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(54) WATER HEATING SYSTEM WITH SMART TANK LOADNG

(57) The present invention discloses a water heating system including a hot water tank for storage of domestic water, a heating module disposed outside of and coupled to the hot water tank; and a controller. The heating module is operable to increase the amount of domestic hot water inside of the hot water tank. The controller is configured to track and store usage data of the domestic hot water discharged from the hot water tank in a previous time period and control the activation of the heating module in accordance with the stored usage data. By learning the previous users' habits of hot water usage, the control of reloading hot water tank becomes more effective and helps to save energy.

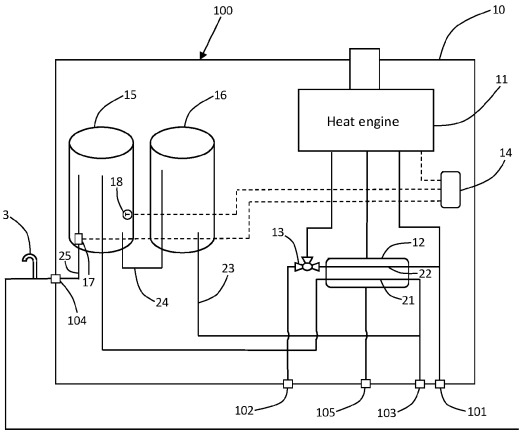

Fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a domestic water heating system, and more particularly to a domestic water heating system with a hot water tank.

BACKGROUND OF THE INVENTION

[0002] A domestic water heating system normally includes a hot water tank for storage of domestic hot water for subsequent use in the household, e.g. for baths, showers, and kitchen appliances. The system generally includes a heat engine such as a gas burner or an electric heating element to maintain a set temperature of the water in the tank. When there is a hot water demand, the water tank discharges hot water through its water outlet, meanwhile, the heat engine, such as the gas burner can be activated to produce instantaneous hot water for the water demand, which allow to reach very high specific flow rate of hot water output. Nevertheless, the water demand does not always require a big amount of hot water. If there are multiple tappings for short and low hot water demands, the gas burner has to be activated frequently although the hot water storage in the water tank is enough to meet the demands. Obviously, frequent on/off cycles of the gas burner will shorten the life of the appliance and also cause unnecessary energy consumption.

SUMMARY OF THE INVENTION

[0003] It is an object of present invention to provide a water heating system with a hot water tank that is able to be reloaded efficiently, thereby avoiding frequent on/off cycles of the heat engine and reducing energy consumption accordingly.

[0004] According to present invention there is provided a water heating system including a hot water tank for storage of domestic water, a heating module disposed outside of and coupled to the hot water tank; and a controller. The heating module is operable to increase the amount of domestic hot water inside of the hot water tank, e.g. the heating module produces and feeds hot water directly into the hot water tank, or the heating module has a coil heat exchanger disposed in the hot water tank to heat the domestic water within the water tank. The heating module can take multiple forms, such as a combustion device fired with combustible gas, an electrical heater with instantaneous electrical heating elements, or a heat pump. The controller is configured to track and store usage data of the domestic hot water discharged from the hot water tank in a previous time period and control the activation of the heating module in accordance with the stored usage data. By learning the previous users' habits of hot water usage, the control of reloading hot water tank becomes more effective and helps to save energy. For example, in the periods of nights or holidays, there is no reload of the hot water tank due to no domestic hot water demand, which causes a big amount of energy saving, besides, the frequent on/off cycles of the heating module can also be avoided.

[0005] In one embodiment, the usage data includes start time, end time and water volume of each specific usage of domestic hot water during the previous time period.

[0006] Preferably, a flow sensor is associated with the hot water tank, e.g. positioned at a hot water outlet of the tank, for detecting flow rate of the domestic hot water discharged from the hot water tank. The controller is electrically connected with the flow sensor to track the start time and the end time and calculate the water volume based on the detected flow rate. In this way, the thermal losses with the discharged hot water can be estimated based on the amount of output hot water, thus, the control of reload of the hot water tank can be achieved without the assistance of the temperature sensor of the hot water tank.

[0007] In one embodiment, the controller is configured to erase a fixed time interval, e.g. 24 hours from the previous time period if no domestic hot water usage is detected in the past fixed time interval.

[0008] Preferably, the controller includes a memory, and the controller is configured to save the usage data into the memory every fixed time interval.

[0009] In one embodiment, the previous time period includes a number of equal time cycles, e.g. a time cycle is one week. Each time cycle is divided into an array of time slots, and the array of time slots can be equal or different. The start time or the end time of each specific usage of domestic hot water corresponds to a specific time slot in the array.

[0010] Preferably, the control of the activation of the heating module is based on the average value or the weighted average value of the water volume of corresponding time slot in the number of equal time cycles.

[0011] In one embodiment, the control of the activation of the heating module includes activating the heating module when the average value or the weighted average value of the water volume in previous, current, or next time slot is larger than or equals to a predetermined threshold.

[0012] In an alternative embodiment, the control of the activation of the heating module includes switching the operation mode for domestic hot water from an ECO mode to a comfort mode when the average value or the weighted average value of the water volume in previous, current, or next time slot is larger than or equals to a predetermined threshold. By this means, the system can operate in an energy saving mode (e.g. ECO mode) when a lower hot water demand is predicted, and when a bigger hot water demand is estimated, the operation mode can be switched to the comfort mode in which big hot water output can assured without any lack of comfort.

[0013] In one embodiment, the heating module is ac-

tivated when one or more parameters of the domestic water are larger than or equals to one or more predetermined set-points respectively during the operation mode for domestic hot water.

[0014] Preferably, the one or more parameters includes temperature of the domestic water inside of the hot water tank, the discharged hot water volume, or the duration of discharged hot water at a certain flow rate.

[0015] Preferably, the one or more predetermined set-points in the ECO mode is higher than the one or more predetermined set-points in the comfort mode respectively.

[0016] In one embodiment, the control of activation of the heating module includes the controller and the heating module enter a stand-by state if no hot water usage is detected in a past fixed time interval.

[0017] In one embodiment, the heating module includes a heat engine fired with fuel gas and a plate heat exchanger, and wherein the heat engine is operable to be either coupled with an external space heater for space heating or coupled with the plate heat exchanger for heating the domestic water.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic diagram showing a water heating system connected with a household water facility in accordance with an exemplary embodiment of present invention;

Fig. 2 is a flowchart showing the implementation of learning users' habits of hot water usage in accordance with the exemplary embodiment of present invention;

Fig. 3 is a flowchart showing the implementation of prediction of hot water usage based on the previous usage data in accordance with the exemplary embodiment of present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Reference will now be made to the drawing figures to describe the preferred embodiments of the present invention in detail. However, the embodiments can not be used to restrict the present invention. Changes such as structure, method and function obviously made to those of ordinary skill in the art are also protected by the present invention.

[0020] A water heating system of the present invention has one hot water tank for storage of domestic water and a heating module disposed outside of and coupled to the hot water tank. The heating module is operable to increase the amount of domestic hot water inside of the hot water tank, e.g. the heating module produces and feeds hot water directly into the hot water tank, or the heating module has a coil heat exchanger disposed in the hot water tank to heat the domestic water within the water tank. The heating module can take multiple forms, such as a combustion device fired with combustible gas, an electrical heater with instantaneous electrical heating elements, or a heat pump. A combustion device will be exemplified to explain the present invention in details in the following embodiments.

[0021] Referring to Fig. 1, in an exemplary embodiment of present invention, a water heating system 100 is a gas boiler integrated with two water tanks. The water heating system 100 includes a housing 10. A heating module is received in the housing 10 and coupled to a hot water tank 15 and a cold water tank 16. The housing 10 defines a first port 101 and a second port 102 for being connected with an external space heaters (not shown, e.g. radiators or under floor heating loops) for space heating, a third port 103 for being connected to water mains to introduce cold water, a fourth port 104 for being connected to home water facilities (e.g. a faucet 3) for hot water output, and a fifth port for introducing fuel gas for combustion.

[0022] The heating module includes a heat engine 11, a plate heat exchanger 12, a three-way valve 13 couple to the heat engine 11 and the plate heat exchanger via pipelines. The heat engine 11 typically includes a burner combined with ignition and monitoring electrodes for combustion of a mixture of fresh air and fuel gas to generate hot fumes, and a finned tube heat exchanger with a fluid path extends therethrough for obtaining heat from the hot fumes passing through the finned tube heat exchanger. The plate heat exchanger 12 has a domestic water path 21 and a transfer fluid path 22 therein, and the two paths 21, 22 are physically isolated to avoid mixing the domestic water and the transfer fluid, but allowing heat interchanging therebetween. The three-way valve 13 can be activated to enable the heat engine 11 to either couple with the external space heaters via the first and the second ports 101, 102 for space heating, or coupled with the plate heat exchanger 14 for heating the domestic water flow through the domestic water path 21.

[0023] The hot water tank 15 is mainly used for storage of domestic hot water, and the cold water tank 16 is normally used for storage of cold water. Of course, if there is no hot water demand for a long time, e.g. more than 24 hours, the system enters a stand-by state, and hot water inside of the hot water tank cools down; in addition, the hot water in the hot water tank 15 can also overflow into the cold water tank 16. In present embodiment, the two water tanks 15, 16 are both received in the housing 10, of course, they can also be positioned outside of the housing 10 in an alternative embodiment. Moreover, the cold water tank 16 can be omitted in other embodiments. In this embodiment, a branch line 23 extends into the cold water tank 16 to introduce cold water fed into the

system via the third port 103, and a connection line 24 extends into both the hot water tank 15 and the cold water tank 16 for fluid communication therebetween. The domestic water path 21 extends further into the hot water tank 15 to feed hot water. As mentioned above, in an alternative embodiment, the part of the domestic fluid path 21 positioned inside of the hot water tank 15 can be a coil heat exchanger for heating the domestic water within the hot water tank 15.

[0024] A temperature sensor 18 is disposed in the hot water tank 15 for detecting the temperature of domestic water within the tank 15. A flow sensor 17 is associated with the hot water tank 15 for detecting flow rate of the domestic hot water discharged from the hot water tank 15. The flow sensor 17 can be positioned inside or outside of the hot water tank 15 and adjacent to a hot water outlet of the hot water tank 15. The flow sensor 17 can also be disposed in the line 25 between the hot water outlet of the tank 15 and the fourth port 104 of the system. A controller 14 is provided in the housing 11 and electrically connected with the heat engine 11, the flow sensor 17, and the temperature sensor 18. The controller 14 can take the form of an electronic control board with a number of electronic components connected in accordance with certain wiring patterns. The controller 14 may include a processor and a memory storing data and executable instructions for configuring the processor to implement one or more functions and steps of the methods disclosed hereinafter. The memory can be implemented as an electrical, magnetic or optical memory, or any combination of these or other types of storage devices. The controller 14 can also be incorporated into an application-specific or general-use integrated circuit. For example, one or more method steps can be implemented in hardware in an Application-Specific Integrated Circuit (ASIC) or a Field-Programmable Gate Array (FPGA). The controller 14 further includes a real-time clock.

[0025] In present invention, the controller 14 is configured to track and store usage data of domestic hot water discharged from the hot water tank 15 in a previous time period and control the activation of the heating module in accordance with the stored usage data. The previous time period include one or more equal time cycles, e.g. a time cycle is one week. It will take two weeks (time cycles) as an example in this embodiment disclosed hereinafter. Each week is divided into an array of time slots. For example, each time slot can be defined as 15 minutes, so there are total 672 time slots one week. Fig. 2 shows steps of the controller implementing an algorithm for learning the users' habits of using hot water. In this embodiment, a fixed time interval, such as 24 hours is defined, certainly, one week (time cycle) includes 7 fixed time intervals (24H x 7).

[0026] The real-time clock starts timing (step 51). The controller 14 checks if the cumulative time reaches the length of one week (step 52), if yes, the controller 14 resets the real-time clock (step 52), and the clock starts timing again. When there is a hot water demand, the controller 14 can receive a signal from the flow sensor 17 (step 54). At this time, a first index will be set to a corresponding time slot in the array, and the volume of hot water output within this time slot will be calculated based on a detected flow rate via the flow sensor and recorded accordingly. When this time slot is lapsed, and the hot water output continues, a second index will be set to the next time slot and the volume of hot water output within the next time slot will also be calculated and recorded. The controller 14 repeats the operations till the end of hot water demand. In this way, the start time, the end time, and the water volume of each usage of domestic hot water can be tracked and recorded (step 57). The usage data is first stored in a buffer, such as the cache of the processor, and then saved into the memory every 24 hours (step 58). If no domestic hot water usage is detected via the flow sensor in the past fixed time interval, namely 24 hours (step 55), the controller 14 is configured to erase the fixed time interval from the previous time period, in other words, the 24 hours are deducted from the cumulative time.

[0027] It is obvious to the skilled person that, the real-time clock can start timing at the beginning of hot water usage for the first time, that is, the first index is set to the first time slot. Since two-week hot water usage date is applied in this embodiment, an average value or a weighted average value of the water volume of corresponding time slot in the two weeks will be used for the later prediction of hot water usage. For example, it consumes 40 liters of hot water in the 10th time slot of the first week, and it consumes 20 liters of hot water in the 10th time slot of the second week, therefore, the controller 14 predicts that an average of 30 liters or 28 liters (e.g. 0.4x40 + 0.6x20) of hot water will be used in the 10th time slot. In other embodiments, the prediction can be based on the usage data of one or more weeks, of course, more samples can ensure higher accuracy. In addition, the learning or monitoring of the users' habits of hot water usage can be conducted weak by weak, and the usage data can be changed in real time. In such case, the prediction can be based on the usage data of the last one or more weeks that can be defined according to requirements.

[0028] Fig. 3 is a flowchart showing the implementation of prediction of hot water usage and control of the heat engine accordingly. When the system enters the operation mode for domestic hot water (step 61), the system first operates in an ECO mode (step 62). In the operation mode for domestic hot water, the heating module can be activated when one or more parameters of the domestic water are larger than or equals to one or more predetermined set-points respectively. The parameters may include temperature of the domestic water inside of the hot water tank, the discharged hot water volume, or the duration of discharged hot water at a certain flow rate. In this embodiment, during the system operates in the ECO mode, the heat engine can be activated when temperature of the domestic water inside of the hot water tank is

larger than or equals to 45□, or the discharged hot water volume is larger than or equals to 30 liters, or the duration of discharged hot water at the flow rate of 10 L/min is larger than or equals to 90 seconds. Then the controller 14 is configured to calculate the probability of the hot water demand. As mentioned above, the controller calculates the average value or the weighted average value of the water volume in previous, current, or next time slot (step 63). The controller is further configured to check whether the calculated average value or weighted average value is larger than or equals to a predetermined threshold, such as 10 liters (step 64); if no, which means the probability of big hot water demand is lower, and the system continues to operate in the ECO mode to keep a lower energy consumption; if yes, which means there may exist a big hot water demand, and then the controller is configured to check if there is a holiday mode (step 65).

[0029] If the whold family is in holiday, there will be no hot water usage for a long time. In this embodiment, if no hot water usage is detected in a past fixed time interval, e.g. 24 hours, the holiday mode will be activated, and the controller and the heating module enter a stand-by state until a tapping occurs (step 66). If a tapping occurs, the system exits the holiday mode. Return to the step 65, if the holiday mode is not activated, the controller is configured to switch the operation mode for domestic hot water from the ECO mode to a comfort mode (step 67). In the comfort mode, the activation of the heating module becomes active with respect to that in the ECO mode due to the big hot water demand is predicted, which results in the one or more predetermined set-points in the comfort mode is lower than the one or more predetermined set-points in the ECO mode respectively. In this embodiment, during the system operates in the comfort mode, the heat engine can be activated when temperature of the domestic water inside of the hot water tank is larger than or equals to 30□, or the discharged hot water volume is larger than or equals to 10 liters, or the duration of discharged hot water at the flow rate of 10 L/min is larger than or equals to 30 seconds. In an alternative embodiment, the holiday mode is not necessary thus can be omitted. In addition, the operation mode for domestic hot water can be simplified by removing the ECO mode and the comfort mode, in such embodiment, the heating module is only activated when a big hot water demand is predicted, that is, the controller is configured to activate the heating module when the average value or the weighted average value of the water volume in previous, current, or next time slot is larger than or equals to the predetermined threshold.

[0030] By learning the previous users' habits of hot water usage, the control of reloading hot water tank becomes more effective. For example, in the periods of nights or holidays, there is no reload of the hot water tank due to no domestic hot water demand, which causes a big amount of energy saving, besides, the frequent on/off cycles of the heating module can also be avoided. Moreover, the system can operate in an energy saving mode (e.g. ECO mode) for domestic hot water when a lower hot water demand is predicted, and when a bigger hot water demand is estimated, the operation mode can be switched to the comfort mode in which big hot water output can assured without any lack of comfort. Furthermore, the flow sensor is associated with the hot water tank for detecting the flow rate of the discharged hot water, e.g. positioned at the hot water outlet of the tank, by this means, the thermal losses with the discharged hot water can be estimated based on the amount of output hot water, thus, the control of reload of the hot water tank can be achieved without the assistance of the temperature sensor of the hot water tank.

[0031] It is to be understood, however, that even though numerous, characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosed is illustrative only, and changes may be made in detail, especially in matters of number, shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broadest general meaning of the terms in which the appended claims are expressed.

Claims

1. A water heating system, comprising:

   a hot water tank for storage of domestic water;
   a heating module disposed outside of and coupled to the hot water tank; and
   a controller capable of activating the heating module to increase the amount of domestic hot water inside of the hot water tank, wherein the controller is configured to track and store usage data of the domestic hot water discharged from the hot water tank in a previous time period and control the activation of the heating module in accordance with the stored usage data.

2. A water heating system according to claim 1, wherein said usage data comprises start time, end time and water volume of each specific usage of domestic hot water during said previous time period.

3. A water heating system according to claim 2, further comprising a flow sensor associated with the hot water tank for detecting flow rate of the domestic hot water discharged from the hot water tank, and wherein the controller is electrically connected with the flow sensor to track said start time and said end time and calculate the water volume based on the detected flow rate.

4. A water heating system according to any of preceding claims, wherein the controller is configured to erase a fixed time interval from said previous time

period if no domestic hot water usage is detected in the past fixed time interval.

5. A water heating system according to claim 4, wherein the controller comprises a memory, and the controller is configured to save the usage data into the memory every fixed time interval.

6. A water heating system according to claim 2, wherein said previous time period comprises a plurality of equal time cycles, and each time cycle is divided into an array of time slots; wherein the start time or the end time of each specific usage of domestic hot water corresponds to a specific time slot in the array.

7. A water heating system according to claim 6, wherein said control of the activation of the heating module is based on the average value or the weighted average value of the water volume of corresponding time slot in said plurality of equal time cycles.

8. A water heating system according to claim 7, wherein said control of the activation of the heating module comprises activating the heating module when the average value or the weighted average value of the water volume in previous, current, or next time slot is larger than or equals to a predetermined threshold.

9. A water heating system according to claim 7, wherein said control of the activation of the heating module comprises switching the operation mode for domestic hot water from an ECO mode to a comfort mode when the average value or the weighted average value of the water volume in previous, current, or next time slot is larger than or equals to a predetermined threshold.

10. A water heating system according to claim 9, wherein the heating module is activated when one or more parameters of the domestic water are larger than or equals to one or more predetermined set-points respectively during the operation mode for domestic hot water.

11. A water heating system according to claim 10, wherein said one or more parameters comprise temperature of the domestic water inside of the hot water tank, the discharged hot water volume, or the duration of discharged hot water at a certain flow rate.

12. A water heating system according to claims 10 or 11, wherein said one or more predetermined set-points in the ECO mode is higher than said one or more predetermined set-points in the comfort mode respectively.

13. A water heating system according to claim 1, wherein said control of activation of the heating module comprises the controller and the heating module enter a stand-by state if no hot water usage is detected in a past fixed time interval.

14. A water heating system according to claim 1, wherein the heating module comprises a heat engine fired with fuel gas and a plate heat exchanger, and wherein the heat engine is operable to be either coupled with an external space heater for space heating or coupled with the plate heat exchanger for heating the domestic water.

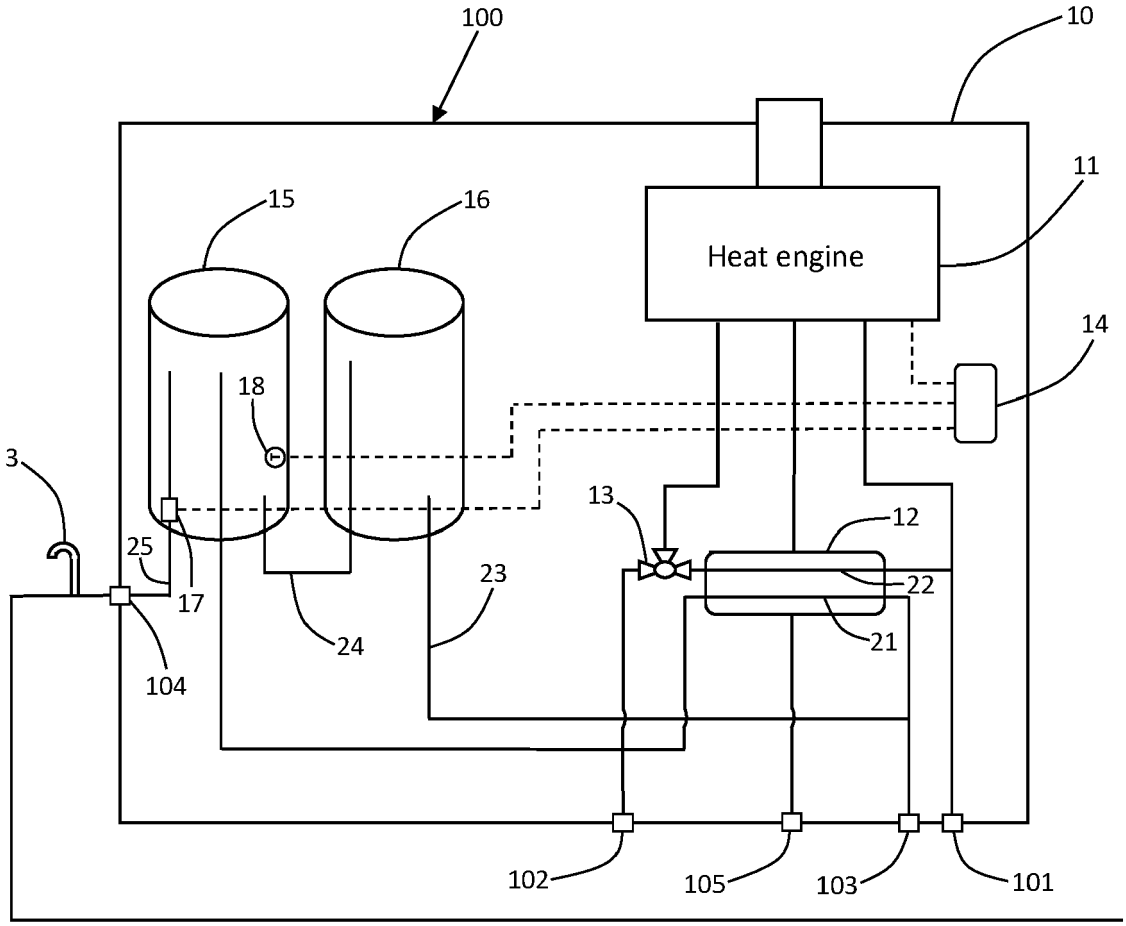
100
10
11
Heat engine
15
16
14
18
3
13
12
25
17
23
22
24
21
104
102
105
103
101

Fig. 1

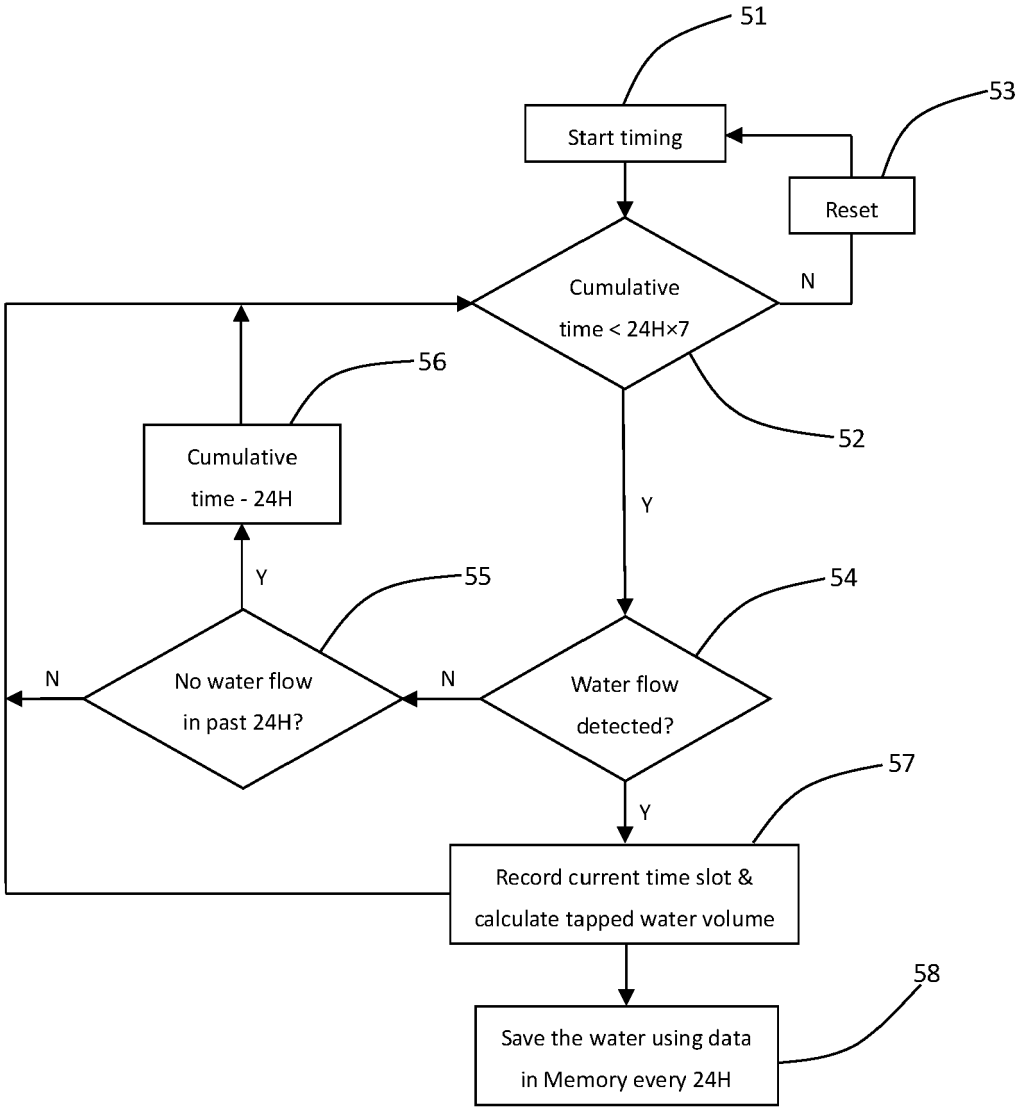
51
Start timing
53
Reset
Cumulative
time < 24H×7
N
52
Y
56
Cumulative
time - 24H
Y
55
54
N
No water flow
in past 24H?
N
Water flow
detected?
Y
57
Record current time slot &
calculate tapped water volume
58
Save the water using data
in Memory every 24H

Fig. 2

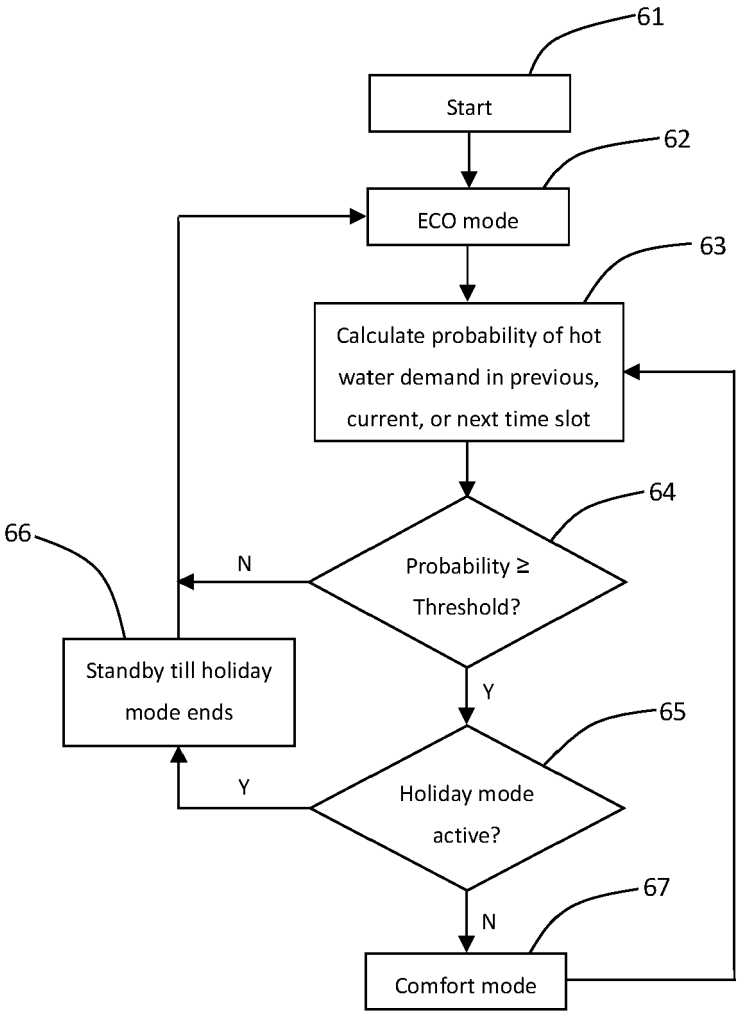
61
Start
62
ECO mode
63
Calculate probability of hot water demand in previous, current, or next time slot
64
Probability ≥ Threshold?
N
66
Standby till holiday mode ends
Y
65
Holiday mode active?
Y
N
67
Comfort mode

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 20 19 6600

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 9 063 551 B2 (DEIVASIGAMANI SRIDHAR [US]; AKASAM SIVAPRASAD [US] ET AL.) 23 June 2015 (2015-06-23) * column 5, line 5 - column 28, line 42; figures 1,4,11 *	1-14	INV. F24D3/08 F24D17/00 F24D19/10 F24H9/20
X	EP 2 873 931 A1 (MITSUBISHI ELECTRIC CORP [JP]) 20 May 2015 (2015-05-20) * page 3, paragraph 15 - page 15, paragraph 170; figures 1,2,5 *	1-8,14	
X	US 10 451 294 B2 (SANTA CLARA UNIV [US]) 22 October 2019 (2019-10-22) * column 1, line 39 - column 6, line 62; figures 1,4,8a,8b,8c *	1-7,13, 14	
X	JP 2017 026254 A (NORITZ CORP) 2 February 2017 (2017-02-02) * the whole document *	1,2,6,7, 9,10,12	
X	US 2019/293303 A1 (ZHANG YANDA [US]) 26 September 2019 (2019-09-26) * page 3, paragraph 35 - page 16, paragraph 213; figure 1c *	1-3,14	TECHNICAL FIELDS SEARCHED (IPC) F24D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 February 2021	Hoffmann, Stéphanie

CATEGORY OF CITED DOCUMENTS

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23-02-2021

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 9063551 B2	23-06-2015	NONE	
EP 2873931 A1	20-05-2015	CN 104412046 A	11-03-2015
		EP 2873931 A1	20-05-2015
		JP 5818985 B2	18-11-2015
		JP WO2014002131 A1	26-05-2016
		US 2015159913 A1	11-06-2015
		WO 2014002131 A1	03-01-2014
US 10451294 B2	22-10-2019	NONE	
JP 2017026254 A	02-02-2017	NONE	
US 2019293303 A1	26-09-2019	NONE	

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