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(54) Title: NEW METHOD

(57) Abstract: The present application relates to a plant (310) comprising a plurality of connected process units (316, 318, 320), said plant (310) being suitable for processing a liquid food preparation by a defined process, said process involving a plurality of steps where each of these steps are carried out in a process unit (316, 318, 320), said process unit being connected to other parts of said plant by valves (324, 350, 334, 336, 338, 339, 344), characterized in that each process unit (316, 318, 320) may be cleaned separately and that cleaning liquids are dispensed directly to each process unit (316, 318, 320) during cleaning. The application also discloses a cleaning method, a specific construction element that may be included in such a plant and a system for carrying out the cleaning operation.



WO 2012/160185 A2

NEW METHOD

The present invention relates to cleaning of a food plant of the type which produces liquid food such as a dairy or a plant for producing fruit juices. More specifically, the invention relates to a more efficient method for cleaning a
5 food plant producing liquid food, in which method environmental impact is minimized. The invention also provides a food plant and a unit module in such a food plant adapted for the method as well as a system for controlling cleaning of a food plant.

10 Technical background

Within all food production, not least in the dairy industry, a meticulous cleaning of all production equipment is an imperative requirement for good production. Careless hygiene may involve serious consequences since milk is
15 a perfect nutrient bed where bacteria rapidly multiply. When foods are produced, such as milk products but also other liquid food products and in particular such liquid products that can be stored without refrigeration, it has been considered necessary to sterilize all parts of the plant before starting production.

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Today, most dairy equipment is cleaned using automatic cleaning CIP (Cleaning-In-Place). In this instance, the cleaning takes place in circulation cycle and complies with a predetermined program where different cleaning solutions, temperatures and circulation times are carefully tried out and
25 specified. The cleaning is typically followed by a pre-sterilization using hot water in the same circulation cycle.

In the developed world, extremely large units have recently been made operational for the production of foods. Ever increasing quantities of food are
30 produced for a steadily growing market. As a result, the demands on available

production time have also increased. In order to be able to increase available production time, it is necessary to shorten the time needed for cleaning the process equipment without, to this end, any deterioration in the efficiency of the cleaning methods. US 2008/0276968 (incorporated by reference)

5 discloses a method for cleaning a food plant in which water, an alkaline detergent solution and an acidic cleaning solution are dispensed to the plant according to a specific schedule. US 2008/0105280 (incorporated by reference) and US 2010/0236581 (incorporated by reference) describe a pretreatment method for increasing efficiency of conventional CIP methods

10 where the equipment is pre-treated with a pre-treatment agent such as alkaline compound, an acid compound or an oxidizer.

When carrying out CIP methods in industrial plants, it is highly important to control dispensing of cleaning chemicals. US 5,974,345 (incorporated by

15 reference) discloses a dispensing system for a dairy, which system is adapted for dispensing cleaning chemicals to a dairy plant in specific cycles. The system monitors flow of different cleaning chemicals and generates an alarm signal in case a particular flow rate is less than a predetermined flow rate. WO 2006/032731 (incorporated by reference) describes a system for

20 dispensing cleaning chemical to process equipment in food industry where the cleaning chemicals are recycled and reduced as long as the cleaning chemicals fulfill certain specific minimum requirements. The flow of cleaning chemicals is continuously monitored and when a result not fulfilling these requirements has been obtained, the associated cleaning chemical is

25 discarded.

However, there are drawbacks associated with the above disclosed CIP methods. As already indicated, plants for processing liquid food products and in particular milk products are large. Present CIP methods are all focused on

30 cleaning a complete plant at the same time. Huge amounts of chemicals for cleaning and energy for heating are consumed. Accordingly, the environmental impact of conventional CIP methods could be considerable. Furthermore, as already indicated, there is also a need for increasing

available production time in such plants. There is also a demand on the market for a larger amount of different product variants. As it sometimes is necessary to clean important parts of the plant before starting production of a different product, a larger variety of products may lead to reduced production time in present plants for processing liquid food products.

Accordingly, there is a need for CIP methods associated with a reduced consumption of chemicals and energy. There is also a need for more efficient CIP methods in order to minimize stand-still during maintenance and in order to maximize production time and flexibility.

Summary of the invention

The above disclosed problems are solved by the subject matter of the present claims. In a first aspect, the invention provides a method for cleaning defined parts of a production plant comprising a plurality of connected process units, said production plant being suitable for processing a liquid food preparation by a defined process, said process involving a plurality of steps where each of these steps are carried out in different process units, said such process unit being connected to other parts of said plant by valves, said method comprising the steps of

- a) providing a production plant comprising a plurality of connected process units;
- b) based upon production considerations, taking a decision identifying a subset of process unit(s) that should be cleaned;
- c) disconnecting the process unit(s) of the subset identified in step b), by closing one or more valves, in such a way that liquids in the disconnected process unit cannot be transferred from the disconnected process units to the remaining process unit(s) that are not to be cleaned;
- d) dispensing a sequence of cleaning liquids according to a *per se* known scheme directly and only to the process unit(s) of the subset identified in step b), thereby cleaning the process units of the subset identified in step b); and

e) connecting the process units of the subset identified in step b), by opening the valve(s) that were closed in step c).

As disclosed herein, the term "defined parts of a production plant" relates to a part of but not the complete production plant. Similarly, the term "a subset of process units" relates to some but not all of the process units. Accordingly, the present invention aims at cleaning parts of a liquid food-producing plant but the invention does not relate to simultaneous cleaning of all process units of said plant.

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As disclosed herein, the term "clean" or "cleaning" relates to a cleaning-in-place (CIP) process in which a production plant or a part of such a plant is rinsed with a sequence of cleaning liquids. CIP processes are widely used plants for processing liquid food preparations. In particular, such processes have been used in dairy plants. Examples of such processes and equipment for carrying them out can be found in US 5,974,345, US 2008/0276968, US 2008/0105280, US 2010/0236581, US 4,445,522, and WO 2006/032731.

As disclosed herein, the term "production plant" or "plant" relates to any kind of plant for producing a liquid food preparation in industrial scale. In a production plant of the type discussed in the present application, it is important maintain a high hygienic standard in order to ensure high quality and performance. Typically, a production plant of the present application could be a dairy, a plant for manufacturing vegetable oils or fruit juices.

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As disclosed herein, the term "process unit" is intended to comprise all kinds of different parts of which a production plant is constructed which parts are in direct contact with a liquid food preparation during the process. Accordingly, a process unit in accordance with the present invention could be a tank for mixing or fermentation, a separator, a unit for squeezing or pressing fruit or other plant parts in order to obtain fruit juice or vegetable oil. A process unit in accordance with the present invention could also be a part of a packaging machine that is in direct contact with the liquid food preparation or even a

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pipe for transporting the liquid food preparation. A combined structure capable of carrying out several steps of the production process for producing the liquid food preparation could also be regarded as a process unit. A process unit is delimited from other process units by valves. Any valve type normally used in connection with a process plant for producing a liquid food preparation could be used. Typically, a valve in a production plant in accordance with the present invention is remotely controlled by central process control means. Examples of special valve types used in CIP technologies and that could be used in connection with the present invention are disclosed in US 2003/0070253 (incorporated by reference), and WO 98/38082 (incorporated by reference). The term "connected process unit" relates to a process unit used in production where a valve delimiting the process unit from an adjacent process unit is open. A disconnected process unit on the other hand is not used in production and all valves adjacent to process units used in production are closed. It is also possible to disconnect a plurality of adjacent process units. In this case it is not necessary that the valves separating the disconnected process units are closed. Typically, a disconnected process unit or a plurality of adjacent disconnected process units are cleaned by the cleaning method of the present invention. Adjacent disconnected process units may be cleaned together and be in liquid contact with each other.

As disclosed herein, the terms "liquid food preparation" or "product" relates to any kind of liquid food preparation, including intermediate preparations which are intended to be further processed. Examples of such liquid food preparations or products are milk and milk products such as cream, yoghurt and other fermented milk products, but also fruit juices such as orange juice, grape juice and apple juice, as well as vegetable oils such as olive oil, sunflower oil, and rape oil.

As disclosed herein, the term "cleaning liquid" relates to a liquid dispensed to a process unit during a CIP process. Typical examples of cleaning liquids are water, hot water, an aqueous detergent solution, an aqueous acid solution

such as a solution of a mineral acid (such as phosphoric acid, nitric acid, sulphuric acid) or an organic acid (such as lactic acid, acetic acidhydroxyacetic acid, citric acid, glutamic acid, glutaric acid, and gluconic acid), and an aqueous solution of an alkaline agent (such as sodium

5 hydroxide, potassium hydroxide, triethanol amine, diethanol amine, monoethanol amine, and sodium carbonate). Normally, cleaning liquids are dispensed in sequences. Cleaning liquids and sequences of then in CIP methods are well-known to the skilled person. Examples of cleaning liquids and sequences of cleaning liquids can be found in WO 2006/032731, US

10 2008/0105280, US 2010/0236581, US 4,530,370, and US 2008/0276968.

In a preferred embodiment, the cleaning liquids dispensed in step d) are, at least partially, stored and recirculated.

15 It is preferred that the decision to clean one or more process unit(s) referred to in step b) is taken when there is no production process going on in said one or more process unit(s), and when no production process is scheduled to start within a predetermined amount of time. Preferably, said predetermined amount of time is within the range of 15 – 60 minutes.

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In a specific variant of the method of the first embodiment suitable for a plant wherein at least two of the process units of said production plant are assembled in parallel, thereby forming a unit module, it is preferred that one of said process units are cleaned in accordance with steps c) – e) while the

25 other of said process units is used in production.

Preferably, the cleaning liquids dispensed in sequence in step d) of the method of the first embodiment are selected from the group of water, hot water, an aqueous detergent solution, an aqueous acid solution such as a

30 solution of a mineral acid, such as phosphoric acid, nitric acid, sulphuric acid or an organic acid such as lactic acid, acetic acid, hydroxyacetic acid, citric acid, glutamic acid, glutaric acid, and gluconic acid, and an aqueous solution of an alkaline agent such as sodium hydroxide, potassium hydroxide,

triethanol amine, diethanol amine, monoethanol amine, and sodium carbonate.

- In a second embodiment, the present invention provides a unit module for processing a liquid food preparation, said unit module being adapted for carrying out a single processing step constituting a part of a complete process, said unit model being adapted for carrying out said specific variant of the first embodiment, wherein in that each unit module is comprised of at least two process units connected in parallel by valves, wherein each process unit is independently connected by valves to a cleaning liquid inlet and independently connected by valves to a cleaning liquid outlet, thereby rendering it possible to clean one processing unit and simultaneously carrying out said single processing step in at least one of the other process unit(s).
- It is preferred that each of said cleaning liquid inlet and cleaning liquid outlet are connected to each process unit by valves controlled by a control unit.

It is preferred that each of said cleaning liquid inlet and cleaning liquid outlet are adapted for being connected to a distribution network for distributing, recycling, and/or discarding cleaning liquids.

- In a third embodiment, the present invention provides a plant comprising a plurality of connected process units, said plant being suitable for processing a liquid food preparation by a defined process, said process involving a plurality of steps where each of these steps are carried out in a process unit, said process unit being connected to other parts of said plant by valves, wherein each process unit is adapted for being disconnected from other process units of said plant while being individually cleaned, and that there are means for dispensing cleaning liquids directly into each process unit during cleaning.
- Preferably, said plant contains a cleaning network comprising a plurality of loops in which cleaning liquids are circulated, each loop being associated with a particular cleaning liquid, and where valves are set up to distribute one

cleaning liquid at a time from a certain loop to a process unit about to be cleaned.

Preferably, said plant comprises a unit module according to the second
5 embodiment.

In a fourth embodiment, the invention provides a system for carrying out the method of the first embodiment, said system comprising:

- 10 a) means for entering information about which products that are going to be produced, the amounts of these products and optionally the scheduled time frame for production of said products;
- b) at least one means for monitoring flow of raw material and/or product through the production plant;
- c) at least one remotely controllable cleaning module set up to dispense a *per*
15 se known sequence of cleaning chemicals to a subset of process units adapted for being disconnected from the rest of said plant while being individually cleaned;
- d) a database set up to store information in real time about which products that are going to be produced, the amounts of these products and optionally
20 the scheduled time frame for production of said products;
- e) a database set up to store information in real time about which products that have been produced;
- f) a database containing pre-recorded information about the cleaning needs of the production plant as a function of change of production from one product to
25 another; and
- g) a calculating means,

said calculating means being set up to store information obtained from said means for entering information about which products that are going to be produced, the amounts of these products and optionally the scheduled time
30 frame for production of these products in said database set up to store information in real time about which products that are going to be produced, the amounts of these products and optionally the scheduled time frame for production of said products;

said calculating means being set up to receive information about the produced amount of a certain product in real time from said at least one means for monitoring flow of raw material and/or product, said calculating means being set up to use this information to update said database for storing
5 information in real time about which products that are going to be produced, and to update said database set up to store information in real time about which products that have been produced;

said calculating means being set up to determine when production should be changed from production of a first product to production of a
10 second product, and said calculating means being set up to determine the cleaning needs of the production plant using information in said database containing pre-recorded information about the cleaning needs of the production plant as a function of change of production from one product to another;

said calculating means being set up to submit said determined cleaning needs to said at least one remotely controllable cleaning module, said calculating means being set up to disconnect a subset of process units deemed necessary to clean by closing suitable valves and opening valves necessary for dispensing and removing cleaning liquids during cleaning, said
20 cleaning module being set up to dispense a *per se* known sequence of cleaning chemicals to said process units that are deemed necessary to clean, and

said calculating means being set up to connect said subset of process units when the cleaning process has been finalized by opening suitable
25 valves.

As disclosed herein, the term "calculating means" relates to a computer set up for controlling the production plant and the process run therein. Any computer adapted for controlling such a system may be used in accordance
30 with the present invention.

As disclosed herein, the term "means for entering information" relates to any kind of means for entering information to a computer system. Typically, such

a means could be a keyboard or a compressible screen, a mobile handheld unit for remote control or similar.

As disclosed in this context, the term “product” relates to a finished product
5 made from a liquid food preparation as previously defined. Examples of products in accordance with the present invention are milk and milk products such as cream, yoghurt and other fermented milk products, but also fruit juices such as orange juice, grape juice and apple juice, as well as vegetable oils such as olive oil, sunflower oil, and rape oil.

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As disclosed herein, the term “raw material” relates to the starting material for producing the finished product. Typically, a raw material in accordance with the present invention could be milk, fruit, or plant parts containing vegetable oil.

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As disclosed herein, the term “cleaning module” relates to a module comprising containers for cleaning liquids and a system for distributing defined sequences of cleaning liquids. Such modules are previously known and examples may be found in US 4,530,370, WO 2006/032731, and US
20 5,974,345.

Short description of the figures

The present invention will now be further disclosed by reference to the
25 enclosed figures, in which:

Figure 1 discloses a process unit in accordance with the present invention;

Figure 2 describes a unit module in accordance with the present invention;

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Figure 3 shows a part of a production plant comprising unit module and two additional process units in order to illustrate the principles of the cleaning method of the invention;

Figure 4 reveals a schedule of a system for carrying out the cleaning method of the invention; and

- 5 Figure 5 outlines a network for distributing a plurality of cleaning liquids to process modules of a production plant.

Detailed description of the invention

- 10 As already mentioned, the present invention provides a method for cleaning a production plant as well as a system for carrying out the cleaning method. A basic structural unit in a production plant that could be cleaned by a method according to the present application is referred to as a "process unit" and such a process unit 10 is shown in Figure 1. As already mentioned, the term
- 15 "process unit" comprises all kinds of different parts of which a production plant is constructed, which parts are in direct contact with liquid food preparation during the process. Hence, such a process unit 10 could be a tank for mixing or fermentation, a separator, a pump, a part of a packaging machine or even a pipe. The process unit 10 is separated from other process units 12, 14 of
- 20 the plant by at least one valve 16, 18. When at least one of the valve(s) 16, 18 is open, the process unit 10 is referred to as a connected process unit. In case at least one of such valves 16, 18 is closed and there is no liquid contact between the process unit 10 and other process units 12, 14 of the plant, the process unit 10 is referred to as a disconnected process unit.

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- The process unit 10 is cleaned by the cleaning method of the present invention when said unit 10 is disconnected. Valves 20, 22 are opened and a cleaning liquid or a sequence of cleaning liquids from a cleaning unit (not shown in Figure 1) are dispensed into the process unit 10 from cleaning liquid
- 30 inlet 24 and returned to the cleaning unit by cleaning liquid outlet 26. Valves 20, 22 are closed when cleaning has been finalized and the process unit is re-connected to adjacent connected process units. It is possible to clean adjacent disconnected process units together. In case process units 10 and

12 both are about to be cleaned, the liquid contact between these process units is maintained by keeping valve 16 open. The liquid contact between process units 10 and 12 and other process units adjacent to units 10 and 12 that are not to be cleaned is interrupted, typically by closing suitable valves.

- 5 The cleaning method is then run as indicated above.

Another basic structural unit in the production plant of the present application is referred to as a "unit module" and such a unit module 100 is disclosed in Figure 2. As mentioned above, a unit module 100 is comprised of at least two
10 process units 102, 104 connected in parallel by valves 114, 116, 118, 120, wherein each process unit 102, 104 is independently connected by valves 122, 130 to a cleaning liquid inlet 124, 134, and independently connected by valves 126, 132 to a cleaning liquid outlet 128, 136. In the embodiment shown in Figure 2, there is a branch part 110 of the pipe from adjacent process unit
15 106. Similarly, there is a branch part 112 of the pipe from adjacent process unit 108. However, valves 114 and 116 could be replaced with a single three-port valve and in that case there is no need for any branch point. Similarly, valves 118 and 120 and branch part 112 could be replaced by a single three-part valve. The process units 102 and 104 are cleaned in the same manner
20 as described above. Before cleaning process unit 102, said unit is disconnected, typically by closing valves 114 and 118. Subsequently, valves 122 and 126 are opened. A cleaning liquid or a sequence of cleaning liquids are then dispensed into process unit 102 through cleaning liquid inlet 124 and then lead away through cleaning liquid outlet 128. Similarly, before cleaning
25 process unit 104, said unit is disconnected, typically by closing valves 116 and 120. Subsequently, valves 130 and 132 are opened. A cleaning liquid or a sequence of cleaning liquids are then dispensed into process unit 104 through cleaning liquid inlet 134 and then lead away through cleaning liquid outlet 136.

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A main advantage of including a unit module, such as the one disclosed in Figure 2, in a production plant for processing a liquid food preparation is that the production of liquid food product may continue in one of the process units

in parallel in the same time as the other process unit is cleaned. Accordingly, a plant for processing a liquid food preparation comprising such a unit module is quite flexible. It is possible to change products quickly. It is also possible to extend production time as some parts of the plant are cleaned while other
5 parts are used in production.

A product plant for processing a liquid food preparation may be built up of process units and unit modules in any order. Figure 3 shows an example of a product plant comprising a process unit 200 followed by a unit module
10 202 and another process unit 204. However, there are many other ways of combining these basic structures. It is easy for a skilled person to conceive useful variants after studying the present description.

The cleaning method of the present application is carried out by a system
15 briefly outlined in Figure 4. The product plant 310 for processing a liquid food preparation is comprised of process unit 316 and unit module 322. The product plant 310 is cleaned cleaning liquids dispensed from cleaning network 312. More specifically, raw material enters the product plant 310 at raw material inlet 346, passes through valve 324 and enters process unit 316.
20 After treatment in process unit 316, the liquid food preparation is forwarded through valve 350 to unit module 322. The liquid food may then pass through process unit 318 and associated valves 334 and 339 and/or process unit 320 and associated valves 336 and 338. Subsequently, the liquid food preparation or product passes through valve 344 to a means 314 for monitoring flow of
25 product before the product exits the production plant at a product outlet 348.

The production plant 310 is controlled by a computer or calculating means 300. An operator may enter information about which products that are going to be produced by using a means 302 for entering information. The
30 calculating means 300 receives the information from said means 302 for entering information and stores this information in a database 304 set up to store information in real time. The entered and stored information relates to which products are going to be produced, the amounts of these products and

optionally the scheduled time frame for production of said products. The calculating means 300 continuously receives information from said means 314 for monitoring flow of product and is set up to update the information in said database 304 containing information about which products are going to be produced and also a further database 306 containing information about which products that have been produced. Typically, when said means 314 for measuring product flow has detected that a certain amount of product has been produced, said calculating means 300 subtracts this amount from the amount registered in said database 304 about how much of the product that is going to be produced. The amount subtracted from database 304 is added to database 306.

When production of a particular product has been finalized, the calculating means 300 is set up to adapt the production plant 310 to production of a new product taking information in database 308 into account. Database 308 contains pre-recorded information about the cleaning needs of the production plant 310 as a function of change of production from a specific first product to a specific second product. Such an adaptation may include cleaning of one or more process units 316, 318, 320. When calculating means 300 has identified the cleaning needs of process plant 310, the calculating means 300 disconnects the process units in need of cleaning, opens those valves 326, 328, 330, 332, 340, 342 distributing and returning cleaning liquid from the disconnected process unit(s) 316, 318, 320, and subsequently orders the cleaning module 312 to dispense a cleaning liquid or a sequence of cleaning liquids. When the cleaning liquid(s) have been dispensed, the calculating means 300 closes those valves 326, 328, 330, 332, 340, 342 distributing and returning cleaning liquid from the disconnected process unit(s) 316, 318, 320, and finally connects these disconnected process unit(s) 316, 318, 320.

As already mentioned, the cleaning module is set up to dispense a cleaning liquid or a sequence of cleaning liquids. Cleaning liquids and sequences of such liquids are well-known in the art of Cleaning-in-place. It is easy for the skilled person to select a suitable variant. Furthermore, the cleaning liquids

are typically recovered in order to reduce consumption of chemicals and environmental impact. The skilled person is aware of techniques, such as the one disclosed in WO 2006/032731 for monitoring quality of cleaning liquids in order to be able to dispense with cleaning liquids not fulfilling basic quality
5 criteria.

Figure 5 discloses a more detailed outline of the cleaning network 400 referred to as 312 in Figure 4. In the specific embodiment shown in Figure 4, two process units 410, 412 connected to the cleaning network are shown for
10 simplicity. Typically, most process units of a production plant, if not all process units, are connected to the cleaning network 400. In order to increase clarity and to focus on the cleaning function, the connections between these process units 410, 412 and other possible process units in the plant have therefore been omitted in Figure 5. Process unit 410 is separately connected
15 to the cleaning network 400 by incoming conduit 448, which conduit 448 dispenses incoming cleaning liquids into the process units 410. When the cleaning liquids have passed through process unit 410, they are lead out therefrom through conduit 450. Similarly process unit 412 is separately
20 connected to the cleaning network 400 by incoming conduit 452, which conduit 452 dispenses incoming cleaning liquids into the process units 412. When the cleaning liquids have passed through process unit 412, they are lead out therefrom through conduit 454.

Cleaning network 400 is set up to distribute a multitude of different cleaning
25 liquids. The network in Figure 5 includes four different storage tanks 402, 404, 406, 408, where each of them typically is intended for distributing a particular type of cleaning liquid. The skilled person realizes that the amount of storage tanks and cleaning liquids is adapted for the needs of a particular plant. Storage tank 402 is connected to a loop 403 comprising circulation pump 414,
30 outgoing conduit 422, turning point 430, and incoming conduit 438. The particular cleaning liquid in storage tank 402 and the associated loop 403 is then circulated. Typically, the loop 403 is extended to all parts of the plant in

order to enable general distribution of that cleaning liquid when there is a need for cleaning a particular process unit.

Storage tank 404 is connected to a loop 405 comprising circulation pump 416,
5 outgoing conduit 424, turning point 432, and incoming conduit 440. The particular cleaning liquid in storage tank 404 and the associated loop 405 is then circulated. Typically, the loop 405 is extended to all parts of the plant in order to enable general distribution of that cleaning liquid when there is a need for cleaning a particular process unit.

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Storage tank 406 is connected to a loop 407 comprising circulation pump 418,
outgoing conduit 426, turning point 434, and incoming conduit 442. The particular cleaning liquid in storage tank 406 and the associated loop 407 is then circulated. Typically, the loop 407 is extended to all parts of the plant in
15 order to enable general distribution of that cleaning liquid when there is a need for cleaning a particular process unit.

Storage tank 408 is intended for storing a non-recycled cleaning liquid, which typically could be cold drinking water. The cleaning liquid from storage tank
20 408 is forwarded to conduit 428 by pump 420.

Incoming conduit 448 transporting cleaning liquids to process unit 410 is connected to conduit 428 and loops 403, 405, 407 by valve arrangements 460, 468, 470, 472, and 474. Valve 460 is an ordinary valve set up to open or
25 close incoming conduit 448. Valve arrangement 474 is typically a three-way valve rendering it possible to close each way independent of each other. Each of the valve arrangements 468, 470, 472, are independently set up in such a way that the cleaning liquid in conduit 436, loop 405 or loop 407 are either guided into incoming conduit 448 in the direction towards process unit
30 410 or in such a way that the cleaning liquid stays in conduit 436, loop 405 or loop 407.

Outgoing conduit 450 transporting used cleaning liquids from process unit 410 is connected to loops 403, 405, 407 and waste water conduit 444 by valve arrangements 462, 476, 478, 480 and 482. The cleaning liquids are pumped through process unit 410 and outgoing conduit 450 by pump 456.

- 5 Valve arrangement 462 is an ordinary valve set up to open or close outgoing conduit 450. Valve arrangement 482 is typically a three-way valve rendering it possible to close each way independent of each other. Each of the valve arrangements 476, 478, 480, are independently set up in such a way that the specific cleaning liquid in each loop 403, 405, 407 is circulated in each loop
10 and outgoing cleaning liquid in outgoing conduit passes outside said loop, or alternatively specific outgoing cleaning liquid in conduit 450 is returned to the specific loop 403, 405, or 407 from which it originates. Furthermore, and in particular if the specific outgoing cleaning liquid fails to fulfill a certain quality requirement, this specific outgoing cleaning liquid will not be recycled but will
15 be transported to three-way valve 482 and subsequently to waste water conduit 444.

- Incoming conduit 452 transporting cleaning liquids to process unit 412 is connected to conduit 428 and loops 403, 405, 407 by valve arrangements
20 464, 484, 486, 488, and 490. Valve 464 is an ordinary valve set up to open or close incoming conduit 452. Valve arrangement 490 is typically a three-way valve rendering it possible to close each way independent of each other. Each of the valve arrangements 484, 486, 488, are independently set up in such a way that the cleaning liquid in conduit 436, loop 405 or loop 407 are
25 either guided into incoming conduit 452 in the direction towards process unit 412 or in such a way that the cleaning liquid stays in conduit 436, loop 405 or loop 407.

- Outgoing conduit 454 transporting used cleaning liquids from process unit
30 412 is connected to loops 403, 405, 407 and waste water conduit 444 by valve arrangements 466, 492, 494, 496 and 498. The cleaning liquids are pumped through process unit 412 and outgoing conduit 454 by pump 458. Valve arrangement 466 is an ordinary valve set up to open or close outgoing

conduit 454. Valve arrangement 498 is typically a three-way valve rendering it possible to close each way independent of each other. Each of the valve arrangements 492, 494, 496, are independently set up in such a way that the specific cleaning liquid in each loop 403, 405, 407 is circulated in each loop and outgoing cleaning liquid in outgoing conduit passes outside said loop, or alternatively specific outgoing cleaning liquid in conduit 454 is returned to the specific loop 403, 405, or 407 from which it originates. Furthermore, and in particular if the specific outgoing cleaning liquid fails to fulfill a certain quality requirement, this specific outgoing cleaning liquid will not be recycled but will be transported to three-way valve 498 and subsequently to waste water conduit 444.

Process unit 410 is cleaned by transporting different cleaning liquids through the unit. Typically, only one type of cleaning liquid is transported through process unit 410 at a time. In case process unit 410 is to be cleaned with the cleaning liquid of storage tank 402 and loop 403, valve 474 is changed so that the particular cleaning liquid enters incoming conduit 448. Valves 470 and 472 are set in such a way that circulation in loops 405 and 407 as well as liquid transport in conduit 428 are not interrupted and that cleaning liquid may pass through incoming conduit 448. Valves 460 and 462 are both opened in order to enable the cleaning liquid to pass through process unit 410. The cleaning liquid is then transported back in outgoing conduit 450. Valves 476 and 478 are set in such a way that circulation in loops 405 and 407 are not interrupted. Valve 480 is set in such a way that the cleaning liquid is returned to storage tank 402.

The valves are set in an analogous manner when cleaning liquid from any of loops 405 and 407 is going to be distributed to process unit 410.

Sometimes, and as already mentioned, it is desirable not to recycle the cleaning liquid. In this case, the cleaning liquid is transported through outgoing conduit 450 to valve 482. Valve 482 is opened and the cleaning liquid is forwarded to waste water conduit 444. Typically, this is the situation

when it has been concluded that the cleaning liquid is of inferior quality or if the cleaning liquid originates from a storage tank without any recirculation loop such as tank 408.

- 5 Similarly, process unit 412 is cleaned by transporting different cleaning liquids through the unit. Typically, only one type of cleaning liquid is transported through process unit 412 at a time. In case process unit 412 is to be cleaned with the cleaning liquid of storage tank 402 and loop 403, valve 490 is changed so that the particular cleaning liquid enters incoming conduit 452.
- 10 Valves 486 and 488 are set in such a way that circulation in loops 405 and 407 as well as liquid transport in conduit 428 are not interrupted and that cleaning liquid may pass through incoming conduit 452. Valves 464 and 466 are both opened in order to enable the cleaning liquid to pass through process unit 412. The cleaning liquid is then transported back in outgoing
- 15 conduit 454. Valves 492 and 494 are set in such a way that circulation in loops 405 and 407 are not interrupted. Valve 496 is set in such a way that the cleaning liquid is returned to storage tank 402.

The valves are set in an analogous manner when cleaning liquid from any of

20 loops 405 and 407 is going to be distributed to process unit 412.

Sometimes, and as already mentioned, it is desirable not to recycle the cleaning liquid. In this case, the cleaning liquid is transported through outgoing conduit 454 to valve 498. Valve 498 is opened and the cleaning

25 liquid is forwarded to waste water conduit 444. Typically, this is the situation when it has been concluded that the cleaning liquid is of inferior quality or if the cleaning liquid originates from a storage tank without any recirculation loop such as tank 408.

30 The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

CLAIMS

1. A method for cleaning defined parts of a production plant (310) comprising
5 a plurality of connected process units (10, 102, 104, 316, 318, 320), said
production plant (310) being suitable for processing a liquid food preparation
by a defined process, said process involving a plurality of steps where each of
these steps are carried out in different process units (10, 102, 104, 316, 318,
320), said such process unit (10, 102, 104, 316, 318, 320) being connected to
10 other parts of said plant 310 by valves (16, 18, 114, 116, 118, 120, 324, 350,
334, 336, 338, 339), said method comprising the steps of
a) providing a production plant (310) comprising a plurality of connected
process units (10, 102, 104, 316, 318, 320);
b) based upon production considerations, taking a decision identifying a
15 subset of process unit(s) (10, 102, 104, 316, 318, 320) that should be
cleaned;
c) disconnecting the process unit(s) (10, 102, 104, 316, 318, 320) of the
subset identified in step b), by closing one or more valves (16, 18, 114, 116,
118, 120, 324, 350, 334, 336, 338, 339), in such a way that liquids in the
20 disconnected process unit cannot be transferred from the disconnected
process units to the remaining process unit(s) that are not to be cleaned;
d) dispensing a sequence of cleaning liquids according to a *per se* known
scheme directly and only to the subset of the process unit(s) identified in step
b), thereby cleaning the subset of the process units identified in step b); and
25 e) connecting the subset of the process units identified in step b), by opening
the valve(s) that were closed in step c).
2. A method according to claim 1, characterized in that the cleaning liquids
dispensed in step d) are, at least partially, stored and recirculated.
- 30 3. A method according to claim 1 or claim 2, characterized in that the decision
to clean a subset of one or more process unit(s) (10, 102, 104, 316, 318, 320)
referred to in step b) is taken when there is no production process going on in

said subset of one or more process unit(s), and when no production process is scheduled to start within a predetermined amount of time.

4. A method according to claim 3, characterized in that said predetermined
5 amount of time is within the range of 15 – 60 minutes.
5. A method according any of claims 1 or 2, suitable for a plant (310) wherein
at least two of the process units (10, 102, 104, 316, 318, 320) of said
production plant (310) are assembled in parallel, thereby forming a unit
10 module (100), characterized in that one of said process units are cleaned in
accordance with steps c) – e) while the other of said process units is used in
production.
6. A method according to any of claims 1 – 5, characterized in that the
15 cleaning liquids dispensed in sequence in step d) are selected from the group
of water, hot water, an aqueous detergent solution, an aqueous acid solution
such as a solution of a mineral acid, such as phosphoric acid, nitric acid,
sulphuric acid, or an organic acid such as lactic acid, acetic acid,
hydroxyacetic acid, citric acid, glutamic acid, glutaric acid, and gluconic acid,
20 and an aqueous solution of an alkaline agent, such as sodium hydroxide,
potassium hydroxide, triethanol amine, diethanol amine, monoethanol amine,
and sodium carbonate.
7. A unit module (100) for processing a liquid food preparation, said unit
25 module being adapted for carrying out a single processing step constituting a
part of a complete process, said unit model being adapted for carrying out the
method of claim 5, characterized in that each unit module (100) is comprised
of at least two process units (102, 104) connected in parallel by valves (114,
116, 118, 120), wherein each process unit (102, 104) is independently
30 connected by valves (122, 130) to a cleaning liquid inlet (124, 134) and
independently connected by valves (126, 132) to a cleaning liquid outlet (128,
136), thereby rendering it possible to clean one processing unit and

simultaneously carrying out said single processing step in at least one of the other process unit(s).

8. A unit module (100) according to claim 7, characterized in that each of said
5 cleaning liquid inlet (124, 134) and cleaning liquid outlet (128, 136) are connected to each process unit (102, 104) by valves (122, 126, 130, 132) controlled by a control unit (300).

9. A unit module (100) according to claim 7 or claim 8, characterized in that
10 each of said cleaning liquid inlet (124, 134) and cleaning liquid outlet (128, 136) are adapted for being connected to a cleaning network (312, 400) for distributing, recycling, and/or discarding cleaning liquids.

10. A plant (310) comprising a plurality of connected process units (316, 318,
15 320), said plant (310) being suitable for processing a liquid food preparation by a defined process, said process involving a plurality of steps where each of these steps are carried out in a process unit (316, 318, 320), said process unit being connected to other parts of said plant by valves (324, 350, 334, 336, 338, 339, 344), characterized in that each process unit (316, 318, 320) is
20 adapted for being disconnected to other process units of said plant while being individually cleaned and that there are means for dispensing cleaning liquids directly to each process unit (316, 318, 320) during cleaning.

11. A plant according to claim 10, characterized in that it contains a cleaning
25 network (312, 400) comprising a plurality of loops (403, 405, 407) in which cleaning liquids are circulated, each loop being associated with a particular cleaning liquid, and where valves (468, 470, 472, 474, 476, 478, 480, 484, 486, 488, 490, 492, 494, 496) are set up to distribute one cleaning liquid at a time from a certain loop (403, 405, 407) to a process unit (410, 412) about to
30 be cleaned.

12. A plant (310) according to claim 10 or claim 11, characterized in that said plant comprises a unit module (100) according to any of claims 7 – 9.

13. A system for carrying out the method of any of claims 1 – 6, said system comprising:

- a) means (302) for entering information about which products that are going to be produced, the amounts of these products and optionally the scheduled time frame for production of said products;
- b) at least one means (314) for monitoring flow of raw material and/or product through the production plant (310);
- c) at least one remotely controllable cleaning network (312, 400) set up to dispense a *per se* known sequence of cleaning chemicals to a subset of process units (316, 318, 320) adapted for being disconnected from the rest of said plant while being individually cleaned;
- d) a database (304) set up to store information in real time about which products that are going to be produced, the amounts of these products and optionally the scheduled time frame for production of said products;
- e) a database (306) set up to store information in real time about which products that have been produced;
- f) a database (308) containing pre-recorded information about the cleaning needs of the production plant as a function of change of production from one product to another; and
- g) a calculating means (300),

said calculating means (300) being set up to store information obtained from said means (302) for entering information about which products that are going to be produced, the amounts of these products and optionally the scheduled time frame for production of these products in said database (304) set up to store information in real time about which products that are going to be produced, the amounts of these products and optionally the scheduled time frame for production of said products;

said calculating means (300) being set up to receive information about the produced amount of a certain product in real time from said at least one means (314) for monitoring flow of raw material and/or product, said calculating means (300) being set up to use this information to update said database (304) for storing information in real time about which products that

are going to be produced, and to update said database (306) set up to store information in real time about which products that have been produced;

5 said calculating means (300) being set up to determine when production should be changed from production of a first product to production of a second product, and said calculating means (300) being set up to determine the cleaning needs of the production plant (310) using information is said database (308) containing pre-recorded information about the cleaning needs of the production plant (310) as a function of change of production from one product to another;

10 said calculating means (300) being set up to submit said determined cleaning needs to said at least one remotely controllable cleaning network (312, 400), said calculating means being set up to disconnect a subset of process units (316, 318, 320) deemed necessary to clean by closing suitable valves (324, 350, 334, 336, 338, 339, 344) and opening valves (326, 328, 15 330, 332, 340, 342) necessary for dispensing and removing cleaning liquids during cleaning, said cleaning network (312, 400) being set up to dispense a *per se* known sequence of cleaning chemicals to said process units (316, 318, 320) that are deemed necessary to clean, and

20 said calculating means (300) being set up to connect said subset of process units (316, 318, 320) when the cleaning process has been finalized by opening suitable valves (324, 350, 334, 336, 338, 339, 344).

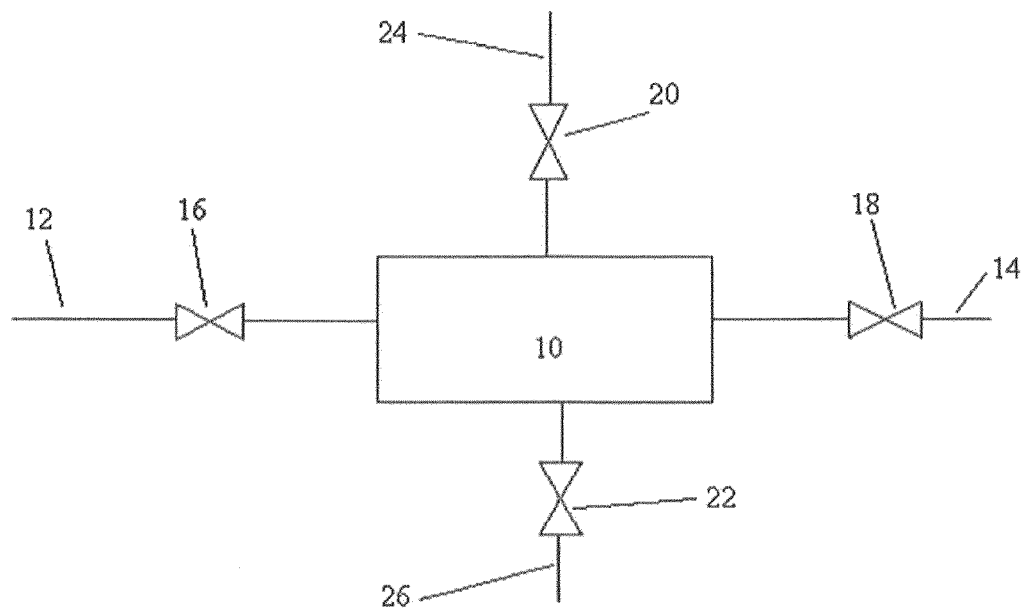
1/3

Fig. 1

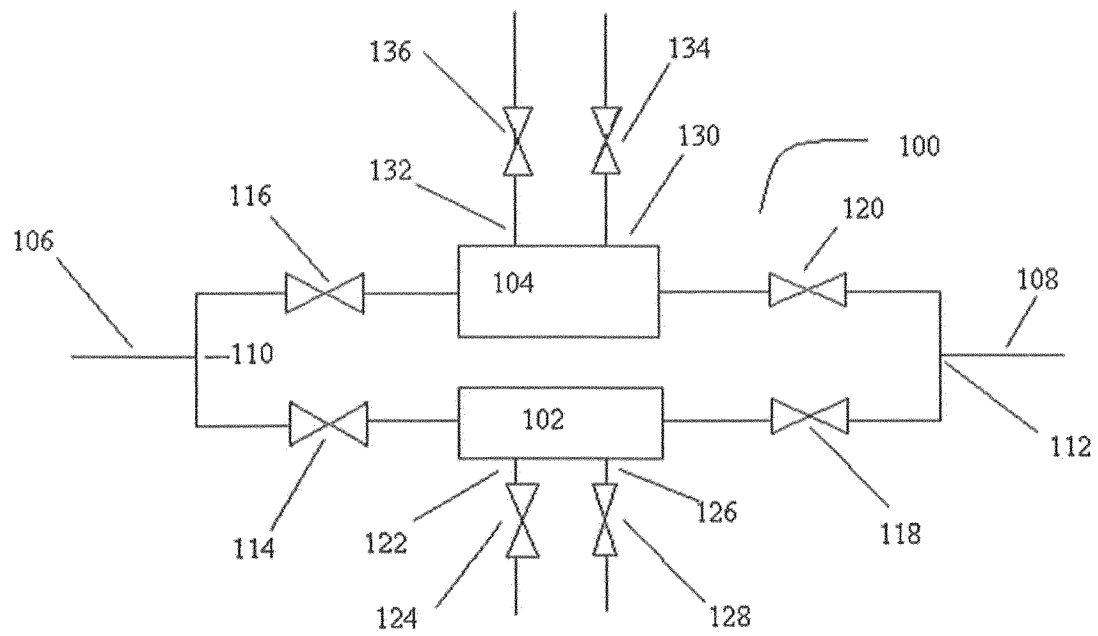


Fig. 2

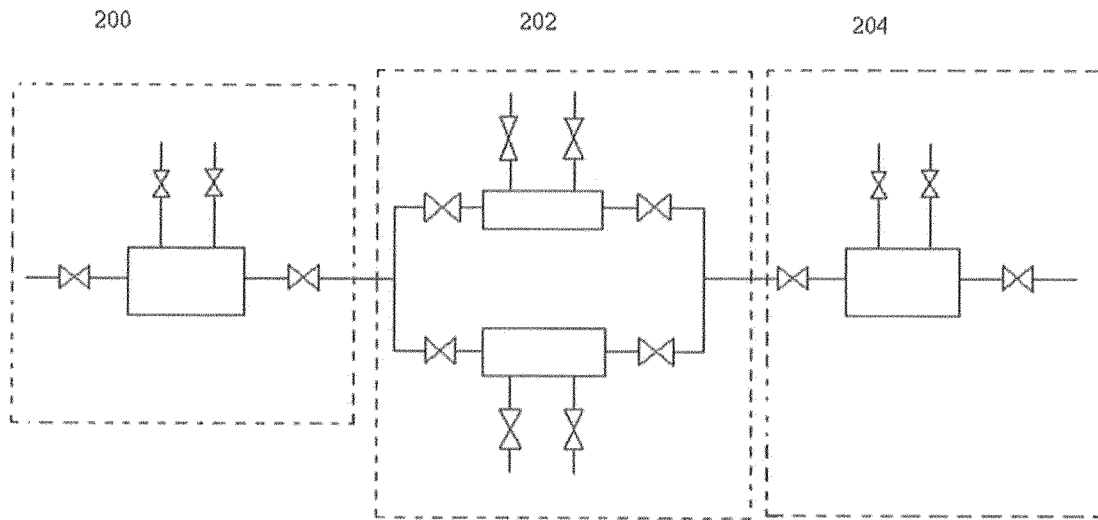


Fig. 3

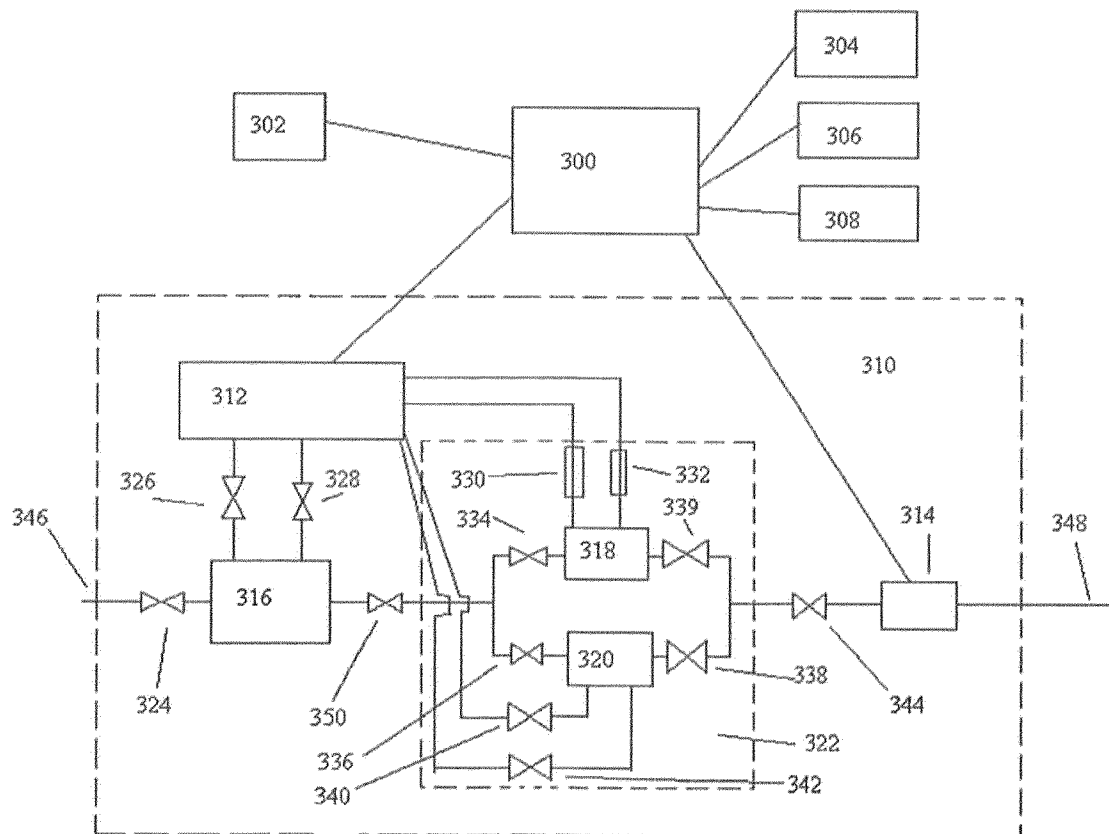


Fig. 4

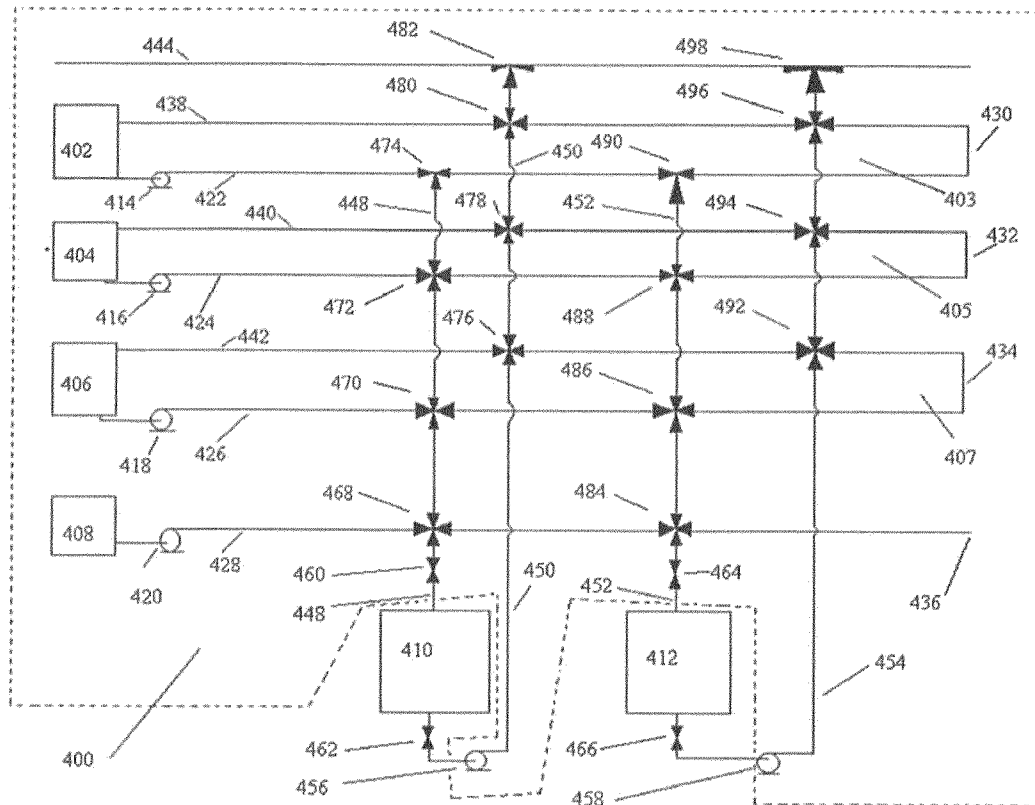


Figure 5.