



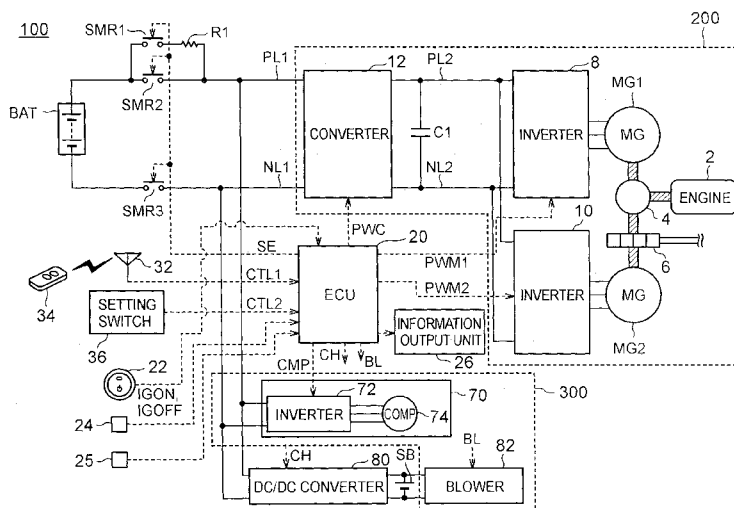
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- (71) **Applicant:** TOYOTA JIDOSHA KABUSHIKI KAISHA [JP/JP]; 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP).
- (72) **Inventor:** MASUDA, Tomokazu; c/o TOYOTA JIDOSHA KABUSHIKI KAISHA, c/o 1, Toyota-cho, Toyota-shi, Aichi-ken, 471-8571 (JP).
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FIG. 1



- (S7) Abstract:** An air-conditioning unit (300) performs pre-air conditioning due to operating in accordance with a day and time set by a user, even if the user gets in a vehicle (100). The user is able to set periodic pre-air conditioning by inputting a set day and time including a day of the week designated and/or a workday/weekend or holiday designated. The ECU (20) uses an information output unit (26) to output information for prompting a user to cancel or correct a periodic pre-air conditioning setting on the basis of that no user gets in the vehicle (100) even when a prescribed time period elapses after pre-air conditioning and periodic pre-air conditioning is performed.

VEHICLE

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

[0001] This invention relates to a vehicle, and more particularly, a vehicle capable of so-called “pre-air conditioning” in which an air conditioner is operated before a user gets in the vehicle.

10 2. Description of Related Art

[0002] In a vehicle which is configured to be able to generate vehicle drive power by an electric motor, such as an electric vehicle, a hybrid vehicle or a fuel cell vehicle, an electric storage device having a relatively large capacity is installed in order to store electric power for driving the motor. In a vehicle of this kind, the air-conditioner is
15 generally operated by electric power from the electric storage device, regardless of the driving of the engine. Therefore, it is possible to carry out a cooling operation or a warming operation by the air-conditioner using electric power from the electric storage device, even before the user gets in the vehicle, in other words, to carry out the pre-air conditioning.

20 [0003] Japanese Patent Application Publication No. 2008-308114 (JP 2008-308114 A) describes an air-conditioning control device for a vehicle having a pre-air conditioning function such as that described above, in which the pre-air conditioning is performed on the basis of a predicted departure time input by the user.

[0004] However, in a case where a user does not get in the vehicle even though a
25 prescribed time elapses after start of the pre-air conditioning based on the user's settings, then the energy for pre-air-conditioning will be consumed wastefully. In particular, when regular pre-air conditioning is performed by specifying a day of the week, for example, then there is a risk of repeated operation of wasteful pre-air conditioning.

SUMMARY OF THE INVENTION

[0005] The object of this invention is to avoid consumption of energy by repeated wasteful operation of an air-conditioner before a user gets in a vehicle, in accordance with the user's settings.

5 [0006] The vehicle according to one aspect of the invention includes: an air-conditioner configured to adjust the temperature inside a vehicle cabin; a boarding detector configured to detect that a user gets in the vehicle; a setting unit configured to set a periodic operation day and time for the air-conditioner on the basis of a user input; a controller configured to operate the air-conditioner in accordance with the periodic
10 operation day and time set by the user input; and an output unit. The output unit is configured to output information to the user, the information prompting cancellation or correction of the periodic operation date and time, when the boarding detector detects that no user gets in the vehicle within a prescribed time period from the periodic operation day and time and the controller operates the air-conditioner in accordance with the periodic
15 operation day and time.

[0007] According to the vehicle described above, it is possible to provide the user automatically with an opportunity to cancel or correct the periodic setting, when the boarding detector detects that no user gets in the vehicle even though a prescribed time period elapses after start of periodic pre-air conditioning set by the user. Therefore, it is
20 possible to avoid useless energy consumption due to repeated operation of wasteful pre-air conditioning based on a periodic operation day and time setting, without the user being aware.

[0008] The output unit may output information to the user, when the boarding detector detects that no user gets in the vehicle within a prescribed time period from the operation day and time for the prescribed number of times in succession and when the
25 air-conditioner is operated in accordance with the periodic operation day and time.

[0009] By adopting this configuration, it is possible to prevent information for prompting cancellation or correction of the periodic operation day and time from being

output with excessive frequency to the user, and therefore it is possible to prevent causing a sense of unease in the user.

[0010] The periodic operation day and time may include a day of the week and a time at which the air-conditioner is operated.

5 [0011] According to this invention, in a vehicle having a function which enables an air-conditioner to operate before a user gets in the vehicle, it is possible to avoid consumption of energy by repeated wasteful operation of the air-conditioner before the user gets in the vehicle, in accordance with the user's settings.

10 BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Features, advantages, and technical and industrial significance of exemplary embodiments of the invention will be described below with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

FIG. 1 is a block diagram for illustrating the approximate configuration of a vehicle
15 having a pre-air conditioning function according to an embodiment of this invention;

FIG. 2 is a chart showing an example of periodic setting of pre-air conditioning;

FIG. 3 shows a flowchart for describing a control process relating to the pre-air conditioning which is set periodically in a vehicle according to this invention;

FIG. 4 is a flowchart for showing control processing when the user gets in the vehicle
20 according to this embodiment;

FIG. 5 is a flowchart for showing control processing relating to the pre-air conditioning when starting operation in the vehicle according to this embodiment; and

FIG. 6 is a diagram showing one example of information output to the user.

25 DETAILED DESCRIPTION OF EMBODIMENTS

[0013] Below, embodiments of this invention are described in detail with reference to the accompanying drawings. The same or equivalent portions in the drawings below are labelled with the same reference numerals and description thereof is not repeated, in principle.

[0014] FIG. 1 is a block diagram for illustrating the approximate configuration of a vehicle having a pre-air conditioning function according to an embodiment of this invention.

[0015] Referring to FIG. 1, the vehicle 100 according to embodiment of this invention includes: an electric storage device BAT, a drive unit 200, and an air-conditioning unit 300.

[0016] The electric storage device BAT is configured by an electricity storage element which can be recharged. For example, the electric storage device can be a secondary battery, such as a nickel hydrogen or a lithium ion battery. Below, the electric storage device BAT is referred to simply as the "battery BAT". The electric storage device installed in the vehicle 100 is not limited to a secondary battery, and may also use an electrical dual-layer capacitor, for example.

[0017] The battery BAT supplies DC power to the drive unit 200 and the air-conditioning unit 300, via a positive line PL1 and a negative line NL1. Furthermore, the battery BAT is charged with DC power from the drive unit 200.

[0018] The drive unit 200 is configured to be able to generate drive power for the vehicle 100 by DC power supplied from the battery BAT. More specifically, the drive unit 200 comprises an engine 2, motor-generators MG1, MG2, a power split mechanism 4, a speed reduction mechanism 6, inverters 8, 10, a capacitor C1 and a converter 12.

[0019] The engine 2 generates drive force by causing a crank shaft (not illustrated) to rotate by burning a mixture of fuel and air. The drive power generated by the engine 2 is divided into two paths by the power split mechanism 4. One of these two paths is a path for driving vehicle wheels (not illustrated, same applies below) via the speed reduction mechanism 6, and the other path is a path for driving the motor-generator MG1.

[0020] The motor-generators MG1, MG2 are each three-phase alternating current (AC) rotary motors, for example. The motor-generator MG1 generates three-phase AC voltage using the motive power of the engine 2, and outputs this AC voltage to the inverter 8. Furthermore, the motor-generator MG1 is driven by the inverter 8 and starts the engine

2. The motor-generator MG2 is driven by the inverter 10 and generates a drive force for driving the vehicle wheels. Furthermore, during regenerative braking of the vehicle 100, the motor-generator MG2 generates electricity from the rotational force of the vehicle, and outputs a three-phase AC voltage produced by this electricity generation, to the inverter 10.

5 [0021] The inverter 8 is connected to a positive line PL2 and a negative line NL2, and performs power conversion from DC to AC, or from AC to DC, between the converter 12 and the motor-generator MG1. More specifically, the inverter 8 includes a 3-phase arm circuit consisting of a plurality of switching elements which are respectively connected in series. The switching elements perform a periodic switching operation in
10 accordance with a switching command PWM1. Consequently, the abovementioned power conversion is achieved.

[0022] The inverter 10 is connected to the positive line PL2 and the negative line NL2, and performs power conversion from DC to AC, or from AC to DC, between the converter 12 and the motor-generator MG2. More specifically, the inverter 10 includes a
15 3-phase arm circuit consisting of a plurality of switching elements which are respectively connected in series. The switching elements perform a periodic switching operation in accordance with a switching command PWM2. Consequently, the abovementioned power conversion is achieved.

[0023] The capacitor C1 is connected to the positive line PL2 and the negative
20 line NL2 and smoothens the voltage between the positive line PL2 and the negative line NL2.

[0024] The converter 12 raises the DC voltage output from the battery BAT in response to a switching command PWC, and outputs this raised voltage to the positive line PL2. Furthermore, the converter 12, in response to the switching command PWC,
25 reduces the DC power supplied from the inverters 8, 10 via the positive line PL2, to the voltage level of the battery BAT, and supplies the DC power to the battery BAT.

[0025] The air-conditioning unit 300 is configured to operate by the DC power from the battery BAT. More specifically, the air-conditioning unit 300 includes a compression unit 70 and a blower 82.

[0026] The compression unit 70 includes an A/C inverter 72 and a compressor (COMP) 74. The A/C inverter 72 converts the DC power from the battery BAT into AC power and supplies this AC power to the COMP 74. The compressor 74 compresses a coolant due to receiving a supply of AC power. A blower 82 blows air of which the temperature has been adjusted by the operation of the compressor 74, into the vehicle cabin.

[0027] The vehicle 100 is also provided with a DC/DC converter 80 and a battery SB for supplying power for an auxiliary equipment system.

[0028] The DC/DC converter 80 is connected to the positive line PL1 and the negative line NL1. The DC/DC converter 80, in response to a control command CH, converts the voltage of the battery BAT to the operating voltage of the auxiliary equipment system (for example, DC 12V).

[0029] The battery SB is mounted in a vehicle 100 as a subsidiary electric storage device (sub-battery) which is used as a power source for the auxiliary equipment system. The battery SB is a lead battery, for example, and is charged by DC power from the DC/DC converter 80. Furthermore, the battery SB supplies the electric power stored therein, to the blower 82, or auxiliary equipment such as audio devices, cabin interior lighting, indicators, or the like (none illustrated). In this way, the DC power from the DC/DC converter 80 is supplied to an auxiliary equipment group, principally, the battery SB and the blower 82.

[0030] The vehicle 100 also includes system main relays SMR1, SMR2, SMR3, an electronic control unit (ECU) 20, a limit resistance R1, a power switch 22, a door sensor 24, a sitting sensor 25, an information output unit 26, a reception antenna 32 and a setting switch 36.

[0031] The system main relay SMR1 and the limit resistance R1 are connected in series between the positive terminal of the battery BAT and the positive line PL1. The system main relay SMR2 is provided in parallel to the serially connected system main relay SMR1 and the limit resistance R1, and is connected between the positive terminal of the battery BAT and the positive line PL1. The system main relay SMR3 is connected

between the negative terminal of the battery BAT and the negative line NL1. The system main relays SMR1 to SMR3 are placed in a conductive state (on state) or a non-conducting state (off state) in response to a control command SE.

[0032] When the battery BAT is connected electrically to the drive unit 200 and the air-conditioning unit 300, then the system main relays SMR1, SMR3 are placed in an on state first, and then the system main relay SMR2 is placed in an on state. Consequently, it is possible to restrict the inrush current produced when the battery BAT is electrically connected, by means of the limit resistance R1. After the inrush current is limited, the system main relay SMR1 is placed in an off state.

[0033] The power switch 22 is an operating switch for the user to start and stop operation of the vehicle. When the power switch 22 is operated by the user, a power source input command ACC for the auxiliary equipment group, a command IGON for starting up the vehicle system shown in FIG. 1 (and in particular, the drive unit 200), or a command IGOFF for stopping the vehicle system, are output to the ECU 20. Consequently the ECU 20 can detect that a user (occupant) gets in the vehicle 100, in response to the output of the power switch 22 in accordance with the operation by the user.

[0034] For example, a command ACC is generated when the power switch 22 is operated with the power source of the vehicle 100 in an off state, whereby the supply of the power source to the auxiliary equipment group is started, and furthermore when the power switch 22 is operated further from this state, an IGON command is issued and the vehicle system is started up (IG on state). On the other hand, if the power switch 22 is operated with the vehicle system in an operating state (IG on state), then the command IGOFF is generated. Desirably, the operations for starting and stopping the vehicle 100, in other words, the commands IGON and IGOFF, are issued by combining the operation of the power switch 22 with another operation (for instance, depression of the brake pedal by the user).

[0035] The door sensor 24 detects opening and closing of a door (not illustrated) of the vehicle 100. The ECU 20 can detect that a user (occupant) gets in the vehicle 100,

in response to opening of the door in the IG off state (the vehicle system stopped state), by the door sensor 24.

[0036] A sitting sensor 25 detects the user who sits on a seat, by detecting the application of a load to an occupant seat (not illustrated) of the vehicle 100. The ECU 20
5 can detect that a user (occupant) gets in the vehicle 100, on the basis of the output from the sitting sensor 25.

[0037] In this way, the ECU 20 can detect that a user gets in the vehicle 100 by the output from the power switch 22, the door sensor 24 and the sitting sensor 25. In other words, the power switch 22, the door sensor 24 and the sitting sensor 25 correspond
10 to one embodiment of a "boarding detector". The "boarding detector" can be configured by any device, provided that the device is capable of detecting the fact that a user (occupant) gets in the vehicle 100.

[0038] The information output unit 26 is configured to output a visual and/or audible message to the user, in accordance with a command from the ECU 20. Thereby,
15 it is possible to report information to the user. Typically, the information output unit 26 can be configured by a liquid crystal touch panel (instrument panel) and/or an audio speaker inside the vehicle cabin. Alternatively, it is also possible to configure the information output unit 26 by a screen and/or audio speaker of a communication device 34.

[0039] The ECU 20 executes a stored program in response to the command IGON.
20 Accordingly, the vehicle system shown in FIG. 1 is started, and the vehicle 100 is placed in a state in which the vehicle 100 can travel. In other words, the vehicle 100 is placed in a state in which the vehicle 100 can start travelling by means of an operation by the user. For example, the vehicle is in a state in which the drive unit 200 can generate drive power for the vehicle 100, if the user releases the brake and depresses the accelerator pedal (not
25 illustrated).

[0040] The ECU 20 executes calculation processing on the basis of signals transmitted from respective sensors which are not illustrated (for example, a vehicle speed sensor, etc.), the state of travel, the accelerator depression amount, the state of charge (SOC) of the battery BAT, a map stored in the ECU 20, and so on. The ECU 20

generates a control command SE and switching commands PWC, PWM1, PWM2, etc. for performing control of the vehicle in accordance with operations performed by the driver. Furthermore, the ECU 20 sends a control command CH to the DC/DC converter 80 in order to drive the auxiliary equipment.

5 **[0041]** The ECU 20 is connected to a setting switch 36 and a reception antenna 32. The ECU 20 performs control for conditioning the air of the interior of the vehicle cabin, in response to an air-conditioning request CTL1 from the setting switch 36 or the air-conditioning request CTL 2 from the reception antenna 32.

10 **[0042]** The reception antenna 32 receives an air-conditioning request CTL1 sent by wireless or wired communication from a communication device 34. The communication device 34 is not limited in particular, and may be a special remote control device or a portable information terminal, for example. The setting switch 36 is disposed on the instrument panel, for instance, and is operated by the user.

15 **[0043]** The ECU 20 can control air-conditioning of the interior of the vehicle cabin, by operating the air-conditioning unit 300 in accordance with the air-conditioning requests CTL1, CTL2, even if no user is in the vehicle 100. In other words, the vehicle 100 is configured to be able to execute a pre-air conditioning.

20 **[0044]** To give a concrete description, when the pre-air conditioning is performed, the ECU 20 firstly outputs a control command SE to the system main relays SMR1 to SMR3, and then connects the battery BAT to the positive line PL1 and the negative line NL1. As described above, firstly, the system main relays SMR1, SMR3 switch on and then the system main relay SMR2 switches on. Thereupon, the system main relay SMR1 switches off. Accordingly, the battery BAT can supply DC power to the air-conditioning unit 300.

25 **[0045]** The ECU 20 does not output the switching commands PWM1, PWM2, PWC during operation of the pre-air conditioning. Therefore, the inverters 8, 10 and the converter 12 remain stopped. Moreover, the ECU 20 supplies a control command CMP to the compression unit 70 (A/C inverter 72). Thereby, the compression unit 70 is operated. Moreover, the ECU 20 respectively supplies control commands CH and BL to

the DC/DC converter 80 and the blower 82, to operate the DC/DC converter 80 and the blower 82.

[0046] The ECU 20 has a clock (timer) function, and is able to operate the air-conditioning unit 300 in accordance with an operation day and time for the pre-air conditioning which has been set previously by the user. In other words, the “controller” is configured by the ECU 20. By sending the air-conditioning requests CTL1, CTL2 corresponding to the user inputs to the communication device 34 or the setting switch 36, to the ECU 20, the ECU 20 is able to set the operation day and time of the air-conditioning unit 300 for the pre-air conditioning (hereinafter, simply called the operation day/time) in accordance with the input by the user. Consequently, a pre-air conditioning function is achieved. For example, the ECU 20 starts the pre-air conditioning in accordance with the operating day/time set by the user, and furthermore, when the temperature of the vehicle cabin reaches a prescribed temperature (for example, a user set temperature) after starting the pre-air conditioning, or when a prescribed air-conditioning time has elapsed, then the ECU 20 terminates the pre-air conditioning by stopping the air-conditioning unit 300.

[0047] In one mode of the pre-air conditioning, the user is able to instruct periodic operation of the pre-air conditioning on a plurality of occasions which match the operating day/time, by one user setting, by designating an operating day/time including a designation of a day of the week. Here, the designation of a day of the week may include selecting several days of the week, either by directly selecting each day from Sunday to Saturday, or by specifying weekdays or rest days (which may include festival days). Setting an operation day/time which is linked to the operation of pre-air conditioning the number of times set by the user may be called “periodic setting” below. Periodic setting is also set by a user input to the communication device 34 or the setting switch 36. In other words, the communication device 34 and setting switch 36 correspond to one embodiment of a “setting unit”.

[0048] FIG. 2 is a chart showing an example of periodic setting of pre-air conditioning. Referring to FIG. 2, the operation day/time in the periodic setting by the user includes a day of the week designated (a designation of Sunday to Saturday, weekdays

(Monday to Friday), and so on), and a time (hour, minute). For instance, the example in FIG. 3 shows a state where n periodic settings have been input by the user (where n is a natural number). According to the first periodic setting, the pre-air conditioning is performed at 6 p.m. every weekday, in other words, every day from Monday to Friday, until the periodic setting is cancelled.

[0049] The pre-air conditioning setting also includes the user set temperature or the air-conditioning time. The user set temperature and the air-conditioning time may be designated for each operation day/time, or a common temperature may be designated for each operation day/time.

10 [0050] Alternatively, the user may designate a departure day and time of the vehicle 100, rather than directly inputting the operation day/time, in other words, the pre-air conditioning time. In this case, the operation day/time for pre-air conditioning is derived by the ECU 20 by reverse calculation from the departure day and time.

15 [0051] The count value is defined in accordance with the respective periodic settings of the pre-air conditioning. In other words, the count value $CNT(i)$ is defined in accordance with the i th periodic setting. For instance, in the example in FIG. 2; the count values $CNT(1)$ to $CNT(n)$ are assigned respectively to the n periodic settings (where i is a natural number satisfying $1 \leq i \leq n$).

20 [0052] As described above, the air-conditioning unit 300 operates by using the stored electric power in the battery BAT. Consequently, if no user gets in the vehicle even though a prescribed time period elapses after the pre-air conditioning is started, the energy is consumed wastefully. Therefore, if periodic pre-air conditioning is performed in accordance with the periodic settings, there is a risk that wasteful pre-air conditioning will be performed repeatedly.

25 [0053] Therefore, in a vehicle according to this embodiment, control of the following kind is performed so as to avoid repeated operation of wasteful pre-air conditioning, in accordance with a periodic pre-air conditioning instruction by the user.

[0054] FIG. 3 is a flowchart for describing a control process relating to the pre-air conditioning which has been set periodically.

[0055] The control process according to the flowchart shown in FIG. 3 is performed cyclically by the ECU 20 in FIG. 1.

[0056] The ECU 20 confirms whether or not a periodic setting for the pre-air conditioning has been set, in step S100. For example, if the operation day/time of the pre-air conditioning that has been set by the user includes a plurality of days and times based on a day of the week designation, or the like, then step S100 issues an affirmative determination (YES). The ECU 20 skips steps S110 to S130 and terminates processing, if a periodic setting for the pre-air conditioning has not been set (NO in S100).

[0057] The ECU 20 determines whether or not a periodically set operation day/time has been reached, in step S110, if a periodic setting for the pre-air conditioning has been set (YES in S100). If the periodically set operation day/time has not been reached (NO in S110), then the ECU 20 skips steps S120 and S130 and terminates processing.

[0058] If a periodic setting for the pre-air conditioning has been made, and the periodically set day/time has been reached (YES in S110), then the ECU 20 advances the processing to step S120 and operates the air-conditioning unit 300. Accordingly, the pre-air conditioning is performed. As described above, the pre-air conditioning which has been started is terminated if the temperature of the vehicle cabin reaches a prescribed temperature, or if a prescribed air-conditioning time has elapsed.

[0059] Moreover, the ECU 20 advances processing to step S130, and stores setting information relating to the pre-air conditioning performed by step S120. For example, the ECU 20 stores information for identifying the periodic setting by the user which corresponds to the pre-air conditioning that has been performed, as well as switching on a flag which indicates that the pre-air conditioning has been performed on the basis of a periodic setting.

[0060] FIG. 4 is a flowchart for showing control processing when the user gets in the vehicle, in a vehicle according to this embodiment.

[0061] Referring to FIG. 4, the ECU 20 determines, by step S200, whether or not detection that a user gets in the vehicle 100 has been made on the basis of the output of at

least one of the power switch 22, the door sensor 24 and the sitting sensor 25 illustrated in FIG. 1.

[0062] The ECU 20 starts up the processing by steps S210 to S290 described below, if the fact that a user gets in the vehicle is detected (YES in S200). On the other hand, if the fact that no user gets in the vehicle (NO in S200), then the processing by steps 5 S210 to S290 is not started up.

[0063] In step S210, the ECU 20 reads out information relating to the periodic settings for the pre-air conditioning stored in step S130 (FIG. 3). Consequently, it is possible to identify whether or not the pre-air conditioning based on a periodic setting has 10 been performed since the last time the user left the vehicle or ended driving, and before the next time that the user gets in the vehicle, and whether the pre-air conditioning has been carried out in accordance with any one of the n periodic settings input by the user. Here, it is supposed that the pre-air conditioning is performed in accordance with the k th periodic setting (where k is a natural number satisfying $1 \leq k \leq n$).

15 [0064] In step S215, the ECU 20 determines whether or not the pre-air conditioning has been performed on the basis of a periodic setting before the user gets in the vehicle. If the pre-air conditioning based on a periodic setting has not been performed (NO in S215), then the following steps S220 to S290 are skipped and processing is terminated.

20 [0065] If the pre-air conditioning based on a periodic setting has been performed (YES in S215), then in step S220, the ECU 20 calculates the elapsed time ΔT from the pre-air conditioning based on a periodic setting until the user gets in the vehicle. Moreover, in step S230, the ECU 20 compares the elapsed time ΔT calculated in step S220 with the reference time T_t .

25 [0066] If the elapsed time ΔT is longer than the reference time T_t , in other words, if no user gets in the vehicle even though the reference time T_t has elapsed after pre-air conditioning (YES in S230), then the ECU 20 advances the processing to step S240, and increments the count value $CNT(k)$ of the k th periodic setting corresponding to the performed pre-air conditioning by 1.

[0067] Moreover, in step S250, the ECU 20 compares the count value CNT(k) counted in step S240 with a reference value Ct. Thereupon, when the count value CNT(k) reaches the reference value Ct, then in step S260, the ECU 20 switches on a flag FLG(k) corresponding to the periodic setting in question, and then advances the processing to step S290.

[0068] On the other hand, in step S260, the ECU 20 clears the count value CNT(k) corresponding to the kth periodic setting, to zero, if the elapsed time ΔT calculated in step S220 is less than or equal to the reference time Tt, in other words, if a user gets in the vehicle before the reference time Tt has elapsed after pre-air conditioning. Moreover, the ECU 20 switches off the flag FLG(k) in step S280, and then advances processing to step S290.

[0069] Furthermore, the ECU 20 switches off the flag FLG(k) in step S280, and then advances processing to step S290 if there is a negative determination (NO) in step S250, in other words, if the count value CNT(k) counted by step S240 has not reached the reference value Ct. In this case, the count value CNT(k) is maintained at the value after the counting in step S240.

[0070] When the processing relating to the count value CNT(k) and the flag FLG(k) of the kth periodic setting corresponding to the pre-air conditioning that has been performed terminates (S240 to S280), then in step S290, the ECU 20 clears the memory contents relating to the periodic setting of the pre-air conditioning that has been performed. Accordingly, when the pre-air conditioning based on a periodic setting is performed subsequently, it is possible to store new information relating to that periodic setting.

[0071] In this way, the elapsed time ΔT from the pre-air conditioning based on the periodic setting in question until a user actually gets in the vehicle is managed respectively for each of the periodic settings for the pre-air conditioning made by the user as shown in FIG. 2. If the elapsed time ΔT is longer than the reference time Tt, in other words, the fact that a user gets in the vehicle is not detected even though the reference time Tt has elapsed after start of periodically set pre-air conditioning, consecutively for the reference number of times Ct, then it is determined that wasteful pre-air conditioning based

on a periodic setting is being carried out, and the flag corresponding to that periodic setting is switched on. It is also possible to set $Ct=1$. In this case, if the fact that the user gets in the vehicle is not detected even though the reference time Tt has elapsed after start of a periodically set the pre-air conditioning, then the pre-air conditioning based on that periodic setting can be determined to be wasteful and the corresponding flag can be switched on, immediately.

[0072] FIG. 5 is a flowchart for describing control processing relating to the pre-air conditioning when driving is started in the vehicle according to this embodiment of the invention, in other words, when a command IGON is generated. In other words, the control processing illustrated in FIG. 5 is performed when the control processing shown in FIG. 4 has terminated, during the series of operations for starting operation of the vehicle by the user's getting in the vehicle and also operating the power switch 22.

[0073] Referring to FIG. 5, upon generation of the command IGON in step S300 (YES in S300), the ECU 20 performs a series of processing by steps S310 to S390. On the other hand, if command IGON is not generated (NO in S300), then the ECU 20 does not start up the processing by steps S310 to S390.

[0074] In step S310, the ECU 20 sets parameter i to an initial value 1 ($i = 1$), and also advances the processing to step S320.

[0075] In step S320, the ECU 20 determines whether or not the flag $FLG(i)$ corresponding to the i th periodic setting is on, in accordance with the current value of the parameter i . If $FLG(i)$ is on (YES in S320), then the ECU 20 advances processing to step S330, and outputs information for prompting the user to correct or cancel the i th periodic setting, from the information output unit 26, to the user.

[0076] FIG. 6 shows one example of output information in a case where step S330 is performed when $i = 1$. More specifically, using the information output unit 26 shown in FIG. 1, screen information is output to the user to report that wasteful energy consumption has occurred due to a pre-air conditioning specifying "weekdays 6 p.m." which corresponds to a first periodic setting illustrated in FIG. 2. Moreover, screen

information is output to the user to request the user to input an instruction regarding whether or not to switch off the periodic setting in question.

[0077] The user can select whether or not to cancel the periodic setting of the displayed pre-air conditioning shown in the screen information, by operating a touch panel, or the like. In this way, it is possible to output, to the user, information for prompting cancellation or correction of the periodic setting in question, in respect of the i th periodic setting for which the corresponding FLG(i) has been switched on.

[0078] Referring again to FIG. 5, in step S340, the ECU 20 confirms the input of an instruction from the user in respect of the information output in step S330. If the user inputs a correction or cancellation instruction in respect of the i th periodic setting, for instance, if the user clicks "Yes" on the screen in FIG. 6, then the ECU 20 advances processing to step S350 and performs correction/cancellation of the periodic setting in question.

[0079] On the other hand, if the user does not input a correction/cancellation instruction (NO in S340), for instance, if the user selects "No" on the screen in FIG. 6, then the ECU 20 maintains the i th periodic setting in step S360.

[0080] Moreover, after step S350 or S360 is performed, then in step S370, the ECU 20 switches off the flag FLG(i) corresponding to the i th periodic setting for which correction/cancellation has been prompted to the user.

[0081] When the processing relating to the flag FLG(i) based on steps S320 to S360 terminates, the ECU 20 advances processing to step S380 and increments parameter i by 1. In step S390, the ECU 20 then compares the parameter i incremented in step S380 with the number of periodic settings for the pre-air conditioning (n).

[0082] The ECU 20 repeatedly performs the processing in steps S320 to S380, while $i \leq n$ (NO verdict in S390). On the other hand, the ECU 20 terminates processing when $i > n$ (YES in S390).

[0083] Consequently, it is possible to confirm whether or not the corresponding flag is switched on, for each of the n periodic settings for the pre-air conditioning which

have been set by the user, and furthermore to output information for prompting the user to correct/cancel the periodic setting in question, if the flag is on.

[0084] Consequently, in the vehicle according to this embodiment, it is possible to motivate the user to correct or cancel a periodic setting, in accordance with the fact that
5 a user gets in the vehicle is not detected even though a prescribed time (reference time T_t) has elapsed after a periodically set pre-air conditioning is started. Therefore, it is possible to avoid useless energy consumption due to repeated operation of wasteful pre-air conditioning based on a periodic setting, without the user being aware.

[0085] Furthermore, by adopting a mode in which information for prompting a
10 user to correct/cancel a periodic setting is output when wasteful pre-air conditioning based on the periodic setting occurs the prescribed number of times consecutively, in accordance with the reference value C_t shown in FIG. 4, then it is possible to avoid causing the user concern due to this information being output with excessive frequency.

[0086] If, after completion of the pre-air conditioning, the operation day/time for
15 pre-air conditioning based on another periodic setting is reached before it is detected that a user gets in the vehicle (step S110 in FIG. 3), then desirably, the operation of pre-air conditioning is masked in step S120 (FIG. 3). This is in order to avoid repeated operation of wasteful pre-air conditioning in cases where no user gets in the vehicle 100 for a long period of time, for instance, when the user is away travelling. In this case, in step S130
20 (FIG. 3), if the setting information for the masked pre-air conditioning is not stored, then it is possible to detect the pre-air conditioning which is useless, in respect of the pre-air conditioning that has actually been performed.

[0087] If the day and time set by the user for the pre-air conditioning is changed
after completion of the pre-air conditioning and before detecting that the user gets in the
25 vehicle, then desirably, the pre-air conditioning corresponding to the changed day/time setting is performed without masking, even before the user gets in the vehicle. This is in order to prioritize the wishes of the user in changing the settings.

[0088] The configuration of the drive unit 200 in the vehicle 100 is one example, which serves to assert the applicability of this invention, without limiting the configuration

of the vehicle drive system. Furthermore, it is also possible add a composition for charging the battery BAT (vehicle-mounted electric storage device) by a power source external to the vehicle, to the configuration of the vehicle 100 shown in FIG. 1. In a vehicle that can be externally charged in this way, it is possible to charge the battery BAT, by power from an external power source electrically connected to the vehicle 100 via a charging cable, or an external power source which supplies electricity to the vehicle 100 by a non-contact method via electromagnetic coupling using a coil, or the like. In a vehicle which can have an external electric power source, there is a possibility that the pre-air conditioning will be performed during external charging, in other words, during the supply of electricity from an external power source. In this case, unlike the vehicle in FIG. 1, the pre-air conditioning is performed by using power from an external power source, but by applying this invention, it is possible to avoid useless consumption of energy from an external power source due to wasteful pre-air conditioning based on periodic settings. In this way, it is possible to apply this invention commonly to vehicles equipped with a pre-air conditioning function, without any limitation on the configuration of the vehicle drive system or the presence/absence of the external charging function, etc.

[0089] Furthermore, in a vehicle having an external charging function, a mode can be envisaged in which the vehicle is incorporated into a household energy management system and external charging is performed or a charging day/time is set, from the control panel provided in the household, but in a system of this kind, the communication device 34 and the information output unit 26 shown in FIG. 1 may be provided on the control panel described above.

[0090] The embodiment disclosed here is exemplary in all respects and should not be regarded as restrictive. The scope of this invention is indicated by the scope of the claims and not by the description given above, and is intended to include all modifications within the same sense and scope as the claims.

CLAIMS:

1. A vehicle, comprising:

an air-conditioner configured to adjust a temperature inside a vehicle cabin;

a boarding detector configured to detect that a user gets in the vehicle;

a setting unit configured to set a periodic operation day and time for the air-conditioner on the basis of a user input;

a controller configured to operate the air-conditioner in accordance with the periodic operation day and time set by the user input; and

an output unit configured to output information to the user, the information prompting cancellation or correction of the periodic operation day and time, when the boarding detector detects that no user gets in the vehicle within a prescribed time period from the periodic operation day and time and the controller operates the air-conditioner in accordance with the periodic operation day and time.

2. The vehicle according to claim 1, wherein the output unit is configured to output the information to the user, when the boarding detector detects that no user gets in the vehicle within the prescribed time period from the periodic operation day and time for the prescribed number of times in succession and when the air-conditioner is operated in accordance with the periodic operation day and time.

3. The vehicle according to claim 1 or 2, wherein the periodic operation day and time includes a day of the week and a time at which the air-conditioner is operated.

FIG. 1

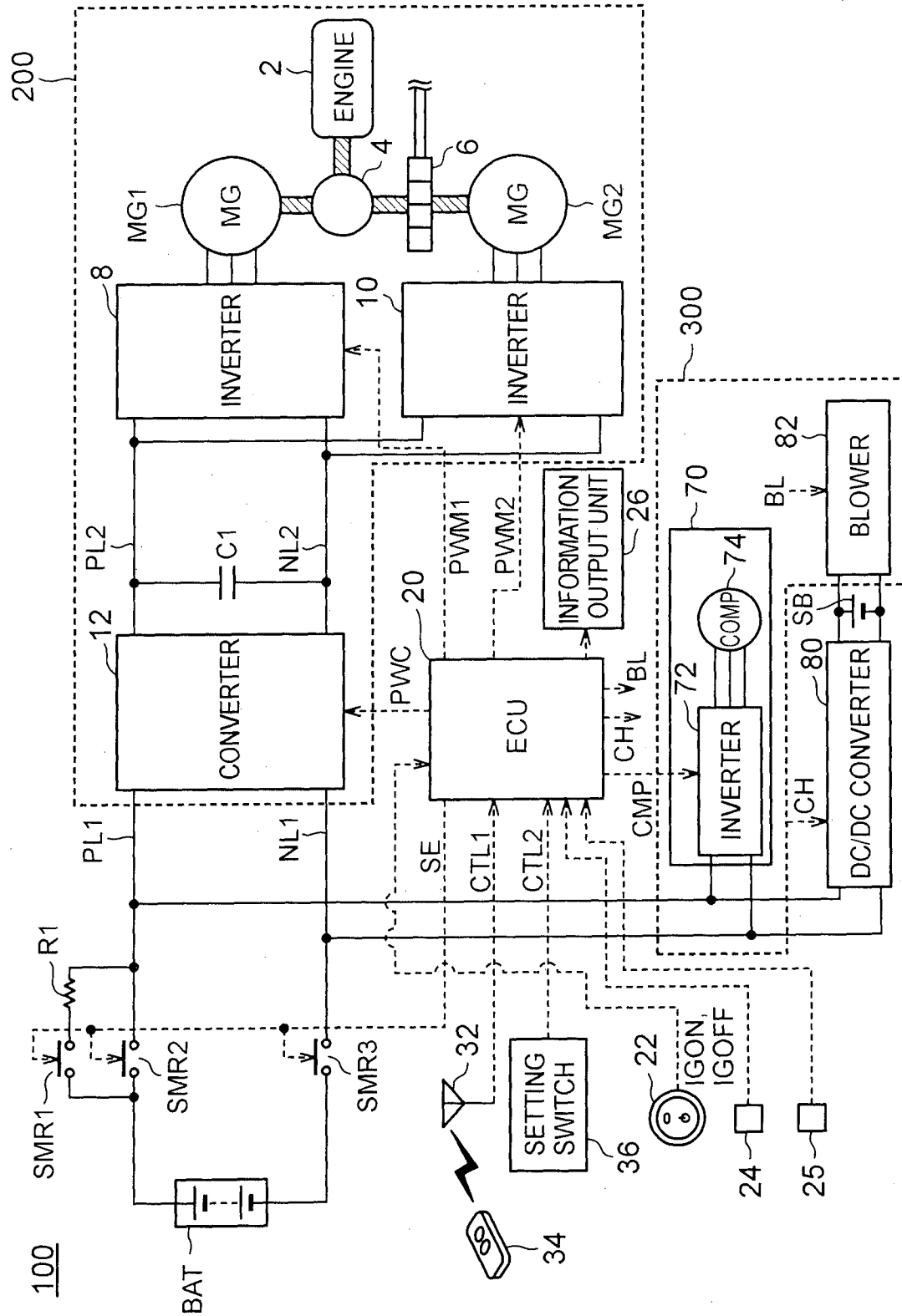


FIG. 2

DAY OF WEEK	TIME	COUNT VALUE
WEEKDAYS	PM 6:00	CNT(1)
MONDAY	AM 10:00	CNT(2)
FRIDAY	AM 10:00	CNT(3)
⋮	⋮	⋮
SUNDAY	PM 1:00	CNT(n)

FIG. 3

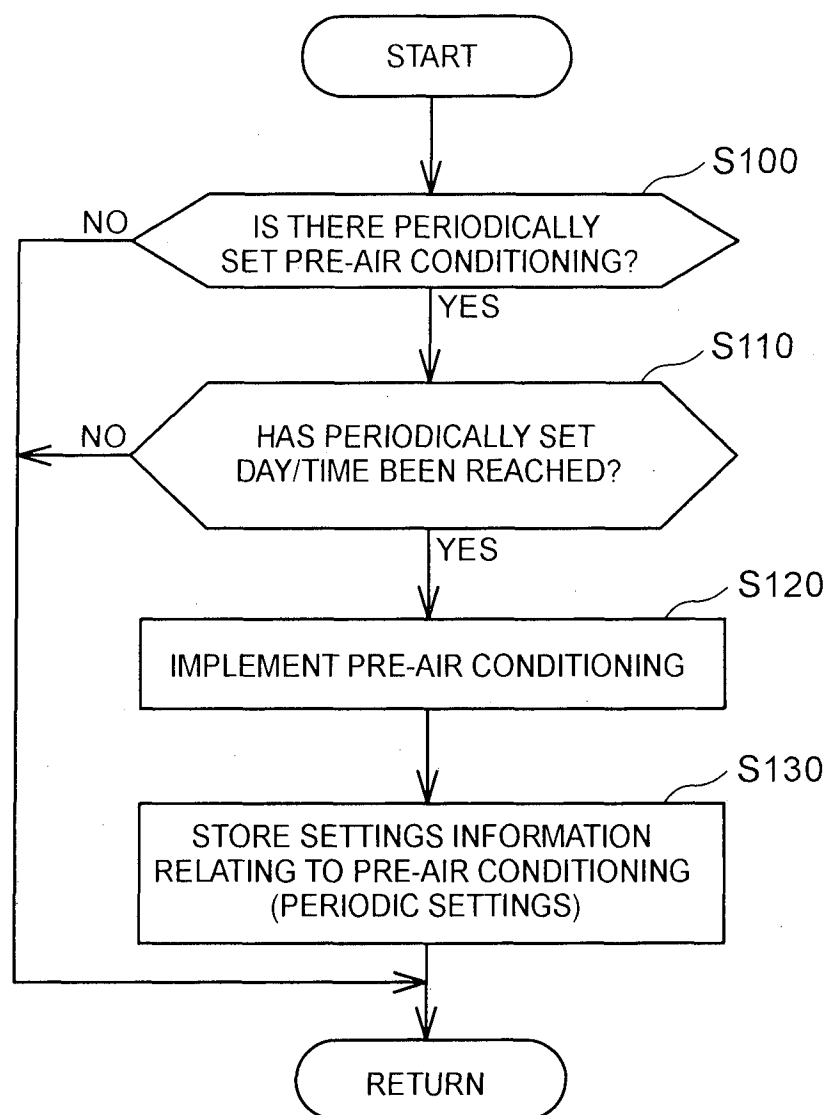


FIG. 4

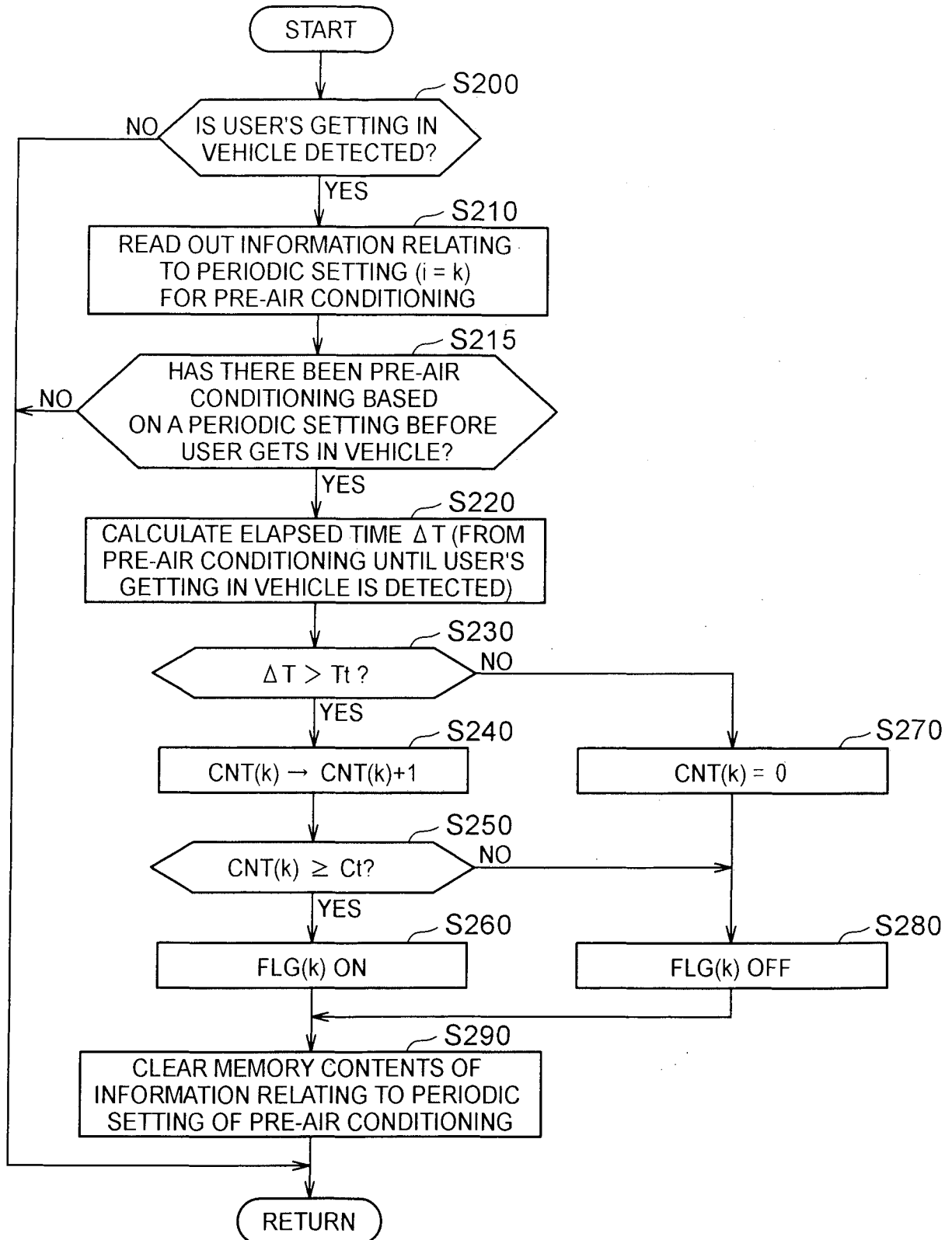


FIG. 5

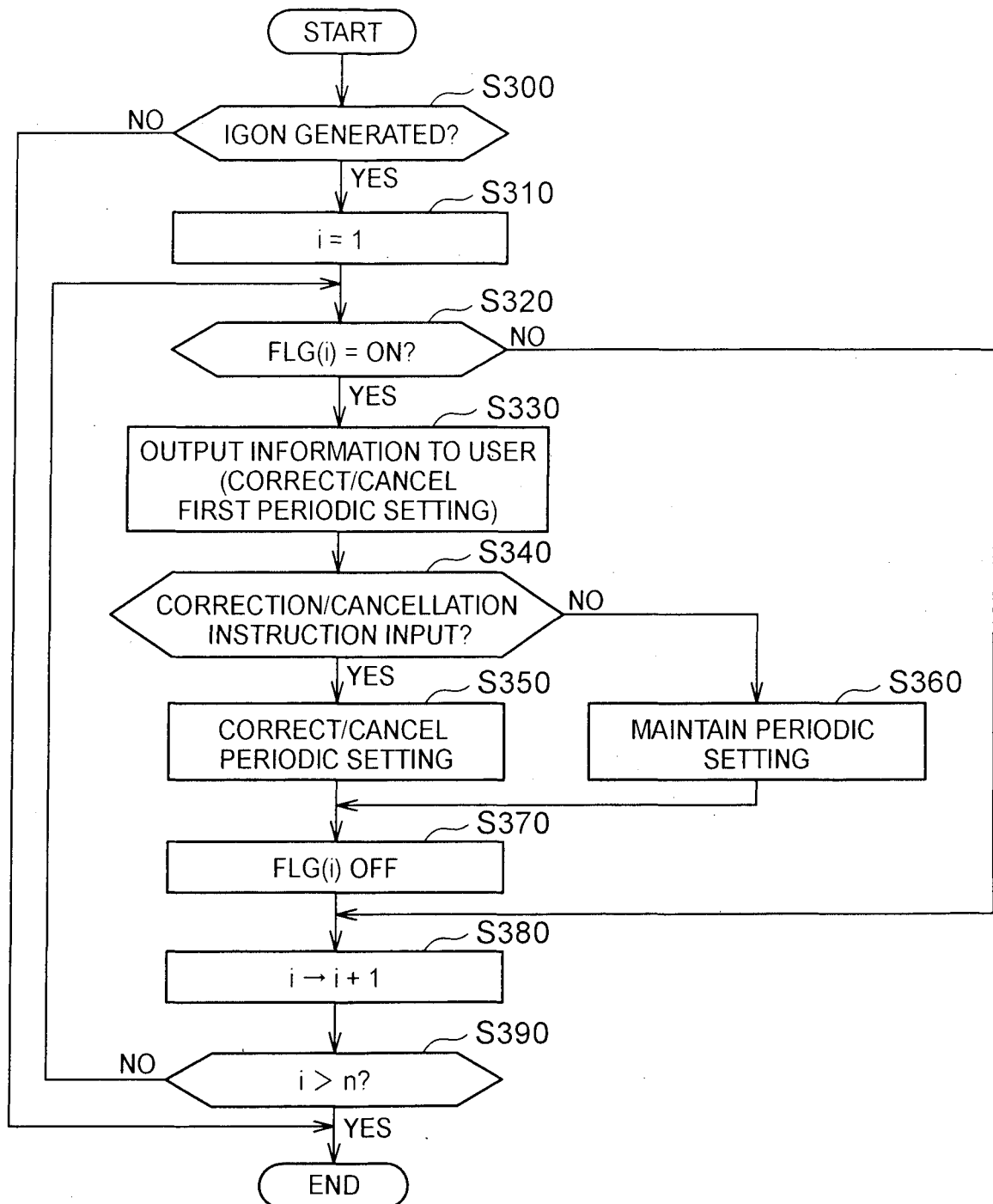


FIG. 6

PRE-AIR
CONDITIONING COMPLETED WEEKDAYS 6:00 PM

ENERGY RELATING TO SETTING GIVEN ABOVE IS BEING WASTED.
DO YOU WANT TO SWITCH OFF THIS SETTING?

YES NO

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/001776

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60H1/00
ADD.

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)

B60H

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2013/234651 A1 (BUFORD KEITH D [US]) 12 September 2013 (2013-09-12) paragraphs [0002] - [0018]; claims 1-20; figures 1-2 -----	1-3
A	JP 2011 148325 A (TOKAI RIKI CO LTD) 4 August 2011 (2011-08-04) abstract; claims 1-3 -----	1-3
A	US 2012/267442 A1 (CHOI DAVE [US] ET AL) 25 October 2012 (2012-10-25) claims 1,21-28; figures -----	1-3

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

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Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Chavel, Jérôme

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2014/001776

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JP 2011148325 A	04-08-2011	NONE	

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