

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
14 February 2008 (14.02.2008)

PCT

(10) International Publication Number
WO 2008/018669 A1

(51) International Patent Classification:
A61C 19/00 (2006.01)

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(21) International Application Number:
PCT/KR2007/000503

(22) International Filing Date: 29 January 2007 (29.01.2007)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
20-2006-0021146 7 August 2006 (07.08.2006) KR
20-2006-0022539 23 August 2006 (23.08.2006) KR

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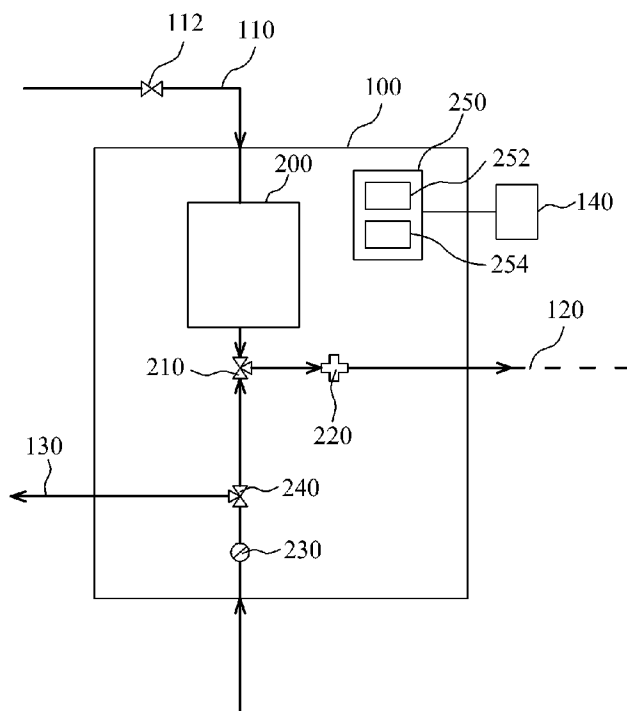
(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS,
JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT,
LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ,
NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU,
SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR,
TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI,
FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT,
RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA,
GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

(54) Title: A DENTAL CLEAN WATER PROCESS SYSTEM



(57) Abstract: The present invention relates to a dental water processing system which senses the pressure or the flow rate of dental water in a pipe at regular intervals, and, when the sensing result corresponds to the operating condition inputted by a user or a manufacturer, automatically circulates the dental water in the pipe, thereby preventing a biofilm, etc. from forming on the inner surface of the pipe, or which necessarily circulates or purges dental water in a pipe for a predetermined period at a predetermined time, thereby preventing a biofilm, etc. from forming on the inner surface of the pipe.

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Description

A DENTAL CLEAN WATER PROCESS SYSTEM

Technical Field

- [1] The present invention relates to a dental water processing system, and more particularly, to a dental water processing system which senses the pressure or the flow rate of dental water in a pipe at regular intervals, and, when the sensing result corresponds to an operating condition inputted by a user or a manufacturer, automatically circulates the dental water in the pipe or circulates or purges the dental water in the pipe for a predetermined period at a predetermined time, thereby preventing a biofilm, etc. from forming on the inner surface of the pipe.

Background Art

- [2] As is generally known in the art, the water supplied to a medical appliance for dental surgery (specifically, a unit chair) is used to cool the heat generated in dental implements such as dental handpieces, remove particulates and foreign matter which are produced when grinding the teeth, etc., and to gargle the oral cavity. The water supplied to the medical appliance for dental surgery must be hygienic and sterilized since the water comes into direct contact with a portion of a tooth which is damaged or is undergoing treatment.
- [3] Accordingly, in the conventional art, as the water supplied to the medical appliance for dental surgery, instead of municipal water, cleaned dental water, obtained by removing the impurities contained in municipal water, has been used.
- [4] However, in the case where medical appliances for dental surgery are not used, such as at lunch time, during which dental practice is temporarily interrupted, after closing time, or on days when a dental office is closed, such as weekends, the dental water stagnates in a pipe, and as a result, a biofilm is likely to form on the inner surface of the pipe.
- [5] Because the biofilm is formed of organic or inorganic substance, harmful microbes such as bacteria or pathogens can be produced in a region where the biofilm is present.
- [6] Due to this fact, secondary infections can occur in a patient.

Disclosure of Invention

Technical Problem

- [7] Accordingly, the present invention has been made in an effort to solve the problems occurring in the related art, and an object of the present invention is to provide a dental water processing system which senses the pressure or the flow rate of dental water in a pipe at regular intervals, and, when the sensing result corresponds to the operating condition inputted by a user or a manufacturer, automatically circulates the dental

water in the pipe, thereby preventing a biofilm, etc. from forming on the inner surface of the pipe.

- [8] Another object of the present invention is to provide a dental water processing system which necessarily circulates or purges dental water in a pipe for a pre-determined period at a predetermined time even when a medical appliance for dental surgery is not used, thereby preventing a biofilm, etc. from forming on the inner surface of the pipe.

Technical Solution

- [9] In order to achieve the above objects, according to one aspect of the present invention, there is provided a dental water processing system for conveying dental water to a unit chair for dental surgery, comprising a circulation pipe connected to a water purifier to supply dental water to the unit chair for dental surgery; a first valve placed between the water purifier and the circulation pipe; a second valve installed at a predefined position on the circulation pipe; a circulation pump installed at a pre-determined position on the circulation pipe; a pressure sensor and/or a flow sensor installed at a preset position on the circulation pipe; and a control section for controlling the first valve, the second valve, the circulation pump, and the pressure sensor and/or the flow sensor, wherein the control section controls the first valve, the second valve and the circulation pump in response to a pressure and/or a flow rate sensed by the pressure sensor and/or the flow sensor so as to open and close the circulation structure of the circulation pipe to thereby circulate dental water.
- [10] According to another aspect of the present invention, the dental water processing system further comprises a third valve, placed between the first valve and the second valve; and a fourth valve, installed at a predetermined position on an introduction pipe for supplying tap water to the water purifier, wherein the third valve and the fourth valve are controlled by the control section.
- [11] According to another aspect of the present invention, the first valve is placed adjacent to an outlet port of the water purifier and has flow paths that ensure that, when the first valve is opened, dental water exiting from the water purifier is directed into the circulation pipe, and, when the first valve is closed, dental water circulated through the circulation pipe is redirected into the circulation pipe.
- [12] According to another aspect of the present invention, the second valve has flow paths that ensure that, when the second valve is opened, dental water circulated through the circulation pipe is directed into a discharge pipe, and, when the second valve is closed, dental water circulated through the circulation pipe is directed into the first valve.
- [13] According to another aspect of the present invention, the third valve has flow paths

that ensure that, when the third valve is opened, dental water flowing therein from the second valve is directed into the first valve, and, when the third valve is closed, the dental water flowing therein from the second valve is directed into the fourth valve.

- [14] According to another aspect of the present invention, the fourth valve has flow paths that ensure that, when the fourth valve is opened, tap water introduced through the introduction pipe is directed into the water purifier, and, when the fourth valve is closed, dental water flowing therein from the third valve is directed into the water purifier.
- [15] According to another aspect of the present invention, the dental water processing system further comprises a discharge pipe connected to the second valve.
- [16] According to another aspect of the present invention, the dental water processing system further comprises at least one branch pipe branched from the circulation pipe and connected to the unit chair, wherein a shutoff valve is installed at a predetermined position on the branch pipe.
- [17] According to another aspect of the present invention, the control section comprises a data processing part, for comparing data acquired from the pressure sensor and/or the flow sensor with an operating condition, and an apparatus control part for controlling the operation of the water purifier, the circulation pump, the first valve and the second valve in response to a signal from the data processing part.
- [18] According to another aspect of the present invention, the control section comprises a data processing part for comparing data acquired from the pressure sensor and/or the flow sensor with an operating condition; and an apparatus control part for controlling the operation of the water purifier, the circulation pump, the first valve, the second valve, the third valve and the fourth valve in response to a signal from the data processing part.
- [19] According to another aspect of the present invention, the dental water processing system further comprises an input section connected to the control section so that a user can input a pressure value and/or a flow rate value as the operating condition.
- [20] In order to achieve the above objects, according to another aspect of the present invention, there is provided a dental water processing system for conveying dental water to a unit chair for dental surgery, comprising a circulation pipe connected to a water purifier and the unit chair for dental surgery, and an air pipe connected to the circulation pipe, wherein dental water is circulated by opening and closing the circulation pipe, or dental water in the circulation pipe is purged by introducing compressed air from the air pipe into the circulation pipe.
- [21] In order to achieve the above objects, according to another aspect of the present invention, there is provided a dental water processing system for conveying dental water to a unit chair for dental surgery, comprising a circulation pipe connected to a

water purifier to supply dental water to the unit chair for dental surgery; a fifth valve placed between the water purifier and the circulation pipe; an air pipe connected to the fifth valve; a sixth valve placed at the region where the water purifier and the circulation pipe are connected to each other; a seventh valve placed at a predefined position on the circulation pipe; a discharge pipe connected to the seventh valve; a circulation pump installed at a predetermined position on the circulation pipe; and a control section for controlling the fifth valve, the sixth valve, the seventh valve, and the circulation pump.

- [22] According to another aspect of the present invention, the dental water processing system further comprises an eighth valve placed between the sixth valve and the seventh valve; and a ninth valve placed between an introduction pipe, for supplying tap water to the water purifier, and the water purifier, wherein the eighth valve and the ninth valve are controlled by the control section.
- [23] According to another aspect of the present invention, the fifth valve has flow paths that ensure that, when the fifth valve is opened, dental water exiting from the water purifier is directed into the sixth valve, and, when the fifth valve is closed, compressed air supplied through the air pipe is directed into the sixth valve.
- [24] According to another aspect of the present invention, the sixth valve has flow paths that ensure that, when the sixth valve is opened, dental water exiting from the water purifier or compressed air flowing therein through the air pipe is directed into the circulation pipe, and, when the sixth valve is closed, dental water circulated through the circulation pipe is redirected into the circulation pipe.
- [25] According to another aspect of the present invention, the seventh valve has flow paths that ensure that, when the seventh valve is opened, dental water circulated through the circulation pipe is directed into the discharge pipe, and, when the seventh valve is closed, dental water circulated through the circulation pipe is directed into the sixth valve.
- [26] According to another aspect of the present invention, the eighth valve has flow paths that ensure that, when the eighth valve is opened, dental water flowing therein from the seventh valve is directed into the sixth valve, and, when the eighth valve is closed, dental water flowing therein from the seventh valve is directed into the ninth valve.
- [27] According to another aspect of the present invention, the ninth valve has flow paths that ensure that, when the ninth valve is opened, tap water flowing therein through the introduction pipe is directed into the water purifier, and, when the ninth valve is closed, dental water flowing therein from the eighth valve is directed into the water purifier.
- [28] According to another aspect of the present invention, the dental water processing

system further comprises at least one branch pipe, which branches from the circulation pipe and is connected to the unit chair, wherein a shutoff valve is installed at a pre-determined position on the branch pipe.

[29] According to another aspect of the present invention, the control section comprises a timer for comparing an already inputted time and a current time; and an apparatus control part for controlling the water purifier, the fifth valve, the sixth valve, the seventh valve, and the circulation pump in response to a signal from the timer.

[30] According to still another aspect of the present invention, the control section comprises a timer for comparing an already inputted time and a current time; and an apparatus control part for controlling the water purifier, the fifth valve, the sixth valve, the seventh valve, the eighth valve, the ninth valve, and the circulation pump in response to a signal from the timer.

[31] According to a still further aspect of the present invention, the dental water processing system further comprises an input section connected to the control section so that a user can input a time and a period.

Advantageous Effects

[32] Thanks to the features of the dental water processing system according to the present invention, the pressure or the flow rate of dental water in a circulation pipe is sensed at regular intervals, and, when the sensing result corresponds to the operating condition inputted by a user or a manufacturer, the dental water in the circulation pipe is automatically circulated, whereby it is possible to prevent a biofilm, etc. from forming on the inner surface of the circulation pipe.

[33] Further, in the dental water processing system according to the present invention, even when a medical appliance for dental surgery is not used and dental water stagnates in the circulation pipe, the dental water in the circulation pipe is forcibly circulated to prevent the dental water from stagnating in the circulation pipe, or is purged to prevent a biofilm from forming on the inner surface of the circulation pipe.

[34] Therefore, according to the dental water processing system of the present invention, it is possible to convey clean dental water to a medical appliance for dental surgery.

Brief Description of the Drawings

[35] FIG. 1 is a diagram schematically illustrating the construction of a dental water processing system in accordance with an embodiment of the present invention;

[36] FIG. 2 is diagrams schematically illustrating embodiments of a dental water processing apparatus which is employed in the dental water processing system shown in FIG. 1, wherein FIG. 2a illustrates a first embodiment and FIG. 2b illustrates a second embodiment;

[37] FIG. 3 is a diagram schematically illustrating the construction of a dental water

processing system in accordance with another embodiment of the present invention;
and

[38] FIG. 4 is diagrams schematically illustrating embodiments of a dental water processing apparatus which is employed in the dental water processing system shown in FIG. 3, wherein FIG. 4a illustrates a third embodiment and FIG. 4b illustrates a fourth embodiment.

[39] <Description of Reference Numerals for Main Parts of Drawings>

[40] 100: dental water processing apparatus

[41] 110: introduction pipe

[42] 120: circulation pipe 130: discharge pipe

[43] 200: water purifier 210: first valve

[44] 220: circulation pump

[45] 230: pressure sensor and/or flow sensor

[46] 240: second valve 250: control section

[47] 260: third valve 270: fourth valve

Best Mode for Carrying Out the Invention

[48] Reference will now be made in greater detail to a preferred embodiment of the invention, an example of which is illustrated in the accompanying drawings. Wherever possible, the same reference numerals will be used throughout the drawings and the description to refer to the same or like parts.

[49] FIG. 1 is a diagram schematically illustrating the construction of a dental water processing system in accordance with an embodiment of the present invention.

[50] Referring to FIG. 1, a dental water processing system includes a dental water processing apparatus 100 having a water purifier and a circulation pipe 120 connected to the dental water processing apparatus 100.

[51] An introduction pipe 110 having a water supply valve 112 for controlling the supply of tap water (that is, municipal water) is connected to the dental water processing apparatus 100. Tap water can be supplied into the dental water processing apparatus 100 through the introduction pipe 110.

[52] The circulation pipe 120 is connected to the dental water processing apparatus 100 such that some of the dental water purified by the water purifier provided in the dental water processing apparatus 100 can be conveyed to a medical appliance for dental surgery such as a unit chair and the remainder of the dental water can be returned to the dental water processing apparatus 100.

[53] At this time, the dental water may be conveyed to a plurality of medical appliances for dental surgery.

[54] A branch pipe 122 is branched from a predetermined portion of the circulation pipe

120 by a T-joint, and is connected to the unit chair (not shown). A shutoff valve 124 is installed at a predetermined position on the branch pipe 122 and is capable of interrupting the supply of the dental water to the unit chair.

[55] The dental water processing apparatus 100 has a discharge pipe 130 for discharging contaminant-containing water produced in the dental water processing apparatus 100.

[56] FIG. 2 is diagrams schematically illustrating embodiments of the dental water processing apparatus 100 which is employed in the dental water processing system shown in FIG. 1, wherein FIG. 2a illustrates a first embodiment and FIG. 2b illustrates a second embodiment.

[57] Referring to FIG. 2a, the first embodiment of the dental water processing apparatus 100 according to the present invention includes a water purifier 200 for purifying the tap water introduced therein through the introduction pipe 110.

[58] The water purifier 200 can be composed of a plurality of filters, a motor pump, a purified water tank, and so forth. A conventional water purifier can be used as the water purifier 200.

[59] The water purifier 200 purifies the tap water introduced therein through the introduction pipe 110. Then, the purified dental water exits from the water purifier 200 through the outlet port of the water purifier 200.

[60] At this time, the water purifier 200 functions to remove impurities (for example, rust, bacteria, microbes, etc.) contained in the tap water.

[61] A first valve 210 is disposed adjacent to the outlet port of the water purifier 200.

[62] The first valve 210 is a 3-way valve. The first valve 210 has flow paths that ensure that, when the first valve 210 is opened, the dental water exiting from the water purifier 200 is directed into the circulation pipe 120, and, when the first valve 210 is closed, the dental water exiting from the water purifier 200 is shut off and the dental water flowing into the first valve 210 from a second valve 240 in a dental water circulation procedure, which will be described later in detail, is redirected into the circulation pipe 120.

[63] A circulation pump 220 can be installed at a predetermined position on the circulation pipe 120, into which the dental water flows with the first valve 210 opened.

[64] In general, a motor pump (not shown) is arranged in the water purifier 200 in order to increase the supply pressure of purified dental water so that the water pressure in the circulation pipe 120 can be maintained constant by virtue of the power of the motor pump. However, since it is necessary to ensure that, in the dental water circulation procedure, which will be described later in detail, the dental water can be circulated through the circulation pipe 120 even when the water purifier 200 is not actuated, the circulation pump 220 is needed. Also, when appropriate water pressure cannot be maintained in the circulation pipe 120 using only the motor pump in the water purifier

200, since the length of the circulation pipe 120 is considerable, the circulation pump 220 can also be operated.

[65] As described above with reference to FIG. 1, some of the dental water directed into the circulation pipe 120 through the first valve 210 is conveyed to the medical appliances for dental surgery, which are connected to the circulation pipe 120, and the remainder of the dental water is circulated and then redirected into the circulation pipe 120.

[66] A pressure sensor and/or a flow sensor 230 for sensing the pressure and/or the flow rate of the dental water can be installed at a preset position on the circulation pipe 120. While FIG. 2a illustrates that the pressure sensor and/or the flow sensor 230 is installed on the circulation pipe 120 in the dental water processing apparatus 100, the pressure sensor and/or the flow sensor 230 can be installed at different positions on the circulation pipe 120.

[67] The pressure sensor and/or the flow sensor 230 can repeatedly sense at regular intervals the pressure and/or the flow rate of the dental water in the circulation pipe 120, and repeatedly transmit sensed data to the data processing part 252 of a control section 250. The interval can be optionally set by a user or a manufacturer.

[68] A second valve 240 is installed on the circulation pipe 120 in the dental water processing apparatus 100 so that the dental water can be redirected into the circulation pipe 120 after being circulated through the circulation pipe 120.

[69] The second valve 240 comprises a 3-way valve. The second valve 240 has flow paths which ensure that, when the second valve 240 is opened, the dental water flowing into the second valve 240 from the circulation pipe 120 is directed into the discharge pipe 130, and, when the second valve 240 is closed, the dental water is prevented from being directed into the discharge pipe 130, and instead is directed toward the first valve 210.

[70] The dental water processing apparatus 100 can be provided with the control section 250. The control section 250 controls the water purifier 200, the first valve 210, the second valve 240 and the circulation pump 220, and receives the data sensed by the pressure sensor and/or the flow sensor 230.

[71] An input section 140 can be connected to the control section 250 so that a user or a manufacturer can input data required for controlling the dental water processing system. The input section 140 can be attached outside the dental water processing apparatus 100 and can be provided as a separate device. Also, it can be envisaged that the input section 140 is not separately provided, but is connected to a central control unit such as a computer or the like.

[72] The control section 250 can be composed of the data processing part 252 and an apparatus control part 254. The data processing part 252 functions to store the data

(operating conditions for the circulation of dental water), inputted from the input section 140, process the inputted data and the data sensed by the pressure sensor and/or the flow sensor 230, and transmit a circulation start signal or a circulation end signal to the apparatus control part 254. The apparatus control part 254 functions to control the operations of the water purifier 200, the first valve 210, the second valve 240 and the circulation pump 220 in response to the circulation start signal or the circulation end signal from the data processing part 252.

[73] The data processing part 252 transmits the circulation start signal when the pressure in the circulation pipe 120, which is transmitted from the pressure sensor 230, is higher than the pressure which is inputted from the input section 140, and transmits the circulation end signal when the pressure in the circulation pipe 120, which is transmitted from the pressure sensor 230, is lower than the pressure which is inputted from the input section 140.

[74] Further, the data processing part 252 transmits the circulation start signal when the flow rate in the circulation pipe 120, which is transmitted from the flow sensor 230, is less than the flow rate that is inputted from the input section 140 and transmits the circulation end signal when the flow rate in the circulation pipe 120, which is transmitted from the flow sensor 230, is greater than the flow rate that is inputted from the input section 140.

[75] The case in which the sensed pressure is higher than the inputted pressure and the sensed flow rate is less than the inputted flow rate corresponds to when only a small number of medical appliances for dental surgery, which are connected to the circulation pipe 120, are operated and the dental water in the circulation pipe 120 is not substantially used. In this case, since the dental water in the circulation pipe 120 is not substantially used, a phenomenon occurs in which the dental water stagnates. As a consequence, the probability of a biofilm being created on the inner surface of the circulation pipe 120 increases.

[76] Therefore, in the dental water processing apparatus 100 according to the first embodiment shown in FIG. 2a, the tap water introduced through the introduction pipe 110 is purified using the water purifier 200, the purified dental water is directed into the circulation pipe 120 with the first valve 210 opened, and the dental water directed into the circulation pipe 120 is conveyed to the medical appliances for dental surgery, which are connected to the circulation pipe 120.

[77] The remaining dental water, which is left after being conveyed to the medical appliances for dental surgery, enters the dental water processing apparatus 100 through the circulation pipe 120 and is discharged through the discharge pipe 130 with the second valve 240 in an open state.

[78] If the dental water stagnates in the circulation pipe 120 for an extended period, as

mentioned above in the background part, a biofilm is likely to be created on the inner surface of the circulation pipe 120, and harmful bacteria or pathogens can be produced in the circulation pipe 120 due to the presence of the biofilm. These harmful bacteria or pathogens can be transferred to a patient through the medical appliances for dental surgery, which are connected to the circulation pipe 120, and can cause secondary infections in the patient.

[79] The dental water processing apparatus 100 according to the first embodiment of the present invention shown in FIG. 2a is constructed in a manner such that, when a large number of medical appliances for dental surgery, which are connected to the circulation pipe 120, are not operated and the dental water stagnates in the circulation pipe 120, circulation operation can be implemented to intentionally circulate the dental water in the circulation pipe 120.

[80] In the circulation operation in the dental water processing system, a user or a manufacturer first inputs, through the input section 140, operating conditions for allowing the dental water processing system to implement the circulation operation.

[81] At this time, the operating conditions can be a pressure and/or a flow rate of dental water.

[82] The operating conditions are stored in the data processing part 252 of the control section 250.

[83] The data processing part 252 repeatedly compares the inputted operating conditions with the data sensed from the pressure sensor and/or the flow sensor. At this time, as a result of the comparison between the operating conditions and the sensed data, if the sensed data satisfies the operating conditions (that is to say, if the sensed pressure is higher than the inputted pressure or the sensed flow rate is less than the inputted flow rate), the data processing part 252 transmits the operation start signal to the apparatus control part 254. Conversely, as a result of the comparison between the operating conditions and the sensed data, if the sensed data is found not to satisfy the operating conditions, the data processing part 252 transmits the operation end signal to the apparatus control part 254.

[84] Upon receipt of the operation start signal, the apparatus control part 254 interrupts the operation of the water purifier 200, converts the first valve 210 and the second valve 240 from the opened state to the closed state, and actuates the circulation pump 220.

[85] Accordingly, the first valve 210 shuts off the dental water exiting from the water purifier 200 and redirects the dental water circulated through the second valve 240 into the circulation pipe 120. The second valve 240 directs the dental water entering the dental water processing apparatus 100 through the circulation pipe 120, not into the discharge pipe 130 but toward the first valve 210. As the circulation pump 220 is

actuated, the dental water in the circulation pipe 120 is continuously circulated to prevent a biofilm from being created due to stagnation of the dental water.

[86] Conversely, upon receipt of the operation end signal, the apparatus control part 254 interrupts the circulation operation of the dental water processing system and thereby returns the dental water processing system to a normal state. To this end, the apparatus control part 254 interrupts the operation of the circulation pump 220 and converts the first and second valves 210 and 240 from the closed state to the opened state.

[87] At this time, the data processing part 252 of the control section 250 continuously compares the operating conditions inputted from the input section 140 with the data sensed by the pressure sensor and/or the flow sensor 230. As a result of this comparison, if the operating conditions are found to be satisfied, the data processing part 252 transmits the operation start signal to the apparatus control part 254 to restart the circulation operation.

[88] Thus, once the circulation operation is completed, in the dental water processing system, the inside of the circulation pipe 120 can be kept in a clean state, and therefore, it is possible to continuously convey clean dental water to the medical appliances for dental surgery.

[89] Referring to FIG. 2b, the second embodiment of the dental water processing apparatus 100 according to the present invention is constructed in the same manner as the first embodiment, described above with reference to FIG. 2a, except that a third valve 260 is additionally provided between the first valve 210 and the second valve 240, and a fourth valve 270 is additionally provided between the introduction pipe 110 and the water purifier 200 to communicate with the third valve 260.

[90] The fourth valve 270 comprises a 3-way valve. The fourth valve 270 has flow paths which ensure that, when the fourth valve 270 is opened, the tap water introduced through the introduction pipe 110 is directed into the water purifier 200, and, when the fourth valve 270 is closed, the dental water flowing into the fourth valve 270 from the third valve 260 is directed into the water purifier 200.

[91] A first valve 210 is disposed adjacent to the outlet port of the water purifier 200.

[92] The first valve 210 has flow paths which ensure that, when the first valve 210 is opened, the dental water exiting from the water purifier 200 is directed into the circulation pipe 120, and, when the first valve 210 is closed, the dental water exiting from the water purifier 200 is shut off and the dental water flowing into the first valve 210 from the third valve 260 in a dental water circulation procedure, which will be described later in detail, is redirected into the circulation pipe 120.

[93] A circulation pump 220 can be installed at a predetermined position on the circulation pipe 120, into which the dental water flows with the first valve 210 opened.

[94] In general, a motor pump is arranged in the water purifier 200 in order to increase

the supply pressure of purified dental water so that the water pressure in the circulation pipe 120 can be maintained constant by virtue of the power of the motor pump.

However, since it is necessary to ensure that, in the dental water circulation procedure, which will be described later in detail, the dental water can be circulated through the circulation pipe 120 even when the water purifier 200 is not actuated, the circulation pump 220 is needed. Also, when appropriate water pressure cannot be maintained in the circulation pipe 120 using only the motor pump in the water purifier 200, since the length of the circulation pipe 120 is considerable, the circulation pump 220 can also be operated.

[95] As described above with reference to FIG. 1, some of the dental water directed into the circulation pipe 120 through the first valve 210 is conveyed to the medical appliances for dental surgery, which are connected to the circulation pipe 120, and the remainder of the dental water is circulated and then redirected into the circulation pipe 120.

[96] A pressure sensor and/or a flow sensor 230 for sensing the pressure and/or the flow rate of the dental water can be installed at a preset position on the circulation pipe 120. While this second embodiment, shown in FIG. 2b, illustrates that the pressure sensor and/or the flow sensor 230 is installed on the circulation pipe 120 in the dental water processing apparatus 100, the pressure sensor and/or the flow sensor 230 can be installed at different positions on the circulation pipe 120.

[97] The pressure sensor and/or the flow sensor 230 can repeatedly sense, at regular intervals, the pressure and/or the flow rate of the dental water in the circulation pipe 120, and repeatedly transmit sensed data to the data processing part 252 of a control section 250. The interval can be optionally set either by a user or by a manufacturer.

[98] A second valve 240 is installed on the circulation pipe 120 in the dental water processing apparatus 100 so that the dental water can be redirected into the circulation pipe 120 after being circulated through the circulation pipe 120.

[99] The second valve 240 has flow paths which ensure that, when the second valve 240 is opened, the dental water flowing into the second valve 240 from the circulation pipe 120 is directed into the discharge pipe 130, and, when the second valve 240 is closed, the dental water is prevented from being directed into the discharge pipe 130 and instead is directed toward the third valve 260, which will be described below in detail.

[100] The third valve 260 is provided between the first valve 210 and the second valve 240. The third valve 260 comprises a 3-way valve. The third valve 260 has flow paths which ensure that, when the third valve 260 is opened, the dental water flowing into the third valve 260 from the second valve 240 is directed into the first valve 210, and, when the third valve 260 is closed, the dental water flowing into the third valve 260 from the second valve 240 is directed into the fourth valve 270.

- [101] The dental water processing apparatus 100 can be provided with the control section 250. The control section 250 controls the water purifier 200, the first valve 210, the second valve 240, the third valve 260, the fourth valve 270 and the circulation pump 220, and receives the data sensed by the pressure sensor and/or the flow sensor 230.
- [102] An input section 140 can be connected to the control section 250, so that a user or a manufacturer can input data required for controlling the dental water processing system. The input section 140 can be attached outside the dental water processing apparatus 100, and can be provided as a separate device. Also, it can be envisaged that the input section 140 is not separately provided, but is connected to a central control unit such as a computer or the like.
- [103] The control section 250 can be composed of the data processing part 252 and an apparatus control part 254. The data processing part 252 functions to store the data (operating conditions for the circulation of dental water) inputted from the input section 140, process the inputted data and the data sensed by the pressure sensor and/or the flow sensor 230, and transmit a circulation start signal or a circulation end signal to the apparatus control part 254. The apparatus control part 254 functions to control the operations of the water purifier 200, the first valve 210, the second valve 240, the third valve 260, the fourth valve 270 and the circulation pump 220 in response to the circulation start signal or the circulation end signal from the data processing part 252.
- [104] The data processing part 252 transmits the circulation start signal when the pressure in the circulation pipe 120, which is transmitted from the pressure sensor 230, is higher than the pressure which is inputted from the input section 140, and transmits the circulation end signal when the pressure in the circulation pipe 120, which is transmitted from the pressure sensor 230, is lower than the pressure which is inputted from the input section 140.
- [105] Further, the data processing part 252 transmits the circulation start signal when the flow rate in the circulation pipe 120, which is transmitted from the flow sensor 230, is less than the flow rate which is inputted from the input section 140, and transmits the circulation end signal when the flow rate in the circulation pipe 120, which is transmitted from the flow sensor 230, is greater than the flow rate which is inputted from the input section 140.
- [106] The case in which the sensed pressure is higher than the inputted pressure and the sensed flow rate is less than the inputted flow rate corresponds to when only a small number of medical appliances for dental surgery, which are connected to the circulation pipe 120, are operated and not much dental water in the circulation pipe 120 is used. In this case, since not much dental water in the circulation pipe 120 is used, a phenomenon occurs in which the dental water stagnates. As a consequence, the probability of a biofilm being created on the inner surface of the circulation pipe 120

increases.

- [107] Therefore, in the dental water processing apparatus 100 according to the second embodiment shown in FIG. 2b, the tap water introduced through the introduction pipe 110 is purified using the water purifier 200, the purified dental water is directed into the circulation pipe 120 with the first valve 210 opened, and the dental water directed into the circulation pipe 120 is conveyed to the medical appliances for dental surgery, which are connected to the circulation pipe 120.
- [108] The remaining dental water, which is left after being conveyed to the medical appliances for dental surgery, enters the dental water processing apparatus 100 through the circulation pipe 120 and is discharged through the discharge pipe 130 with the second valve 240 opened.
- [109] If the medical appliances for dental surgery, which are connected to the circulation pipe 120, are not used, the dental water in the circulation pipe 120 is not used, and stagnates. If this situation is maintained for an extended period, as mentioned above in the background part, a biofilm is likely to be created on the inner surface of the circulation pipe 120, and harmful bacteria or pathogens can be produced in the circulation pipe 120 due to the presence of the biofilm. These harmful bacteria or pathogens can be transferred to a patient through the medical appliances for dental surgery, which are connected to the circulation pipe 120, and can cause secondary infections in the patient.
- [110] The dental water processing apparatus 100 according to the second embodiment of the present invention, shown in FIG. 2b, is constructed in a manner such that, when the medical appliances for dental surgery are not operated and the dental water stagnates in the circulation pipe 120, circulation operation can be implemented to intentionally circulate the dental water in the circulation pipe 120.
- [111] In the circulation operation in the dental water processing system, a user or a manufacturer first inputs, through the input section 140, operating conditions for allowing the dental water processing system to implement the circulation operation.
- [112] At this time, the operating conditions can be a pressure and/or a flow rate of dental water.
- [113] The operating conditions are stored in the data processing part 252 of the control section 250.
- [114] The data processing part 252 repeatedly compares the inputted operating conditions with the data sensed from the pressure sensor and/or the flow sensor. At this time, as a result of the comparison between the operating conditions and the sensed data, if the sensed data satisfies the operating conditions (that is to say, if the sensed pressure is higher than the inputted pressure or the sensed flow rate is less than the inputted flow rate), the data processing part 252 transmits the operation start signal to the apparatus

control part 254. Conversely, as a result of the comparison between the operating conditions and the sensed data, if the sensed data does not satisfy the operating conditions, the data processing part 252 transmits the operation end signal to the apparatus control part 254.

[115] Upon receipt of the operation start signal, the apparatus control part 254 controls the water purifier 200, the first valve 210, the second valve 240, the third valve 260 and the fourth valve 270 in a manner such that the water purifier 200 is continuously operated, the first valve 210 is held in the opened state, the second valve 240 is converted from the opened state to the closed state, the third valve 260 is held in the closed state, and the fourth valve 270 is converted from the opened state to the closed state.

[116] At this time, the circulation pump 220, installed on the circulation pipe 120, can be operated under the control of the apparatus control part 254.

[117] Hence, the fourth valve 270 prevents the tap water, flowing through the introduction pipe 110, from being introduced into the water purifier 200, and allows the dental water flowing therein from the third valve 260 to be introduced into the water purifier 200. The water purifier 200 re-purifies the dental water introduced through the fourth valve 270. The first valve 210 redirects the dental water re-purified by the water purifier 200 into the circulation pipe 120. The second valve 240 directs the dental water, circulated through the circulation pipe 120, into the third valve 260. The third valve 260 directs the dental water flowing therein from the second valve 240 into the fourth valve 270. Thanks to this fact, as the dental water stagnating in the circulation pipe 120 can be circulated and then re-purified by the water purifier 200, not only can the impurities, which may be generated in the circulation pipe 120, be removed, but it is also possible to prevent a biofilm from being created due to the stagnation of the dental water.

[118] Conversely, upon receipt of the operation end signal, the apparatus control part 254 interrupts the circulation operation of the dental water processing system and thereby returns the dental water processing system to a normal state. To this end, the apparatus control part 254 interrupts the operation of the water purifier 200 and the circulation pump 220 and converts the second and fourth valves 240 and 270 from the closed state to the opened state.

[119] Immediately before the circulation operation starts or after the circulation operation is finished, since the dental water processing system does not operate, the operation of the water purifier 200 is interrupted as described above. However, in the case where the medical appliances for dental surgery, which are connected to the circulation pipe 120, are operated at the same time that the circulation operation is completed, the water purifier 200 can be continuously operated without being interrupted.

[120] The reason why the operation of the first valve 210 and the third valve 260 is not changed by the circulation end signal resides in that it is not necessary to change the first valve 210 from the opened state even under the circulation operation or while the dental water processing system is used, and the third valve 260 can be held in the opened state or the closed state when the first valve 210 is held in the opened state, the second valve 240 is held in the opened state and the fourth valve 270 is held in the opened state.

[121] At this time, the data processing part 252 of the control section 250 continuously compares the operating conditions inputted from the input section 140 with the data sensed by the pressure sensor and/or the flow sensor 230. As a result of this comparison, if the operating conditions are found to be satisfied, the data processing part 252 transmits the operation start signal to the apparatus control part 254 to restart the circulation operation.

[122] Thus, once the circulation operation is completed, in the dental water processing system, the inside of the circulation pipe 120 can be kept in a clean state, and therefore, it is possible to continuously convey clean dental water to the medical appliances for dental surgery.

Mode for the Invention

[123] FIG. 3 is a diagram schematically illustrating the construction of a dental water processing system in accordance with another embodiment of the present invention.

[124] Referring to FIG. 3, a dental water processing system includes a dental water processing apparatus 300 having a water purifier, and a circulation pipe 320 connected to the dental water processing apparatus 300.

[125] An introduction pipe 310 having a water supply valve 312 for controlling the supply of tap water (that is, municipal water) is connected to the dental water processing apparatus 300. Tap water can be supplied into the dental water processing apparatus 300 through the introduction pipe 310.

[126] The circulation pipe 320 is connected to the dental water processing apparatus 300 such that some of the dental water purified by the water purifier arranged in the dental water processing apparatus 300 can be conveyed to a medical appliance for dental surgery, such as a unit chair, and the remainder of the dental water can be returned to the dental water processing apparatus 300.

[127] A branch pipe 322 is branched from a predetermined portion of the circulation pipe 320 by a T-joint and is connected to the unit chair (not shown). A shutoff valve 324 is installed at a predetermined position on the branch pipe 322 and is capable of preventing conveyance of the dental water to the unit chair.

[128] The dental water processing apparatus 300 has a discharge pipe 330 for discharging

contaminant-containing water produced in the dental water processing apparatus 300.

[129] The dental water processing apparatus 300 further has an air pipe 510 for purging the dental water from the dental water processing apparatus 300.

[130] FIG. 4 is diagrams schematically illustrating embodiments of the dental water processing apparatus 300 which is employed in the dental water processing system shown in FIG. 3, wherein FIG. 4a illustrates a third embodiment and FIG. 4b illustrates a fourth embodiment.

[131] Referring to FIG. 4a, the third embodiment of the dental water processing apparatus 300 according to the present invention includes a water purifier 400 for purifying the tap water introduced therein through the introduction pipe 310, a fifth valve 410, which is connected to the water purifier 400 and communicates with the air pipe 510, a sixth valve 420, which is connected to the fifth valve 410, a circulation pipe 320, which is connected to the sixth valve 420, a circulation pump 440, which is disposed at a predetermined position on the circulation pipe 320, a seventh valve 430, which is installed at a predefined position on the circulation pipe 320, and a discharge pipe 330, which is connected to the seventh valve 430.

[132] The water purifier 400 can be composed of a plurality of filters, a motor pump, a purified water tank, and so forth. A conventional water purifier can be used as the water purifier 400.

[133] The water purifier 400 purifies the tap water, introduced therein through the introduction pipe 310. Then, the purified dental water exits from the water purifier 400 through the outlet port of the water purifier 400.

[134] The water purifier 400 functions to remove impurities contained in the tap water. The water purifier 400 purifies the tap water introduced therein through the introduction pipe 310 and discharges the purified dental water through the outlet port thereof.

[135] The fifth valve 410 is disposed adjacent to the outlet port of the water purifier 400.

[136] The fifth valve 410 is a 3-way valve. The fifth valve 410 has flow paths which ensure that, when the fifth valve 410 is opened, the dental water exiting from the water purifier 400 is directed into the sixth valve 420, which will be described below in detail, and, when the fifth valve 410 is closed, the dental water exiting from the water purifier 400 is prevented from being directed into the sixth valve 420 and the compressed air supplied through the air pipe 510 is directed into the sixth valve 420.

[137] The fifth valve 410 is connected with the sixth valve 420, which in turn is connected with the circulation pipe 320.

[138] The sixth valve 420 comprises a 3-way valve. The sixth valve 420 has flow paths which ensure that, when the sixth valve 420 is opened, the dental water flowing therein through the fifth valve 410 or the compressed air flowing therein through the air pipe

510 is directed into the circulation pipe 320, and, when the sixth valve 420 is closed, the dental water from the fifth valve 410 or the compressed air from the air pipe 510 is shut off and the dental water flowing therein through the seventh valve 430, which will be described below in detail, is directed into the circulation pipe 320.

[139] The circulation pump 440 is installed at the predetermined position on the circulation pipe 320. That is to say, the circulation pump 440 can be located at the predetermined position on the circulation pipe 320, into which the dental water flows, with the fifth valve 410 and the sixth valve 420 opened. Here, a motor pump (not shown) is arranged in the water purifier 400 in order to increase the supply pressure of purified dental water so that the water pressure in the circulation pipe 320 can be kept constant by virtue of the power of the motor pump. However, since it is necessary to ensure that, in the dental water circulation procedure, which will be described later in detail, the dental water can be circulated through the circulation pipe 320 even when the water purifier 400 is not actuated, the circulation pump 440 is needed. Also, when appropriate water pressure cannot be maintained in the circulation pipe 320 using only the motor pump in the water purifier 400, since the length of the circulation pipe 320 is considerable, the circulation pump 440 can also be operated.

[140] As described above with reference to FIG. 1, some of the dental water directed into the circulation pipe 320 through the fifth valve 410 and the sixth valve 420 is conveyed to the medical appliances for dental surgery, which are connected to the circulation pipe 320, and the remainder of the dental water is circulated and then redirected into the circulation pipe 320.

[141] The seventh valve 430 is installed on the circulation pipe 320 in the dental water processing apparatus 300 so that the dental water can be redirected into the circulation pipe 320 after being circulated through the circulation pipe 320.

[142] The seventh valve 430 comprises a 3-way valve. The seventh valve 430 has flow paths which ensure that, when the seventh valve 430 is opened, the dental water or the compressed air flowing therein from the circulation pipe 320 is directed into the discharge pipe 330, and, when the seventh valve 430 is closed, the dental water is prevented from being directed into the discharge pipe 330, and instead is directed into the sixth valve 420.

[143] An input section 340 can be connected to a control section 450, so that a user or a manufacturer can input data required for controlling the dental water processing system. The input section 340 can be attached outside the dental water processing apparatus 300, and can be provided as a separate device. Also, it can be envisaged that the input section 340 is not separately provided, but is connected to a central control unit such as a computer or the like.

[144] The control section 450 can be composed of a timer 452 and an apparatus control

part 554. The timer 452 functions to store the data (data such as circulation operation time and period and purging operation time and period), compare the time thereof with the inputted data, and transmit a circulation operation start signal, a circulation operation end signal, a purging operation start signal or a purging operation end signal to the apparatus control part 454. The apparatus control part 554 functions to control the operation of the water purifier 400, the fifth valve 410, the sixth valve 420, the seventh valve 430 and the circulation pump 440 in response to the circulation operation start signal, the circulation operation end signal, the purging operation start signal or the purging operation end signal from the timer 452.

[145] Therefore, in the dental water processing apparatus 300 according to the third embodiment shown in FIG. 4a, the tap water, introduced through the introduction pipe 310, is purified using the water purifier 400, the purified dental water is directed into the circulation pipe 320 with the fifth and sixth valves 410 and 420 opened, and the dental water directed into the circulation pipe 320 is conveyed to the medical appliances for dental surgery, which are connected to the circulation pipe 320.

[146] The remaining dental water, which is left after being conveyed to the medical appliances for dental surgery, enters the dental water processing apparatus 300 through the circulation pipe 320 and is discharged through the discharge pipe 330 with the seventh valve 430 opened.

[147] If the medical appliances for dental surgery, which are connected to the circulation pipe 320, are not used, the dental water in the circulation pipe 320 is not used, and stagnates. If this situation persists for an extended period, as mentioned above in the background part, a biofilm is likely to be created on the inner surface of the circulation pipe 320, and harmful bacteria or pathogens can be produced in the circulation pipe 320 due to the presence of the biofilm. These harmful bacteria or pathogens can be transferred to a patient through the medical appliances for dental surgery, which are connected to the circulation pipe 320, and can cause secondary infections in the patient.

[148] The dental water processing apparatus 300 according to the third embodiment of the present invention, shown in FIG. 4a, is constructed in a manner such that, when the medical appliances for dental surgery are not operated and the dental water stagnates in the circulation pipe 320, a circulation operation or purging operation can be implemented to intentionally circulate or purge the dental water in the circulation pipe 320.

[149] First, the circulation operation in the dental water processing system will be described. A user or a manufacturer first inputs, through the input section 340, a circulation operation time and period for allowing the dental water processing system to implement the circulation operation.

- [150] The circulation operation time may be the time at which the medical appliances of the dental water processing system are not operated. In general, the times at which all of the medical appliances are simultaneously stopped may include lunch time, the time after closing time or the days that the dental office is closed, or may be a time that is predefined by a user (a time that is predefined by a user for the circulation operation).
- [151] The circulation operation time and period are stored in the timer 452 of the control section 450.
- [152] The timer 452 repeatedly compares the inputted circulation operation time with the time of the timer 452. At this time, if the circulation operation time and the time of the timer 452 (that is, the current time) correspond to each other, the timer 452 transmits the circulation operation start signal to the apparatus control part 454.
- [153] Upon receipt of the circulation operation start signal, the apparatus control part 454 interrupts the operation of the water purifier 400, continuously holds the fifth valve 410 in the opened state, converts the sixth valve 420 from the opened state to the closed state, actuates the circulation pump 440, and converts the seventh valve 430 from the opened state to the closed state.
- [154] Accordingly, the fifth valve 410 continuously shuts off the compressed air from the air pipe 510, and the sixth valve 420 shuts off the dental water exiting from the water purifier 400 and redirects the dental water, circulating through the seventh valve 430, into the circulation pipe 320. As the seventh valve 430 is converted into the closed state, the seventh valve 430 prevents the dental water from flowing into the discharge pipe 330 and guides the dental water toward the sixth valve 420. Further, as the circulation pump 440, which is located at the predetermined position on the circulation pipe 320, is actuated, the dental water in the circulation pipe 320 is continuously circulated to prevent a biofilm from being created due to stagnation of the dental water.
- [155] The timer 452 of the control section 450 repeatedly compares the inputted circulation operation period with the time that has elapsed since the circulation operation time. If the circulation operation period and the lapsed period correspond to each other, the timer 452 transmits the circulation operation end signal to the apparatus control part 454 of the control section 450.
- [156] Upon receipt of the circulation operation end signal, the apparatus control part 454 finishes the circulation operation of the dental water processing system and thereby returns the dental water processing system to a normal state. To this end, the apparatus control part 254 interrupts the operation of the circulation pump 440 and converts the sixth and seventh valves 420 and 430 from the closed state to the opened state, so that they are in a normal state.
- [157] The timer 452 of the control section 450 continuously compares the circulation operation time with the current time. As a result of this comparison, if the circulation

operation time and the current time correspond to each other, the timer 452 transmits the circulation operation start signal to the apparatus control part 454 to restart the circulation operation.

[158] Thus, once the circulation operation is completed, in the dental water processing system, the inside of the circulation pipe 320 can be kept in a clean state, and therefore, it is possible to continuously convey clean dental water to the medical appliances for dental surgery.

[159] Next, the purging operation in the dental water processing system will be described. A user or a manufacturer first inputs, through the input section 340, a purging operation time and period at and for which the dental water processing system implements a purging operation, and a refilling operation time and period, at and for which the dental water processing system implements a refilling operation.

[160] The purging and refilling operation times and periods are stored in the timer 452 of the control section 450.

[161] The timer 452 repeatedly compares the inputted purging operation time with the time of the timer 452. When the purging operation time and the time of the timer 452 (that is, the current time) correspond to each other, the timer 452 transmits the purging operation start signal to the apparatus control part 454.

[162] Upon receipt of the purging operation start signal, the apparatus control part 454 interrupts the operation of the water purifier 400, switches the fifth valve 410 to the closed state, and continuously keeps the sixth valve 420 and the seventh valve 430 in the opened state.

[163] Accordingly, the fifth valve 410 directs the compressed air from the air pipe 510 into the sixth valve 420, and the sixth valve 420 directs the compressed air into the circulation pipe 320. The compressed air, introduced into the circulation pipe 320, purges the dental water in the circulation pipe 320 through the seventh valve 430 and the discharge pipe 330.

[164] As the purging operation is implemented in this way, the dental water in the circulation pipe 320 is purged to the outside, and thereby, it is possible to prevent a biofilm from being created due to the presence of dental water in the circulation pipe 320.

[165] The timer 452 of the control section 450 repeatedly compares the inputted purging operation period with the time that has elapsed since the purging operation time. If the purging operation period and the lapsed time correspond to each other, the timer 452 transmits the purging operation end signal to the apparatus control part 454 of the control section 450.

[166] Upon receipt of the purging operation end signal, the apparatus control part 454 finishes the operation of purging the dental water processing system. At this time, by

switching the seventh valve 430 into the closed state, the space inside the circulation pipe 320 can be maintained in a state in which it is filled with the compressed air.

[167] The timer 452 repeatedly compares the refilling operation time, inputted from the input section 340, with the current time. When the refilling operation time and the current time correspond to each other, the timer 452 transmits the refilling operation start signal to the apparatus control part 454 to start the refilling operation.

[168] Namely, the fifth valve 410 is converted into the opened state, and the seventh valve 430 is converted into the opened state. By this fact, the space inside the circulation pipe 320, which is filled with the compressed air, is refilled with the dental water.

[169] Thus, once the purging operation is completed, in the dental water processing system, the inside of the circulation pipe 320 can be kept in a clean state, and therefore, it is possible to continuously convey clean dental water to the medical appliances for dental surgery. Further, if desired, by adding various chemicals into the compressed air or heating the compressed air to a high temperature and then introducing the heated compressed air into the circulation pipe 320, organic substances, such as bacteria or pathogens, which cling to the inner surface of the circular pipe 320, can be removed.

[170] Referring to FIG. 4b, the fourth embodiment of the dental water processing apparatus 300 according to the present invention is constructed in the same manner as the third embodiment, described above with reference to FIG. 4a, except that an eighth valve 460 is additionally provided between the sixth valve 420 and the seventh valve 430, and a ninth valve 470 is additionally provided between the introduction pipe 310 and the water purifier 400 to communicate with the eighth valve 460.

[171] The eighth valve 460 is a 3-way valve. The eighth valve 460 has flow paths that ensure that, when the eighth valve 460 is opened, the dental water flowing therein from the seventh valve 430 is directed into the sixth valve 420, and, when the eighth valve 460 is closed, the dental water flowing therein from the seventh valve 430 is directed into the ninth valve 470.

[172] The ninth valve 470 is a 3-way valve. The ninth valve 470 has flow paths that ensure that, when the ninth valve 470 is opened, the tap water flowing therein through the introduction pipe 310 is directed into the water purifier 400, and, when the ninth valve 470 is closed, the dental water flowing therein from the eighth valve 460 is directed into the water purifier 400.

[173] The dental water processing apparatus 300 can be provided with a control section 450. The control section 250 controls the water purifier 400, the fifth valve 410, the sixth valve 420, the seventh valve 430, the eighth valve 460, the ninth valve 470 and the circulation pump 440.

[174] Also, similar to the third embodiment shown in FIG. 4a, an input section 340 can be

connected to the control section 450, so that a user or a manufacturer can input data required for controlling the dental water processing system. The control section 450 can be composed of a timer 452 and an apparatus control part 454. The timer 452 functions to store the data (data such as circulation operation time and period and a purging operation time and period), compare the time thereof with the inputted data, and transmit a circulation operation start signal, a circulation operation end signal, a purging operation start signal, a purging operation end signal, a refilling operation start signal or a refilling operation end signal to the apparatus control part 454. The apparatus control part 454 functions to control the operation of the water purifier 400, the fifth valve 410, the sixth valve 420, the seventh valve 430, the eighth valve 460, the ninth valve 470 and the circulation pump 440 in response to the various signals from the timer 452.

[175] Therefore, in the dental water processing apparatus 300 according to the fourth embodiment, shown in FIG. 4b, the tap water introduced through the introduction pipe 310 is purified using the water purifier 400, the purified dental water is directed into the circulation pipe 320 with the fifth and sixth valves 410 and 420 opened, and the dental water directed into the circulation pipe 320 is conveyed to the medical appliances for dental surgery, which are connected to the circulation pipe 320.

[176] The remaining dental water, which is left after being conveyed to the medical appliances for dental surgery, enters the dental water processing apparatus 300 through the circulation pipe 320, and is discharged through the discharge pipe 330 with the seventh valve 430 opened.

[177] The circulation operation in the dental water processing system according to the fourth embodiment, shown in FIG. 4b will be described. A user or a manufacturer first inputs, through the input section 340, a circulation operation time and period for allowing the dental water processing system to conduct the circulation operation.

[178] The circulation operation time and period are stored in the timer 452 of the control section 450.

[179] The timer 452 repeatedly compares the inputted circulation operation time with the time of the timer 452. At this time, if the circulation operation time and the time of the timer 452 (that is, the current time) are the same as each other, the timer 452 transmits the circulation operation start signal to the apparatus control part 454.

[180] Upon receipt of the circulation operation start signal, the apparatus control part 454 controls the water purifier 400, the circulation pump 440, the fifth valve 410, the sixth valve 420, the seventh valve 430, the eighth valve 460 and the ninth valve 470 in a manner such that the water purifier 400 is continuously operated, the circulation pump 440 is actuated, the fifth valve 410 and the sixth valve 420 are continuously kept in the opened state, and the seventh valve 430, the eighth valve 460 and the ninth valve 470

are switched from the opened state to the closed state.

- [181] Accordingly, in the circulation operation, the ninth valve 470 prevents tap water from being introduced into the water purifier 400, introduces the dental water flowing therein from the eighth valve 460 into the water purifier 400 to allow the dental water to be re-purified so that the dental water, which is likely to be contaminated while being circulated through the circulation pipe 320, can be re-purified, and directs the re-purified dental water into the circulation pipe 320 through the fifth and sixth valves 410 and 420. The dental water, having passed through the circulation pipe 320, is redirected into the ninth valve 470 through the seventh and eighth valves 430 and 460 to repeat the above-described procedure.
- [182] In the above-described circulation operation, as the dental water stagnating in the circulation pipe 320 can be circulated and then re-purified by the water purifier 400, the impurities, which can be generated in the circulation pipe 320, can be removed, and it is possible to prevent a biofilm from forming due to the stagnation of the dental water.
- [183] The timer 452 of the control section 450 repeatedly compares the inputted circulation operation period with the time that has elapsed since the circulation operation time. If the circulation operation period and the elapsed time are the same as each other, the timer 452 transmits the circulation operation end signal to the apparatus control part 454 of the control section 450.
- [184] Upon receipt of the circulation operation end signal, the apparatus control part 454 finishes the circulation operation of the dental water processing system and thereby returns the dental water processing system to a normal state. To this end, the apparatus control part 254 interrupts the operation of the water purifier 400 and the circulation pump 440 and switches the seventh valve 430, the eighth valve 460 and the ninth valve 470 from the closed state to the opened state.
- [185] The timer 452 of the control section 450 continuously compares the circulation operation time with the current time. As a result of this comparison, if the circulation operation time and the current time are the same as each other, the timer 452 transmits the circulation operation start signal to the apparatus control part 454 to restart the circulation operation.
- [186] Thus, once the circulation operation is completed, in the dental water processing system, the inside of the circulation pipe 320 can be maintained in a clean state, and therefore, it is possible to continuously convey clean dental water to the medical appliances for dental surgery.
- [187] Next, the operation of purging the dental water processing system according to the forth embodiment shown in FIG. 4b will be described. A user or a manufacturer first inputs through the input section 340 a purging operation time and period at and for

which the dental water processing system implements a purging operation, and a refilling operation time and period at and for which the dental water processing system implements refilling operation.

- [188] The purging and refilling operation times and periods are stored in the timer 452 of the control section 450.
- [189] The timer 452 repeatedly compares the inputted purging operation time with the time of the timer 452. At this time, if the purging operation time and the time of the timer 452 (that is, the current time) are the same as each other, the timer 452 transmits the purging operation start signal to the apparatus control part 454.
- [190] Upon receipt of the purging operation start signal, the apparatus control part 454 interrupts the operation of the water purifier 400, switches the fifth valve 410 into the closed state, and continuously holds the sixth valve 420 and the seventh valve 430 in the opened state.
- [191] Accordingly, the fifth valve 410 directs the compressed air from the air pipe 510 into the sixth valve 420, and the sixth valve 420 directs the compressed air into the circulation pipe 320. The compressed air introduced into the circulation pipe 320 purges the dental water in the circulation pipe 320 through the seventh valve 430 and the discharge pipe 330.
- [192] As the purging operation is implemented in this way, the dental water in the circulation pipe 320 is purged to the outside, and thereby, it is possible to prevent a biofilm from forming due to the presence of dental water in the circulation pipe 320.
- [193] The timer 452 of the control section 450 repeatedly compares the inputted purging operation period with the time that has elapsed since the purging operation time. If the purging operation period and the elapsed time are the same as each other, the timer 452 transmits the purging operation end signal to the apparatus control part 454 of the control section 450.
- [194] Upon receipt of the purging operation end signal, the apparatus control part 454 finishes the purging operation of the dental water processing system. At this time, by switching the seventh valve 430 into the closed state, the space inside the circulation pipe 320 can be maintained in a state in which it is filled with the compressed air.
- [195] The timer 452 repeatedly compares the refilling operation time, inputted from the input section 340, with the current time. When the refilling operation time and the current time are the same as each other, the timer 452 transmits the refilling operation start signal to the apparatus control part 454 to start the refilling operation.
- [196] Namely, the fifth valve 410 is switched into the opened state, and the seventh valve 430 is switched into the opened state. By this fact, the space inside the circulation pipe 320, which is filled with the compressed air, is refilled with the dental water.
- [197] Thus, once the purging operation is completed, in the dental water processing

system, the inside of the circulation pipe 320 can be maintained in a clean state, and therefore, it is possible to continuously convey clean dental water to the medical appliances for dental surgery. Further, if desired, by adding various chemicals into the compressed air or heating the compressed air to a high temperature and then introducing the heated compressed air into the circulation pipe 320, organic substances, such as bacteria or pathogens, which cling to the inner surface of the circular pipe 320, can be removed.

[198] At this time, although the circulation operation, the purging operation and the refilling operation, explained in each of the third and fourth embodiments, can be implemented separately, it can be envisaged that the circulation operation can be implemented for a predetermined period, the purging operation is continuously implemented to purge the dental water in the circulation pipe, and then, when the dental water is needed, the refilling operation is implemented to refill the dental water in the circulation pipe. Further, it can be envisaged that the purging operation is first implemented to purge the dental water in the circulation pipe, the refilling operation is implemented after the lapse of a predetermined period to refill the dental water in the circulation pipe, and then, the circulation operation is implemented immediately before the use of the dental water, to thereby prevent the dental water from stagnating in the circulation pipe.

[199] Although preferred embodiments of the present invention have been described for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Industrial Applicability

[200] The present invention can be used in a dental office, etc., which is equipped with a dental water supply system. The dental water processing system according to the present invention can prevent a biofilm from forming on the inner surface of a circulation pipe through circulating or purging the dental water in the circulation pipe.

Claims

- [1] A dental water processing system for conveying dental water to a unit chair for dental surgery, comprising:
a circulation pipe connected to a water purifier to supply dental water to the unit chair for dental surgery;
a first valve placed between the water purifier and the circulation pipe;
a second valve installed at a predefined position on the circulation pipe;
a circulation pump installed at a predetermined position on the circulation pipe;
a pressure sensor and/or a flow sensor installed at a preset position on the circulation pipe; and
a control section for controlling the first valve, the second valve, the circulation pump, and the pressure sensor and/or the flow sensor,
wherein the control section controls the first valve, the second valve and the circulation pump in response to a pressure and/or a flow rate sensed by the pressure sensor and/or the flow sensor so as to open and close a circulation structure of the circulation pipe to thereby circulate dental water.
- [2] The dental water processing system according to claim 1, further comprising:
a third valve placed between the first valve and the second valve; and
a fourth valve installed at a predetermined position on an introduction pipe for supplying tap water to the water purifier,
wherein the third valve and the fourth valve are controlled by the control section.
- [3] The dental water processing system according to claim 1 or 2, wherein the first valve is placed adjacent to an outlet port of the water purifier and has flow paths that ensure that, when the first valve is opened, dental water exiting from the water purifier is directed into the circulation pipe, and, when the first valve is closed, dental water circulated through the circulation pipe is redirected into the circulation pipe.
- [4] The dental water processing system according to claim 1 or 2, wherein the second valve has flow paths that ensure that, when the second valve is opened, dental water circulated through the circulation pipe is directed into a discharge pipe, and, when the second valve is closed, dental water circulated through the circulation pipe is directed into the first valve.
- [5] The dental water processing system according to claim 2, wherein the third valve has flow paths that ensure that, when the third valve is opened, dental water flowing therein from the second valve is directed into the first valve, and, when the third valve is closed, the dental water flowing therein from the second valve is directed into the fourth valve.

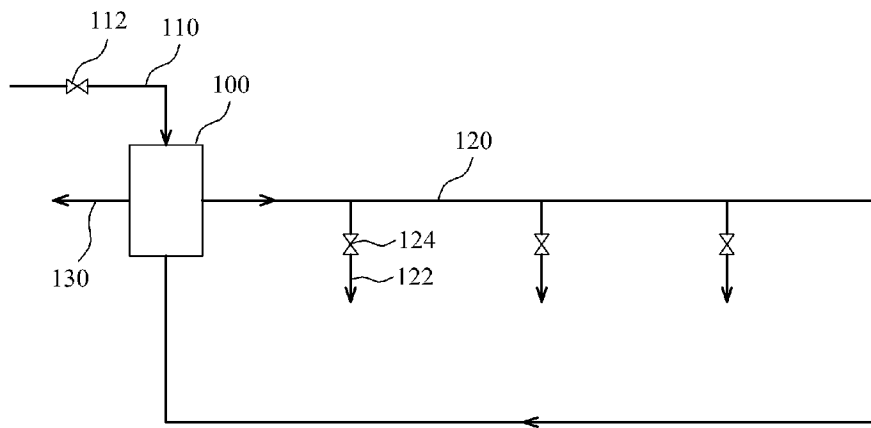
- [6] The dental water processing system according to claim 2, wherein the fourth valve has flow paths that ensure that, when the fourth valve is opened, tap water introduced through the introduction pipe is directed into the water purifier, and, when the fourth valve is closed, dental water flowing therein from the third valve is directed into the water purifier.
- [7] The dental water processing system according to claim 1 or 2, further comprising:
a discharge pipe connected to the second valve.
- [8] The dental water processing system according to claim 1 or 2, further comprising:
at least one branch pipe, which branches from the circulation pipe and is connected to the unit chair,
wherein a shutoff valve is installed at a predetermined position on the branch pipe.
- [9] The dental water processing system according to claim 1, wherein the control section comprises:
a data processing part for comparing data acquired from the pressure sensor and/or the flow sensor with an operating condition; and
an apparatus control part for controlling operation of the water purifier, the circulation pump, the first valve and the second valve in response to a signal from the data processing part.
- [10] The dental water processing system according to claim 2, wherein the control section comprises:
a data processing part for comparing data acquired from the pressure sensor and/or the flow sensor with an operating condition; and
an apparatus control part for controlling operation of the water purifier, the circulation pump, the first valve, the second valve, the third valve and the fourth valve in response to a signal from the data processing part.
- [11] The dental water processing system according to claim 2, further comprising:
an input section connected to the control section so that a user can input a pressure value and/or a flow rate value as the operating condition.
- [12] A dental water processing system for conveying dental water to a unit chair for dental surgery, comprising:
a circulation pipe connected to a water purifier and the unit chair for dental surgery; and
an air pipe connected to the circulation pipe,
wherein dental water is circulated by opening and closing the circulation pipe, or dental water in the circulation pipe is purged by introducing compressed air from

- the air pipe into the circulation pipe.
- [13] A dental water processing system for conveying dental water to a unit chair for dental surgery, comprising:
a circulation pipe connected to a water purifier to supply dental water to the unit chair for dental surgery;
a fifth valve placed between the water purifier and the circulation pipe;
an air pipe connected to the fifth valve;
a sixth valve, placed at a region where the water purifier and the circulation pipe are connected with each other;
a seventh valve, placed at a predefined position on the circulation pipe;
a discharge pipe connected to the seventh valve;
a circulation pump installed at a predetermined position on the circulation pipe;
and
a control section for controlling the fifth valve, the sixth valve, the seventh valve, and the circulation pump.
- [14] The dental water processing system according to claim 13, further comprising:
an eighth valve placed between the sixth valve and the seventh valve; and
a ninth valve placed between an introduction pipe for supplying tap water to the water purifier and the water purifier,
wherein the eighth valve and the ninth valve are controlled by the control section.
- [15] The dental water processing system according to claim 13 or 14, wherein the fifth valve has flow paths that ensure that, when the fifth valve is opened, dental water exiting from the water purifier is directed into the sixth valve, and, when the fifth valve is closed, compressed air supplied through the air pipe is directed into the sixth valve.
- [16] The dental water processing system according to claim 13 or 14, wherein the sixth valve has flow paths that ensure that, when the sixth valve is opened, dental water exiting from the water purifier or compressed air flowing therein through the air pipe is directed into the circulation pipe, and, when the sixth valve is closed, dental water circulated through the circulation pipe is redirected into the circulation pipe.
- [17] The dental water processing system according to claim 13 or 14, wherein the seventh valve has flow paths that ensure that, when the seventh valve is opened, dental water circulating through the circulation pipe is directed into the discharge pipe, and, when the seventh valve is closed, dental water circulating through the circulation pipe is directed into the sixth valve.
- [18] The dental water processing system according to claim 14, wherein the eighth

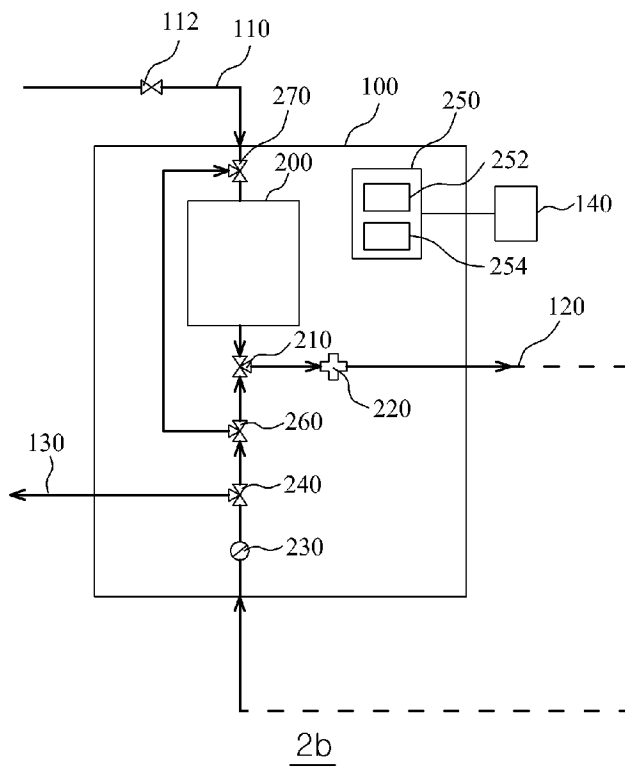
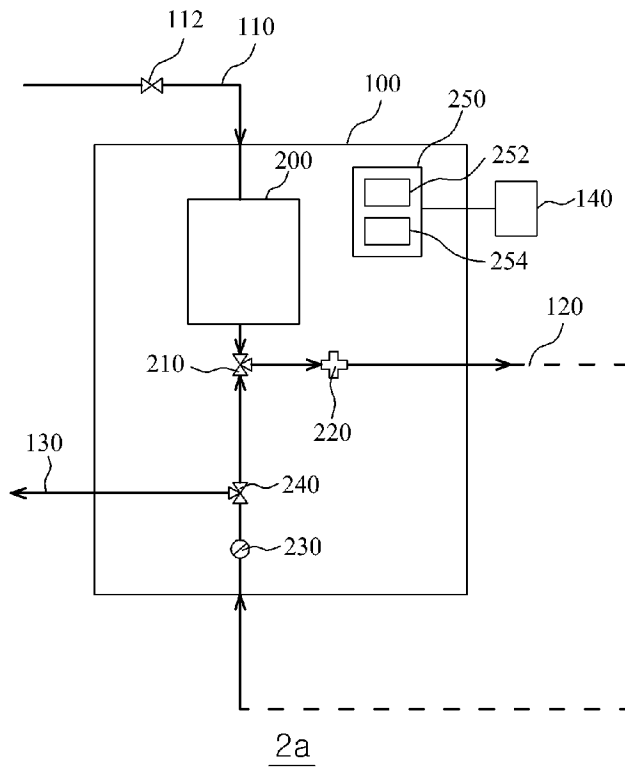
valve has flow paths that ensure that, when the eighth valve is opened, dental water flowing therein from the seventh valve is directed into the sixth valve, and, when the eighth valve is closed, dental water flowing therein from the seventh valve is directed into the ninth valve.

- [19] The dental water processing system according to claim 14, wherein the ninth valve has flow paths that ensure that, when the ninth valve is opened, tap water flowing therein through the introduction pipe is directed into the water purifier, and, when the ninth valve is closed, dental water flowing therein from the eighth valve is directed into the water purifier.
- [20] The dental water processing system according to claim 13 or 14, further comprising:
at least one branch pipe branched from the circulation pipe and connected to the unit chair,
wherein a shutoff valve is installed at a predetermined position on the branch pipe.
- [21] The dental water processing system according to claim 13, wherein the control section comprises:
a timer for comparing an already inputted time and a current time; and
an apparatus control part for controlling the water purifier, the fifth valve, the sixth valve, the seventh valve, and the circulation pump in response to a signal from the timer.
- [22] The dental water processing system according to claim 14, wherein the control section comprises:
a timer for comparing an already inputted time with a current time; and
an apparatus control part for controlling the water purifier, the fifth valve, the sixth valve, the seventh valve, the eighth valve, the ninth valve, and the circulation pump in response to a signal from the timer.
- [23] The dental water processing system according to claim 15, further comprising:
an input section connected to the control section so that a user can input a time and a period.

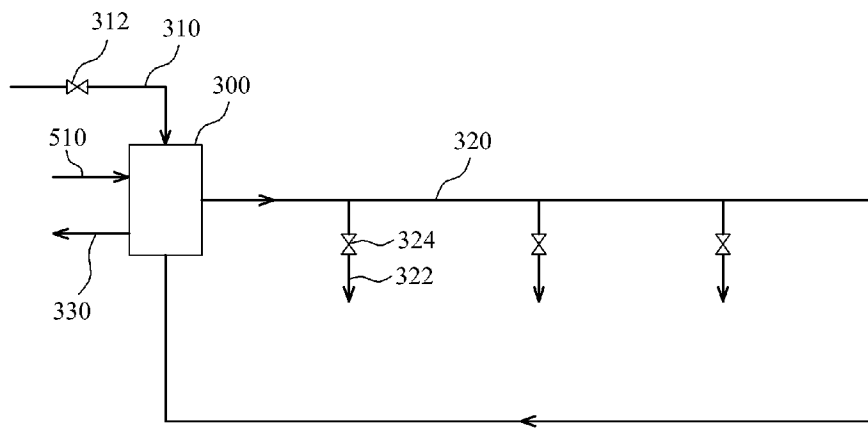
[Fig. 1]



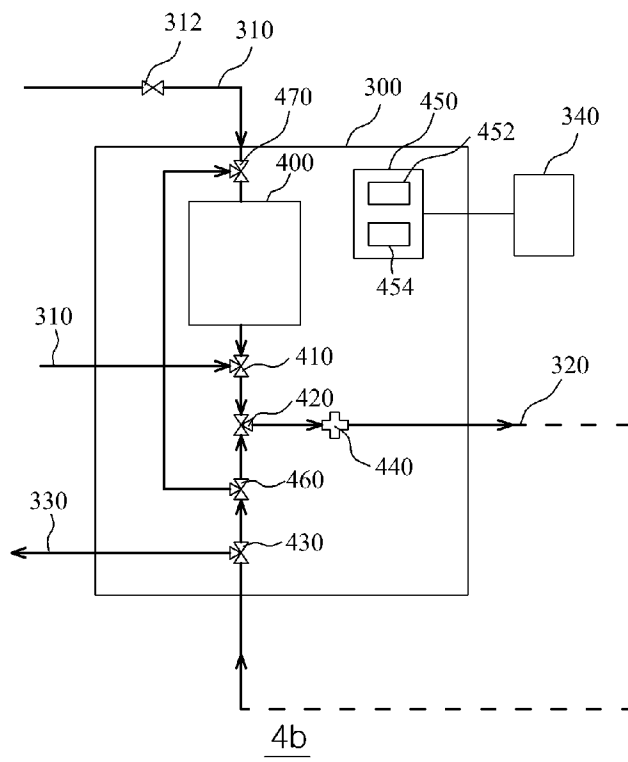
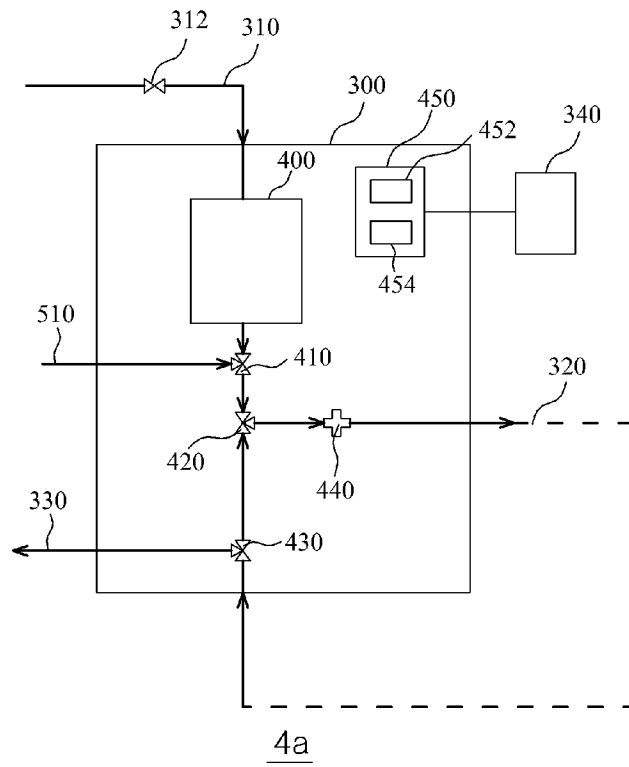
[Fig. 2]



[Fig. 3]



[Fig. 4]



A. CLASSIFICATION OF SUBJECT MATTER*A61C 19/00(2006.01)i*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 : A61C 19/00, A61G 17/02, B01D 35/00, C02F 1/78

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility Models and Applications for Utility Models since 1975

Japanese Utility Models and Applications for Utility Models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS, WPI, USPTO, PAJ, etc."

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 14-360613 A (Osada Res. Inst. Ltd.) 17 Dec. 2002 - See Claim 1; Fig. 1.	1-23
A	US 6464868 B1 (Amos Korin) 15 Oct. 2002 - See column 8, line 39 - column 9, line 63; Figs. 2, 10, 11.	1-23
A	US 5785523 A (Thad J. Overmyer) 28 Jul. 1998 - See the whole document.	1-23
A	JP 08-196553 A (Osada Res. Inst. Ltd.) 06 Aug. 1996 - See the whole document; Fig. 1	1-23



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

05 JUNE 2007 (05.06.2007)

Date of mailing of the international search report

05 JUNE 2007 (05.06.2007)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2007/000503

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