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(54) Apparatus and process for producing raw of bleached chemimechanical wood pulps by a continuous impregnation process.

(57) An apparatus and process for producing chemimechanical wood pulp wherein the mixture is fed from a first tank, into which the product and reagents are continuously fed, to a series of successive tanks of which at least one can be kept substantially empty in turn, the level of the product suspension present in each tank being able to be externally set so that the flow from one tank to another and thus the total product reaction time become controlled in accordance with said level, it also being possible to keep those products simultaneously present in the plant but with different characteristics separate from each other by virtue of said tank which is kept substantially empty in turn.

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APPARATUS AND PROCESS FOR PRODUCING RAW OR BLEACHED CHEMIMECHANICAL WOOD PULPS BY A CONTINUOUS IMPREGNATION PROCESS

Processes for producing bleached or raw wood pulps for the paper industry are well known, and in particular the so-called "chemi-mechanical" processes which are fully illustrated in Italian patents 665,340 and 867,303 in the name of Giorgio Gazza.

Although said processes are perfectly efficient from the physical and chemical aspects, they have serious plant and operational deficiencies.

The reason for this is that they operate discontinuously during the initial stages of the overall process, ie those stages which produce coarse impregnated pulp intended for the subsequent refining operations.

This means that they operate in the form of closed cycles, in each of which a finite quantity of raw material is treated, and it is therefore difficult to adapt them for operation when the raw material characteristics vary or when it is required to change the characteristics of the intermediate product which constitutes the coarse pulp.

The consequence is a slowing-down of the production rate due to the need to completely empty the plant if one of the aforesaid changes occurs.

Basically, in the said known processes the chemimechanical wood pulp is prepared from perennial or annual plants, or from wood processing waste, by the following operations:

- the wood fragments, commonly known and indicated hereinafter as "chips" are further reduced in size and are treated to form a fibrous mass in which the fibres are at least partly separated from each other, and a dimensional selection is carried out with the dust and fragments outside the acceptable size range being removed;
- the chips treated and selected in this manner are then washed with water, by which they remain at least partly impregnated;
- after checking their moisture content, the next operation is to impregnate them with an aqueous solution of NaOH, H_2O_2 and other reagents, inside a tank into which steam is also fed, and mechanical mixing is carried out; all the necessary components in this tank are proportioned to the quantity of dry product immersed in the tank;
- the product then passes to one or more (generally two) mixing tanks connected in series, from the last of which there being withdrawn the pulp to undergo subsequent refining and continuation of the chemical bleaching reaction.

The process is discontinuous in the sense that all the material, in each processing stage, remains in its respective tank as there is no transfer between one tank and another during the various operations.

According to a known modification, the impregnation and refining operations can be implemented in a single tank of special characteristics, but again discontinuously.

The material obtained then passes to the subsequent refining stages.

The problem which the present patent proposes to solve is to make the material flow continuous, and to make it possible to instantaneously vary the process parameters without waiting for the plant to be completely emptied, and thus without slowing-down the production

rate.

According to the invention, this is made possible by connecting in series a certain number of impregnation tanks, each of which is provided with means for controlling the allowable maximum and minimum level, and means for feeding the wood suspension to any one or more of the downstream tanks, means also being provided for regenerating and recycling the liquor deriving from draining the coarse pulp downstream of the last tank, from which the pulp is fed to subsequent refining and continuation of the bleaching reaction.

According to the invention, control means and means for processing the physical and chemical characteristics of the products fed into the plant are also provided, these means controlling suitable multi-way valves which regulate their flow through the plant, said control means also controlling the regulation, proportioning, recycling and flow of the reagents used (delignifying and bleaching agents, or only delignifying agents).

According to the process of the invention, the material is passed from a first tank into which the product and reagents are continuously fed, to a series of subsequent tanks of which at least one can be kept substantially empty in turn, the level of the product suspension present in each tank being able to be set externally and used as a basis for regulating the flow from one tank to another and thus the total reaction time of the product, it also being possible to keep those products of different characteristics which are simultaneously present in the plant separate from each other by virtue of said tank which is kept substantially empty in turn.

The invention will be more apparent, and its merits and characteristics better understood, from the detailed description given hereinafter with reference to the figures of the accompanying drawings, which illustrate a preferred embodiment thereof using five impregnation tanks plus one tank for collecting and making-up

the liquor.

For space reasons, the plant flow diagram is shown on three drawings, of which Figure 2 of the second drawing is a continuation of Figure 1 of the first drawing, and Figure 3 of the third drawing is a continuation of Figure 2 of the second drawing.

The flow diagram shown on the drawings (Figure 1) includes a silo 1, shown diagrammatically, from the base of which two screw feeders 2 withdraw the raw material in the form of crushed pieces of wood, commonly known as chips.

The screw feeders 2 discharge the chips on to conveyor belts 3 feeding a vibrating screen 4 which separates the dust and the chips lying outside the acceptable size range.

Downstream of the screen 4, the accepted chips are fed by the conveyor belt 5 to the pair of proportioning screw feeders 6 feeding the size reduction unit 7, which converts the chips into a ground product able to form a wood suspension in water.

The size reduction unit 7 discharges the material on to a Redler conveyor 8 which conveys it to a vibration table 9 on which moisture sensing means 10 acting by induction are disposed.

The product passes from the vibrating table 9 to a continuous weighing device 11.

The data determined by the means 10 and 11 are transmitted in the form of electrical signals to an electronic processor CE which is programmed to calculate from them the "absolute dry" weight of the ground wood passing beyond the weighing means.

The procesor CE is also programmed to calculate the quantities of the various chemical products and water required for the treatment in accordance with the desired percentages and in accordance with the

quantity of dry wood treated, and to transmit corresponding pulses to the various metering pumps 12A, 12B, 12C and 12D which withdraw the aqueous solutions of said products from the respective containers 13A, 13B, 13C and 13D.

From the weighing means 11, the screened and weighed product is fed by a further Redler conveyor 14 to a screw feeder 15 to which the metered chemical products withdrawn from the tanks 13A, 13B, 13C and 13D are also fed.

The screw feeder 15, which is of variable speed, feeds the product together with the metered aqueous solutions to a first tank indicated by M.

Said tank M also receives the recycled liquid or liquor, which is regenerated to give it the required characteristics and in particular the same characteristics as the aforesaid mixture of aqueous solutions.

The recycled liquor is fed by the pipe 16 partly into the screw feeder 15 and partly directly into the tank M through the branches 17 and 18.

The tank M is provided with suitable mechanical mixers 19 and two electronic level sensors/indicators for maximum level 20 and minimum level 21 respectively, their positions being set by the processor CE, to which they feed their signals.

The tank M comprises an outlet pipe 22 containing a shut-off valve 23, and connected to the suction side of a pump 24.

The delivery pipe 25 from the pump 24 contains a control valve 26 operated by the processor CE as described hereinafter.

Downstream of the valve 26 there is a three-way valve 27 which can direct the aqueous suspension either to a four-way valve 28 or directly to a tank A.

The tank A is provided with mechanical mixers indicated by 29 and with electronic level sensors/indicators for maximum level 30 and minimum level 31 respectively, their positions being set by the processor CE to which they feed their signals.

The tank A comprises an outlet pipe 32 containing a shut-off valve 33 and connected to the suction side of a pump 34.

The delivery pipe 35 from the pump 34 contains a control valve 36 operated by the processor CE as described hereinafter.

Downstream of the valve 36, the pipe 35 leads into the tank B.

The tank B is provided with mechanical mixers indicated by 38 and with electronic level sensors/indicators for maximum level 39 and minimum level 40 respectively, their positions being set by the processor CE to which they feed their signals.

The tank B comprises an outlet pipe 41 containing a shut-off valve 42 and connected to the suction side of a pump 43.

The delivery pipe 44 from the pump 43 contains a control valve 45 operated by the processor CE as described hereinafter.

Downstream of the valve 45, the pipe 44 leads to a three-way valve 46 from which there branch a pipe 47 opening into the tank C and a pipe 48 feeding a proportioning device 49 also controlled by CE and from which the material is partly recycled through 50 into the tank B and partly fed through 51 to a drainage screw 52, from which the separated solid material proceeds, to undergo subsequent refining and continuation of the bleaching reaction, and the residual liquor flows into the tank Z through 53.

The tank C is provided with mechanical mixers indicated by 52 and with electronic level sensors/indicators for maximum level 55 and minimum level 56 respectively, their positions being set by the

processor CE to which they feed their signals.

The tank C comprises an outlet pipe 57 containing a shut-off valve 58 and connected to the suction side of a pump 59.

The delivery pipe 60 from the pump 59 contains a control valve 61 operated by the processor CE as described hereinafter.

Downstream of the valve 61, the pipe 60 leads to a three-way valve 62 from which there branch a pipe 63 opening into the tank D and a pipe 64 feeding a proportioning device 65 also controlled by CE and from which the material is partly recycled through 66 into the tank C and partly fed to the pipe 51.

The tank D is provided with mechanical mixers indicated by 67 and with electronic level sensors/indicators for maximum level 68 and minimum level 69 respectively, their positions being set by the processor CE to which they feed their signals.

The tank D comprises an outlet pipe 70 containing a shut-off valve 71 and connected to the suction side of a pump 72.

The delivery pipe 73 from the pump 72 contains a control valve 74 operated by the processor CE as described hereinafter.

Downstream of the valve 74 the pipe 73 leads to a proportioning device 75 also controlled by CE and from which the material is partly recycled through 76 into the tank D and partly fed to the pipe 51.

The tank Z, to which the liquor trickling from the drainage screw 52 flows, is provided with means 77 for analysing said liquor which feed their data to the processor CE, which controls the metering pumps 12A, 12B, 12C and 12D so that they feed the reagents properly proportioned to make-up the solution characteristics to the required values.

The make-up reagents flow to the tank Z through the pipe 78 which is provided with a shut-off valve 79.

The tank Z is also provided with electronic temperature sensing/indicating means 80 which feed data to the processor CE for controlling the steam feed through the valve 81 in order to maintain the required temperature in Z.

Two pumps 82 and 83 are connected to the bottom of the tank Z. The pump 82, namely the wash pump, feeds a pipe 84 from which pipes 85, 86, 87, 88 and 89 branch and are connected respectively to the suction side of the pumps 24, 34, 43, 59 and 72 by way of the shut-off valves 90, 91, 92, 93 and 94.

The pump 83, namely the recycling pump, feeds the liquor through a control valve 95 and through the pipe 16 to the tank M and to the screw feeder 15.

The level indicators 20 and 21 feed their signals to the processor CE, this latter controlling the operation of the valve 95 and of the screw feeder 15.

Three pipes 96, 97 and 98 branch from the four-way valve 28 and are connected to the tanks B, C and D respectively.

The plant heretofore described can operate continuously in the following manner.

The tank M receives from the screw feeder 15 the material in the form of wetted chips together with the required reagent solution determined in accordance with the "absolute dry" weight of the fed material.

The reagent solution is partly recycled from the tank Z and partly withdrawn from the tanks 13A, 13B, 13C and 13D as a result of the instantaneous commands of the processor CE which receives data from

the weighing means 11, from the moisture sensing means 10 and from the means 77 provided in the tank Z.

When the level in the tank M has reached the required level set by the operator, the pump 24 together with its valve units starts to operate under the control of the processor CE and feed material to the tank A, from which in the same manner the material passes to the tanks B, C and D by the successive operation of the pumps 34, 43 and 59 and their valve means.

The level in each tank is transmitted to the processor CE which controls the operation of the discharge pump of the upstream tank.

The material is withdrawn from the tank D by the pump 72 and partly fed to the subsequent processes and partly recycled to the tank D by the proportioning device 75.

The fact that the levels in the individual tanks are regulated means in practice that, once the process is properly operating, the total residence time of the material in the tanks can be set, and the reagents undergo continuous feed in the correct required quantities.

The three-way valves 46 and 62 are set to feed the pipes 47 and 63.

If it is required to modify the product characteristics on termination of impregnation, ie the characteristics of the coarse pulp leaving the feed screw 52, the procedure is as follows:

a) the suspension feed to the tank M is reduced by adjusting its level indicators which by way of the processor CE control the upstream feed devices, until it is practically empty

b) at this point the pump 24 stops and the tank M begins to be fed with the new suspension having the required different characteristics; at the same time the level in tank A falls as all the other pumps are in operation; in practice, if between the maximum and minimum levels there is a capacity equal to one half of a tank, the system is regulated such that

when the tank M is empty, the tank A is half full

c) when the tank A is empty, and thus the tank M is half full, the pump 34 stops for the time necessary to completely fill the tank M and to half empty the tank B

d) the precedure is repeated until the tanks B, C and D are completely emptied in succession, and at this point only the new fibre suspension with the required different characteristics is present in the plant without the cycle having had to be interrupted, and in particular without the two types of suspension having come into contact with each other.

It should be noted that the entire procedure is controlled by the processor CE which on the basis of the data which it receives from the described means is able to control the process parameters to the required values for the entire process duration.

Besides operating in the aforesaid manner, the described plant can, if required, operate in accordance with a cycle in which the tanks B, C and D are alternately filled, while the tank A remains inactive.

With this second method of operation, which is convenient when long and precise residence times for the wood suspension in the tanks are required, the valve 27 is rotated so as to feed the valve 28, which fills the tanks B, C and D in succession.

The valves 46 and 62 are set in this case to feed the pipes 48 and 64.

The throughput of the pumps and of the relative valves is adjusted so that when the tanks C is full, the residence time required for the product in the tank B is complete.

At this point, while filling the tank D, the tank B begins to empty by the effect of its pump 43 and the relative valves, the product being discharged to the screw 52 through the proportioning device 49 and pipe 51, and partially recycled through 50.

The procedure is repeated until the tanks B, C and D are completely emptied in succession, and any required modifications to the process parameters can be made when at least one of said three tanks is completely empty.

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The valves 90, 91, 92, 93 and 94 are opened after emptying the tanks A, B, C or D, in order to wash the pipes and prevent the formation of blockages.

PATENT CLAIMS

1. An apparatus for producing chemimechanical wood pulp impregnated with chemical delignifying and bleaching or only delignifying agents, characterised by comprising, downstream of suitable crushing and grinding means for the wooden pieces, the following devices:

- tanks containing the various reagents in aqueous solution and each provided with a metering pump;
- a metering screw feeder for said pieces, and with which there are associated
- means for measuring the moisture content and
- continuous weighing means from which a continuous stream of said ground wooden pieces flows to
- a first tank provided with a mechanical mixer, adjustable electronic maximum and minimum level indicators and a discharge pump, by which the material is fed selectively, through a flow control valve,
- to a plurality of tanks connected in series and each provided with adjustable electronic maximum and minimum level indicators, a mechanical mixer and a discharge pump which feeds the downstream tank by way of a flow control valve;
- at least the last of the tanks of said plurality of tanks being provided, downstream of the respective discharge pump, with a rotary proportioning device which feeds part of the aqueous suspension to drainage means feeding the drained coarse pulp to the subsequent refining processes, and recycles the remaining part of the suspension to said last tank;
- a last tank which receives the liquor from said drainage means, to recycle it to said first tank after restoring its physical and chemical characteristics;

electronic means being provided for receiving and processing the data from said moisture measuring means, from said continuous weighing means and from said level indicators, and for controlling the product and reagent flows through said tanks.

2. An apparatus as claimed in claim 1, characterised in that

downstream of the flow control valve contained in the delivery pipe from the discharge pump of the first tank, there are connected in series a three-way valve and a multi-way valve, of which the former is arranged to selectively feed the stream either to the multi-way valve or to the first tank of said plurality of tanks, and the second is arranged to selectively feed the stream in succession to each of the tanks of said plurality of tanks with the exception of the first.

3. An apparatus as claimed in claim 1, characterised in that a three-way valve is contained in the delivery pipe of the respective discharge pump between the second and the penultimate tank of said plurality of tanks and selectively feeds the stream either to the next tank or to a rotary proportioning device which itself feeds part of the stream to said drainage means and recycles the remaining part to the same tank.

4. An apparatus as claimed in claim 1, characterised in that said last tank comprises a discharge pump, the delivery pipe of which comprises a flow control valve and leads to said first tank.

5. An apparatus as claimed in claim 1, characterised in that said last tank comprises a discharge pump, the delivery pipe of which has a number of branches equal to the number of tanks of said plurality of tanks plus one branch for said first tank, these branches leading to the suction pipes of the discharge pumps of said first tank and of each of the tanks of said plurality of tanks, a shut-off valve being provided in each branch.

6. An apparatus as claimed in claim 1, characterised in that each of the tanks comprises a shut-off valve upstream of the respective discharge pump.

7. An apparatus as claimed in the preceding claims, characterised in that the drive motors of the discharge pumps and metering pumps, the control valves, the shut-off valves, the proportioning devices and the three-way and multi-way valves are controlled by the

electronic processor, which receives the signals from said level sensing, moisture measuring and continuous weighing means.

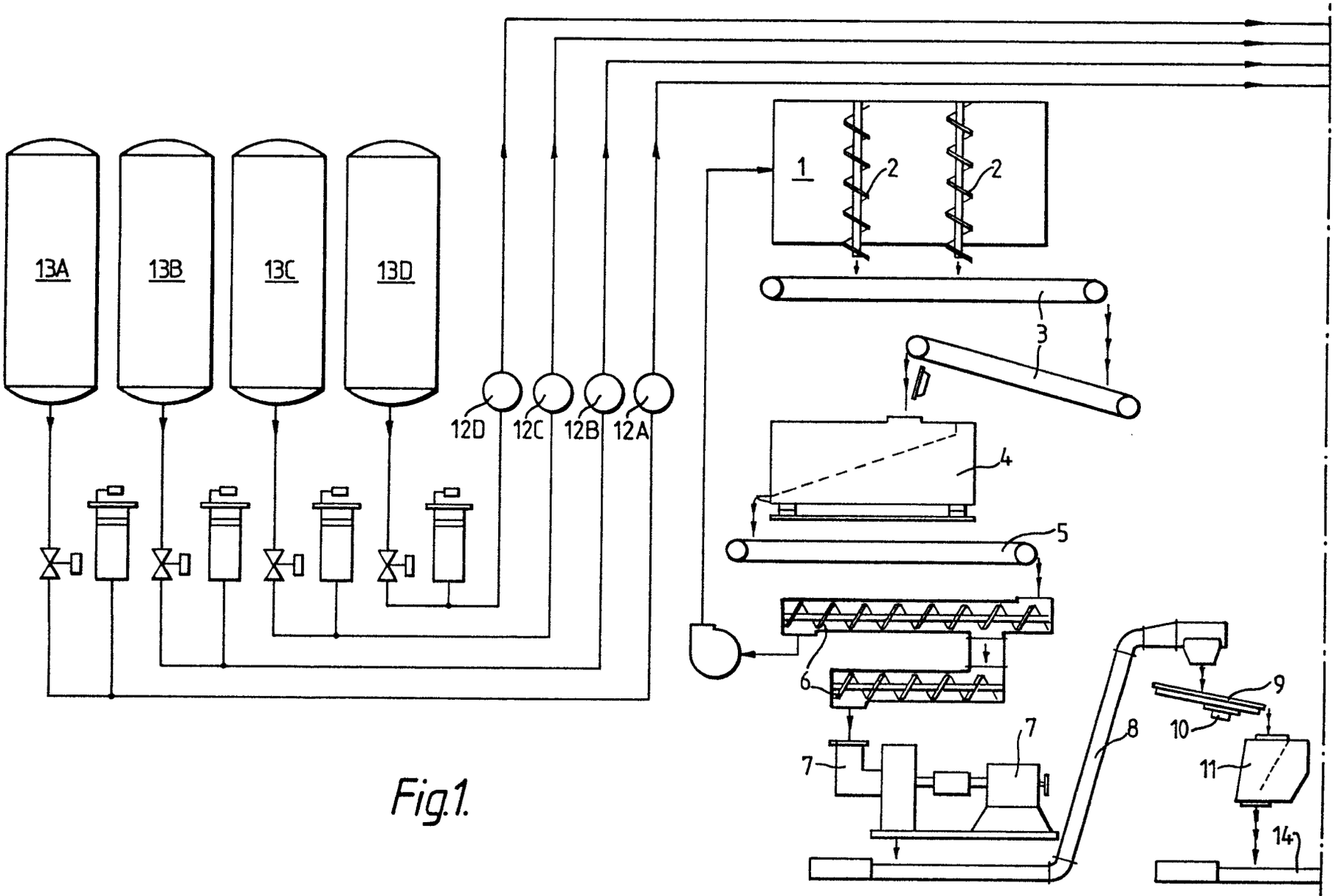

Fig.1.

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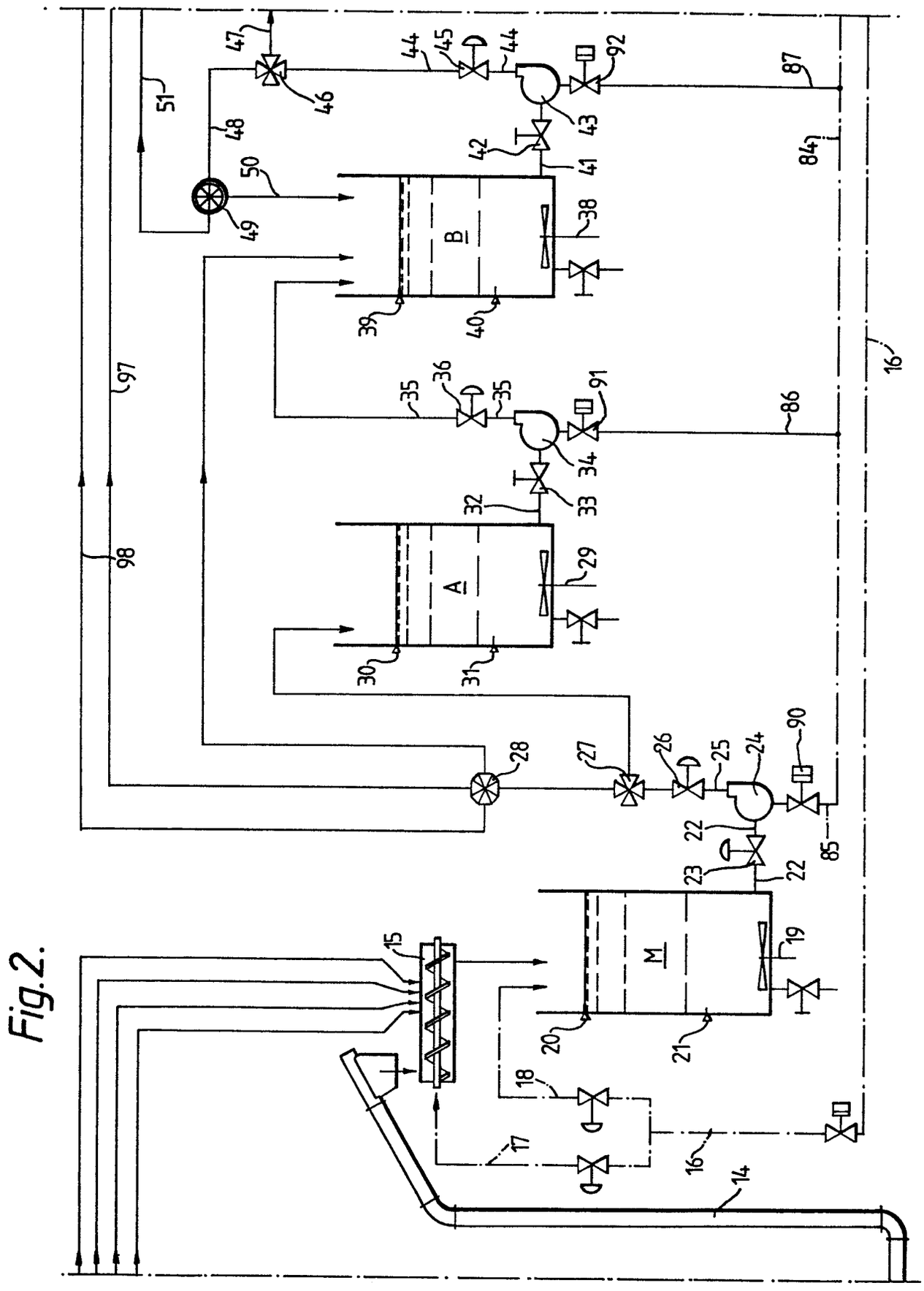

Fig.2.

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Fig.3.