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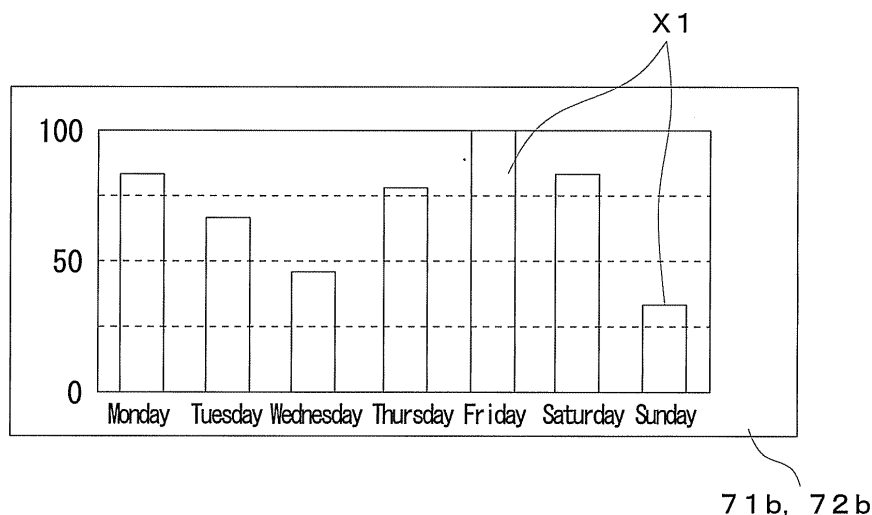
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(54) **HOT WATER SUPPLY DEVICE**

(57) An object of this invention is to provide a hot water supply apparatus capable of facilitating the energy saving by notifying the status of the actual operation compared with the set-up operation. This invention calculates an achievement rate of an actual operation compared with a set-up ideal operation and displays the achieve-

ment rate on the displays of a remote controller for kitchen (71) and a remote controller for bathroom (72) based on memorized information. By this, it is easy to know the status of the actual operation compared with the set-up ideal operation. Therefore, it becomes possible to facilitate the energy saving by notifying the status of the actual operation compared with the set-up ideal operation.

FIG. 2



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Description

TECHNICAL FIELD

[0001] The present invention relates to a hot water supply apparatus of which a display of a remote controller is capable of displaying information of status of passed operation and the like.

BACKGROUND ART

[0002] Conventionally, A hot water supply apparatus having a memory for memorizing information of the amount of energy consuming for heating water, and a display for displaying the information memorized in the memory, and the hot water supply apparatus displays the amount of energy consuming of every period, such as every 24 hours (see the patent document 1).
Patent Document 1: Japanese Patent publication No. 2000-274809

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0003] In the said conventional hot water supply apparatus, a display is provided on a remote controller provided on a wall of a kitchen or a bathroom, and the display shows a consumed electrical power of both of today and yesterday to aim at increasing the consciousness for saving energy. However, since only the consumed electrical power of both today and yesterday is displayed, it is impossible to know a status of the actual operation compared with a set-up operation which is set up as the most ideal operation.

[0004] An object of the present invention is to provide a hot water supply apparatus capable of facilitating the energy saving by notifying the status of the actual operation compared with the set-up operation.

MEANS FOR SOLVING THE PROBLEM

[0005] To achieve the above object, in the present invention, a hot water supply apparatus comprises a memory for memorizing information relating to a past operation, a calculation portion for calculating an actual achievement rate of an actual operation compared with a set-up operation based on the information memorized in the memory, and a display portion for displaying a calculated result by the calculation portion.

[0006] By this, since the actual achievement rate compared with the set-up operation is displayed, it is easy to know the status of the actual operation compared with the set-up operation.

EFFECT OF THE INVENTION

[0007] According to this invention, it is possible to know

the status of the actual operation compared with the set-up operation. Therefore, it becomes possible to facilitate the energy saving by notifying users of the status of the actual operation compared with the set-up operation.

[0008] The above and other objects, features, and advantages of the present invention will become more apparent from the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a schematic configuration view of a hot water supply apparatus showing a first embodiment of the present invention;

FIG. 2 is a display portion of a remote controller for kitchen and a remote controller for bathroom for displaying achievement rates;

FIG. 3 is a schematic configuration view of the hot water supply apparatus showing a second embodiment of the present invention;

FIG. 4 is a display portion of the remote controller for kitchen and the remote controller for bathroom for displaying achievement percentages;

FIG. 5 is a display portion of the remote controller for kitchen and the remote controller for bathroom for displaying achievement percentages of a heating-up operation only;

FIG. 6 is a display portion of the remote controller for kitchen and the remote controller for bathroom for displaying achievement percentages of an adding water and heating operation only;

FIG. 7 is a display portion of the remote controller for kitchen and the remote controller for bathroom for displaying achievement percentages of the heating-up operation and achievement percentage of the adding water and heating operation respectively.

DESCRIPTION OF SYMBOLS

[0010] 70 ... controller, 71 ... remote controller for kitchen, 71a...

switch, 71b... display portion, 72 ... remote controller for bathroom, 72a ... switch, 72d ... display portion, X1... achievement rate, X2, X3... achievement percentage.

BEST MODE FOR CARRYING OUT THE INVENTION

[0011] FIGS. 1 and 2 show a first embodiment of the present invention.

FIG. 1 is a schematic configuration view of a hot water supply apparatus, FIG. 2 is a display portion of a remote controller for kitchen and a remote controller for bathroom for showing an achievement rate.

[0012] The hot water supply apparatus comprises a heat pump unit 10 for heating water using electrical power, a tank unit 20 for storing hot water heated by the heat

pump unit 10, a water supply pipe 30 for supplying water to the tank unit 20, to a bathroom, and to a kitchen, a hot water supply pipe 40 for supplying hot water stored in the tank unit 20 to the bathroom and the kitchen, a first circulation circuit 50 for circulating water between the heat pump unit 10 and tank unit 20, and a second circulation circuit 60 for circulating water in a bathtub 61 between the tank unit 20 and the bathtub 61 in the bathroom. This hot water supply apparatus is to store hot water heated by the heat pump unit 10 in the tank unit 20 so that hot water stored in the tank unit 20 is supplied for washing dishes in the kitchen, for bathing in the bathroom, and etc., and also hot water stored in the tank unit 20 is supplied as a heat source for reheating stored hot water in the bathtub 61.

[0013] The heat pump unit 10 comprises an electrically-powered compressor 11, a gas cooler 12, an expansion valve 13, and an evaporator 14, which are connected in series by pipes made by copper or stainless steel so as to configure a refrigerant circuit 10a. Also, the refrigerant circuit 10a is filled with carbon dioxide as a refrigerant of which high-pressure side becomes in a supercritical state. The gas cooler 12 is a refrigerant-water heat exchanger in which a flow passage on a water side forms a part of the first circulation circuit 50. The evaporator 14 is a refrigerant-air heat exchanger, and a fan 14a is provided in vicinity of the evaporator 14 so that air which conducts heat exchange with the refrigerant in the evaporator 14 can flow through the evaporator.

[0014] The tank unit 20 comprises a hot water storage tank 21, a reheating heat exchanger 22 for conducting heat exchange between water in the bathtub 61, which flows through the second circulation circuit 60, and hot water in the hot water storage tank 21, and a third circulation circuit 23 for circulating hot water between the hot water storage tank 21 and the reheating heat exchanger 22.

[0015] The hot water storage tank 21 is made of stainless steel or fiber reinforced plastic (FRP), etc., and is covered with a heat insulating material such as glass-wool, foamed urethane, or etc. so as to prevent heat radiation of a stored hot water. Also, in this embodiment, as the hot water storage tank 21, a 370 liters tank is used.

[0016] The reheating heat exchanger 22 is a water-water heat exchanger, and one side of its flow passage of the reheating heat exchanger 22 is a part of the second circulation circuit 60, and the other side of the flow passage of the reheating heat exchanger 22 is a part of the third circulation circuit 23.

[0017] The third circulation circuit 23 is configured by connecting in series an upper part of the hot water storage tank 21, the reheating heat exchanger 22, a circulation pump 23a, and a lower part of the hot water storage tank 21 by copper pipes or stainless steel pipes. Hot water in the upper part of the hot water storage tank 21 returns to the lower part of the hot water storage tank 21 via the reheating heat exchanger 22 by the circulation pump 23a.

[0018] The water supply pipe 30 comprises a first water supply pipe 31 connected to the lower part of the hot water storage tank 21, a second water supply pipe 32 connected to the hot water supply pipe 40, and a third water supply pipe 33 connected to faucets A in the bathroom and the kitchen. A pressure reducing valve 30a is provided on the water supply pipe 30 which is located at an upper stream side relative to the first, second, and third water supply pipes 31, 32, 33 so as to reduce pressure of water supplied from waterworks to make the water pressure be at a predetermined pressure and make the water flow.

[0019] The hot water supply pipe 40 comprises a first hot water supply pipe 41, one side of which is connected to the upper part of the hot water storage tank 21 and the other side of which is connected to a first mixing valve 40a and a second mixing valve 40b for mixing hot water in the hot water storage tank 21 with water which flows through the second water supply pipe 32, a second hot water supply pipe 42, one side of which is connected to the first mixing valve 40a and the other side of which is connected to the faucets A in the bathroom and the kitchen, and a third hot water supply pipe 43, one side of which is connected to the second mixing valve 40b and the other side of which is connected to the second circulation circuit 60. Hot water in the upper part of the hot water storage tank 21 flows through the hot water supply pipe 40 in accordance with pressure of water flows into the hot water storage tank 21 from the first water supply pipe 31. Also, on the third hot water supply pipe 43, a solenoid valve 43a for opening and closing the flow passage of the third hot water supply pipe 43 is provided.

[0020] The first circulation circuit 50 is configured by connecting in series the lower part of the hot water storage tank 21, a circulation pump 51, the gas cooler 12, and the upper part of the hot water storage tank 21 by copper pipes, stainless steel pipes, vulcanized polyethylene pipes, or etc., water in the lower part of the hot water storage tank 21 flows into the upper part of the hot water storage tank 21 via the gas cooler 12 by the circulation pump 51.

[0021] The second circulation circuit 60 is configured by connecting in series the bathtub 61, the circulation pump 62, the reheating heat exchanger 22, and the bathtub 61 by copper pipes, stainless steel pipes, vulcanized polyethylene pipes, or etc., water in the bathtub 61 returns to the bathtub 61 via the reheating heat exchanger 22 by the circulation pump 62.

[0022] Also, electric power for operating the hot water supply apparatus is supplied from an electric power company, which is a combination of an electric power generated by a plurality of methods, such as thermal power generation, nuclear power generation, water power generation, and etc. Also, the electric power supplied from the electric power company during day time (for example, 7:00~23:00) is mainly generated by thermal power generation and nuclear power generation, and the electric power supplied from the electric power company during

night time (for example, 23:00~7:00) the electrical power generated mainly by nuclear power generation. An emitted amount of carbon dioxide from nuclear power generation is smaller than an emitted amount of carbon dioxide from thermal power generation. Therefore, the emitted amount of carbon dioxide when generating electric power which is supplied during night time (for example, 0.260 kgCO₂/kWh) is smaller than an emitted amount of carbon dioxide when generating electric power which is supplied during day time (for example, 0.357 kgCO₂/kWh). Also, regarding electric power supplied from electric power company, charges for electric power during night time (for example 7:00-23:00, 8 yen/kWh) is set up to be cheaper than charges for electric power during day time (for example 23:00-7:00, 26 yen/kWh).

[0023] Also, this hot water supply apparatus comprises a controller 70 provided in the tank unit 20 for controlling operations, a remote controller for kitchen 71, and a remote controller for bathroom 72 provided respectively in a kitchen and a bathroom so as to control and set up the operations.

[0024] The controller 70 comprises a microcomputer of which a memory of the microcomputer memorizes settings for operations and operation modes, and memorizes programs for calculating achievement rates of actual operations compared with an operation set up as an ideal operation, and the programs display on a display portion, which is described below, of the remote controller for the kitchen 71 and the remote controller for the bathroom 72 the calculated results. Also, the memory memorizes data relating to passed operation statuses such as data of passed periods in which the adding water and heating operations are operated and data of amount of water when the adding water and heating operations are operated. Also, the controller 70 is capable of selecting an appropriate operation mode so as to operate effectively based on, for example, an actual status of using hot water compared with a passed operation status such as temperature of hot water stored in the hot water storage tank 21.

[0025] The controller 70 is connected to flow sensors 73 for measuring an amount of water heated by a heat pump unit 10. The sensors 73 are provided on the remote controller for kitchen 71, the remote controller for bathroom 72, and the first circulation circuit 50.

[0026] The remote controller for kitchen 71 and the remote controller for bathroom 72 are connected to the controller 70 by communication cables respectively, the remote controller for kitchen 71 and the remote controller for bathroom 72 respectively comprises a switch for operations relating to, for example, supplying hot water to the bathtub 61 or reheating the hot water, a switch for setting temperature which is used to set up temperature of hot water to be supplied, a priority switch for changing a priority relating to the remote controllers for kitchen and bathroom, a plurality of switches 71a and 72a such as a communication switch for having conversations between a person in the kitchen and a person in the bathroom,

and a displays 71b and 72b for displaying operation status and set-up temperature, etc.

[0027] Displays of the displays 71b and 72b can be changed by operating the switches 71a and 72b. The displays 71a, 71b display the achievement rates of actual operations compared with set-up ideal operations day by day including the day and the past six days.

[0028] In the above described hot water supply apparatus, the compressor 11, the fan 14a, and the circulation pump 51 are operated so as to conduct the heating-up operation for heating water by using night-time electric power and to conduct the adding water and heating operation for adding water and heating the added water when the amount of the remaining hot water in the hot water storage tank 21 becomes less than a predetermined amount. By this, a refrigerant discharged from the compressor 11 absorbs heat by flowing into the evaporator 14 via the expansion valve 13 after radiating heat by passing through the gas cooler 12, and is suck up by the compressor 11. Also, water in the lower part of the hot water storage tank 21 passes through the first circulation circuit 50 by the circulation pump 51, the water is heated in the gas cooler 12 by exchanging heat with the refrigerant, and is stored in the upper part of the hot water storage tank 21. When a predetermined amount of hot water at the predetermined temperature is stored in the hot water storage tank 21, the operations of the compressor 11, the fan 14a, and the circulation pump 51 are stopped.

[0029] As to the heating-up operation, according to the operation modes, temperature of hot water stored in the hot water storage tank 21 is set up within 65~90°C, and the amount of hot water to be stored in the hot water storage tank 21 is set up within 370 liters to 320 liters. Also, as to the adding water and heating operation, temperature of hot water stored in the hot water storage tank 21 is set up to be a set-up temperature of the immediately preceded heating-up operation.

[0030] As to the heating-up operation, to prevent the hot water storage tank 21 from emitting heat, the controller 70 starts the heating-up operation by a time which is calculated reversely so that the heating-up operation is completed by the time when the night-time electric power supply is stopped. For example, if it takes five hours to fill water at a predetermined temperature in the hot water storage tank 21 by the heating-up operation, the heating-up operation starts on 2:00 and finishes at 7:00.

[0031] Also, hot water in the upper part of the hot water storage tank 21 passes through the first hot water supply pipe 41, then, by the first mixing valve 40a, the hot water is mixed with water which passes through the second water supply pipe 32 and temperature of the mixed hot water becomes the set-up temperature set up by the remote controller for kitchen 71 or the remote controller for bathroom 72, the hot water flows through the second hot water supply pipe 42, and the hot water is supplied from the faucet A in the kitchen or in the bathroom.

[0032] Also, hot water in the upper part of the hot water

storage tank 21 passes through the first hot water supply pipe 41, then, by the second mixing valve 40b, the hot water is mixed with water passes through the second water supply pipe 32 and temperature of the mixed hot water becomes the set-up temperature set up by the remote controller for kitchen 71 or the remoter controller for bathroom 72, the hot water flows through the third hot water supply pipe 43 and the second circulation circuit 60, and the hot water is supplied to the bathtub 61 when the bathtub 61 is to be filled with hot water.

[0033] Also, as to a reheating operation, by operating the circulation pumps 23a and 62, hot water in the bathtub 61 is circulated by the second circulation circuit 60, and hot water in the hot water storage tank 21 is circulated by the third circulation circuit 23. By this, hot water in the bathtub 61 is heated at the reheating heat exchanger 21 by exchanging heat with hot water in the upper part of the hot water storage tank 21 and flows back to the bathtub 61.

[0034] A method for calculating an achievement rate X1 of an actual operation compared with a set-up ideal operation is explained below. The achievement rate X1 is calculated by subtracting a value which is calculated by multiplying an amount of water A (liters), which is the amount of water heated by the heating-up operation, and a value B (1/liters), which is the value per 1 liter, and a coefficient K (for example, 7:00~23:00=1, 23:00~7:00 = 0.3) relating to periods in which the heating-up operation is operated from a value 100 defined as an ideal set-up operation of the adding water and heating operation.

[0035] For example, when $B = 0.5$, $K = 1(7:00\sim 23:00)$, $0.3(23:00\sim 7:00)$, for twenty four hours as one unit, if 50 liters of water is heated during 7:00-23:00, and 30 liters of water is heated during 23:00~7:00 by the adding water and heating operation, the calculation will be the achievement rate $X1 = 100 - 50(\text{liters}) \times 0.5(1/\text{liters}) \times 1 - 30(\text{liters}) \times 0.5(1/\text{liters}) \times 0.3 = 60.5$. In other word, the value of the achievement rate X1 becomes 100 if the adding water and heating operation is not conducted for twenty four hours. And the more the amount of water heated by the adding water and heating operation increase, the smaller the value of the achievement rate X becomes. Also, the value of the achievement rate X1 becomes smaller if the adding water and heating operation is conducted during 7:00~23:00 compared with the adding water and heating operation conducted during 23:00~7:00 even though amount of water heated by the adding water and heating operation is the same.

[0036] The coefficient K becomes different between the time period 7:00~23:00 and the time period 23:00~7:00 considering that charges for electric power are different and emitting amounts of carbon dioxide when generating energy are different according to the time periods. In other word, during 7:00-23:00, the charge for electric power is higher and the emitting amount of carbon dioxide when generating energy is larger. Also, during 23:00-7:00, the charge for electric power is cheaper and the emitting amount of carbon dioxide when generating energy

is smaller. Therefore, if a time table for the charges for electric power and a time table for the emitting amount of carbon dioxide when generating energy are different each other, the coefficient K should be set up based on the conditions thereof respectively.

[0037] Also, as shown in FIG.2, the achievement rates X1 which are calculated by the controller 70 are displayed on the display portions 71b and 72b as a bar graph of which a maximum value of the achievement rate X1 is 100. The bar graph of the achievement rates X1 of the past seven days is displayed day by day. By this, it becomes possible to compare the achievement rates X1 of the past seven days easily.

[0038] By the hot water supply apparatus of this embodiment, the achievement rate X1 of an actual operation compared with the set-up ideal operation is calculated based on the operation information memorized in the memory, the calculated achievement rates X1 are displayed on the display portions 71b and 72b of the remote controller for kitchen 71 and the remote controller for bathroom 72. By this, it is easy to know the status of the actual operation compared with the set-up ideal operation. Therefore, it becomes possible to facilitate the energy saving by notifying users of the status of the actual operation compared with the set-up ideal operation.

[0039] FIGS.3-7 show the second embodiment of the present invention. FIG. 3 is a schematic configuration view of the hot water supply apparatus. FIG.4 is a display portion of the remote controller for kitchen and remote controller for bathroom for displaying achievement percentages. FIG.5 is a display portion of the remote controller for kitchen and remote controller for bathroom for displaying achievement percentages by conducting the heating-up operation only. FIG.6 is a display portion of the remote controller for kitchen and the remote controller for bathroom for displaying achievement percentages by conducting the adding water and heating operation only. FIG.7 is a display portion of the remote controller for kitchen and the remote controller for bathroom for displaying sequentially the achievement percentages by conducting the heating-up operation and the adding water and heating operation respectively. Also, the compositions which are the same to the ones in the previously explained first embodiment are assigned the same symbols.

[0040] The controller 70 of this hot water supply apparatus is connected with a first temperature sensor 74 for detecting temperature of water before heated by the heat pump unit 10 and a second temperature sensor 75 provided on the heat pump unit 10 for detecting outside-air temperature.

[0041] The controller 70 memorizes data obtained, for example, by an experiment about a power consumption amount $W(\text{Wh})$ of the heat pump unit 10 when heating a water $F(1)$ being at a water temperature $T_b(^{\circ}\text{C})$ and at a outside-air temperature $T_a(^{\circ}\text{C})$ to become an objective temperature $T_c(^{\circ}\text{C})$, and/or by a passed actual operation data. Based on the detected temperature $T1$ of the first temperature sensor 74 and the detected temperature $T2$

of the second temperature sensor 75, the power consumption amount W(Wh) for heating water to the objective temperature $T_c(^{\circ}\text{C})$ is calculated.

[0042] Also, the controller 70 calculates emitted amounts of carbon dioxide C(kg) and charges for electric power R(yen) based on the power consumption amounts W(Wh) for conducting the heating-up operation and the adding water and heating operation, and time periods in which the heating-up operation is conducted. Also, the achievement percentages X2 and X3 are calculated as the achievement rates of an actual operation compared with the most effective operation in respect of the emitting amount of carbon dioxide C(kg) and charges for electric power R(yen) respectively. Also, the controller 70 displays the achievement percentages X2 and X3 of the emitted amounts of carbon dioxide C(kg) and the charges for electric power R(yen) on the display portions 71b and 72b of the remote controller for kitchen 71 and the remote controller for bathroom 72.

[0043] By the above-mentioned hot water supply apparatus, the controller 70 calculates an achievement percentage X21 of the heating-up operations as follows. The controller 70 calculates a presumed power consumption amount W1(Wh) for heating water F1(liters) being at a detected temperature T1($^{\circ}\text{C}$) detected by the first temperature sensor 74, when the second temperature sensor 75 detects a temperature at a detected temperature T2($^{\circ}\text{C}$), to an objective temperature Tc1($^{\circ}\text{C}$), and based on the calculated power consumption amount W1(Wh), a presumed emitting amount of carbon dioxide C1(kg) (for example, 0.260 kgCO₂/kWh generated by an actual heating-up operation is calculated. Also the controller 70 calculates a presumed emitting amount of carbon dioxide Cmin(kg) generated by conducting the most effective heating-up operation (for example, water temperature is at 65 $^{\circ}\text{C}$, stored water amount is 320 liters), and a presumed emitted amount of carbon dioxide Cmax(kg) generated by conducting the least effective heating-up operation (for example, water temperature is at 90 $^{\circ}\text{C}$, stored water amount is 370 liters) based on the detected temperature T1($^{\circ}\text{C}$) of the first temperature sensor 74 and the detected temperature T2($^{\circ}\text{C}$) of the second temperature sensor 75. Moreover, the controller 70 calculates the achievement percentage X21 from a presumed emitting amount of carbon dioxide C1(kg) which will be generated from the actual heating-up operation, the presumed emitting amount of carbon dioxide Cmin(kg) generated from the most effective heating-up operation, and the presumed emitting amount of carbon dioxide Cmax1(kg) generated from the least effective heating-up operation, like the achievement percentage $X21 = (Cmax1 - C1) / (Cmax1 - Cmin) \times 100$.

[0044] Also, the controller 70 calculates an achievement percentage X22 relating to the adding water and heating operation as follows. At each time in which the adding water and heating operation is conducted, the controller 70 calculates a presumed power consumption amount W2(Wh) for heating water F2(liters) being at a

detected temperature T1($^{\circ}\text{C}$) detected by the first temperature sensor 74, when the second temperature sensor 75 detects a temperature T2($^{\circ}\text{C}$), to an objective temperature Tc1($^{\circ}\text{C}$), and based on the calculated power consumption amount W2(kg), a presumed emitting amount of carbon dioxide C2(kg) generated from an actual adding water and heating operation is calculated. At this time, since emitting amounts of carbon dioxide C21(kg) for each unit power become different depending on time periods in which the adding water and heating operation is conducted, a presumed emitting amount of carbon dioxide C21(kg) generated from the adding water and heating operation conducted during 7:00~23:00 (for example, 0.357 kgCO₂/kWh) and a presumed emitting amount of carbon dioxide C22(kg) generated from the adding water and heating operation conducted during 23:00~7:00 (for example, 0.260 kgCO₂/kWh) are calculated respectively. Also, the controller 70 calculates a presumed emitting amount of carbon dioxide Cmax2(kg) generated from the least effective adding water and heating operation (for example, the adding water and heating operation during the time period of 7:00~23:00 with added water amount of 700 liters) based on the detected temperature T1($^{\circ}\text{C}$) detected by the first temperature sensor 74 and the detected temperature T2($^{\circ}\text{C}$) detected by the second temperature sensor 75. Moreover, the controller 70 calculates an achievement percentage X22 from presumed amounts of CO₂ emission C1(kg) and C2(kg) generated from actual adding water and heating operations, and the presumed emitting amount of carbon dioxide Cmax(kg) generated from the least effective adding water heating operation, like the achievement percentage $X22 = ((Cmax2 - C21 - C22) / Cmax2) \times 100$.

[0045] Therefore, the achievement percentage X2 of an emitted amount of carbon dioxide generated both by the heating-up operation and the adding water and heating operation is calculated like $X2 = ((Cmax1 - C1) + (Cmax2 - C21 - C22)) / ((Cmax - Cmin) + Cmax2) \times 100$.

[0046] Also, the controller 70 calculates an achievement percentage X3 of a charge for electric power R(yen) like calculating the achievement percentage X2 of an emitted amount of carbon dioxide C(kg). The controller 70 calculates the achievement percentage X31 of the heating-up operation as follows. The controller 70 calculates a presumed power consumption amount W1(Wh) for heating water F1(liters) being at a detected temperature T1($^{\circ}\text{C}$) detected by the first temperature sensor 74, when the second temperature sensor 75 detects a temperature T2($^{\circ}\text{C}$), to an objective temperature Tc1($^{\circ}\text{C}$), and based on the calculated consumption power amount W1(Wh), a charge for electric power R1(yen) for an actual heating-up operation is calculated (for example, 8 yen/kWh). Also, the controller 70 calculates a presumed charge for electric power Rmin(yen) for the most effective heating-up operation (for example, water temperature is at 65 $^{\circ}\text{C}$ with stored water amount of 320 liters) and a presumed charge for electric power Rmax1(yen) for the least effective heating-up operation (for example, water

temperature is at 90°C with stored water amount of 320 liters) based on the detected temperature T1(°C) detected by the first temperature sensor 74 and the detected temperature T2(°C) detected by the second temperature sensor 75. Moreover, the controller 70 calculates the achievement percentage X31 of the heating-up operation from the presumed charge for electric power R1(yen) for an actual heating-up operation, the presumed charge for electric power Rmin(yen) for the most effective heating-up operation, and the presumed charge for electric power Rmax1(yen) for the least effective heating-up operation, like the achievement percentage $X31 = (R_{max1} - R1) / (R_{max1} - R_{min}) \times 100$.

[0047] Also, the controller 70 calculates an achievement percentage X32 as follows. At each time in which the adding water and heating operation is conducted, the controller 70 calculates a presumed power consumption amount W2(Wh) for heating water F2(liters) being at a detected temperature T1(°C) detected by the first temperature sensor 74, when the second temperature sensor 75 detects a temperature T2(°C), to an objective temperature Tc1(°C), and based on the calculated power consumption amount W2(Wh), a presumed charge for electric power R2(yen) is calculated for an actual adding water and heating operation. At this time, Since presumed charges for electric power for each time period differ according to time periods in which the adding water and heating operation is conducted, a presumed charge for electric power R21(yen) for conducting the adding water and heating operation during 7:00~23:00 (for example, 26 yen/kWh), and a presumed charge for electric power R22 for conducting the adding water and heating operation during 23:00~7:00 (for example, 8 yen/kWh) are calculated respectively. Also, the controller 70 calculates a presumed charge for electric power Rmax2(yen) for the least effective adding water and heating operation (for example, the adding water and heating operation during the time period of 7:00~23:00 with added water amount of 700 liters) based on the detected temperature T1(°C) detected by the first temperature sensor 74 and the detected temperature T2(°C) detected by the second temperature sensor 75. Moreover, the controller 70 calculates the achievement percentage X32 from the presumed charges for electric power R21(yen) and R22(yen) for conducting the actual adding water and heating operation, and the presumed charge for electric power Rmax(yen) for the least effective adding water and heating operation, like the achievement percentage $X32 = ((R_{max2} - R21 - R22) / R_{max2}) \times 100$.

[0048] By this, an achievement percentage X3 of the charge for electric power R(yen) for conducting both the heating-up operation and the adding water and heating operation is calculated like the achievement percentage $X3 = ((R_{max1} - R1) + (R_{max2} - R21 - R22)) / (R_{max1} - R_{min} + R_{max2}) \times 100$.

[0049] Moreover, as shown in FIG.4, the calculated achievement rates X2 and X3 are displayed on the display portions 71b and 72b of the remote controller for

kitchen 71 and the remote controller for bathroom 72 with bar graphs of which maximum percentages of the achievement percentages X2 and X3 are 100%. The achievement rates X2 and X3 of the past seven days are shown by the bar graphs day by day. By this, it becomes possible to compare the achievement percentages X2 and X3 of the past seven days easily. Also, instead of displaying the achievement percentages X2 and X3, the achievement percentages X21 and X31 for conducting the heating-up operation and the achievement percentages X22 and X32 for conducting the adding water and heating operation can be displayed on the display portions 71b and 72b respectively as shown in FIGS. 5 and 6, or the achievement percentages of X21 and X31 for conducting the heating-up operation and the achievement percentages X22 and X32 for adding water and heating operation can be displayed on the display portions 71b and 72b side by side as shown in FIG.7.

[0050] Also, either the achievement percentage X2 of the emitted amount of carbon dioxide C(kg) or the achievement percentage X3 of the electric charge R(yen) is displayed on the display portions 71b and 72b of the remote controller for kitchen 71 and remote controller for bathroom 72, and the other one of the X2 or X3 can be displayed by operating the switches 71a and 72a.

[0051] Also, when the achievement percentages X22 and X32 of the adding water and heating operation is higher than a predetermined percentage, the controller 70 displays on the display portions 71b and 72b an indication showing an operation mode which is to lower a temperature of water stored in the hot water storage tanks 21 when conducting the heating-up operation, or changes operation modes automatically. Also, when the achievement percentages X22 and X32 of the adding water and heating operation are lower than a predetermined percentage, the controller 70 calculates the achievement percentages X2 and X3 of the case in which the operation mode is changed to the one which is with higher temperature of water stored in the hot water storage tank 21 in the heating-up operation, and if the controller judges that it is possible to reduce energy in total, the controller displays an indication showing a suggestion of changing operation modes on the display portions 71b and 72b, or changes operation modes automatically. Moreover, if the result of the achievement percentage X2 and the achievement percentage X3 are different from each other, it becomes possible to select which one of achievement percentage X2 or the achievement percentage X3 to be a criterion for the suggestion of changing operation modes or for changing operation modes automatically by operating switches 71a and 72a.

[0052] By the hot water supply apparatus of this embodiment, the achievement percentage X2 of the actual operation compared with a set-up ideal operation based on the stored operation data is calculated, and the calculated achievement percentage X2 is displayed on the display portions 71b and 72b of the remote controller for kitchen 71 and the remote controller for bathroom 72. By

this, it becomes possible to know the actual operation compared with the set-up ideal operation easily. Therefore, it is capable of facilitating the energy saving by notifying users of the status of the actual operation compared with the set-up ideal operation.

[0053] Also, the achievement percentage X2 of the emitted amount of carbon dioxide generated from the actual operation compared with a presumed emitting amount of carbon dioxide which is supposed to be emitted from the set-up ideal operation is calculated, the calculated achievement percentage X2 is displayed on the display portions 71b and 72b of the remote controller for kitchen 71 and the remote controller for bathroom 72. By this, it becomes possible to notify users of a status of an actual operation from the aspect of emitted amount of carbon dioxide. Therefore, it becomes possible to improve consciousness of users for energy saving.

[0054] Also, the achievement percentage X3 of the charge for electric power for the actual operation compared with a presumed charge for electric power which is supposed to be charged for the set-up ideal operation is calculated, the calculated achievement percentage X3 is displayed on the display portions 71b and 72b of the remote controller for kitchen 71 and the remote controller for bathroom 72. By this, it becomes possible to notify users of a status of an actual operation from the economical aspect. Therefore, it becomes possible to improve consciousness of users for economical saving.

[0055] Also, the achievement percentage X2 of the emitted amount of carbon dioxide and the achievement percentage X3 of the charge for electric power can be switched and displayed alternatively on the display portions 71b and 72b of the remote controller for kitchen 71 and the remote controller for bathroom 72. By this, users can select which one of the achievement percentage X2 of the emitted amount of carbon dioxide or the achievement percentage X3 of the charge for electric power to be displayed according to their needs. Therefore, it becomes further effectively possible to improve consciousness of users for energy saving.

[0056] Also, the achievement percentages X2 and X3 of the past seven days can be displayed day by day on the display portions 71b and 72b of the remote controller for kitchen 71 and the remote controller for bathroom 72. By this, it becomes possible to compare the passed achievement percentages X2 and X3 easily. Therefore, it is capable of facilitating the energy saving further.

[0057] Also, based on the passed achievement percentages X2 and X3, the best operation mode can be selected and displayed on the display portions 71b and 72b of the remote controller for kitchen 71 and the remote controller for bathroom 72, and operation modes can be changed automatically. By this, it becomes possible to operate by the best operation mode. Therefore, it becomes capable of practicing further energy saving.

[0058] The preferred embodiments described in this specification are illustrative and not restrictive. The scope of invention is given by the appended claims, and all

changes and modifications included in the meaning of claims are embraced in the present invention.

5 Claims

1. A hot water supply apparatus comprising:

a memory (70) for memorizing information relating to a past operation;
a calculation portion (70) for calculating an actual achievement rate (X1, X2, X3) of an actual operation compared with a set-up operation based on the information memorized in the memory; and
a display portion (71b, 72b) for displaying a calculated result by the calculation portion (70).

2. The hot water supply apparatus according to claim 1, wherein

the calculating portion (70) calculates the achievement rate (X2) of an emitted amount of carbon dioxide in the actual operation compared with an emitted amount of carbon dioxide which is supposed to be emitted in the set-up operation.

3. The hot water supply apparatus according to claim 1, wherein

the calculating portion (70) calculates the achievement rate (X3) of a charge for consumed energy in the actual operation compared with a charge for consumed energy which is supposed to be consumed in the set-up operation.

4. The hot water supply apparatus according to claim 1 further comprising a display changer (71a, 71a), the hot water supply apparatus wherein the calculating portion (70) calculates the achievement rate (X2) of an emitted amount of carbon dioxide in the actual operation compared with an emitted amount of carbon dioxide which is supposed to be emitted in the set-up operation, and the calculating portion (70) calculates the achievement rate (X3) of a charge for consumed energy in the actual operation compared with a charge for consumed energy which is supposed to be consumed in the set-up operation,

and the display changer (71a, 71b) is provided for changeably displaying on the display portion (71b, 72b) either the achievement rate (X2) of the emitted amount of carbon dioxide or the achievement rate (X3) of the charge for consumed energy.

5. The hot water supply apparatus according to any one of claims 1-4, wherein

the display portion (71b, 72b) displays a series of achievement rates (X1, X2, X3) of a passed predetermined period.

6. The hot water supply apparatus according to any one of claims 1-5, further comprising:

a plurality of operation modes of which a set-up amount of water to be heated, a set-up temperature of heated water, and the like are different each other; and
a controller (70) for selecting the best operation mode based on the past achievement rate (X1, X2, X3).

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FIG. 1

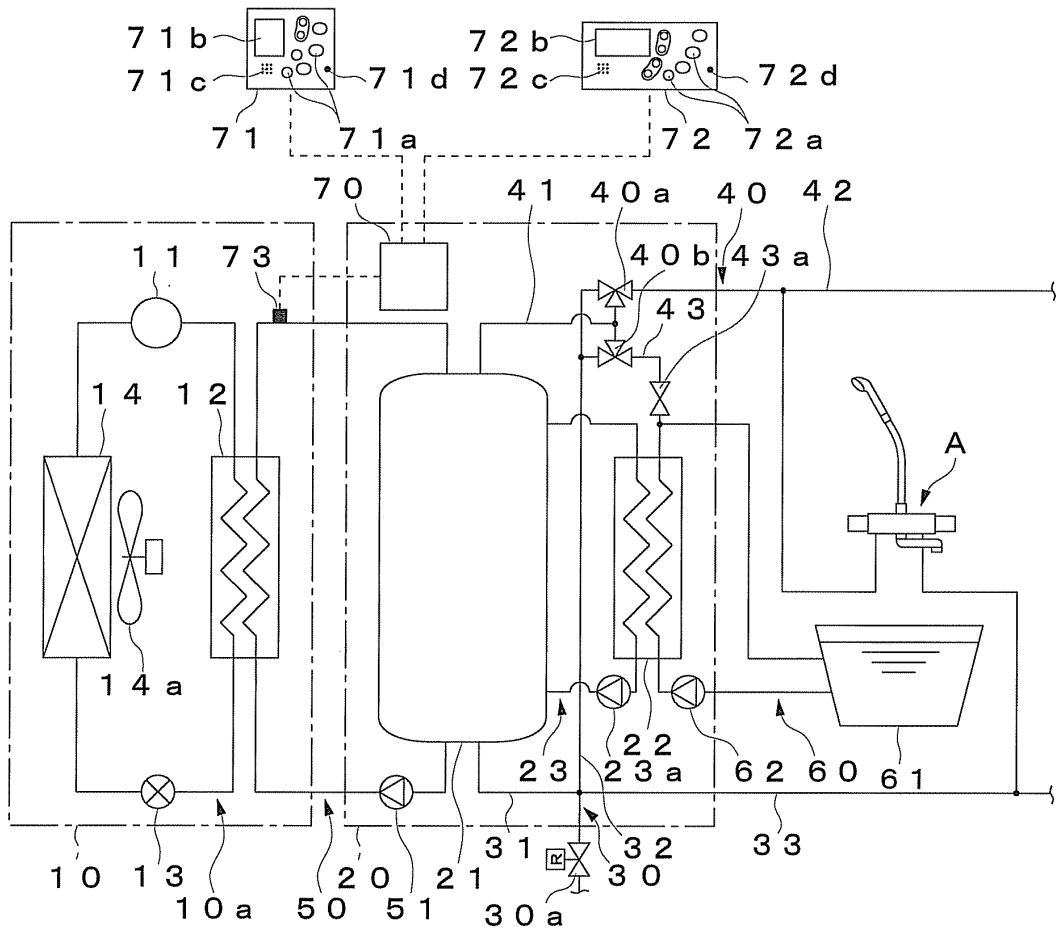


FIG. 2

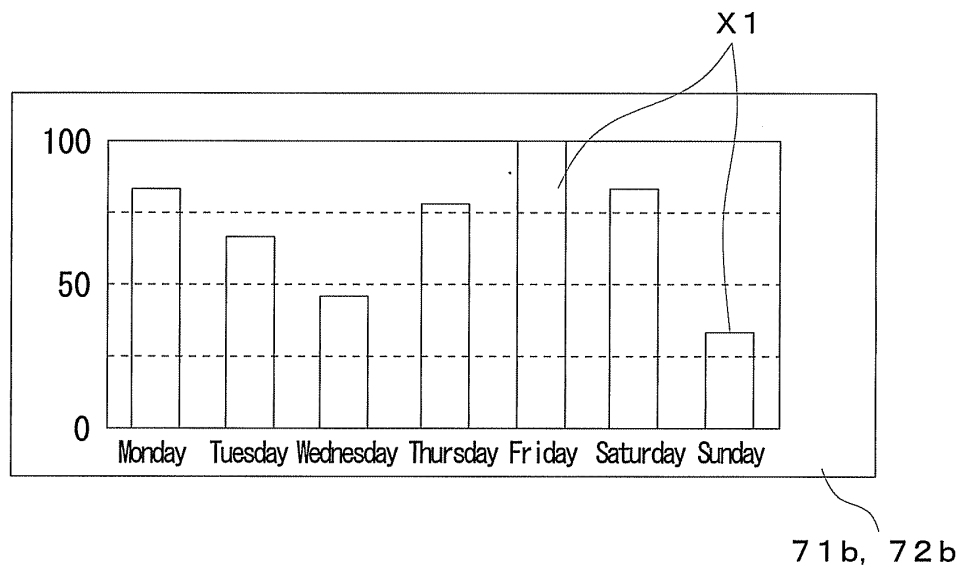


FIG. 3

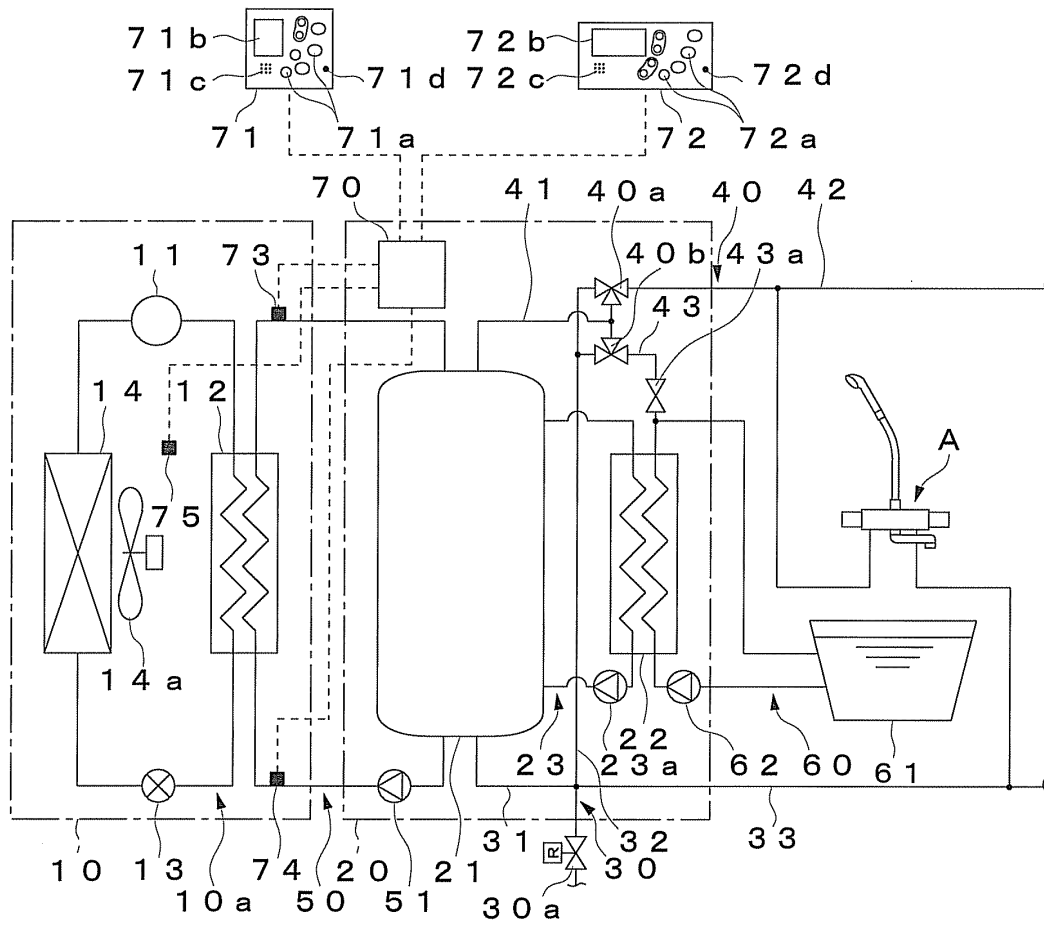


FIG. 4

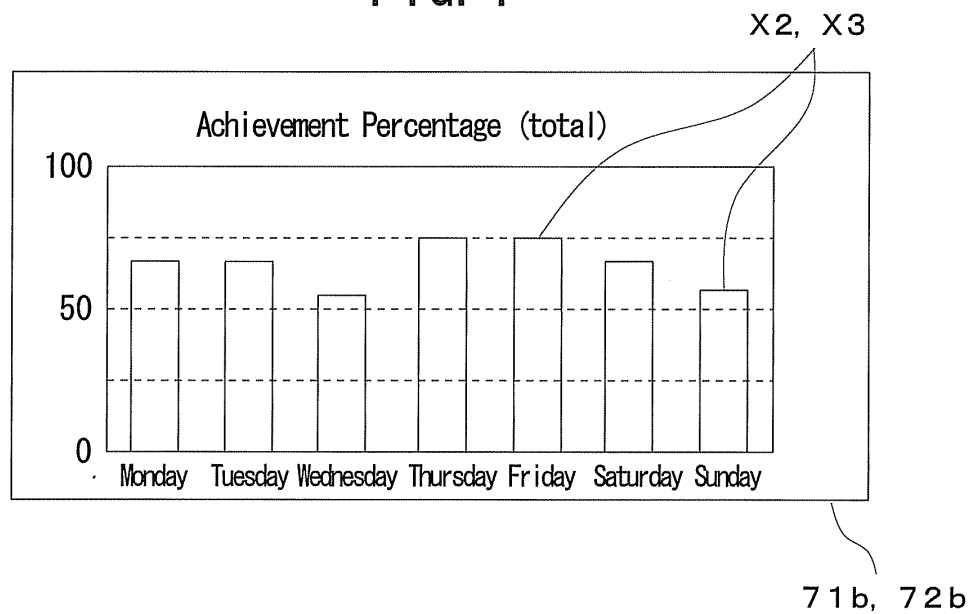


FIG. 5

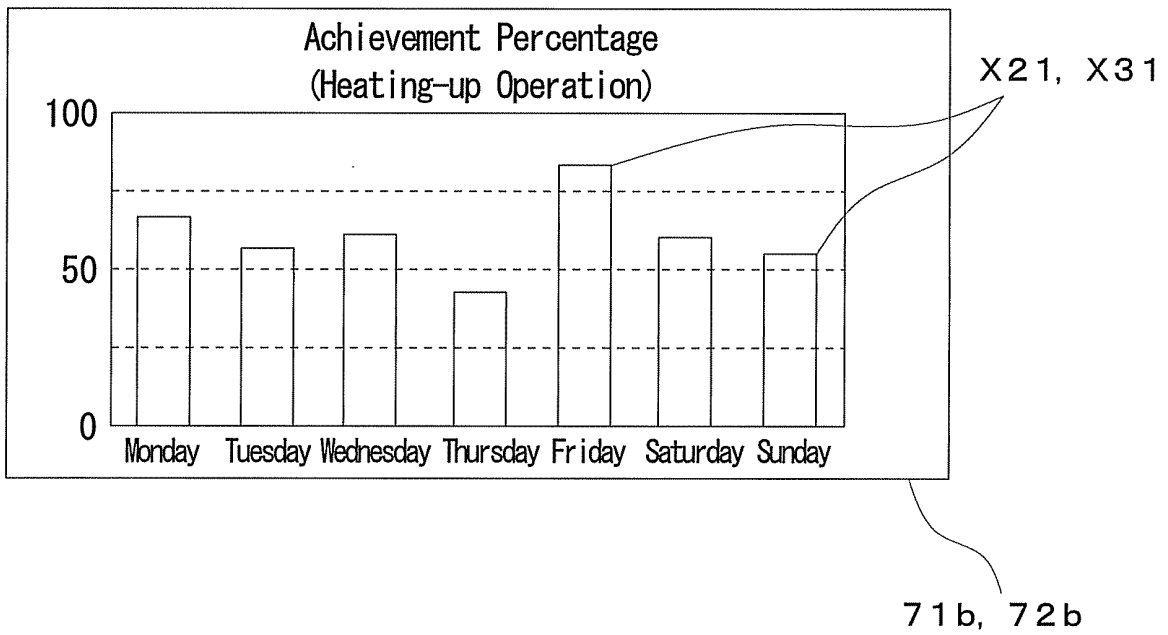


FIG. 6

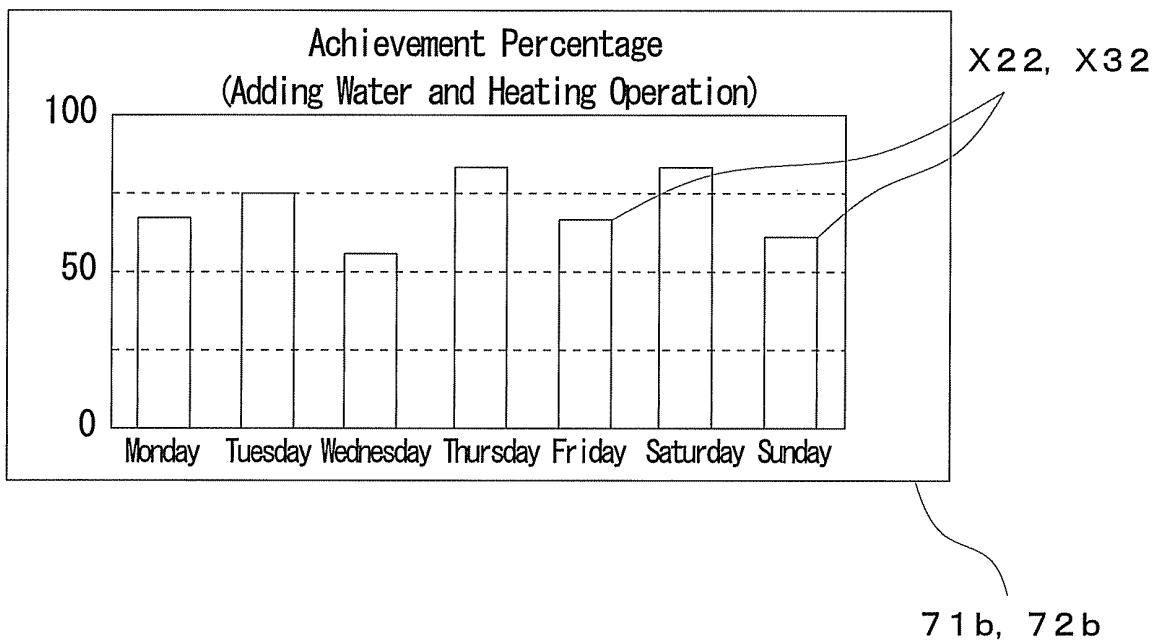
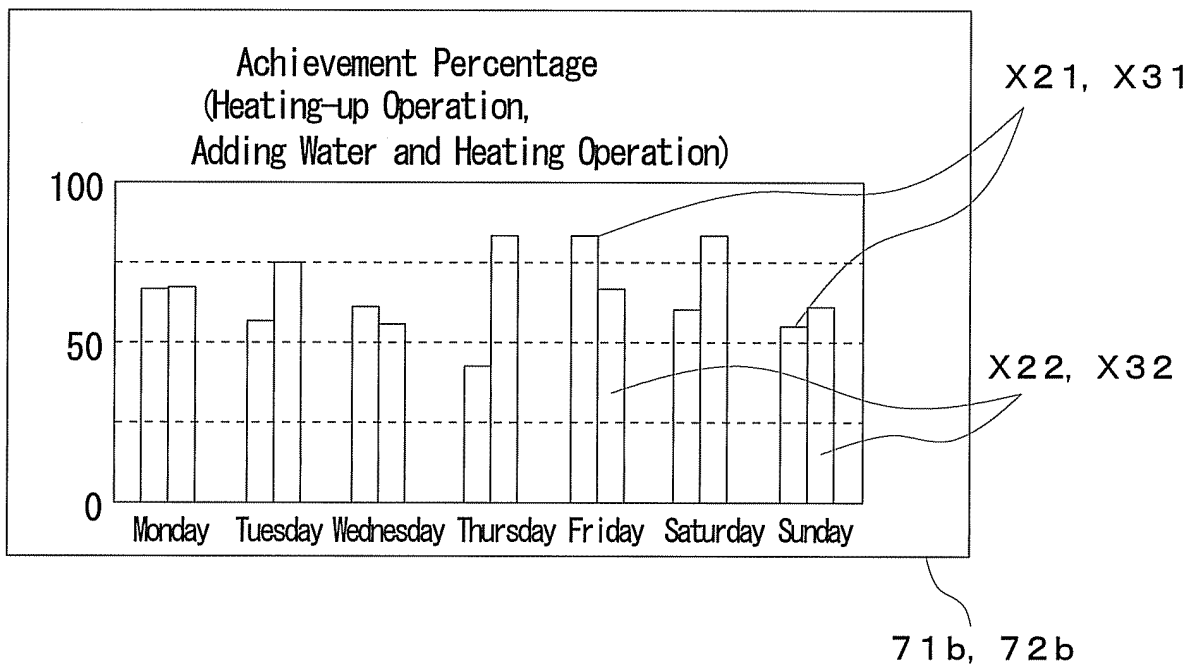


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/069129

A. CLASSIFICATION OF SUBJECT MATTER

F24H1/00(2006.01)i, F24H1/18(2006.01)i, H04Q9/00(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F24H1/00, F24H1/18, H04Q9/00

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2009

Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2005-291626 A (Gastar Co., Ltd.), 20 October, 2005 (20.10.05), Par. Nos. [0013], [0032] to [0035], [0083] to [0115], [0139] to [0153]; Figs. 1 to 7 (Family: none)	1-6
Y	JP 2006-64326 A (Noritz Corp. et al.), 09 March, 2006 (09.03.06), Full text; Figs. 1 to 10 (Family: none)	1-6
Y	JP 2006-349483 A (Kosumoraifu Kabushiki Kaisha), 28 December, 2006 (28.12.06), Par. Nos. [0081] to [0083] (Family: none)	1-6

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

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"&" document member of the same patent family

Date of the actual completion of the international search
14 January, 2009 (14.01.09)Date of mailing of the international search report
27 January, 2009 (27.01.09)Name and mailing address of the ISA/
Japanese Patent Office

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/069129

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2005-332103 A (Tokyu Construction Co., Ltd.), 02 December, 2005 (02.12.05), Full text; Figs. 1 to 7 (Family: none)	1-6

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

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