

WATER CLEANER AND WATER CLEANING METHOD USING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to Korean Patent Application No. 10-2006-0063142, filed on July 5, 2006, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a water cleaner and a water cleaning method using the same, and more particularly, to a water cleaner, which is capable of precisely detecting an extent of contamination of a filter based on an actual amount of use of purified water and informing a user of the detected extent of contamination so that the user exchanges the filter and uses and maintain the water cleaner simply and conveniently, and a water cleaning method using the same.

2. Description of the Related Art

A water cleaner, being widely used in our daily life, is an apparatus for purifying such raw water as tap water to a water quality standard according to the provision of Article 5, Clause 3 of 'Drinking Water Control Law' (in Korea). A water cleaner may be classified with standards of its purpose, constitution,

purification principle, etc.

Of these standards, the purification principle, which is the most popular standard, may be divided into a natural filtration system, a direct-connection filtration system, a distillation system and a reverse osmosis system. The natural filtration system is to store a specified amount of raw water and filter the stored raw water in the process of filtration by its weight, and the direct-connection filtration system is to directly connect a water cleaner to a hydrant or the like to which raw water is supplied, and purify the raw water by passing the raw water through a filter using water supply pressure. The distillation system is to collect vapor generated by boiling raw water, and the reverse osmosis system is to remove impurities from raw water using a semipermeable film, which is so-called membrane.

The distillation system and the reverse osmosis system have a demerit of removing beneficial substances such as dissolved oxygen, various minerals and so on in addition to contaminated substances contained in the raw water, although these systems can obtain relatively pure water. The natural filtration system and the direct-connection filtration system have no demerit of the distillation system and the reverse osmosis system, but have a difficulty in maintaining a filter. Recently, with increased interest in health care, the distillation system and the reverse osmosis system have shown a downward trend in their use. The

direct-connection filtration system is being most popular since it needs no raw water storage, has a simple structure, and is convenient for use.

A purification process of a general water cleaner employing the direct-connection filtration system includes steps of water supply, preliminary filtration, absorption, main filtration, water discharge. Specifically, external raw water is supplied into the water cleaner, impurities contained in the raw water is preliminarily filtered out, volatile organic substances are absorbed and removed, fine impurities are finally filtered out by a ceramic filter, and the finally-filtered water is discharged to a user. For the filtration, the direct-connection filtration water cleaner includes various kinds of filters suitable for the respective steps, such as a carbon filter, including the ceramic filter. Typically, maintenance of these filters has a critical effect on the performance of the direct-connection filtration water cleaner.

There have been proposed various methods of catching a replacement time of filters depending on an extent of contamination of the filters to increase the use efficiency of the filters and maintain the best purification capacity of the water cleaner. However, these proposed methods are insufficient for detecting the extent of contamination of the filters and catching the replacement time of the filters. At present, it is under actual circumstances that a user replaces a filter with a

new one with the passage of a specified period of time, for example, once a month, or depending on his subjective feeling, for example, the taste of water, which shows a significant difference from maintenance of the filters based on objective data on the extent of contamination of the filters.

Accordingly, wastefulness of costs and man power is caused by unnecessarily frequent replacement of the filter and there may frequently occur some cases where the user drinks contaminated water due to missing of a proper replacement chance of the filter. In particular, to replace a filter with a new one, an existing water cleaner has to be totally disassembled, which imposes a heavy burden on a user.

SUMMARY OF THE INVENTION

To overcome the above problems, it is an object of the present invention to provide a water cleaner, which is capable of precisely determining an extent of contamination of various filters provided in the water cleaner and allowing any users to replace and maintain a filter with a new one simply and easily, and a water cleaning method using the same.

It is another object of the present invention to provide a water cleaner, which is capable of precisely detecting an extent of contamination of a filter based on an actual amount of use of purified water and informing a user of the detected extent of

contamination so that the user exchanges the filter with a new one and uses and maintain the water cleaner simply and conveniently, and a water cleaning method using the same.

To achieve the above objects, according to an aspect, the present invention provides a water cleaner that purifies raw water and discharges purified water, comprising: a plurality of tanks each containing a filter; a main body that is combined with the plurality of tanks and is provided with a raw water pipe into which the raw water is supplied, a purified water pipe from which the purified water is discharged, and a plurality of passages connecting the raw water pipe to the purified water pipe via the plurality of tanks, wherein the passages cause the raw water in the raw water pipe to pass through the plurality of tanks and then to be discharged to the purified water pipe; a first measuring unit that measures the supply amount of the raw water supplied to the raw water pipe; and a control unit that calculates an extent of contamination of the filter based on a result of the measurement of the first measuring unit.

Preferably, the control unit calculates the extent of contamination of the filter by comparing the maximum purification flow amount of the filter with the supply amount of the raw water. The water cleaner further comprises a second measuring unit that measures the discharge amount of the purified water discharged to the purified water pipe, and the control unit calculates an extent of contamination of the filter

based on a result of the measurement of the first and second measuring units. The water cleaner further comprises a display unit that displays the extent of contamination of the filter calculated by the control unit. The display unit displays the extent of contamination of the filter with numerals, symbols or pictures.

Preferably, the main body comprises: a top cover to which the plurality of tanks are detachably combined; a middle plate that is attached closely to the rear side of the top cover, the plurality of passages being defined between the middle plate and the top cover; and a bottom cover that is combined to the top cover at the bottom of the middle plate. The plurality of tanks is divided into a first tank to a n -th ($n > 1$) tank, the first tank being first supplied with the raw water, and the n -th tank being last supplied with the raw water, and an inlet through which external water flows in and an outlet through which internal water flows out are provided at one side of each of the plurality of tanks combined to the top cover. An inlet hole and an outlet hole are formed in the top cover in a one-to-one correspondence to the inlet and the outlet of each tank, and the plurality of passages comprises a raw water supply passage that communicates the raw water pipe with the inlet of the first tank, $(n-1)$ passages that communicate outlets of previous tanks to inlets of next tanks from the first tank up to the n -th tank, and a purified water discharge passage that connects the outlet

of the n-th tank to the purified water pipe.

Preferably, the middle plate is formed with a raw water supply hole and a purified water discharge hole that communicate with the raw water supply passage and the purified water discharge passage, respectively, and the raw water pipe and the purified water pipe are connected to the raw water supply passage and the purified water discharge passage via the raw water supply hole and the purified water discharge hole, respectively. The raw water pipe is connected to the raw water supply hole by the first measuring unit. The first measuring unit comprises: a first flow-in port connected to the raw water pipe; a first flow-out port connected to the raw water supply hole; and a first housing containing a first impeller rotating by flow of the raw water flowing from the first flow-in port into the first flow-out port and a first counter counting the number of rotation of the first impeller, and the supply amount of the raw water is measured based on the number of rotation of the first impeller. The water cleaner further comprises a decompressing means that is mounted in the first housing and adjusts the supply pressure of the raw water delivered to the first flow-out port.

Preferably, the water cleaner further comprises a second measuring unit that measures the discharge amount of the purified water discharged to the purified water pipe, and the control unit calculates an extent of contamination of the filter

based on a result of the measurement of the first and second measuring units. The middle plate is formed with a first connecting hole that communicates with a (n-1)-th passage and a second connecting hole that communicates with a n-th passage, and the first connecting hole is connected to the second connecting hole by the second measuring unit. The second measuring unit comprises: a second flow-in port connected to the first connecting hole; a second flow-out port connected to the second connecting hole; and a second housing containing a second impeller rotating by flow of water flowing from the second flow-in port into the second flow-out port and a second counter counting the number of rotation of the second impeller, and the discharge amount of the purified water is measured based on the number of rotation of the second impeller.

Preferably, the plurality of tanks each further comprises an annular rotating flange projecting such that the inlet and the outlet are placed in an inner side of the rotating flange, the top cover further comprises an annular fixed flange projecting such that the inlet hole and the outlet hole that communicate with the inlet and the outlet of each tank in a one-to-one correspondence are placed in an inner side of the fixed flange, the rotating flange being inserted in the fixed flange, and the plurality of tanks are assembled with a one-to-one correspondence combination between the rotating flange and the fixed flange. The water cleaner further comprises: at least one

fitting end projecting from an outer surface of the rotating flange; and a screw joining part that is provided along an inner surface of the fixed flange, the fitting end being joined to the screw joining part by a screwed manner, and the rotating flange is combined with the fixed flange in a one-to-one correspondence.

Preferably, the plurality of tanks each comprises: a first check valve that covers and encloses the inlet selectively; a flow-in space that communicates with the inlet via the first check valve; a second check valve that covers and encloses the outlet selectively; and a flow-out space that communicates with the outlet via the second check valve, and the filter is interposed between the flow-in space and the flow-out space. The first and second check valves comprise first and second packings that cover and enclose the inlet and the outlet by an elastic force of a spring, respectively.

Preferably, the middle plate further comprises an inlet pin projecting to pass through the inlet hole, the top cover further comprises an outlet pin projecting upward in the fixed flange, and the first check valve is opened by the inlet pin and the second check valve is opened by the outlet pin when the tanks are assembled.

Preferably, the filter is one selected from a carbon filter, a ceramic filter and a functional filter. The functional filter comprises fine ceramic balls containing vitamin.

According to another aspect, the present invention provides a

water cleaning method of obtaining purified water in a water cleaner by passing raw water through a plurality of tanks each containing a filter, comprising the steps of: a) measuring the supply amount of the raw water supplied to the water cleaner; and b) calculating an extent of contamination of the filter based on the supply amount of the raw water by comparing the maximum purification flow amount of the filter with the supply amount of the raw water. The water cleaning method further comprises: between the a) step and the b) step, a') measuring the discharge amount of the purified water obtained in the water cleaner, and the c) step comprises calculating the extent of contamination of the filter by comparing the maximum purification flow amount of the filter with the supply amount of the raw water and the discharge amount of the purified water.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and/or other aspects and advantages of the present invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a block diagram of a water cleaner according to an embodiment of the present invention;

FIGs. 2a and 2b are external perspective views of the water cleaner according to the embodiment of the present invention;

FIG. 3 is a partially-exploded perspective view of the water

cleaner according to the embodiment of the present invention;

FIG. 4 is an internal exploded perspective view of the water cleaner according to the embodiment of the present invention;

FIGs. 5a and 5b are exploded perspective views of a main body of the water cleaner according to the embodiment of the present invention;

FIGs. 6a and 6b are a plan view and a rear side view of a top cover of the water cleaner, respectively, according to the embodiment of the present invention;

FIGs. 7a and 7b are a plan view and a rear side view of a middle plate of the water cleaner, respectively, according to the embodiment of the present invention;

FIG. 8 is a perspective view of the main body of the water cleaner according to the embodiment of the present invention;

FIG. 9 is a rear side perspective view of a tank of the water cleaner according to the embodiment of the present invention; and

FIGs. 10 to 12 are sectional views of the tank of the water cleaner according to the embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, exemplary embodiments of the present invention will be described with reference to the accompanying drawings.

FIG. 1 is a block diagram of a water cleaner according to an

embodiment of the present invention. The water cleaner generally includes a tank unit 100, a main body 200 and a controller 300.

The tank unit 100 comprises a plurality of tanks T1 to T6, each having an inlet through which external water flows in and an outlet through which internal water flows out, with a purposed-built filter. Water flowing in the tanks T1 to T6 through respective inlets passes through respective filters and then is discharged through respective outlets.

The tanks T1 to T6 are detachably combined to the main body 200. In the main body 200 are provided a raw water pipe 202 that is connected to a hydrant or the like and to which raw water is supplied, a purified water pipe 242 attached with a sluice valve such as a cock to be switched on/off by operation of a user, and a plurality of passages 222, 224, 226, 228, 230, 232 and 234 through which the raw water from the raw water pipe 202 passes through the plurality of tanks T1 to T6 in turn and then is discharged to the purified water pipe 242.

Assuming that the number of tanks T1 to T6 is n ($n > 1$), the plurality of passages 222, 224, 226, 228, 230, 232 and 234 may comprise a raw water supply passage 222 that connects the raw water pipe 202 to a first tank T1, $(n-1)$ passages 224, 226, 228, 230 and 232 that connect outlets of previous tanks T1 to T6 to inlets of next tanks T1 to T6 from the first tank T1 up to the last n -th tank T6, and a purified water discharge passage 234 that connects an outlet of the last n -th tank T6 to the purified

water pipe 242. Specifically, as shown in the figure, assuming that six tanks T1 to T6 are first to sixth tanks T1 to T6 according to an order of supply of raw water, the raw water supply passage 222 connects the raw water pipe 202 to the inlet of the first tank T1, a first passage 224 connects the outlet of the first tank T1 to the inlet of the second tank T2, a second passage 226 connects the outlet of the second tank T2 to the inlet of the third tank T3, a third passage 228 connects the outlet of the third tank T3 to the inlet of the fourth tank T4, a fourth passage 230 connects the outlet of the fourth tank T4 to the inlet of the fifth tank T5, a fifth passage 232 connects the outlet of the fifth tank T5 to the inlet of the sixth tank T6, and the purified water discharge passage 234 connects the outlet of the sixth tank T6 to the purified water pipe 242.

The controller 300 detects an extent of contamination of filters contained in the tanks T1 to T6 based on an actual use amount of purified water, and calculates and displays a replacement time of the filters based on the detected extent of contamination. To this end, the controller 300 may comprise a first measuring unit 310 that measures the amount of flow of the raw water supplied to the raw water pipe 202, a control unit 340 that calculates the extent of contamination of filters contained in the tanks T1 to T6 and the replacement time of filters based on a result of the measurement, and a display unit 350 that displays the filter replacement time calculated by the control

unit 340 for user.

Specifically, the control unit 340 calculates the extent of contamination according to a ratio of maximum purification flow amount (preset for each filter) to actually-purified flow amount based on the raw water inflow amount measured by the first measuring unit 310 and controls the display unit 350 to display a replacement time of each filter when the maximum purification flow amount approaches the actually-purified flow amount. In this case, preferably, in addition to the first measuring unit 310, a second measuring unit 360 may be also used to measure a flow amount of purified water discharged through the purified water pipe 242 so that reliability of a result of the calculation of the control unit 340 is further improved.

A supply amount of raw water first supplied to the raw water pipe 202 is measured while passing through the first measuring unit 310, the raw water is purified while passing through the first to sixth tanks T1 to T6 via the plurality of passages 222, 224, 226, 228, 230, 232 and 234 in turn, a discharge amount of the purified water is measured while passing through the second measuring unit 360, and the purified water is delivered to the user through the purified water pipe 242. In this course, the control unit 340 calculates the extent of contamination of filters based on the supply amount of raw water and the discharge amount of purified water, which are measured by the first and second measuring units 310 and 360, respectively, and

controls the display unit 350 to display a result of the calculation for the user.

Hereinafter, details of the water cleaner will be described with reference to FIG. 1 and relevant figures.

FIGs. 2a and 2b are a front side external perspective view and a rear side external perspective view of the water cleaner, respectively, according to the embodiment of the present invention. FIG. 3 is a partially-exploded perspective view of the water cleaner according to the embodiment of the present invention, showing the main body 200 placed on a floor, the tank unit 100 comprising the plurality of tanks T1 to T6 to be assembled into the main body 200, and a case 400 covering the main body 200 to secure a space to accommodate these tanks T1 to T6 and forming an external appearance of the water cleaner.

In the front side of the case 400 are provided the display unit 350, operation buttons 332, etc. These components 350 and 332 and the control unit 340 may be mounted on a printed circuit board (PCB) 330. In this case, the control unit 340 may comprise a microcomputer, the display unit 350 may comprise a liquid crystal display (LCD) device to display an extent of contamination of each filter with numerals, figures and/or pictures for the user, and the operation buttons 332 changes a picture of the display unit 350 or turns on/off the water cleaner to user's intention. The control unit 340 and the display unit 350 need driving power. To this end, a battery case

290 in which a battery 500 is accommodated may be inserted in one side of the main body 200. At the front side of the main body 200 is provided a pin connector 502 through which the driving power from the battery 500 is supplied to the water cleaner. The pin connector 502 may be combined with a socket connector 336 drawn out of the printed circuit board 330 via a cable 334. The front side of the case 400 is covered by a lid cover 402 provided with button holes 404 and a window 406 to expose the operation buttons 332 and the display unit 350, respectively, so that the printed circuit board 330, the control unit 340, the socket connector 336, the pin connector 502, etc. can be protected.

In the rear side of the main body 200 are provided a raw water pipe connecting port 254 for raw water supply and a purified water pipe connecting port 274 for purified water discharge, both of which are exposed to the outside of the water cleaner. The raw water pipe 202 is connected to the raw water pipe connecting port 254 to receive the raw water from the hydrant and the purified water pipe 242 is connected to the purified water pipe connecting port 274 to supply the purified water to the user.

The remaining components except the main body 200 and the tank unit 100, for example, the battery case 290, the printed circuit board 330, the operation buttons 332, the control unit 340, the display unit 350, the cable 334, the pin connector 336,

the socket connector 502, the case 400, etc. may be modified in their detailed shapes and mounting positions in various ways, without any limitation, according to a design of the water cleaner.

FIG. 4 is an exploded perspective view of the tank unit 100 and the main body 200 as main parts of the water cleaner according to the embodiment of the present invention, and FIGs. 5a and 5b are a top side exploded perspective view and a bottom side exploded perspective view of the main body 200 of the water cleaner, respectively.

FIG. 4 shows the tank unit 100 comprising six cylindrical tanks T1 to T6 by way of an example. Although the tanks T1 to T6 have different functions, structures and operations, which will be described in detail later, according to their respective built-in filters, they will be distinguished as the first to sixth tanks T1 to T6 according to an arrangement order as long as they are not particularly mentioned.

When the tanks T1 to T6 are combined to the main body 200, the main body 200 has a stable box shape. The main body 200 may comprise a top cover 210 into which the tanks T1 to T6 are assembled, a middle plate 250 attached closely to the rear side of the top cover 210, with the plurality of passages 222, 224, 226, 228, 230, 232 and 234 defined between the middle plate 250 and the top cover 210, and a bottom cover 280 that is provided at the bottom of the middle plate 250 and assembled with the top

cover 210, and provides a space in which the first and second measuring units 310 and 360 and the battery case 290 are mounted.

Hereinafter, the top cover 210, the middle plate 250 and the bottom cover 280 that compose the main body 200 will be described in more detail.

First, the top cover 210 is considered.

FIGs. 6a and 6b are a plan view and a rear side view of the top cover 210. Referring to FIGs. 6a and 6b in conjunction with the shown figures, the top cover 210 includes a top side 212 into which the tanks T1 to T6 are assembled and a side wall 214 projecting downward along an edge of the top side 212. The top cover 210 is a part where the tanks T1 to T6 can be assembled and disassembled and serves to connect the inlets and the outlets of the tanks T1 to T6 to the plurality of passages 222, 224, 226, 228, 230, 232 and 234 defined between the top cover 210 and the middle plate 250.

To this end, a joining structure which can be assembled and disassembled is provided in bottom portions of the tanks T1 to T6 and top portions of the top cover 210. Specifically, first to sixth rotating flanges TF1 to TF6, each of which comprises an annular lug, project downward from the bottom of the first to sixth tanks T1 to T6, respectively, and first to sixth fixed flanges CF1 to CF6, each of which comprises an annular lug and in which the first to sixth rotating flanges TF1 to TF6 are inserted respectively, project upward from the top of the top

cover 212. At least one fitting end 104 projects from an outer surface of each of the first to sixth rotating flanges TF1 to TF6. In an inner surface of each of the first to sixth fixed flanges CF1 to CF6 is provided a screw joining part 216 to which a corresponding fitting end 104 of each of the first to sixth rotating flanges TF1 to TF6 is rotatably joined by a screwed manner.

When the rotating flanges CF1 to CF6 of the tanks T1 to T6 is inserted in the fixed flanges TF1 to TF6 of the top cover 210 and then are rotated, the fitting ends 104 of the rotating flanges CF1 to CF6 are rotated and fixed along the screw joining parts 216 of the fixed flanges TF1 to TF6, and may be released from the screw joining parts 216 in a reversed process.

Referring to FIG. 9 which is a rear side perspective view of the first tank T1, in an inner side of the first rotating flange TF1 are provided a first inlet T1a through which external water flows in and a first outlet T1b through which internal water flows out. The first to sixth tanks T1 to T6 have the same shape and hence have inlets and outlets, respectively. For convenience, to distinguish between inlets and outlets assigned to the first to sixth tanks T1 to T6, a suffix a indicates an inlet and a suffix b indicates an outlet. Although all not shown in the figures, reference numerals T1a and T1b denote the first inlet and the first outlet of the first tank T1, respectively, reference numerals T2a and T2b denote the second inlet and the

second outlet of the second tank T2, respectively, reference numerals T3a and T3b denote the third inlet and the third outlet of the third tank T3, respectively, reference numerals T4a and T4b denote the fourth inlet and the fourth outlet of the fourth tank T4, respectively, reference numerals T5a and T5b denote the fifth inlet and the fifth outlet of the fifth tank T5, respectively, and reference numerals T6a and T6b denote the sixth inlet and the sixth outlet of the sixth tank T6, respectively.

Referring to FIGs. 4, 5a, 5b, 6a and 6b again, in inner surfaces of the first to sixth fixed flanges CF1 to CF6 on the top cover 210 are provided first to sixth inlet holes and outlet holes that communicate with the inlet and outlets of the first to sixth tanks T1 to T6, respectively. In this case, to distinguish between inlet holes and outlet holes assigned to the first to sixth fixed flanges CF1 to CF6, a suffix a indicates an inlet hole and a suffix b indicates an outlet hole. Although all not shown in the figures, reference numerals CF1a and CF1b denote the first inlet hole and the first outlet hole of the first fixed flange CF1, respectively, reference numerals CF2a and CF2b denote the second inlet hole and the second outlet hole of the second fixed flange CF2, respectively, reference numerals CF3a and CF3b denote the third inlet hole and the third outlet hole of the third fixed flange CF3, respectively, reference numerals CF4a and CF4b denote the fourth inlet hole and the

fourth outlet hole of the fourth fixed flange CF4, respectively, reference numerals CF5a and CF5b denote the fifth inlet hole and the fifth outlet hole of the fifth fixed flange CF5, respectively, and reference numerals CF6a and CF6b denote the sixth inlet hole and the sixth outlet hole of the sixth fixed flange CF6, respectively. When the first to sixth rotating flanges TF1 to TF6 of the first to sixth tanks T1 to T6 are assembled into the first to sixth fixed flanges CF1 to CF6 of the top cover 210, respectively, the first inlet hole CF1a and the first outlet hole CF1b communicate with the first inlet T1a and the first outlet T1b of the first tank T1, respectively, the second inlet hole CF2a and the second outlet hole CF2b communicate with the second inlet T2a and the second outlet T2b of the second tank T2, respectively, the third inlet hole CF3a and the third outlet hole CF3b communicate with the third inlet T3a and the third outlet T3b of the third tank T3, respectively, the fourth inlet hole CF4a and the fourth outlet hole CF4b communicate with the fourth inlet T4a and the fourth outlet T4b of the fourth tank T4, respectively, the fifth inlet hole CF5a and the fifth outlet hole CF5b communicate with the fifth inlet T5a and the fifth outlet T5b of the fifth tank T5, respectively, and the sixth inlet hole CF6a and the sixth outlet hole CF6b communicate with the sixth inlet T6a and the sixth outlet T6b of the sixth tank T6, respectively.

In addition, in the rear side of the top cover 210 are

provided a plurality of grooves in which the plurality of passages 222, 224, 226, 228, 230, 232 and 234 can be formed by close adhesion to the middle plate 250. Specifically, the raw water supply passage 222 communicating with the first inlet hole CF1a, the first passage 224 communicating the first outlet hole CF1b with the second inlet hole CF2a, the second passage 226 communicating the second outlet hole CF2b with the third inlet hole CF3a, the third passage 228 communicating the third outlet hole CF3b with the fourth inlet hole CF4a, the fourth passage 230 communicating the fourth outlet hole CF4b with the fifth inlet hole CF5a, the fifth passage 232 communicating the fifth outlet hole CF5b with the sixth inlet hole CF6a, and the purified water discharge passage 234 communicating with the sixth outlet hole CF6b are provided independent of each other. Although the figures show one end of the fifth passage 232, which communicates with the fifth outlet hole CF5b and the other end of the fifth passage 232, which communicates with the sixth inlet hole CF6a, with a middle portion of the fifth passage 232 disconnected, the fifth outlet hole CF5b and the sixth inlet hole CF6a are connected to each other by means of the second measuring unit 360, which will be described later.

In addition, at the side wall 214 of the top cover 210 is provided a battery receiving port 248 in which the battery case 290 is received. Also, at a proper position inside the battery receiving port 248 is provided a fixing member 298 such as a

hock for fixing and releasing at least one side of the battery case 290 by means of a spring. In addition, at the side wall 214 of the top cover 210 near the battery receiving port 248 is provided a push button 296 for fixing or releasing the insertion state of the battery case 290 by controlling the fixing member 298 through user's manipulation.

Next, the middle plate 250 is considered.

FIG. 7a is a plan view of the middle plate 250 attached closely to the rear side of the top cover 210, and FIG. 7b is a rear side view of the middle plate 250 facing the bottom plate 280.

Referring to FIGs. 5a, 5b, 6a, 6b, 7a and 7b, the middle plate 250, which is attached closely to the rear side of the top cover 201, makes the plurality of passages 222, 224, 226, 228, 230, 232 and 234 independent of each other. Also, on the middle plate 250 are mounted the first and second measuring units 310 and 360 and other connecting members. When the middle plate 250 is attached closely to the rear side of the top cover 210, a raw water supply hole 252 communicating with the raw water supply passage 222 and a purified water discharge hole communicating with the purified water discharge passage 234 protrude through the top cover 210. At this time, the raw water supply hole 252 is connected to the raw water pipe 202 via the raw water connecting port 254 and the purified water discharge hole 272 is connected to the purified water pipe 274 via the purified water

connecting port 274.

In addition, the first and second measuring units 310 and 360 are provided in the rear side of the middle plate 250. The first measuring unit 310 connects the raw water supply hole 252 to the raw water connecting port 254 and the second measuring unit 360 connects one end 232a of the fifth passage 232 defined between the second measuring unit 360 and the top cover 210 to the other end 232b. The first measuring unit 310 comprises a first flowing-in water port 312 connected to the raw water connecting port 254, a first flowing-out water port 316 connected to the raw water supply hole 252, and a first housing 314 interposed therebetween. The second measuring unit 360 comprises a first flowing-in water port 362 connected to a first connecting hole 262 perforated in the middle plate 250 to communicate with the one end 232a of the fifth passage 232 of the rear side of the top cover 210, a second flowing-out water port 366 connected to a second connecting hole 266 perforated in the middle plate 250 to communicate with the other end 232b of the fifth passage 232 of the rear side of the top cover 210, and a second housing 364 interposed therebetween.

In addition, a purified water discharge port 276 is provided at the purified water discharge hole 272 of the rear side of the middle plate 250 and is connected to the purified water connecting port 274 via a tube 278.

Although not clearly shown in the figures, in the first and

second housings 314 and 364 of the first and second measuring units 310 and 360 are mounted an impeller rotating by a moving fluid and a counter such as a lead switch for measuring the number of rotation of the impeller, thereby allowing the flow amount of water to be measured based on a result of counting by the counter. Preferably, in the first housing 314 of the first measuring unit 310 is mounted a decompressing means using a flexible diaphragm such as rubber. The decompressing means allows a supply pressure of the raw water supplied to the raw water supply hole 252 via the first flow-out water port 316 to be constant. For reference, the first measuring unit 310 is disclosed in Korean Patent Applications No. 10-2004-50984 and No. 10-2004-15194, owned by the present applicant, on the basis of which the second measuring unit 360 may be easily practiced by those skilled in the art.

Now, the bottom cover 280 will be described with reference to FIGs. 5a and 5b. In the bottom cover 280 is defined a mounting space 288 in which the battery case 290 inserted in the battery receiving port 248 is accommodated. In the mounting space 288 is provided a leaf spring 286 pushing out the battery case 290 in a direction opposite to an insertion direction.

When the battery case 290 is inserted into the mounting space 288 of the bottom cover 280 via the battery receiving port 248 of the side wall 214 of the top cover 210, at least one side of the battery case 290 is caught and fixed by a fixing member 289

of the top cover 210, with the battery case 290 elasticated by an elastic force of the leaf spring 286. When a user pushes the push button 296, the battery case 290 is pushed out by an elastic force of the lead spring 286.

FIG. 8 is a perspective view of the main body 200 of the water cleaner when viewed from an angle different from those at FIGs. 4, 5a and 5b, according to the embodiment of the present invention, showing the first to sixth fixed flanges CF1 to CF6 projecting from the top side of the top cover 210, the screw joining parts 216 provided in the inner surfaces of the first to sixth fixed flanges CF1 to CF6, and portions of the first to sixth inlet holes CF1a to CF6a and the first to sixth outlet holes CF1b to CF6b. Outlet pins 218 projecting from the top side 212 of the top cover 210 at the inner surfaces of the first to sixth fixed flanges CF1 to CF 6 and inserted in the first to sixth outlets T1b to T6b of the first to sixth tanks T1 to T6, and inlet pins 268 projecting from the top side of the middle cover 250 and inserted in the first to sixth inlets T1a to T6a of the first to sixth tanks T1 to T6 after passing through the first to sixth inlet holes CF1a to CF6a will be described later (see FIGs. 5a, 6a and 7a).

The above-described main body 200 may be summarized with a moving path of the raw water as follows.

Hydrant → raw water pipe 202 → raw water pipe connecting port 254 → first measuring unit 310 → raw water supply hole 252

→ raw water supply passage 222 → first inlet hole CF1a → first tank T1 → first outlet hole CF1b → first passage 214 → second inlet hole CF2a → second tank T2 → second outlet hole CF2b → second passage 226 → third inlet hole CF3a → third tank T3 → third outlet hole CF3b → third passage 228 → fourth inlet hole CF4a → fourth tank T4 → fourth outlet hole CF4b → fourth passage 230 → fifth inlet hole CF5a → fifth tank T5 → fifth outlet hole CF5b → one end 232a of fifth passage 232 → first connecting hole 262 → second measuring unit 360 → second connecting hole 266 → other end 232b of fifth passage 232 → sixth inlet hole CF6a → sixth tank T6 → sixth outlet hole CF6b → purified water discharge passage 234 → purified water discharge hole 272 → purified water discharge port 276 → tube 278 → purified water pipe connecting port 274 → purified water pipe 242 → user

Hereinafter, the tank unit 100 is considered.

It is shown in FIG. 9 that the first to sixth inlets T1a, T2a, T3a, T4a, T5a and T6a and the first to sixth outlets T1b, T2b, T3b, T4b, T5b and T6b are provided in the first to sixth rotating flanges TF1 to TF6 of the first to sixth tanks T1 to T6), respectively. In this case, preferably, the first to sixth inlets T1a, T2a, T3a, T4a, T5a and T6a of the tanks T1 to T6 may be located at central portions of the rotating flanges TF1 to TF6 and the first to sixth outlets T1b, T2b, T3b, T4b, T5b and

T6b may be located at outer sides of the rotating flanges TF1 to TF6.

The tanks T1 to T6 used in the water cleaner of the present invention may be generally classified into three kinds of tanks depending a built-in filter and its function, that is, a carbon tank containing a carbon filter for filtering and removing volatile organic substances contained in the raw water, a ceramic tank containing a ceramic filter for removing fine impurities contained in the raw water, and a functional tank containing a functional filter containing beneficial substances such as vitamin for improving quality of the purified water. Each of the first to sixth tanks T1 to T6 may contain at least one of the carbon filter, the ceramic filter and the functional filter, which may be selected in various ways in their order or combination according to use purpose.

FIGs. 10 to 12 are sectional views of these three kinds of tanks, respectively. For convenience, it is assumed that a carbon tank shown in FIG. 10 is the first tank T1, a ceramic tank shown in FIG. 11 is the third tank T3, and a functional tank shown in FIG. 12 is the sixth tank T6.

First, in the first tank T1 shown as the carbon tank in FIG. 10 are defined a flow-in space I communicating selectively with the first inlet T1a via a first check valve 110 and a flow-out space O communicating selectively with the first outlet T1b via a second check valve 120, with a cylindrical carbon filter C

interposed therebetween and forming two spaces separately from each other.

In more detail, as shown in the figure, inside the first tank T1 is provided a first transfer pipe 116 of a predetermined height communicating selectively with the first inlet T1a via the first check valve 110. The carbon filter C surrounding the first transfer pipe 116 is placed at a position lower than the predetermined height. The bottom side of the carbon filter C is mounted on and attached closely to a first annular carbon filter frame 115a that surrounds an outer surface of the first transfer pipe 116 and is attached closely to an inner surface of the first tank T1. The top side of the carbon filter C is covered and enclosed by a second annular carbon filter frame 115b that surrounds the outer surface of the first transfer pipe 116. With the carbon filter C as a boundary, the flow-in space I is defined by the inside of the first transfer pipe 116 and the outer side of the carbon filter C, and the flow-out space O is defined between the first transfer pipe 116 and the carbon filter C.

Between the first inlet T1a and the first transfer pipe 116 is interposed the first check valve 110 to selectively open the first inlet T1a. Between the flow-out space O and the first outlet T1b is interposed the second check valve 120 to selectively open the first outlet T1b. To this end, the first check valve 110 comprises a first circular packing 112 covering

and enclosing the first inlet T1a and a first spring 114 exercising an elastic force to allow the first packing 112 to cover the first inlet T1a, and the second check valve 120 comprises a second circular packing 122 surrounding the outer side of the first transfer pipe 116 and covering and enclosing the first outlet T1b and a second spring 124 exercising an elastic force to allow the second packing 122 to cover the first outlet T1b.

Consequently, when the first and second packings 112 and 122 are raised, they open the first inlet T1a and the second outlet T1b. Referring to FIG. 8, when the first rotating flange TF1 of the first tank T1 is inserted and fixed in the first fixed flange CF1 of the top cover 210, the first packing 122 is raised by the inlet pin 268 inserted in the first inlet T1a to open the first inlet T1a, and the second packing 112 is raised by the outlet pin 218 inserted in the first outlet T1b to open the first outlet T1b. In addition, by opening of the first and second check valves 110 and 120, the first inlet hole CF1a of the top cover 210 communicates with the first inlet T1a of the first tank T1 and the first outlet hole CF1b of the top cover 210 communicates with the first outlet T1b of the first tank T1. The raw water delivered from the first inlet hole CF1a of the top cover 210 is supplied into the first tank T1 via the first inlet T1a of the first tank T1 and then overflows the first transfer pipe 116 to be filled in the flow-in space I. While the

raw water filled in the flow-in space I flows into the flow-out space O after passing through the carbon filter C, volatile organic substances are absorbed and removed from the raw water and the resultant raw water is discharged to the first outlet hole CF1b of the top cover 210 via the first outlet T1b (see FIGs. 5a, 6a and 7a).

In FIG. 10, reference numeral 118 denotes a first hole plate that surrounds the outer side of the first transfer pipe 116 in the flow-out space O to support the second spring 124 and is formed with a plurality of first through holes h1 to prevent flow of the raw water from being obstructed. Reference numeral 126 denotes a first buffer plate that surrounds the outer side of the first transfer pipe 116 at a predetermined position on the top side of the carbon filter C so that the raw water overflowing the first transfer pipe 116 is evenly filled throughout the flow-out space O of the first tank T1.

FIG. 11 is a sectional view of the third tank T3 as the ceramic tank. As shown in this figure, a second transfer pipe 136 communicating with the third inlet T3a via a third check valve 130 is directly inserted in a ceramic filter S. Accordingly, the flow-in space I is defined by only the inside of the second transfer pipe 136 communicating selectively with the third inlet T3a via the third check valve 130, and the flow-out space O in the outside of the ceramic filter S communicates with the third outlet T3b via a fourth check valve 140.

The ceramic filter S is formed with a plurality of fine holes. The third check valve 130 comprises a third circular packing 132 covering and enclosing the third inlet T3a and a third spring 134 exercising an elastic force to allow the third packing 132 to cover the third inlet T3a, and the fourth check valve 140 comprises a fourth circular packing 142 surrounding the outer side of the second transfer pipe 136 and covering and enclosing the third outlet T3b and a fourth spring 144 exercising an elastic force to allow the fourth packing 142 to cover the third outlet T3b.

In addition, a second hole plate 138 to support the fourth spring 144 surrounds the outer side of the second transfer pipe 136 and terminates the flow-out space O. The second hole plate 138 is formed with a plurality of second through holes h2. Similarly to the above description, when the third rotating flange TF3 of the third tank T3 is inserted and fixed in the third fixed flange CF3 of the top cover 210, the third packing 132 is raised by the inlet pin 268 inserted in the third inlet T3a to open the third inlet T3a, and accordingly, the third inlet hole CF3a of the top cover 210 communicates with the third inlet T3a of the third tank T3. Also, the fourth packing 142 is raised by the outlet pin 218 inserted in the third outlet T3b to open the third outlet T3b, and accordingly, the third outlet hole CF3b of the top cover 210 communicates with the third outlet T3b of the third tank T3.

Consequently, while the raw water supplied into the third inlet hole CF3a of the top cover 210 flows into the third tank T3 via the third inlet T3a and passes through the ceramic filter S, a main filtration step of removing fine impurities is performed, and then the resultant raw water is discharged to the third outlet hole CF3b of the top cover 210 via the third outlet T3b (see FIGs. 5a, 6a, 7a and 8).

Finally, FIG. 12 is a sectional view of the sixth tank T6 as the functional tank, which is similar in its structure and operation to the carbon tank shown in FIG. 10. As shown in FIG. 12, the flow-in space I communicating selectively with the sixth inlet T6a via a fifth check valve 150 and the flow-out space O communicating selectively with the sixth outlet T6B via a sixth check valve 160 are defined with functional filters B interposed therebetween.

More specifically, inside the sixth tank T6 is provided a third transfer pipe 156 of a predetermined height communicating selectively with the sixth inlet T6a via the fifth check valve 150. A plurality of functional filters B is placed at a position lower than the predetermined height. The functional filters B contain various beneficial substances, such as vitamin, which are added to stable substances such as ceramic balls, to be dissolved into purified water for the purpose of improving quality of the purified water. The functional filters B are mounted on a third hole plate 158 that surrounds the outer side

of the third transfer pipe 156 and is formed with a plurality of third through holes h3 and an annular functional filter frame 155 that surrounds the outer side of the third transfer pipe 156 and is attached closely to an inner surface of the sixth tank T6. The flow-in space I is defined by from the sixth inlet T6b up to the inside and outside of the third transfer pipe 156 and the flow-out space O is defined below the third hole plate 150 and the functional filter frame 155.

Between the sixth inlet T6a and the third transfer pipe 156 is interposed a fifth check valve 150 comprising a fifth circular packing 152 covering and enclosing the sixth inlet T6a and a fifth spring 154 exercising an elastic force to allow the fifth packing 152 to cover the sixth inlet T6a in order to selectively open the sixth inlet T6a. Also, between the third hole plate 158 and the sixth outlet T6b is interposed a sixth check valve 160 comprising a sixth circular packing 162 surrounding the outer side of the third transfer pipe 158 and covering and enclosing the sixth outlet T6b and a sixth spring 164 exercising an elastic force to allow the sixth packing 162 to cover the sixth outlet T6b in order to selectively open the sixth outlet T6b.

Accordingly, when the sixth rotating flange TF6 of the sixth tank T6 is inserted and fixed in the sixth fixed flange CF6 of the top cover 210, the fifth packing 152 is raised by the inlet pin 268 inserted in the fifth inlet T6a to open the fifth inlet

T6a, and accordingly, the sixth inlet hole CF6a of the top cover 210 communicates with the sixth inlet T6a of the sixth tank T6 and the sixth outlet hole CF6b of the top cover 210 communicates with the sixth outlet T6b of the sixth tank T6.

Consequently, the raw water supplied from the main body 200 into the sixth inlet hole CF6a is supplied into the sixth tank T6 via the sixth inlet T6a, and then overflows the third transfer pipe 156 to be filled in the flow-in space I. While the raw water filled in the flow-in space I flows into the flow-out space O after passing through the functional filters B, beneficial substances such as vitamin are dissolved into the raw water and the resultant raw water is discharged to the sixth outlet hole CF6b of the top cover 210 via the sixth outlet T6b. In FIG. 12, reference numeral 166 denotes a second hole plate that surrounds the outer side of the third transfer pipe 156 at a predetermined position on the top side of the functional filters B so that the raw water overflowing the third transfer pipe 156 is evenly filled in the sixth tank T6.

As described above with reference to FIGs. 1, 2a, 2b, 3, 4, 5a, 5b, 6a, 6b, 7a, 7b, and 8 to 12, the reason why the check valves 110, 120, 130, 140, 150 and 160 to open/close the inlets T1a to T6a and the outlets T1b to T6b are provided in the tanks T1 to T6 of the water cleaner is to prevent any accident which may happen due to water drained out of the tanks T1 to T6 or water strongly ejected by internal high pressure of the tanks T1

to T6 when the tanks T1 to T6 are disassembled from the main body 200.

As described above, users can confirm an extent of contamination of the filters C, S and B through the display unit 350 while using the water cleaner of the present invention, and moreover, disassembles the tanks T1 to T6 and repair or replace them with new ones without difficulty at a replacement time of the filters C, S and B.

As apparent from the above description, according to the present invention, there is provided a water cleaner, which is capable of precisely detecting an extent of contamination of filters based on an actual amount of use of purified water and informing a user of the detected extent of contamination so that the user catches an correct replacement time of the filters, thereby increasing use efficiency of the filters and maintaining an optimal purification capacity.

In addition, there is provided a water cleaner with a very easy and safe filter replacement process, which is capable of allowing any users to replace and maintain filters easily and conveniently.

While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as

defined by the appended claims and equivalents thereof.

WHAT IS CLAIMED IS:

1. A water cleaner that purifies raw water and discharges purified water, comprising:

a plurality of tanks each containing a filter;

a main body that is combined with the plurality of tanks and is provided with a raw water pipe into which the raw water is supplied, a purified water pipe from which the purified water is discharged, and a plurality of passages connecting the raw water pipe to the purified water pipe via the plurality of tanks, wherein the passages cause the raw water in the raw water pipe to pass through the plurality of tanks and then to be discharged to the purified water pipe;

a first measuring unit that measures the supply amount of the raw water supplied to the raw water pipe; and

a control unit that calculates an extent of contamination of the filter based on a result of the measurement of the first measuring unit.

2. The water cleaner according to claim 1, wherein the control unit calculates the extent of contamination of the filter by comparing the maximum purification flow amount of the filter with the supply amount of the raw water.

3. The water cleaner according to claim 1, further

comprising a second measuring unit that measures the discharge amount of the purified water discharged to the purified water pipe,

wherein the control unit calculates an extent of contamination of the filter based on a result of the measurement of the first and second measuring units.

4. The water cleaner according to claim 1, further comprising a display unit that displays the extent of contamination of the filter calculated by the control unit.

5. The water cleaner according to claim 4, wherein the display unit displays the extent of contamination of the filter with numerals, symbols or pictures.

6. The water cleaner according to claim 1, wherein the main body comprises:

a top cover to which the plurality of tanks are detachably combined;

a middle plate that is attached closely to the rear side of the top cover, the plurality of passages being defined between the middle plate and the top cover; and

a bottom cover that is combined to the top cover at the bottom of the middle plate.

7. The water cleaner according to claim 6, wherein the plurality of tanks is divided into a first tank to a n-th ($n > 1$) tank, the first tank being first supplied with the raw water, and the n-th tank being last supplied with the raw water, and

wherein an inlet through which external water flows in and an outlet through which internal water flows out are provided at one side of each of the plurality of tanks combined to the top cover.

8. The water cleaner according to claim 7, wherein an inlet hole and an outlet hole are formed in the top cover in a one-to-one correspondence to the inlet and the outlet of each tank, and

wherein the plurality of passages comprises a raw water supply passage that communicates the raw water pipe with the inlet of the first tank, $(n-1)$ passages that communicate outlets of previous tanks to inlets of next tanks from the first tank up to the n-th tank, and a purified water discharge passage that connects the outlet of the n-th tank to the purified water pipe.

9. The water cleaner according to claim 8, wherein the middle plate is formed with a raw water supply hole and a purified water discharge hole that communicate with the raw water supply passage and the purified water discharge passage, respectively, and

wherein the raw water pipe and the purified water pipe are connected to the raw water supply passage and the purified water

discharge passage via the raw water supply hole and the purified water discharge hole, respectively.

10. The water cleaner according to claim 9, wherein the raw water pipe is connected to the raw water supply hole by the first measuring unit.

11. The water cleaner according to claim 10, wherein the first measuring unit comprises:

- a first flow-in port connected to the raw water pipe;
- a first flow-out port connected to the raw water supply hole;

and

- a first housing containing a first impeller rotating by flow of the raw water flowing from the first flow-in port into the first flow-out port and a first counter counting the number of rotation of the first impeller,

wherein the supply amount of the raw water is measured based on the number of rotation of the first impeller.

12. The water cleaner according to claim 11, further comprising a decompressing means that is mounted in the first housing and adjusts the supply pressure of the raw water delivered to the first flow-out port.

13. The water cleaner according to claim 8, further

comprising a second measuring unit that measures the discharge amount of the purified water discharged to the purified water pipe,

wherein the control unit calculates an extent of contamination of the filter based on a result of the measurement of the first and second measuring units.

14. The water cleaner according to claim 13, wherein the middle plate is formed with a first connecting hole that communicates with a (n-1)-th passage and a second connecting hole that communicates with a n-th passage, and

wherein the first connecting hole is connected to the second connecting hole by the second measuring unit.

15. The water cleaner according to claim 14, wherein the second measuring unit comprises:

a second flow-in port connected to the first connecting hole;
a second flow-out port connected to the second connecting hole; and

a second housing containing a second impeller rotating by flow of water flowing from the second flow-in port into the second flow-out port and a second counter counting the number of rotation of the second impeller,

wherein the discharge amount of the purified water is measured based on the number of rotation of the second impeller.

16. The water cleaner according to claim 8, wherein the plurality of tanks each further comprises an annular rotating flange projecting such that the inlet and the outlet are placed in an inner side of the rotating flange,

wherein the top cover further comprises an annular fixed flange projecting such that the inlet hole and the outlet hole that communicate with the inlet and the outlet of each tank in a one-to-one correspondence are placed in an inner side of the fixed flange, the rotating flange being inserted in the fixed flange, and

wherein the plurality of tanks are assembled with a one-to-one correspondence combination between the rotating flange and the fixed flange.

17. The water cleaner according to claim 16, further comprising:

at least one fitting end projecting from an outer surface of the rotating flange; and

a screw joining part that is provided along an inner surface of the fixed flange, the fitting end being joined to the screw joining part by a screwed manner,

wherein the rotating flange is combined with the fixed flange in a one-to-one correspondence.

18. The water cleaner according to claim 8, wherein the plurality of tanks each comprises:

a first check valve that covers and encloses the inlet selectively;

a flow-in space that communicates with the inlet via the first check valve;

a second check valve that covers and encloses the outlet selectively; and

a flow-out space that communicates with the outlet via the second check valve,

wherein the filter is interposed between the flow-in space and the flow-out space.

19. The water cleaner according to claim 18, wherein the first and second check valves comprise first and second packings that cover and enclose the inlet and the outlet by an elastic force of a spring, respectively.

20. The water cleaner according to claim 19, wherein the middle plate further comprises an inlet pin projecting to pass through the inlet hole,

wherein the top cover further comprises an outlet pin projecting upward in the fixed flange, and

wherein the first check valve is opened by the inlet pin and the second check valve is opened by the outlet pin when the

tanks are assembled.

21. The water cleaner according to claim 1, wherein the filter is one selected from a carbon filter, a ceramic filter and a functional filter.

22. The water cleaner according to claim 21, wherein the functional filter comprises fine ceramic balls containing vitamin.

23. A water cleaning method of obtaining purified water in a water cleaner by passing raw water through a plurality of tanks each containing a filter, comprising the steps of:

a) measuring the supply amount of the raw water supplied to the water cleaner; and

b) calculating an extent of contamination of the filter based on the supply amount of the raw water by comparing the maximum purification flow amount of the filter with the supply amount of the raw water.

24. The water cleaning method according to claim 23, further comprising: between the a) step and the b) step,

a') measuring the discharge amount of the purified water obtained in the water cleaner,

wherein the c) step comprises calculating the extent of

contamination of the filter by comparing the maximum purification flow amount of the filter with the supply amount of the raw water and the discharge amount of the purified water.