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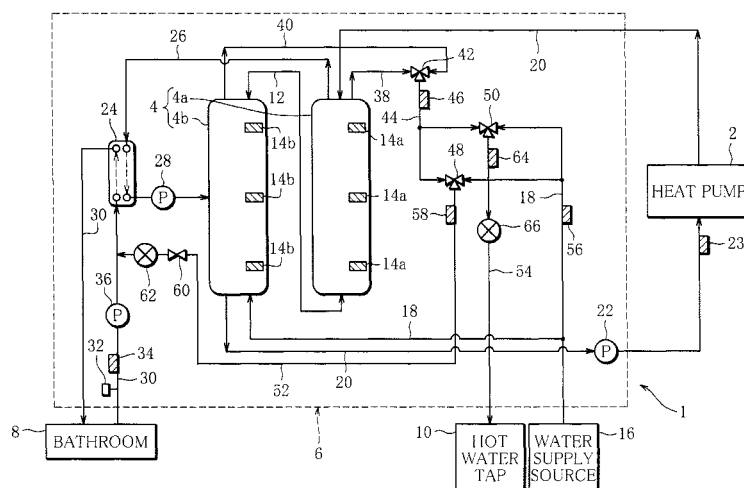
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(54) **HOT-WATER STORAGE TYPE HOT-WATER SUPPLY DEVICE**

(57) There are provided a hot water tank (4) having a first end from which high temperature water boiled by a heat pump (2) is fed and a second end from which low temperature water is fed, the tank in which hot water inside is stored in layers of hot temperature water, medium temperature water whose temperature is lower than the high temperature water but is higher than low temperature water, and the low temperature water, in the order named; hot water supply means (42, 48, 50) that dis-

charges the hot water in the hot water tank (4) from the first end of the hot water tank (4); hot water supply amount-detecting means (62, 66) that detects a supply amount of hot water that is supplied by the hot water supply means (42, 48, 50); and a control unit that withholds execution of a hot water boiling operation using the heat pump when the hot water supply amount (V) detected by the hot water supply amount-detecting means (62, 66) is equal to or more than prescribed hot water supply amount (V_S).

FIG. 1



Description

Technical Field

[0001] The invention relates to a storage-type hot water supplier that stores and uses hot water heated by a heat pump.

Background Art

[0002] A storage-type hot water supplier has been lately introduced, which stores in a hot water tank the hot water heated and boiled by means of a high-efficiency heat pump during hours when an electric utility rate is relatively low, and uses the stored water to supply hot water, fill a bathtub, reheat bathtub water, to thereby save energy.

[0003] The hot water tank of the storage-type hot water supplier is generally supplied with water from the lower part and with boiled hot water from the upper part. The hot water in the tank is stored in layers of high and low temperature waters. During the reheating of bathtub water or the like, the supplier executes heat exchange between the high temperature water and the bathtub water. Medium temperature water whose temperature is decreased by the heat exchange is returned to a middle part of the tank and forms a medium temperature water layer.

[0004] However, because of its low temperature, the medium temperature water cannot be reused for heat exchange with the bathtub water or the like. Moreover, there is a problem that the heat pump has the characteristic that its COP (Coefficient of Performance) is decreased when boiling the medium temperature water than when boiling the low temperature water.

[0005] In consideration of this problem, a storage-type hot water supplier has first and second hot water tanks, returns the medium temperature water produced by heat exchange carried out during the bathtub water reheating or the like to the upper part of the first hot water tank, and preferentially uses high or medium temperature water in the first hot water tank when supplying hot water, to thereby consume the medium temperature water (for example, see Unexamined Japanese Patent Publication No. 2004-101134).

[0006] In the storage-type hot water supplier, when a reduction in hot water within the hot water tank is detected, the heat pump performs an additional boiling operation such as the adding and boiling of water. This boiling operation is executed when the amount of hot water left in the hot water tank is reduced by hot water supply or bathtub filling or when the temperature of the remaining hot water is decreased.

[0007] Especially, during bathtub filling, a large quantity of hot water is supplied over a long time as compared to during simple hot water supply. For that reason, the boiling operation and the hot water supply operation are often carried out at the same time.

[0008] In general, the boiling operation is an operation of feeding hot water into the hot water tank from the upper part of the hot water tank, whereas the hot water supply operation is an operation of discharging the hot water in the hot water tank from the upper part of the hot water tank. These two operations create two oppositely-directed hot water flows within the hot water tank. Such oppositely-directed hot water flows disturb a hot water distribution formed in layers of high, medium, and low temperature waters aligned in this order within the hot water tank, enlarge the medium temperature water layer, and thus increase the amount of medium temperature water.

[0009] During the bathtub filling, hot water is supplied by opening/closing an electromagnetic valve. Compared with the simple hot water supply, the flow rate and velocity of the hot water moving in the hot water tank are increased. As a result, a disturbance of the hot water distribution in the hot water tank, namely, an increase of the medium temperature water, becomes more pronounced.

[0010] The above-mentioned conventional technology, however, has no particular method for coping with the increase of the medium temperature water. Although the medium temperature water is preferentially consumed, the boiling of the remaining medium temperature water, which is low in COP, has to be carried out when the late-night boiling is finished next time. Consequently, there occurs a problem that the COP of the storage-type hot water supplier is decreased.

Disclosure of the Intention

[0011] The invention has been made in light of the above-mentioned issue. It is an object of the invention to provide a storage-type hot water supplier in which COP is greatly enhanced by preventing a disturbance of a hot water distribution in a hot water tank and thus preventing an increase of medium temperature water.

[0012] In order to achieve the object, the storage-type hot water supplier of the invention is a storage-type hot water supplier that stores and uses hot water boiled by means of a heat pump. The storage-type hot water supplier includes a hot water tank having a first end from which high temperature water boiled by the heat pump is fed and a second end from which low temperature water is fed, the tank in which hot water inside is stored in layers of hot temperature water, medium temperature water whose temperature is lower than the high temperature water but is higher than low temperature water, and the low temperature water, in the order named; hot water supply means that discharges the hot water in the hot water tank from the first end of the hot water tank; hot water supply amount-detecting means that detects a supply amount of hot water that is supplied by the hot water supply means; and a control unit that withholds execution of a hot water boiling operation using the heat pump when the hot water supply amount detected by the hot water supply amount-detecting means is equal to or more than prescribed hot water supply amount.

[0013] The storage-type hot water supplier is capable of preventing a disturbance of a hot water distribution in the hot water tank, which occurs when the hot water boiling operation and the hot water supply operation are simultaneously carried out, and thus preventing an increase of the medium temperature water, to thereby greatly enhance COP of the storage-type hot water supplier.

[0014] According to a preferred aspect, in the storage-type hot water supplier, the control unit executes the boiling operation after a lapse of predetermined time after the hot water supply of the hot water supply means is finished.

[0015] With this configuration, it is possible to start the boiling operation after the disturbance of a hot water distribution in the hot water tank, which occurs due to hot water supply, is cleared. For that reason, the increase of the medium temperature water can be more effectively prevented, which greatly enhances the COP of the storage-type hot water supplier.

[0016] According to a preferred aspect, in the storage-type hot water supplier, the control unit stops the boiling operation when the hot water supply amount detected by the hot water supply amount-detecting means during the boiling operation is equal to or more than the prescribed hot water supply amount.

[0017] With this configuration, even during the boiling operation, if there is a possibility of a disturbance of the hot water distribution in the hot water tank as a result of an increase of the hot water supply amount, it is possible to prevent such a disturbance and more effectively prevent the increase of the medium temperature water. This greatly improves the COP of the storage-type hot water supplier.

[0018] According to a preferred aspect, in the storage-type hot water supplier, the hot water supply means supplies hot water to a bathtub according to a bathtub filling process carried out by the control unit. The control unit withholds the execution of the boiling operation until the bathtub filling process is finished, and executes the boiling operation after the bathtub filling process is finished.

[0019] With this configuration, during the bathtub filling time when the flow rate and velocity of hot water moving within the hot water tank are increased, it is possible to reliably prevent a disturbance of a hot water distribution in the hot water tank and more effectively prevent an increase of the medium temperature water. This further improves the COP of the storage-type hot water supplier.

Brief Description of the Drawings

[0020]

FIG. 1 is a schematic configuration view of a storage-type hot water supplier according to one embodiment of the invention;

FIG. 2 is a flowchart showing a control routine of boiling control in case that the routine executes a hot

water boiling operation during hot water supply or bathtub filling in the storage-type hot water supplier shown in FIG. 1; and

FIG. 3 is a flowchart showing a control routine of boiling control in case that the routine starts the hot water boiling operation during hot water boiling or bathtub filling in the storage-type hot water supplier shown in FIG. 1.

10 Best Mode of Carrying out the Invention

[0021] An embodiment of the invention will be described below with reference to the attached drawings.

[0022] FIG. 1 shows a schematic configuration view of a storage-type hot water supplier according to the invention. A hot water supplier 1 includes a heat pump 2 that heats hot water and a tank unit 6 having a hot water tank 4 that stores hot water. The hot water supplier 1 stores in the hot water tank 4 the hot water heated and boiled by means of the heat pump 2. The hot water supplier 1 uses the stored hot water to carry out the filling of a bathtub, the reboiling of bathtub water, hot water supply to a hot water tap, not shown, of the bathroom, kitchen, lavatory, shower or the like.

[0023] All detailed description of the heat pump 2 will be omitted as the heat pump 2 is a publicly-known device in which a refrigerant circulates through a compressor, a condenser, an expansion valve and an evaporator, not shown, and the hot water in the hot water tank 4 is heated and boiled through heat exchange with a refrigerant flowing through the condenser.

[0024] The tank unit 6 has a high temperature tank 4a and a low temperature tank 4b, which serve as the hot water tank 4. The high temperature tank 4a and the low temperature tank 4b have the same shape. A lower end of the high temperature tank 4a and an upper end of the low temperature tank 4b are serially connected to each other through a connecting path 12. In other words, the hot water tank 4 has an integral structure in which an upper part of the high temperature tank 4a forms a first end of the hot water tank 4, and a lower part of the low temperature tank 4b forms a second end of the hot water tank 4.

[0025] In the high temperature tank 4a and the low temperature tank 4b, there are disposed thermistor groups 14a and 14b vertically arranged at given intervals. The thermistor groups 14a and 14b detect hot water temperatures at their positions.

[0026] Connected to a lower end of the low temperature tank 4b is a water supply path 18 extending from an external water supply source 16 such as a city's water supply source.

[0027] A boiling circulation path 20 provided with the heat pump 2 is connected to the lower end of the low temperature tank 4b and an upper end of the high temperature tank 4a. The boiling circulation path 20 is provided with a boiling circulation pump 22 interposed between the low temperature tank 4b and the heat pump

2, and a boiling thermistor 23 that detects temperature of hot water flowing through the boiling circulation path 20. The boiling circulation pump 22 functions to discharge hot water existing in the lower end side in the low temperature tank 4b through the boiling circulation path 20 and feed the hot water into the upper end side in the high temperature tank 4a via the heat pump 2.

[0028] A reboiling circulation path 26 provided with a reboiling heat exchanger 24 is connected to the upper end of the high temperature tank 4a and a vertically middle part of a lateral surface of the low temperature tank 4b. The reboiling circulation path 26 is provided with a reboiling circulation pump 28 interposed between the reboiling heat exchanger 24 and the low temperature tank 4b. The reboiling circulation pump 28 functions to discharge hot water existing in the upper end side in the high temperature tank 4a through the reboiling circulation path 26 and feed the hot water into the middle part in the low temperature tank 4b via the reboiling heat exchanger 24.

[0029] The reboiling heat exchanger 24 is also interposed in a bathwater circulation path 30 and functions to carry out heat exchange between hot water flowing through the bathwater circulation path 30 and hot water flowing through the reboiling circulation path 26.

[0030] The bathwater circulation path 30 is connected to a bathtub in a bathroom 8 and designed to circulate hot water in the bathtub. The bathwater circulation path 30 is provided with not only the reboiling heat exchanger 24 but also a water level sensor 32 that detects a water level of the bathtub, a bathwater thermistor 34 for detecting temperature of hot water flowing through the bathwater circulation path 30, namely hot water temperature in the bathtub, and a bathwater circulation pump 36. The bathwater circulation pump 36 functions to discharge the hot water in the bathtub through the bathwater circulation path 30 and feed the hot water into the bathtub again via the reboiling heat exchanger 24.

[0031] A high temperature water discharging path 38 is connected to the upper end of the high temperature tank 4a, and a low temperature water discharging path 40 to the upper end of the low temperature tank 4b.

[0032] The high temperature water discharging path 38 and the low temperature water discharging path 40 are made of pipe members. The high temperature water discharging path 38 and the low temperature water discharging path 40 join together through a tank-side mixing valve (hot water supply means) 42 at a predetermined junction, and are then connected to a combined water discharging path 44. The combined water discharging path 44 is made of a pipe member as with the high temperature water discharging path 38 and the low temperature water discharging path 40. The combined water discharging path 44 is provided with a combined water discharging thermistor 46 that detects temperature of hot water flowing through the combined water discharging path 44.

[0033] The combined water discharging path 44 is di-

vided into two parts in the downstream side of the combined water discharging thermistor 46. One of the parts is connected to a bathroom-side mixing valve (hot water supply means) 48, and the other to a hot water supply-side mixing valve (hot water supply means) 50.

[0034] The bathroom-side mixing valve 48 and the hot water supply-side mixing valve 50 are connected with the water supply path 18. A bathtub filling path 52 and a hot water supply path 54 are connected to the bathroom-side mixing valve 48 and the hot water supply-side mixing valve 50, respectively. The bathroom-side mixing valve 48 and the hot water supply-side mixing valve 50 function to adjust a mixing ratio of hot water from the combined water discharging path 44 and water from the water supply path 18 and discharge hot water into the bathtub filling path 52 and the hot water supply path 54. The water supply path 18 is provided with a water supply thermistor 56 that detects temperature of water passing through the water supply path.

[0035] The bathtub filling path 52 is connected to the bathwater circulation path 30 and provided with a bathtub filling thermistor 58 that detects temperature of hot water flowing through the bathtub filling path 52, an electromagnetic valve 60 that is opened/closed to open/close the bathtub filling path 52, and a bathtub filling flow sensor (hot water supply amount-detecting means) 62 that detects a flow rate of hot water supplied from the bathtub filling path 52 to the bathwater circulation path 30.

[0036] The hot water supply path 54 is connected to a hot water tap 10 and provided with a hot water supply thermistor 64 that detects temperature of hot water flowing through the hot water supply path 54 and a hot water flow sensor (hot water supply amount-detecting means) 66 that detects a flow rate of hot water supplied from the hot water supply path 54 to the hot water tap 10.

[0037] The hot water supplier 1 is provided with a control unit, not shown. The control unit controls the heat pump 2, circulation pumps 22, 28 and 36, the mixing valves 42, 48 and 50, the electromagnetic valve 60 and the like according to arbitrary conditions on the basis of information detected by the thermistors 14a, 14b, 23, 34, 46, 56, 58 and 64, the water level sensor 32, the flow sensors 62 and 66 and the like.

[0038] Actuation of the hot water supplier 1 according to the invention thus configured will be described below.

[0039] The high temperature tank 4a and the low temperature tank 4b are always filled with hot water. The hot water is layered by temperature.

[0040] When the hot water in the tank is discharged by hot water supply, low temperature water having relatively low temperature (ranging from 0 to 20°C, for example) is replenished from the water supply source 16 to the low temperature tank 4b. A low temperature water layer is thus formed in a lower part of the low temperature tank 4b.

[0041] The boiling operation in the hot water supplier 1 is carried out by actuating the heat pump 2 and the boiling circulation pump 22.

[0042] The actuation of the boiling circulation pump 22 delivers the low temperature water from the lower end side in the low temperature tank 4b through the boiling circulation path 20 to the heat pump 2. High temperature water that is heated and boiled to high temperature (ranging from about 65 to 90°C, for example) by the heat pump 2 is delivered to the upper end side in the high temperature tank 4a.

[0043] The hot water circulation by using the heat pump 2 is continued for predetermined time, and a high temperature water layer is therefore expanded from an upper part to a lower part of the high temperature tank 4a, and is further expanded from an upper part to the lower part of the low temperature tank 4b through the connecting path 12. Amount of the high temperature water, or amount of remaining hot water, is detected from a temperature distribution detected by the thermistor groups 14a and 14b located in the tanks 4a and 4b. The boiling operation is carried out mainly during predetermined late night hours when electricity is relatively less expensive.

[0044] The rebelling operation in the hot water supplier 1 is carried out by actuating the reboiling circulation pump 28 and the bathwater circulation pump 36 when the water level of the bathtub in the bathroom 8, which is detected by the water level sensor 32, is equal to or higher than prescribed water level.

[0045] To be more specific, as a result of the actuation of the reboiling circulation pump 28, the high temperature water is delivered from the upper end side of the high temperature tank 4a through the reboiling circulation path 26 to the reboiling heat exchanger 24. Medium temperature water that is reduced in temperature (ranging from 40 to 60°C, for example) by heat exchange with the bathwater in the reboiling heat exchanger 24 flows into the middle part of the low temperature tank 4b.

[0046] Such circulation of hot water using the reboiling heat exchanger 24 forms a medium temperature water layer in the middle part of the low temperature tank 4b, that is, between the high and low temperature water layers. The medium temperature water layer is also produced, for example, when the high temperature water is left for long hours and decreased in temperature.

[0047] As a result of the actuation of the bathwater circulation pump 36, the hot water in the bathtub of the bathroom 8 is delivered through the bathwater circulation path 30 to the reboiling heat exchanger 24. The hot water heated by heat exchange with the high temperature water in the reboiling heat exchanger 24 is returned into the bathtub, to thereby carry out the reboiling operation.

[0048] The hot water supplier 1 starts to fill the bathtub in the bathroom 8 when the electromagnetic valve 60 is opened, and supplies hot water when the hot water tap 10 is turned on.

[0049] To be more concrete, the opening of the electromagnetic valve 60 discharges hot water from the bathtub filling path 52 to the bathwater circulation path 30, and delivers the hot water into the bathtub through the

bathwater circulation path 30, thereby filling the bathtub. The hot water tap 10 is turned on to discharge the hot water of the hot water supply path 54 out of the hot water tap 10, to thereby supply hot water.

[0050] A mixing ratio of the hot water from the combined water discharging path 44 and the low temperature water from the water supply path 18 is adjusted by controlling the tank-side mixing valve 42, the bathroom-side mixing valve 48 and the hot water supply-side mixing valve 50 according to the control of the control unit so that the hot water discharged during the bathtub filling and the hot water supply, that is, the hot water passing through the bathtub filling path 52 and the hot water supply path 54, has arbitrary prescribed temperature.

[0051] The hot water passing through the combined water discharging path 44 is a fixture of the hot water passing through the high temperature water discharging path 38 and the hot water passing through the low temperature water discharging path 40.

[0052] Since the high temperature water discharging path 38 is connected to the upper end of the high temperature tank 4a, into which the high temperature water is delivered, the hot water discharged from the high temperature water discharging path 38 is the high temperature water stored in the upper end side of the high temperature tank 4a. The hot water discharged from the low temperature water discharging path 40 is the hot water stored in the upper end side of the low temperature tank 4b. This hot water is occasionally low or high temperature water, but most of the time is medium temperature water since medium temperature water in the middle part of the low temperature tank 4b enters into the low temperature water discharging path 40. In this manner, hot water boundary layers including high, medium and low temperature water layers are formed in the order from the top within the hot water tank 4 consisting of the high temperature tank 4a and the low temperature tank 4b.

[0053] In the present embodiment, the control unit controls the temperature and flow rate of the hot water discharged from the hot water tank 4 during the bathtub filling and the hot water supply as described above, and also implements hot water boiling control in the heat pump 2 according to the flow rate of hot water discharged from the hot water tank 4, namely the hot water supply amount.

[0054] With reference to a flowchart shown in FIG. 2, a control routine of the boiling control implemented by the control unit will be described below in detail.

[0055] First of all, when there is a demand of the boiling operation using the heat pump 2 due to a decrease in amount or temperature of remaining hot water stored in the hot water tank 4, the boiling control is implemented, and the routine proceeds to S1 (hereinafter, "S" means a step).

[0056] S1 makes a determination as to whether hot water is being supplied to the hot water tap 10. If the result is YES, and it is determined that the hot water supply is being in process, the routine advances to S2. If the

result is NO, and it is determined that the hot water supply is not being in process, the routine moves to S3.

[0057] If the routine advances to S2, a flow rate F or hot water supplied to the hot water tap 10, which is detected by the hot water supply flow sensor 66, becomes equal to or higher than a prescribed flow rate F_S , and a determination is made as to whether $F \geq F_S$ is true. If the result is YES, and it is determined that $F \geq F_S$ is true, the routine proceeds to S4. If the result is NO, and it is determined that $F \geq F_S$ is not true, the routine moves to S7.

[0058] If the routine advances to S4, hot water supply time T when $F \geq F_S$ is true is continued for or longer than predetermined time T_S . A determination is made as to whether $T \geq T_S$ is true. If the result is YES, and it is determined that $T \geq T_S$ is true, the routine proceeds to S5. If the result is NO, and it is determined that $T \geq T_S$ is not true, the routine moves to S7.

[0059] If the routine moves from S1 to S3, a determination is made as to whether the bathtub filling of the bathroom 8 is being in process. If the result is YES, and it is determined that the bathtub filling is being in process, the routine advances to S5. If the result is NO, and it is determined that the bathtub filling is not being in process, the routine proceeds to S7.

[0060] If the routine moves from S3 or S4 to S5, a determination is made, on the basis of information detected by the flow sensors 62 and 66 and the like, as to whether the hot water supply or the bathtub filling has been finished. If the result is YES, and it is determined that the hot water supply or the bathtub filling has been finished, the routine proceeds to S6. If the result is NO, and it is determined that the hot water supply or the bathtub filling has not been finished, the present step is taken again. Completion of the bathtub filling is determined specifically by whether the bathtub filling process carried out by the control unit has been finished.

[0061] If the routine advances to S6, standby time T_1 of the boiling operation after the hot water supply or the bathtub filling becomes equal to or more than predetermined time T_{S1} . A determination is then made as to whether $T_1 \geq T_{S1}$ is true. If the result is YES, and it is determined that $T_1 \geq T_{S1}$ is true, the routine proceeds to S7. If the result is NO, and it is determined that $T_1 \geq T_{S1}$ is not true, the present step is taken again.

[0062] If the routine moves from S3, S4 or S6 to S7, the boiling operation is executed, and the pump 2 starts to boil the hot water in the hot water tank 4.

[0063] A flowchart of FIG. 3 shows a control routine of the boiling control in case that the hot water supply or the bathtub filling is started in the middle of the boiling operation. In this case, the routine first moves to S11.

[0064] S11 makes a determination as to whether the hot water supply has been started. If the result is YES, and it is determined that the hot water supply has been started, the routine advances to S12. If the result is NO, and it is determined that the hot water supply has not been started, the routine proceeds to S13.

[0065] If the routine moves to S12, a determination is

made, as in S2, as to whether $F \geq F_S$ is true. If the result is YES, and it is determined that $F \geq F_S$ is true, the routine advances to S14. If the result is NO, and it is determined that $F \geq F_S$ is not true, the routine returns to S11.

[0066] If the routine moves to S14, as in S4, a determination is made as to whether $T \geq T_S$ is true. If the result is YES, and it is determined that $T \geq T_S$ is true, the routine advances to S15. If the result is NO, and it is determined that $T \geq T_S$ is not true, the routine returns to S11.

[0067] If the routine moves from S11 to S13, a determination is made as to whether the bathtub filling has been started. If the result is YES, and it is determined that the bathtub filling has been started, the routine advances to S15. If the result is NO, and it is determined that the bathtub filling has not been started, the routine returns to S11.

[0068] If the routine moves from S13 or S14 to S15, the hot water boiling operation using the heat pump 2 is stopped, and the routine proceeds to S16.

[0069] As with S5, S16 makes a determination as to whether the hot water supply or the bathtub filling has been finished. If the result is YES, and it is determined that the hot water supply or the bathtub filling has been finished, the routine proceeds to S17. If the result is NO, and it is determined that the hot water supply or the bathtub filling has not been finished, the present step is taken again.

[0070] If the routine moves to S17, a determination is made, as in S6, as to whether $T_1 \geq T_{S1}$ is true. If the result is YES, and it is determined that $T_1 \geq T_{S1}$ is true, the routine advances to S18. If the result is NO, and it is determined that $T_1 \geq T_{S1}$ is not true, the present step is taken again.

[0071] If the routine moves to S18, the boiling operation is re-executed, and the hot water boiling is started again.

[0072] As described above, in the present embodiment, the boiling control is implemented so that the hot water supply operation including the bathtub filling and the boiling operation using the heat pump 2 are not simultaneously carried out on predetermined conditions. This effectively prevents a disturbance of the hot water boundary layers, or that of the hot water distribution, and thus suppresses an increase of the medium temperature water.

[0073] More concretely, if the flow rate F of the hot water supplied to the hot water tap 10, which is detected by the hot water supply flow sensor 66, becomes equal to or higher than the prescribed flow rate F_S , and moreover, if the hot water supply time T of the hot water supply carried out on the above condition is continued for or longer than the predetermined time T_S , the control unit withholds the execution of the hot water boiling operation using the heat pump 2, and executes the boiling operation when the standby time T_1 after the hot water supply is finished becomes equal to or more than the predetermined time T_{S1} .

[0074] By multiplying the prescribed flow rate F_S by

the predetermined time T_S , prescribed hot water supply amount V_S that does not disturb the hot water boundary layers in the hot water tank 4 as a volumetric flow rate of the hot water discharged from the hot water tank 4. For this reason, if the execution of the hot water boiling operation using the heat pump 2 is held off when hot water supply amount V calculated by multiplying the flow rate F and the time T becomes equal to or more than the prescribed hot water supply amount V_S , it is possible to prevent a disturbance of the hot water distribution in the hot water tank 4, which occurs as a result of simultaneous hot water boiling and supply operations, and suppress an increase of the medium temperature water.

[0075] However, if the boiling operation is executed after a lapse of the predetermined time T_{S1} after the hot water supply is finished, the boiling operation can be started once the disturbance of the hot water distribution in the hot water tank 4, which occurs due to the hot water supply, is cleared. It is then possible to minimally lessen the boiling operation of the medium temperature water, in which COP is low. Consequently, the COP of the hot water supplier 1 is greatly enhanced.

[0076] When the bathtub filling is in process, and the hot water supplier 1 operates according to the bathtub filling process carried out by the control unit, the control unit withholds the execution of the boiling operation until the bathtub filling process is finished. The control unit executes the boiling operation when the standby time T after the bathtub filling process is finished becomes equal to or more than the predetermined time T_{S1} . With this configuration, during the bathtub filling of the bathroom 8, in which the flow rate and velocity of the hot water moving within the hot water tank 4 are increased, it is possible to reliably prevent the disturbance of the hot water distribution in the hot water tank 4 and more effectively prevent an increase of the medium temperature water. This further enhances the COP of the hot water supplier 1.

[0077] If the hot water supply in which the flow rate F is equal to or higher than the prescribed flow rate F_S is continued for or longer than the predetermined time T_S during the boiling operation, and the hot water supply amount V thus becomes equal to or more than the prescribed hot water supply amount V_S or the bathtub filling is started, the control unit stops the boiling operation and then re-executes the boiling operation after a lapse of the predetermined time T_{S1} after the hot water supply or the bathtub filling is finished. With this configuration, even during the boiling operation, it is possible to prevent the disturbance of the hot water distribution in the hot water tank 4, which occurs due to an increase of the hot water supply amount V , and suppress the increase of the medium temperature water. This enhances the COP of the hot water supplier 1.

[0078] Although the description of one embodiment of the invention will be finished here, the invention is not limited to the above embodiment, and may be modified in various ways without deviating from the gist of thereof.

[0079] For example, the embodiment executes the boiling operation after a lapse of the predetermined time T_{S1} after the hot water supply or the bathtub filling is finished. However, the predetermined time T_{S1} may be set at zero, and the boiling operation may be executed immediately after the hot water supply or the bathtub filling is finished. In this case, it is possible at least to prevent the hot water boiling and supply operations from being carried out at the same time. This prevents the disturbance of the hot water distribution in the hot water tank 4, and suppresses the increase of the medium temperature water.

[0080] Although the embodiment, has the high temperature tank 4a and the low temperature tank 4b which serve as the hot water tank 4, the invention does not have to include two tanks as in the embodiment, and for example, may include a single tank. If the hot water tank is formed of a single tank, it is preferable that the low temperature water discharging path should be connected to the tank so as to be located above the rebelling circulation path 26 in order to discharge the medium temperature water from the low temperature water discharging path at the time of discharging hot water.

Claims

1. A storage-type hot water supplier that stores and uses hot water boiled by means of a heat pump, comprising:

a hot water tank having a first end from which high temperature water boiled by the heat pump is fed and a second end from which low temperature water is fed, the tank in which hot water inside is stored in layers of hot temperature water, medium temperature water whose temperature is lower than the high temperature water but is higher than low temperature water, and the low temperature water, in the order named; hot water supply means that discharges the hot water in the hot water tank from the first end of the hot water tank;

hot water supply amount-detecting means that detects a supply amount of hot water that is supplied by the hot water supply means; and a control unit that withholds execution of a hot water boiling operation using the heat pump when the hot water supply amount detected by the hot water supply amount-detecting means is equal to or more than prescribed hot water supply amount.

2. The storage-type hot water supplier according to claim 1, wherein the control unit executes the boiling operation after a lapse of predetermined time after the hot water supply of the hot water supply means is finished.

3. The storage-type hot water supplier according to either one of claims 1 and 2, wherein the control unit stops the boiling operation when the hot water supply amount detected by the hot water supply amount-detecting means during the boiling operation is equal to or more than the prescribed hot water supply amount. 5
4. The storage-type hot water supplier according to any one of claims 1 to 3, wherein:the hot water supply means supplies hot water to a bathtub according to a bathtub filling process carried out by the control unit; and 10
the control unit withholds the execution of the boiling operation until the bathtub filling process is finished, 15
and executes the boiling operation after the bathtub filling process is finished.

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FIG. 1

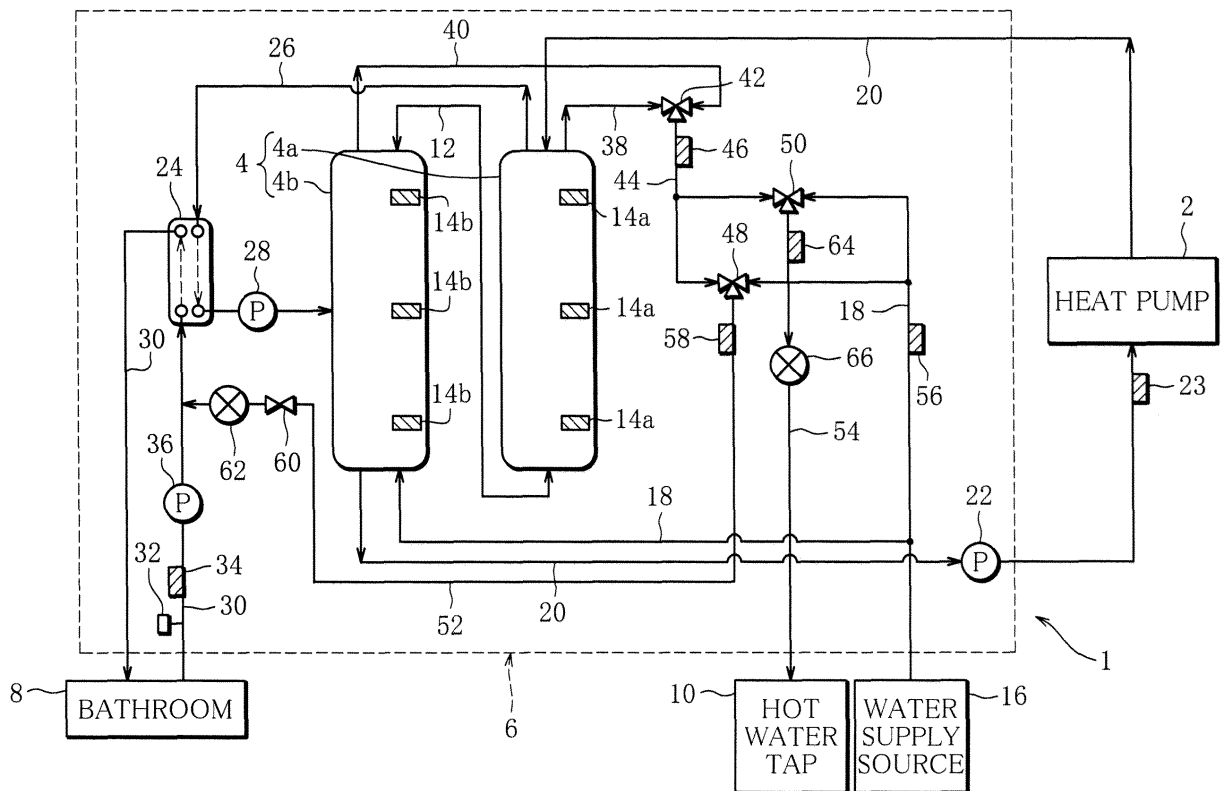


FIG. 2

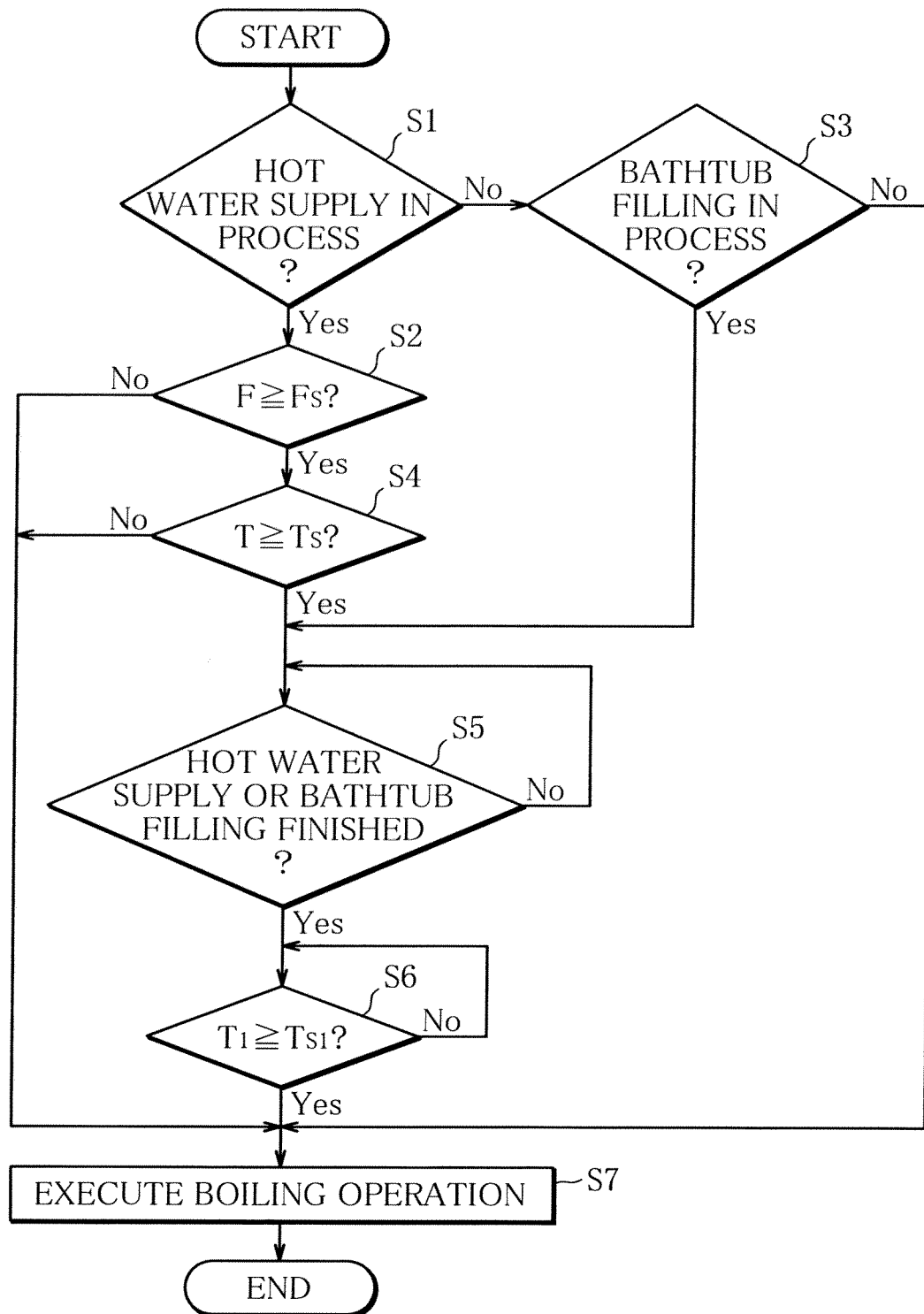
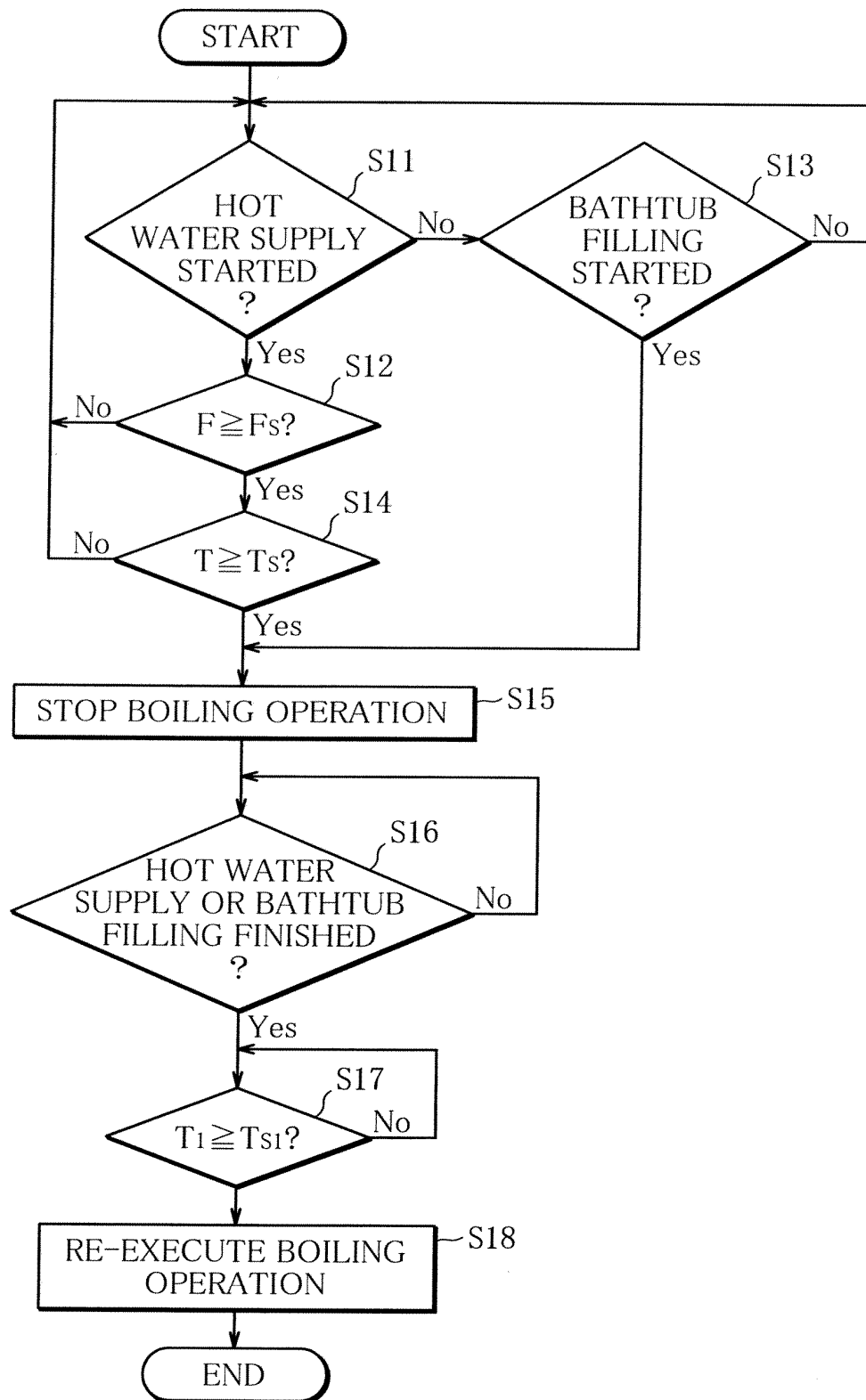


FIG. 3



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/052797

A. CLASSIFICATION OF SUBJECT MATTER F24H1/00(2006.01) i, F24H1/18(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		
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 2003-254608 A (Matsushita Electric Industrial Co., Ltd.), 10 September, 2003 (10.09.03), Par. Nos. [0019] to [0024]; Fig. 1 (Family: none)	1-4
Y	JP 2007-147246 A (Denso Corp.), 14 June, 2007 (14.06.07), Par. No. [0021]; Fig. 1 (Family: none)	1-4
Y	JP 2005-16759 A (Hitachi Home & Life Solution, Inc.), 20 January, 2005 (20.01.05), Par. Nos. [0054] to [0056]; Figs. 1, 4 (Family: none)	1-4
☐ 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 another 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 21 April, 2009 (21.04.09)		Date of mailing of the international search report 12 May, 2009 (12.05.09)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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