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(54) Engine driven type air conditioner and method of controlling the same

Verbrennungsmotorgetriebene Klimaanlage und dazugehöriges Steuerungsverfahren

Climatiseur actionné par un moteur à combustion et méthode pour le commander

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an engine driving type air conditioner for variably controlling the rotational number of an engine and circulating refrigerant discharged from a compressor driven by the engine to thereby carry out an air conditioning operation and a method of controlling the engine driving type air conditioner, and also relates to an overload control operation of the engine.

2. Description of the Related Art

[0002] There has been hitherto known a so-called engine driving type air conditioner in which a compressor of an outdoor unit is driven by an engine using gas or the like as fuel to compress and circulate refrigerant.

[0003] In some of this type of engine driving type air conditioners, the engine rotational number is variably controlled in accordance with an air conditioning load, the discharge pressure of the refrigerant at the exit of the compressor, the suction pressure of the refrigerant at the entrance of the compressor and the temperature at the refrigerant inlet/outlet port of a heat exchanger are measured, the shaft output of the compressor is calculated from the measurement result and then it is judged on the basis of the shaft output whether the engine is under overload state or not (for example, JP-A-6-137701).

[0004] When the engine load is estimated from the shaft output of the compressor as described above, it is required to consider the volumetric efficiency and power efficiency of the compressor. However, the volumetric efficiency and power efficiency of the compressor are not fixed, and some difference which is not negligible occurs in accordance with the rotational velocity of the compressor or refrigerant pressure. Therefore, there has been a problem that it is difficult to estimate the engine load with high precision.

[0005] EP 1 334 852 A2 discloses an engine driving type air conditioner according to the preamble of claim 1.

[0006] US 5,454,229 A describes a refrigeration unit in which a control unit receives inputs from sensors including an engine RPM-sensor.

SUMMARY OF THE INVENTION

[0007] Therefore, the present invention has been implemented in view of the foregoing situation, and has an object to provide an engine driving type air conditioner and a control method therefore in which it is accurately judged whether an engine is under overload state or not, and the overload state of the engine can be properly avoided on the basis of the judgment result.

[0008] In order to attain the above object, according to a first aspect of the present invention, an engine driving type air conditioner that is equipped with a compressor driven by an engine, an outdoor unit having an outdoor heat exchanger, an outdoor expansion valve and an outdoor fan and an indoor unit having an indoor heat exchanger, an indoor expansion valve and an indoor fan, and variably controls the rotational number of an engine in accordance with an air conditioning load and circulating

refrigerant discharged from the compressor between the outdoor heat exchanger and the indoor heat exchanger to thereby carry out an air conditioning operation, comprises: a judging unit for achieving information on at least one of the rotational number of the engine, the opening degree of a fuel adjusting valve and the opening degree of a throttle, and judging on the basis of the information thus achieved whether the engine to be controlled in accordance with an air conditioning load is under overload state or not; and a control unit for carrying out engine load reducing control of reducing the load of the engine if it is judged by the judging unit that the engine is under overload state.

[0009] According to a second aspect of the present invention, the above engine driving type air conditioner further comprises a storage unit for mapping at least one of the rotational number of the engine, the opening degree of the fuel adjusting valve and the opening degree of the throttle and at least one of the torque value of the engine, an ignition demand voltage and an excess air factor in association with each other and storing a mapping result, wherein the judging unit refers to the information stored in the storage unit to specify at least one of the torque value of the engine, the ignition demand voltage and the excessive air factor on the basis of the information thus achieved, compares the specified value with a predetermined setting value and judges on the basis of the comparison result whether the engine is under overload state.

[0010] According to a third aspect of the present invention, the above engine driving type air conditioner further comprises a storage unit for storing a calculation equation of calculating at least one of the torque value of the engine, an ignition demand voltage and an excess air factor from at least one of the rotational number of the engine, the opening degree of the fuel adjusting valve and the opening degree of the throttle, wherein the judging unit specifies at least one of the torque value of the engine, the ignition demand voltage and the excessive air factor on the basis of the information thus achieved by using the calculation equation stored in the storage unit, compares the specified value with a predetermined setting value and judges on the basis of the comparison result whether the engine is under overload state.

[0011] According to a fourth aspect of the present invention, the above engine driving type air conditioner further comprises a bypass pipe connected between a refrigerant high pressure side and a refrigerant lowpressure side with respect to the compressor to return apart of the refrigerant at the refrigerant high pressure side of the compressor to the refrigerant low pressure side of the compressor, and a bypass valve disposed in the bypass pipe to adjust the refrigerant amount to be returned, wherein when it is judged that the engine is under overload state, the control unit carries out at least one of adjustment of the expansion valve corresponding to one heat exchanger functioning as an evaporator out of the outdoor heat exchanger and the indoor heat exchanger, adjustment of the rotational velocity of the fan corresponding to the other heat exchanger functioning as a condenser out of the outdoor heat exchanger and the indoor heat exchanger, adjustment of the rotational number of the engine and adjustment of the opening degree of the bypass valve in the bypass pipe provided between the refrigerant high pressure side and the refrigerant low pressure side.

[0012] According to a fifth aspect of the present invention, in the above engine driving type air conditioner, wherein in accordance with the air conditioning load, the control unit changes at least one of the lower limit value of the opening degree of the expansion valve corresponding to the heat exchanger functioning as the evaporator when the opening degree concerned is adjusted, the upper limit value of the rotational velocity of the fan corresponding to the heat exchanger functioning as the condenser when the rotational velocity concerned is adjusted, the lower limit value of the rotational number of the engine when the rotational number of the engine is adjusted, and the upper limit value of the opening degree of the bypass valve when the opening degree concerned is adjusted.

[0013] According to a sixth aspect of the present invention, a method of controlling an engine driving type air conditioner that is equipped with a compressor driven by an engine, an outdoor unit having an outdoor heat exchanger, an outdoor expansion valve and an outdoor fan and an indoor unit having an indoor heat exchanger, an indoor expansion valve and an indoor fan, and variably controls the rotational number of an engine in accordance with an air conditioning load and circulating refrigerant discharged from the compressor between the outdoor heat exchanger and the indoor heat exchanger to thereby carry out an air conditioning operation, comprising the steps of: achieving information on at least one of the rotational number of the engine, the opening degree of a fuel adjusting valve and the opening degree of a throttle; judging on the basis of the information thus achieved whether the engine to be controlled in accordance with an air conditioning load is under overload state or not; and carrying out engine load reducing control of reducing the load of the engine if it is judged that the engine is under overload state.

[0014] According to a seventh aspect of the present invention, the above method further comprises the steps of: mapping at least one of the rotational number of the engine, the opening degree of the fuel adjusting valve and the opening degree of the throttle and at least one of the torque value of the engine, an ignition demand voltage and an excess air factor in association with each other; creating a data base from the mapping result; referring to the data base to specify at least one of the torque value of the engine, the ignition demand voltage and the excessive air factor from the information on at least one of the rotational number of the engine, the opening degree of the fuel adjusting valve and the opening degree of the throttle; comparing the specified value with a predetermined setting value; and judging on the basis of the comparison result whether the engine is under overload state.

[0015] According to an eighth aspect of the present invention, the above method further comprises the steps of: creating a calculation equation of calculating at least one of the torque value of the engine, an ignition demand voltage and an excess air factor from at least one of the rotational number of the engine, the opening degree of the fuel adjusting valve and the opening degree of the throttle; specifying at least one of the torque value of the engine, the ignition demand voltage and the excessive air factor on the basis of the information on at least one of the rotational number of the engine, the opening degree of the fuel adjusting valve and the opening degree of the throttle by using the calculation equation; comparing the specified value with a predetermined setting value; and judging on the basis of the comparison result whether the engine is under overload state.

[0016] According to a ninth aspect of the present invention, in the above method wherein the air conditioner further comprises a bypass pipe connected between a refrigerant high pressure side and a refrigerant low pressure side with respect to the compressor to return apart of the refrigerant at the refrigerant high pressure side of the compressor to the refrigerant low pressure side of the compressor, and a bypass valve disposed in the bypass pipe to adjust the refrigerant amount to be returned, and when it is judged that the engine is under overload state, at least one of adjustment of the expansion valve corresponding to one heat exchanger functioning as an evaporator out of the outdoor heat exchanger and the indoor heat exchanger, adjustment of the rotational velocity of the fan corresponding to the other heat exchanger functioning as a condenser out of the outdoor heat exchanger and the indoor heat exchanger, adjustment of the rotational number of the engine and adjustment of the opening degree of the bypass valve in the bypass pipe provided between the refrigerant high pressure side and the refrigerant low pressure side.

[0017] According to a tenth aspect of the present invention, the above method further comprises a step of, in accordance with the air conditioning load, changing at least one of the lower limit value of the opening degree of the expansion valve corresponding to the heat exchanger functioning as the evaporator when the opening degree concerned is adjusted, the upper limit value of the rotational velocity of the fan corresponding to the heat exchanger functioning as the condenser when the rotational velocity concerned is adjusted, the lower limit value of the rotational number of the engine when the rotational number of the engine is adjusted, and the upper limit value of the opening degree of the bypass valve when the opening degree concerned is adjusted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

Fig. 1 is a diagram showing the construction of an engine driving type air conditioner according to an embodiment;
Fig. 2 is block diagram showing the construction of a control device;
Fig. 3 is a diagram showing a data base; and
Fig. 4 is a flowchart showing engine load reducing processing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Preferred embodiments according to the present invention will be described hereunder with reference to the accompanying drawings.

[0020] Fig. 1 is a diagram showing the construction of an engine driving type air conditioner 100 according to an embodiment.

[0021] The engine driving type air conditioner 100 comprises one outdoor unit 1 and a plurality of (for example, two) indoor units 2a, 2b which are connected to each other through a refrigerant pipe (inter-unit pipe) 3 comprising a gas pipe 3a and a liquid pipe 3b. The engine driving type air conditioner 100 is further equipped with a control device 4 for controlling the driving of the air conditioner 100 and an operating unit 5 for carrying out operations such as driving instruction, etc. of the control device 4.

[0022] The operating unit 5 is a so-called remote controller for operating/stopping the indoor units 2a, 2b, etc., a remote operating device for carrying out various kinds of settings and the driving state of the indoor units 2a, 2b and the outdoor unit 1 or the like. In this embodiment, the engine driving type air conditioner 100 is designed so as to circulate alternative refrigerant R410 which is high in refrigerant performance per unit volume and small in pressure loss.

[0023] The outdoor unit 1 is disposed outdoors. The outdoor unit 1 is equipped with an engine 10 for generating driving force by combusting fuel gas or the like, a compressor 11 which is connected to the engine 10 through a driving force transmitting unit (not shown) and compressing and discharging the alternative refrigerant R410a, a four-way valve 12 for inverting the circulation direction of the refrigerant, an outdoor heat exchanger 13 for carrying out the heat exchange between the refrigerant and the outside air, an outdoor expansion valve 14 for reducing the pressure of the refrigerant, and an accumulator 15 for carrying out gas-liquid separation on the refrigerant sucked in the compressor 11, these elements being connected to one another through the refrigerant pipe. An outdoor fan 16 for blowing air to the outdoor heat exchanger 13 id disposed in proximity to the outdoor heat exchanger 13.

[0024] The outdoor unit 1 is equipped with a bypass pipe 17 which is connected between a refrigerant high-pressure side (the discharge side of the compressor 11) and a refrigerant low-pressure side (the entrance side of the accumulator 15 in Fig. 1), and a bypass valve (electrically-operated valve) 18 provided in the bypass pipe. By adjusting the opening degree of the bypass valve 18, the return amount of a part of the refrigerant which is discharged from the compressor 11 and returned through the bypass pipe 17 to the suction side of the compressor 11 is adjusted, whereby the circulation amount of the refrigerant circulated through the outdoor unit 1 and the indoor units 2a, 2b is adjusted.

[0025] Furthermore, the outdoor unit 1 is further equipped with a liquid-refrigerant pipe 40 for suitably supplying liquid-refrigerant flowing through the pipe 19 (corresponding to the liquid pipe 3b at the outdoor unit 1 side) to the entrance of the accumulator 15 provided at the suction side of the compressor 11, and also a liquid valve (electrically-operated valve) 41 provided in the liquid pipe 40. The liquid valve 41 is normally closed. However, when the temperature of the refrigerant discharged from the compressor 11 exceeds a predetermined temperature (this temperature is varied in accordance with the kind of the refrigerant, and for example it is set to about 115°C or the like), the liquid valve 41 is opened, and the liquid refrigerant whose temperature is low is supplied from the pipe 19 at the outdoor unit 1 side through the liquid-refrigerant pipe 40 to the entrance side of the accumulator 15. Accordingly, the temperature of the gas refrigerant sucked into the compressor 11 is reduced, and thus overheat of the refrigerant discharged from the compressor 11 can be prevented.

[0026] The indoor unit 2a, 2b is equipped with an indoor heat exchanger 20a, 20b for carrying out the heat exchange between the refrigerant and indoor air in a room in which the indoor unit 2a, 2b is secured, and an indoor expansion valve 21a, 21b for controlling the refrigerant amount of the refrigerant flowing into the indoor unit 2a, 2b, the indoor heat exchangers 20a, 20b and the indoor expansion valves 21a, 21b being connected to one another through the refrigerant pipe. Furthermore, an indoor fan 22a, 22b for blowing air to the indoor heat exchanger 20a, 20 is disposed in proximity to the indoor heat exchanger 20a, 20b.

[0027] Furthermore, air-fuel mixture is supplied from an engine fuel supply device 31 into the combustion chamber of the engine 10 for driving the compressor 11. The engine fuel supply device 31 includes fuel cutoff valves 33, a zero governor 34, a fuel adjusting valve 35 and a throttle valve 36 which are successively disposed in a fuel supply pipe 32 in this order, and the throttle valve

36 is connected to the combustion chamber of the engine 10. The fuel cutoff valves 33 constitute a close type fuel cutoff valve mechanism, and one of the cutoff of the fuel gas with no leakage and the intercommunication of the fuel gas is selectively performed by fully closing or opening the fuel cutoff valves 33.

[0028] Fig. 2 is a block diagram showing the construction of a control device 4. The control device 4 is equipped with a setting unit 47 for setting a driving instruction, etc. to the engine 10 and the compressor 11, EEPROM (storage unit) 42 for storing various kinds of setting data of the engine driving type air conditioner 100, control programs, control data and a data base 50 (see Fig. 3), etc., CPU 43 for controlling the whole of the engine driving type air conditioner 100 on the basis of the control programs, etc. stored in EEPROM 42, RAM 44 for temporarily storing various kinds of data, a transceiver 45 for making communications with the operating unit 5, and an interface (I/F) 46 for transmitting/receiving signals to/from the respective units of the engine driving type air conditioner 100.

[0029] The control device 4 is further connected through the I/F 46 to a rotational number detector (not shown) for detecting the rotational number of the engine 10, and temperature sensors (an indoor temperature sensor for measuring the indoor temperature (not shown), temperature sensors for measuring the refrigerant temperature at the inlet/outlet ports of each of the heat exchangers 13, 20a, 20b (not shown), and temperature sensors 23a, 23b for measuring the air blow-out temperature of the indoor fans 22a, 22b of the indoor units 2a, 2b (not shown)), and it is designed so as to achieve the information on the rotational number of the engine and the temperature at each place.

[0030] When the operating unit 5 is manipulated, the control device 4 controls each of the engine 10, the four-way valve 12, the outdoor expansion valve 14 and the outdoor fan 16 of the outdoor unit 1 and the indoor expansion valves 21a, 21b and the indoor fans 22a, 22b of the indoor units 2a, 2b.

[0031] Specifically, the control device 4 switches the four-way valve 12 to set the air conditioner 1 to cooling operation or heating operation. That is, when the four-way valve 12 is switched to the cooling side, the refrigerant flows as indicated by a broken-line arrow, the outdoor heat exchanger 13 functions as a condenser and the indoor heat exchangers 20a, 20b function as evaporators, so that the operation state of the air conditioner is set to a cooling operation state and each of the indoor heat exchangers 20a, 20b cools a room. When the control device 4 switches the four-way valve 12 to the heating side, the refrigerant flows as indicated by a solid-line arrow, the indoor heat exchangers 20a, 20b function as condensers and the outdoor heat exchanger 13 functions as an evaporator, so that the operation state of the air conditioner is set to a heating operation state and each of the indoor heat exchangers heats a room.

[0032] Furthermore, the control device 4 controls the opening degrees of the fuel adjusting valve 35 and throttle valve 36 (the fuel adjusting valve opening degree, the throttle opening degree) on the basis of the difference between the set temperature set by the operating unit 5 and the indoor temperature achieved from the indoor temperature sensor, etc. to variably control the rotational number of the engine 10, and also it controls the opening degrees of the outdoor expansion valve 14 and indoor expansion valves 21a, 21b on the basis of the refrigerant temperature difference between the refrigerant inlet/outlet ports of the heat exchangers 13, 20a, 20b.

[0033] Under the air conditioning operation, the control device 4 judges whether the engine 10 controlled in accordance with the air conditioning load is under overload state or not. If it is judged that the engine 10 is under overload state, the control device 4 carried out the processing of reducing the engine load (the engine load reducing processing) . In this embodiment, the control device 4 achieves information indicating the present control state of the engine 10 (control information) such as the rotational number of the engine 10, the fuel adjusting valve opening degree and the throttle opening degree, refers to a data base 50 on the basis of these information and judges whether the engine 10 is under overload state or not. Fig. 3 shows an example of a data base 50.

[0034] The data base 50 describes the engine number of the engine, the fuel adjusting valve opening degree, the throttle opening degree, the torque value of the engine, the engine heat efficiency, the IG (ignition) demand voltage, the fuel gas flow amount and λ (excess air factor) in association with one another. The engine rotational number, the fuel adjusting valve opening degree and the throttle opening degree are measurable information under control of the engine 10, and the torque value, the IG demand voltage and λ are information needed to judge whether the engine 10 is under overload state or not. That is, if the torque value is excessively large, the durability of the engine is lowered. If the IG demand voltage is high, the coil lifetime is lowered. Furthermore, if λ is reduced, knocking occurs and the engine may be damaged. That is, these information is information for specifying a situation that the engine load is high (load specifying information). Furthermore, the engine heat efficiency is information for judging whether the engine is driven at a rotational speed which provides an excellent engine heat efficiency under power saving operation. Furthermore, the fuel gas flow amount is information suitably used under gas demand control or under power saving operation.

[0035] For example, the data base 50 is achieved as follows. That is, torques of 1, 3, 5, 7, 9, 11 and 13 (Kg·m) are respectively applied as a load to the engine 10, and the fuel adjusting valve opening degree and the throttle opening degree are adjusted so that the engine 10 is rotated at 1000 (rpm) under each torque. Furthermore, various parameters such as the fuel adjusting valve opening degree, the throttle opening degree, the fuel gas flow amount, the torque value, the engine heat efficiency, the IG demand voltage, the fuel gas flow amount and λ under the above state are achieved by measurements or the like. Furthermore, with respect to the engine rotational number of 1200 (rpm), 1400 (rpm), .., 2000 (rpm), the fuel adjusting valve opening degree, the throttle opening degree, the fuel gas flow amount, the engine heat efficiency, the IG demand voltage, the fuel gas flow amount and λ under each torque are likewise achieved by measurements or the like. The measurement data thus achieved are mapped to create the data base 50. The data base 50 thus achieved is stored in EEPROM 42 of the control device 42. The creation of the data base 50 is not limited to the actual measurement, and it may be created by simulation or the like. For example, various parameters as described above are determined by simulation while the driving condition of the engine 10 is variously varied, and the data base 50 is created on the basis of these parameters.

[0036] Fig. 4 is a flowchart showing the engine load reducing processing.

[0037] First, the control device 4 achieves the information on the present engine rotational number, fuel adjusting valve opening degree and throttle opening degree, refers to the data base 50 stored in EEPROM 42 and achieves the information on the present torque value, IG demand voltage and λ on the basis of the engine rotational number, the fuel adjusting valve opening degree and the throttle opening degree from the data base 50 (step S1). In this case, when the torque value, the IG demand voltage and λ cannot be directly specified from the data base 50, they may be achieved by carrying out an interpolative calculation from a driving condition having parameters near to the present engine rotational number, fuel adjusting valve opening and throttle opening degree.

[0038] Subsequently, the control device 4 judges on the basis of the torque value, IG demand voltage and λ thus achieved whether the engine 10 is under overload state or not (step S2). Specifically, the control device 4 judges whether the torque value is higher than a predetermined torque upper limit value, whether the IG demand voltage is higher than a predetermined voltage upper limit value and whether λ is smaller than a predetermined λ lower limit value. If at least one of these conditions is satisfied, it is judged that the engine 10 is under overload state. If there is no condition satisfied, it is judged that the engine 10 is not under overload state.

[0039] If it is judged that the engine 10 is under overload state (step S2: YES), the control device 4 carries out the engine load reducing processing of reducing the load of the engine 10.

[0040] The engine load reducing processing will be describedbelow in detail.

[0041] First, the control device 4 judges whether the opening degree of the expansion value at the evaporator side (the indoor expansion valves 21a, 21b under cooling operation, the outdoor expansion valve 14 under heating operation) is coincident with a predetermined lower limit value L1 (step S3). If the opening degree is not coincident with the lower limit value L1 (if the opening degree is larger than the lower limit value L1), the control device 4 reduces the opening degree of the expansion valve by a predetermined amount (step S4). Here, the lower limit value L1 of the expansion valve is set to such a value that the air conditioning performance is not remarkably degraded, and by reducing the expansion valve opening degree so that the air conditioning performance is not remarkably degraded, the circulation amount of the refrigerant can be reduced, and thus the engine load can be reduced.

[0042] The control device 4 shifts to the processing of step S1 after the expansion valve opening degree is reduced or if it is judged that the engine 10 is not under overload state, so that it is continuously judged whether the engine 10 is under overload state or not. Therefore, the control device 4 gradually reduces the expansion valve opening degree at the evaporator side and thus gradually reduces the engine load every time it is judged that the engine 10 is under overload state. Nevertheless, if it is still judged that the engine 10 is under overload state and the opening degree of the expansion valve at the evaporator side is reduced till the lower limit value L1 (step S3: lower limit value L1), the control device 4 shifts to the processing of step S5.

[0043] In the processing of step S5, the control device 4 judges whether the rotational velocity of the fan at the condenser side (the outdoor fan 16 under cooling operation, the indoor fans 22a, 22b under heating operation) is coincident with a predetermined upper limit value U2. If the rotational velocity of the fan is not coincident with the predetermined upper limit value U2 (if the rotational velocity is smaller than the upper limit value U2), the control device 4 increases the rotational velocity of the fan by a predetermined amount (step S6). Here, the upper limit value U2 is set to the permissible upper limit rotational velocity of the fan or the upper limit rotational velocity within the permissible range of noise caused by the fan. By increasing the rotational velocity of the fan as described above, the condensing pressure can be increased, and the load of the engine 10 can be reduced.

[0044] After the rotational velocity of the fan is increased, the control device 4 shifts to the processing of the step S1 to gradually increase the rotational velocity of the fan every time it is judged again that the engine 10 is under overload state. Nevertheless, if it is judged that the engine 10 is still under overload state and the rotational velocity of the fan reaches the upper limit value U2 (step S5: upper limit value U2), the control device 4 shifts to the processing of step S7.

[0045] In the processing of step S7, the control device 4 judges whether the rotational number of the engine is coincident with the lower limit value L3, and if it is not coincident with the lower limit value L3 (if it is larger than a lower limit value L3), the control device reduces the rotational number of the engine by a predetermined amount (stepS8). Here, the lower limit value L3 is set to such an engine rotational number that the air conditioning performance is not remarkably degraded. By reducing the engine rotational number as described above, the compression ratio of the compressor 11 is lowered and thus the engine load can be reduced.

[0046] After the rotational number of the engine 10 is lowered, the control device 4 shifts to the processing of step S1 to gradually reduce the rotational number of the engine every time it is judged again that the engine 10 is under overload state. Nevertheless, if it is judged that the engine 10 is under overload state and the rotational number of the engine reaches the lower limit value L3 (step S7: lower limit value L3), the control device 4 shifts to the processing of step S9.

[0047] In the processing of step S9, the control device 4 judges whether the opening degree of the bypass valve 18 is coincident with a predetermined upper limit value L4. If it is not coincident with the upper limit value L4 (if it is smaller than the upper limit value L4), the opening degree of the bypass valve 18 is increased by a predetermined amount (step S10). Here, the upper limit value L4 is set to such an opening degree of the bypass valve that the air conditioning performance is not remarkably degraded. By opening the bypass valve 18 as described above, the compression ratio of the compressor 11 is lowered, and the engine load can be reduced.

[0048] After the bypass valve 18 is opened, the control device 4 shifts to the processing of step S1 to gradually increase the opening degree of the bypass valve 18 every time it is judged again that the engine 10 is under overload state. Nevertheless, if it is judged that the engine 10 is still under overload state, the opening degree of the bypass valve 18 is finally increased up to the upper limit value L4.

[0049] As described above, when the engine falls into the overload state, the adjustment of the expansion valve opening degree at the evaporator side, the adjustment of the speed of the fan at the condenser, the adjustment of the rotational number of the engine and the adjustment of the bypass valve opening degree are successively carried out, so that the engine 10 can be returned from the overload state to the normal load state in some step. However, if it is judged that the engine 10 is still under overload even when all the steps have been carried out, it may be considered that some abnormality such as an error or the like occurs in the engine rotational number, the fuel adjusting valve opening degree and the throttle opening degree achieved. Therefore, the control device 4 preferably carries out the processing of outputting a predetermined alarm or the like.

[0050] The upper limit value L1, the upper limit value L2, the lower limit value L3 and the upper limit value L4 are set to the opening degree of the expansion valve at the evaporator side, the rotational velocity of the fan at the condenser side, the engine rotational number and the bypass opening degree at which the air conditioning performance is not remarkably degraded. If these values are set to fixed values, for example, if the lower limit value L1 is set in conformity with a case where the air conditioning load is large, there may occur such a case that the engine load can be reduced without remarkably degrading the air conditioning performance even when the expansion valve opening degree is set to a value lower than the lower limit value L1 in the case of a small air conditioning load. Therefore, the adjustment amount of the engine load is limited.

[0051] Therefore, according to this embodiment, the control device 4 controls to change at least one of the lower limit value L1, the upper limit value L2, the lower limit value L3 and the upper limit value L4 in accordance with the present air conditioning load. Specifically, the control device 4 achieves the information on the blow-out air temperature of the indoor units 2a, 2b from the temperature sensors 23a, 23b, and changes the values L1 to L4 in accordance with the blow-out air temperature. For example, the control device 4 identifies which one of the following temperature ranges the blow-out air temperature belongs to under cooling operation: a first temperature range of 8°C or less, a second temperature range from 8°C to 12°C, a third temperature range from 12°C to 16°C and a fourth range of 16°C or more, and changes the respective values L1 to L4 in accordance with the identified temperature range. Accordingly, each of the opening degree of the expansion value at the evaporator, the rotational velocity of the fan at the condenser, the engine rotational number and the bypass valve opening degree can be varied over a broad range. That is, the adjustment amount of the engine load can be sufficiently secured, and the engine 10 can be more surely avoided from the overload state.

[0052] As described above, according to the engine driving type air conditioner 100 of this embodiment, on the basis of the engine rotational number, the fuel adjusting valve opening degree and the throttle opening degree, it is judged whether the engine 10 is under overload state, whereby the engine load can be judged on the basis of the present control state of the engine 10. Accordingly, as compared with the case where it is indirectly judged from the shaft output of the compressor whether the engine is under overload state or not, it can be judged with high precision whether the engine 10 is under overload state or not.

[0053] Furthermore, when the engine 10 is under overload state, the engine load is reduced in the following order: reducing the opening degree of the expansion valve at the evaporator side till the lower limit value L1, increasing the speed of the fan at the condenser side up to the upper limit value L2, reducing the engine rotational number till the lower limit value L3 and increasing the opening degree of the bypass valve 18 up to the upper limit value L4, whereby the engine load can be reduced while preferentially controlling the opening degree of the expansion valve at the evaporator side which is generally carried out when the engine load is reduced, and also the engine 10 can be surely avoided from the overload state.

[0054] Still furthermore, the respective values L1 to L4 are varied I n accordance with the air conditioning load on a real-time basis, and the adjustment amount of the engine load can be broadly secured, so that the engine 10 can be more surely avoided from the overload state.

[0055] The present invention is not limited to the above embodiment. For example, the respective setting values and the construction of the pipes are not limited to the above embodiment, and various modifications may be suitably made without departing from the subject matter of the present invention.

[0056] For example, in the above embodiment, all the information on the engine rotational number, the fuel adjusting valve opening degree and the throttle opening degree are achieved, and then it is judged on the basis of these information whether the engine 10 is under overload state. However, it may be modified so that any one or two of these information is achieved, and then it is judged on the basis of the information whether the engine 10 is under overload state. In this case, it is also judged from the actual state (control state) of the engine 10 whether the engine 10 is under overload state, and thus the overload state of the engine 10 can be judged with higher precision as compared with the case where the overload state of the engine is indirectly judged on the basis of the shaft output of the compressor.

[0057] Furthermore, in the above embodiment, the engine rotational number, the fuel adjusting valve opening degree, the throttle opening degree, the torque value of the engine 10, the engine heat efficiency, the IG demand voltage, the fuel gas flow amount and λ are mapped to create the data base, and the data base thus created is stored in the storage unit. However, the engine heat efficiency and the fuel gas flow amount maybe omitted. Furthermore, experiment data achieved by measuring the engine rotational number, the fuel adjusting valve opening degree, the throttle opening degree, the torque value, the IG demand voltage and λ in advance are learned by using a neural network serving as an information processing mechanism constructed by imitating the structure of human's brain to create a calculation equation of calculating at least one of the torque value, the IG demand voltage and λ from at least one of the engine rotational number, the fuel adjusting valve opening degree and the throttle opening degree, and the calculation equation thus created is stored in a storage unit. According to this modification, the use amount of EEPROM 42 can be suppressed.

[0058] Furthermore, in the above embodiment, when the engine 10 is under overload state, the adjustment of the expansion valve opening degree at the evaporator side, the adjustment of the speed of the fan at the condenser side, the adjustment of the engine rotational number and the adjustment of the bypass valve opening degree are successively carried out. However, all the engine load reducing control steps as described above are not necessarily carried out, and anyone or plural of the above control steps may be carried out.

Claims

1. An engine driving type air conditioner (100) that is equipped with a compressor (11) driven by an engine (10), an outdoor unit (1) having an outdoor heat exchanger (13), an outdoor expansion valve (14) and an outdoor fan (16) and an indoor unit (2a, 2b) having an indoor heat exchanger (20a, 20b), an indoor expansion valve (21a, 21b) and an indoor fan (22a, 22b), and variably controls a rotational number of the engine in accordance with an air conditioning load and circulating refrigerant discharged from the compressor between the outdoor heat exchanger and the indoor heat exchanger to thereby carry out an air conditioning operation, **characterized by** comprising:

    a storage unit (42) configured to store a torque value of the engine, the rotational number of the engine, an opening degree of a fuel adjusting valve, an opening degree of a throttle, an ignition demand voltage and an excess air factor in association with one another;
    a control device (4) comprising a judging unit configured to measure the rotational number of the engine, the opening degree of the fuel adjusting valve and the opening degree of the throttle under the air conditioning operation, to achieve information on the torque value of the engine, the ignition demand voltage and the excess air factor on the basis of the information that is stored in the storage unit and that is measured under the air conditioning operation and to judge on the basis of the achieved information whether the engine is under overload state or not; and
    a control unit configured to carry out engine load reducing control of reducing the load of the engine if it is judged by the judging unit that the engine is under overload state.

2. The engine driving type air conditioner (100) according to claim 1, wherein the storage unit (42) is configured to store the torque value of the engine, the rotational number of the engine, the opening degree of the fuel adjusting valve, the opening degree of the throttle, the ignition demand voltage and the excess air factor achieved by a measurement while a predetermined torque is applied as a load to the engine, and the fuel adjusting valve opening degree and the throttle opening degree are adjusted so that the engine is rotated at a predetermined rotational number.

3. The engine driving type air conditioner (100) according to claim 2, wherein:

    the storage unit (42) is configured to map the torque value of the engine, the rotational number of the engine, the opening degree of the fuel adjusting valve, the opening degree of the throttle, the ignition demand voltage and the excess air factor achieved by multiple measurements by varying the torque applied to the engine and the rotational number of the engine, and to store a mapping result; and

the judging unit refers to the information stored in the storage unit to specify the torque value of the engine, the ignition demand voltage and the excessive air factor on the basis of the rotational number of the engine, the opening degree of the fuel adjusting valve, the opening degree of the throttle measured under the air conditioning operation, compares the specified value with a predetermined setting value and judges on the basis of the comparison result whether the engine (10) is under overload state.

4. The engine driving type air conditioner (100) according to any one of claims 1 to 3, wherein:

the storage unit (42) is configured to store a calculation equation of calculating the torque value of the engine, the ignition demand voltage and the excess air factor on a basis of the rotational number of the engine, the opening degree of the fuel adjusting valve and the opening degree of the throttle measured under the air conditioning operation; and

the judging unit specifies the torque value of the engine, the ignition demand voltage and the excessive air factor on the basis of the information thus achieved by using the calculation equation stored in the storage unit, compares the specified value with a predetermined setting value and judges on the basis of the comparison result whether the engine (10) is under overload state.

5. The engine driving type air conditioner according to claim 1, further comprising a bypass pipe (17) connected between a refrigerant high pressure side and a refrigerant low pressure side with respect to the compressor (11) to return a part of the refrigerant at the refrigerant high pressure side of the compressor (11) to the refrigerant low pressure side of the compressor, and a bypass valve (18) disposed in the bypass pipe to adjust the refrigerant amount to be returned.

6. The engine driving type air conditioner according to claim 5, wherein when it is judged that the engine is under overload state, the control unit carries out at least one of adjustment of the expansion valve (14) corresponding to one heat exchanger functioning as an evaporator out of the outdoor heat exchanger and the indoor heat exchanger, adjustment of the rotational velocity of the fan corresponding to the other heat exchanger functioning as a condenser out of the outdoor heat exchanger and the indoor heat exchanger, adjustment of the rotational number of the engine (10) and adjustment of the opening degree of the bypass valve in the bypass pipe provided between the refrigerant high pressure side and the refrigerant low pressure side.

7. The engine driving type air conditioner according to claim 5, wherein in accordance with the air conditioning load, the control unit changes at least one of the lower limit value of the opening degree of the expansion valve corresponding to the heat exchanger functioning as the evaporator when the opening degree concerned is adjusted, the upper limit value of the rotational velocity of the fan corresponding to the heat exchanger functioning as the condenser when the rotational velocity concerned is adjusted, the lower limit value of the rotational number of the engine (10) when the rotational number of the engine is adjusted, and the upper limit value of the opening degree of the bypass valve when the opening degree concerned is adjusted.

8. A method of controlling an engine driving type air conditioner (100) that is equipped with a compressor (11) driven by an engine (10), an outdoor unit (1) having an outdoor heat exchanger (13), an outdoor expansion valve (14) and an outdoor fan (16) and an indoor unit (2a, 2b) having an indoor heat exchanger (20a, 20b), an indoor expansion valve (21a, 21b) and an indoor fan (22a, 22b), and variably controls a rotational number of an engine in accordance with an air conditioning load and circulating refrigerant discharged from the compressor between the outdoor heat exchanger and the indoor heat exchanger to thereby carry out an air conditioning operation, **characterized by** comprising the steps of:

storing a torque value of the engine, the rotational number of the engine, an opening degree of a fuel adjusting valve, an opening degree of a throttle, an ignition demand voltage and an excess air factor in association with one another;

measuring the rotational number of the engine, the opening degree of the fuel adjusting valve and the opening degree of the throttle under the air conditioning operation, to achieve information on the torque value of the engine, the ignition demand voltage and the excess air factor on the basis of the information that is stored in the storage unit and that is measured under the air conditioning operation and to judge on the basis of the achieved information whether the engine is under overload state or not; and

carrying out engine load reducing control of reducing the load of the engine if it is judged by the judging unit that the engine is under overload state.

9. The method according to claim 8, wherein the storage step is configured to store the torque value of the engine, the rotational number of the engine, the opening degree of the fuel adjusting valve, the opening degree of the throttle, the ignition demand voltage and the excess air factor achieved by a measurement while a predetermined torque is applied as a load to the engine, and the fuel adjusting valve opening degree and the throttle opening degree are adjusted so that the engine is rotated at a predetermined rotational number.

10. The method according to claim 9, wherein:

the storage step is configured to map the torque value of the engine, the rotational number of the engine, the opening degree of the fuel adjusting valve, the opening degree of the throttle, the ignition demand voltage and the excess air factor achieved by multiple measurements by varying the torque applied to the engine and the rotational number of the engine, and to store a mapping result; and
the judging step refers to the information stored in the storage unit to specify the torque value of the engine, the ignition demand voltage and the excessive air factor on the basis of the rotational number of the engine, the opening degree of the fuel adjusting valve, the opening degree of the throttle measured under the air conditioning operation, compares the specified value with a predetermined setting value and judges on the basis of the comparison result whether the engine (10) is under overload state.

11. The method according to any one of claims 8 to 10, wherein:

the storage step is configured to store a calculation equation of calculating the torque value of the engine, the ignition demand voltage and the excess air factor on a basis of the rotational number of the engine, the opening degree of the fuel adjusting valve and the opening degree of the throttle measured under the air conditioning operation; and
the judging step specifies the torque value of the engine, the ignition demand voltage and the excessive air factor on the basis of the information thus achieved by using the calculation equation stored in the storage unit, compares the specified value with a predetermined setting value and judges on the basis of the comparison result whether the engine (10) is under overload state.

12. The method according to claim 8, wherein the air conditioner further comprises a bypass pipe connected between a refrigerant high pressure side and a refrigerant low pressure side with respect to the compressor to return a part of the refrigerant at the refrigerant high pressure side of the compressor to the refrigerant low pressure side of the compressor, and a bypass valve disposed in the bypass pipe to adjust the refrigerant amount to be returned, and when it is judged that the engine is under overload state, at least one of adjustment of the expansion valve corresponding to one heat exchanger functioning as an evaporator out of the outdoor heat exchanger and the indoor heat exchanger, adjustment of the rotational velocity of the fan corresponding to the other heat exchanger functioning as a condenser out of the outdoor heat exchanger and the indoor heat exchanger, adjustment of the rotational number of the engine and adjustment of the opening degree of the bypass valve in the bypass pipe provided between the refrigerant high pressure side and the refrigerant low pressure side.

13. The method according to claim 12, further comprising a step of, in accordance with the air conditioning load, changing at least one of the lower limit value of the opening degree of the expansion valve corresponding to the heat exchanger functioning as the evaporator when the opening degree concerned is adjusted, the upper limit value of the rotational velocity of the fan corresponding to the heat exchanger functioning as the condenser when the rotational velocity concerned is adjusted, the lower limit value of the rotational number of the engine when the rotational number of the engine is adjusted, and the upper limit value of the opening degree of the bypass valve when the opening degree concerned is adjusted.

Patentansprüche

1. Motorbetriebene Klimaanlage (100), die mit einem Kompressor (11), der von einem Motor (10) betrieben wird, einer Außeneinheit (1) mit einem Außen-Wärmetauscher (13), einem Außen-Expansionsventil (14) und einem Außengebläse (16) und einer Inneneinheit (2a, 2b) mit einem Innen-Wärmetauscher (20a, 20b), einem Innen-Expansionsventil (21a, 21b) und einem Innengebläse (22a, 22b) versehen ist und variabel eine Drehzahl des Motors in Übereinstimmung mit einer Klimatisierungslast steuert und Kühlmittel, das von dem Kompressor abgegeben wird, zwischen dem Außen-Wärmetauscher und dem Innen-Wärmetauscher zirkuliert, um dadurch einen Klimatisierungsvorgang durchzuführen, **gekennzeichnet durch**:

eine Speichereinheit (42), die ausgebildet ist,

um einen Drehmomentwert des Motors, die Drehzahl des Motors, einen Öffnungsgrad eines Brennstoff-Einstellventils, einen Öffnungsgrad einer Drossel, eine Zündungs-Anforderungsspannung und einen Luft-Überschussfaktor in Zuordnung zueinander zu speichern,
eine Steuervorrichtung (4) mit einer Beurteilungseinheit, die ausgebildet ist, um die Drehzahl des Motors, den Öffnungsgrad des Brennstoff-Einstellventils und den Öffnungsgrad der Drossel bei dem Klimatisierungsvorgang zu messen,
Informationen hinsichtlich des Drehmomentwerts der Maschine, der Zündungs-Anforderungsspannung und des Luft-Überschussfaktors auf Grundlage der Informationen, die in der Speichereinheit gespeichert sind und die bei dem Klimatisierungsvorgang gemessen werden, zu erhalten und auf Grundlage der erhaltenen Informationen zu beurteilen, ob der Motor in einem Überlastzustand ist oder nicht, und
eine Steuereinheit, die ausgebildet ist, um eine Motor-Lastreduktionssteuerung zur Verminderung der Last des Motors durchzuführen, falls **durch** die Beurteilungseinheit festgestellt wird, dass der Motor in einem Überlastzustand ist.

2. Motorbetriebene Klimaanlage (100) nach Anspruch 1, wobei die Speichereinheit (42) ausgebildet ist, um den Drehmomentwert des Motors, die Drehzahl des Motors, den Öffnungsgrad des Brennstoff-Einstellventils, den Öffnungsgrad der Drossel, die Zündungs-Anforderungsspannung und den Luft-Überschussfaktor zu speichern, die durch eine Messung erhalten werden, während ein vorgegebenes Drehmoment als eine Last an den Motor angelegt wird, wobei der Öffnungsgrad des Brennstoff-Einstellventils und der Drossel-Öffnungsgrad so eingestellt werden, dass der Motor mit einer vorgegebenen Drehzahl dreht.

3. Motorbetriebene Klimaanlage (100) nach Anspruch 2, wobei:

die Speichereinheit (42) ausgebildet ist, um den Drehmomentwert des Motors, die Drehzahl des Motors, den Öffnungsgrad des Brennstoff-Einstellventils, den Öffnungsgrad der Drossel, die Zündungs-Anforderungsspannung und den Luft-Überschussfaktor, die durch mehrere Messungen durch Variation des an den Motor angelegten Drehmoments und der Drehzahl des Motors gemessen wurden, zu kartieren und das Kartierungsergebnis zu speichern, und
die Beurteilungseinheit sich auf die Informationen, die in der Speichereinheit gespeichert sind, bezieht, um den Drehmomentwert des Motors, die Zündungs-Anforderungsspannung und den Luft-Überschussfaktor auf Grundlage der Drehzahl des Motors, des Öffnungsgrads des Brennstoff-Einstellventil, des Öffnungsgrads der Drossel, die bei dem Klimatisierungsvorgang gemessen wurden, zu spezifizieren, den spezifizierten Wert mit einem vorgegebenen Einstellwert zu vergleichen und auf Grundlage des Vergleichsergebnisses zu beurteilen, ob der Motor (10) in einem Überlastzustand ist.

4. Motorbetriebene Klimaanlage (100) nach einem der Ansprüche 1 bis 3, wobei die Speichereinheit (42) ausgebildet ist, um eine Berechnungsgleichung zur Berechnung des Drehmomentwert des Motors, der Zündungs-Anforderungsspannung und des Luft-Überschussfaktors auf Grundlage der Drehzahl des Motors, des Öffnungsgrads des Brennstoff-Einstellventils und des Öffnungsgrads der Drossel, die bei dem Klimatisierungsvorgang gemessen wurden, zu speichern und
die Beurteilungseinheit den Drehmomentwert des Motors, die Zündungs-Anforderungsspannung und den Luft-Überschussfaktor auf Grundlage der Informationen, die so erhalten wurden, durch Verwendung der Berechnungsgleichung, die in der Speichereinheit gespeichert ist, zu spezifizieren, den spezifizierten Wert mit einem vorgegebenen Einstellwert zu vergleichen und auf Grundlage des Vergleichsergebnisses zu beurteilen, ob der Motor (10) in einem Überlastzustand ist.

5. Motorbetriebene Klimaanlage nach Anspruch 1 mit ferner einer Umgehungsleitung (70), die zwischen einer Kühlmittel-Hochdruckseite und einer Kühlmittel-Niederdruckseite bezüglich des Kompressors (11) angeordnet ist, um einen Teil des Kühlmittels an der Kühlmittel-Hochdruckseite des Kompressors (11) zu der Kühlmittel-Niederdruckseite des Kompressors zurückzuführen, und einem Umgehungsventil (18), das in der Umgehungsleitung angeordnet ist, um den zurückzuführenden Anteil des Kühlmittels einzustellen.

6. Motorbetriebene Klimaanlage nach Anspruch 5, wobei, wenn beurteilt wird, dass der Motor in einem Überlastzustand ist, die Steuereinheit mindestens eines der Einstellung des Expansionsventils (14) entsprechend einer Wärmetauscherfunktion als einer von dem Außen-Wärmetauscher und dem Innen-Wärmetauscher, eine Einstellung der Drehgeschwindigkeit des Gebläses entsprechend dem anderen Wärmetauscher von dem Außen-Wärmetauscher und dem Innen-Wärmetauscher, der als Kondensor funktioniert, eine Einstellung der Drehzahl des Motors (10) und eine Einstellung des Öffnungsgrads des Umgehungsventils in der Umgehungsleitung, die zwischen der Kühlmittel-Hochdruckseite und der Kühlmittel-Niederdruckseite vorgesehen ist, durchführt.

7. Motorbetriebene Klimaanlage nach Anspruch 5, wobei in Übereinstimmung mit der Klimatisierungslast die Steuereinheit mindestens eines aus dem unteren Grenzwert des Öffnungsgrades des Expansionsventils entsprechend dem Wärmetauscher, der als Verdampfer funktioniert, wenn der betreffende Öffnungsgrad, eingestellt wird, dem oberen Grenzwert der Drehgeschwindigkeit des Gebläses entsprechend dem Wärmetauscher, der als der Kondensor dient, wenn die Drehgeschwindigkeit eingestellt wird, dem unteren Grenzwert der Drehzahl des Motors (10), wenn die Drehzahl des Motors eingestellt wird, und dem oberen Grenzwert des Öffnungsgrades des Umgehungsventils, wenn der betreffende Öffnungsgrad eingestellt wird, ändert.

8. Verfahren der Steuerung einer motorbetriebenen Klimaanlage (100), die mit einem Kompressor (11) ausgestattet ist, der durch einen Motor (10) betrieben wird, einer Außeneinheit (1) mit einem Außen-Wärmetauscher (13), einem Außen-Expansionsventil (14) und einem Außengebläse (16) und einer Inneneinheit (2a, 2b) mit einem Innen-Wärmetauscher (20a, 20b), einem Innen-Expansionsventil (21a, 21b) und einem Innengebläse (22a, 22b) und der eine Drehzahl eines Motors in Übereinstimmung mit einer Klimatisierungslast steuert und Kühlmittel, das aus dem Kompressor abgegeben wird, zwischen dem Außen-Wärmetauscher und dem Innen-Wärmetauscher zirkuliert, um dadurch einen Klimatisierungsvorgang zu steuern, **gekennzeichnet durch** die Schritte:

Speichern eines Drehmomentwerts des Motors, der Drehzahl des Motors, eines Öffnungsgrades eines Brennstoff-Einstellventils, eines Öffnungsgrades einer Drossel, einer Zündungs-Anforderungsspannung und einem Luft-Überschussfaktor in Zuordnung zueinander,
Messen der Drehzahl des Motors, des Öffnungsgrades des Brennstoff-Einstellventils und des Öffnungsgrades der Drossel bei dem Klimatisierungsvorgang, um Informationen hinsichtlich des Drehmomentwerts des Motors, der Zündungs-Anforderungsspannung und des Luft-Überschussfaktors auf Grundlage der Informationen, die in der Speichereinheit gespeichert sind und die bei dem Klimatisierungsvorgang gemessen werden, zu erhalten und aufgrund der erhaltenen Informationen zu beurteilen, ob der Motor in einem Überlastzustand ist oder nicht, und Durchführen einer Motorlast-Reduktionssteuerung der Reduktion der Last auf den Motor, falls **durch** die Beurteilungseinheit beurteilt wird, dass der Motor in einem Überlastzustand ist.

9. Verfahren Anspruch 8, wobei der Speicherschritt ausgebildet ist, um den Drehmomentwert des Motors, die Drehzahl des Motors, den Öffnungsgrad des Brennstoff-Einstellventils, den Öffnungsgrad der Drossel, die Zündungs-Anforderungsspannung und den Luft-Überschussfaktor zu speichern, die durch Messung erhalten werden, während ein vorgegebenes Drehmoment als eine Last an den Motor angelegt wird, wobei der Öffnungsgrad des Brennstoff-Einstellventils und der Öffnungsgrad der Drossel so eingestellt werden, dass der Motor mit einer vorgegebenen Drehzahl dreht.

10. Verfahren nach Anspruch 9, wobei:

der Speicherschritt ausgebildet ist, um den Drehmomentwert des Motors, die Drehzahl des Motors, den Öffnungsgrad des Brennstoff-Einstellventils, den Öffnungsgrad der Drossel, die Zündungs-Anforderungsspannung und den Luft-Überschussfaktor, die durch mehrere Messungen durch Variation des an den Motor angelegten Drehmoments und der Drehzahl des Motors gemessen wurden, zu kartieren und das Kartierungsergebnis zu speichern,
und
der Beurteilungsschritt sich auf die Informationen, die in der Speichereinheit gespeichert sind, bezieht, um den Drehmomentwert des Motors, die Zündungs-Anforderungsspannung und den Luft-Überschussfaktor auf Grundlage der Drehzahl des Motors, des Öffnungsgrads des Brennstoff-Einstellventils, des Öffnungsgrads der Drossel, die bei dem Klimatisierungsvorgang gemessen wurden, zu spezifizieren, den spezifizierten Wert mit einem vorgegebenen Einstellwert zu vergleichen und auf Grundlage des Vergleichsergebnisses zu beurteilen, ob der Motor (10) in einem Überlastzustand ist.

11. Verfahren nach einem der Ansprüche 8 bis 10, wobei:

der Speicherschritt ausgebildet ist, um eine Berechnungsgleichung zur Berechnung des Drehmomentwerts des Motors, der Zündungs-Anforderungsspannung und des Luft-Überschussfaktors auf Grundlage der Drehzahl des Motors, des Öffnungsgrads des Brennstoff-Einstellventils und des Öffnungsgrads der Drossel, die bei dem Klimatisierungsvorgang gemessen wurden, zu speichern und der Beurteilungsschritt den Drehmomentwert des Motors, die Zündungs-Anforderungsspannung und den Luft-Überschussfaktor auf Grundlage der Informationen, die so erhalten wurden, durch Verwendung der Berechnungsgleichung, die in der Speichereinheit gespeichert ist, zu spezifizieren, den spezifizierten Wert mit einem vorgegebenen Einstellwert zu vergleichen und auf Grundlage des Vergleichsergebnisses zu beurteilen, ob der Motor (10) in einem Überlastzustand ist.

12. Verfahren nach Anspruch 8, wobei die Klimaanlage ferner eine Umgehungsleitung aufweist, die zwischen einer Kühlmittel-Hochdruckseite und einer Kühlmittel-Niederdruckseite bezüglich des Kompressors angeordnet ist, um einen Teil des Kühlmittels an der Kühlmittel-Hochdruckseite des Kompressors zu der Kühlmittel-Niederdruckseite des Kompressors zurückzuführen, und ein Umgehungsventil, das in der Umgehungsleitung angeordnet ist, um den zurückzuführenden Anteil des Kühlmittels einzustellen, wobei, wenn beurteilt wird, dass der Motor in einem Überlastzustand ist, mindestens eines der Einstellung des Expansionsventils entsprechend einer Wärmetauscherfunktion als einer von dem Außen-Wärmetauscher und dem Innen-Wärmetauscher, eine Einstellung der Drehgeschwindigkeit des Gebläses entsprechend dem anderen Wärmetauscher von dem Außen-Wärmetauscher und dem Innen-Wärmetauscher, der als Kondensor funktioniert, eine Einstellung der Drehzahl des Motors und eine Einstellung des Öffnungsgrades des Umgehungsventils in der Umgehungsleitung, die zwischen der Kühlmittel-Hochdruckseite und der Kühlmittel-Niederdruckseite vorgesehen ist.

13. Verfahren nach Anspruch 12 mit ferner einem Schritt, in Übereinstimmung mit der Klimatisierungslast, der Änderung von mindestens einem aus dem unteren Grenzwert des Öffnungsgrades des Expansionsventils entsprechend dem Wärmetauscher, der als Verdampfer funktioniert, wenn der betreffende Öffnungsgrad, eingestellt wird, dem oberen Grenzwert der Drehgeschwindigkeit des Gebläses entsprechend dem Wärmetauscher, der als der Kondensor dient, wenn die betreffende Drehgeschwindigkeit eingestellt wird, dem unteren Grenzwert der Drehzahl des Motors, wenn die Drehzahl des Motors eingestellt wird, und dem oberen Grenzwert des Öffnungsgrades des Umgehungsventils, wenn der betreffende Öffnungsgrad, eingestellt wird.

Revendications

1. Climatiseur du type à entraînement par un moteur à combustion interne (100) qui est équipé d'un compresseur (11) entraîné par un moteur à combustion interne (10), d'une unité extérieure (1) comportant un échangeur de chaleur extérieur (13), un détendeur extérieur (14) et un ventilateur extérieur (16), et d'une unité intérieure (2a, 2b) comportant un échangeur de chaleur intérieur (20a, 20b), un détendeur intérieur (21a, 21b) et un ventilateur intérieur (22a, 22b), et qui commande de manière variable un nombre de tours du moteur à combustion interne conformément à une charge de climatisation et un fluide frigorigène en circulation déchargé du compresseur entre l'échangeur de chaleur extérieur et l'échangeur de chaleur intérieur pour, de ce fait, effectuer une opération de climatisation, **caractérisé en ce qu'**il comprend :

une unité de mémorisation (42) configurée pour mémoriser une valeur de couple du moteur à combustion interne, le nombre de tours du moteur à combustion interne, un degré d'ouverture d'une soupape d'ajustement de carburant, un degré d'ouverture d'un papillon, une tension de demande d'allumage et un facteur d'air en excès en association les uns avec les autres ;
un dispositif de commande (4) comprenant une unité de jugement configurée pour mesurer le nombre de tours du moteur à combustion interne, le degré d'ouverture de la soupape d'ajustement de carburant et le degré d'ouverture du papillon pendant l'opération de climatisation, pour obtenir des informations concernant la valeur de couple du moteur à combustion interne, la tension de demande d'allumage et le facteur d'air en excès sur la base des informations qui sont mémorisées dans l'unité de mémorisation et qui sont mesurées pendant l'opération de climatisation et pour juger, sur la base des informations obtenues, si le moteur à combustion interne est dans un état de surcharge ou non ; et
une unité de commande configurée pour effectuer une commande de réduction de charge de moteur à combustion interne pour réduire la charge du moteur à combustion interne s'il est jugé par l'unité de jugement que le moteur à combustion interne est dans un état de surcharge.

2. Climatiseur du type à entraînement par un moteur à combustion interne (100) selon la revendication 1, dans lequel l'unité de mémorisation (42) est configurée pour mémoriser la valeur de couple du moteur à combustion interne, le nombre de tours du moteur à combustion interne, le degré d'ouverture de la soupape d'ajustement de carburant, le degré d'ouverture du papillon, la tension de demande d'allumage et le facteur d'air en excès obtenus par une mesure alors qu'un couple prédéterminé est appliqué en tant que charge au moteur à combustion interne, et le degré d'ouverture de soupape d'ajustement de carburant et le degré d'ouverture de papillon sont ajustés de sorte que le moteur à combustion interne soit mis en rotation à un nombre de tours prédéterminé.

3. Climatiseur du type à entraînement par un moteur à combustion interne (100) selon la revendication 2, dans lequel :

l'unité de mémorisation (42) est configurée pour mapper la valeur de couple du moteur à combustion interne, le nombre de tours du moteur à combustion interne, le degré d'ouverture de la soupape d'ajustement de carburant, le degré d'ouverture du papillon, la tension de demande d'allumage et le facteur d'air en excès obtenus par de multiples mesures en modifiant le couple appliqué au moteur à combustion interne et le nombre de tours du moteur à combustion interne, et pour mémoriser un résultat de mappage ; et

l'unité de jugement se réfère aux informations mémorisées dans l'unité de mémorisation pour spécifier la valeur de couple du moteur à combustion interne, la tension de demande d'allumage et le facteur d'air en excès sur la base du nombre de tours du moteur à combustion interne, du degré d'ouverture de la soupape d'ajustement de carburant, du degré d'ouverture du papillon mesurés pendant l'opération de climatisation, compare la valeur spécifiée avec une valeur de réglage prédéterminée et juge, sur la base du résultat de comparaison, si le moteur à combustion interne (10) est dans un état de surcharge.

4. Climatiseur du type à entraînement par un moteur à combustion interne (100) selon l'une quelconque des revendications 1 à 3, dans lequel :

l'unité de mémorisation (42) est configurée pour mémoriser une équation de calcul pour calculer la valeur de couple du moteur à combustion interne, la tension de demande d'allumage et le facteur d'air en excès sur la base du nombre de tours du moteur à combustion interne, du degré d'ouverture de la soupape d'ajustement de carburant et du degré d'ouverture du papillon mesurés pendant l'opération de climatisation ; et

l'unité de jugement spécifie la valeur de couple du moteur à combustion interne, la tension de demande d'allumage et le facteur d'air en excès sur la base des informations ainsi obtenues en utilisant l'équation de calcul mémorisée dans l'unité de mémorisation, compare la valeur spécifiée avec une valeur de réglage prédéterminée et juge, sur la base du résultat de comparaison, si le moteur à combustion interne (10) est dans un état de surcharge.

5. Climatiseur du type à entraînement par un moteur à combustion interne selon la revendication 1, comprenant en outre un tuyau de dérivation (17) relié entre un côté haute pression de fluide frigorigène et un côté basse pression de fluide frigorigène par rapport au compresseur (11) pour renvoyer une partie du fluide frigorigène du côté haute pression de fluide frigorigène du compresseur (11) vers le côté basse pression de fluide frigorigène du compresseur, et une soupape de dérivation (18) disposée dans le tuyau de dérivation pour ajuster la quantité de fluide frigorigène à renvoyer.

6. Climatiseur du type à entraînement par un moteur à combustion interne selon la revendication 5, dans lequel, lorsqu'il est jugé que le moteur à combustion interne est dans un état de surcharge, l'unité de commande effectue au moins l'un d'un ajustement du détendeur (14) correspondant à un échangeur de chaleur fonctionnant en tant qu'évaporateur parmi l'échangeur de chaleur extérieur et l'échangeur de chaleur intérieur, d'un ajustement de la vitesse de rotation du ventilateur correspondant à l'autre échangeur de chaleur fonctionnant en tant que condenseur parmi l'échangeur de chaleur extérieur et l'échangeur de chaleur intérieur, d'un ajustement du nombre de tours du moteur à combustion interne (10) et d'un ajustement du degré d'ouverture de la soupape de dérivation dans le tuyau de dérivation prévu entre le côté haute pression de fluide frigorigène et le côté basse pression de fluide frigorigène.

7. Climatiseur du type à entraînement par un moteur à combustion interne selon la revendication 5, dans lequel, conformément à la charge de climatisation, l'unité de commande modifie au moins l'une de la valeur de limite inférieure du degré d'ouverture du détendeur correspondant à l'échangeur de chaleur fonctionnant en tant qu'évaporateur lorsque le degré d'ouverture concerné est ajusté, de la valeur de limite supérieure de la vitesse de rotation du ventilateur correspondant à l'échangeur de chaleur fonctionnant en tant que condenseur lorsque la vitesse de rotation concernée est ajustée, de la valeur de limite inférieure du nombre de tours du moteur à combustion interne (10) lorsque le nombre de tours du moteur à combustion interne est ajusté, et de la valeur de limite supérieure du degré d'ouverture de la soupape de dérivation lorsque le degré d'ouverture concerné est ajusté.

8. Procédé de commande d'un climatiseur du type à entraînement par un moteur à combustion interne (100) qui est équipé d'un compresseur (11) entraîné par un moteur à combustion interne (10), d'une unité extérieure (1) comportant un échangeur de chaleur extérieur (13), un détendeur extérieur (14) et un ventilateur extérieur (16) et d'une unité intérieure (2a, 2b) comportant un échangeur de chaleur intérieur (20a, 20b), un détendeur intérieur (21a, 21b) et un ventilateur intérieur (22a, 22b), et qui commande de manière variable un nombre de tours d'un moteur à combustion interne conformément à une charge de climatisation et un fluide frigorigène en circulation déchargé du compresseur entre l'échangeur de chaleur extérieur et l'échangeur de chaleur intérieur pour, de ce fait, effectuer une opération de climatisation, **caractérisé en ce qu'**il comprend les étapes :

de mémorisation d'une valeur de couple du moteur à combustion interne, du nombre de tours du moteur à combustion interne, d'un degré d'ouverture d'une soupape d'ajustement de carburant, d'un degré d'ouverture d'un papillon, d'une tension de demande d'allumage et d'un facteur d'air en excès en association les uns avec les autres ;
de mesure du nombre de tours du moteur à combustion interne, du degré d'ouverture de la soupape d'ajustement de carburant et du degré d'ouverture du papillon pendant l'opération de climatisation, pour obtenir des informations concernant la valeur de couple du moteur à combustion interne, la tension de demande d'allumage et le facteur d'air en excès sur la base des informations qui sont mémorisées dans l'unité de mémorisation et qui sont mesurées pendant l'opération de climatisation et pour juger, sur la base des informations obtenues, si le moteur à combustion interne est dans un état de surcharge ou non ; et
d'exécution d'une commande de réduction de charge de moteur à combustion interne pour réduire la charge du moteur à combustion interne s'il est jugé par l'unité de jugement que le moteur à combustion interne est dans un état de surcharge.

9. Procédé selon la revendication 8, dans lequel l'étape de mémorisation est configurée pour mémoriser la valeur de couple du moteur à combustion interne, le nombre de tours du moteur à combustion interne, le degré d'ouverture de la soupape d'ajustement de carburant, le degré d'ouverture du papillon, la tension de demande d'allumage et le facteur d'air en excès obtenus par une mesure alors qu'un couple prédéterminé est appliqué en tant que charge au moteur à combustion interne, et le degré d'ouverture de soupape d'ajustement de carburant et le degré d'ouverture de papillon sont ajustés de sorte que le moteur à combustion interne soit mis en rotation à un nombre de tours prédéterminé.

10. Procédé selon la revendication 9, dans lequel :

l'étape de mémorisation est configurée pour mapper la valeur de couple du moteur à combustion interne, le nombre de tours du moteur à combustion interne, le degré d'ouverture de la soupape d'ajustement de carburant, le degré d'ouverture du papillon, la tension de demande d'allumage et le facteur d'air en excès obtenus par de multiples mesures en modifiant le couple appliqué au moteur à combustion interne et le nombre de tours du moteur à combustion interne, et pour mémoriser un résultat de mappage ; et
l'étape de jugement se réfère aux informations mémorisées dans l'unité de mémorisation pour spécifier la valeur de couple du moteur à combustion interne, la tension de demande d'allumage et le facteur d'air en excès sur la base du nombre de tours du moteur à combustion interne, du degré d'ouverture de la soupape d'ajustement de carburant, du degré d'ouverture du papillon mesurés pendant l'opération de climatisation, compare la valeur spécifiée avec une valeur de réglage prédéterminée et juge, sur la base du résultat de comparaison, si le moteur à combustion interne (10) est dans un état de surcharge.

11. Procédé selon l'une quelconque des revendications 8 à 10, dans lequel :

l'étape de mémorisation est configurée pour mémoriser une équation de calcul pour calculer la valeur de couple du moteur à combustion interne, la tension de demande d'allumage et le facteur d'air en excès sur la base du nombre de tours du moteur à combustion interne, du degré d'ouverture de la soupape d'ajustement de carburant et du degré d'ouverture du papillon mesurés pendant l'opération de climatisation ; et
l'étape de jugement spécifie la valeur de couple du moteur à combustion interne, la tension de demande d'allumage et le facteur d'air en excès sur la base des informations ainsi obtenues en utilisant l'équation de calcul mémorisée dans l'unité de mémorisation, compare la valeur spécifiée avec une valeur de réglage prédéterminée et juge, sur la base du résultat de comparaison, si le moteur à combustion interne (10) est dans un état de surcharge.

12. Procédé selon la revendication 8, dans lequel le climatiseur comprend en outre un tuyau de dérivation relié entre un côté haute pression de fluide frigorigène et un côté basse pression de fluide frigorigène par rapport au compresseur pour renvoyer une partie du fluide frigorigène du côté haute pression de fluide frigorigène du compresseur vers le côté basse pression de fluide frigorigène du compresseur, et une soupape de dérivation disposée dans le tuyau de dérivation pour ajuster la quantité de fluide frigorigène à renvoyer, et lorsqu'il est jugé que le moteur à combustion interne est dans un état de surcharge, au moins l'un de l'ajustement du détendeur correspondant à un échangeur de chaleur fonctionnant en tant qu'évaporateur parmi l'échangeur de chaleur extérieur et l'échangeur de chaleur intérieur, de l'ajustement de la vitesse de rotation du ventilateur correspondant à l'autre échangeur de chaleur fonctionnant en tant que condenseur parmi l'échangeur de chaleur extérieur et l'échangeur de chaleur intérieur, de l'ajustement du nombre de tours du moteur à combustion interne et de l'ajustement du degré d'ouverture de la soupape de dérivation dans le tuyau de dérivation prévu entre le côté haute pression de fluide frigorigène et le côté basse pression de fluide frigorigène est effectué.

13. Procédé selon la revendication 12, comprenant en outre une étape, conformément à la charge de climatisation, de modification d'au moins l'une de la valeur de limite inférieure du degré d'ouverture du détendeur correspondant à l'échangeur de chaleur fonctionnant en tant qu'évaporateur lorsque le degré d'ouverture concerné est ajusté, de la valeur de limite supérieure de la vitesse de rotation du ventilateur correspondant à l'échangeur de chaleur fonctionnant en tant que condenseur lorsque la vitesse de rotation concernée est ajustée, de la valeur de limite inférieure du nombre de tours du moteur à combustion interne lorsque le nombre de tours du moteur à combustion interne est ajusté, et de la valeur de limite supérieure du degré d'ouverture de la soupape de dérivation lorsque le degré d'ouverture concerné est ajusté.

FIG. 1

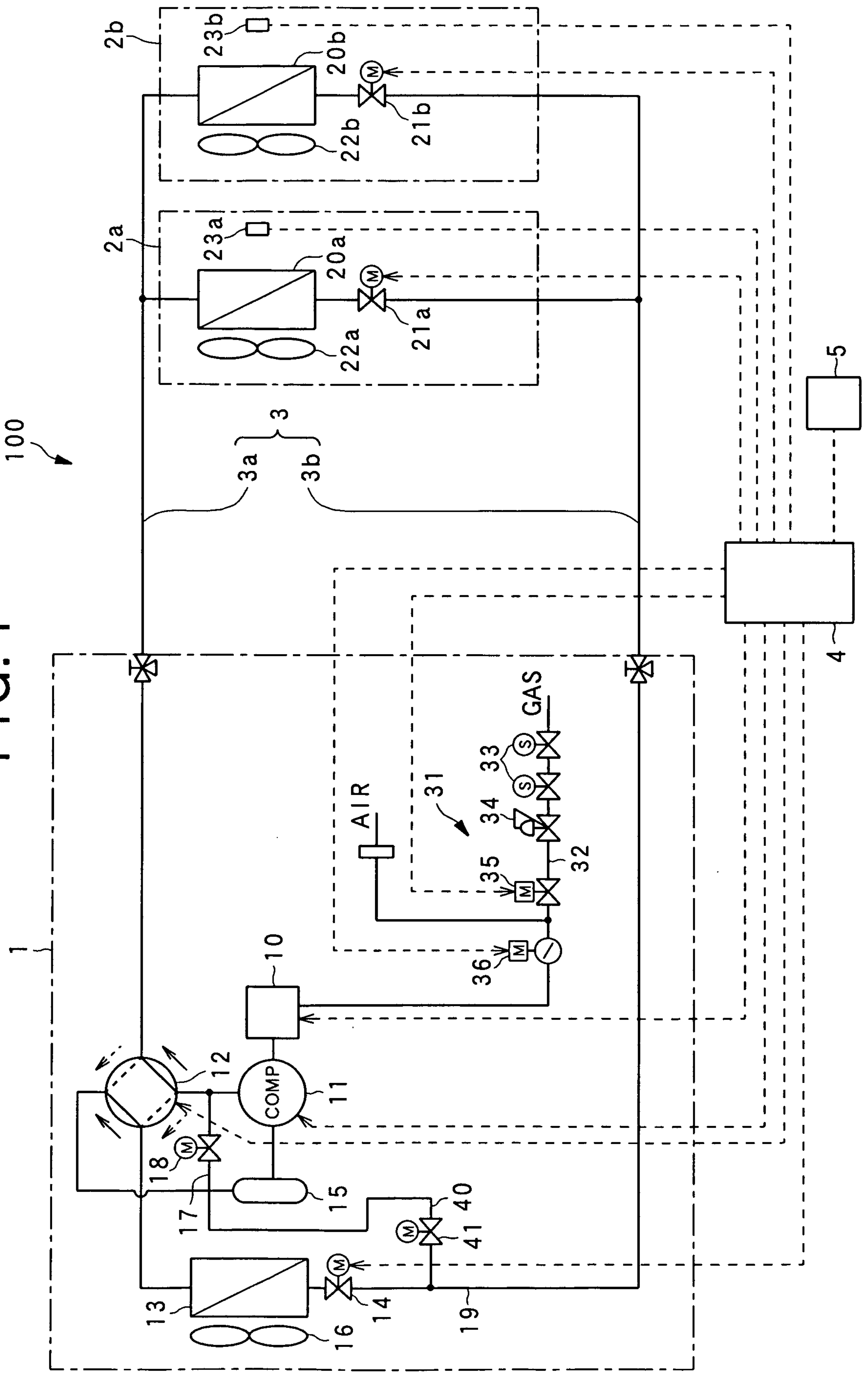

100
1
2a
2b
3
3a
3b
4
5
10
11
12
13
14
15
16
17
18
19
20a
20b
21a
21b
22a
22b
23a
23b
31
32
33
34
35
36
40
41
COMP
AIR
GAS
M
S

FIG. 2

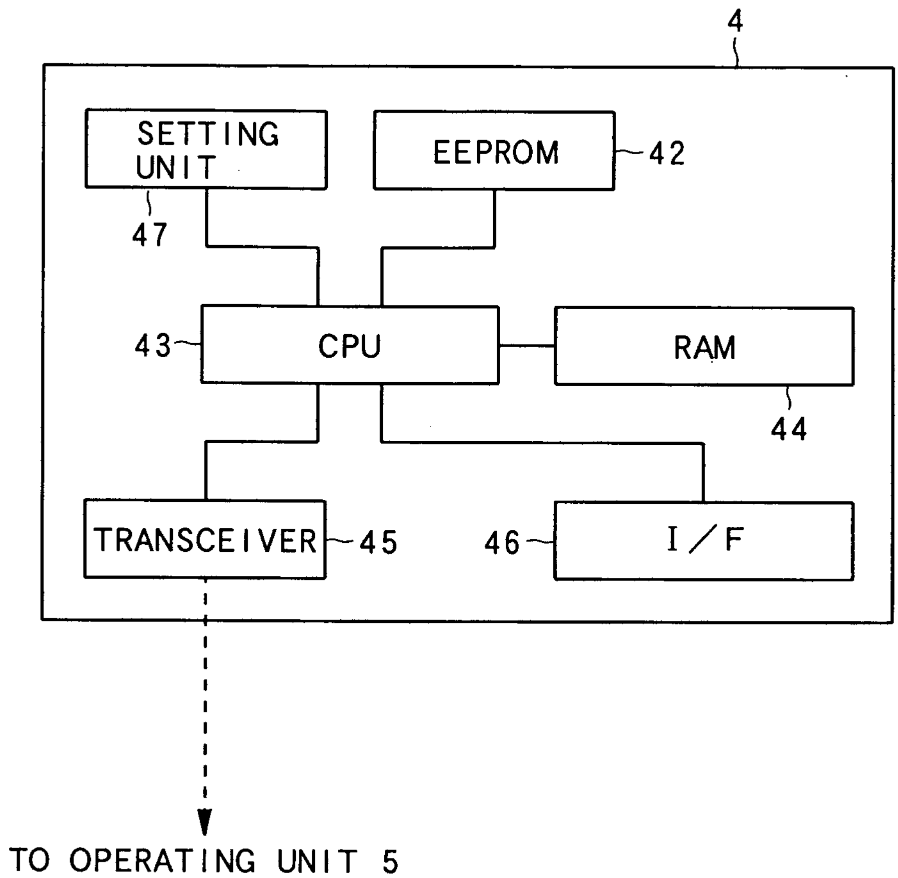
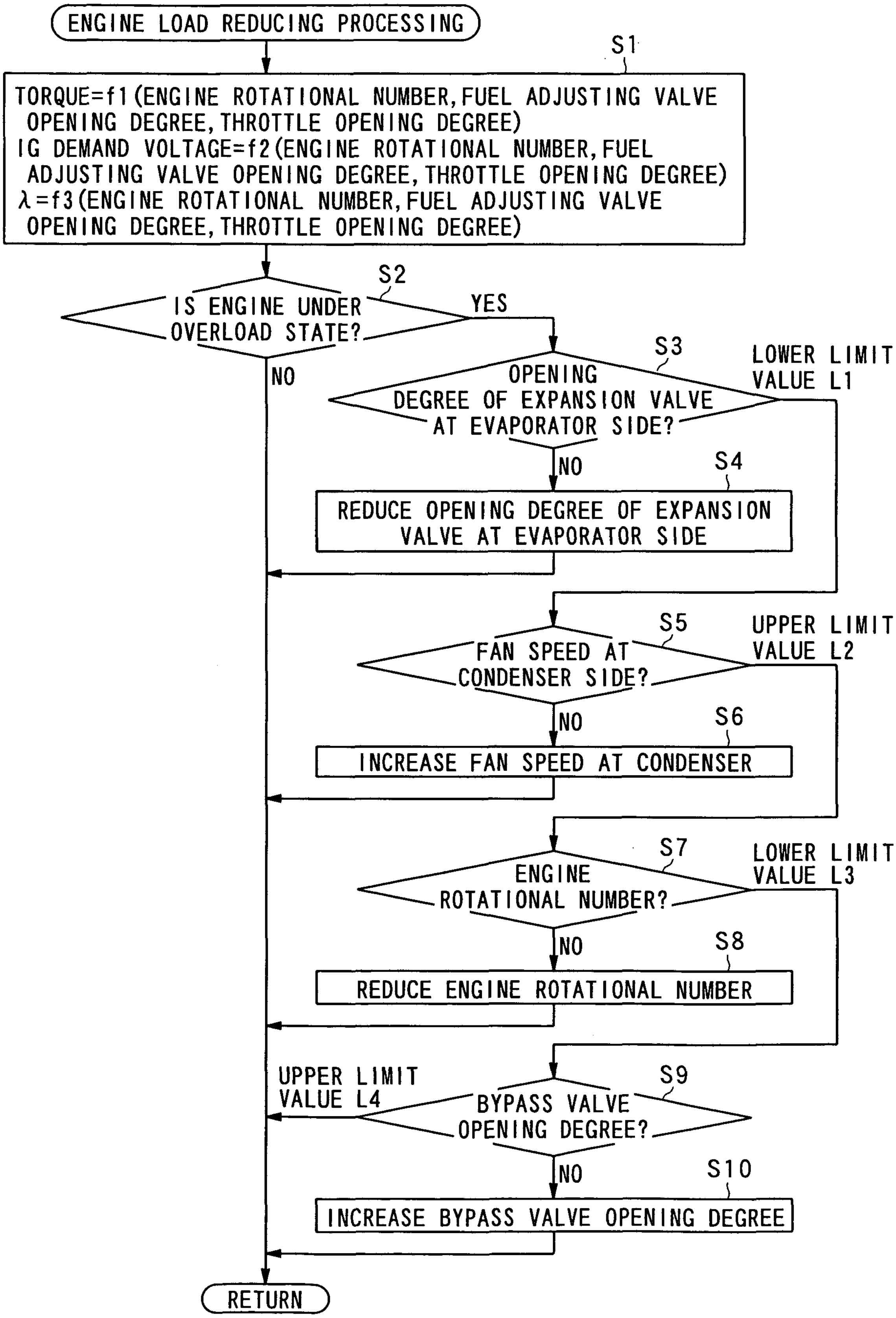

4
SETTING UNIT
47
EEPROM
42
43
CPU
RAM
44
TRANSCEIVER
45
46
I/F
TO OPERATING UNIT 5

FIG. 3

50

ENGINE ROTATIONAL NUMBER	OPENING DEGREE OF FUEL ADJUSTING VALVE	OPENING DEGREE OF THROTTLE	TORQUE (ENGINE TORQUE)	ENGINE HEAT EFFICIENCY	IGNITION DEMAND VOLTAGE	FUEL GAS FLOW AMOUNT	λ (EXCESS AIR FACTOR)
A1	B1	C1	D1	E1	F1	G1	H1
A2	B2	C2	D2	E2	F2	G2	H2
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

FIG. 4


ENGINE LOAD REDUCING PROCESSING
S1
TORQUE=f1(ENGINE ROTATIONAL NUMBER, FUEL ADJUSTING VALVE OPENING DEGREE, THROTTLE OPENING DEGREE)
IG DEMAND VOLTAGE=f2(ENGINE ROTATIONAL NUMBER, FUEL ADJUSTING VALVE OPENING DEGREE, THROTTLE OPENING DEGREE)
λ=f3(ENGINE ROTATIONAL NUMBER, FUEL ADJUSTING VALVE OPENING DEGREE, THROTTLE OPENING DEGREE)
S2
IS ENGINE UNDER OVERLOAD STATE?
YES
NO
S3
OPENING DEGREE OF EXPANSION VALVE AT EVAPORATOR SIDE?
LOWER LIMIT VALUE L1
NO
S4
REDUCE OPENING DEGREE OF EXPANSION VALVE AT EVAPORATOR SIDE
S5
FAN SPEED AT CONDENSER SIDE?
UPPER LIMIT VALUE L2
NO
S6
INCREASE FAN SPEED AT CONDENSER
S7
ENGINE ROTATIONAL NUMBER?
LOWER LIMIT VALUE L3
NO
S8
REDUCE ENGINE ROTATIONAL NUMBER
S9
BYPASS VALVE OPENING DEGREE?
UPPER LIMIT VALUE L4
NO
S10
INCREASE BYPASS VALVE OPENING DEGREE
RETURN

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 6137701 A **[0003]**
- EP 1334852 A2 **[0005]**
- US 5454229 A **[0006]**