inefficient.

In the present invention, a rotatable foraminous cylinder is entirely enclosed within a circular housing and operates fully submerged in the thin fibrous stock continuously supplied to it. Means are provided within the housing to assist in transferring thickened stock from the exterior of the foraminous cylinder to a discharge outlet for thickened stock. The cylinder also is rotated at sufficient speed to inhibit the build-up of material on the foraminous surface, thus enabling a greater percent of the dilution water to pass through the screen, and at rates much higher than hitherto possible.

For example, the foraminous surface of the cylinder may consist of a 40 to 60 mesh screen, which has an open area of about 40% and 20% respectively. Theoretically, if the entire screen is enclosed in a housing and clear water fed therethrough, it is possible to have a drainage rate of about 750 gallons per minute per square foot of wire area at a pressure differential of one foot of water. When even a dilute suspension of particulate solids is fed through such an arrangement, it is obviously impossible to keep the wire screen perfectly clear, but if a filter mat is not allowed to accumulate on the screen, the efficiency of water removal may be kept quite high. Stated another way, the actual physical size of the in-line thickener is largely a function of the ability to keep the wire screen clean in order to take advantage of a higher drainage rate. In this invention, the wire screen is kept substantially free of fiber build-up by turbulent action of the entering flow against the rotating screen, by high velocity and reduced pressure in the area immediately preceding the thickened stock discharge, and by lowered pressures and a certain amount of backflow at the thickened stock discharge outlet. Further, the enclosed design permits operation with controllable pressure drop across the screen to effect a maximum drainage rate.

The thickener shown in FIG. 1 is the simplest version of a suitable apparatus, and comprises a horizontal cylindrical casing 11 in which is mounted a rotatable cylinder 10 having a suitably supported annular foraminous surface 13, which may be a fine mesh wire screen. Cylinder 10 has one end closed and the other end open to serve filtrate opening 16. The casing 11 has an inlet 12 through which a thin stock suspension is fed, a discharge outlet 14 for thickened stock, and a discharge outlet 16 for filtrate. Mounted on casing 11 are baffles 15 and 17 arranged in close proximity to the annular foraminous member 13 to form narrow slot-like apertures 19 and 21 immediately preceding discharge outlet 14.

In operation, a thin stock suspension of fibers is introduced through inlet 12 and flows both in the clockwise direction of rotation of annular screen 13 through annular channel 23 and in counterflow to screen rotation through annular channel 25, while draining excess water through the screen to a low pressure area on the interior thereof. Turbulence created by the rotating screen discourages fiber build-up on the screen, thus permitting a rapid flow of substantially fiber free water through the screen to be discharged through filtrate outlet 16. Thickened stock passes through narrow apertures 19 and 21, where increased velocity caused by the restricted flow creates further turbulence and a region of low pressure. The increased velocity and low pressure in the restricted area of the narrow apertures further insures against any tendency for fiber build-up on the screen by literally tearing the fibers away from the screen. Some backflow of water through the screen in the area between baffles 15 and 17 also insures against fiber build-up.

FIG. 2 shows another embodiment of suitable apparatus. Cylindrical casing 31, with thin stock inlet 33, rectangular thickened stock outlet 35 and filtrate outlet 37, encloses offset rotatable cylinder 32 having an annular foraminous surface 39. The rotatable cylinder 32 has closed sides suitably sealed to exclude flow therethrough and is provided with a filtrate outlet 37 in one of the sides. Outlet 35 is provided with a slidable conduit 36 the walls of which form baffles which may be moved toward, or away from, rotating screen surface 39 to narrow, or widen slot-like apertures 34 and 38 between the conduit ends and the screen surface. Varying the dimension of apertures 34 and 38, controls to some extent, the degree of thickening obtained by regulating the velocity and therefore the degree of turbulence in these areas. Adjustment of apertures 34 and 38 can further be used to control the pressure drop at this point and thereby regulate the reverse flow of filtrate through the screen to assist in maintaining it clean as hereinafter described.

In operation, foraminous cylinder 32 is rapidly rotated in a clock-wise direction while thin stock is introduced at lower inlet 33 to flow around the outer surface of rotating screen 39, in tapering channels 41 and 43. Turbulence created by the action of the flow against the rotating screen prevents the fibers from building up to any extent on the screen surface as water drains therethrough. Substantially clear water is discharged from the interior through outlet 37 while thickened stock is discharged through outlet 35. As the stock flows through narrow apertures 34 and 38, the increased velocity produces a small area of reduced pressure which, with the assistance of some backflow through the screen from the interior of the rotating cylinder, acts to remove from the screen any fibers which may have begun to accumulate.

FIG. 3 illustrates a modified version of the inline thickener employing dual inlets 51 and 52, dual rotating screens 53 and 54, dual filtrate outlets 55 and 56, and a single outlet 57 for thickened stock. The narrowed channel 59, intermediate screens 53 and 54, creates a low pressure area to aid in keeping screens clean. Baffles 58 assist in removing minor amounts of stock which might accumulate on the screens. These baffles 58 are held in near proximity of screen to assist in generating additional low pressure regions to tear the fiber mat off. A partition may be placed between the doctors to assist this latter action.

FIG. 4 illustrates an embodiment of a thickener apparatus with increased capacity having multiple inlets and outlets. Cylindrical housing 61 is provided with multiple thin stock inlets 63, multiple thick stock outlets 64, filtrate outlet 66, and an enclosed suitably supported rotating screen 65. Similar to the apparatus of FIG. 2, the walls of rectangular outlet conduits 67 form adjustable baffles to control the dimensions of the discharge apparatus 69 and 70 and readily control the final consistency of the treated stock suspension. Another modification shown in FIG. 4 is an optional extension 68 of the wall of the lip

entering the outlet conduit wall which aids in the efficiency of operation by providing a larger area of low pressure.

FIG. 5 is an enlarged view of one of the outlet areas of FIG. 4 illustrating in more detail the pressure differentials which occur within the thickener and have a substantial effect on the mechanics of operation. The pressure of the stock suspension at P_1 and P_2 is substantially the pressure generated by the pump which supplies the stock to the thickener. Pressure at P_1 is slightly lower than P_2 but is not significantly different. The pressure at P_3 within the rotating cylinder is considerably lower than at P_1 and P_2 and implements a rapid flow of dilution water through foraminous element 65. Stock counterflowing through restricted aperture 70 is increased in velocity by the restriction and creates reduced pressure in that area. The combined action of high velocity and low pressure keeps the screen 65 relatively clear at this point. On the coflow side at 65a there is some slight tendency for the fibers to form a mat on the screen. However, as the flow is forced through restricted aperture 69 there is again a considerable increase in velocity of flow accompanied by a large pressure drop. The pressure drop in the area P_4 causes some flow of clear filtrate back through the screen, as indicated by arrows 71. The backflow plus the high velocity of the stream of thickened stock keeps the screen 65 relatively free of fiber build-up. Pressure at P_5 preferably is slightly less than at P_3 . Where the rotating screen passes under outlet conduit 68 to form restricted aperture 70, the high velocity counterflow through the restricted aperture helps maintain a clean screen. The efficiency of operation depends on how well the foraminous surface of the rotating element is kept free of fiber accumulation.

In the longitudinal section of FIG. 6, cylindrical housing 61, provided with face plate 86, is suitably mounted on stand 74 to enclose foraminous cylinder 75 rotatably driven by powered shaft 76 turning in bearings 77. The cylindrical surface of cylinder 75, shown in this illustration, is perforated metal plate. The driven side 78 of the rotating cylinder 75 is closed, and suitably sealed by packings 79 and seal rings 85. The opposite side of the rotating cylinder is open and sealed at its peripheral edge by seal rings 83 mounted on annular member 80 which rotates with the screen in an annular race provided in the face plate 86. Filtrate outlet 66 is located in the wall of housing 61 opposite the closed side 78 of cylinder 75. Thickened stock outlets 64 each have an adjustable conduit 67 mounted therein held in place by turn screws 81 thus enabling conduit 67 to be moved toward, or away from, foraminous surface 65 to act as baffles which narrow or enlarge thickened stock discharge aperture 62.

FIG. 7 illustrates another structural arrangement of a thickener having multiple inlets and outlets. Cylindrical housing 91 is provided with an inner shell 96 which forms an annular chamber suitably compartmented to provide integral inlet and outlet channels and eliminate additional fittings, pipes, flexible joints and the like, otherwise required for the multiple connections. Multiple inlets 93 and multiple outlets 92 are located within the annular chamber. Filtrate outlet is shown at 95 and the foraminous screen at 94. The arrangement of the radially adjustable outlet conduit indicated generally by 90 in FIG. 7 is shown in detail in FIG. 8. A radially adjustable outlet conduit 109 is slidably mounted on the outer cylindrical housing 91 by means of a mounting plate 108 and attachment screws 104, and sealed by pressure gaskets 114. Discharge aperture 112 may be adjusted by moving the outlet conduit in or out by means of lock nuts 106 on threaded adjustment stud 105. The adjustment stud 105 is suitably sealed at 107. The direction of flow from annular channel 110 through adjustable outlet conduit 109 and out of discharge outlet 92 is similar to that shown in FIGS. 4 and 5 and described above.

While the in-line thickener of this invention may be

5

employed in an almost unlimited number of applications requiring thickening of aqueous suspensions of particulate material, it will be described herein as it relates to thickening dilute slurries of food pulp fibers.

After a pulp slurry is screened or centrifugally cleaned, it is usually delivered to washers or deckers at a consistency of about 0.40% to 0.70% fibers by weight. In order to handle the pulp at such low consistencies, the washer or decker is necessarily large. However, if the stock is prethickened about 50%, i.e. to a consistency of about 0.60% to about 1.00%, it was found that the size of the washer could be reduced by more than one-third and still get satisfactory results. By employing the in-line thickener of this invention the pulp stock is prethickened to fall within the indicated range before delivery to the washer.

Example 1

Employing an in-line thickener of the type shown in FIG. 2, kraft pulp at a consistency of .43% was fed through inlet 33 at the rate of about 38 gallons per minute. A forty mesh screen 30 was rotated at about forty r.p.m. The outlet opening 34 was set at $\frac{3}{16}$ ". The thickened pulp was discharged from outlet 35 at the rate of about 23 gallons per minute and had a consistency of about .73%. The filtrate discharged through outlet 37 at about 15 gallons per minute was relatively free of fiber, containing only about .01% by weight.

Example 2

Maintaining the other conditions the same as in Example 1, stock flow was increased to about 48 gallons per minute. Thickened stock was discharged at about 31 gallons per minute with a consistency of about .67%. The filtrate contained about .02% fiber.

Example 3

With the outlet opening 34 set at $\frac{1}{4}$ " and the feed at about 47 gallons per minute, thickened stock was dis-

6

charged at about 31 gallons per minute and a consistency of about .64%. The filtrate contained about .02% fiber.

Example 6

At a screen speed of 125 r.p.m., the pressure drop across the screen was about 13.9" Hg. The thickened stock discharged at about 42 gallons per minute at a consistency of about 1.03%. The filtrate contained about .026% fiber.

Example 7

At a screen speed of 175 r.p.m., pressure drop across the screen was about 9.5" Hg. The thickened stock discharged at about 45 gallons per minute at a consistency of about 1.07%. The filtrate contained about .03% fiber.

Example 8

At a screen speed of 200 r.p.m., pressure drop across the screen was about 8.3" Hg. The thickened stock discharged at about 45 gallons per minute at a consistency of about 1.05%. The filtrate contained about .044% fiber.

Example 9

At a screen speed of 225 r.p.m., pressure drop across the screen was about 7.3" Hg. The thickened stock discharged at about 46 gallons per minute at a consistency of about .98%. The filtrate contained about .060% fiber.

Example 10

At a screen speed of 250 r.p.m., pressure drop across the screen was about 6.4" Hg. The thickened stock discharged at about 45 gallons per minute at a consistency of about .94%. The filtrate contained about .102% fiber.

Example 11

At a screen speed of 275 r.p.m., pressure drop across the screen was about 5.9" Hg. The thickened stock discharged at about 49 gallons per minute at a consistency of about .95%. The filtrate contained about .040% fiber.

A tabulation of the above Examples 5-11 provides the following data:

TABLE 1

Ex. No.	Approx. flow, g.p.m.	Screen speed, r.p.m.	Pressure Drop, in. Hg	Thickened stock discharge, g.p.m.	Thickened stock consistency, percent	Filtrate consistency, percent
5-----	77.3	100	15.4	45	.95	.028
6-----	78.2	125	13.9	42	1.03	.026
7-----	79.5	175	9.5	45	1.07	.036
8-----	78.5	200	8.3	45	1.05	.044
9-----	78.6	225	7.3	46	.98	.060
10-----	77.5	250	6.4	45	.94	.102
11-----	78.7	275	5.9	49	.95	.040

charged at about 31 gallons per minute and a consistency of .64%. The filtrate contained about .02% fiber.

Example 4

Using the same conditions as Example 3 but an outlet opening of $\frac{5}{16}$ ", thickened stock was discharged at about 33 gallons per minute and a consistency of about .63%. The filtrate contained .01% fiber.

Examples 5-11

In the following examples, the stock was fed to the thickener at a rate of about 78 gallons per minute and a consistency of about 0.63%, the screen was rotated at speeds ranging from 100 to 275 r.p.m., and the outlet opening set at $\frac{1}{16}$ ". The thickened stock was discharged at an average rate of about 45 gallons per minute and a consistency of about .98%. The filtrate averaged about .05% fiber. As speed of the screen was increased, pressure drop across the screen decreased from 15.4" Hg to 5.9" Hg.

Example 5

At a screen speed of 100 r.p.m. pressure drop across the screen was about 15.4" Hg. Thickened stock was discharged at about 45 gallons per minute at a consist-

The data indicates that when the outlet opening and rate of flow are maintained substantially constant, the cylindrical screen may be operated at varying speeds and still function satisfactorily. The most efficient screen speed under the given conditions appears to be between 125 and 175 r.p.m. It was found that screen speeds in this range, and a rate of flow sufficient to maintain the pressure drop across the screen at about 9" Hg produced the most efficient results. At somewhat lower speeds and constant flow, the pressure drop is greater but a thicker mat of fibers tends to build up on the screen and is less efficient. At higher speeds and constant flow, while more clean screen is presented to the stock, and more turbulence is created to help remove the mat, centrifugal force and a lower pressure drop cuts down on efficiency.

Example 12

In this example, the multiple inlet and outlet thickener shown in FIGS. 4 and 5 was employed. Stock at a consistency of 0.37% was fed through all four inlets at a total rate of 423 gallons per minute. The 40 mesh screen was rotated at 115 r.p.m. Pressure drop across the screen measured about 5.6" Hg. The discharge aper-

tures between the screen surface and outlet opening were set at $\frac{3}{16}$ ". Thickened stock discharged at about 240 gallons per minute at a consistency of about .70%. The filtrate contained about .028% fiber.

Example 13

The apparatus of FIG. 4 was employed. Stock at a consistency of about .37% was fed through all four inlets at a total rate of about 445 gallons per minute. The screen was rotated at about 75 r.p.m. Pressure drop was about 7.8" Hg. Discharge apertures were set at $\frac{1}{8}$ ". Thickened stock discharged at about 254 gallons per minute at a consistency of about .65%. The filtrate contained about .08% fiber.

It was found further that, if the existing thick stock is throttled down by a valve or other means, increased efficiency of operation could be obtained, as shown by the following two examples.

Example 14

The apparatus of FIG. 4 was employed. Stock at a consistency of about .64% was fed through all four inlets at a total rate of about 373 gallons per minute. The screen was rotated at about 75 r.p.m. Pressure drop was about 8.3" Hg. Discharge aperture was set at $\frac{1}{8}$ ". Thickened stock discharged at about 297 gallons per minute at a consistency of about .864%. The filtrate contained about .028% fiber.

Example 15

Using the same apparatus as in Example 14, stock at a consistency of about .61% was fed at a total rate of about 406 gallons per minute. Screen rotation was 75 r.p.m. Pressure drop was about 8.1" Hg. Discharge aperture was set at $\frac{1}{8}$ ". The discharging thickened stock was throttled down by means of a valve to slightly reduce total discharge flow and pressure. Thickened stock discharged at a rate of about 254 gallons per minute and a consistency of about .918%. The filtrate contained about .20% fiber.

Additional tests indicated that the multiple inlet apparatus could be run employing only alternate inlets and outlets without seriously affecting efficiency but with some decrease in capacity.

It was also discovered that increasing the length, i.e. cross sectional width, of the outlet lip, shown at 68 in FIGS. 4 and 5, gave an additional boost to efficiency.

Example 16

The FIG. 4 apparatus was employed closing off alternate inlets and outlets so that only two of each were used. Thin stock at a consistency of about .566% was fed through two inlets at a total rate of about 320 gallons per minute. The outlet aperture was set at $\frac{3}{16}$ " and the discharge lip lengthened as at 68 in FIGS. 4 and 5. The screen was rotated at 135 r.p.m. Pressure drop across the screen was about 6.9" Hg. Stock discharged at about 191 gallons per minute and about .95% consistency. Filtrate contained about .01% fiber.

Example 17

Only two inlets and outlets were employed as in Example 16. Thin stock at about .588% consistency was fed through the inlets at a total rate of about 324 gallons per minute. The outlet aperture arrangement was set as in Example 16 and the screen rotated at about 135 r.p.m. Pressure drop was about 5.4" Hg. The discharge thickened stock was throttled down to reduce total discharge flow and increase outlet pressure. Thickened stock was discharged at about 162 gallons per minute and a consistency of about 1.13%. The filtrate contained about .01% fiber.

As noted previously, several factors influence the operation of the in-line thickener. These include, screen speed, size of outlet aperture, length of outlet aperture,

inlet consistency, pressure drop across the screen, and throttling of outlet flow.

Effects of each of these are generally described below:

As screen speed is increased, total flow will not change much. Outlet consistency increases at first and then decreases. This is explained in that as speed increases, more screen area is presented to the stock being treated. However, as screen speed increases the greater turbulence which helps to keep the surface clean is offset by centrifugal force which prevents more filtrate from passing through. Screen speeds in the range of about 115 r.p.m. to 135 r.p.m. appear to be optimum.

When the size of the outlet apertures is small, the efficiency is high but there is a greater tendency to plug. As the outlet aperture is increased in size, an increase in total flowthrough is possible at the same drop in pressure but outlet consistency is decreased.

As the lip of the outlet aperture is lengthened, a larger and more efficient area of low pressure is created as a venturi effect and overall efficiency is increased. Length of the opening, however, must be balanced with total outlet area to permit sufficient flowthrough.

At higher inlet consistencies, operation is generally more efficient but the danger of plugging is greater.

At a greater pressured drop across the screen, more drainage is possible, but the tendency of a mat to form thereon is also increased, so that one offsets the other. A pressure differential of about 9" Hg across the screen appears optimum. Higher pressures account for greater drainage but at a loss of efficiency compared to power input.

Throttling the outlet flows of both the thickened stock and filtrate improves efficiency but must be carefully controlled to prevent plugging.

Under a given set of conditions each of these factors can be controlled to give the most efficient service, depending upon the results desired.

The invention as set forth herein has wide application to the treatment of fluid suspensions of particulate material and is especially adaptable for use in pulp and papermaking, although not limited thereto.

Modifications of this invention will be readily apparent to those skilled in the art.

What is claimed is:

1. In a method for continuously thickening a dilute suspension of fibrous pulp in water by flowing a continuous stream of said suspension under pressure against the fluid permeable surface of a rotating screen while said stream is confined in an annular space surrounding said screen whereby a pressure drop between the exterior and interior of said screen causes a portion of the dilution water to pass through said screen to leave a thickened suspension of fibers in said annular space from where the thickened suspension is subsequently discharged; the improvement which comprises:

- (a) directing a large volume turbulent flow of the dilute liquid suspension of pulp under pressure against the surface of the rotating screen in a direction substantially radial to said screen, causing said stream to divide into two portions flowing in arcuate paths around said screen, with one portion flowing in the direction of rotation of said screen and the second portion flowing counter to said direction of rotation;
- (b) rotating said screen at a speed sufficient to maintain a high degree of turbulence in said flow to minimize fiber build-up on said screen; and
- (c) subsequently reducing abruptly the total cross-sectional flow in each of said divided portions by sharply constricting each of said cross-sectional areas of flow to a drastically narrowed section adjacent said screen immediately prior to discharge, whereby the velocity of each of said thickened portions is increased in the reduced cross-sectional areas of flow simultaneously creating a region of lower pressure in

9

the reduced cross-sectional flow adjacent said screen and in the entire discharge area, said lower pressure being less than the pressure of the dilution water in the interior of the screen causing a minor portion of the dilution water to flow from the interior through said screen into said discharge area along with said thickened portions.

2. The method of claim 1 in which the low pressure in the reduced cross-sectional flow and the discharge area is adjusted by varying the amount of restriction in said cross-sectional area.

3. The method of claim 1 in which multiple streams of the dilute suspension are introduced against said screen and into said annular space at equally spaced intervals around said screen, and said thickened portions are discharged from said annular space at points equally spaced between each of said points of introduction.

4. An apparatus for the continuous thickening of a dilute liquid suspension of fiber stock which comprises a housing consisting of an annular casing and end walls; a drum disposed for rotation within said casing; means for rotating said drum; said drum having a cylindrical foraminous surface, one open side and one closed side, and the interior of said drum being free of obstructions; said foraminous surface being spaced from said casing to provide an annular channel between the outer foraminous surface of said drum and the inner surface of said casing; inlet means in said casing for introducing a dilute liquid suspension of fibers into said channel for treatment; outlet means in said casing circumferentially spaced from said inlet means through which the treated fiber suspension is removed from said channel; discharge means

10

in an end wall of said housing in communication with the open side of said drum through which dilution liquid is discharged from the interior of said drum; and imperforate baffle members arranged in said channel on each side of said outlet means and extending inwardly from said casing along said end walls toward said foraminous surface, said members stopping short of said foraminous surface and defining narrow slot-like apertures between said members and said surface.

5. The apparatus of claim 4 in which said baffles comprise slidable elements disposed within said outlet means and which are radially adjustable with respect to said drum.

6. The apparatus of claim 4 in which said casing is provided with a multiplicity of inlets and outlets alternately spaced around the circumference of said channel.

References Cited by the Examiner

UNITED STATES PATENTS

1,869,797	8/1932	Cleaver	210—360
2,328,220	8/1943	Linderoth	55—290
2,442,234	5/1948	Dunmire	210—360
2,538,575	1/1951	Kracklauer	210—409 X
2,670,849	3/1954	Dunmire	210—402 X
3,019,903	2/1962	Daane	210—391 X

FOREIGN PATENTS

81,743 10/1934 Sweden.

REUBEN FRIEDMAN, *Primary Examiner*.

HERBERT L. MARTIN, *Examiner*.