



(51) International Patent Classification:

B60H 1/00 (2006.01) *B60H 3/00* (2006.01)
B60H 1/32 (2006.01)

(21) International Application Number:

PCT/JP2014/083498

(22) International Filing Date:

11 December 2014 (11.12.2014)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

2014-001790 8 January 2014 (08.01.2014) JP

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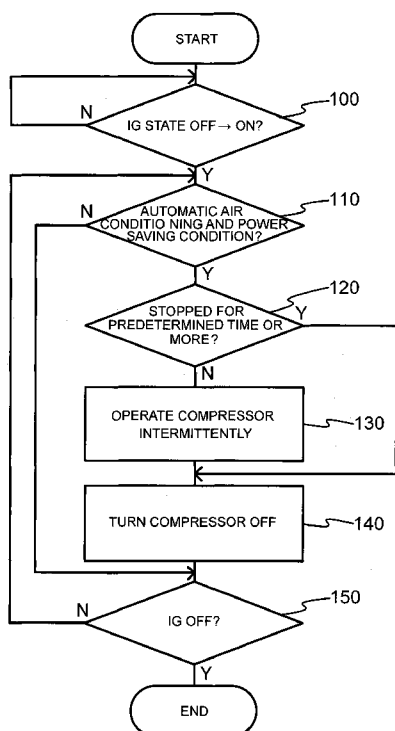
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) Title: VEHICLE AIR CONDITIONING DEVICE

FIG.3



(57) Abstract: An object is to prevent unnecessary operation of a compressor and suppress deterioration in fuel economy. When automatic air conditioning is instructed and a predetermined condition for stopping a compressor in order to save power is met (110), in a case in which a predetermined time or more has elapsed from stoppage of the compressor a previous time, stoppage of the compressor is maintained (120, 140), and in a case in which the predetermined time has not elapsed, the compressor is intermittently operated in a predetermined cycle (120, 130). Namely, when a condition for stopping the compressor in order to save power is met, intermittent operation and maintaining of stoppage of the compressor are switched in accordance with whether or not time from stoppage of the compressor has reached a predetermined time or more. Due thereto, unnecessary operation of the compressor is prevented, and a deterioration in fuel economy can be suppressed.



(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE,

SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (*Art. 21(3)*)

DESCRIPTION

VEHICLE AIR CONDITIONING DEVICE

Technical Field

[0001] The present invention relates to a vehicle air conditioning device that is mounted in a vehicle and conditions the air of the vehicle cabin interior.

Background Art

[0002] A typical vehicle air conditioning device has a coolant cycle that evaporates coolant by circulating the coolant to an evaporator by a compressor and decreasing pressure at the evaporator. In such a vehicle air conditioning device, when condensed water that has adhered to the evaporator dries, foul-smelling components that have adhered to the evaporator separate and are blown-out into the vehicle cabin interior. Various techniques have been proposed as techniques for preventing the blowing-out of such foul-smelling components into the vehicle cabin interior.

[0003] For example, Japanese Patent Application Laid-Open (JP-A) No. 2002-248933 discloses, while the post-evaporator temperature is less than or equal to the wet bulb temperature, after a predetermined time has elapsed from stoppage of the compressor, operating the compressor intermittently for a predetermined time, and, on the other hand, when the post-evaporator temperature is greater than the wet bulb temperature, stopping the intermittent operation mode.

[0004] Due thereto, by operating the compressor intermittently, the speed at which the wet surface ratio of the evaporator decreases is slowed, and foul-smelling components, that have adhered to the surface of the evaporator, being dispersed into the vehicle cabin interior can be suppressed. On the other hand, by stopping the intermittent mode, an increase in the operation rate of the compressor can be suppressed.

[0005] However, in the technique disclosed in JP-A No. 2002-248933, when the surface of the evaporator is completely dry, even if the compressor is operated intermittently, the compressor is operated superfluously, which leads to deterioration in fuel economy. Further, by operating the compressor thoughtlessly at the time when the surface of the evaporator is completely dry, condensed water adheres to the evaporator which leads also to floating-about of foul-smelling components, and therefore, there is room for improvement.

SUMMARY OF INVENTION

Technical Problem

[0006] The present invention was made in consideration of the above-described circumstances, and an object thereof is to suppress needless operation of a compressor and suppress deterioration in fuel economy.

Solution to Problem

[0007] In order to achieve the above-described object, a first aspect of the present invention includes: a compressor that compresses and circulates a coolant to an evaporator; and a control unit that, when a predetermined condition for stopping the compressor in order to save power is met, in a case in which elapsed time from stoppage of the compressor a previous time is less than a predetermined time, controls the compressor so as to repeat stoppage and operation of the compressor in a predetermined cycle, and, in a case in which the elapsed time is greater than or equal to the predetermined time, controls the compressor so as to maintain stoppage of the compressor.

[0008] In accordance with the first aspect of the present invention, the compressor compresses and circulates coolant to the evaporator. Namely, due to coolant being compressed and circulated by the compressor and the pressure of the coolant being reduced by the evaporator, air that passes through the evaporator can be cooled.

[0009] Further, at the control unit, when a predetermined condition for stopping the compressor in order to save power is met, in a case in which elapsed time from stoppage of the compressor the previous time is less than a predetermined time, the compressor is controlled so as to repeat stoppage and operation of the compressor in a predetermined cycle, and, in a case in which the elapsed time is greater than or equal to the predetermined time, the compressor is controlled so as to maintain stoppage of the compressor. Note that, as in the invention of a fifth aspect, a time, that corresponds to the time until condensed water on a surface of the evaporator dries, can be used as the predetermined time.

[0010] Namely, in a case in which the time that has elapsed from stoppage of the compressor the previous time is less than the predetermined time, the compressor is operated intermittently. Due thereto, a rise in temperature can be suppressed in the course of the condensed water on the surface of the evaporator drying. Therefore, foul smells arising can be suppressed.

[0011] Further, in a case in which the time that has elapsed from stoppage of the compressor the previous time is greater than or equal to the predetermined time, stoppage of the

compressor is maintained. Due thereto, if there is a state in which the condensed water on the surface of the evaporator has already dried and foul smells will not arise, power that is wasted due to the compressor being operated is suppressed. Accordingly, unnecessary operation of the compressor is suppressed, and deterioration in fuel economy can be suppressed.

[0012] As in a second aspect of the present invention, when a predetermined condition for stopping the compressor in order to save power is met, in a case in which external air temperature, that is detected by an external air temperature detecting unit for detecting external air temperature, is higher than a predetermined threshold temperature, the control unit may further control the compressor so as to operate the compressor regardless of the elapsed time. Namely, if the external air temperature is higher than the threshold temperature, the amount of water retained by the evaporator (the amount of condensed water) is large, and the strength of foul smells in the course of drying is strong. However, by operating the compressor, a rise in temperature is suppressed, and foul smells can be suppressed.

[0013] Further, as in a third aspect of the present invention, when a predetermined condition for stopping the compressor in order to save power is met, in a case in which windshield humidity, that is detected by a windshield humidity detecting unit for detecting windshield humidity, is higher than a predetermined threshold humidity, the control unit may further control the compressor so as to operate the compressor regardless of the elapsed time. Due thereto, if the windshield humidity is higher than the threshold humidity, the occurrence of fogging of the windshield can be prevented, and both fuel savings and an anti-fogging performance can be achieved.

[0014] Further, as in a fourth aspect of the present invention, when a predetermined condition for stopping the compressor in order to save power is met, in a case in which a judgment relating to cooling/heating, that is based on a target blow-out temperature computed on the basis of a temperature setting, is other than a judgment to carry out heating, the control unit may further control the compressor so as to operate the compressor regardless of the elapsed time. Namely, if the judgment relating to cooling/heating is other than a judgment to carry out heating, there are cases in which control is carried out so as to blow-out a large amount of air conditioned air toward the vicinity of the face of a vehicle occupant where it is easy to experience foul smells. However, even if a large amount of air conditioned air is blown-out toward the vicinity of the face of a vehicle occupant, because the compressor is

operated, a rise in temperature is suppressed and foul smells can be suppressed.

Advantageous Effects of Invention

[0015] As described above, in accordance with the present invention, there are the effects that unnecessary operation of a compressor is prevented, and deterioration in fuel economy can be suppressed.

BRIEF DESCRIPTION OF DRAWINGS

[0016] Fig. 1 is a block drawing showing the schematic structure of a vehicle air conditioning device relating to an embodiment of the present invention.

Fig. 2 is a block drawing showing transitions of the state of a compressor in the vehicle air conditioning device relating to the embodiment of the present invention.

Fig. 3 is a flowchart showing an example of the flow of processings that are carried out by an air conditioner ECU of the vehicle air conditioning device relating to the embodiment of the present invention.

Fig. 4 is a flowchart showing an example of processings of a first modified example that are carried out by the air conditioner ECU of the vehicle air conditioning device relating to the embodiment of the present invention.

Fig. 5 is a drawing for explaining threshold values for judging whether or not external air temperature is high.

Fig. 6 is a flowchart showing an example of processings of a second modified example that are carried out by the air conditioner ECU of the vehicle air conditioning device relating to the embodiment of the present invention.

Fig. 7 is a drawing for explaining threshold values for judging whether or not windshield humidity is high.

Fig. 8 is a drawing for explaining an example of air blowing modes.

Fig. 9 is a flowchart showing an example of processings of a third modified example that are carried out by the air conditioner ECU of the vehicle air conditioning device relating to the embodiment of the present invention.

Fig. 10 is a drawing for explaining threshold values for judging whether or not a judgment relating to cooling/heating is other than a judgment to carry out heating.

Fig. 11 is a flowchart showing an example of processings of a fourth modified example that are carried out by the air conditioner ECU of the vehicle air conditioning device relating to the embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0017] An example of an embodiment of the present invention is described in detail hereinafter with reference to the drawings. Fig. 1 is a block diagram showing the schematic structure of a vehicle air conditioning device relating to the embodiment of the present invention.

[0018] At the vehicle air conditioning device 10, a refrigeration cycle is structured by a coolant circulation path that includes a compressor 14 that serves as a compressor, a condenser 16, an expansion valve 18, and an evaporator 20 that serves as an evaporator.

[0019] The compressor 14 compresses a coolant and circulates it through the circulation path. Note that the compressor 14 may be mechanically driven by using the power of the vehicle (the engine or the like), or, an electric compressor may be applied and made able to be driven without the power of the vehicle. In a case of mechanical driving, the on/off state of the compressor 14 is controlled by an electromagnetic clutch that carries out transfer or non-transfer of the power. In a case in which the power of the vehicle is the engine and the compressor 14 is turned on while the engine is stopped, the compressor 14 can be operated by turning the compressor 14 on from after start-up of the engine. Further, in a case of using a compressor that is driven mechanically, the vehicle air conditioning device 10 can be installed in a vehicle that travels by power of an internal combustion engine such as an engine or the like, or in a hybrid vehicle that has an engine and a motor, or the like. In a case of using an electric compressor, the vehicle air conditioning device 10 can be installed in an electric automobile or the like in addition to those described above.

[0020] The evaporator 20 cools air that passes-through the evaporator 20 (hereinafter, this air is called post-evaporator air) by vaporizing coolant that has been compressed and liquefied. At this time, due to the evaporator 20 cooling the air that passes therethrough, moisture within the air is condensed, and the post-evaporator 20 air is thereby dehumidified.

[0021] Due to the expansion valve 18 that is provided at the upstream side of the evaporator rapidly decreasing the pressure of the liquefied coolant, the expansion valve 18 makes the coolant into the form of a mist and supplies it to the evaporator. Due thereto, the efficiency of vaporizing the coolant at the evaporator 20 is improved.

[0022] The evaporator 20 of the vehicle air conditioning device 10 is provided within an air conditioning duct 38. Both ends of this air conditioning duct 38 are open, and air intake ports 40, 42 are formed at one open end thereof. Plural air blow-out ports 44 (44A, 44B,

44C are illustrated as an example in the present embodiment), that open toward the vehicle cabin interior, are formed at the other open end. Note that the air blow-out ports 44 include, for example, a blow-out port that blows air out toward a windshield (DEF), blow-out ports that blow air out toward vehicle occupants (Face), blow-out ports that blow air out toward the feet (Foot), and the like.

[0023] The air intake port 42 communicates with the vehicle exterior, and can introduce external air into the air conditioning duct 38. Further, the air intake ports 40 communicate with the vehicle cabin interior, and can introduce air of the vehicle cabin interior (internal air) into the air conditioning duct 38. Note that the air blow-out ports 44 are, for example, the defroster blow-out port 44A that blows air out toward the windshield glass (hereinafter simply called windshield), side and center register blow-out ports 44B, and feet blow-out ports 44C.

[0024] A blower fan 46 is provided within the air conditioning duct 38 between the evaporator 20 and the air intake ports 40, 42. Further, mode switching dampers 48 are provided in the vicinity of the air intake ports 40, 42. The mode switching dampers 48 carry out opening and closing of the air intake ports 40, 42 due to operation of an actuator of a motor 24 for the mode switching dampers, or the like.

[0025] The blower fan 46 rotates due to driving of a blower motor 22, and draws air in from the air intake ports 40 and the air intake port 42 into the air conditioning duct 38 interior, and further sends this air out toward the evaporator 20. At this time, external air or internal air is introduced into the air conditioning duct 38 interior in accordance with the opened/closed states of the air intake ports 40, 42 by the mode switching dampers 48. Namely, an internal air circulating mode and an external air introducing mode are switched by the mode switching dampers 48.

[0026] An air mix damper 50 and a heater core 52 are provided downstream of the evaporator 20. The air mix damper 50 rotates due to driving of a motor 36 for the air mix damper, and adjusts the amount of the post-evaporator 20 air that passes-through the heater core 52 and the amount of the post-evaporator 20 air that bypasses the heater core 52. Engine cooling water circulates at the heater core 52, and the heater core 52 heats the air, that has been guided by the air mix damper 50, by this engine cooling water. Note that, in the case of an electric automobile that does not use an engine for power, an electric heater or the like is used instead of the heater core 52.

[0027] The post-evaporator 20 air is guided to and heated by the heater core 52 in accordance with the degree of opening of the air mix damper 50, and further, is

mixed-together with air that has not been heated by the heater core 52, and thereafter, is sent-out toward the air blow-out ports 44. In the vehicle air conditioning device 10, temperature adjustment of the air that is blown-out from the air blow-out ports 44 toward the vehicle cabin interior is carried out by controlling the air mix damper 50 and regulating the amount of air that is heated by the heater core 52.

[0028] Blow-out port switching dampers 54 are provided in vicinities of the respective air blow-out ports 44 in respective correspondence therewith. In the vehicle air conditioning device 10, the air whose temperature has been adjusted can be blown-out into the vehicle cabin interior from desired positions by opening and closing the air blow-out ports 44A, 44B, 44C by these blow-out port switching dampers 54.

[0029] Further, the vehicle air conditioning device 10 has an air conditioner ECU (Electronic Control Unit) 11 (serving as a control unit) for carrying out various types of control of the vehicle air conditioner 10. The aforementioned blower motor 22, the motor 24 for the mode switching dampers, the motor 36 for the air mix damper, a motor 34 for the blow-out port switching dampers, the compressor 14, an external air temperature sensor 32 (serving as an external air temperature detecting unit), an internal air temperature sensor 30, a sunlight sensor 28, a windshield humidity sensor 13 (serving as a windshield humidity sensing unit), and a windshield temperature sensor 15 are connected to the air conditioner ECU 11.

[0030] Further, an operation portion 19, for carrying out various types of operations of the vehicle air conditioning device 10 such as setting of the temperature of the vehicle air conditioning device 10 and selecting of the blow-out ports and the like, is connected to the air conditioner ECU 11.

[0031] Further, detected values of the external air temperature sensor 32, the internal air temperature sensor 30, the sunlight sensor 28, the windshield humidity sensor 13, and the windshield temperature sensor 15 are inputted to the air conditioner ECU 11, and the air conditioner ECU 11 carries out air conditioning control of the vehicle cabin interior in accordance with the settings of the operation portion 19 and the like and on the basis of the results of detection of the respective sensors. Note that the windshield humidity sensor 13 and the windshield temperature sensor 15 are respectively provided at the windshield, and the windshield humidity sensor 13 detects the humidity of the vehicle cabin interior (in particular, in a vicinity of the windshield surface), and the windshield temperature sensor 15 detects the windshield ambient temperature. Further, the windshield humidity sensor 13 and the

windshield temperature sensor 15 are illustrated as being separate, but may be structured integrally.

[0032] Note that, in a case in which the power of the vehicle is an engine, an engine ECU 12 that controls operation of the engine is connected to the air conditioner ECU 11. In this case, the detected value, that is inputted to the engine ECU 12, of a water temperature sensor 17 that detects the water temperature of the engine cooling water is inputted to the air conditioner ECU 11, and, in a case in which heating is carried out, engine start-up and the like are carried out on the basis of the results of detection of the water temperature. Note that Fig. 1 illustrates an example in which the detected value of the water temperature sensor 17 is inputted to the air conditioner ECU 11 via the engine ECU 12, but the water temperature sensor 17 may be directly connected to the air conditioner ECU 11.

[0033] The air conditioner ECU 11 carries out air conditioning of the vehicle cabin interior by controlling the blower motor 22, the compressor 14, the motor 24 for the mode switching dampers, the motor 36 for the air mix damper, the motor 34 for the blow-out port switching dampers, and the like on the basis of the detected values of the respective sensors.

[0034] As an example of the various types of control that the air conditioner ECU 11 carries out, for example, at the time when the ignition switch is on, the air conditioner ECU 11 determines a target blow-out temperature, in accordance with following formula (1) and on the basis of the results of detection of the respective sensors and the contents of the settings of the operation portion 19 and the like, and carries out air conditioning control such that the temperature becomes the target blow-out temperature.

[0035] $T_{ao} = k_1 \times T_{set} - k_2 \times T_a - k_3 \times T_r - k_4 \times ST + C$ (1)

[0036] Here, k_1 , k_2 , k_3 , k_4 and C respectively represent constants, and T_{set} represents the set temperature, T_r represents the vehicle cabin interior temperature, T_a represents the external air temperature, and ST represents the amount of sunlight.

[0037] Further, when the air conditioner ECU 11 carries out air conditioning control, the air conditioner ECU 11 also carries out, in accordance with the target blow-out temperature and the like, control (hereinafter, on occasion, called automatic air conditioning) such as on/off control of the compressor 14, driving control of the motor 36 for the air mix damper, switching control of the air blow-out ports 44, switching control of the air intake ports 40, 42 (mode switching control of the internal air circulating mode and the external air introducing mode), and the like. Note that the switching control of the air intake ports 40, 42, the on/off of the compressor 14, and the like can also be carried out manually by a vehicle passenger

operating the operation portion 19. A case in which the compressor and the like are operated manually is, on occasion, called manual air conditioning.

[0038] Further, in a case in which the humidity detected by the windshield humidity sensor 13 is greater than or equal to a threshold humidity that is set in advance, the air conditioner ECU 11 can also carry out anti-fogging control by effecting control so as to turn the compressor 14 on and carrying out dehumidifying.

[0039] Further, in a case in which the water temperature detected by the water temperature sensor 17 is less than or equal to a threshold water temperature that is set in advance, the air conditioner ECU 11 can also carry out control to prohibit operation of the blower motor 22 and prevent the feeling of cold air in the winter.

[0040] Here, because the compressor 14 in the vehicle air conditioning device 10 relating to the embodiment of the present invention can transition to plural states, transitioning of the state of the compressor 14 is described. Fig. 2 is a block diagram showing transitions of the state of the compressor 14 at the vehicle air conditioning device 10 relating to the embodiment of the present invention.

[0041] When an ignition switch (IG) is turned from off to on, the compressor 14 of the vehicle air conditioning device 10 relating to the present embodiment can transition to the states of processings 1 through 4 as shown in Fig. 2.

[0042] Concretely, it is deemed that condition 1 is met in a case in which, when the IG is turned from off to on, the time from stoppage of the compressor 14 reaches a predetermined time or more, and a predetermined condition for stopping the compressor 14 in order to save power is satisfied, and automatic air conditioning is instructed by the operation portion 19. When condition 1 is met, the compressor 14 transitions to the state of processing 2. The state of processing 2 is a state in which the compressor 14 is stopped. Here, in a case in which the predetermined condition for stopping the compressor 14 in order to save power is not met, or in a case in which a condition that predetermined fogging has arisen is met on the basis of the results of detection of the windshield humidity sensor 13, the compressor 14 transitions to the state of processing 4. Processing 4 is the state of usual control, and, on the basis of the settings of the operation portion 19, the target blow-out temperature T_{ao} is computed and control of the compressor 14 and the like is carried out.

[0043] On the other hand, it is deemed that condition 2 is met in a case in which, when the IG is turned from off to on, the time from stoppage of the compressor 14 is less than the predetermined time, and the predetermined condition for stopping the compressor 14 in order

to save power is satisfied, and automatic air conditioning is instructed by the operation portion 19. When condition 2 is met, the compressor 14 transitions to the state of processing 3. The state of processing 3 is a state in which the compressor 14 is operated intermittently in a predetermined cycle (hereinafter, upon occasion, called intermittent operation). As the intermittent operation, for example, operating and stopping may be repeated each predetermined time, or the operation time and the stoppage time may be made to differ such as operation is carried out for one second and stoppage is carried out for 20 seconds, or the like. Further, in the state of processing 3, for example, in a case in which a predetermined time, in which it is assumed that the condensed water that has adhered to the surface of the evaporator 20 will have dried, has elapsed, the compressor 14 transitions to the state of processing 2, and, before this time elapses, in a case in which the predetermined condition for stopping the compressor 14 in order to save power is not met, the compressor 14 transitions to the state of processing 4 and transitions to the aforementioned state of usual control.

[0044] Further, the compressor 14 transitions to the state of processing 1 in a case in which, when the IG is turned from off to on, both of above-described conditions 1, 2 are not met.

The state of processing 1 is a standby state. Here, in a case in which above-described condition 1 is met, the compressor 14 transitions to the state of above-described processing 2, and, in a case in which above-described condition 2 is met, the compressor 14 transitions to the state of above-described processing 3. Further, in a case in which manual air conditioning is instructed by the operation portion 19, the compressor 14 transitions to the state of processing 4, and manual air conditioning control is carried out as the usual control.

[0045] Note that at least one condition among, for example, the condition of a predetermined temperature at which foul smells do not arise, or the condition of stopping of the compressor 14 being possible due to the cooling load, and the condition of the windshield not fogging, can be used as the aforementioned predetermined condition for stopping the compressor 14 in order to save power. However, conditions other than these may be employed.

[0046] Some of the processings carried out by the air conditioner ECU 11 in the vehicle air conditioning device 10 relating to the embodiment of the present invention that is structured as described above, are described next. Fig. 3 is a flowchart showing an example of the flow of processings carried out by the air conditioner ECU 11 of the vehicle air conditioning device 10 relating to the embodiment of the present invention.

[0047] In step 100, it is judged by the air conditioner ECU 11 whether or not the state of the

ignition switch (IG) has changed from off to on. When the judgment becomes affirmative, the routine moves on to step 110. Namely, these processings start when the ignition switch is turned on.

[0048] In step 110, it is judged by the air conditioner ECU 11 whether or not automatic air conditioning has been instructed by the operation portion 19 and the predetermined condition for stopping the compressor 14 in order to save power (the power saving condition) is met. If this judgment is negative, the routine moves on to step 150, and if this judgment is affirmative, the routine moves on to step 120.

[0049] In step 120, it is judged by the air conditioner ECU 11 whether or not there is a state in which the compressor 14 has been stopped for a predetermined time or more. For example, it may be judged whether or not a predetermined time or more has elapsed from the state of the ignition switch the previous time having changed from on to off, or it may be judged whether or not the time from the compressor 14 being turned off the previous time has reached the predetermined time or more during the time from the ignition switch being turned on to being turned off (i.e., during one trip). Then, if this judgment is negative, the routine moves on to step 130, and, if this judgment is affirmative, the routine moves on to step 140. Note that the predetermined time is the time from stoppage of the compressor 14 until foul smells arise, and is a time that is determined by experimentation. Further, in other words, this is a time corresponding to the time until the condensed water on the surface of the evaporator 20 dries.

[0050] In step 130, the compressor 14 is controlled by the air conditioner ECU 11 so as to be operated intermittently in a predetermined cycle, and the routine moves on to step 140. Namely, the compressor 14 is operated intermittently such that there is the state of above-described processing 3. Due thereto, a rise in temperature can be suppressed in the course of the condensed water on the surface of the evaporator 20 drying, and therefore, foul smells arising can be suppressed. Note that the intermittent operation of the compressor 14 is carried out until for example the time, in which it is assumed that the condensed water that has adhered to the surface of the evaporator 20 will dry, elapses, and the routine moves on to step 140.

[0051] Further, in step 140, the compressor 14 is turned off by the air conditioner ECU 11, and the routine moves on to step 150. Namely, if the time from stoppage of the compressor 14 is less than a predetermined time, the compressor 14 is intermittently operated, and thereafter, is stopped. On the other hand, if the time from stoppage of the compressor 14 is

the predetermined time or more, stoppage is maintained without carrying out intermittent operation of the compressor 14. Due thereto, if there is a state in which the condensed water on the surface of the evaporator 20 has already dried and foul smells will not arise, power that is wasted due to the compressor 14 being operated is suppressed. Accordingly, in the case of the compressor 14 that is driven mechanically, wasteful starting-up of the engine is suppressed, and deterioration in fuel economy can be prevented. In the case of the electric compressor 14, the electric power that is consumed by the compressor 14 can be reduced. Further, in a case of having an electric fan for cooling of the condenser 16, this also leads to a reduction in the electric power consumed by the electric fan. Moreover, because adhesion of condensed water to the evaporator 20 due to unnecessary operation of the compressor 14 can be prevented, foul smells arising can be suppressed.

[0052] In step 150, it is judged by the air conditioner ECU 11 whether or not the ignition switch (IG) has been turned off. If this judgment is negative, the routine returns to step 110, and the above-described processings are repeated. If this judgment is affirmative, the series of processings ends.

[0053] In this way, when a condition for stopping the compressor 14 in order to save power is met, switching between intermittent operation and maintaining of the stoppage of the compressor 14 is carried out in accordance with whether or not the time from the stoppage of the compressor 14 the previous time has reached a predetermined time or more. Due thereto, unnecessary operation of the compressor 14 is prevented, and a deterioration in fuel economy can be suppressed.

[0054] A first modified example of the processings that are carried out at the air conditioner ECU 11 of the vehicle air conditioning device 10 relating to the embodiment of the present invention is described next. Fig. 4 is a flowchart showing an example of processings of the first modified example that are carried out by the air conditioner ECU 11 of the vehicle air conditioning device 10 relating to the embodiment of the present invention. Note that processings that are the same as those of the above-described embodiment are described by using the same reference numerals.

[0055] In the first modified example, as compared with the above-described embodiment, when the external air temperature is high, the amount of water retained by the evaporator 20 (the amount of condensed water) is large, and the strength of foul smells in the course of drying is strong. Therefore, the compressor 14 is turned on.

[0056] Namely, in step 100, it is judged by the air conditioner ECU 11 whether or not the

state of the ignition switch (IG) has changed from off to on. When the judgment becomes affirmative, the routine moves on to step 110. Namely, these processings start when the ignition switch is turned on.

[0057] In step 110, it is judged by the air conditioner ECU 11 whether or not automatic air conditioning has been instructed by the operation portion 19 and the predetermined condition for stopping the compressor 14 in order to save power (the power saving condition) is met. If this judgment is negative, the routine moves on to step 150, and if this judgment is affirmative, the routine moves on to step 112.

[0058] In step 112, it is judged by the air conditioner ECU 11 whether or not the external air temperature is high. If this judgment is affirmative, the routine moves on to step 160, and if this judgment is negative, the routine moves on to step 120. Note that the judgment as to whether or not the external air temperature is high is concretely carried out by using threshold values having hysteresis and shown in Fig. 5. Namely, when the external air temperature falls from a higher level and becomes less than or equal to A°C (e.g., 10°C), the external air temperature is judged to be low. When the external air temperature rises from a lower level and becomes greater than or equal to B°C (e.g., 15°C), the external air temperature is judged to be high.

[0059] In step 160, the compressor 14 is controlled by the air conditioner ECU 11 so as to be turned on, and the routine moves on to step 150. Due thereto, if the external air temperature is high, the amount of water retained by the evaporator 20 (the amount of condensed water) is large and the strength of foul smells in the course of drying is strong. However, due to the compressor 14 being turned on, a rise in temperature is suppressed, and foul smells can be suppressed.

[0060] On the other hand, in step 120, it is judged by the air conditioner ECU 11 whether or not there is a state in which the compressor 14 has been stopped for a predetermined time or more. For example, it may be judged whether or not a predetermined time or more has elapsed from the state of the ignition switch the previous time having changed from on to off, or it may be judged whether or not the time from the compressor 14 being turned off the previous time has reached the predetermined time or more during the time from the ignition switch being turned on to being turned off (i.e., during one trip). Then, if this judgment is negative, the routine moves on to step 130, and, if this judgment is affirmative, the routine moves on to step 140. Note that the predetermined time is the time from stoppage of the compressor 14 until foul smells arise, and is a time that is determined by experimentation.

Further, in other words, this is a time corresponding to the time until the condensed water on the surface of the evaporator 20 dries.

[0061] In step 130, the compressor 14 is controlled by the air conditioner ECU 11 so as to be operated intermittently in a predetermined cycle, and the routine moves on to step 140. Namely, the compressor 14 is operated intermittently such that there is the state of above-described processing 3. Due thereto, a rise in temperature can be suppressed in the course of the condensed water on the surface of the evaporator 20 drying, and therefore, foul smells arising can be suppressed. Note that the intermittent operation of the compressor 14 is carried out until for example the time, in which it is assumed that the condensed water that has adhered to the surface of the evaporator 20 will dry, elapses, and the routine moves on to step 140.

[0062] Further, in step 140, the compressor 14 is turned off by the air conditioner ECU 11, and the routine moves on to step 150. Namely, if the time from stoppage of the compressor 14 is less than a predetermined time, the compressor 14 is intermittently operated, and thereafter, is stopped. On the other hand, if the time from stoppage of the compressor 14 is the predetermined time or more, stoppage is maintained without carrying out intermittent operation of the compressor 14. Due thereto, if there is a state in which the condensed water on the surface of the evaporator 20 has already dried and foul smells will not arise, power that is wasted due to the compressor 14 being operated is suppressed. Accordingly, in the case of the compressor 14 that is driven mechanically, wasteful starting-up of the engine is suppressed, and deterioration in fuel economy can be prevented. In the case of the electric compressor 14, the electric power that is consumed by the compressor 14 can be reduced. Further, in a case of having an electric fan for cooling of the condenser 16, this also leads to a reduction in the electric power consumed by the electric fan. Moreover, because adhesion of condensed water to the evaporator 20 due to unnecessary operation of the compressor 14 can be prevented, foul smells arising can be suppressed.

[0063] In step 150, it is judged by the air conditioner ECU 11 whether or not the ignition switch (IG) has been turned off. If this judgment is negative, the routine returns to step 110, and the above-described processings are repeated. If this judgment is affirmative, the series of processings ends.

[0064] A second modified example of the processings that are carried out at the air conditioner ECU 11 of the vehicle air conditioning device 10 relating to the embodiment of the present invention is described next. Fig. 6 is a flowchart showing an example of

processings of the second modified example that are carried out by the air conditioner ECU 11 of the vehicle air conditioning device 10 relating to the embodiment of the present invention. Note that processings that are the same as those of the above-described embodiment are described by using the same reference numerals.

[0065] In the second modified example, as compared with the above-described embodiment, when the windshield humidity is high, there is the possibility that the windshield will fog-up, and therefore, the compressor 14 is turned on.

[0066] Namely, in step 100, it is judged by the air conditioner ECU 11 whether or not the state of the ignition switch (IG) has changed from off to on. When the judgment becomes affirmative, the routine moves on to step 110. Namely, these processings start when the ignition switch is turned on.

[0067] In step 110, it is judged by the air conditioner ECU 11 whether or not automatic air conditioning has been instructed by the operation portion 19 and the predetermined condition for stopping the compressor 14 in order to save power (the power saving condition) is met. If this judgment is negative, the routine moves on to step 150, and if this judgment is affirmative, the routine moves on to step 114.

[0068] In step 114, it is judged, by the air conditioner ECU 11 and on the basis of the results of detection of the windshield humidity sensor 13, whether or not the windshield humidity is high. If this judgment is affirmative, the routine moves on to step 160, and if this judgment is negative, the routine moves on to step 120. Note that the judgment as to whether or not the windshield humidity is high is concretely carried out by using threshold values having hysteresis and shown in Fig. 7. Namely, when the windshield humidity falls from a higher level and becomes less than or equal to A%, the windshield humidity is judged to be low (dehumidifying is not needed). When the windshield humidity rises from a lower level and becomes greater than or equal to B%, the windshield humidity is judged to be high (dehumidifying is needed).

[0069] In step 160, the compressor 14 is controlled by the air conditioner ECU 11 so as to be turned on, and the routine moves on to step 150. Due thereto, if the windshield humidity is high, the occurrence of fogging of the windshield can be prevented, and both fuel savings and an anti-fogging performance can be achieved.

[0070] On the other hand, in step 120, it is judged by the air conditioner ECU 11 whether or not there is a state in which the compressor 14 has been stopped for a predetermined time or more. For example, it may be judged whether or not a predetermined time or more has

elapsed from the state of the ignition switch the previous time having changed from on to off, or it may be judged whether or not the time from the compressor 14 being turned off the previous time has reached the predetermined time or more during the time from the ignition switch being turned on to being turned off (i.e., during one trip). Then, if this judgment is negative, the routine moves on to step 130, and, if this judgment is affirmative, the routine moves on to step 140. Note that the predetermined time is the time from stoppage of the compressor 14 until foul smells arise, and is a time that is determined by experimentation. Further, in other words, this is a time corresponding to the time until the condensed water on the surface of the evaporator 20 dries.

[0071] In step 130, the compressor 14 is controlled by the air conditioner ECU 11 so as to be operated intermittently in a predetermined cycle, and the routine moves on to step 140. Namely, the compressor 14 is operated intermittently such that there is the state of above-described processing 3. Due thereto, a rise in temperature can be suppressed in the course of the condensed water on the surface of the evaporator 20 drying, and therefore, foul smells arising can be suppressed. Note that the intermittent operation of the compressor 14 is carried out until for example the time, in which it is assumed that the condensed water that has adhered to the surface of the evaporator 20 will dry, elapses, and the routine moves on to step 140.

[0072] Further, in step 140, the compressor 14 is turned off by the air conditioner ECU 11, and the routine moves on to step 150. Namely, if the time from stoppage of the compressor 14 is less than a predetermined time, the compressor 14 is intermittently operated, and thereafter, is stopped. On the other hand, if the time from stoppage of the compressor 14 is the predetermined time or more, stoppage is maintained without carrying out intermittent operation of the compressor 14. Due thereto, if there is a state in which the condensed water on the surface of the evaporator 20 has already dried and foul smells will not arise, power that is wasted due to the compressor 14 being operated is suppressed. Accordingly, in the case of the compressor 14 that is driven mechanically, wasteful starting-up of the engine is suppressed, and deterioration in fuel economy can be prevented. In the case of the electric compressor 14, the electric power that is consumed by the compressor 14 can be reduced. Further, in a case of having an electric fan for cooling of the condenser 16, this also leads to a reduction in the electric power consumed by the electric fan. Moreover, because adhesion of condensed water to the evaporator 20 due to unnecessary operation of the compressor 14 can be prevented, foul smells arising can be suppressed.

[0073] In step 150, it is judged by the air conditioner ECU 11 whether or not the ignition switch (IG) has been turned off. If this judgment is negative, the routine returns to step 110, and the above-described processings are repeated. If this judgment is affirmative, the series of processings ends.

[0074] A third modified example of the processings that are carried out at the air conditioner ECU 11 of the vehicle air conditioning device 10 relating to the embodiment of the present invention is described next. Fig. 8 is a drawing for explaining an example of air blowing modes, and Fig. 9 is a flowchart showing an example of processings of the third modified example that are carried out by the air conditioner ECU 11 of the vehicle air conditioning device 10 relating to the embodiment of the present invention. Note that processings that are the same as those of the above-described embodiment are described by using the same reference numerals.

[0075] In the third modified example, for example, there are a Face mode, a Bi-Level (B/L) mode, a Foot mode, and a Foot/DEF (F/D) mode as the air blowing modes. In detail, in the case of the Face mode, air is blown-out from the side and center register blow-out ports 44B. Concretely, air is blown-out from arrows A, B shown in Fig. 8. Further, in the case of the B/L mode, air is blown-out from the side and center register blow-out ports 44B and the feet blow-out ports 44C. Concretely, air is blown out from arrows A, B, C shown in Fig. 8. Further, in the case of the Foot mode, air is blown out from the defroster blow-out port 44A, the center register blow-out ports among the side and center register blow-out ports 44B, and the feet blow-out ports 44C. Concretely, air is blown-out from arrows B, C, D shown in Fig. 8. Moreover, in the case of the F/D mode, air is blown-out from the defroster blow-out port 44A, the center register blow-out ports among the side and center register blow-out ports 44B, and the feet blow-out ports 44C. Concretely, air is blown-out from arrows B, C, D shown in Fig. 8, but the point that the proportion of the amount that is blown-out from the defroster blow-out port 44A is greater than the others differs from the Foot mode.

[0076] Further, in the third modified example, in a case other than a judgment to carry out heating, control is carried out by the air conditioner ECU 11 such that the B/L mode or the Face mode is set.

[0077] In the third modified example, as compared with the above-described embodiment, in a case in which the judgment relating to cooling/heating that is based on the target blow-out temperature is other than a judgment to carry out heating, control is carried out such that the B/L mode or the Face mode is set, and a large amount of the air conditioned air is blown out

in the vicinity of the face of the vehicle occupant, and it is easy for the vehicle occupant to experience foul smells. Therefore, the compressor 14 is turned on.

[0078] Namely, in step 100, it is judged by the air conditioner ECU 11 whether or not the state of the ignition switch (IG) has changed from off to on. When the judgment becomes affirmative, the routine moves on to step 110. Namely, these processings start when the ignition switch is turned on.

[0079] In step 110, it is judged by the air conditioner ECU 11 whether or not automatic air conditioning has been instructed by the operation portion 19 and the predetermined condition for stopping the compressor 14 in order to save power (the power saving condition) is met. If this judgment is negative, the routine moves on to step 150, and if this judgment is affirmative, the routine moves on to step 116.

[0080] In step 116, it is judged by the air conditioner ECU 11 whether or not the judgment relating to cooling/heating is other than a judgment to carry out heating. If this judgment is affirmative, the routine moves on to step 160, and if this judgment is negative, the routine moves on to step 120. Note that the judgment as to whether or not the judgment relating to cooling/heating is other than a judgment to carry out heating, is concretely carried out by using threshold values having hysteresis and shown in Fig. 10. Namely, when the target blow-out temperature falls from a higher level and becomes less than or equal to A°C (e.g., 28°C), there is a judgment to carry out cooling, and when the target blow-out temperature rises from a lower level and becomes greater than or equal to B°C (e.g., 40°C), there is a judgment to carry out heating.

[0081] In step 160, the compressor 14 is controlled by the air conditioner ECU 11 so as to be turned on, and the routine moves on to step 150. Due thereto, even if much air conditioned air is blown-out in the vicinity of the face of the vehicle occupant, by turning the compressor 14 on, a rise in temperature is suppressed and foul smells can be suppressed.

[0082] On the other hand, in step 120, it is judged by the air conditioner ECU 11 whether or not there is a state in which the compressor 14 has been stopped for a predetermined time or more. For example, it may be judged whether or not a predetermined time or more has elapsed from the state of the ignition switch the previous time having changed from on to off, or it may be judged whether or not the time from the compressor 14 being turned off the previous time has reached the predetermined time or more during the time from the ignition switch being turned on to being turned off (i.e., during one trip). Then, if this judgment is negative, the routine moves on to step 130, and, if this judgment is affirmative, the routine

moves on to step 140. Note that the predetermined time is the time from stoppage of the compressor 14 until foul smells arise, and is a time that is determined by experimentation. Further, in other words, this is a time corresponding to the time until the condensed water on the surface of the evaporator 20 dries.

[0083] In step 130, the compressor 14 is controlled by the air conditioner ECU 11 so as to be operated intermittently in a predetermined cycle, and the routine moves on to step 140. Namely, the compressor 14 is operated intermittently such that there is the state of above-described processing 3. Due thereto, a rise in temperature can be suppressed in the course of the condensed water on the surface of the evaporator 20 drying, and therefore, foul smells arising can be suppressed. Note that the intermittent operation of the compressor 14 is carried out until for example the time, in which it is assumed that the condensed water that has adhered to the surface of the evaporator 20 will dry, elapses, and the routine moves on to step 140.

[0084] Further, in step 140, the compressor 14 is turned off by the air conditioner ECU 11, and the routine moves on to step 150. Namely, if the time from stoppage of the compressor 14 is less than a predetermined time, the compressor 14 is intermittently operated, and thereafter, is stopped. On the other hand, if the time from stoppage of the compressor 14 is the predetermined time or more, stoppage is maintained without carrying out intermittent operation of the compressor 14. Due thereto, if there is a state in which the condensed water on the surface of the evaporator 20 has already dried and foul smells will not arise, power that is wasted due to the compressor 14 being operated is suppressed. Accordingly, in the case of the compressor 14 that is driven mechanically, wasteful starting-up of the engine is suppressed, and deterioration in fuel economy can be prevented. In the case of the electric compressor 14, the electric power that is consumed by the compressor 14 can be reduced. Further, in a case of having an electric fan for cooling of the condenser 16, this also leads to a reduction in the electric power consumed by the electric fan. Moreover, because adhesion of condensed water to the evaporator 20 due to unnecessary operation of the compressor 14 can be prevented, foul smells arising can be suppressed.

[0085] In step 150, it is judged by the air conditioner ECU 11 whether or not the ignition switch (IG) has been turned off. If this judgment is negative, the routine returns to step 110, and the above-described processings are repeated. If this judgment is affirmative, the series of processings ends.

[0086] A fourth modified example of the processings that are carried out at the air

conditioner ECU 11 of the vehicle air conditioning device 10 relating to the embodiment of the present invention is described next. Fig. 11 is a flowchart showing an example of processings of the fourth modified example that are carried out by the air conditioner ECU 11 of the vehicle air conditioning device 10 relating to the embodiment of the present invention. Note that processings that are the same as those of the above-described embodiment are described by using the same reference numerals.

[0087] In the fourth modified example, the compressor 14 is turned on in a case in which any condition among the conditions of the first through third modified examples (external air temperature, windshield humidity, judgment relating to cooling/heating) is met during one trip that is from the ignition switch being turned on to the ignition switch being turned off.

[0088] Namely, in step 100, it is judged by the air conditioner ECU 11 whether or not the state of the ignition switch (IG) has changed from off to on. When the judgment becomes affirmative, the routine moves on to step 110. Namely, these processings start when the ignition switch is turned on.

[0089] In step 110, it is judged by the air conditioner ECU 11 whether or not automatic air conditioning has been instructed by the operation portion 19 and the predetermined condition for stopping the compressor 14 in order to save power (the power saving condition) is met. If this judgment is negative, the routine moves on to step 150, and if this judgment is affirmative, the routine moves on to step 118.

[0090] In step 118, it is judged by the air conditioner ECU 11 whether or not any of the above-described conditions of the first through third modified examples (the judgment relating to the external air temperature of step 112, the judgment relating to the windshield humidity of step 114, the judgment relating to cooling/heating of step 116) has been met. Namely, it is judged by the air conditioner ECU 11 whether or not the external air temperature is high, or whether or not the windshield humidity is high, or whether or not the judgment relating to cooling/heating is other than a judgment to carry out heating. If any of the conditions have been met and the judgment is affirmative in step 118, the routine moves on to step 160. If the judgment is negative in step 118, the routine moves on to step 120.

[0091] In step 160, the compressor 14 is controlled by the air conditioner ECU 11 so as to be turned on, and the routine moves on to step 170 where it is judged by the air conditioner ECU 11 whether or not the ignition switch (IG) has been turned off. Here, the routine stands-by until the judgment is affirmative, and the series of processings ends at the time when the judgment becomes affirmative. Due thereto, repeating of the stoppage control of

the compressor 14 of step 140 and the operation control of the compressor 14 of step 160 is prevented. Accordingly, dispersing of foul-smelling components that is due to the repetition of maintaining of and drying of the condensed water that has adhered to the evaporator 20 can be prevented, and fuel savings and an anti-fogging performance can both be achieved.

[0092] On the other hand, in step 120, it is judged by the air conditioner ECU 11 whether or not there is a state in which the compressor 14 has been stopped for a predetermined time or more. For example, it may be judged whether or not a predetermined time or more has elapsed from the state of the ignition switch the previous time having changed from on to off, or it may be judged whether or not the time from the compressor 14 being turned off the previous time has reached the predetermined time or more during the time from the ignition switch being turned on to being turned off (i.e., during one trip). Then, if this judgment is negative, the routine moves on to step 130, and, if this judgment is affirmative, the routine moves on to step 140. Note that the predetermined time is the time from stoppage of the compressor 14 until foul smells arise, and is a time that is determined by experimentation. Further, in other words, this is a time corresponding to the time until the condensed water on the surface of the evaporator 20 dries.

[0093] In step 130, the compressor 14 is controlled by the air conditioner ECU 11 so as to be operated intermittently in a predetermined cycle, and the routine moves on to step 140. Namely, the compressor 14 is operated intermittently such that there is the state of above-described processing 3. Due thereto, a rise in temperature can be suppressed in the course of the condensed water on the surface of the evaporator 20 drying, and therefore, foul smells arising can be suppressed. Note that the intermittent operation of the compressor 14 is carried out until for example the time, in which it is assumed that the condensed water that has adhered to the surface of the evaporator 20 will dry, elapses, and the routine moves on to step 140.

[0094] Further, in step 140, the compressor 14 is turned off by the air conditioner ECU 11, and the routine moves on to step 150. Namely, if the time from stoppage of the compressor 14 is less than a predetermined time, the compressor 14 is intermittently operated, and thereafter, is stopped. On the other hand, if the time from stoppage of the compressor 14 is the predetermined time or more, stoppage is maintained without carrying out intermittent operation of the compressor 14. Due thereto, if there is a state in which the condensed water on the surface of the evaporator 20 has already dried and foul smells will not arise, power that is wasted due to the compressor 14 being operated is suppressed. Accordingly, in the case of

the compressor 14 that is driven mechanically, wasteful starting-up of the engine is suppressed, and deterioration in fuel economy can be prevented. In the case of the electric compressor 14, the electric power that is consumed by the compressor 14 can be reduced. Further, in a case of having an electric fan for cooling of the condenser 16, this also leads to a reduction in the electric power consumed by the electric fan. Moreover, because adhesion of condensed water to the evaporator 20 due to unnecessary operation of the compressor 14 can be prevented, foul smells arising can be suppressed.

[0095] In step 150, it is judged by the air conditioner ECU 11 whether or not the ignition switch (IG) has been turned off. If this judgment is negative, the routine returns to step 110, and the above-described processings are repeated. If this judgment is affirmative, the series of processings ends.

[0096] Note that the above-described fourth modified example has a combination of all of the first through third modified examples. However, the fourth modified example may have a combination of any two of the modified examples, and not all of the first through third modified examples. Namely, in step 118, it may be judged whether or not at least two conditions among steps 112, 114, 116 are met. Further, the processing of step 170 after step 160 in the fourth modified example may be added to the first through third modified examples.

[0097] Further, the processings that are carried out by the air conditioner ECU 11 in the above-described embodiment and modified examples may be stored on a storage medium or the like and distributed, as a program.

The disclosure of Japanese Patent Application No. 2014-001790 filed January 8, 2014 is incorporated herein by reference in its entirety.

All publications patent applications, and technical standards mentioned in this specification are herein incorporated by reference to the same extent as if each individual publication, patent application, or technical standard was specifically and individually indicated to be incorporated by reference.

CLAIMS

Claim 1. A vehicle air conditioning device comprising:

a compressor that compresses and circulates a coolant to an evaporator; and

a control unit that, when a predetermined condition for stopping the compressor in order to save power is met, in a case in which elapsed time from a previous stoppage of the compressor is less than a predetermined time, controls the compressor so as to repeat stoppage and operation of the compressor in a predetermined cycle, and, in a case in which the elapsed time is greater than or equal to the predetermined time, controls the compressor so as to maintain stoppage of the compressor.

Claim 2. The vehicle air conditioning device of Claim 1, wherein, when a predetermined condition for stopping the compressor in order to save power is met, in a case in which external air temperature, that is detected by an external air temperature detecting unit for detecting external air temperature, is higher than a predetermined threshold temperature, the control unit further controls the compressor so as to operate the compressor regardless of the elapsed time.

Claim 3. The vehicle air conditioning device of Claim 1, wherein, when a predetermined condition for stopping the compressor in order to save power is met, in a case in which windshield humidity, that is detected by a windshield humidity detecting unit for detecting windshield humidity, is higher than a predetermined threshold humidity, the control unit further controls the compressor so as to operate the compressor regardless of the elapsed time.

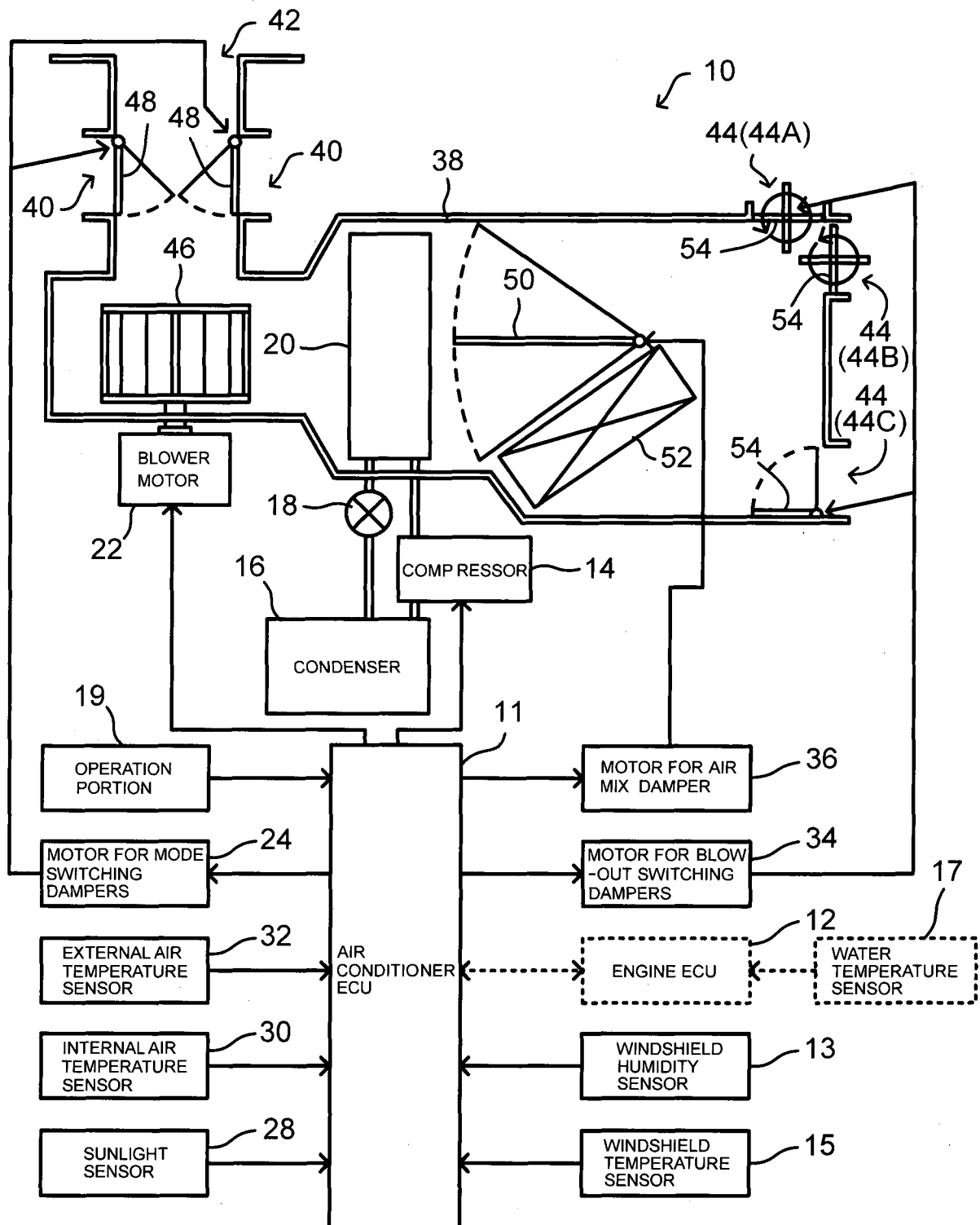
Claim 4. The vehicle air conditioning device of Claim 1, wherein, when a predetermined condition for stopping the compressor in order to save power is met, in a case in which a judgment relating to cooling/heating, that is based on a target blow-out temperature computed on the basis of a temperature setting, is other than a judgment to carry out heating, the control unit further controls the compressor so as to operate the compressor regardless of the elapsed time.

Claim 5. The vehicle air conditioning device of any one of Claims 1 through 4, wherein the predetermined time is a time corresponding to time until condensed water on a surface of the

evaporator dries.

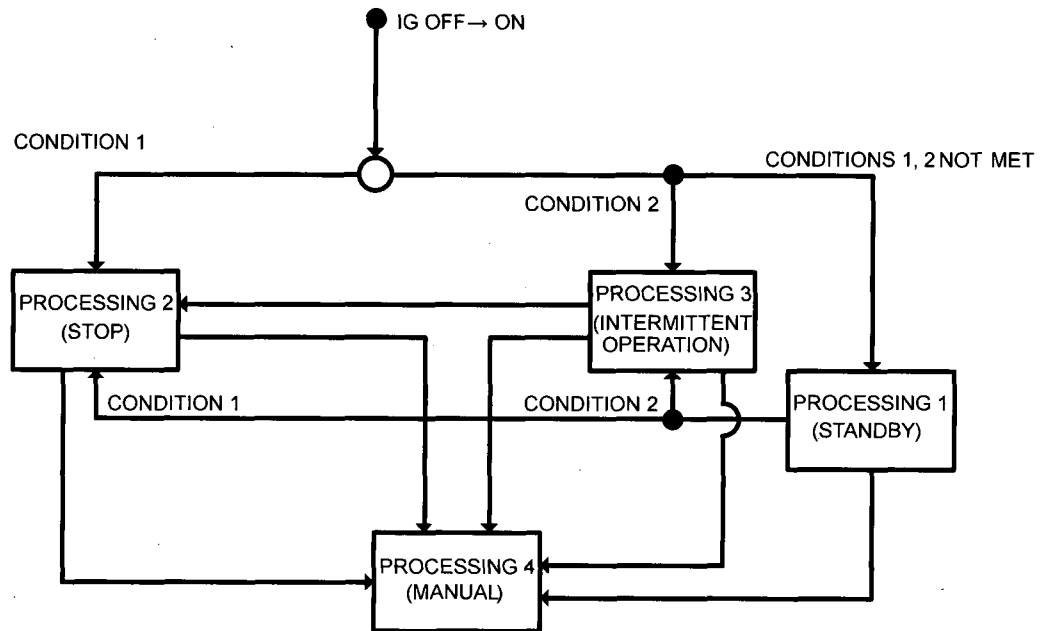
1 / 11

FIG.1



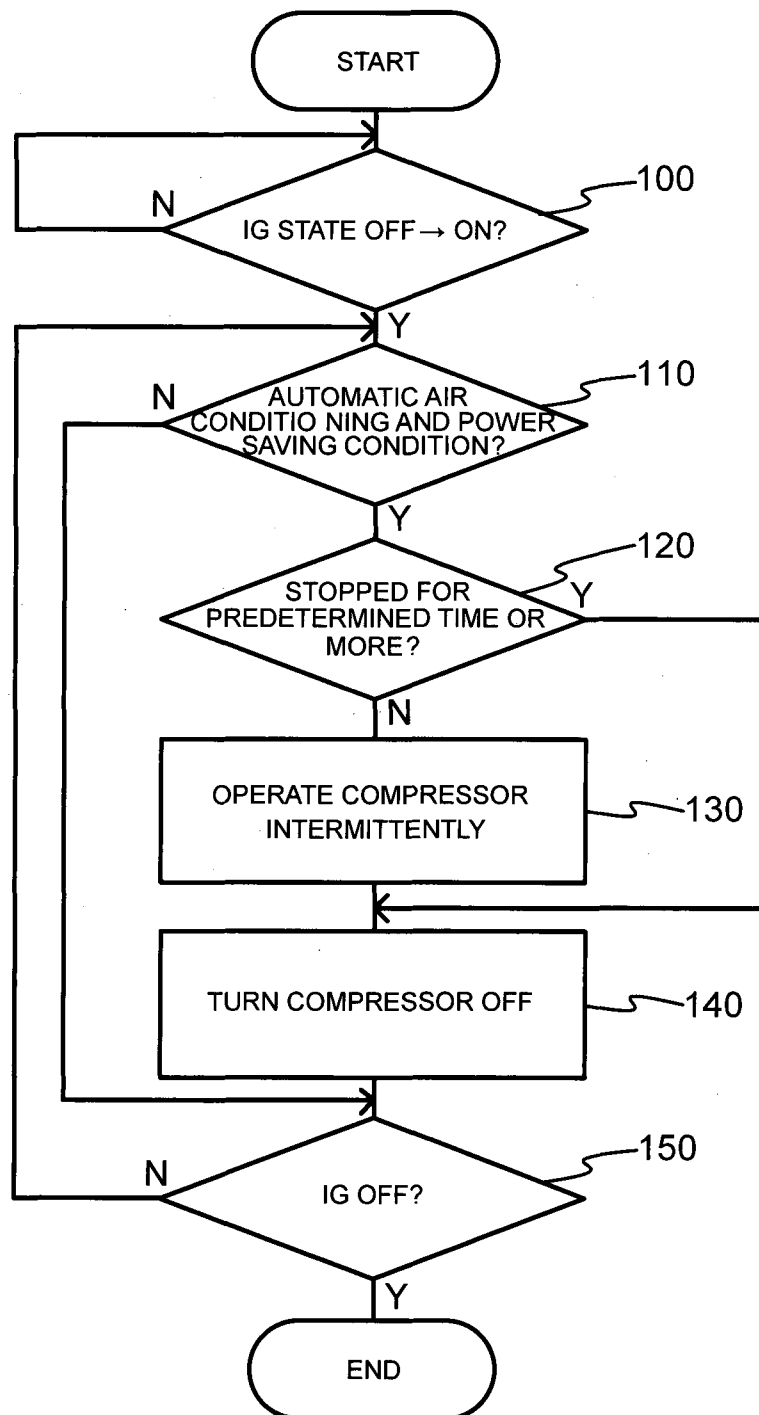
2 / 11

FIG.2



3 / 11

FIG.3



4 / 11

FIG.4

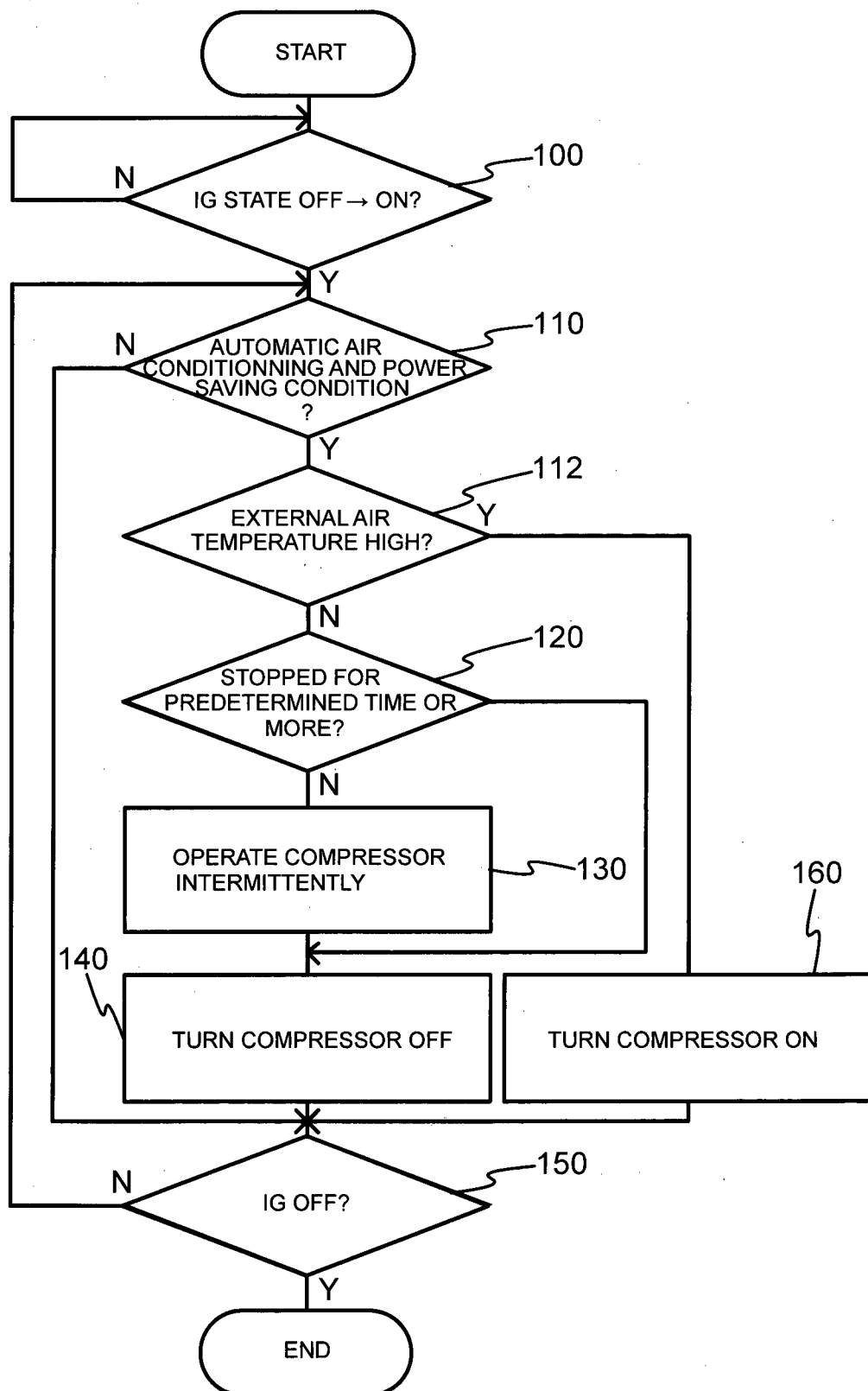
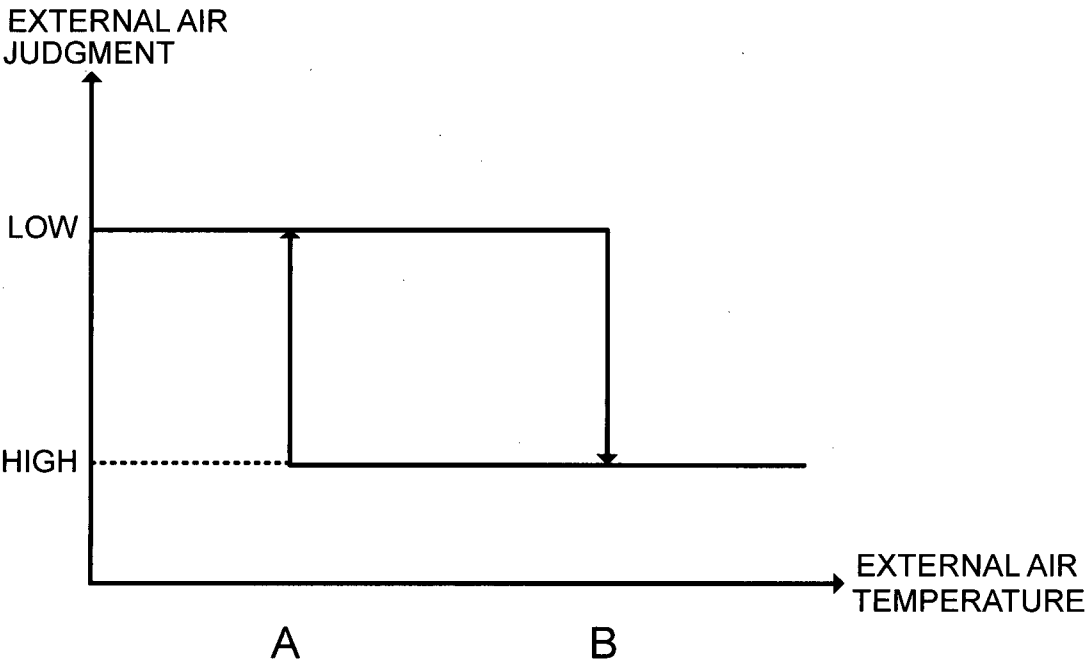
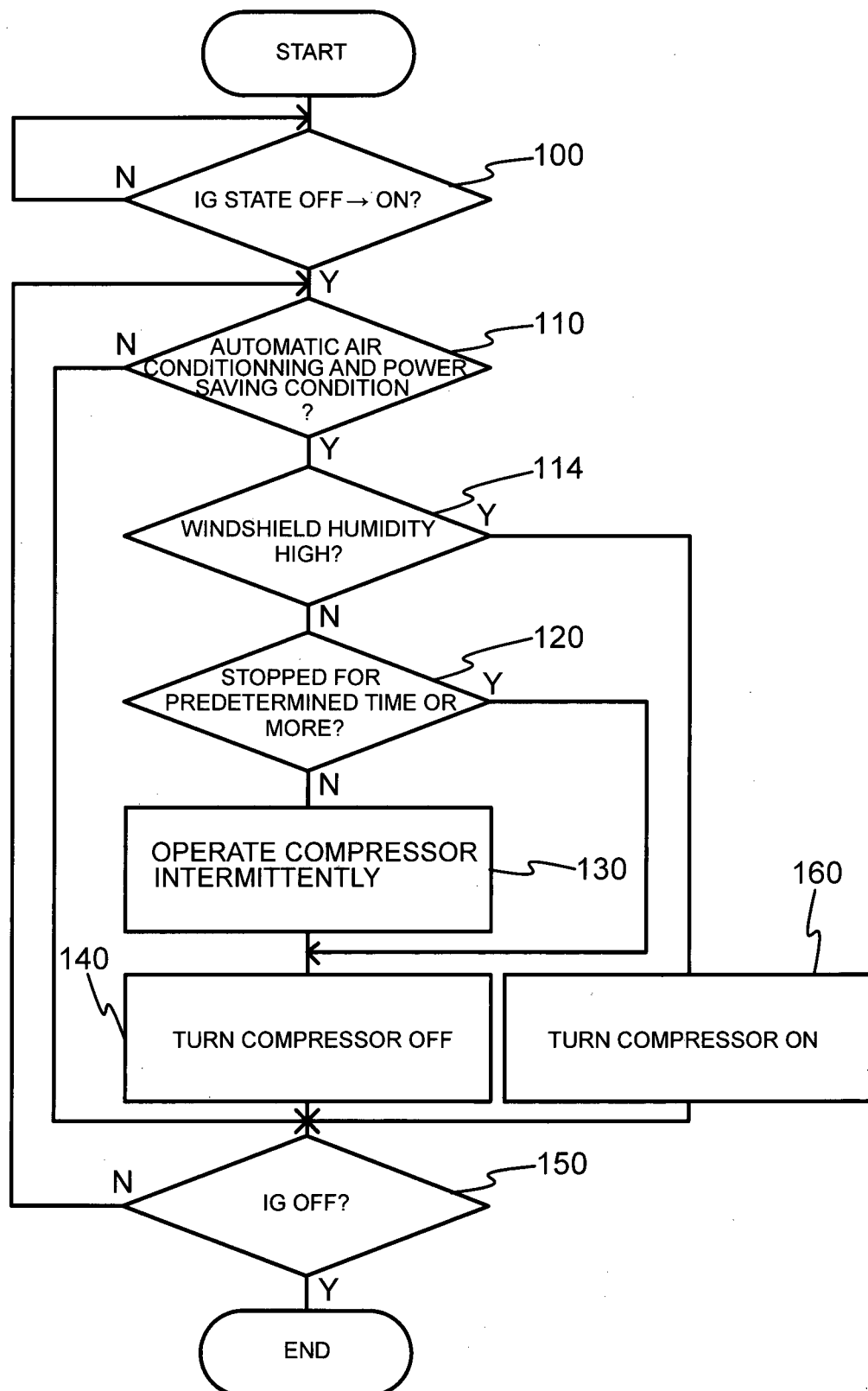


FIG.5



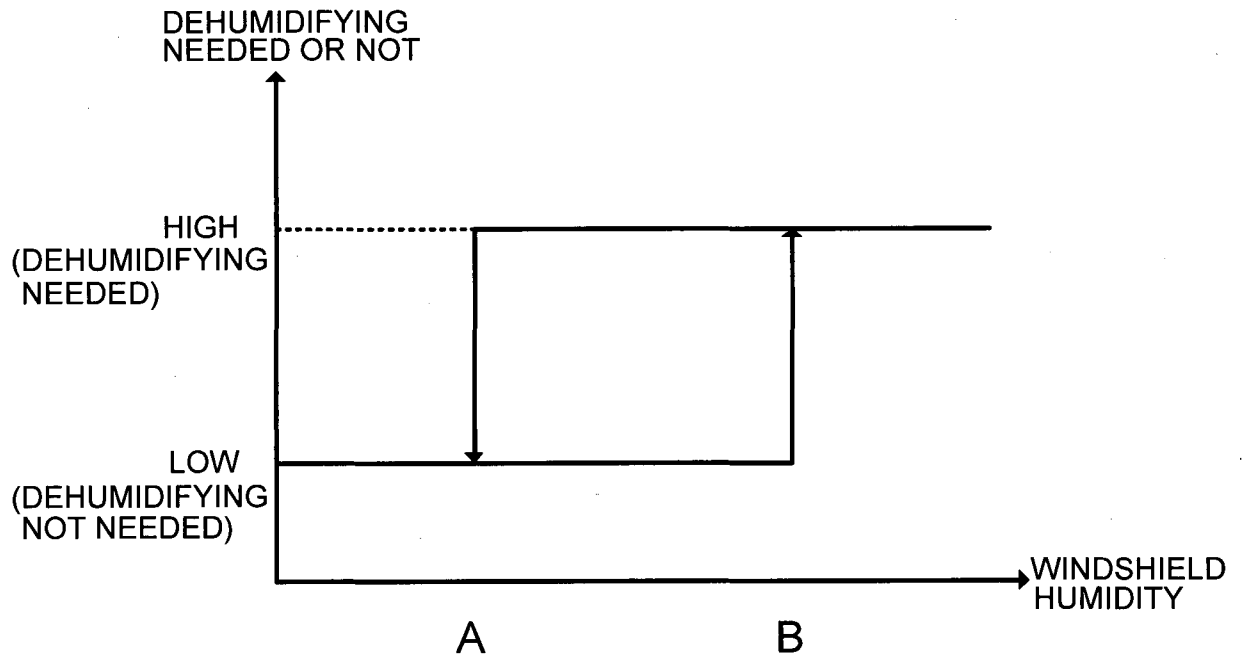
6 / 11

FIG.6



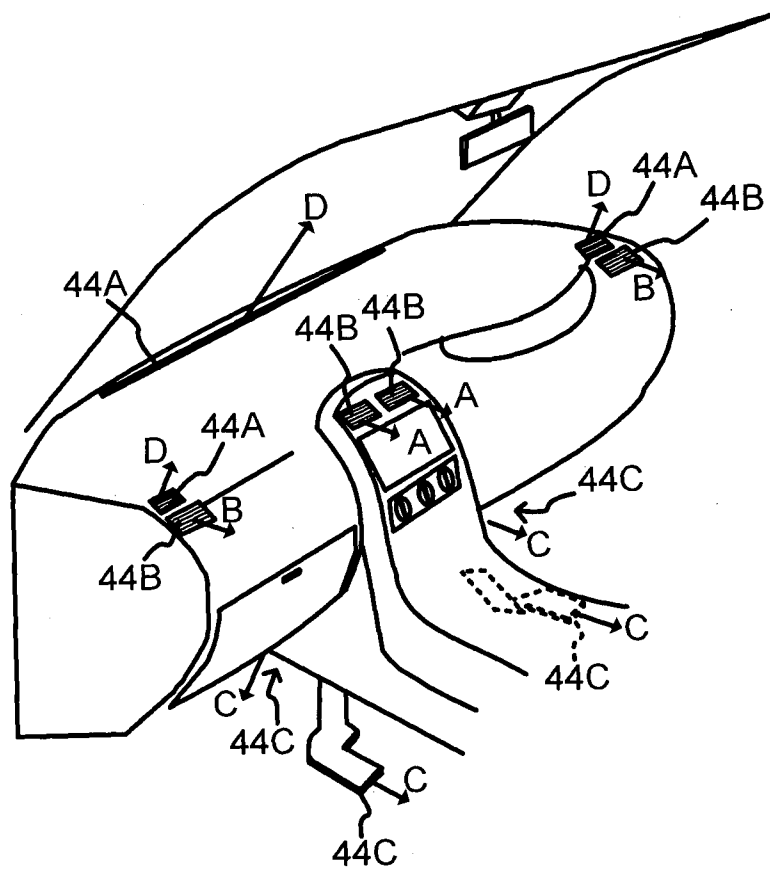
7 / 11

FIG.7



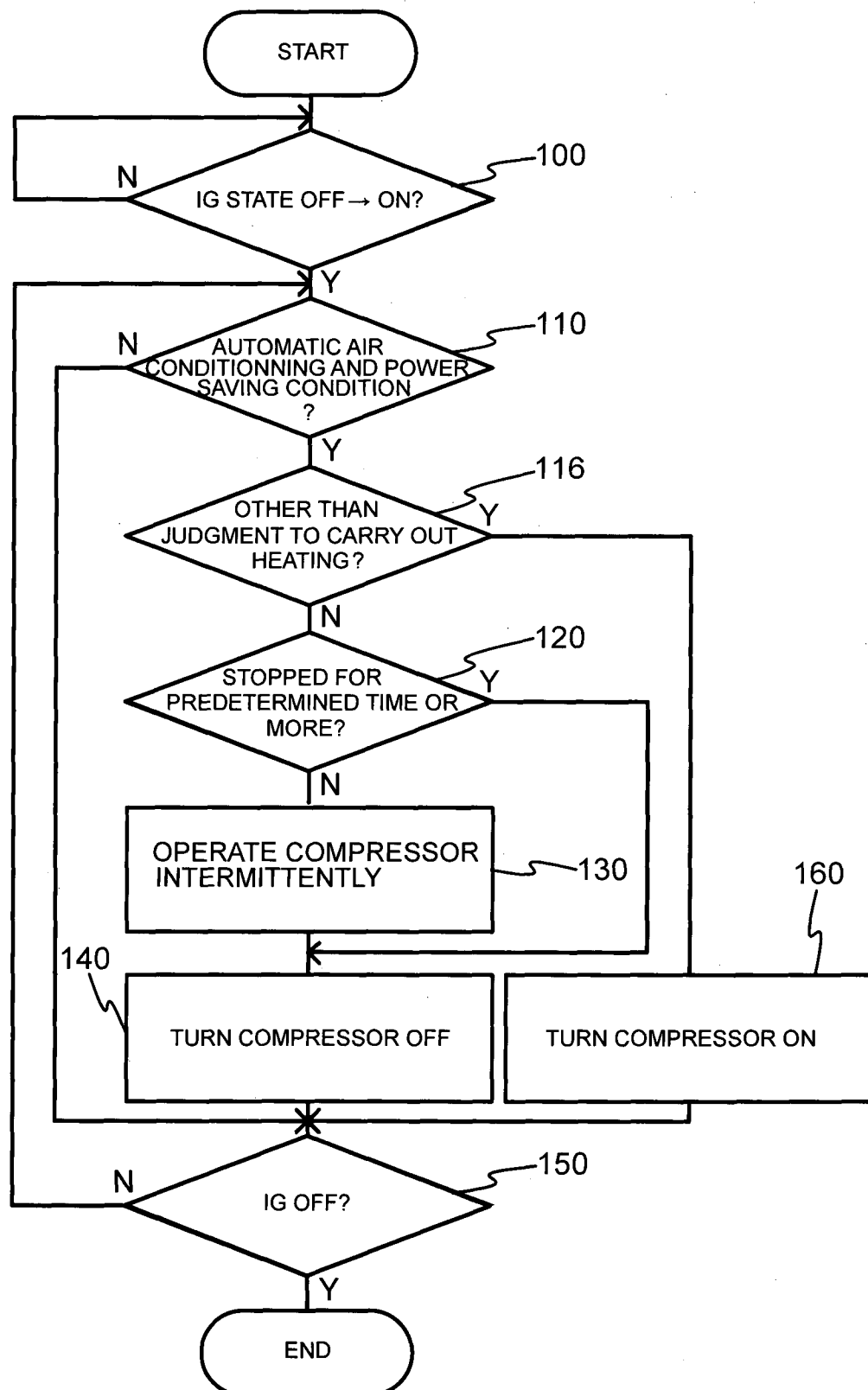
8 / 11

FIG.8



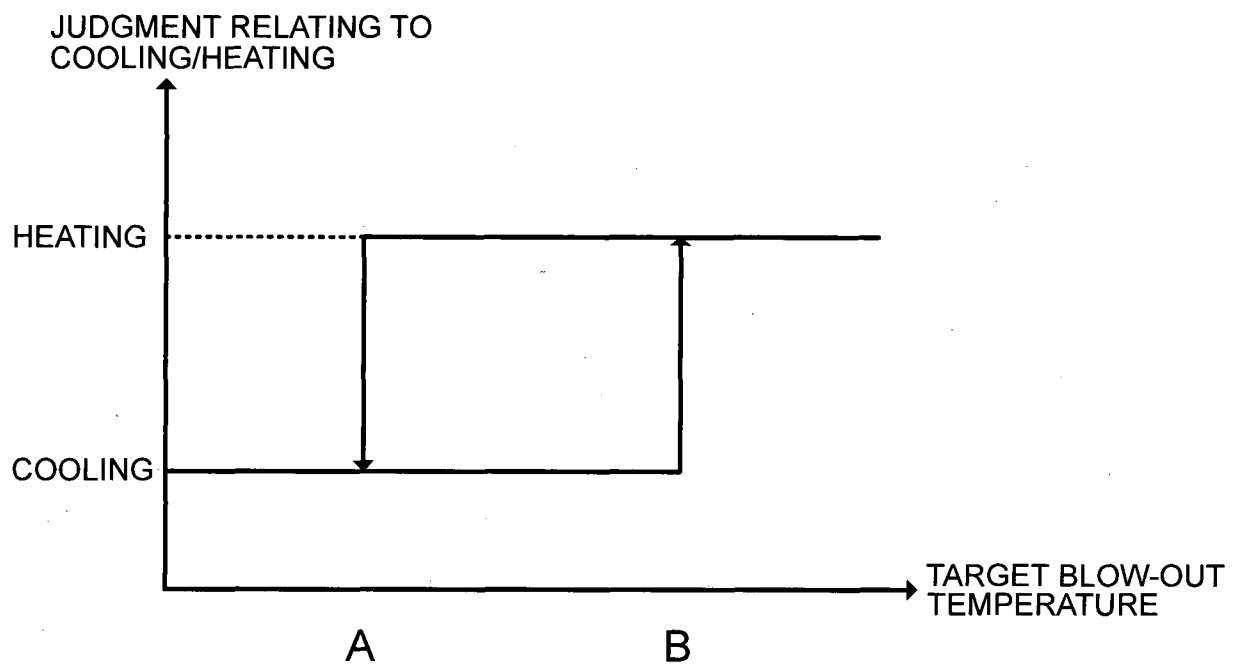
9 / 11

FIG.9



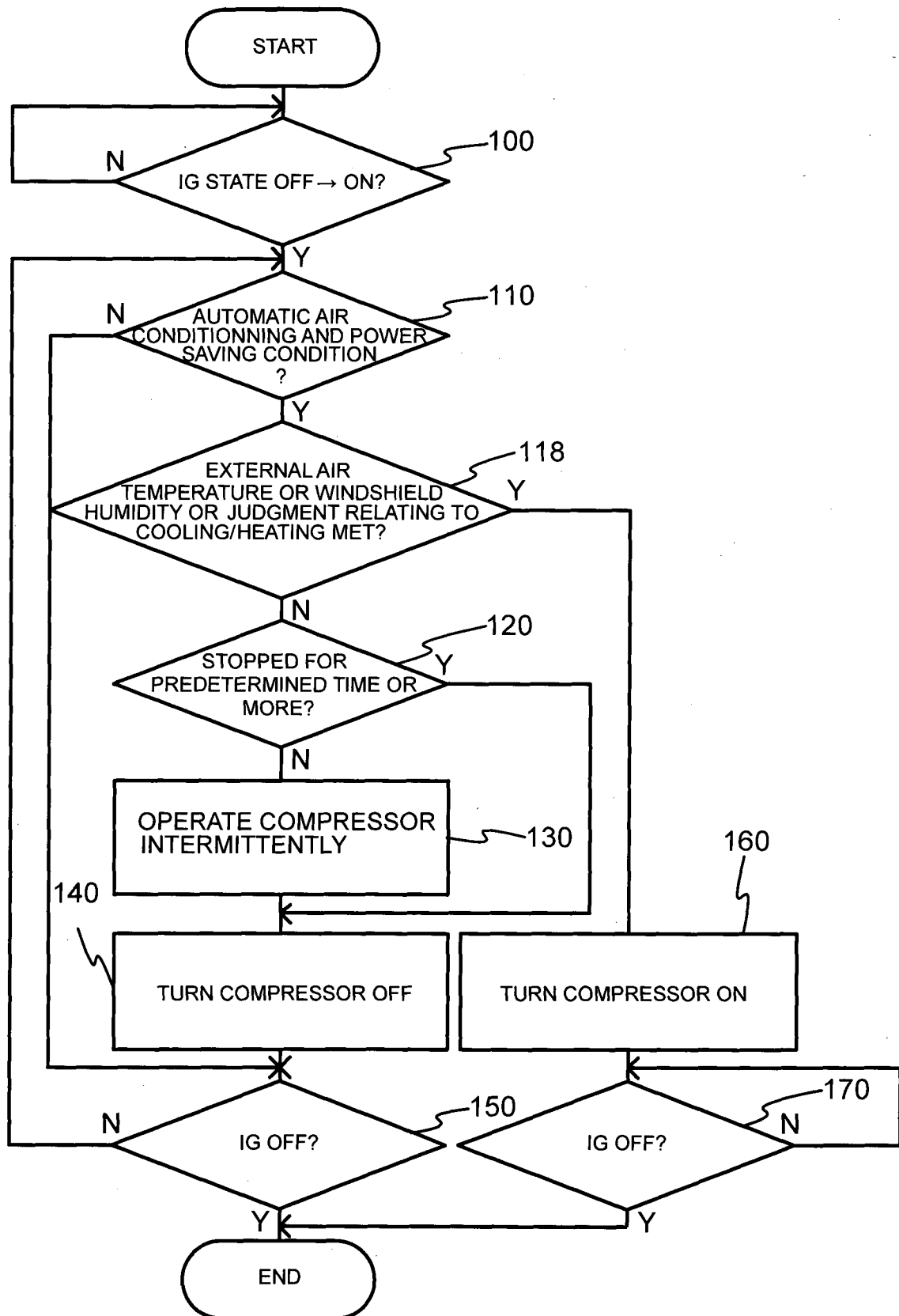
10 / 11

FIG.10



11 / 11

FIG.11



INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2014/083498

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60H1/00 B60H1/32 B60H3/00
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.
Y	EP 1 544 556 A1 (VALEO CLIMATISATION [FR]) 22 June 2005 (2005-06-22) paragraphs [0031] - [0039]; figures 2,3 -----	1-5
Y	US 2012/240607 A1 (MISUMI HARUKI [JP] ET AL) 27 September 2012 (2012-09-27) paragraphs [0076] - [0078]; figures 3-5 -----	1-5
A	US 2001/049943 A1 (NAKAMURA HIROKI [JP] ET AL) 13 December 2001 (2001-12-13) paragraphs [0220] - [0236]; figure 34 -----	1-5



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"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

19 March 2015

Date of mailing of the international search report

31/03/2015

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/JP2014/083498

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