



(51) International Patent Classification:

F24H 1/22 (2006.01) F24H 9/20 (2006.01)
F24H 9/18 (2006.01)

(21) International Application Number:

PCT/KR2012/01 1187

(22) International Filing Date:

20 December 2012 (20.12.2012)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

10-201 1-0147238

30 December 2011 (30.12.2011)

KR

10-2012-0038687 13 April 2012 (13.04.2012)

KR

(71) Applicant: COWAY CO., LTD. [KR/KR]; 136-23,
Yugumagoksa-ro, Yugu-eup, Gongju-si, Chungcheong-
nam-do 314-895 (KR).

(72) Inventors: KA, Jin-Seong; R&D Center Seoul National
University Research Park, 60, Nakseong-daerol5-gil,
Gwanak-gu, Seoul, 151-851 (KR). NOH, Jin-Hwan; R&D
Center Seoul National University Research Park, 60, Na-

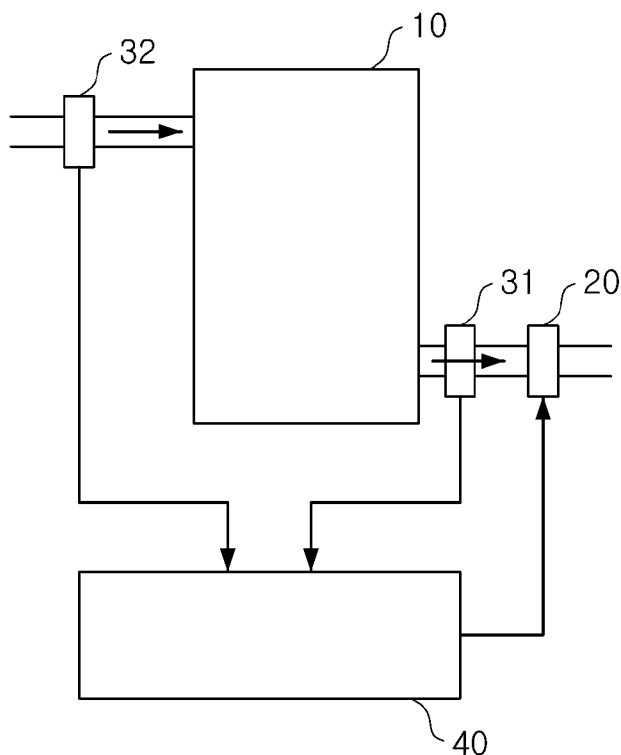
kseong-daerol5-gil, Gwanak-gu, Seoul, 151-851 (KR).
MOON, Hyun-Seok; R&D Center Seoul National Univer-
sity Research Park, 60, Nakseong-daerol5-gil, Gwanak-gu,
Seoul, 151-851 (KR). KIM, Jae-Man; R&D Center Seoul
National University Research Park, 60, Nakseong-daerol5-
gil, Gwanak-gu, Seoul, 151-851 (KR). LEE, Young-Jae;
R&D Center Seoul National University Research Park, 60,
Nakseong-daerol5-gil, Gwanak-gu, Seoul, 151-851 (KR).
MO, Byung-Sun; R&D Center Seoul National University
Research Park, 60, Nakseong-daerol5-gil, Gwanak-gu,
Seoul, 151-851 (KR). PARK, Si-Jun; R&D Center Seoul
National University Research Park, 60, Nakseong-daerol5-
gil, Gwanak-gu, Seoul, 151-851 (KR). KIM, Dae-Hwan;
R&D Center Seoul National University Research Park, 60,
Nakseong-daerol5-gil, Gwanak-gu, Seoul, 151-851 (KR).

(74) Agent: C&S PATENT AND LAW OFFICE; 7th Floor,
Daelim Acrotel, 13, Eonju-ro 30-gil, Gangnam-gu, Seoul,
135-971 (KR).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

[Continued on nextpage]

(54) Title: HOT WATER SUPPLY APPARATUS AND HOT WATER SUPPLY METHOD



(57) Abstract: There are provided a hot water supply ap-
paratus and a hot water supply method. The hot water
supply apparatus includes: a heater heating introduced
water to a heater heating capacity; an ejection valve ad-
justing an amount of water ejected from the heater; a
temperature sensor measuring an ejection temperature of
ejected water; and a controller controlling a degree of
opening of the ejection valve according to a change in
the ejection temperature value.



UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— with international search report (Art. 21(3))

(84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ,

Description

Title of Invention: HOT WATER SUPPLY APPARATUS AND HOT WATER SUPPLY METHOD

Technical Field

- [1] The present invention relates to a hot water supply apparatus and a hot water supply method, and more particularly, to a direct-type hot water supply apparatus and a direct-type hot water supply method for rapidly dispensing hot water.

[2]

Background Art

- [3] A hot water supply apparatus used in water purifiers, or the like, may be classified as a water tank-type hot water supply apparatus in which a heater is installed in a water tank or a direct-type hot water supply apparatus in which water is heated by using a heater whenever necessary.
- [4] The water tank-type hot water supply apparatus filters room temperature water supplied from a water supply with a filter, or the like, to obtain purified water appropriate for drinking, heats the purified water stored in a water tank, and supplies the heated water to a user. In this case, the water tank-type hot water supply apparatus includes a purified water tank storing filtered purified water in a room temperature state and a hot water tank storing hot water heated to a certain temperature. It may be configured such that the purified water is supplied to the hot water tank and heated by a heater installed in the hot water tank to be hot water.
- [5] However, in the water tank-type hot water supply apparatus, the temperature of water in the water tank should be maintained at a pre-set temperature, regardless of whether or not hot water is used, consuming standby power, and since the hot water tank should be further provided, sufficient space may be required. Also, in terms of the characteristics of water having high specific heat, a standby time as long as tens of seconds to a few minutes is required.
- [6] Thus, recently, a direct-type hot water supply apparatus that instantly heats and supplies water according to a hot water supply request from the user has been used, but even the direct-type hot water supply apparatus cannot provide hot water having a target temperature desired by a user during an initial stage of water ejection.

[7]

Disclosure of Invention

Technical Problem

- [8] An aspect of the present invention provides a direct-type hot water supply apparatus and a direct-type hot water supply method for rapidly dispensing hot water.

Solution to Problem

- [9] According to an aspect of the present invention, there is provided a hot water supply apparatus including: a heater heating introduced water with a heater heating capacity; an ejection valve adjusting an amount of water ejected from the heater; a temperature sensor measuring an ejection temperature of ejected water; and a controller controlling a degree of opening of the ejection valve according to a change in the ejection temperature value.
- [10] Here, the controller may calculate a difference between the ejection temperature and a target temperature and control the degree of opening of the ejection valve proportionally, according to the difference.
- [11] Here, the hot water supply apparatus may further include: a voltage detection unit detecting a supply voltage supplied from a power source, wherein the controller may calculate the heater heating capacity by using the supply voltage and set the degree of opening of the ejection valve by using the heater heating capacity and a change in the ejection temperature value.
- [12] Here, when a hot water dispensing signal for requesting dispensing of hot water is input or when a pre-set time interval has lapsed, the voltage detection unit may detect the supply voltage.
- [13] Here, the voltage detection unit may convert the supply voltage input as AC (alternating current) voltage into DC (direct current) voltage, and quantize the converted DC voltage to detect a magnitude of the supply voltage.
- [14] Here, the controller may set a proportional factor corresponding to the heater heating capacity, and set a degree of opening of the ejection valve such that it is proportional to the difference between the ejection temperature and a target temperature.
- [15] Here, when the ejection temperature is higher than the target temperature, the controller may open the ejection valve by a value proportional to a difference between the ejection temperature and the target temperature, and when the ejection temperature is lower than the target temperature, the controller may shut off the ejection valve by a value proportional to a difference between the target temperature and the ejection temperature.
- [16] Here, when the ejection temperature is equal to or lower than a pre-heat reference temperature, the controller may operate the heater for a pre-set preheating time (or a warm-up time) before opening the ejection valve.
- [17] Here, the controller may set the preheating time to be lengthened in the case that the measured ejection temperature is low.
- [18] Here, the controller may measure a usage waiting time between the last water ejection time and a next water ejection time, and set the preheating time according to

the ejection temperature.

- [19] Here, the controller may set a pre-set degree of opening as an initial degree of opening of the ejection valve.
- [20] Here, the controller may receive an inflow temperature from an injection temperature sensor measuring an inflow temperature of water injected into the heater, calculate an ejection amount of water to be ejected from the heater by using the inflow temperature, the heater heating capacity, and the target temperature, and set an initial degree of opening of the ejection valve according to the calculated ejection amount.
- [21] Here, the controller may measure a usage waiting time between the last ejection time to a next ejection time, and set an initial degree of opening of the ejection valve according to the usage waiting time and the ejection temperature.
- [22] According to another aspect of the present invention, there is provided a hot water supply method including: an initial ejection operation of setting an initial degree of opening of an ejection valve adjusting an ejection amount of water ejected from a heater and opening the ejection valve by the pre-set degree of opening, when a hot water supply signal is input; and an ejection control operation of adjusting an ejection temperature of water ejected from the heater to reach a target temperature by controlling a degree of opening of the ejection value.
- [23] The initial ejection operation may include: an initial open setting operation of setting a pre-set degree of opening as an initial degree of opening of the ejection value according to the ejection temperature; and an initial opening operation of opening the ejection value according to the set degree of opening of the ejection valve.
- [24] In the initial open setting operation, an inflow temperature of water flowing into the heater may be received, an ejection amount of water to be ejected from the heater may be calculated by using the inflow temperature, a heater heating capacity of the heater, and the target temperature, and an initial degree of opening of the ejection valve may be subsequently set according to the calculated ejection amount.
- [25] The initial ejection operation may further include: a heater heating capacity calculation operation of measuring a supply voltage supplied from a power source and calculating the heater heating capacity by using the supply voltage.
- [26] In the heater heating capacity calculation operation, when a hot water dispensing signal for requesting dispensing of hot water is input or when a pre-set time interval has lapsed, the heater heating capacity may be calculated by measuring the supply voltage.
- [27] In the heater heating capacity calculation operation, an AC supply voltage supplied from the power source may be converted into DC voltage, and the converted DC voltage may be quantized to measure a magnitude of the supply voltage.
- [28] In the initial open setting operation, a usage waiting time between the last ejection

time to a next ejection time may be measured, and an initial degree of opening of the ejection valve may be set by using the usage waiting time and the ejection temperature.

[29] The initial ejection operation may further include a preheating operation of operating the heater to heat water within the heater during a preheating time when the measured ejection temperature is equal to or lower than a preheating reference temperature.

[30] In the preheating operation, the preheating time may be set to be lengthened in the case that the measured ejection temperature is low.

[31] In the ejection control operation, a degree of opening of the ejection valve may be adjusted according to a change in the ejection temperature, wherein when the ejection temperature is higher than the target temperature, the ejection valve may be open by a value proportional to a difference between the ejection temperature and the target temperature, and when the ejection temperature is lower than the target temperature, the ejection valve may be shut off by a value proportional to a difference between the target temperature and the ejection temperature.

[32] In the ejection control operation, an ejection amount of water to be ejected from the heater may be calculated by using the inflow temperature, the heater heating capacity, and the target temperature, and a degree of opening of the ejection valve may be adjusted according to the calculated ejection amount of water.

Advantageous Effects of Invention

[33] In the case of the hot water supply apparatus and the hot water supply method according to embodiments of the present invention, hot water having a target temperature desired by a user can be provided during an initial ejection time.

[34] Also, since a control operation for extracting the target temperature is minimized, energy required for extracting hot water can be reduced.

[35] Also, since hot water is generated in consideration of a change in a heater heating capacity according to a voltage variation of a commercial AC power source, hot water having accurate target temperature can be dispensed. Also, since a heater heating capacity is calculated by directly measuring a voltage applied to the heater, hot water having a target temperature desired by a user can be provided even internationally, where the magnitudes of voltages of commercial AC power are different.

[36]

Brief Description of Drawings

[37] FIG. 1 is a block diagram illustrating a hot water supply apparatus according to an embodiment of the present invention.

[38] FIG. 2 is a flow chart illustrating a hot water supply method according to an embodiment of the present invention.

[39] FIG. 3 is a flow chart illustrating an initial ejection operation of the hot water supply

method according to an embodiment of the present invention.

[40] FIGS. 4 and 5 are graphs showing an ejection temperature of water ejected from the hot water supply apparatus according to an embodiment of the present invention.

[41]

Best Mode for Carrying out the Invention

[42] Hereinafter, embodiments will be described in detail with reference to the accompanying drawings such that they can be easily practiced by those skilled in the art to which the present invention pertains. In describing the present invention, if a detailed explanation for a related known function or construction is considered to unnecessarily divert the gist of the present invention, such explanation will be omitted but would be understood by those skilled in the art. Also, similar reference numerals are used for the similar parts throughout the specification.

[43] It will be understood that when an element is referred to as being "connected to" another element, it can be directly connected to the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly connected to" another element, no intervening elements are present. In addition, unless explicitly described to the contrary, the word "comprise" and variations such as "comprises" or "comprising," will be understood to imply the inclusion of stated elements but not the exclusion of any other elements.

[44] FIG. 1 is a block diagram illustrating a hot water supply apparatus according to an embodiment of the present invention.

[45] Referring to FIG. 1, a hot water supply apparatus according to an embodiment of the present invention may include a heater 10, an ejection valve 20, a temperature sensor 31, an injection temperature sensor 32, and a controller 40.

[46] Hereinafter, the hot water supply apparatus according to an embodiment of the present invention will be described with reference to FIG. 1.

[47] The heater 10 may heat introduced water by a heater heating capacity. The heater heating capacity, relating to power consumption of the heater 10, may be represented by watts (W). The heater 10 may uniformly heat introduced water by pre-set heater heating capacity.

[48] A quantity of heat the introduced water receives from the heater 10 may be proportional to the heater heating capacity and a time (or a period of time) during which water is heated by the heater 10. Thus, when the heater heating capacity of the heater 10 is uniformly maintained, a quantity of heat the introduced water receives from the heater 10 may be proportional to a period of time during which the water is heated by the heater 10. Here, the period of time during which the introduced water is heated by the heater 10 may be determined according to a time required for the introduced water

to be ejected from the heater through the ejection valve 20, and thus, the heating time may be adjusted according to a degree of opening of the ejection valve 20.

[49] An ON or OFF operation of the heater 10 may be controlled by the controller 40, and when a hot water dispensing signal is input, the controller 40 may turn on the heater 10 to heat introduced water by the heater heating capacity.

[50] However, when a voltage or a current supplied to the heater 10 is not uniform, the heater heating capacity may not be uniformly maintained. The heater heating capacity may be calculated by using at least two of any of a heater voltage V , a heater current I , and heater resistance R ($P = V \cdot I = V^2/R = I^2 \cdot R$), and a commercial AC power source supplying power to the heater 10 may have a voltage variation of approximately 15% in actuality. Thus, a voltage distributed to the heater 10 may be varied according to the voltage variation of the commercial AC power source, which may lead to a variation in the heater heating capacity.

[51] In general, the voltage variation of the commercial AC power source is admitted as an allowable error range so a difference in the heater heating capacity based on the voltage variation may not be considered. However, when a heating time is short, like that of a direct-type hot water supply apparatus, and it is required to supply hot water having an accurate target temperature, an error due to the voltage variation of the commercial AC power source may be required to be considered. Thus, a voltage detection unit for detecting a magnitude of a supply voltage supplied by the commercial AC power source, namely, a power source, may be additionally configured. Namely, a heating time with respect to water introduced into the heater 10 may be set in consideration of heater heating capacity based on a magnitude of a supply voltage measured by the voltage detection unit.

[52] In detail, the voltage detection unit may perform half-wave rectification, smoothing, and voltage drop on the AC voltage supplied from the power source to convert it into DC voltage, and quantizes an analog value of the DC voltage by an analog-to-digital converter (ADC) to thus obtain the supply voltage value. For example, in case of using a commercial AC 220V power source, a supply voltage supplied from the power source may be varied from 198V to 253V due to voltage variation, and the voltage detection unit may divide the voltage range by 10V intervals and measure the supply voltage by any one of 200V, 210V, 220V, 230V, 240V, and 250V. Thus, the controller 40 may calculate heater heating capacity based on the respective measured supply voltages, and set a degree of opening or closing of the ejection valve 20.

[53] However, in order to prevent power consumption in the voltage detection, the voltage detection unit may detect the voltage supply only at a pre-set time interval or only when a hot water dispensing signal is input.

[54] In addition, if a magnitude of any one of a voltage and a current supplied from the

power source is known, the heater heating capacity may be calculated, so a current detection unit detecting a supply current supplied from the power source, instead of the voltage detection unit, may also be utilized.

[55] The ejection valve 20 may adjust an amount of water ejected from the heater 10. As discussed above, by adjusting an ejection amount of water ejected from the heater 10, a period of time during which water introduced into the heater 10 is heated in the heater 10 may be adjusted. In detail, as the ejection valve 20 is more open, a time for heating the introduced water by the heater 10 may be shortened, and as the ejection value 20 is reduced, a time for heating the introduced water by the heater 10 may be lengthened. Thus, the controller 40 may control a temperature of water ejected from the heater 10 to be a target temperature by adjusting the degree of opening of the ejection valve 20.

[56] Here, the ejection valve 20 may adjust the degree of opening of the ejection valve 20 by adjusting a size of a sectional area of an open flow channel or an opening time of the ejection valve 20 according to a control signal from the controller 40.

[57] Here, the ejection valve 20 may include a flow channel blocking unit such as a disk, or the like, to block a portion or the entirety of the flow channel along which water is dispensed from the heater 10. Here, by adjusting a size of a sectional area of the flow channel blocked by the flow channel blocking unit, an amount of water ejected from the heater 10 per unit area may be adjusted.

[58] Also, the ejection valve 20 may adjust an amount of water ejected from the heater 10 per unit time by periodically repeatedly opening and closing the ejection valve 20 within a short time, and the periodical opening and closing of the ejection valve 20 may be implemented by pulse width modulation (PWM). For example, the ejection valve 20 receives a control signal having a form of a pulse having a predetermined period transmitted by the controller 40, and when a pulse is high, the ejection valve 20 is open, and when a pulse is low, the ejection valve 20 may be closed. Here, as the number of high pulses among the pulses transmitted by the controller 40 is increased, the ejection valve may eject a larger amount of water per unit time from the heater 10.

[59] Thus, an amount of ejected water per unit time, i.e., an ejection speed of water introduced into the heater 10 may be determined by using the ejection valve 20. As the ejection speed becomes faster, a period of time during which water introduced into the heater 10 is heated in the heater 10 is reduced, so a temperature of water ejected from the heater 10 may be lowered. Conversely, when the ejection speed is reduced, a period of time during which water introduced into the heater 10 remains within the heater 10 is increased, so that a heating time of the water introduced by the heater 10 is increased and a temperature of water obtained from the heater is increased.

[60] Here, a degree of opening of the ejection valve 20 may be successively adjusted from a fully degree of opening to a completely shutoff degree or the degree of opening may

be set according to a pre-set number of stages. For example, the degree of opening may be divided into four stages from a fully degree of opening to a completely shutoff degree. Namely, a first stage may be a complete shutoff, a second stage may be 1/3 open, a third stage may be 2/3 open, and a fourth stage may be completely open. In this case, the ejection valve 20 may set the degree of opening by a pre-set number of stages by using a stepping motor.

[61] Here, the ejection valve 20 may have an initial degree of opening set to control an ejection temperature at an initial ejection as the target temperature. Namely, in order to dispense water having a target temperature starting from when water is obtained from the heater 10, and an initial degree of opening of the ejection valve 20 may be set by the controller 40.

[62] The temperature sensor 31 may measure an ejection temperature of ejected water. As the temperature sensor 31, any temperature may be utilized as long as it can measure a temperature of water. As illustrated in FIG. 1, the temperature sensor 31 may be provided between the ejection valve 20 and the heater 10. Thus, when the ejection valve 20 is completely shut off, an ejection temperature measured by the temperature sensor 31 may be a temperature of water stored in the heater 10.

[63] The hot water supply apparatus according to an embodiment of the present invention may further include an injection temperature sensor 32. The injection temperature sensor 32 may measure an inflow temperature of water flowing into the heater 10. The measured inflow temperature may be used to set an initial degree of opening of the ejection valve 20 afterwards.

[64] When the hot water dispensing signal is input, the controller may operate the heater 10, and in order to eject water having the target temperature starting from the initial water ejection, the controller 40 may set an initial degree of opening of the ejection valve 20.

[65] As discussed above, an ejection temperature measured by the temperature sensor 31 may be equal to a temperature of water stored in the heater 10. Thus, by differentiating the initial degree of opening of the ejection valve 20 according to an ejection temperature in the case of the initial water ejection, the most appropriate degree of opening of the ejection valve 20 may be obtained experimentally. Namely, a pre-set degree of opening may be set as an initial degree of opening of the ejection valve 20 according to the measured ejection temperature, whereby water close to the target temperature can be ejected starting from the initial water ejection.

[66] Here, the controller 40 may measure a usage waiting time between the last water ejection time and a next water ejection time, and set the initial degree of opening of the ejection valve 20 according to the usage waiting time and the ejection temperature. Namely, the controller 40 may set the initial degree of opening in consideration of the

usage waiting time as well as the ejection temperature.

[67] Also, the controller 40 may receive an inflow temperature of water injected to the heater 10, and calculate an ejection amount of water to be ejected from the heater by using the received inflow temperature, the heater heating capacity, and the target temperature. Thus, the controller 40 may set the initial degree of opening of the ejection valve 20 by using the calculated ejection amount.

[68] For example, the controller 40 may calculate an initial ejection amount of water ejected from the heater 10 by using equation

[69]
$$V = \frac{w(\Delta t)}{(c)(\rho)(T_1 - T_2)}$$
, and may set an initial degree of opening of the

ejection valve 20 according to the calculated ejection amount. Namely, the controller 40 may set the initial degree of opening of the ejection valve 20 more accurately upon receiving the inflow temperature from the injection temperature sensor 32. Here, V is a volume of ejected water, w is heater heating capacity of the heater 10, c is a specific heat of water, p is density of water, At is a heating time, Ti is a target temperature, and T₂ is an inflow temperature.

[70] After the initial water ejection, the controller 40 may control a degree of opening of the ejection valve according to a change in the ejection temperature value.

[71] As discussed above, a temperature of water flowing into the heater 10 may be increased in proportion to the heater heating capacity and a heating time by the heater 10.

[72] In general, the heater heating capacity is uniformly maintained, so the controller 40 may control the heating time during which the introduced water is heated by the heater by adjusting the degree of opening of the ejection valve 20. Thus, the controller 40 may control a temperature of water ejected from the heater 10 such that it is the target temperature by adjusting the degree of opening of the ejection valve 20 according to the ejection temperature measured by the temperature sensor 31.

[73] In detail, the controller 40 may obtain a difference between the ejection temperature and the target temperature and control a degree of opening of the ejection valve 20 such that the degree of opening is proportional to the difference. Namely, when the ejection temperature is higher than the target temperature, the controller 40 may open the ejection valve by a degree proportional to the difference between the ejection temperature and the target temperature, and when the ejection temperature is lower than the target temperature, the controller 40 may shut off the ejection valve by a degree proportional to the difference between the target temperature and the ejection temperature. Here, in adjusting the degree of opening of the ejection valve 20, the degree

of opening of the ejection valve 20 may be set by using a proportional expression generated according to the difference between the ejection temperature and the target temperature or by using a table created experimentally according to the ejection temperature.

[74] However, as mentioned above, the heater heating capacity of the heater 10 may be varied by a voltage variation of the commercial AC power source. Thus, in order to more accurately adjust the temperature, preferably, the initial degree of opening of the ejection valve 20 is set in consideration of even a change in the heater heating capacity due to a voltage variation of the commercial AC power source.

[75] To this end, the heater 10 may further include a voltage detection unit detecting a supply voltage supplied from the power source, and the controller 40 may obtain the heater heating capacity from the supply voltage. In detail, a heater voltage value actually applied to the heater 10 may be obtained from the supply voltage, and an actual heater heating capacity of the heater 10 may be calculated by using the heater voltage. Namely, the controller 40 may calculate the actual heater heating capacity by substituting a resistance value and the heater voltage of the heater 10 to $P = V \cdot I = V^2/R$.

[76] First, in order to set an initial degree of opening of the ejection valve 20 corresponding to the ejection temperature, the controller 40 may use the actual calculated heater heating capacity. Namely, although the ejection temperature is the same, if the measured heater heating capacity is different, the initial degree of opening may be differed, and the most appropriate degree of opening of the ejection valve 10 may be experimentally obtained according to the ejection temperature at the initial water ejection time and the measured heater heating capacity. Thus, the degree of opening set according to the measured ejection temperature and heater heating capacity may be set as an initial degree of opening of the ejection valve 20, whereby water close to the target temperature can be ejected starting from the initial water ejection time.

[77] Also, when the inflow temperature of water injected into the heater 10 is received, an initial ejection amount V of water ejected from the heater 10 may be calculated by substituting the actually calculated heater heating capacity to the heater heating capacity w in the above equation

$$V = \frac{w(\Delta t)}{(c)(\rho)(T_1 - T_2)} \quad . \text{ In this case ' the heater}$$

heating capacity may be calculated based on a voltage actually applied to the heater 10, based on which an initial degree of opening of the ejection valve 20 is adjusted, whereby the temperature can be more accurately adjusted.

[78] After the initial water ejection, the controller 40 may utilize the actually calculated

heater heating capacity to adjust a degree of opening of the ejection valve 20 according to a change in the ejection temperature value. In detail, a proportional factor in proportion to the heater heating capacity may be set, and a degree of opening of the ejection valve 40 may be set in proportion to a difference between the ejection temperature and the target temperature. In adjusting the degree of opening of the ejection valve 20, the degree of opening of the ejection valve 20 may be set by using a proportional expression generated according to the heater heating capacity and the difference between the ejection temperature and the target temperature or by using a table created experimentally according to the heater heating capacity and the ejection temperature.

- [79] For example, a supply voltage measured by the voltage detection unit may be quantized to 200V, 210V, 220V, 230V, 240V, and 250V, and there may be a proportional factor previously set according to each supply voltage value. Thus, the degree of opening of the ejection valve 20 may be adjusted by using the proportional factor and the ejection temperature. Here, the proportional factor may be experimentally obtained.
- [80] Here, the controller 40 directly calculates the heater heating capacity based on the supply voltage measured by the voltage detection unit, so it can perform controlling according to a voltage variation of the commercial AC power. Thus, hot water having a target temperature desired by a user can be provided without performing a set-up process even internationally, where the voltage range of the commercial AC power is different. Namely, consistency can be provided even internationally, where the voltage range of the commercial AC power is different.
- [81] However, the hot water supply apparatus is a direct-type hot water supply apparatus, so although the initial degree of opening of the ejection valve 20 is set according to the ejection temperature, heating of introduced water may not be sufficient and water not having a target temperature may be provided. However, the user ejects water in his expectation that the hot water supply apparatus provides water having the target temperature, so it is essential for the hot water supply apparatus to provide water having the target temperature even in an initial water ejection time.
- [82] Thus, when a temperature of water stored in the heater 10 is lower than a preheating reference temperature, the controller 40 may operate the heater 10 during a preheating period of time before the ejection valve 20 is open.
- [83] Namely, before water stored in the heater 10 is ejected, water stored in the heater 10 may be initially heated to perform preheating to increase a temperature, and thereafter, water may start to be ejected. In this case, a response time may be delayed by a time taken for the preheating after the user inputs a hot water dispensing signal requesting supply of hot water, but the target temperature of water desired by the user may be

provided starting from the initial water ejection time.

[84] Here, the hot water supply apparatus may supply hot water again soon after hot water was supplied to the user. In this case, since a temperature of water present in the heater 10 is already close to the target temperature, preheating may not be required. Conversely, the hot water supply apparatus may supply hot water long after it has supplied hot water to the user. For example, the hot water supply apparatus may supply hot water two hours after it initially supplied hot water. In this case, the water present in the heater 10 may have become cold, having a significant difference from the target temperature.

[85] Thus, the controller 40 may check a temperature of water stored in the heater 10 by using the temperature sensor 31, and only when a temperature of stored water is lower than a preheating reference temperature, e.g., 60 degrees or below.

[86] Also, the controller 40 may set the preheating time such that the preheating time is lengthened as a temperature of water stored in the heater 10, i.e., as an ejection temperature, is lower. Since a difference between the ejection temperature and the target temperature is increased, the preheating time may be set to be lengthened to sufficiently heat water stored in the heater 10. Conversely, when the ejection temperature is high, since the temperature is close to the target temperature, water stored in the heater 10 may be heated for a short period of time, sufficient to reach the target temperature.

[87] In addition, the controller 40 may measure a usage waiting time between the last water ejection time and a next water ejection time, and set the preheating time and a degree of opening of the ejection valve 20 according to the measured ejection temperature.

[88] When an input of the hot water dispensing signal is stopped, the hot water supply apparatus may completely shut off the ejection valve 20 in order to cut off hot water supply, and in this case, the water stored in the heater 10 may be in a state of having been heated to the target temperature. In this case, however, when the hot water supply apparatus no longer operates afterwards, the temperature of water stored in the heater 10 may be decreased over time. Thus, a degree of opening of the ejection valve 20 may be set in consideration of the usage waiting time as well as a temperature difference between the target temperature and the ejection temperature.

[89] In addition, in order to dispense water having the target temperature quickly, the controller 40 may adjust a degree of opening of the ejection valve 20 according to a variation of the ejection temperature value. A specific operation in relation to the operation of the controller 40 will be described with reference to FIGS. 4 and 5.

[90] FIG. 4(a) is a graph showing an ejection temperature in case of a first water ejection. Namely, FIG. 4(a) shows a graph in case that hot water is ejected after a certain time

has passed since water was lately ejected. Referring to FIG. 4(a), it can be seen that the ejection temperature is converged into the target temperature, and this may be obtained by controlling the degree of opening of the ejection valve as discussed above.

[91] In this case, however, as shown in FIG. 4(a), the ejection temperature may fluctuate up and down based on the target temperature during the process in which the ejection temperature is converged into the target temperature, and according to fluctuation of the ejection temperature, the user may be supplied with very hot water or cold water unexpectedly. Also, a time required for the ejection temperature to be stabilized to the target temperature may be lengthened. Thus, the ejection valve 20 is required to be controlled in order to minimize fluctuation of the ejection temperature curve.

[92] FIG. 4(b) is a graph showing an ejection temperature in case of a continuous water ejection. Since hot water is continuously dispensed, the ejection temperature is not sharply increased at an initial stage as that of FIG. 4(b), but fluctuation appears in the ejection temperature curve. Thus, the ejection valve 20 is required to be controlled to minimize the fluctuation.

[93] Therefore, the controller 40 may calculate a variation in the ejection temperature values, and adjust a degree of opening of the ejection valve 20 according to the calculated variation, thus minimizing fluctuation.

[94] First, the controller 40 may calculate a difference between the ejection temperature and the target temperature, and determine whether the hot water dispensing is a first water ejection or a continuous water ejection, according to the difference value.

[95] For example, when the difference between the ejection temperature and the target temperature is equal to or greater than a pre-set value, the controller 40 may determine that the hot water extraction is a first water ejection, and when the difference between the ejection temperature and the target temperature is smaller than the pre-set value, the controller 40 may determine that the hot water extraction is a continuous water ejection.

[96] Here, the difference between the ejection temperature and the target temperature may be obtained in an initial period when the hot water dispensing starts, and in this case, the first water ejection and the continuous water ejection may be obviously discriminated.

[97] Namely, in case of the first water ejection, a temperature of water stored in the heater 10 may be close to room temperature (approximately 26 degrees Celsius), but in the case of the continuous water ejection, since water has been already heated, the temperature of water stored in the heater 10 may nearly be equal to the target temperature (85 degrees Celsius).

[98] Thus, based on the difference between the ejection temperature and the target temperature, first water ejection and continuous water ejection may be discriminated, and

the ejection valve 20 may be differently controlled according to the first water ejection and the continuous water ejection.

[99] When the hot water extraction is first water ejection, the controller 40 may calculate a variation of the ejection temperature, and a degree of opening of the ejection valve 20 may be adjusted according to a variation of the ejection temperature.

[100] The variation of the ejection temperature may be obtained by measuring the ejection temperature value at every pre-set time interval, and calculating differences between the measured ejection temperature values. Here, when the calculated variation of the ejection temperature is equal to or greater than a first reference variation, it may be considered that the ejection temperature is rapidly increased, and in this case, a number of fluctuations and a fluctuation amplitude of the ejection temperature curve may be increased.

[101] Thus, when the variation is determined to be the rapid increase, a degree of opening of the ejection valve 20 may be fixed to a degree of opening at a point in time when the variation is calculated, and the fixed degree of opening may be maintained for a first pre-set period of time. Namely, in order to lower the variation of the ejection temperature, controlling of the degree of opening of the ejection valve 20 according to the ejection temperature may be stopped for the first pre-set period of time, whereby the variation of the ejection temperature may be reduced as shown in FIG. 5.

[102] Referring to FIG. 4(a), even in the case of the first water ejection, the ejection temperature may be gradually increased with the lapse of time and a difference between the ejection temperature and the target temperature may be less than the pre-set value. Thus, in this case, the controller 40 may control the degree of opening of the ejection valve 20 in the same manner as that of the continuous water ejection. Hereinafter, an operation of the controller 40 in the case of continuous water ejection will be described.

[103] When the hot water extraction is determined to be the continuous water ejection, as discussed above, a variation of the ejection temperature may be calculated and whether the variation is equal to or greater than a second reference variation. The second reference variation may be a value smaller than the first reference variation. When the variation is equal to or greater than the second reference variation, it may be considered that the ejection temperature is gently increased.

[104] When the ejection temperature is gently increased, it may be anticipated that a fluctuation amplitude and the number of fluctuations of the ejection temperature curve are increased, and thus, the degree of opening of the ejection valve 20 may be fixed to the degree of opening at the timing at which the variation was calculated. Here, a fixed period of time may be a second pre-set period of time shorter than the first-pre set period of time, and the variation of the ejection temperature may be reduced by

stopping control of the ejection valve 20.

[105] Thus, by adjusting a degree of opening of the ejection valve 20 according to the variation of the ejection temperature, the ejection temperature can be quickly converged into the target temperature, and by shortening a control time of the ejection valve 20, energy consumption according to control of the ejection valve 20 can be saved.

[106] Although not shown, a water purifier may include the hot water supply apparatus. The water purifier may include a purification filter filtering tap water supplied from a mains water supply, and water purified by the purification filter may be introduced to the heater 10. Thereafter, the purified water may be heated in the heater 10 and subsequently ejected through the ejection valve 20 so as to be provided to the user. Here, the controller 40 may control a degree of opening of the ejection valve 20 to adjust a temperature of the dispensed water to the target temperature. Similarly, the controller 40 may adjust a degree of opening of the ejection valve 20 by using the temperature sensor 31 and the injection temperature sensor 32, and preheat water introduced into the heater 10 by controlling the heater 10 and the ejection valve 20.

[107] FIG. 2 is a flow chart illustrating a hot water supply method according to an embodiment of the present invention, and FIG. 3 is a flow chart illustrating an initial ejection operation of the hot water supply method according to an embodiment of the present invention.

[108] Referring to FIGS. 2 and 3, a hot water supply apparatus according to an embodiment of the present invention may include an initial eject operation (S10) and an ejection control operation (S20). The initial eject operation (S10) may include an initial opening setting process (S11), a preheating process (S12), and an initial opening process (S13).

[109] Hereinafter, a hot water supply method according to an embodiment of the present invention will be described with reference to FIGS. 2 and 3.

[110] In the initial eject operation (S10), when a hot water supply signal is input, an initial degree of opening of the ejection valve for adjusting an ejection amount of water ejected from the heater is set, and the ejection valve may be open by the pre-set degree of opening. The initial eject operation (S10) is an operation in which the heater starts to eject water according to the input hot water supply signal. In this operation, an initial degree of opening of the ejection valve may be set in order to dispense water having a target temperature starting from an initial water ejection.

[111] In detail, the initial eject operation (S10) may include an initial opening setting operation (S11) and an initial opening operation (S13).

[112] In the initial opening setting operation (S11), a pre-set degree of opening may be set as an initial degree of opening of the ejection valve according to the ejection tem-

perature.

[113] The ejection temperature may be measured by using the temperature sensor positioned between the heater and the ejection valve. Before the ejection valve is open, the ejection temperature may be a temperature of water stored in the heater. Thus, a temperature of water stored in the heater may be measured by using the ejection temperature before the ejection valve is open, and an initial degree of opening of the ejection valve may be set according to the measured temperature of water.

[114] In detail, a temperature of water stored in the heater may vary depending how long it has passed starting from the last water ejection, so the initial degree of opening is required to be changed according to a temperature of water stored in the heater.

[115] For example, when one minute has passed since water was finally ejected, a temperature of the stored water may be close to the target temperature, so there is no need to heat water for a long time, and thus, the initial degree of opening may be set to allow a relatively large amount of water to be ejected.

[116] Meanwhile, when two hours have passed since water was finally ejected, a temperature of the stored water may be significantly different from the target temperature, so the water may be required to be heated by the heater for a long period of time. In this case, the initial degree of opening may be set to allow a relatively small amount of water to be ejected.

[117] Here, as for the initial degree of opening depending on the ejection temperature, the most appropriate initial degree of opening may be experimentally obtained by varying the initial degree of opening of the ejection valve according to the measured ejection temperature, whereby initial degree of openings of the ejection valve according to respective ejection temperatures may be set in advance.

[118] In addition, as discussed above, the temperature of water stored in the heater may vary according to a degree of elapsed time starting from the last water ejection time, i.e., a usage waiting time between the last water ejection time and a next water ejection time. Thus, in the initial opening setting operation (SI 1), a usage waiting time between the last water ejection time a next water ejection time is measured and the initial degree of opening of the ejection valve may be set by using the usage waiting time and the ejection temperature.

[119] In the initial opening setting operation (SI 1), besides the ejection temperature, an inflow temperature of water introduced into the heater may be further received, based on which the initial degree of opening of the ejection valve may be set.

[120] In detail, an initial ejection amount of the heater required to eject water having the target temperature may be calculated by using an equation

$$V = \frac{w(\Delta t)}{(c)(\rho)(T_1 - T_2)}, \text{ and the initial degree of opening of the ejection}$$

valve may be set according to the calculated initial ejection amount of the heater.

Namely, the initial degree of opening of the ejection valve may be set more accurately upon receiving the inflow temperature. Here, V is a volume of ejected water, w is a heater heating capacity of the heater 10, c is a specific heat of water, p is a density of water, Δt is a heating time, T_i is a target temperature, and T_2 is an inflow temperature.

[121] In this case, however, the initial degree of opening is set on the assumption that the heater heating capacity of the heater is uniform, but in actuality, the heater heating capacity of the heater may vary according to a voltage variation of the commercial AC power source supplying power to the heater. Thus, in order to set a more accurate initial opening degree of the ejection valve, a change in the heater heating capacity is required to be taken into consideration.

[122] To this end, the initial ejection operation (S10) may further include a heater heating capacity calculation operation (not shown), and in the heater heating capacity calculation operation, a supply voltage supplied from the power source may be measured and the heater heating capacity may be calculated by using the supply voltage.

[123] In detail, in the heater heating capacity calculation operation, the AC supply voltage supplied from the power source may be converted into DC voltage, and the converted DC voltage may be quantized to detect the supply voltage. Namely, the AC voltage supplied from the power source is half-wave rectified, smoothed, and voltage-dropped so as to be converted into DC voltage, and thereafter, the DC voltage is quantized by an ADC to thus measure the supply voltage. Thus, when commercial AC power having 220V varied from 198V to 253V is supplied, the power is divided by 10V intervals so as to be measured as any one of 200V, 210V, 220V, 230V, 240V, and 250V. Since a resistance value of the heater is uniform, when the supply voltage is measured, a heater voltage value applied to the heater may be obtained, and the heater heating capacity may be easily calculated by using $P = V \cdot I = V^2/R$.

[124] Thereafter, in the initial opening setting operation (SI 1), a degree of opening of the ejection valve may be set by using the heater heating capacity calculated during the heater heating capacity calculation operation. In detail, in the initial opening setting operation (SI 1), although an ejection temperature is uniform, if the calculated heater heating capacity is different, the degree of opening of the ejection valve may be changed, and the most appropriate degree of opening of the ejection valve may be experimentally obtained according to the ejection temperature at the initial water ejection time and the measured heater heating capacity. Thus, a pre-set degree of opening may be set to the initial degree of opening of the ejection valve according to the measured ejection temperature and the heater heating capacity.

[125] Also, when an inflow temperature of water injected to the heater is received, an initial ejection amount V of water ejected from the heater 10 may be calculated by sub-

stituting the actually calculated heater heating capacity to the heater heating capacity w in the above equation . In this case, the heater

$$V = \frac{w(\Delta t)}{(c)(\rho)(T_1 - T_2)}$$

heating capacity may be calculated based on a voltage actually applied to the heater 10, based on which an initial degree of opening of the ejection valve 20 is adjusted, whereby the temperature can be more accurately adjusted.

[126] In addition, in the heater heating capacity calculation operation, at every pre-set time intervals or when a hot water dispensing signal is input, a voltage supplied from the power source, namely, a supply voltage, may be measured. This is to reduce power consumption required for measuring the supply voltage.

[127] Although the initial degree of opening of the ejection valve for dispensing water having the target temperature has been set in the initial opening setting operation (SI 1), if a temperature of water stored in the heater is excessively low, dispensed water may not have been sufficiently heated, and thus, water not having the target temperature may be provided.

[128] Thus, the initial ejection operation (S10) further includes a preheating operation (S12). When a measured ejection temperature is lower than a preheating reference temperature, the heater may be operated to heat water stored in the heater during a preheat period of time. When water stored in the heater is lower than the preheating reference temperature, the water is preheated before being ejected. Thus, when water is ejected after the preheating operation (S12), the water having the target temperature may be ejected starting from the initial water ejection time.

[129] In detail, when the measured ejection temperature is lower than 60 degrees Celsius, the preheating operation (S12) may be performed, and in the case that the measured ejection temperature is low, the preheating time is set to be lengthened to sufficiently preheat water of the heater.

[130] Here, the initial opening setting operation (SI 1) and the preheating operation (S12) may be simultaneously performed, or the preheating operation (S12) may be first performed and, in the initial opening setting operation (SI 1), the initial degree of opening of the ejection valve may be set in consideration of a temperature of the water preheated during the preheating operation (S12).

[131] In the initial opening operation (S13), the ejection valve may be open according to the pre-set degree of opening of the ejection value. Water having the target temperature may be provided by the initial opening setting operation (SI 1) and the preheating operation (S12), and thereafter, the ejection control operation (S20) may be performed in order to continuously provide water having the target temperature even while water

is being ejected.

[132] In the ejection control operation (S20), water ejected from the heater may be adjusted to have the target temperature by controlling the degree of opening of the ejection valve.

[133] Here, the degree of opening of the ejection valve may be adjusted according to a change in the ejection temperature value. In detail, when the ejection temperature is higher than the target temperature, the ejection valve may be open by a degree in proportion to a difference between the ejection temperature and the target temperature, and when the ejection temperature is lower than the target temperature, the ejection valve may be shut off by a degree in proportion to a difference between the target temperature and the ejection temperature.

[134] When the heater heating capacity of the heater is uniform, a temperature of water ejected from the heater may be increased in proportion to a length of a period of time during which water is heated by the heater. As the ejection valve is opened more widely, an amount of ejected water per unit time is increased, and thus, a period of time during which water is heated by the heater is shortened. Meanwhile, when the ejection valve is closed, an amount of ejected water per unit time is reduced, and thus, a period of time during which water is heated by the heater is lengthened.

[135] Thus, in the ejection control operation (S20), a temperature of water ejected from the heater may be adjusted by adjusting the degree of opening of the ejection valve, and a temperature of water ejected from the heater may be adjusted to reach the target temperature.

[136] Also, in the ejection control operation (S20), an inflow temperature of water introduced to the heater may be received, and a degree of opening of the ejection valve may be adjusted by using the inflow temperature, the heater heating capacity of the heater, and the target temperature.

[137] In detail, in order to eject water having the target temperature by using the inflow temperature, the heater heating capacity, and the target temperature, a required ejection amount may be calculated, and a degree of opening of the ejection valve may be adjusted based on the calculated ejection amount.

[138] For example, an ejection amount of the heater required to eject water having the target temperature may be calculated by using an equation

$$V = \frac{w(\Delta t)}{(c)(\rho)(T_1 - T_2)}, \text{ and a degree of opening of the ejection valve may}$$

be set according to the calculated ejection amount. Namely, a degree of opening of the ejection value may be more accurately set upon receiving the inflow temperature.

Here, V is a volume of ejected water, w is heater heating capacity of the heater 10, c is a specific heat of water, p is density of water, Δt is a heating time, T_1 is a target temperature, and T_2 is an inflow temperature.

[139] In this case, however, as discussed above, the heater heating capacity may vary, so, in order to control a temperature more accurately, a degree of opening of the ejection valve may be adjusted by using the actual heater heating capacity of the heater measured during the heater heating capacity calculation operation.

[140] In detail, a proportional factor in proportion to the heater heating capacity may be set, and a degree of opening of the ejection valve in proportion to a difference between the ejection temperature and the target temperature may be set. To this end, the heater heating capacity and a proportional expression generated according to a difference between the ejection temperature and the target temperature may be used, or a table experimentally created according to the heater heating capacity and the ejection temperature may be used.

[141] Also, when a temperature of water injected into the heater is input, an ejection amount of the heater may be calculated by substituting the actually calculated heater heating capacity to the heater heating capacity (w) in the equation

$$V = \frac{w(\Delta t)}{(c)(p)(T_1 - T_2)} .$$

[142] In the ejection control operation (S20), in order to rapidly dispense water having the target temperature, a degree of opening of the ejection valve may be adjusted by using a variation of the ejection temperature value.

[143] FIG. 4(a) is a graph showing an ejection temperature in case of a first water ejection. Namely, FIG. 4(a) shows a graph in case that hot water is ejected after a certain time has passed since water was lately ejected. Referring to FIG. 4(a), it can be seen that the ejection temperature is converged into the target temperature, and this may be obtained by controlling the degree of opening of the ejection valve as discussed above.

[144] In this case, however, as shown in FIG. 4(a), the ejection temperature may fluctuate up and down based on the target temperature during the process in which the ejection temperature is converged into the target temperature, and according to fluctuation of the ejection temperature, the user may be supplied with very hot water or cold water unexpectedly. Also, a time required for the ejection temperature to be stabilized to the target temperature may be lengthened. Thus, the ejection valve is required to be controlled in order to minimize fluctuation of the ejection temperature curve.

[145] FIG. 4(b) is a graph showing an ejection temperature in case of a continuous water ejection. Since hot water is continuously dispensed, the ejection temperature is not

sharply increased at an initial stage as that of FIG. 4(b), but fluctuation appears in the ejection temperature curve. Thus, the ejection valve is required to be controlled to minimize the fluctuation.

[146] Thus, in the ejection control operation (S20), a variation of the ejection temperature value, and a degree of opening of the ejection valve is adjusted according to the calculated variation to thus minimize the fluctuation.

[147] First, in the ejection control operation (S20), a difference between the ejection temperature and the target temperature is calculated, and whether the hot water dispensing is a first water ejection or a continuous water ejection may be determined according to the difference.

[148] When the difference between the ejection temperature and the target temperature is equal to or greater than a pre-set value, the hot water dispensing may be determined to be the first water ejection, and when the difference between the ejection temperature and the target temperature is smaller than the pre-set value, the hot water dispensing may be determined to be the continuous water ejection.

[149] Here, the difference between the ejection temperature and the target temperature may be obtained at an initial timing at which hot water dispensing starts, and in this case, the first water ejection and the continuous water ejection may be obviously discriminated.

[150] Namely, in the case of the first water ejection, a temperature of water stored in the heater may be close to room temperature (approximately 26 degrees Celsius), but in the case of the continuous water ejection, since water has been already heated, the temperature of water stored in the heater 10 may nearly be the target temperature (85 degrees Celsius).

[151] Thus, based on the difference between the ejection temperature and the target temperature, first water ejection and continuous water ejection may be discriminated, and the ejection valve 20 may be differently controlled according to the first water ejection and the continuous water ejection.

[152] When the hot water extraction is first water ejection, the controller 40 may calculate a variation of the ejection temperature, and a degree of opening of the ejection valve 20 may be adjusted according to a variation of the ejection temperature.

[153] The variation of the ejection temperature may be obtained by measuring the ejection temperature value at every pre-set time interval, and calculating differences between the measured ejection temperature values. Here, when the calculated variation of the ejection temperature is equal to or greater than a first reference variation, it may be considered that the ejection temperature is rapidly increased, and in this case, a number of fluctuations and a fluctuation amplitude of the ejection temperature curve may be increased.

- [154] Thus, when the variation is determined to be the rapid increase, a degree of opening of the ejection valve 20 may be fixed to a degree of opening at a point in time when the variation is calculated, and the fixed degree of opening may be maintained for a first pre-set period of time. Namely, in order to lower the variation of the ejection temperature, controlling of the degree of opening of the ejection valve 20 according to the ejection temperature may be stopped for the first pre-set period of time, whereby the variation of the ejection temperature may be reduced as shown in FIG. 5.
- [155] Referring to FIG. 4(a), even in the case of the first water ejection, the ejection temperature may be gradually increased with the lapse of time and a difference between the ejection temperature and the target temperature may be less than the pre-set value. Thus, in this case, the controller 40 may control the degree of opening of the ejection valve 20 in the same manner as that of the continuous water ejection. Hereinafter, a control method in the case of continuous water ejection will be described.
- [156] When the hot water extraction is determined to be continuous water ejection, as discussed above, a variation of the ejection temperature may be calculated and whether the variation is equal to or greater than a second reference variation. The second reference variation may be a value smaller than the first reference variation. When the variation is equal to or greater than the second reference variation, it may be considered that the ejection temperature is gently increased.
- [157] When the ejection temperature is gently increased, it may be anticipated that a fluctuation amplitude and the number of fluctuations of the ejection temperature curve are increased, and thus, the degree of opening of the ejection valve 20 may be fixed to the degree of opening at the timing at which the variation was calculated. Here, a fixed period of time may be a second pre-set period of time shorter than the first-pre set period of time, and the variation of the ejection temperature may be reduced by stopping control of the ejection valve 20.
- [158] Thus, by adjusting a degree of opening of the ejection valve 20 according to the variation of the ejection temperature, the ejection temperature can be quickly converged into the target temperature, and by shortening a control time of the ejection valve 20, energy consumption according to control of the ejection valve 20 can be saved.
- [159] While the present invention has been shown and described in connection with the embodiments, it will be apparent to those skilled in the art that modifications and variations can be made without departing from the spirit and scope of the invention as defined by the appended claims.

Claims

- [Claim 1] A hot water supply apparatus comprising:
a heater heating introduced water with a heater heating capacity;
an ejection valve adjusting an amount of water ejected from the heater;
a temperature sensor measuring an ejection temperature of ejected water; and
a controller controlling a degree of opening of the ejection valve according to a change in the ejection temperature value.
- [Claim 2] The hot water supply apparatus of claim 1, wherein the controller calculates a difference between the ejection temperature and a target temperature and controls the degree of opening of the ejection valve proportionally, according to the difference.
- [Claim 3] The hot water supply apparatus of claim 1, further comprising a voltage detection unit detecting a supply voltage supplied from a power source, wherein the controller calculates the heater heating capacity by using the supply voltage and sets the degree of opening of the ejection valve by using the heater heating capacity and a change in the ejection temperature value.
- [Claim 4] The hot water supply apparatus of claim 3, wherein when a hot water dispensing signal for requesting an extraction of hot water is input or when a pre-set time interval has lapsed, the voltage detection unit detects the supply voltage.
- [Claim 5] The hot water supply apparatus of claim 3, wherein the voltage detection unit converts the supply voltage input as AC (alternating current) into DC (direct current) voltage, and quantizes the converted DC voltage to detect a magnitude of the supply voltage.
- [Claim 6] The hot water supply apparatus of claim 3, wherein the controller sets a proportional factor corresponding to the heater heating capacity, and sets a degree of opening of the ejection valve such that it is proportional to the difference between the ejection temperature and a target temperature.
- [Claim 7] The hot water supply apparatus of claim 2, wherein when the ejection temperature is higher than the target temperature, the controller opens the ejection valve by a value proportional to a difference between the ejection temperature and the target temperature, and
when the ejection temperature is lower than the target temperature, the controller shuts off the ejection valve by a value proportional to a

- difference between the target temperature and the ejection temperature.
- [Claim 8] The hot water supply apparatus of claim 2, wherein when the ejection temperature is equal to or lower than a pre-heat reference temperature, the controller operates the heater for a pre-set preheating time before opening the ejection valve.
- [Claim 9] The hot water supply apparatus of claim 8, wherein the controller sets the preheating time to be lengthened in the case that the measured ejection temperature is low.
- [Claim 10] The hot water supply apparatus of claim 8, wherein the controller measures a usage waiting time between the last water ejection time and a next water ejection time, and sets the preheating time according to the ejection temperature.
- [Claim 11] The hot water supply apparatus of claim 1, wherein the controller sets a pre-set degree of opening as an initial degree of opening of the ejection valve according to the ejection temperature.
- [Claim 12] The hot water supply apparatus of claim 11, wherein the controller receives an inflow temperature from an injection temperature sensor measuring an inflow temperature of water injected into the heater, calculates an ejection amount of water to be ejected from the heater by using the inflow temperature, the heater heating capacity, and the target temperature, and sets an initial degree of opening of the ejection valve according to the calculated ejection amount.
- [Claim 13] The hot water supply apparatus of claim 11, wherein the controller measures a usage waiting time between the last ejection time to a next ejection time, and sets an initial degree of opening of the ejection valve according to the usage waiting time and the ejection temperature.
- [Claim 14] A hot water supply method comprising:
an initial ejection operation of setting an initial degree of opening of an ejection valve adjusting an ejection amount of water ejected from a heater and opening the ejection valve by the initial degree of opening, when a hot water supply signal is input; and
an ejection control operation of adjusting an ejection temperature of water ejected from the heater to reach a target temperature by controlling a degree of opening of the ejection value.
- [Claim 15] The hot water supply method of claim 14, wherein the initial ejection operation comprises:
an initial open setting operation of setting a pre-set degree of opening as an initial degree of opening of the ejection value according to the

ejection temperature; and

an initial opening operation of opening the ejection value according to the initial degree of opening of the ejection valve.

- [Claim 16] The hot water supply method of claim 15, wherein, in the initial open setting operation, an inflow temperature of water flowing into the heater is received, an ejection amount of water to be ejected from the heater is calculated by using the inflow temperature, a heater heating capacity of the heater, and the target temperature, and an initial degree of opening of the ejection valve is subsequently set according to the calculated ejection amount.
- [Claim 17] The hot water supply method of claim 15, wherein the initial ejection operation further comprises a heater heating capacity calculation operation of measuring a supply voltage supplied from a power source and calculating the heater heating capacity by using the supply voltage.
- [Claim 18] The hot water supply method of claim 17, wherein in the heater heating capacity calculation operation, when a hot water dispensing signal for requesting extraction of hot water is input or when a pre-set time interval has lapsed, the heater heating capacity is calculated by measuring the supply voltage.
- [Claim 19] The hot water supply method of claim 17, wherein in the heater heating capacity calculation operation, an AC supply voltage supplied from the power source is converted into DC voltage, and the converted DC voltage is quantized to measure a magnitude of the supply voltage.
- [Claim 20] The hot water supply method of claim 15, wherein in the initial open setting operation, a usage waiting time between the last ejection time to a next ejection time is measured, and an initial degree of opening of the ejection valve is set by using the usage waiting time and the ejection temperature.
- [Claim 21] The hot water supply method of claim 16, wherein the initial ejection operation further comprises a preheating operation of operating the heater to heat water within the heater during a preheating time when the measured ejection temperature is equal to or lower than a preheating reference temperature.
- [Claim 22] The hot water supply method of claim 21, wherein in the preheating operation, the preheating time is set to be lengthened in the case that the measured ejection temperature is low.
- [Claim 23] The hot water supply method of claim 14, wherein in the ejection control operation, a degree of opening of the ejection valve is adjusted

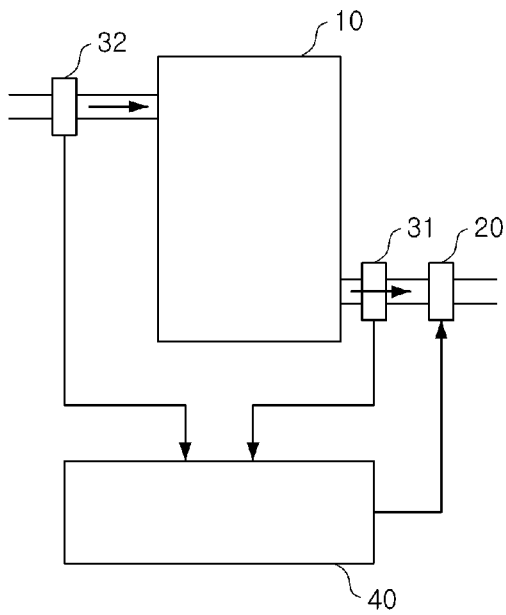
according to a change in the ejection temperature,
wherein when the ejection temperature is higher than the target temperature, the ejection valve is open by a value proportional to a difference between the ejection temperature and the target temperature, and

when the ejection temperature is lower than the target temperature, the ejection valve is shut off by a value proportional to a difference between the target temperature and the ejection temperature.

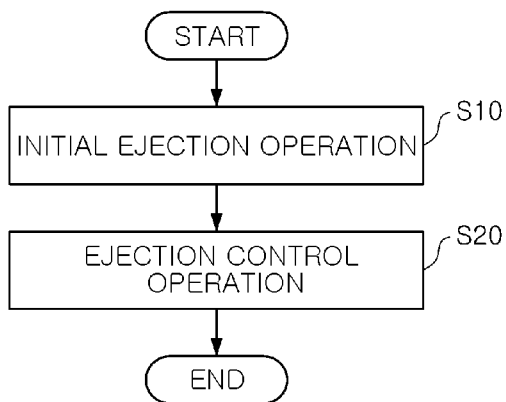
[Claim 24]

The hot water supply method of claim 23, wherein in the ejection control operation, an ejection amount of water to be ejected from the heater is calculated by using the inflow temperature, the heater heating capacity, and the target temperature, and a degree of opening of the ejection valve is adjusted according to the calculated ejection amount of water.

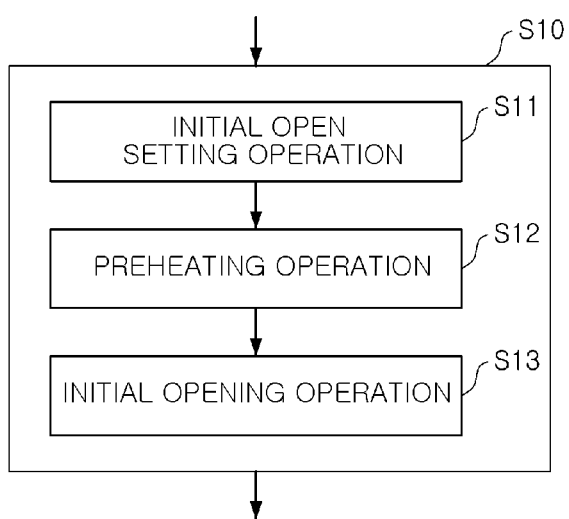
[Fig. 1]



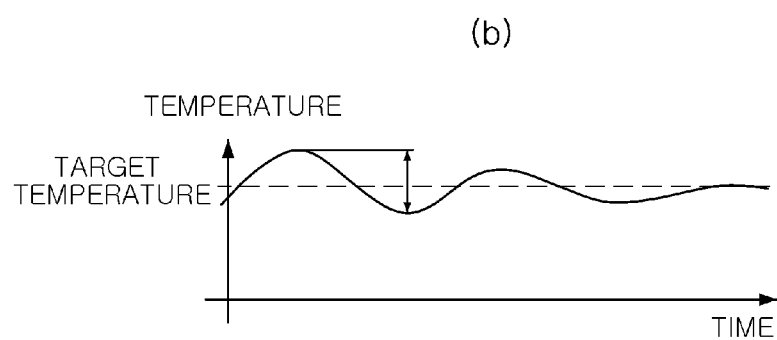
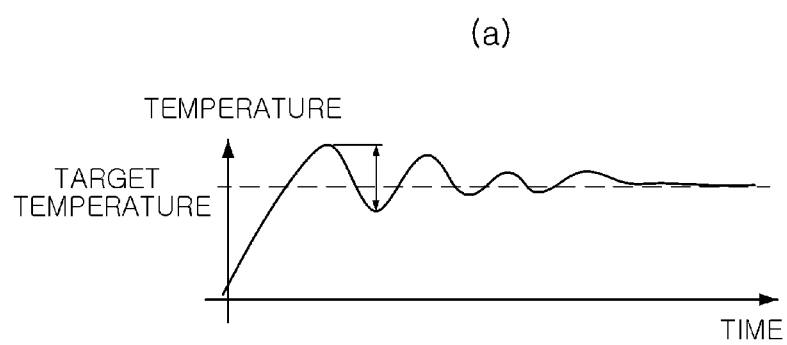
[Fig. 2]



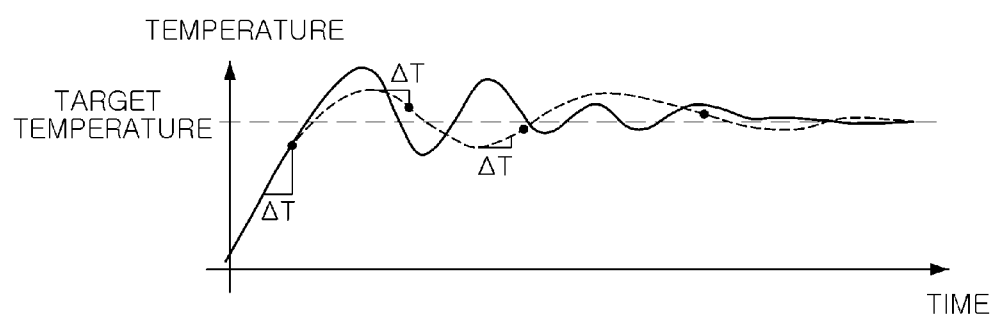
[Fig. 3]



[Fig. 4]



[Fig. 5]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2012/011187**A. CLASSIFICATION OF SUBJECT MATTER****F24H 1/22(2006.01)i, F24H 9/18(2006.01)1, F24H 9/20(2006.01)1**

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)

F24H 1/22; F24H 1/18; F16K 31/02; B01D 35/00; H05B 1/02; B01D 35/18; G05D 23/19

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

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: hot water, purifier, temperature, sensor, detect, voltage

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	KR 10-2009-0085825 A (W00NGJIN C0WAY CO., LTD.) 10 August 2009 See paragraphs [0033]-[0038], [0046], [0054]-[0059] and figures 1,5,6.	1, 2, 7, 11, 14, 15, 23 3, 4, 12, 16-18, 24 5, 6, 8-10, 13, 19-22
Y	KR 10-0827383 B1 (W00NGJIN C0WAY CO., LTD.) 6 May 2008 See paragraphs [0030], [0031], [0034] and figures 1,3.	3, 4, 17, 18
Y	KR 10-2004-0062922 A (LEE, SUN HEE) 9 July 2004 See page 3 lines 4-15 and figure 1.	12, 16, 24
A	JP 08-094177 A (TOTO LTD.) 12 April 1996 See paragraphs [0039]-[0041] and figure 4.	1-24
A	US 2010-0294804 A1 (DALCHAU et al.) 25 November 2010 See paragraphs [0027], [0028] and figure 3.	1-24

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 March 2013 (27.03.2013)

Date of mailing of the international search report

28 March 2013 (28.03.2013)

Name and mailing address of the ISA/KR

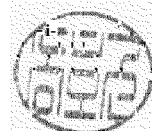
Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan
City 302-70 1 Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

SŌNG, Ho Keun

Telephone No. 82-42-481-5580



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2012/011187

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 10-2009-0085825 A	10 .08 .2009	None	
KR 10-0827383 B1	06 .05 .2008	None	
KR 10-2004-0062922 A	09 .07 .2004	None	
JP 08-094177 A	12 .04. 1996	JP 3572674 B2	06. 10 .2004
US 2010-0294804 A1	25 . 11. 20 10	AR 068230 A1	11. 11.2009
		BR P10703807 A2	28. 04. 2009
		EP 2203379 A2	07. 07 .2010
		W0 2009-033242 A2	19. 03 .2009
		w0 2009-033242 A3	17. 09 .2009