(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 153 271**
A2

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 85730011.5

(22) Date of filing: 28.01.85

(51) Int. Cl.⁴: B 01 F 15/04, B 01 F 3/08, B 01 F 3/04

(30) Priority: 30.01.84 JP 14659/84
16.02.84 JP 27701/84

(43) Date of publication of application: 28.08.85
Bulletin 85/35

(84) Designated Contracting States: DE FR GB IT NL

(71) Applicant: MITSUBISHI JUKOGYO KABUSHIKI KAISHA, 5-1, Marunouchi 2-chome Chiyoda-ku, Tokyo (JP)

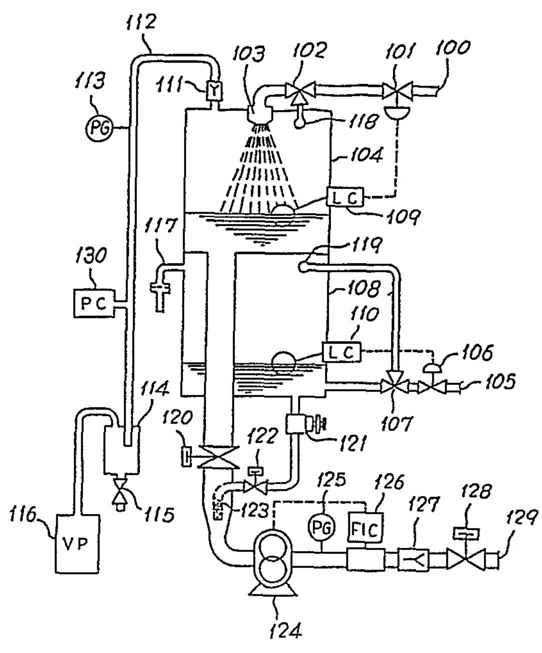
(72) Inventor: Yamaguchi, Shogo c/o Nagoya Machinery Works, Mitsubishi Jukogyo 1, Aza-Takamichi Iwatsuka-cho, Nakamura-ku Nagoya City Aichi Pref. (JP)
Inventor: Tachi, Eiji c/o Nagoya Machinery Works, Mitsubishi Jukogyo 1, Aza-Takamichi Iwatsuka-cho, Nakamura-ku Nagoya City Aichi Pref. (JP)
Inventor: Yoshikawa, Enichi c/o Nagoya Machinery Works, Mitsubishi Jukogyo 1, Aza-Takamichi Iwatsuka-cho, Nakamura-ku Nagoya City Aichi Pref. (JP)

(74) Representative: Meissner, Peter E., Dipl.-Ing. et al, Meissner & Meissner Patentanwälte Herbertstrasse 22, D-1000 Berlin 33 Grunewald (DE)

(54) **Method and apparatus for mixing liquid.**

(57) The present invention relates to a method and apparatus for mixing two kinds of liquid in a predetermined ratio and more particularly to a method and apparatus for mixing liquid by using a constant volume pump. A first liquid and a second liquid are stored in tanks and maintained to a predetermined pressure, respectively. The first and second liquids are supplied to a suction side or an inlet of the constant volume pump and the second liquid supplied to the pump is measured by a measuring means to adjust it to a predetermined amount so that the first and second liquids are mixed in the predetermined ratio.

The method is suitable for mixture of beverages and for this purpose includes a method of evacuating the tank for the first liquid to eliminate oxygen contained in the first liquid. Further, the method includes a method of supplying absorption gas to the first tank with pressure in order to simultaneously perform the evacuation of oxygen from the first liquid and the absorption of gas.



EP 0 153 271 A2

3. BACKGROUND OF THE INVENTION

(1) FIELD OF THE INVENTION

The present invention relates to a method and apparatus for mixing a first liquid and a second liquid in a predetermined ratio for use in manufacture of cooling beverages or a general industry.

(2) DESCRIPTION OF THE PRIOR ART

Fig. 1 shows a construction of a prior art liquid mixing apparatus for use in a manufacturing process of a cooling beverage.

Water to be processed for the manufacture of the cooling beverage is supplied through an inlet 1 to a tank 4 for use in the evacuation of oxygen. A liquid level in the tank 4 is controlled to be maintained to a predetermined level by a water control valve 2.

The tank 4 may be of a packed tower type, a wetted-wall column type, or a tray tower type. A vacuum unit 3 is coupled to the tank 4 so that oxygen contained in the water to be processed is evacuated under vacuum. The evacuated water is sent out from an outlet pipe 5 through a check valve 7 and a water pipe 8 to a water tank 10 by means of a water pump 6.

An inlet valve 9 serves to always maintain constant a level of the evacuated water supplied to the water tank 10. A syrup supply valve 12 serves to maintain constant a level of syrup for use in the manufacture of a cooling beverage in a syrup tank 13 supplied from a supply port 11.

Water in the tank 10 and syrup in the tank 13 are applied with an atmospheric pressure or are pressurized by the same pressure if necessary.

The evacuated water is supplied from the water tank 10 through a water measuring valve 14 and a water mixing valve 15 to a mixing tank 18 having a pressure therein being maintained to an atmospheric pressure. The amount of flowing into the mixing tank 18 is substantially propotional to an opening of the water measuring valve 14 since the pressure applied to the water tank 10 is maintained constant and a difference between a level of the water tank 10 and a level of the mixing tank 18 is always maintained approximately constant.

Syrup is supplied from the syrup tank 13 through a syrup measuring valve 16 and a syrup mixing valve 17 to the mixing tank 18. The amount of flowing into the mixing tank 18 is substantially propotional to an opening of the syrup measuring valve 16 in the same manner as that of water since the pressure applied to the syrup tank 13 is maintained constant and a difference between a level of the syrup tank 13 and a level of the mixing tank 18 is always maintained approximately constant.

The mixed liquid in the tank 18 is sent out with pressure by a mixing pump 19 through a control valve 20 to a next process. The control valve 20 is constructed to automatically control the level of the mixing tank 18 to a constant level.

In the next process, carbon dioxide gas (CO_2) is absorbed or mixed into the mixed liquid. In other words, the mixed liquid of a constant flow rate and supplied through the control valve 20 and the carbon dioxide gas of a constant flow rate and supplied from a supply port 22 through a valve 23 are supplied to a polycarbonator 21. The mixed liquid absorbs the carbon dioxide gas within a pipe 24 and flows into a carbonator tank 26 through a check valve 25. The carbonator tank 26 is connected through a pressure regulating valve 28 to a gas supply port 27 through which carbon dioxide gas is supplied to the tank 26 so that a pressure within the tank 26 is maintained constant.

A cooling unit for the mixed liquid is installed on a way of the pipe 24 if desired, or a cooling plate is disposed in the tank so that the mixed liquid in the tank 26 can be cooled to a predetermined temperature .

The mixed liquid supplied in the carbonator tank 26 is a product containing a necessary amount of carbon dioxide gas absorbed under the pressurized carbon dioxide gas, and is stored below the tank 26 to send out from an outlet 29 to a next process with pressure.

The above liquid mixing apparatus has the following problems when two kinds of liquid are mixed:

(1) It is required to control the liquid levels in three tanks of the water tank 10, the syrup tank 13 and the mixing tank 18, respectively. When oxygen contained in water to be processed is evacuated, control of the level in the tank 4 is required.

(2) Since the mixing pump 19 is provided with the control valve 20 for maintaining constant the liquid level in the mixing tank 18, the mixing pump 19 is required to have relatively large capacity.

(3) When oxygen contained in water to be processed is previously evacuated, the tank 4 and its space are required and further the pump 6 for sending the evacuated water to the water tank 10, the check valve 7, the pipe 8 and the inlet valve 9 are also required.

(4) The carbonator of a relatively large gas absorption apparatus is required since the mixed liquid having a bad gas absorption factor is used for the absorption of carbon dioxide gas.

(5) The apparatus shown in Fig. 1 has five tanks of large and small sizes and many pipes for connecting them to each other are required. Accordingly, a portion or area of this apparatus to be sterilized and washed is large, and time and a amount of liquid for the sterilization and washing are

required much.

4. SUMMARY OF THE INVENTION

It is an object of the present invention to provide a method and apparatus for mixing two kinds of liquid in a predetermined ratio.

It is another object of the present invention to provide a method of previously evacuating oxygen contained in one liquid and an apparatus therefor.

It is still another object of the present invention to provide a new method and apparatus for evacuating oxygen and attaining the absorption of gas.

These and other objects of the present invention will be apparent from the following description in connection with embodiments.

5. BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 shows a prior art mixing apparatus, Fig. 2 shows a mixing apparatus showing an embodiment according to the present invention, and Fig. 3 shows an apparatus of another embodiment according to the present invention.

6. DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

The present invention will now be described with reference to embodiments shown in figures.

Fig. 2 shows a liquid mixing apparatus of an embodiment according to the present invention, in which numeral 100 denotes a supply port of water to be processed which is provided with a liquid level control valve 101. A change-over valve 102 is used to switch a flow way to a supply nozzle 103 for water to be processed or to a washing spray 118. Numeral 104 denotes a water tank and numeral 109 denotes a liquid level controller. Water supplied from the port 100 is controlled by the liquid level controller 109 and the control valve 101 in response to the liquid level in the tank 104 to maintain the liquid level in the tank 104 constant.

A vacuum gauge 113, a vacuum controller 130, a waterdrop separator 114, a drain valve 115 and a vacuum unit 116 are attached to a vacuum pipe 112 connected to the tank 104 through a check valve 111. The water tank 104 is evacuated by the vacuum unit 116.

Numeral 105 denotes a syrup supply port. A liquid level control valve 106 and a change-over valve 107 are disposed on a way of a flow way from the syrup supply port 105. The change-over valve 107 switches the flow way to a syrup tank 108 or a washing spray 119. An amount of syrup supplied from the syrup supply port 105 is controlled by a liquid level controller 110 and the liquid level control valve 106 in accordance with the liquid level in the syrup tank 108 and the liquid level in the tank 108 is maintained constant.

A pipe 117 is to connect the syrup tank 108 to the atmosphere or can be connected to a pressurized gas source if desired so that the syrup tank 108 is maintained to a constant pressure.

The water tank 104 is coupled to a suction side or inlet of a constant volume pump 124 through a valve 120. The syrup tank 108 is also coupled through a measuring valve 121, a valve 122 and a mixing nozzle 123 to the suction side of the constant volume pump 124. The valves 120 and 122 are automatic control valves which open and close in synchronism the start timing and the stop timing of the constant volume tank 124.

A pressure gauge 125 is to measure an output pressure of the constant volume pump 124. A flow meter 126 can automatically control the revolution of the pump 124, if necessary, to control an amount of flowing mixed liquid constant, or can be used to adjust the revolution of the pump 124.

Numeral 127 denotes a check valve, numeral 128 denotes an automatic control valve for adjusting an amount of flowing liquid, and numeral 129 denotes an outlet of the mixed liquid. The check valve 127 is to prevent the mixed liquid from flowing reversely or leaking out when the pump 124 is stopped.

Oxygen contained in water supplied from the supply port 100 to the water tank 104 is sufficiently evacuated in the water tank 104 maintained to a predetermined vacuum by the vacuum unit 116 and the vacuum controller 130, and the liquid level of the water is maintained constant by the liquid level controller 109 and the liquid level control valve 101.

On the other hand, syrup supplied from the supply port 105 is maintained to a constant level by the liquid level controller 110 and the liquid level control valve 106.

The evacuated water is sucked through the valve 120 by the constant volume pump 124.

The suction portion of the pump 124 is maintained to a constant pressure in a range of 0.1 to 0.2 [kg/cm·Abs] determined by the vacuum and the liquid level in the water tank 104.

Syrup in the tank 108 flows out through the valves 121 and 122 from the nozzle 123 into water while scattering sufficiently.

Since a pressure at the nozzle 123 is a sufficiently negative pressure as compared with that in the syrup tank 108, syrup from the tank 108 can flow out into water and the amount of syrup flowing out into water can be adjusted by the measuring valve 121.

A pressure difference between before and after the valve 121 is substantially constant (strictly considering, it changes a little depending on an amount of flowing syrup) and is equal to a sum of a pressure difference between a pressure in the syrup tank 108 and a pressure near the mixing nozzle 123 and a liquid column pressure of syrup. The respective pressures and the liquid column pressure are maintained constant.

The flow rate of the mixed liquid at the suction side of the constant volume pump 124 is depending on the constant volume characteristic of the pump 124 and can be set by the revolution of the pump. Accordingly, the flow meter 126 and the control valve 128 are not necessarily required. Since the constant volume characteristic of the pump 124 is affected by a back pressure of the pump, when the back pressure changes, there are two methods for increasing accuracy of the flow rate of the mixed liquid as follows.

In a first method, a pressure measured by the pressure gauge 125 is not used and the revolution of the pump 124 is adjusted by the flow rate measured by the flow meter 126 to make constant the flow rate of the mixed liquid. This method can be also effected by automatic control.

In a second method, the flow rate of the mixed liquid is adjusted constant by utilizing the fact that the flow rate of the mixed liquid is propotional to the revolution of the pump 124 when the opening of the control valve 128 is adjusted to maintain constant the pressure measured by the pressure gauge 125.

When a flow rate of the mixed liquid outputted from the pump 124 is QM [l/min] and a flow rate of syrup flowing by adjusting the measuring valve 121 is QS [l/min], a flow rate QW [l/min] of the evacuated water to be processed is given by

$$QW = QM - QS$$

When the pressure at the suction side of the pump 124 is maintained constant and the level of syrup in the tank 108 is maintained constant with the pressure therein being the stable atmosphric pressure or maintained to a constant holding pressure, the flow rate of syrup is determined by an opening of the measuring valve 121. Accordingly, by adjusting the revolution of the pump 124 to make constant the flow rate of the mixed liquid, the flow rate of the evacuated water is determined automatically, so that water and syrup can be mixed in a predetermined ratio.

According to the above embodiment, the following effects can be obtained.

(1) As compared with the prior art, an evacuation tank and a mixing tank are not required and the number of tanks is two which is half of that in the prior art.

(2) Since the evacuation tank is not necessary (using the water tank in the prior art), its associated water supply

control equipments, pump for sending out the evacuated water with pressure and pipes for supplying liquid are all unnecessary and the number of components is greatly reduced.

(3) Since the negative pressure for the vacuum evacuation in the water tank is utilized in order to send out syrup from the syrup tank, an additional pressure on the syrup tank is not necessary and it can utilize the stable atmospheric pressure. Further, pressure may be applied if desired.

(4) It is not required to measure or adjust the flow rate of the evacuated water to be processed.

(5) Power consumption can be greatly reduced by using the constant volume pump. Table 1 shows comparison of a power of a motor in the prior art of Fig. 1 and a power of a motor in the present invention.

TABLE 1

Comparison / Mixed Flow Rate	Prior art system of Fig. 1			Volume Control Pump of Present System
	Pump for sending water	Pump for mixing	Total	
100 l/min	3.7kW	7.5kW	11.2kW	3.7kW

200 l/min	3.7kW	7.5kW	11.2kW	5.5kW
300 l/min	5.5kW	11kW	16.5kW	7.5kW
500 l/min	5.5kW	15kW	20.5kW	11.0kW

(6) The apparatus can be sterilized and washed readily and in a short time with less consumption of sterilizer and detergent since tanks are reduced.

(7) The control apparatus and its operation are simple since objects to be controlled are less.

(8) Noise is greatly reduced by using the constant volume pump. For example, if centrifugal pumps 6 and 19 are used in the prior art of Fig. 1, noise is 80 - 90 dB(A), whereas it is about 70 - 75 dB(A) in the present embodiment.

(9) Since the flow rate of the mixed liquid is depending on the constant volume characteristic of the constant volume pump and can be set by the revolution of the pump, the flow meter and the flow rate adjusting valve are not necessary. There is no leakage in a casing of the pump and when the back pressure of the pump changes, a setting flow rate changes. Therefore, when it is required to increase the setting accuracy of the flow rate without influence of

variation of the back pressure, there can be used a method in which the flow rate is measured to control the revolution of the pump or a method in which an opening of the adjusting valve is adjusted so that the output pressure of the pump is always maintained constant.

The foregoing is an example in which oxygen contained in the water tank 104 is evacuated. Description will now be made to another embodiment in which carbon dioxide gas is supplied to the water tank 104 with pressure to evacuate oxygen and effect the absorption of a desired gas at the same time. This embodiment is shown in Fig. 3, in which description of the same components as in Fig. 2 are omitted.

An exhaust pipe 131 connected to the water tank 104 is connected to an exhaust port 135 through an open and close valve 132, a flow rate adjusting valve 133 and a gas flow meter 134.

A gas supply port 136 is connected through a pressure reducing valve 137, a pressure adjusting valve 138, a check valve 139, a pressure adjusting meter 140 and gas ports 141 and 142 to the syrup tank 108 and the water tank 104. CO_2 gas, N_2 gas or the like is supplied from the gas supply port 136 in accordance with an object and the pressure in the water tank 104 and the syrup tank 108 is maintained to a predetermined pressure.

The construction from the water tank 104 and the syrup tank 108 to the outlet 129 is substantially identical with in Fig. 2 except that in the embodiment of Fig. 3 a flow meter 143 and a pressure gauge 144 are disposed on the way of the flow way from the water tank 104 to the constant volume pump 124 while the valve 120 is disposed between the flow meter 143 and the pressure gauge 144.

Water supplied from the supply port 100 is subject to the evacuation process and the absorption process of gas in the water tank 104 maintained to a predetermined pressure by CO_2 gas, N_2 gas or the like supplied from the gas supply port 136. When the pressure in the water tank 104 is maintained to a predetermined pressure by CO_2 gas, water absorbs CO_2 gas and at the same time air (mainly O_2 and N_2) melted in water is separated. When the pressure in the water tank 104 is maintained to a predetermined pressure by N_2 gas, water absorbs N_2 gas under an atomosphere of pressurized N_2 gas and at the same time oxygen O_2 in air (mainly O_2 and N_2) melted in water is separated.

N_2 or O_2 in air separated from water is exhausted from the exhaust port 135 through the exhaust pipe 131, the valves 132, 133 and gas flow meter 134 at an economical exhaust gas flow rate. Thus, the gas purity of CO_2 gas or N_2 gas in the water tank 104 is maintained to a predetermined value or more.

The pressure in the water tank 104 and the syrup tank 108 is maintained to the identical predetermined pressure, and the liquid levels in the water tank 104 and the syrup tank 108 are maintained to the respective predetermined levels.

The evacuated water in the water tank 104 is sucked by the constant volume pump 124 through the measuring valve 143 and the valve 120. On the other hand, syrup in the tank 108 flows out from the mixing nozzle 123 into flow of water through the measuring valve 121 and the valve 122.

In the present embodiment, the pressure near the mixing nozzle 123 is measured by the pressure gauge 144 and the revolution of the constant volume pump 124 can be changed to control the pressure near the nozzle 123 to a desired value.

Adjustment of the flow rate of the mixed liquid exhausted from the pump 125 and adjustment of the mixture ratio of water and syrup are made in the same manner as in the first embodiment.

According to the present embodiment, the following effects are attained.

(1) Since the evacuation process is a replacement process using CO_2 gas or N_2 gas, the vacuum unit is not required and the pressure adjusting mechanism in place of the vacuum unit is simple.

(2) Since the evacuation of water is made at the same time as the absorption of CO_2 gas or N_2 gas and the gas meltability into water is large as compared with the absorption of CO_2 or N_2 gas into the mixed liquid, gas is absorbed effectively, and the polycarbonator may be omitted.

7. CLAIMS

(1) A liquid mixing method comprising steps of maintaining a pressure in a first tank containing a first liquid and a pressure in a second tank containing a second liquid to a predetermined pressure, respectively, supplying said second liquid through measuring means to a suction side of a constant volume pump, supplying said first liquid to the suction side of said constant volume pump, and mixing said first liquid and said second liquid in a predetermined mixture ratio.

(2) A method according to Claim 1, wherein the pressure in said first tank is negative and oxygen in said first liquid is evacuated.

(3) A method according to Claim 1, comprising a step of supplying gas which is absorbed in said first liquid to said first tank with pressure to evacuate oxygen in said first liquid.

(4) A method according to any one of Claims 1 to 3, wherein said first liquid is supplied to said constant volume pump through constant volume means.

(5) A liquid mixing apparatus comprising a first tank for storing first liquid, a second tank for storing second liquid, a first pressure maintaining unit for maintaining a pressure in said first tank to a predetermined pressure, a second pressure maintaining unit for maintaining

a pressure in said second tank to a predetermined pressure, a constant volume pump having a suction side to which said first and second liquid are supplied, and a measuring unit for adjusting an amount of supply of said second liquid.

(6) An apparatus according to Claim 5, comprising a vacuum pump for evacuating said first tank.

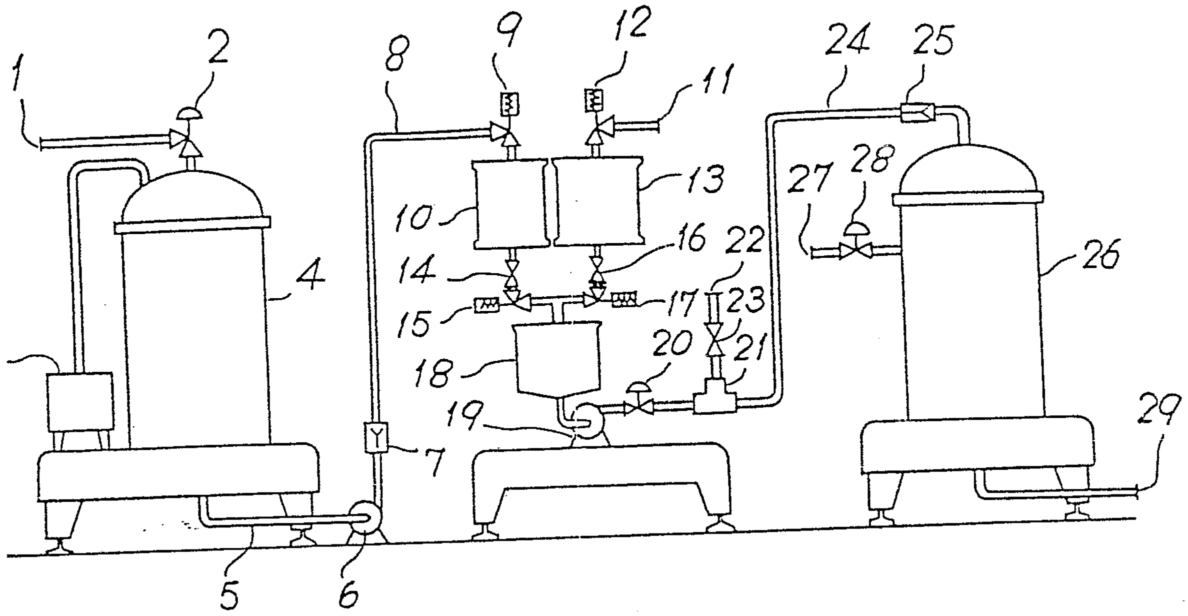
(7) An apparatus according to Claim 5, comprising a gas supply unit for supplying gas absorbed into said first liquid to said first tank with pressure.

(8) An apparatus according to any one of Claims 5 to 7, comprising a measuring unit for adjusting an amount of supply of said first liquid to said constant volume pump.

0153271

epc (59-14659
59-27701

FIG. 1

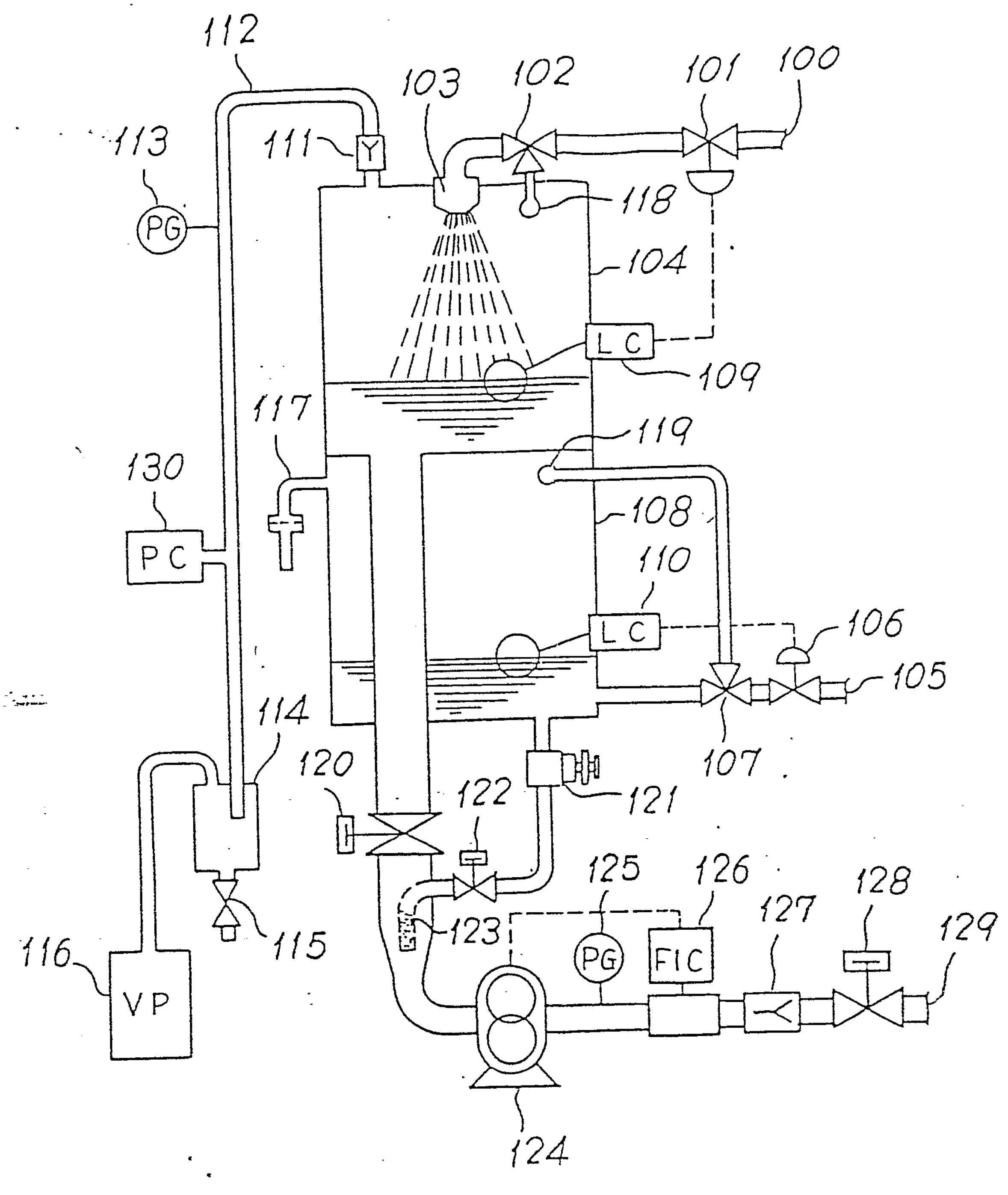


2/3

0153271

(59-14659
59-27701

FIG. 2



3/3

0153271

FIG. 3