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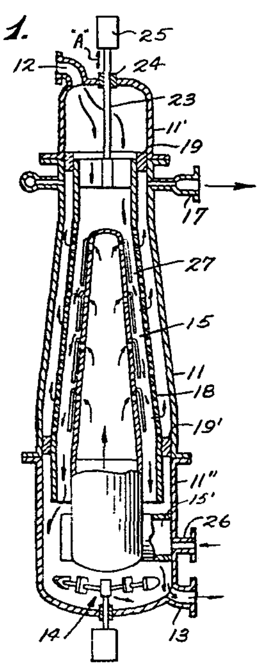
(54) **Pressure diffuser controlling.**

(57) Cellulosic pulp is treated to obtain simultaneous pulp flow and consistency control, utilizing a pressure-tight vessel (10) having a pulp inlet (12), pulp outlet (13), treatment liquid inlet (26), liquid extraction outlet (17), and movable screen (18) adjacent the liquid outlet (17). Pulp is fed into the pulp inlet (12) at a particular flow rate, and treated pulp is withdrawn through the pulp outlet (13) at a particular flow rate. The flow rate of the pulp being withdrawn is set and controlled by controlling the flow rate of the pulp fed into the pulp inlet (12). Liquid is withdrawn through the liquid outlet (17) at a particular flow rate, and the consistency of the pulp being withdrawn through the pulp outlet (13) is set and controlled by controlling the flow rate of liquid from the liquid outlet (17). Treatment liquid is fed into the liquid inlet (26), the nature of the pulp treatment and the qualities of the pulp being controlled by controlling the temperature and chemical makeup of the pulp introduced into the liquid inlet (26). A plurality of vessels (10, 10', 10") may be provided with the pulp withdrawn from each vessel fed to the subsequent vessel, and the liquid withdrawn from each vessel fed to the preceding vessel.

Fig. 1.



EP 0 055 701 A1

Croydon Printing Company Ltd.

PRESSURE DIFFUSER CONTROLLER

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a method for maintaining all flows in and out of pressurized diffuser machines constant and continuous and of stabilized consistency thereby facilitating incorporation of such a machine or machines in a pulp mill process.

Conventional dewatering machines based on the rotating drum principle, such as vacuum washers, air pressure washers, drum presses, wash presses and the like, share the common drawbacks that the outlet consistency is undetermined and that the filtrates must exit into atmospheric filtrate tanks. The outlet consistency varies as a result of temperture fluctuations, changes in the production flow rate, variances in pulp drainage characteristics and mechanical factors associated with the process machinery.

To compensate for these problems, the conventional methods employed filtrate tanks as surge absorbers because the exiting filtrate flow varied with its discharging consistency. These large filtrate tanks must be equipped with level recorders. The tanks must be of considerable dimensions to absorb the mentioned fluctuations and to allow sufficient deaeration of the liquor. As a further drawback, the large size results in significant heat losses.

The conventional filtrate tanks also require adequate pump capacity and pressure head controls to both dilute the incoming stock and circulate the excess (surplus) liquor countercurrently back into the process. Considerable pressure head on the pump or pumps is required since the pressure process is conventionally kept well above the static head of the filtrate tank which was exposed to the atmosphere.

Introduction of a continuous diffuser which did not require any dilution of the incoming stock of medium consistency coupled with some control over outlet consistency by adjusting the extraction flow relative to wash liquor flow marked an improvement over the conventional processes. However, problems with pressure loss in the stock flow and air extrainment in the stock flow remained. Since pulp suspensions often contain liquids with fairly high surface tensions, the entrained air causes the suspension to become foamy, elastic, to emit smelly gases and hard to dewater causing treatment problems in succeeding process machinery. Stacking a series of diffusers in stages within a common tower casing was only a partial soluton because of practical limitations on the number of stages in one tower.

Additionally, the filtrate flow or extraction flow from the conventional diffusers remained intermittent because of the operating principle of the machine. The intermittent flow required periodic injection of liquor to the interior of the diffuser screens. Conventional systems consequently needed adequate liquor tanks, level recorders, pumps and other equipment.

Furthermore, the conventional diffusers needed extraction liquor flow control and separate wash liquor flow control to the preceding stage in multi-stage arrangements.

According to the method of the present invention, all flows in and out of the diffuser are kept constant and continuous to eliminate the problems commonly associated with diffusers. Consequently, pressurized diffusers may now be easily incorporated in a pressurized system thereby eliminating the need for intermediate surge tanks, reducing pump power demand to a minimum, and totally eliminating the air entrainment and gas emission problems since the present invention no longer requires atmospheric discharge. Level controllers will no longer be required and the number of flow controllers is almost halved since the extraction controller for one stage now concurrently serves as the wash liquor controller for the preceding stage. Variations in pulp characteristics, production rate and temperature will not affect pulp consistency since they will be governed purely through flow control using straightforward instrumentation regulators.

Accordingly, the present invention cover a method for controlling the continuous flow of cellulosic material suspensions of medium consistency (8% to 15% BD) in pulp processing to achieve simpler and more efficient dewatering. This method of treating cellulosic pulp suspensions flowing in a relatively continuous stream through pressurized diffusers equipped with pulp inlets and outlets along with treatment liquid inlets and outlets comprises feeding the pulp stream through the pulp inlet into the diffuser, withdrawing the treated pulp through the pulp outlet, governing the pulp withdrawal flow rate through the pulp outlet by controlling the pulp feed flow rate into the pulp inlet, establishing consistency control over pulp withdrawn through the pulp outlet by controlling the liquid flow rate from the liquid outlet. Additional cellulosic flow treatment comprises feeding treatment liquid through the liquid inlet and may also include chemical admission and/or temperature control over the treatment (wash-displacement) liquid relative to the characteristics of the pulp withdrawn through the pulp outlet. Moreover, adapting the method to a multi-stage pressurized diffuser system comprises connecting the desired number of such diffusers in series using the pulp withdrawn from one diffuser as the pulp feed for the succeeding diffuser with optional intermediate temperature and chemical control of the treatment liquid relative to the pulp flow through the pulp outlet. Further, passing the pulp through an enlarged portion of the feed pipe or a vessel between the diffusers provides a desired retention time between liquid extractions. The agitator in the outlet end of the first diffuser in series measures pulp concentration.

BRIEF DESCRIPTION OF THE DRAWINGS

For the purposes of description, the method for maintaining constant continuous cellulosic flows is shown schematically in the accompanying drawings:

FIGURE 1 is a side view, partly in cross-section and partly in elevation, of details of an exemplary diffuser apparatus utilizable in practicing the method of the invention;

FIGURE 2 is illustrative of a single pressurized diffuser stage showing the flow control method;

FIGURE 3 is a drawing of the flow control process with independent control of screen speed;

FIGURE 4 is a drawing of the control process with independent screen speed, temperature and chemical addition control;

FIGURE 5 is a drawing of a multiple stage arrangement using the flow control method; and

FIGURE 6 is a drawing of a multi-stage arrangement with flow control showing intermediate chemical admission, heating and cooling control, and retention.

DETAILED DESCRIPTION OF THE DRAWINGS

The present inventive method maintaining constant and continuous all pulp or cellulosic flows in and out of a pressurized diffuser. An exemplary diffuser utilizable in practicing the present invention is illustrated in FIGURE 1.

The exemplary diffuser 10 illustrated in FIGURE 1 comprises a conical housing 11 with top part 11' and bottom part 11'' having a pulp inlet 12 and outlet 13, with a powered rotatable scraper 14 mounted in the bottom of housing 11 facilitating discharge of pulp from the housing 11 after treatment. A withdrawn liquid outlet 17 extends from the top part of the housing 11. A screen body 18 is mounted inside and substantially concentric with the housing 11, the body 18 having perforations or apertures formed therein to allow passage of liquid therethrough but prevent the passage of suspended solids therethrough. The bearings 19 and 19' are provided between the body 18 and housing 11 to allow relative linear movement of screen 18 with respect to housing 11 in dimension "A".

The screen 18 is rigidly attached to one end thereof to a reciprocal shaft 23, which shaft 23 passes through a seal 24 at the top of the housing 11. A conventional drive device 25 (such as shown in U.S. Patent 4,041,560) reciprocates the shaft 23 in dimension A. Normally, drive 25 will operate to move the screen 18 downwardly at about the same speed as the pulp flow from inlet 12 to outlet 13, and then move it upwardly much more quickly, and then restart the downward movement. The speed and nature of operation of the drive 25 may be varied as desired to accomplish the objectives of the present invention, as may be the details, dimensions, and relative spacings, of the housing 11 and screen 18.

For treatment of suspension passing through the housing 11, a treatment liquid inelt 26 is provided. Treatment liquid introduced through inlet 26 is spread out by baffles 27 arranged circumferentially around a concentric liquid distribution body 15 fastened to the housing part 11'' by three arms 15' of which one is hollow and in connection with inlet 26.

As shown in FIGURE 2, exemplary apparatus utilizable in practicing the method of the invention includes pressurized diffuser 10, and associated inlet and outlet flow controls and the like. The pulp flow (slurry) from a continuous digester, a storage tower or the like enters pipeline 28, flows through stock pump 29 (which alternatively may comprise a valve), and enters the top of the vertically aligned pressurized diffuser 10 and flows past movable screen 18 therein. The pulp flow entering pressurized diffuser 10, possibly of varying consistency, is stabilized in consistency under its passage through the diffuser 10 by means of fine adjustment of the extraction flow 30 through outlet 17 relative to wash liquor flow 31 into inlets 26 of said pressurized diffuser 10. The bottom discharging agitator 14 of pressurized diffuser 10 gives a very reliable output signal for consistency control to a consistency controller 22 and control ratio relay 33. This signal adjusts the set point of control ratio relay 33 between the wash liquor flow control FIC 34 and the extraction liquor flow control FIC 35. Control ratio relay 33 may have a limited range, for example, 0.9-1.3, to keep extraction flow deviations within the desired tolerances.

The discharge flow 36 from outlet 13 is measured by pulp discharge flow monitor 37 and a signal is transmitted to pre-set pulp flow controller FIC 38 which controls the stock pump 29 feeding the diffuser 10 [or controls a valve, depending on the pressure in the preceding vessel and the pressure demand for succeeding processes]. From pulp flow controller FIC 38, a proportional signal is transmitted to pulp flow ratio relay 39 which in turn controls the set point of the wash liquor controller FIC 34 which governs the wash liquid flow to the pressure diffuser 10.

Wash (or displacement) liquor flow controller FIC 34 receives signals from wash liquor sensing means 40 and pulp flow ratio relay 39 to send a composite signal to control ratio relay 33. The composite signal through wash liquor controller FIC 34 governs the flow of wash liquor to the pressurized diffuser 10 through wash liquor control means 41.

The composite signal is sent from wash liquor controller FIC 34 to control ratio relay 33. A signal is then transmitted from control ratio relay 33 to extraction flow controller FIC 35. The combination of the signals from extraction flow sensing means 42 and from the control ratio relay 33 through extraction flow controller FIC 35 governs the extraction flow control means 43.

Thus simultaneous pulp flow and consistency control is achieved by regulating the extraction liquor flow relative to the wash liquor flow with reference to the pulp discharge flow, which in turn governs inlet pulp flow and wash liquor flow. That is, if the consistency of the incoming pulp stream tends to drop, the extraction flow will increase to maintain constant discharge consistency, while the pulp flow entering the diffuser will increase correspondingly so as to maintain a constant fiber flow discharging from the diffuser.

In FIGURE 3, the flow control system operates generally according to the description of FIGURE 2, moreover to optimize performance of pressurized diffuser 10, the speed of screen 18 may be automatically adjusted to match that of the average pulp stream speed through pressurized diffuser 10 by means of a pressure differential control PDC 44 which regulates the drive 25 (e.g., regulates the flow of oil when drive 25 is a hydraulic cylinder) relative to the pressure differential between the top and bottom of diffuser 10, taken at points 45, 46. The optimization process is independent of the flow and consistency control system described in FIGURE 2.

FIGURE 4 shows the flow and consistency control system as shown in FIGURE 2 and the pressure differential control PDC 44 optimization method shown in FIGURE 3 with the addition of chemical admission controller FIC 47 and stock temperature controler TIC 48 which are connected to the wash liquor line 31 just prior to the wash liquor control 41. Displacement or wash liquor enters pipeline 49 and chemical additions made at point 50 are controlled by chemical admission controller FIC 47 which receives the necessary data, for example, on pH or conductivity, from transmitter 51 which may be located directly in the discharging pulp stream 36. The chemical admission controller combines the signal from transmitter 51 with one from chemical flow sensor means 52 to determine the amount of chemical admissions through chemical flow control 53 (which may be a valve or pump). Passing wash (displacement) liquor through heat exchanger 54 permits the indirect heating or cooling of the pulp stream itself passing through the pressurized diffuser 10. The temperature of the heat exchange medium is regulated through temperature controller TIC 48 and attendant flow control 55 wherein the temperature data transmitter 56 may be located in the discharging pulp stream 36. The location of the temperature data transmitter 56 allows automatic temperature control of the pulp stream entering succeeding treatment steps by controlling the temperature of the pulp stream discharging from the preceding diffuser.

A multi-stage pressure diffuser arrangement employing the flow control method can be understood with reference to FIGURE 5. While FIGURE 2 illustrates in detail the flow control system of a single diffuser, FIGURE 5 illustrates a multi-stage arrangement. The wash liquid flow controller 34 of Section A becomes the extraction flow controller for diffuser 10' of Section B, and similarly the wash liquid flow controller 34' of Section B becomes the extraction flow controller for diffuser 10'' of Section C. Via control line 57, the ratio relay 39 sends identical signals to the subsequent flow controllers 34', 34'', so that they are automatically set at the same flow rate.

Note the absence in FIGURE 5 of any intermediate liquor or surge tanks. Therefore, the smaller booster pumps 58, 58', 58'' only have pressure heads sufficient to compensate for decreases in pressure through, for example, control valves 41, 41' and 41'' and pipings. For example, booster pumps 58, 58', 58'' can raise the wash (displacement) liquor pressure from diffuser 10' to that in the preceding diffuser 10. This additional pressure head need basically correspond to pulp line friction losses between the diffusers.

Since all wash (displacement) and extraction liquor flows should be of constant magnitude in a multi-stage arrangement, the extraction flow 30 from the first pressurized diffuser 10 which governs the pulp flow consistency of the system should be free of surge effects. To this end, extraction flow 30 from diffuser 10 should enter a surge or liquor tank 59. Tank 59, the only one required in the flow control system, may be pressurized if the diffusers 10, 10', 10'' are connected in the blow line from a pressurized vessel (e.g., continuous digester or oxygen reactor). A vapor or gas cushion 60 acting on the gas relief flow 61 through valve 62 enables tank 59 to absorb surges. Gas analyzers 63 may be incorporated in the gas relief line 61 if desired. This prevents surge flow variances from affecting succeeding process steps. The other constant flow and consistency effects are obtained according to the steps described with FIGURE 2.

In section C of FIGURE 5, the discharging pulp stream 36'' from the final diffuser 10'' may flow directly to any final treatment or processing stage or into a storage tower. Should pressure diffusers be utilized for high temperature washing (above 100°C), a discharge pressure control PIC 64 governs the pressure of the discharging stream 36'' relative to that of final pressure diffuser 10'' by controlling valve 65. It is understood that the present invention is not limited to a three-stage system.

A multiple stage arrangement employing the flow control method with intermediate chemical admission to the wash (displacement) liquor is illustrated in FIGURE 6. In principle, the chemical admission controller 47' operates in a similar manner to that described with FIGURE 4. The indirect heating and cooling of the wash (displacement) liquor in the heat exchange 54, and associated components also operate in the same manner as in FIGURE 4. Utilization of the optional hydraulically filled retention vessel 66, however, necessitates that the chemical admission controller FIC 47' combines the signals received from transmitter 52 and ratio relay 67 which in turn receives a signal proportional to the pulp flow in line 36. A change in the pulp flow will thus result in an immediate and proportional change in chemical admission flow. In due time a possible fine correction in the setting of the ratio relay 67 will take place through the incoming signal from the chemical sensor 51 located in the pulp discharge line from retention vessel 66. The effect of additional retention time on the chemical properties of the pulp will thus be detected and compensated for.

In the multiple stage arrangement as illustrated in FIGURE 6, it is preferable to maintain all flows in and out of the diffusers constant in order not to induce any changes in consistency throughout the system once stabilized in the first stage. Since the system according to FIGURE 6 incorporates the addition of a smaller flow of chemical solution to the displacement liquid, an equal small flow of extraction liquid from a succeeding stage is bypassed and introduced with the chemical additions to the displacement liquid to any preceding stage of a corresponding pH-rating. This consistency preserving extraction liquor bleed is controlled by flow controller FIC 69 with flow sensor 70 and control valve 71. The flow through line 72 is kept identical to that through line 49 by means of ratio relay 68 transmitting a 1:1 relay signal from flow controller 47' to flow controller 69.

All intermediate stages will have arrangements similar to that described above whenever additives come into the picture. This also applies to the system illustrated in FIGURE 4.

The systems as described above are capable of practicing the method of the invention so that the flow rate of the pulp being withdrawn through the pulp outlet 36 by controlling the flow rate (by conrol of pump 29) of pulp fed into the first stage diffuser 10; and are capable of setting and controlling the consistency of the pulp being withdrawn through outlets 36, 36', 36'' by controlling the flow rate (via flow controller 35) of withdrawn liquid from outlet 17 of first stage diffuser 10 through conduit 30. The nature of the pulp treatment and the qualities of the pulp withdrawn from each stage are controlled by adding desired chemicals to the treatment liquids introduced into inlets 26, 26', 26'' through lines 31, 31', 32'', and controlling the temperature of the treatment liquid via temperature controllers 48, 48', 48'' and associated heat exchangers 54, 54', 54''. The qualities of the withdrawn pulp in lines 36, 36', 36'' are sensed (by components 51, 51', 51'' and 56, 56', 56''), and control of the treatment liquid chemical addition and temperature is effected in response to such sensing.

While the invention has been herein shown and described in what is presently conceived to be the most preferred and practical embodiment thereof, it will be apparent to those of ordinary skill in the art that many modifications may be made thereof within the scope of the invention, which scope is to be accorded the broadest interpretation of the appended claims as to encompass all equivalent methods and procedures.

WHAT IS CLAIMED:

1. A method of treating cellulosic pulp flowing in a substantially continuous stream to obtain simultaneous pulp flow and consistency control, utilizing a pressure-tight vessel having a pulp inlet and pulp outlet, and treatment liquid inlet and liquid extraction outlet comprising the steps of: (a) feeding a stream of pulp into the vessel pulp inlet at a particular flow rate; and (b) withdrawing treated pulp through the pulp outlet at a particular flow rate; and characterized by the steps of:

(c) setting and controlling the flow rate of pulp being withdrawn through the pulp outlet by controlling the flow rate of the pulp being fed into the pulp inlet; (d) withdrawing liquid through the liquid outlet at a particular flow rate; and (e) setting and controlling the consistency of the pulp being withdrawn through the pulp outlet by controlling the flow rate of liquid from the liquid outlet.

2. A method as recited in claim 1 further characterized by the step of: (f) feeding treatment liquid into the liquid inlet.

3. A method as recited in claim 2 further characterized by the steps of: (g) controlling the nature of the pulp treatment and the qualities of the pulp withdrawn in step (b), by adding desired chemicals to the liquid added in step (f), and controlling the temperature of the liquid added in step (f); (h) sensing the qualities of the pulp withdrawn in step (b); and

(i) controlling the chemical addition and temperature of the liquid introduced in step (f) in response to the sensing results obtained in step (h).

4. A method as recited in claim 3 further characterized by the step of: (j) introducing the pulp withdrawn in step (b) into a second subsequent treatment apparatus.

5. A method as recited in claim 4 further characterized by the step of: (k) introducing the pulp withdrawn from the second apparatus into a third subsequent apparatus so that the liquid withdrawn in step (d) serves as the input liquid in step (f) to the preceding apparatus.

6. A process according to claim 4 or 5 further characterized by the step of: (l) retaining the pulp withdrawn in step (b) prior to introducing said pulp into a subsequent apparatus in step (j).

7. A method as recited in claim 2 further characterized by the steps of: (m) measuring the characteristics of the pulp withdrawn in step (b); (n) adjusting the temperature of the pulp undergoing treatment by indirectly heating or cooling the liquid introduced in step (f); (o) controlling the chemical characteristics of the pulp by introducing chemical additives into the liquid introduced in step (f); and (p)

controlling the chemical addition and temperature of the liquid introduced in step (f) in response to measurements obtained in step (m).

8. A method as recited in claim 2 or claim 7 further characterized by the steps of: (q) measuring the flow rate and consistency of pulp withdrawn in step (b); (r) stabilizing and controlling the consistency of pulp withdrawn in step (b) by controlling the liquid extraction relative to the treatment liquid introduction of steps (d) and (f) in response to consistency measurements determined in step (q); and (s) controlling the flow rate of pulp into the vessel inlet in step (a) in response to mesurements of the withdrawn and consistency-stabilized pulp flow rate determined in step (q).

9. The method as recited in claim 1 wherein a moveable screen is provided within the pressure-tight vessel adjacent to the pulp inlet, the method further characterized by the step of matching the screen speed in the direction of pulp flow with that of the average speed of the pulp in the flow undergoing treatment.

Fig. 1.

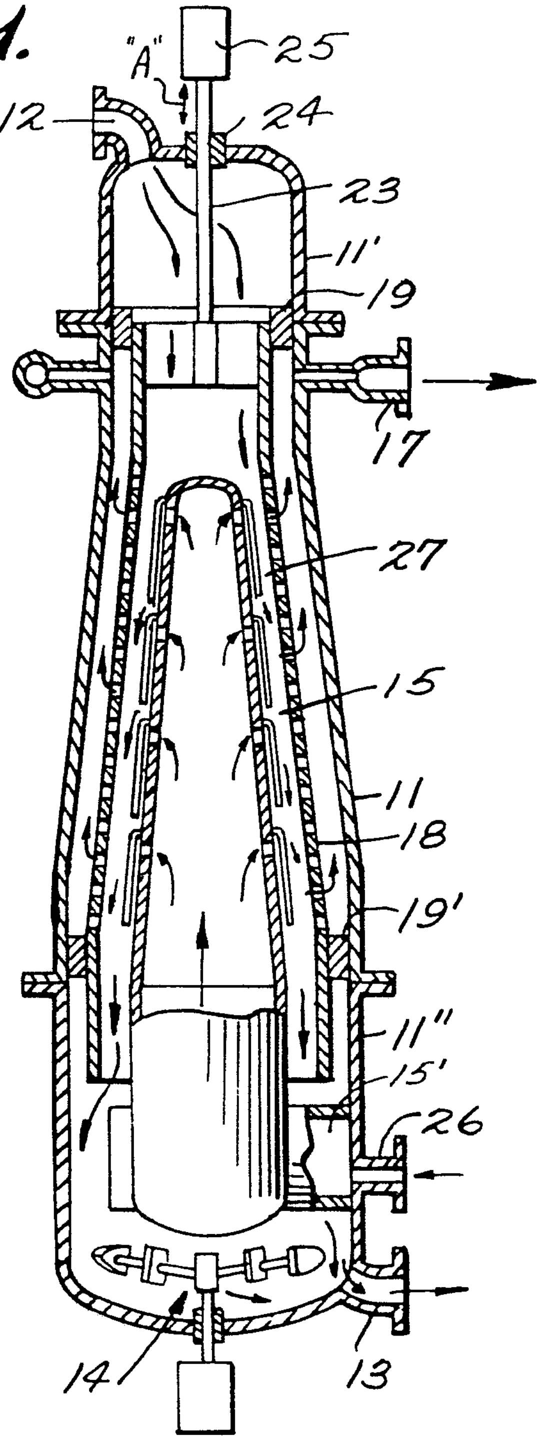


Fig.2.

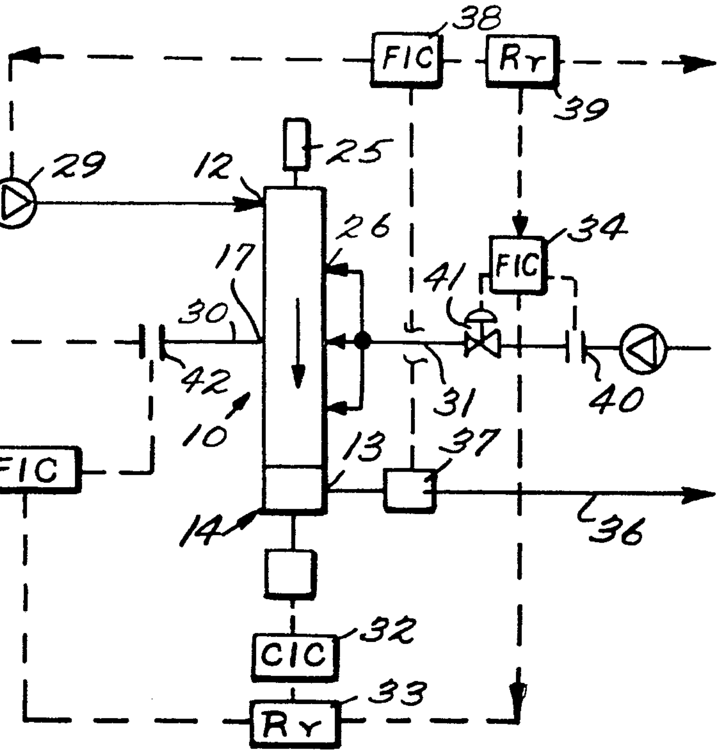


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Fig.3.

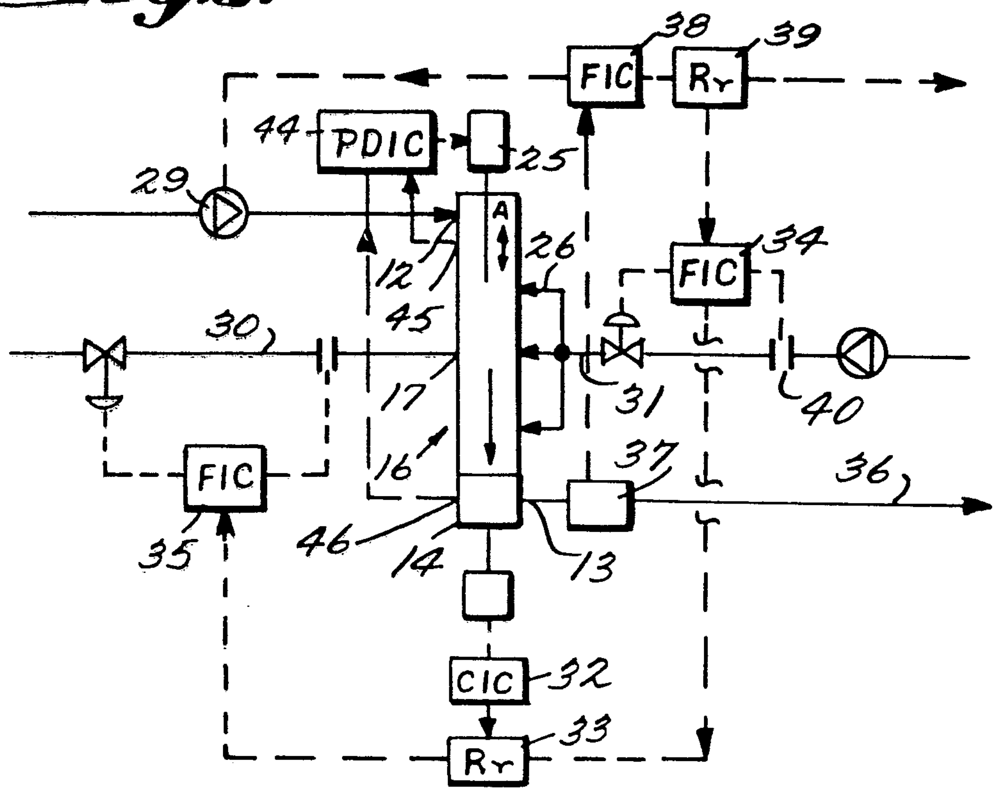

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Fig.4.

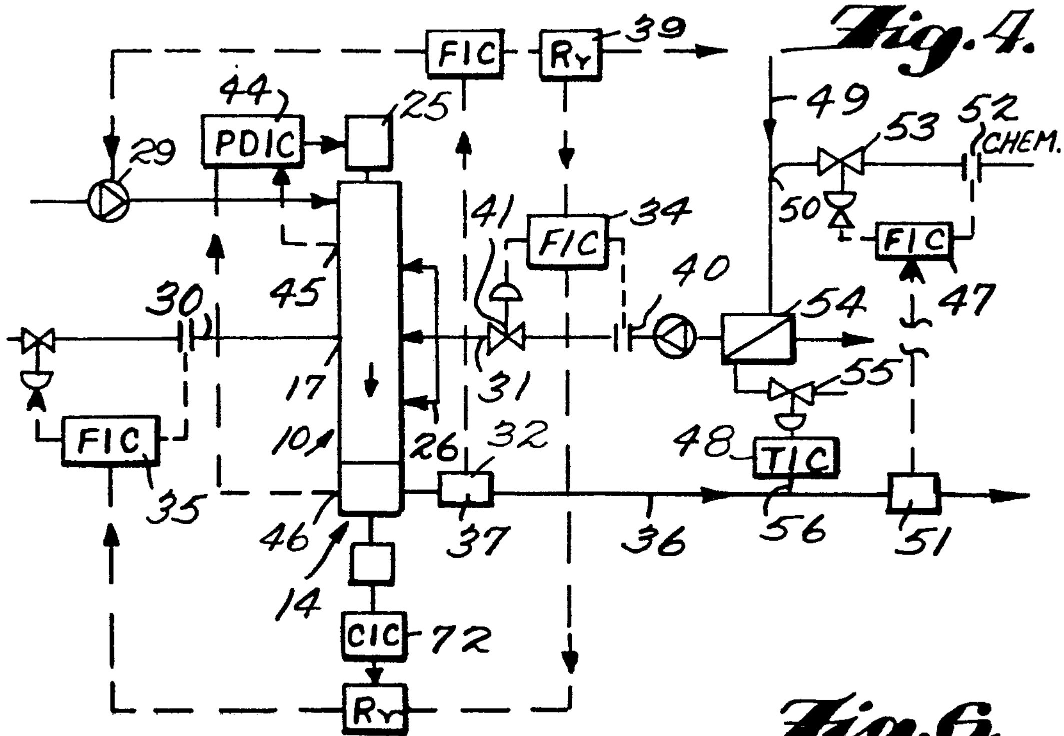
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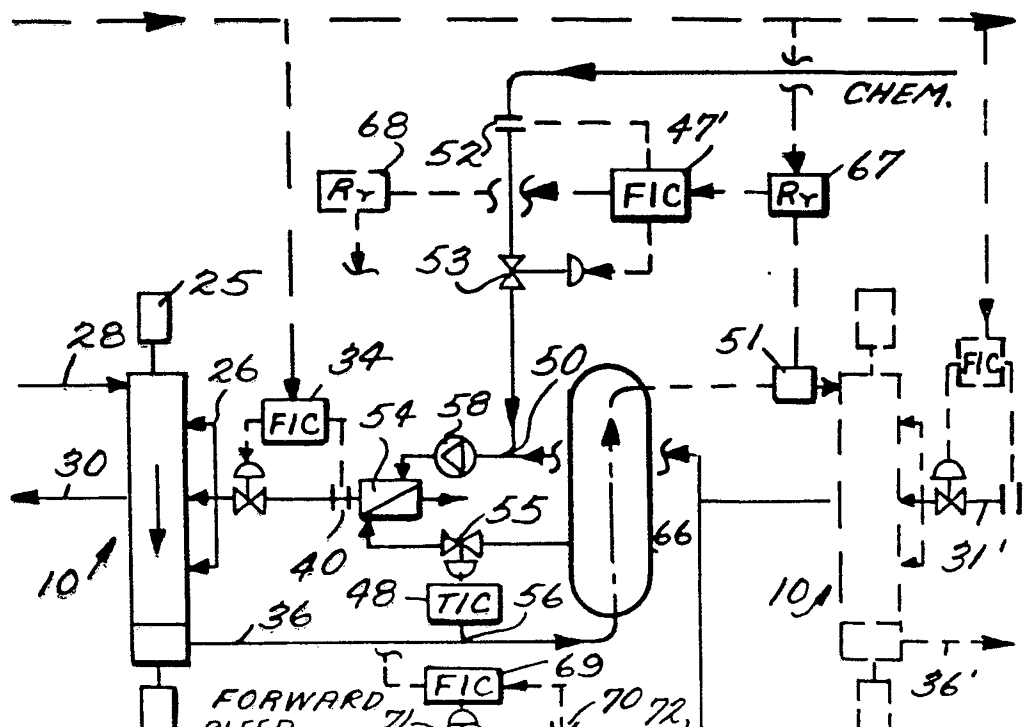
Fig.6.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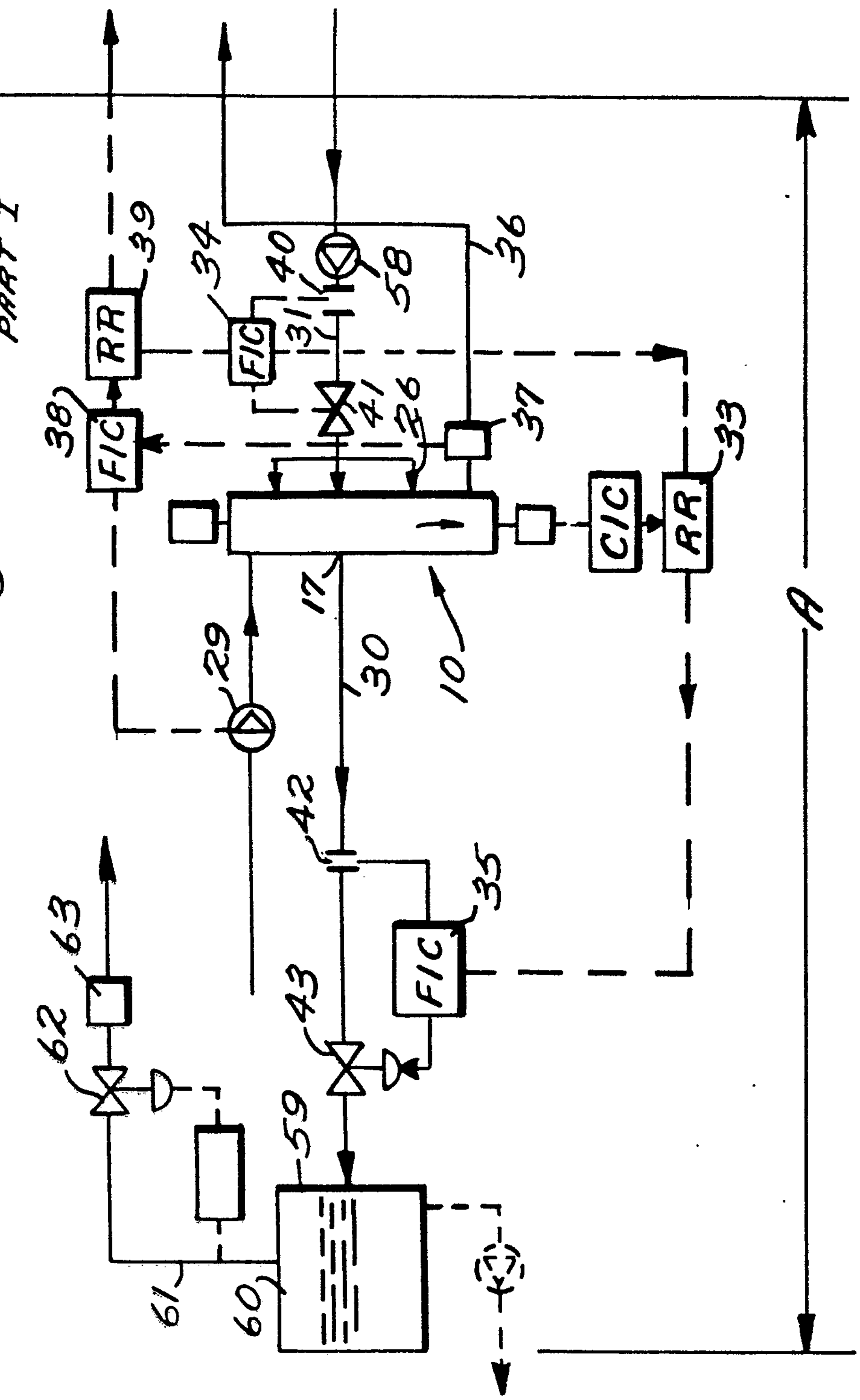
PART I
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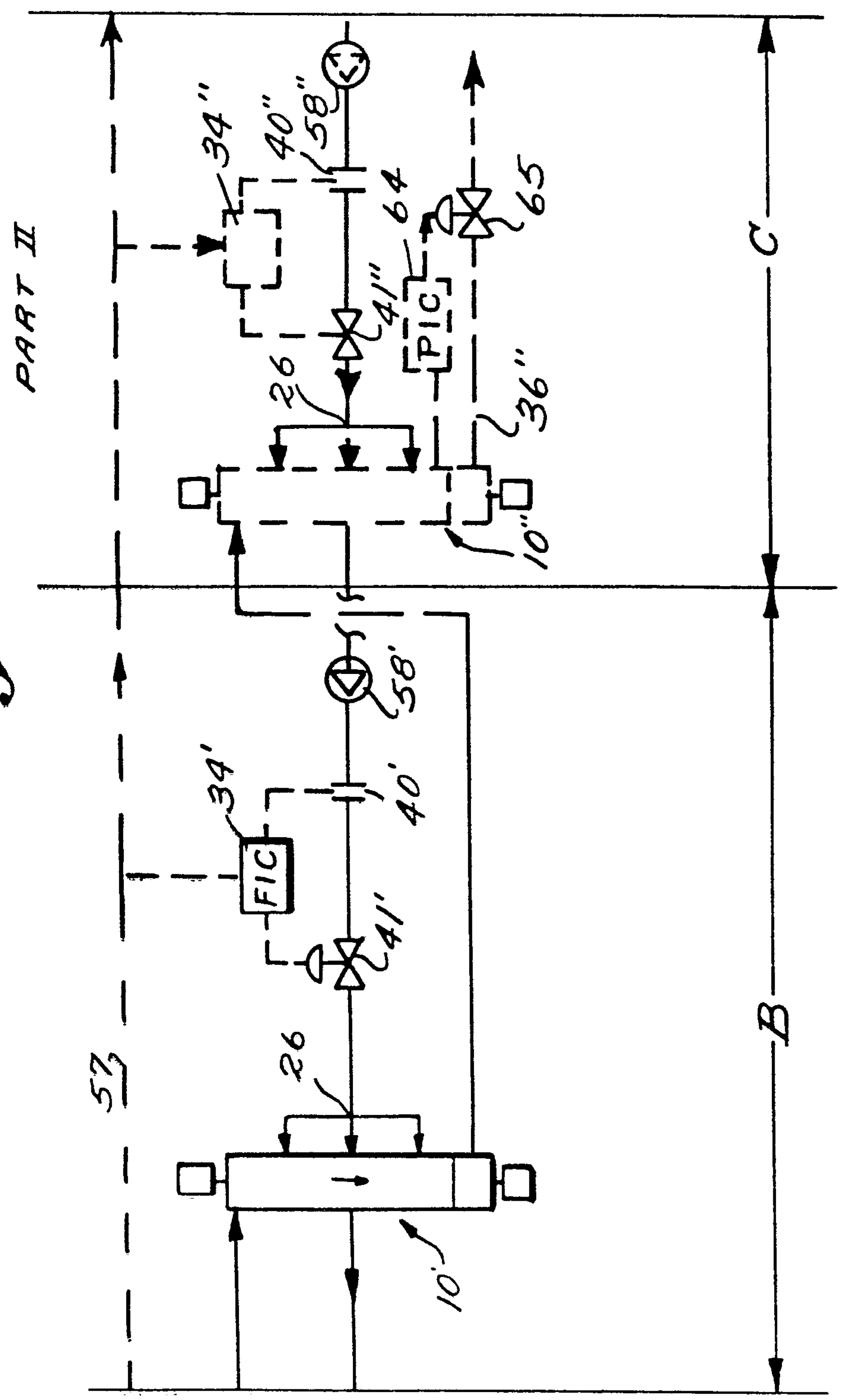
Fig. 5.

Fig.5.



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EUROPEAN SEARCH REPORT

Application number

EP 81 89 0204

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	FR - A - 1 468 440 (KAMYR) * the entire document *	1-5
D,A	US - A - 4 041 560 (F.JACOBSEN) * the entire document *	1,9
A	US - A - 3 807 202 (K.M.GUNKEL) * the entire document *	1,2, 4,5
A	US - A - 3 398 412 (T.E.AREMAA) * the entire document *	1
A	GB - A - 1 566 099 (LARGO LINTEC) * claim 1; figure 1 *	1,4,5
A	TAPPI, JOURNAL OF THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, volume 60,no.9 September 1977 ATLANTA (GA) US A.TOMIAK et al.:"Countercurrent pulp washing theory: an attempt at a synthesis", pages 148-150 * the entire article *	1

CLASSIFICATION OF THE APPLICATION (Int. Cl. [3])

D 21 C 9/02

TECHNICAL FIELDS SEARCHED (Int.Cl [3])

D 21 C
G 05 D

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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L: document cited for other reasons

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X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	05-04-1982	NESTBY

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