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# (54) A method of controlling a pressure-tight vessel for treating cellulosic pulp.

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**US-A-3 398 412**
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## Description

The invention relates to a method of controlling a pressure-tight vessel for treating cellulosic pulp flowing in a substantially continuous stream, comprising feeding pulp into the vessel at a controlled flow rate, withdrawing treated pulp at a controlled flow rate, feeding treatment liquid into the vessel, and withdrawing treatment liquid at a controlled flow rate.

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 temperature 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 solution 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 multistage arrangements.

According to a known method of bleaching cellulosic pulp continuously fed through a bleaching plant comprising at least two chemical treatment stages (FR—A—1 468 440) the consistency and the flow rate of the pulp at a point of supply thereof to the bleaching plant are maintained constant at desired set values, and a desired change of consistency of the pulp at a point of transfer from a preceding stage to a subsequent stage is caused by adding or withdrawing liquid at such a rate as is required for maintaining the rate of flow of the pulp at said transfer point constant at a predetermined value. In practice, in the supply conduit to each stage there are inserted a flow rate meter and a valve controlled by said flow rate meter. There is no relation-back between said valves of different stages. Thus, if there is a change in the consistency of the pulp supplied to the bleaching plant, that will never be known. While the relative values between the consistencies in the different stages of the plant may properly be maintained, the absolute value will not.

The invention as claimed is intended to remedy these drawbacks. It solves the problem of providing a method facilitating control of the absolute value of the consistency of the cellulosic pulp discharged from the plant in that the flow rate of the pulp entering the vessel and the flow rate of the treatment liquid leaving the vessel is controlled in response to the flow rate of the pulp leaving the vessel and consistency of the pulp leaving the vessel.

The advantages offered by the invention are mainly that 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. According to the method of the present invention, all flows in and out of the vessel are kept constant and continuous to eliminate the problems commonly associated with such vessels. 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. The present invention covers 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.

Additional cellulosic flow treatment may include feeding treatment liquid into 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 multistage 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.

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 (Parts I and II on two separate sheets) 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.

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 inlet 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 the 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 32 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 set 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 PDIC 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 PDIC 44 optimization method shown in Figure 3 with the addition of chemical admission controller FIC 47 and stock temperature controller 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 control 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″ 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 through lines 31, 31′, and controlling the temperature of the treatment liquid via temperature controllers 48 and associated heat exchangers 54. The qualities of the withdrawn pulp in lines 36, 36″ are sensed (by components 51 and 56), and control of the treatment liquid chemical addition and temperature is effected in response to such sensing.

## Claims

1. A method of controlling a pressure-tight vessel for treating cellulosic pulp flowing in a substantially continuous stream, comprising:
— feeding pulp into the vessel at a controlled flow rate,
— withdrawing treated pulp at a controlled flow rate,
— feeding treatment liquid into the vessel,
— withdrawing treatment liquid at a controlled flow rate,
characterized in that the flow rate of the pulp entering the vessel and the flow rate of the treatment liquid leaving the vessel is controlled in response to the flow rate of the pulp leaving the vessel and consistency of the pulp leaving the vessel.

2. A method as claimed in claim 1, wherein the nature of the pulp treatment and the qualities of the pulp leaving the vessel are controlled by adding desired chemicals to the treatment liquid and controlling the temperature of the treatment liquid, the qualities of the pulp leaving the vessel are sensed and the chemical addition and temperature of the treatment are controlled in response to the sensing results.

3. A method as claimed in claim 2, wherein the pulp leaving the vessel is fed into a second subsequent treatment apparatus.

4. A method as claimed in claim 3, wherein the pulp leaving the second treatment apparatus is fed into a third subsequent apparatus so that the treatment liquid leaving the vessel serves as treatment liquid for the preceding apparatus.

5. A method as claimed in claim 3 or 4, wherein the pulp leaving the vessel is retained prior to introducing said pulp into a subsequent apparatus.

6. A method as claimed in claim 1, wherein the characteristics of the pulp leaving the vessel are measured, the temperature of the pulp undergoing treatment is adjusted by indirectly heating or cooling the treatment liquid, the chemical characteristics of the pulp are cavrolled by introducing chemical additives into the treatment liquid and the chemical addition and temperature of the treatment liquid are controlled in response to measurements of the characteristics of the pulp.

7. A method as claimed in claim 1 or claim 6, wherein the flow rate and consistency of the pulp leaving the vessel are measured.

8. A method as claimed in claim 1, wherein a movable screen is provided within the pressure-tight vessel adjacent to the pulp inlet and the screen speed in the direction of pulp flow is matched with that of the average speed of the pulp in the flow undergoing treatment.

## Revendications

1. Procédé de régulation d'un récipient sous pression pour le traitement de la pâte cellulosique s'écoulant en un courant sensiblement continu, comprenant:
— l'introduction de la pâte dans le récipient à un débit régulé,

— le déchargement de la pâte traitée à un débit régulé,

— l'introduction du liquide de traitement dans le récipient,

— le soutirage du liquide de traitement à un débit régulé,

caractérisé en ce que le débit de la pâte entrant dans le récipient et le débit du liquide de traitement sortant du récipient sont régulés en réponse au débit et à la consistance de la pâte sortant du récipient.

2. Procédé suivant la revendication 1, dans lequel la nature du traitement de la pâte et les qualités de la pâte sortant du récipient sont régulées par l'addition de produits chimiques désirés au liquide de traitement et par la régulation de la température du liquide de traitement, les qualités de la pâte sortant du récipient sont détectées et l'addition de produits chimiques et la température du traitement sont régulées en réponse aux résultats de cette détection.

3. Procédé suivant la revendication 2, dans lequel la pâte sortant du récipient est introduite dans un deuxième appareil de traitement placé à la suite du premier.

4. Procédé suivant la revendication 3, dans lequel la pâte sortant du deuxième appareil de traitement est introduite dans un troisième appareil de traitement placé à la suite du deuxième, de telle façon que le liquide de traitement sortant du récipient sert de liquide de traitement pour l'appareil précédent.

5. Procédé suivant l'une des revendications 3 ou 4, dans lequel la pâte sortant du récipient est retenue avant son introduction dans un appareil placé à la suite.

6. Procédé suivant la revendication 1, dans lequel les caractéristiques de la pâte à la sortie du récipient sont mesurées, la température de la pâte soumise au traitement est réglée par un chauffage ou un refroidissement indirect du liquide de traitement, les caractéristiques chimiques de la pâte sont régulées par l'introduction de produits chimiques dans le liquide de traitement, et l'addition de produits chimiques et la température du liquide de traitement sont régulées en réponse à des mesures de caractéristiques de la pâte.

7. Procédé suivant l'une des revendications 1 ou 6, dans lequel le débit et la consistance de la pâte à la sortie du récipient sont mesurés.

8. Procédé suivant la revendication 1, dans lequel un filtre mobile est disposé dans le récipient sous pression, au voisinage de l'entrée de la pâte, et la vitesse de déplacement de ce filtre dans le sens de l'écoulement de la pâte correspond à la vitesse moyenne de la pâte dans l'écoulement soumis au traitement.

**Patentansprüche**

1. Verfahren zum Regeln eines Druckbehälters zur Behandlung von Zellstoff, wobei die Pulpe in einer gleichförmigen Strömung geführt wird, mit einem Eintrag der Pulpe in den Behälter mit einer regelbaren Durchflußrate, mit einem Austrag der behandelten Pulpe mit einer regelbaren Durchflußrate, mit einem Eintrag einer Behandlungsflüssigkeit in den Behälter und mit einem Austrag der Behandlungsflüssigkeit mit einer regelbaren Durchflußrate, dadurch gekennzeichnet, daß die Durchflußrate der in den Behälter eingetragenen Pulpe und die Durchflußrate der Behandlungsflüssigkeit aus dem Behälter in Abhängigkeit von der Durchflußrate der Pulpe aus dem Behälter und der Konsistenz der aus dem Behälter ausgetragenen Pulpe geregelt wird.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Art der Behandlung der Pulpe und die Beschaffenheit der aus dem Behälter ausgetragenen Pulpe durch den Zusatz gewünschter Chemikalien zur Behandlungsflüssigkeit und durch Regelung der Temperatur der Behandlungsflüssigkeit geregelt wird, daß die Beschaffenheit der aus dem Behälter ausgetragenen Pulpe gemessen wird und daß der Beimengung von chemischen Zusätzen und die Behandlungstemperatur in Abhängigkeit dieser Meßresultate geregelt wird.

3. Verfahren nach Anspruch 2, dadurch gekennzeichnet, daß die aus dem Behälter ausgetragene Pulpe in einen zweiten, daran anschließenden Behandlungsapparat eingebracht wird.

4. Verfahren nach Anspruch 3, dadurch gekennzeichnet, daß die aus dem zweiten Behandlungsapparat ausgetragene Pulpe in einen dritten, daran anschließenden Apparat eingebracht wird, wobei die aus dem Behälter ausgetragene Behandlungsflüssigkeit als Behandlungsflüssigkeit im vorangehenden Apparat Verwendung findet.

5. Verfahren nach Anspruch 3 oder 4, dadurch gekennzeichnet, daß die aus dem Behälter ausgetragene Pulpe aufgestaut wird, bevor die Pulpe in den daran anschließenden Apparat eingebracht wird.

6. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die charakteristischen Eigenschaften der aus dem Behälter ausgetragenen Pulpe gemessen werden, daß die Temperatur der zu behandelnden Pulpe durch Beheizung oder Abkühlung der Behandlungsflüssigkeit indirekt eingestellt wird, daß die charakteristischen chemischen Eigenschaften der Pulpe durch die Beimengung chemischer Zusätze in die Behandlungsflüssigkeit geregelt werden, und daß die Beimengung chemischer Zusätze und die Temperatur der Behandlungsflüssigkeit in Abhängigkeit der Messungen der charakteristischen Eigenschaften der Pulpe geregelt werden.

7. Verfahren nach Anspruch 1 oder 6, dadurch gekennzeichnet, daß die Durchflußrate und die Konsistenz der aus dem Behälter ausgetragenen Pulpe gemessen werden.

8. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß im Druckbehälter nahe der Eintragsöffnung für die Pulpe ein bewegliches Sieb angeordnet ist, und daß die Siebgeschwindigkeit in Richtung der Strömung der Pulpe mit der durchschnittlichen Geschwindigkeit der in der Strömung zu behandelnden Pulpe übereinstimmt.

Fig. 1.

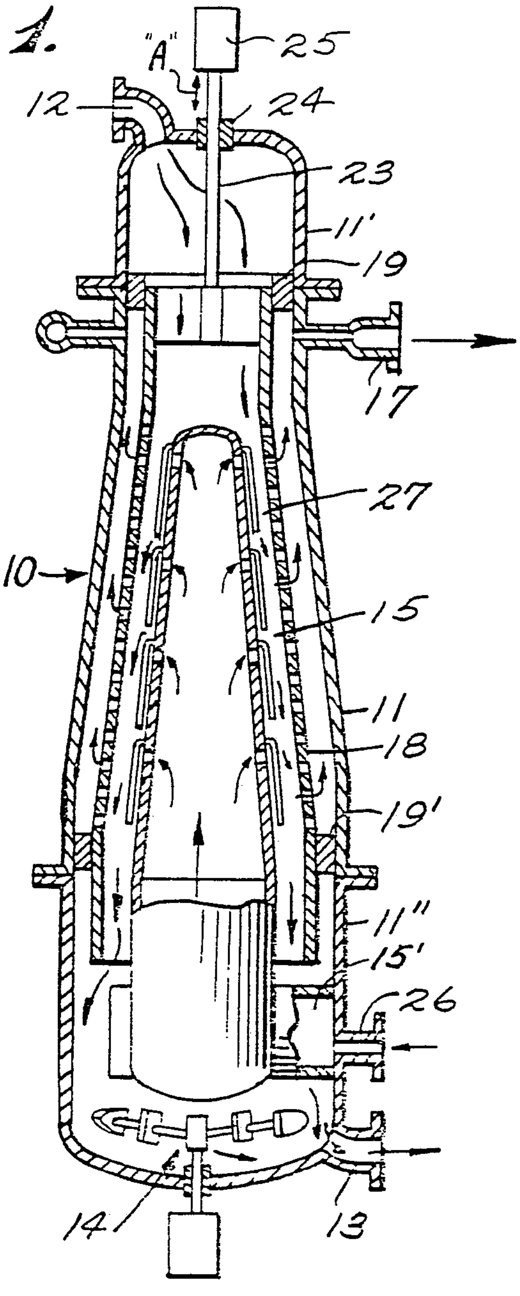

Fig. 2.

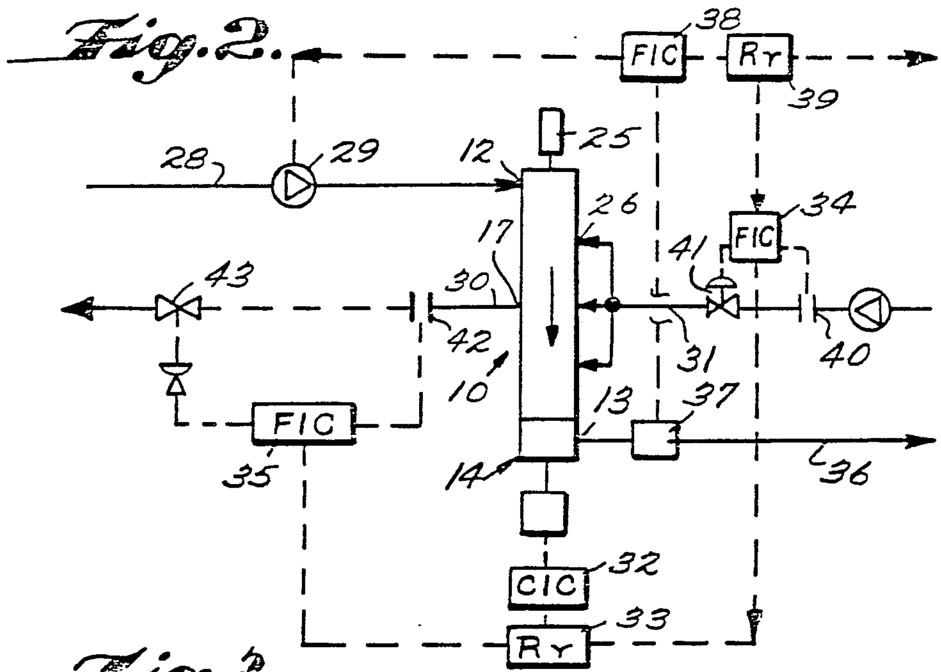
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Fig. 3.

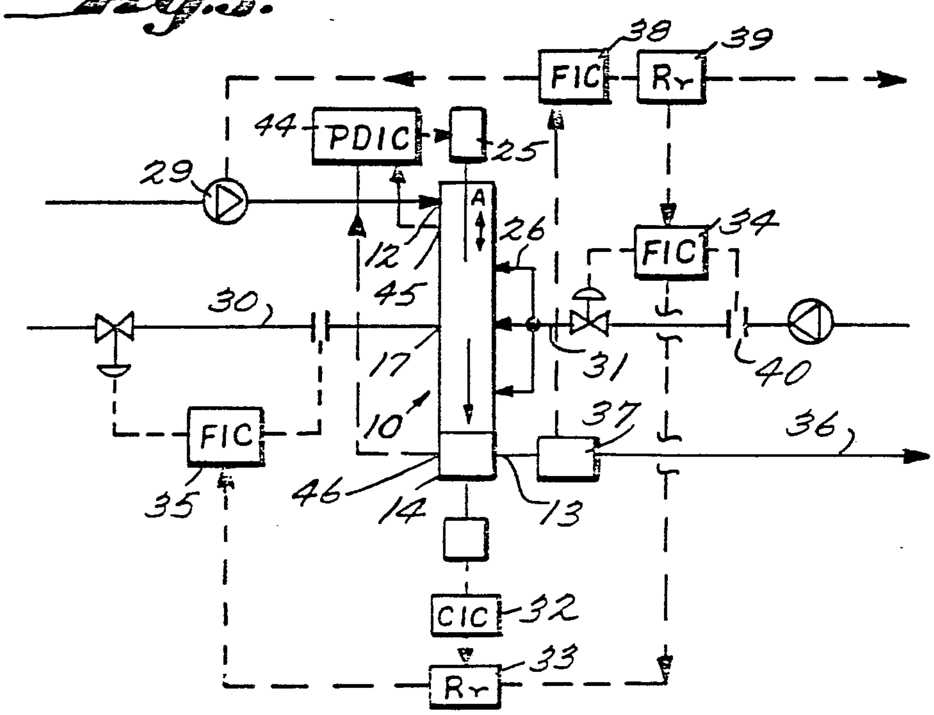
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Fig. 4.

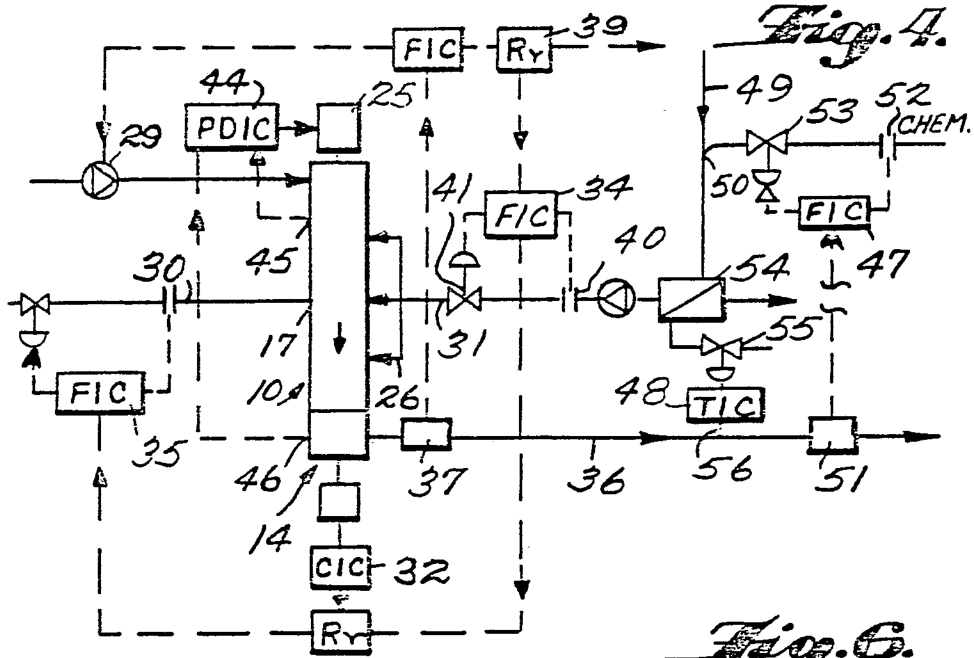
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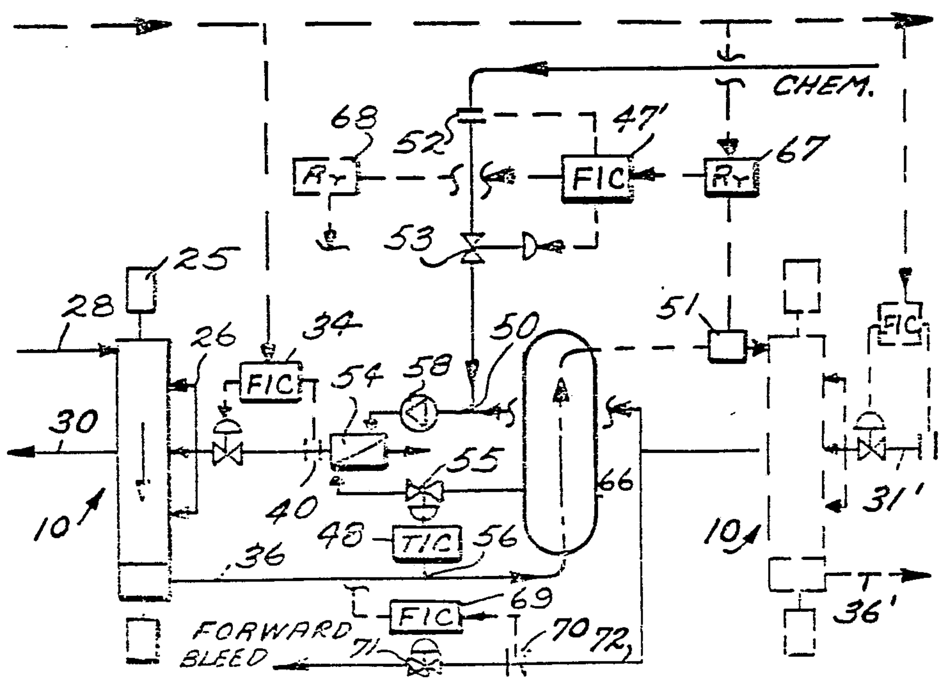
Fig. 6.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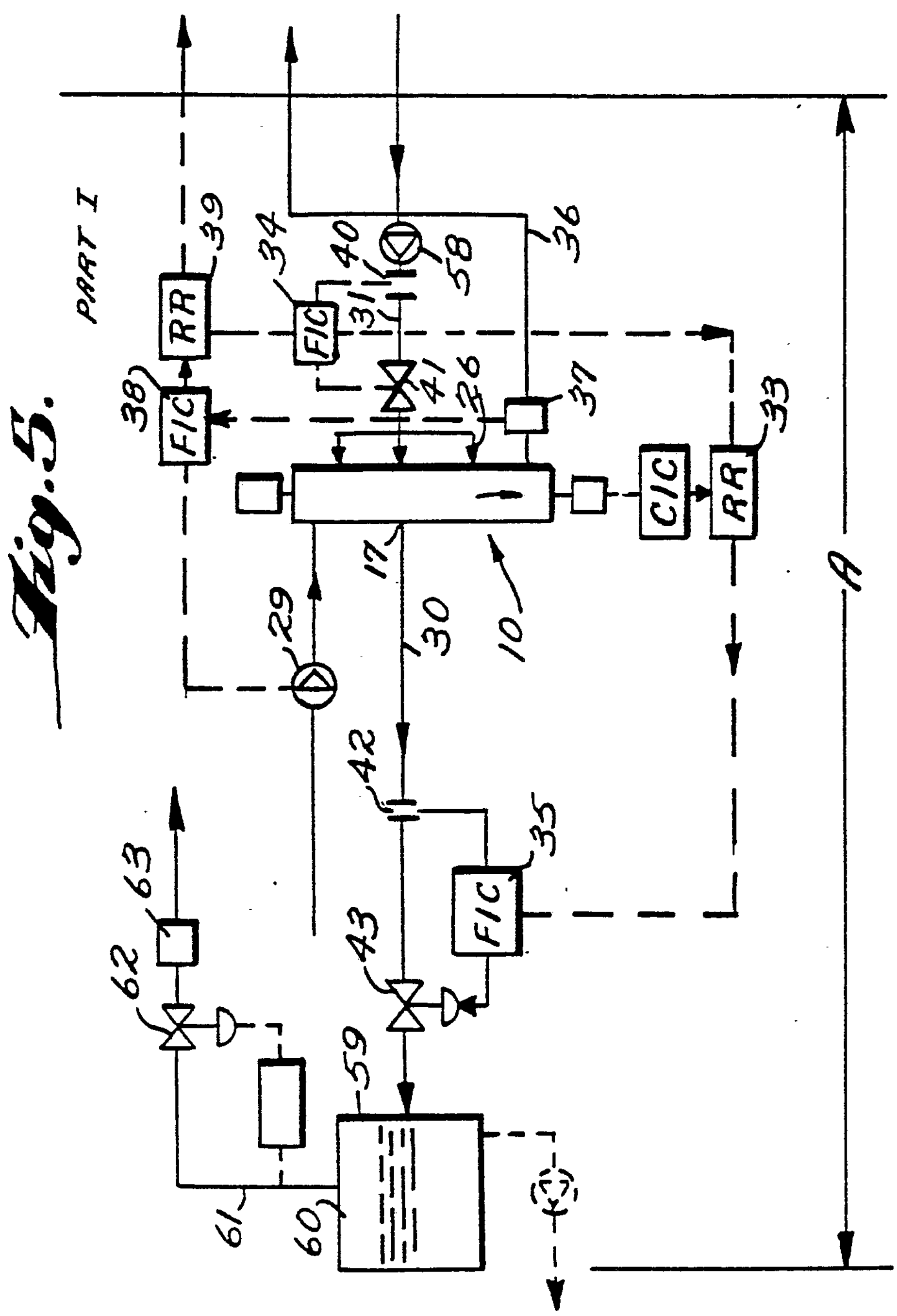
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Fig.5.

Fig. 5.