

TITLE OF THE INVENTION

Liquid Supplying Apparatus

FIELD OF THE INVENTION

The present invention relates to a liquid supplying apparatus adapted to be used for heated water shower bathing, and the like.

BACKGROUND OF THE INVENTION

An electric instantaneous water heater will be described as an example of a liquid supplying apparatus of the prior art by referring to Figs. 9, 10 and 11. Water flowed in from a water inlet pipe 1 is heated in a tank 11 provided with a heater 10, after passing through a flow-rate control valve 7, a flow-rate detector 8 and a water shutoff valve 9. The water then flows out from a showerhead 6 via a shower hose 5 connected to a water outlet pipe 12. A temperature of the heated water can be obtained by controlling a heating value of the heater 10 according to a temperature and a flow rate of the water. In order to obtain a comfortable showering water temperature, a desired temperature for the showering water is set in advance with a water temperature adjusting potentiometer 13 linked to a water temperature adjusting knob 4. The water heater adjusts the shower water to the desired temperature by comparing a resistance value of a thermister 17 for detecting a water temperature in the tank 11 with that of the water temperature adjusting potentiometer 13, and controlling a duty factor of power supply to the heater 10 with a control circuit 16. The water heater can be used for showering unheated water when the water temperature adjusting potentiometer 13 is turned into an OFF position. The tank 11 is also provided with a safety device 14 for preventing an overheating under abnormal conditions. A water shutoff knob 3 is linked to the water shutoff

9902526-4

20 MAY 1999

valve 9 in addition to turning on and off the control circuit 16, so that the water shutoff valve 9 opens to allow water to pass through the water inlet pipe 1, when the water shutoff knob 3 is pushed into an ON position. At the same time with a passage of the water, the flow-rate detector 8 functions to transmit a signal to the control circuit 16, which in turn initiates a heating operation of the heater 10, so as to deliver heated water of a suitable temperature from the showerhead 6. In a word, there has been no electric instantaneous water heater of the ordinary type that delivers heated water mixed with gas, but the types that deliver heated water only.

On the other hand, there is a shower spraying apparatus of a special purpose, as disclosed in Japanese Patent Laid-Open Publication No. S63-294816. The shower spraying apparatus comprises (a) a tank for storing water for shower bathing, (b) a heating device for heating the water in the tank, (c) a pump for delivering heated water in the tank toward a showerhead, (d) a blower for supplying compressed air to the showerhead, and (e) the showerhead for spraying the heated water and the compressed air delivered from the pump and the blower by mixing them together.

However, the foregoing electric instantaneous water heater of the prior art, which is not provided with a means for mixing air into water, necessitates a user to take a shower for a long period of time, because heated shower water in a limited amount of flow supplied from the water inlet pipe can not provide a sufficient washing effect. Further, it falls short of providing a comfortable feeling of taking shower due to a low pressure of the water sprayed from the showerhead.

Also, the shower spraying apparatus of the prior art for spraying water mixed with gas has a structure that mixes the air into water in the showerhead. A structure of this kind makes it difficult to obtain uniform mixing of air into the water, and it can be said hardly that a comfortable feeling of taking shower is provided. The apparatus also has a problem in

respect of its usefulness, since it has no structure for making a spray selection according to an intended usage between heated water only and heated water mixture with air.

SUMMARY OF THE INVENTION

In order to solve the above-cited problems, a liquid supplying apparatus of the present invention comprises (a) a spray unit, (b) a liquid supply path for supplying liquid to the spray unit, and (c) a gas supply unit for injecting gas into the liquid supply path. Therefore, the gas delivered from the gas supply unit is mixed into the liquid at an upper stream of the spray unit of the liquid. Also, the apparatus is so constructed that it can spray either of liquid only and composite liquid mixed with gas from the spray unit.

According to the present invention, the liquid supplying apparatus mixes gas into liquid in the liquid supply path at an upper stream of the spray unit, when it sprays composite liquid mixed with gas. As the result, it can deliver liquid and gas in a state of an exceptionally uniform mixture, thereby making the effect of mixing gas substantially remarkable. In other words, the apparatus is expected to provide an effect of liquid conservation by gaining a sufficient washing effect with a small amount of heated liquid, and a comfortable feel of taking shower as well as a massaging effect by increasing a liquid spray pressure attained by a gas pressure added to the heated liquid of even a low pressure.

Moreover, the invention substantially improves utility of the apparatus, since it can spray either of liquid only and composite liquid mixed with gas from the spray unit, which allows a proper use according to the intended usage.

Reduction to Practice

A liquid supplying apparatus as disclosed in claim 1 comprises (a) a

spray unit, (b) a liquid supply path for supplying liquid to the spray unit, and (c) a gas supply unit for injecting gas into the liquid supply path, wherein the gas delivered from the gas supply unit is mixed into the liquid at an upper stream of the spray unit of the liquid. Also, the apparatus is so constructed that it can spray either of liquid only and composite liquid mixed with gas from the spray unit.

Also, the liquid supplying apparatus mixes gas into liquid in the liquid supply path at an upper stream of the spray unit, when it sprays composite liquid mixed with gas. As the result, it can deliver liquid and gas in a state of an exceptionally uniform mixture, thereby making the effect of mixing gas substantially remarkable. In other words, the apparatus is expected to provide an effect of liquid conservation by gaining a sufficient washing effect with a small amount of heated liquid, and a comfortable feel of taking shower as well as a massaging effect by increasing a liquid spray pressure attained by an addition of gas pressure to the heated liquid of even a low pressure.

Moreover, the apparatus substantially improves its utility, since it can spray either of liquid only and composite liquid mixed with gas from the spray unit, which allows a proper use according to the intended usage.

A liquid supplying apparatus of claim 2 comprises (a) a spray unit, (b) a liquid supply path for supplying liquid to the spray unit, (c) a gas supply unit for injecting gas into the liquid supply path, and (d) a controller for controlling an operation of at least the gas supply unit. The gas supply unit starts its operation for mixing gas into liquid at an upper stream of the spray unit of the liquid in response to an operating signal of the controller.

The invention for controlling an operation of the gas supply unit with a signal from the controller realizes an easy and reliable switching of a form of the liquid delivered from the spray unit, so as to provide an easy-to-operate and highly reliable liquid supplying apparatus.

Also, a liquid supplying apparatus of claim 3 comprises (a) a heat

exchanger for exchanging heat by heating supplied liquid, (b) a liquid outlet pipe and (c) a shower hose for conducting the heat-exchanged liquid toward a spray unit, along the way through a liquid supply path. All of the afore-cited components are housed together with a gas supply unit within one housing body to constitute a liquid heater.

The invention thus provides the liquid heater that can deliver either of liquid only and composite liquid mixed with gas from the spray unit. As the result, the liquid heater is expected to provide an effect of liquid conservation by gaining a sufficient washing effect with a small amount of the heated liquid, and a comfortable feel of taking shower as well as a massaging effect by increasing a liquid spray pressure attained by an addition of gas pressure to the heated liquid of even a low pressure.

Further, a liquid supplying apparatus of claim 4 comprises a notification device for notifying that a gas supply unit is in operation for mixing gas into liquid.

Usefulness of the apparatus can be improved by informing a user of a form of the liquid delivered from a spray unit.

Furthermore, a liquid supplying apparatus of claim 5 comprises a spray unit composed of a showerhead.

The apparatus can thus serve as a shower spraying apparatus expected to provide an effect of liquid conservation by gaining a sufficient washing effect with a small amount of the heated liquid, and a comfortable feel of taking shower as well as a massaging effect by increasing a liquid spray pressure attained by an addition of gas pressure to the heated liquid of even a low pressure.

Moreover, a liquid supplying apparatus of claim 6 is so constructed that gas from a gas supply unit is mixed into liquid at an upper stream of a heat exchanger.

This structure for positioning a mixing point of gas from the gas supply

unit at an upper stream of the heat exchanger along the liquid supply path, where liquid of a low temperature flows through, makes it unnecessary to consider a heat-resistivity in selecting a binding material, thereby allowing use of an inexpensive material and simplifying the structure.

Also, a liquid supplying apparatus of claim 7 is so constructed that gas from a gas supply unit is mixed into liquid at a lower stream of a heat exchanger.

The structure for mixing gas into liquid at the lower stream of the heat exchanger containing a heating source can avoid an expansion of the gas in the heat exchanger, and produces uniform gas bubbles throughout the liquid, so as to improve an effectiveness of the gas mixture.

A liquid supplying apparatus of claim 8 is so constructed that a portion of a gas supply path for conducting gas from a gas supply unit is placed through within a liquid supply path, and the gas supply path is opened in the liquid supply path at an upper stream of a spray unit.

This structure produces quite uniform gas bubbles in the liquid, so as to anticipate an effect of liquid conservation by gaining a sufficient washing effect with a small amount of the heated liquid, and a comfortable feel of taking shower as well as a massaging effect by increasing a liquid spray pressure attained by an addition of gas pressure to the heated liquid of even a low pressure. In addition, conducting the gas through and within the liquid supply path can achieve a simple structure.

Further, a liquid supplying apparatus of claim 9 is so constructed that a gas intake path at an inlet side of a gas supply unit is opened in a downward direction in vicinity of a lower edge of a housing body. Also, an outlet side is joined water-tightly to a coupler connecting between a liquid outlet pipe and a shower hose via a gas supply path.

The above structure allows liquid to drain from the gas intake opening to an outside of the housing body, even in case of a back-flow of the liquid

along the gas supply path due to a failure of a shutoff valve in the gas supply unit. The structure can thus assure safety of the apparatus by preventing the back-flowed liquid from splashing on electrical components including a controller.

A liquid supplying apparatus of claim 10 has a gas supply unit mounted on a housing body after it is wrapped around with a cushioning material such as urethane foam.

The cushioning material suppresses noise and vibrations of the gas supply unit during operation, so as to maintain a comfortable atmosphere while in use.

A liquid supplying apparatus of claim 11 comprises a filter provided on a gas intake opening in order to prevent dusts from entering into it when gas is being mixed into liquid through a gas supply unit, thereby maintaining a delivery of clean liquid.

A liquid supplying apparatus of claim 12 is constructed in a manner that a controller is capable of operating a heat exchanger and a gas supply unit independently from each other. Therefore, a spray unit can deliver either of liquid only and composite liquid mixed with gas, with the liquid supplied in heat-exchanged condition or not in heat-exchanged condition, thereby improving usefulness according to the intended usage.

A liquid supplying apparatus of claim 13 is constructed in a manner that a controller controls a gas supply unit in an operating mode according to a predetermined pattern. The apparatus is set with a variety of mixing conditions of gas into liquid, so as to allow a user to select any of them at his/her choice, thereby improving usefulness and comfortableness.

A liquid supplying apparatus of claim 14 comprises (a) a spray unit, (b) a liquid supply path for supplying liquid to the spray unit, (c) a gas supply unit for injecting gas into the liquid supply path, (d) a flow-rate detector for detecting a flow rate of the liquid flowing in the liquid supply path, and (e) a

controller for controlling an operation according to a signal from the flow-rate detector. The controller is capable of operating the gas supply unit when a signal from the flow-rate detector falls within a predetermined range.

Therefore, the controller turns into a condition capable of operating the gas supply unit, only when a flow rate of the liquid flowing through the liquid supply path is within an extent, for which effectiveness of mixing gas is anticipated, in order to achieve delivery of the gas-mixed liquid effectively. In a word, the gas supply unit is made into an operable condition, only if a flow rate of the liquid is in a predetermined range at a lower side of the flow level, since the effectiveness anticipated by mixing gas is substantially greater at the lower side.

A liquid supplying apparatus of claim 15 comprises (a) a spray unit, (b) a liquid supply path for supplying liquid to the spray unit, and (c) a gaseous product supply unit for injecting gaseous product into the liquid supply path. The liquid supplying apparatus is constructed to mix the gaseous product from the gaseous product supply unit into liquid at an upper stream of the liquid spray unit. Also, it is capable of spraying from the spray unit either of liquid only and composite liquid mixed with gas, so as to gain an effect of liquid conservation although no effect for spray pressure is anticipated.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a general view depicting an electric instantaneous water heater of a first exemplary embodiment of the present invention;

Fig. 2 is a structural presentation of the same water heater;

Fig. 3 is a systematic diagram of the same water heater;

Fig. 4 is a graph representing a characteristic of flow rate against pressure in the same water heater;

Fig. 5 is a graph representing a characteristic of pressure against flow rate in the same water heater;

Fig. 6 is a systematic diagram of an electric instantaneous water heater of a second exemplary embodiment of the present invention;

Fig. 7 is a systematic diagram of an electric instantaneous water heater of a fourth exemplary embodiment of the present invention;

Fig. 8 is a systematic diagram of an electric instantaneous water heater of a sixth exemplary embodiment of the present invention;

Fig. 9 is a general view depicting an electric instantaneous water heater of the prior art;

Fig. 10 is a structural presentation of a main body of the electric instantaneous water heater of the prior art; and

Fig. 11 is a systematic diagram of the electric instantaneous water heater of the prior art.

DETAILED DESCRIPTION OF THE INVENTION

Some variations of an electric instantaneous water heater will be described hereinafter, as exemplary embodiments of the present invention, by referring to the accompanied drawings.

First Exemplary Embodiment

By referring to Figs. 1, 2 and 3, details of a structure will be described now. It shall be noted that descriptions will be made with water as a representative of liquid, and air as a representative of gas to be mixed in the liquid, in the following exemplary embodiments.

A reference numeral 27 represents a liquid supply path connected through a water inlet pipe 18, a reference numeral 27a represents a flow-rate control valve provided at an inlet side of the liquid supply path 27 for controlling a flow rate according to a manipulation of a flow-rate adjusting knob 19, and a reference numeral 28 represents a detector for detecting a flow rate. A reference numeral 29 represents a water shutoff valve activated in conjunction to a manipulation of a water shutoff knob 20, and a reference

numeral 30 represents a water temperature controller. A reference numeral 31 represents a tank constituting a heat exchanger 31a along the way in the liquid supply path 27. An interior of the tank 31 is provided with a heater 36 serving as a heat source for heating water supplied through the water inlet pipe 18 up to a temperature set by the water temperature controller 30. A reference numeral 32 represents a controller for controlling a water temperature and operation of a gas supply unit in response to a manipulation of a switch and a detected signal, and for sending a signal to a notification device 47 during operation of the gas supply unit in order to notify of an operating condition. A reference numeral 33 represents a thermister placed in the tank 31 having a function of a liquid temperature detecting device. A reference numeral 34 represents an air pump defining a gas supply unit for supplying air to be mixed into water, and an external surface of it is wrapped entirely with a cushioning material 34a and mounted on a housing body 50 of the water heater, as shown in Fig. 2. A reference numeral 35 represents an air hose connected to an outlet side of the air pump 34 to serve as a gas supply path for guiding air delivered by the air pump 34 to a connecting end of a water outlet pipe 37. A reference numeral 48 represents an air intake hose connected to an inlet side of the air pump 34 to serve as a gas intake path, an opening of it for taking air is disposed in vicinity of a lower corner of the housing body 50, and the opening is provided with a filter 49.

The electric instantaneous water heater constructed in the housing body 50 operates in a manner, which will be described hereinafter. Water drawn from the water inlet pipe 18 is supplied to the tank 31 containing the heater 36 through the flow-rate control valve 27a, the flow-rate detector 28, and the water shutoff valve 29. The water is then delivered from the showerhead 24 by passing through the shower hose 23 connected to the water outlet pipe 37 after being heated in the tank 31.

A temperature for the heated shower water can be obtained by

controlling a heating value of the heater 36 according to a temperature and a flow rate of the water. When a desired water temperature is set with a water temperature adjusting knob 21 in order to obtain a comfortably heated shower water, the water heater adjusts the shower water to the desired temperature by comparing a resistance value of the thermister 33 for detecting water temperature in the tank 31 with that of the water temperature controller 30, and controlling a duty factor, on/off cycles, etc. of power supply to the heater 36 by the controller 32.

The tank 31 is provided with a safety device 38 for preventing an overheating under abnormal conditions, and it breaks a power supply to the heater 36 if the temperature increases excessively. The water outlet pipe 37 connected to an outlet side of the tank 31 and the shower hose 23 for delivering the heated water to the showerhead 24 are joined with a coupler 46. Also, the air hose 35 connected to an outlet opening 39 of the air pump 34 is joined water-tightly to an appropriate position on the coupler 46. Further, the air hose 35 is inserted through an inside of the shower hose 23 near to an end part of the showerhead 24. The air delivered by the air pump 34 is then mixed into the water near the end part of the showerhead 24, so as to obtain uniformity of the mixture.

In describing the operation according to an order of manipulation, the water shutoff knob 20 is first pushed to turn on the water shutoff valve 29, and heated water begins to be delivered. When an air bubble switch 22 is depressed to an ON position, which causes the controller 32 to start the air pump 34 into operation, and air begins to be supplied. As a result, the air is mixed into the water, as has been described, and the heated water 25 is sprayed from the showerhead 24 in a form of mixture with the air 26.

Fig. 4 shows an amount of water-flow Q_1 and an amount of airflow Q_2 corresponding to a primary pressure P of the supplied water. Reference numerals 40 and 41 represent domains of the water-flow amount Q_1 and the

airflow amount Q_2 respectively. A composite amount of flow 42 delivered from the showerhead 24 becomes a total of the domain of airflow amount Q_2 added to the domain of water-flow amount Q_1 . If the primary pressure of the supplied water is P_a , for example, an amount of water-flow is Q_a . Since the water heater can deliver only this small amount of heated water, in the case of using heated water only, it provides low washing potential and an unsatisfactory feeling when taking a shower. However, if air is mixed, a composite amount of flow equivalent to $Q_a + Q_b$ can be attained due to an additional amount of the air Q_b . Since it can provide an effect equivalent to an amount of water Q_c corresponding to P_b , i.e. a primary pressure in the case of delivering heated water only, a sufficient washing potential and a comfortable feeling of taking shower can be achieved even with the limited amount of water flow.

Fig. 5 shows a water pressure P_1 and an air pressure P_2 corresponding to an amount of heated-water flow Q . Reference numerals 43 and 44 represent domains of the water pressure P_1 and the air pressure P_2 respectively. A composite pressure 45 of the heated water sprayed from the showerhead 24 fits in a pressure domain derived by an addition of the air pressure P_2 to the domain of water pressure P_1 . Like the preceding case of water flow, a spray pressure from the showerhead 24 can be increased by mixing air, even when delivering the heated water in low pressure, so as to achieve a comfortable feeling of taking shower.

Moreover, since air is mixed in the heated water, the washing efficiency is increased substantially due to an effect that is produced when bubbles formed by the air burst.

When the air bubble switch 22 is depressed again into an OFF position, the controller 32 functions to terminate the operation of the air pump 34, which in turn stops mixing of air into the heated water. This causes the showerhead 24 to deliver only the heated water, so as to make it possible to

serve as an ordinary shower.

In addition, if the air bubble switch 22 is left in the ON position, and the water temperature controller 30 is turned into an OFF position, the showerhead 24 sprays unheated water mixed with air, while the power supply to the heater 36 is disconnected. In a ward, the water heater can be used for showering unheated water mixed with air.

As has been described, the electric instantaneous water heater of this first exemplary embodiment mixes air into heated water from an upper stream of the showerhead 24, or a spray unit, by the air pump 34, or a gas supply unit, and it can deliver either of heated or unheated water only, or a mixture of water with air from the showerhead. As the result, it can deliver water and air in a state of an exceptionally uniform mixture, thereby making the effect of mixing air substantially remarkable. In other words, the invention is expected to provide an effect of water conservation by gaining a sufficient washing efficiency with a small amount of heated water, and a comfortable feel of taking shower as well as a massaging effect by increasing a spraying pressure attained by an addition of air pressure to the heated water of even a low pressure.

Moreover, the invention substantially improves utility of the water heater, because it can be used properly according to the intended usage. In addition, it is provided with the notification device for notifying of a mixing operation of air into water, which allows a user to find a status of usage readily at the housing body side, or to verify any trouble such as a failure of the air pump, etc. even if the showerhead 24 is used at a distant away from the housing body, thereby improving convenience of use.

Also, in the water heater of this exemplary embodiment, the air hose 35 is guided through an inside of the shower hose 23, which extends from the coupler 46, to a point of connection between the shower hose 23 and the showerhead 24 where the air hose 35 is opened. The foregoing embodiment

combines the hoses drawn from the housing body 50 into one piece, and simplifies the structure.

Further, a gas intake opening at an end of the air hose 35, i.e. a gas supply path, extending from the air pump 34, i.e. a gas supply unit, is opened in a downward direction in vicinity of a lower end of the housing body 50, where is below the electric components such as the controllers, etc. This structure allows water to drain outside of the main body from the gas intake opening, even in case of a back-flow of the water along the air hose 35 due to a failure of the shutoff valve such as a check valve in the air pump 34. The water heater can thus maintain safety by preventing the back-flowed water from splashing on the electrical components including the controllers. Also, the gas intake opening of the air hose 35 is provided with a filter 49 for removing dusts when air is being drawn, so as to prevent the dusts from entering into water in order to maintain a delivery of clean heated water.

Furthermore, the air pump 34 is mounted on the housing body 50 after it is wrapped around entirely with a cushioning material 34a such as urethane foam. The cushioning material 34a suppresses noise and vibrations of the air pump 34 during operation, so as to maintain a comfortable usage while also preventing troubles that may result from loosening of connections, etc. due to vibrations.

Second Exemplary Embodiment

Fig. 6 depicts a systematic diagram of an electric instantaneous water heater of a second exemplary embodiment of the present invention.

The same components as those of the first exemplary embodiment are assigned with the same reference numerals, and their descriptions will be omitted.

The electric instantaneous water heater of the present exemplary embodiment is so constructed that air from an air pump 34, or a gas supply

unit, is mixed into water at an upper stream of a heat exchanger 31a. In Fig. 6, an air hose 35 connected to an air outlet side of the air pump 34 is joined water-tightly to a liquid supply path 27 at an upper stream of a tank 31, which constitutes the heat exchanger 31a, so as to mix air supplied from the air pump 34 into water in the path.

Since this structure allows the water heater to form a joint for mixing air in the liquid supply path 27 of low temperature, it does not require use of a binding material selected in due consideration of a heat-resistivity. Also because a sealing property can be attained relatively simply, the structure can be simplified and the cost can be reduced at the same time.

Third Exemplary Embodiment

An electric instantaneous water heater of a third exemplary embodiment of the present invention will be described by referring to Fig. 3. The electric instantaneous water heater of the present exemplary embodiment is so constructed that air from an air pump 34, or a gas supply unit, is mixed into water at a lower stream of a heat exchanger 31a. In Fig. 3, an air hose 35 connected to an air outlet side of the air pump 34 is joined water-tightly to a coupler 46, which connects between a water outlet pipe 37 and a shower hose 23, so as to mix air supplied from the air pump 34 into water in there.

The foregoing structure can avoid an expansion of the air in the heat exchanger, and produces uniform air bubbles throughout the water, so as to improve an effectiveness of the air mixture.

Fourth Exemplary Embodiment

Fig. 7 depicts a systematic diagram of an electric instantaneous water heater of a fourth exemplary embodiment of the present invention.

The same components as those of the first exemplary embodiment are assigned with the same reference numerals, and their descriptions will be

omitted.

The electric instantaneous water heater of the present exemplary embodiment is so constructed that it controls an air pump 34, or a gas supply unit, in an operating mode according to any one of predetermined patterns. While an air bubble switch 22 is in an ON position, a selection switch 51 enables a user to select an operating mode of the air pump 34 among the predetermined patterns such as an intermittent operation control 32a, a high / low operation control 32b and a 1 / f operation control 32c, thereby varying a mixing condition of air in the water, and providing the shower spray according to a choice of the user.

Fifth Exemplary Embodiment

A system of an electric instantaneous water heater of a fifth exemplary embodiment of the present invention will be described by referring to Fig. 3.

The electric instantaneous water heater of the present exemplary embodiment is capable of operating an air pump 34, or a gas supply unit, only when a flow-rate of water flowing through a liquid supply path 27 is within a predetermined range. A controller 32 compares a signal from a flow-rate detector 28 with a predetermined value, and it activates the air pump 34 to produce mixture of air and water, if an air bubble switch 22 is turned on while the signal is within the predetermined value.

With the foregoing structure, the water heater turns the air pump 34 into an operable condition only when the flow rate is within a certain extent of low value, for which effectiveness of mixing air is anticipated, in order to achieve delivery of the gas-mixed water effectively. On the other hand, it restricts delivery of the air-mixed water under a condition, i.e. if a large flow is available, for which mixing air is unnecessary.

Sixth Exemplary Embodiment

Fig. 8 depicts a systematic diagram of an electric instantaneous water heater of a sixth exemplary embodiment of the present invention. The same components as those of the first exemplary embodiment are assigned with the same reference numerals, and their descriptions will be omitted.

Although the gas supply unit for mixing air alone into water has been described in the foregoing exemplary embodiments as means to produce mixture of air with water, an electric instantaneous water heater of this exemplary embodiment is provided with a gaseous product supply unit 60. As means to mix gas into water, the gaseous product supply unit 60 comprises a carbonaceous product composing solid material for producing carbonic acid gas by reaction with water, for example, or the like material, which can make a water saving effect, though no effect is anticipated for increasing the spray pressure.

Although the described embodiments have referred to air and carbonic acid gas as the gas supplied by the gas supply unit, it can be a composite of carbonic acid gas and air, or any other kind of gases. A stimulus effect for the blood circulation can be expected, if carbonic acid gas is used.

The foregoing embodiments are provided with the gas supply unit or the gaseous product supply unit encased within the housing body, but they can be arranged outside of the housing body in location separate from the housing body, and connected to the liquid supply path. Also, arrangement of the connection is not limited to that of the foregoing embodiments, but it can be made to a main pipe of the water supply to be connected with the water inlet pipe in the upper stream. The essential thing is that the location can be anywhere in the housing body or the outside as long as it is located in an upper stream of the spray unit, as the liquid supply path includes all of the components situated in the upper stream of the spray unit.

Moreover, although the foregoing exemplary embodiments represent certain variations of shower spraying apparatuses utilizing an electric

instantaneous water heater, it can be a shower spraying apparatus with an ordinary water heater of non-instantaneous type having a heating source of gas, kerosene fuel, etc. beside electric. Or, it can be any kind of liquid supply equipment that delivers either heated or unheated water or the like liquid, other than the shower spraying apparatus.

As has been described, the liquid supplying apparatus of the present invention mixes air into water from an upper stream of the spray unit in the liquid supply path, when spraying composite water mixed with air. As the result, it can deliver water and air in a state of an exceptionally uniform mixture, thereby making the effect of mixing air substantially remarkable. In other words, the apparatus is expected to provide an effect of water conservation by gaining a sufficient washing effect with a small amount of heated water, and a comfortable feel of taking shower as well as a massaging effect by increasing a spraying pressure attained by an addition of air pressure to the heated water of even low pressure.

Also, since the apparatus can deliver either of water only and composite water mixed with air from the spray unit, it can be used properly according to the intended usage, and substantially improves convenience of use.

Furthermore, the liquid supplying apparatus of the present invention is capable of switching a form of water delivered from the spray unit easily and reliably by controlling an operation of the gas supply unit based on a signal from the controller. Accordingly, the invention is able to provide an easy-to-operate and highly reliable liquid supplying apparatus.

What is claimed is:

1. A liquid supplying apparatus comprising:

a spray unit;

a liquid supply path for supplying liquid to said spray unit; and

a gas supply means for injecting gas into said liquid supply path,

wherein the gas from said gas supply means is mixed into the liquid at an upper stream of said spray unit of liquid, and said liquid supplying apparatus is capable of selectively spraying either of liquid only and composite liquid mixed with gas from said spray unit.

2. A liquid supplying apparatus comprising:

a spray unit;

a liquid supply path for supplying liquid to said spray unit;

a gas supply means for injecting gas into said liquid supply path;

and

a controller for controlling an operation of at least said gas supply means,

wherein said gas supply means mixes the gas into the liquid at an upper stream of said spray unit according to a signal from said controller.

3. The liquid supplying apparatus according to any of claim 1 and claim 2, further comprising:

a heat exchanger provided along a way in said liquid supply path for exchanging heat by heating the liquid supplied thereto; and

a liquid outlet pipe and a shower hose for conducting the heat-exchanged liquid toward said spray unit,

wherein said heat exchanger and said gas supply means are stored in a single housing body to compose a liquid heater.



4. The liquid supplying apparatus according to any one of claim 1 through claim 3, further comprising a notification means for notifying that gas from said gas supply means is being mixed into liquid.

5. The liquid supplying apparatus according to any one of claim 1 through claim 4, wherein said spray unit comprises a showerhead.

6. The liquid supplying apparatus according to any one of claim 1 through claim 5, wherein gas from said gas supply means is mixed into liquid in an upper stream of said heat exchanger.

7. The liquid supplying apparatus according to any one of claim 1 through claim 5, wherein gas from said gas supply means is mixed into liquid in a lower stream of said heat exchanger.

8. The liquid supplying apparatus according to any one of claim 1 through claim 7, wherein a portion of a gas supply path for conducting gas from said gas supply means is placed along an inside of said liquid supply path, and said gas supply path is opened in said liquid supply path at an upper stream of said spray unit.

9. The liquid supplying apparatus according to any one of claim 3 through claim 8, wherein said gas supply means opens a gas intake path on a gas inlet side thereof in a downward direction in vicinity of a lower end of said housing body, and water-tightly joins a gas supply path on an outlet side to a coupler connecting between said liquid outlet pipe and said shower hose.

10. The liquid supplying apparatus according to any one of claim 3



through claim 9, wherein said gas supply means is wrapped around with a cushioning material such as urethane foam, and mounted on said housing body.

11. The liquid supplying apparatus according to claim 9, wherein an opening of said gas intake path on a gas inlet side is provided with a filter.

12. The liquid supplying apparatus according to any one of claim 2 through claim 11, wherein said controller is capable of operating said heat exchanger and said gas supply means independently from each other.

13. The liquid supplying apparatus according to any one of claim 2 through claim 12, wherein said controller controls said gas supply means in an operating mode according to a predetermined pattern.

14. A liquid supplying apparatus comprising:

a spray unit;

a liquid supply path for supplying liquid to said spray unit;

a gas supply means for injecting gas into said liquid supply path;

a flow-rate detector for detecting a flow rate of liquid flowing in said liquid supply path; and

a controller for controlling an operation according to a signal from said flow-rate detector,

wherein said controller is capable of operating said gas supply means when a signal from said flow-rate detector falls within a predetermined range.

15. A liquid supplying apparatus comprising:

a spray unit;



a liquid supply path for supplying liquid to said spray unit; and
a gaseous product supply means for injecting gaseous product into said liquid supply path, wherein the gaseous product from said gaseous product supply means is mixed into liquid at an upper stream of said spray unit of the liquid, and said liquid supplying apparatus is capable of spraying either of the liquid only and composite liquid mixed with gas from said spray unit.

