

TITLE OF THE INVENTION

Air Conditioner

BACKGROUND OF THE INVENTION

The present invention relates to a air conditioner for exchanging heat from a refrigerant to the outside so as to adjust at least one of room temperature and humidity to desired temperature or humidity and having a function for controlling an air supplying means that supplies conditioned air to the room so as to vary the air supplying amount in multiple levels corresponding to a reference air amount and irregularly.

A conventional air conditioner exchanges heat from a refrigerant to the outside and operates in various modes such as a heating mode, a cooling mode, a drying mode, and an automatic operating mode. In the automatic operating mode, the air conditioner compares a designated temperature and the room temperature and automatically selects the heating mode or the cooling mode corresponding to the desired result. The user can select a desired mode with a remote controller that is an accessory of the air conditioner so as to air-condition the room.

A particular air conditioner has a special cooling function for supplying air while varying the air supplying amount as with natural air. In this function, a predetermined fluctuation width (amplitude) is designated regardless of the predetermined reference



air amount so as to vary the air amount in the fluctuation width in irregular periods. When the air amount is controlled in such a manner, the user in the room cannot expect the air amount. Thus, since he can unexpectedly feel coolness, the comfortableness in the room improves.

In other words, although this function includes a psychological factor of the user, the coolness that the user feels can be improved in comparison with the conventional temperature control method with equal air amount. Since the coolness is improved, the designated temperature can be increased than the conventional cooling method. Thus, this function contributes to so-called energy saving.

However, in such a function, the fluctuation width of the air supplying amount does not accord with the predetermined reference air amount. Thus, the ratio of the fluctuation width to the predetermined air amount varies corresponding to a change of the predetermined air amount. In other words, when the predetermined reference amount is small (weak), the ratio of the fluctuation width thereto is large. Thus, the user can satisfactorily feel the fluctuation of the air supplying amount. In contrast, when the reference air amount is large (strong), since the ratio of fluctuation width thereto becomes small. Thus, the user cannot satisfactorily feel the fluctuation.



To solve this problem, the ratio in the case that the reference air amount is maximum may be designated to the fluctuation width of which the user can satisfactorily feel the fluctuation function. However, when the reference air amount is small, the ratio of the fluctuation width thereto becomes too large, resulting in increasing the noise. Thus, the user may feel uncomfortableness.

To satisfactorily employ the fluctuation function, the environment in which the air conditioner is used (the efficiency of the air flow and the reference air amount that is often used that depend on the area of the room, the layout of furniture, and so forth) should be considered. Thus, when only the ratio to the reference air amount is considered, the fluctuation function may not be satisfactorily employed.

SUMMARY OF THE INVENTION

The present invention is made from the above-described point of view. An object of the present invention is to provide an air conditioner for improving the fundamental functions (coolness, warmth, and so forth) thereof, reducing noise in association with the operation thereof, and totally improving the comfortableness of the user.

The present invention is an air conditioner having a refrigerating cycle of at least a compressor, a condenser, an expansion device, and an evaporator



connected by a refrigerant pipe and adapted for supplying heated or cooled air to an air-conditioned space with an air supplying device, and adjusting the temperature of the air-conditioned space to a predetermined temperature, comprising a signal output means for outputting a first signal for designating an air supplying amount of the air supplying device a control means for adjusting the air supplying amount of the air supplying device corresponding to the first signal, an air supplying amount compensating means for supplying a second signal to the control means, the second signal being adapted for causing the air supplying amount of the air supplying device to be automatically varied in a predetermined range of the air supplying amount designated corresponding to the first signal, and a variable width control means for designating the predetermined range corresponding to the first signal supplied from the signal output means.

The variation width control means is adapted for designating the predetermined range corresponding to a predetermined ratio of the predetermined air supplying amount corresponding to the first signal supplied from the signal output means.

The variation width control means is adapted for decreasing the predetermined range corresponding to the increase of the predetermined air supplying amount corresponding to the first signal supplied from the

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signal output means.

The variable width control means is adapted for increasing the predetermined range when the predetermined air supplying amount corresponding to the first signal supplied from the signal output means is in a predetermined range.

The air supplying amount compensating means is adapted for automatically varying the designated air supplying amount corresponding to the first signal supplied from the signal output means in such a manner that power spectrum is inversely proportional to frequency.

These and other objects, features and advantages of the present invention will become more apparent in light of the following detailed description of a best mode embodiment thereof, as illustrated in the accompanying drawings.

Brief Description of Drawings

Fig. 1 is a block diagram showing a construction of an air conditioner according to an embodiment of the present invention;

Fig. 2 is a side view showing an internal construction of an indoor unit;

Fig. 3 is a schematic diagram showing a refrigerant circuit of the air conditioner according to the embodiment of the present invention;

Fig. 4 is an electric circuit diagram of the

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indoor unit of the air conditioner according to the embodiment of the present invention;

Fig. 5 is an electric circuit diagram of an outdoor unit of the air conditioner according to the embodiment of the present invention;

Figs. 6 (A) to (C) are fluctuation width designating maps stored in a microcomputer according to the embodiment of the present invention; Fig. 6 (A) is a map showing an air amount and fluctuation width for emphasizing a $1/f$ fluctuation function, Fig. 6 (B) is a map showing air amount and fluctuation width for emphasizing noise reduction, and Fig. 6 (C) is a map showing air amount and fluctuation width for emphasizing the $1/f$ fluctuation function in a predetermined air amount state; and

Fig. 7 is a flow chart for controlling the designation of a fluctuation width for the $1/f$ fluctuation function.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Next, with reference to the accompanying drawings, an embodiment of the present invention will be described. Fig. 1 shows an air conditioner according to the embodiment of the present invention. The air conditioner comprises an indoor unit 10, an outdoor unit 12, and a remote controller 14. The indoor unit 10 and the outdoor unit 12 each have a refrigerant circulating path for circulating a refrigerant. The



remote controller 14 sends operation signals as infrared rays to the air conditioner so as to remotely control it.

The remote controller 14 has various operation keys for turning on/off the power, selecting cooling/heating modes, designating temperature, designating timer, and so forth. With the operation keys, corresponding operation signals are output to the air conditioner. The remote controller 14 has air amount designating keys. With the air amount designating keys, the user can select the air amount from "WEAK", "MEDIUM", and "STRONG".

In this embodiment, an air conditioner that has the three levels of air amount will be exemplified. However, the above-described three levels of air amount are fundamental in the embodiment. Thus, the embodiment can be applied for other constructions of which the air amount is varied in several levels (including for example "breeze", "high power", etc.), the air amount is gradually varied rather than in the fixed levels.

In addition, the remote controller 14 according to the embodiment has a "1/f fluctuation" designating key. With the "1/f fluctuation" designating key, the 1/f fluctuation function is executed.

In the 1/f fluctuation function, a predetermined fluctuation width (amplitude) is designated regardless

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of the predetermined reference air amount. In addition, the air amount is irregularly varied in the fluctuation width so that the power spectrum is inversely proportional to the frequency. Thus, since the air amount is unexpectedly varied, the comfortableness of the user is improved in comparison with the fixed air amount.

In this embodiment, as a means for sending operation signals of the remote controller 14 to the indoor unit 10, electromagnetic waves such as infrared rays are used. The indoor unit 10 has an optical sensor 76B that receives the infrared rays. The optical sensor 76B will be described later.

When an operation signal sent from the remote controller 14 is received by the optical sensor 76B of the indoor unit 10, the air conditioner controls the room temperature, humidity, and so forth corresponding to the code of the received operation signal. It should be noted that the remote controller 14 can be connected to the indoor unit with a signal line.

As shown in Fig. 2, the indoor unit 10 is covered by a casing 202. The casing 202 is detachably secured to the upper and lower edges of a mounting base 200. A cross flow fan 204 is disposed at a center portion of the casing 202. The cross flow fan 204 is driven by a drive force of a fan motor 70E (that will be described later). The cross flow fan 204 sucks air in the room

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from a sucking opening 206 through various filters 208 and an indoor heat exchanger 16 and supplies the resultant air to the indoor through an air path 210. The air path 210 has a horizontal fan 212 and horizontal flaps 214 so as to adjust the direction of the air supplied to the room.

A drain pan 216 is integrally disposed at the casing 202 corresponding to the lower portion of the indoor heat exchanger 16.

Fig. 3 shows a refrigerant circuit of the air conditioner controlled by a control unit according to the embodiment of the present invention. In Fig. 3, reference numeral 26 is a compressor. Reference numeral 29 is a four-way valve. Reference numeral 28 is an outdoor heat exchanger disposed in the outdoor unit 12. Reference numeral 30 is a capillary tube. Reference numeral 16 is an indoor heat exchanger disposed in the indoor unit 10. Reference numeral 24 is an accumulator. These elements are circularly connected by a refrigerant pipe so as to construct a refrigerant cycle.

In the air conditioner, when the four-way valve 29 is placed in the state denoted by a solid line shown in Fig. 3, the refrigerant supplied from the compressor 26 flows in the direction of an arrow denoted by a solid line. Thus, the refrigerant is compressed in the outdoor heat exchanger 28. The refrigerant is



evaporated by the indoor heat exchanger 16. Consequently, the room is cooled. On the other hand, when the four-way valve 29 is placed in the state denoted by a dotted line shown in Fig. 3, the refrigerant supplied from the compressor 26 flows in the direction of an arrow denoted by a dotted line. The refrigerant is compressed by the indoor heat exchanger 16. The refrigerant is evaporated by the outdoor heat exchanger 28. Consequently, the room is heated.

Reference numeral 112A is a fan motor that constructs an outdoor air supplying device. Reference numeral 70E is a fan motor that constructs an indoor air supplying device along with the cross flow fan 204. The fan motor 112A and the fan motor 70E cause air to be supplied to the outdoor heat exchanger 28 and the indoor heat exchanger 16, respectively.

Fig. 4 shows an electric circuit of the indoor unit 10. The electric circuit has a power supply board 70 and a control board 72. The power supply board 70 has a drive circuit 70A, a motor power supply circuit 70B, a control circuit power supply circuit 70C, and a serial circuit power supply circuit 70D. The drive circuit 70A is connected to the fan motor 70E that controls the air amount supplied to the room. The motor power supply circuit 70B generates the power for driving various motors. The control circuit power



supply circuit 70C generates power for the control circuit. The serial circuit power supply circuit 70D generates the power for the serial circuit.

The fan motor 70E of the embodiment is a DC motor. The voltage supplied to the fan motor 70E is controlled with eight bits. Thus, by the voltage control, the air amount can be controlled in 256 levels. This voltage control allows the air amount to be finely controlled for the 1/f fluctuation function.

The control board 72 has a serial circuit 72A, a drive circuit 72B, and a microcomputer 72C. The serial circuit 72A is connected to the serial circuit power supply circuit 70D. The drive circuit 72B drives a motor. The microcomputer 72C functions as a control circuit. The drive circuit 72B is connected to an up/down flap motor 74A, left/right flap motors 74B and 74C, and a floor sensor motor 74D. The up/down flap motor 74A vertically moves a flap. The floor sensor motor 74D rotates a floor sensor that detects the temperature of the entire surface of the floor.

The microcomputer 72C is connected to a display LED, an optical sensor 76B, and a receiving circuit 76A. The display LED is disposed on the display board 76 and displays an operation mode and so forth. The receiving circuit 76a receives an operation signal as infrared rays through the optical sensor 76B from the remote controller 14.



In addition, the microcomputer 72C is connected to an area LED and a floor sensor. The area LED is disposed on the sensor plate 78 and displays the temperature detecting area of the floor.

The remote controller 14 causes the air conditioner to drive the flap motors 74A, 74B, and 74C and change the flap angles and so forth, thereby selecting each mode of heating mode, cooling mode, dry mode, and automatic operating mode, changing the designated temperature, and changing the air supplying amount.

In addition, the microcomputer 72C is connected to a room temperature sensor 80A, a heat exchanger temperature sensor 80B, and a humidity sensor 80C. The room temperature sensor 80A detects the room temperature. The heat exchanger temperature sensor 80B detects the temperature of the refrigerant coil of the indoor heat exchanger 16. The humidity sensor 80C detects the humidity of the room. In addition, the microcomputer 72C is connected to a self diagnosis LED, an operation selection switch, and a self diagnosis switch that are disposed on the switch board 82. The operation selection switch selects one of the heating mode, the cooling mode, the dry mode, and the automatic operation mode.

Display LEDs corresponding to the "heating mode" , "cooling mode", "dry mode", and "automatic operation



mode" are disposed on the display board 76 and light corresponding to the operation modes.

Fig. 5 shows an electric circuit of the outdoor unit 12. This electric circuit has a rectifier circuit 100 and a control board 102. Terminals (1) to (3) of the electric circuit of the outdoor unit 12 are connected to the electric circuit of the indoor unit 10 shown in Fig. 4.

The control board 102 has a serial circuit 102A, noise filters 102B, 102C, and 120D, a switching power supply circuit 102E, and a microcomputer 102F. The serial circuit 102A is connected to the serial circuit power supply circuit 70D of the indoor unit 10. The noise filters 102B, 102C, and 120D remove noise. The switching power supply circuit 102E generates a power for switching the inverter 104. The microcomputer 102F functions as a control circuit.

The switching power supply circuit 102E is connected to the inverter 104. The inverter 104 is connected to a compressor motor 106 that drives the compressor 26, which compresses the refrigerant.

The microcomputer 102F is connected to an outer air temperature thermistor 110A, a coil temperature thermistor 110B, and a compressor temperature thermistor 110C. The outer air temperature thermistor 110A is an outer temperature sensor that detects the temperature of the outer air. The coil temperature



thermistor 110B is a coil temperature sensor that detects the temperature of the refrigerant coil of the outdoor heat exchanger 28. The compressor temperature thermistor 110C is a temperature sensor that detects the temperature of the compressor 26.

The noise filter 102B is connected to a fan motor 112A and a fan motor condenser 112B. The fan motor 112A supplies air to the outdoor heat exchanger 28. In parallel with the fan motor 112A and the fan motor condenser 112B, the four-way valve 27 and a solenoid valve 29 are connected to the noise filter 102B.

In this embodiment, the fluctuation width (amplitude of air amount) of the $1/f$ fluctuation function is varied corresponding to the designated reference air amount.

In other words, the microcomputer 72C stores fluctuation width designating maps corresponding to the predetermined reference air amount (see Figs. 6 (A) to (C)). One of the fluctuation width designating maps is selected corresponding to the position at which the indoor unit 10 is installed. These maps represent the relation between the reference air amount and fluctuation width corresponding to different installation conditions of the air conditioner.

In this embodiment, the three maps have been stored. However, any one or any two of the maps may be selected and stored. In other words, when the



installation condition at which the indoor unit 10 is installed is known, the indoor unit 10 can be operated with only one relation between reference air amount and fluctuation width.

In the map shown in Fig. 6 (A), the fluctuation width increases corresponding to the increase of the air amount. In other words, when the air amount is "weak", the fluctuation width is also "small". When the air amount is "strong", the fluctuation width becomes "large". In the map shown in Fig. 6 (A), the fluctuation width is designated so that the ratio of the fluctuation ratio to each air amount is constant. Thus, since the varying ratio of the air amount of the $1/f$ fluctuation function is constant regardless of the air amount, the user in the room can feel the $1/f$ fluctuation effect regardless of the air amount.

In the map shown in Fig. 6 (B), the fluctuation width decreases corresponding to the increase of the air amount. In other words, when the air amount is "weak", the fluctuation width is "large". When the air amount is "strong", the fluctuation width becomes "weak". Since the air amount and the fluctuation width are controlled in such a manner, when the air amount is "weak", the noise of the air amount is low. Thus, so as to satisfactorily employ the $1/f$ fluctuation function, the fluctuation width is increased. When the air amount is "strong", the noise of the air amount is

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large. Thus, so as to suppress the $1/f$ fluctuation function, the fluctuation width is decreased.

In other words, regardless of the air amount, when the noise is kept almost constant (averaged), the discomfortableness of the noise can be reduced.

In the map shown in Fig. 6 (C), a fluctuation width is designated so that the $1/f$ fluctuation function can be satisfactorily employed with a predetermined air amount. With other than the predetermined air amount, the fluctuation width is suppressed so as to reduce the noise. In Fig. 6 (C), when the air amount is "medium", the $1/f$ fluctuation function is emphasized. When the air amount is "weak" or "strong", the noise reduction is emphasized. In this embodiment, when the indoor unit is installed, one of (1) $1/f$ fluctuation emphasizing state (Fig. 6 (A)), (2) low reduction emphasizing state (Fig. 6 (B)), and (3) combination state (Fig. 6 (C)) is selected and designated. After the indoor unit is installed, the fluctuation width is controlled corresponding to the selected map. In this embodiment, the $1/f$ fluctuation emphasizing state is designated.

Next, the operation of the air conditioner according to this embodiment will be described. First, the normal-operation of the air conditioner will be described.

When the remote controller 14 is operated in the



operation stop state and an operation signal is received by the receiving circuit 76A, the code of the received operation signal is analyzed.

It is determined whether or not the analyzed result is a power on command or a timer designating command. In the power off state, some operation signals of for example temperature designating command and air amount designating command are canceled. Thus, when such operation signals are input, they are not accepted and the receiving circuit 7 is kept in the receiving state.

When a timer designating command is detected, the user of the remote controller 14 can designate the timer so that the air conditioner will operate at a predetermined time (for example, two hours later). Thus, the remote controller 14 outputs a corresponding operation signal to the air conditioner and thereby the timer (on time) is designated in the air conditioner. Thus, the air conditioner automatically operates two hours later.

When a power on command is detected, the air conditioner starts in the designated mode of the last operation.

Thereafter, when an operation signal is received from the remote controller 14, the code of the received operation signal is analyzed and it is determined whether or not the analyzed result is a power off



command, an air amount designating (changing) command, a temperature designating (changing) command, or a timer designating (changing) command. Corresponding to the determined result, an item corresponding to the analyzed result is selected. Thus, the operation of the air conditioner is stopped or the designated operation mode is executed.

When the 1/f fluctuation function is commanded, the fan motor 70E is controlled. The air amount is varied with the fluctuation width corresponding to the designated air amount. Next, with reference to the flow chart of Fig. 7, the air amount control of the 1/f fluctuation function will be described.

At step 300, the air amount that has been designated at present is read. In other words, one of "weak", "medium", and "strong" is selected.

At step 302, one of the maps shown in Figs. 6 (A) to (C) is read. The map that is read is predesignated corresponding to the condition in which the air conditioner is installed. In this embodiment, the map shown in Fig. 6 (A) is selected. At step 304, the fluctuation width is obtained corresponding to the map. In other words, when the air amount is "weak", the fluctuation width is "small". When the air amount is "strong", the fluctuation width becomes "large".

At step 306, a command signal that causes the 1/f fluctuation function to be executed corresponding to

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the map is output. Thereafter, the flow advances to step 308.

At step 308, it is determined whether or not the reference air amount has been changed. When the determined result is YES, the flow returns to step 300 so as to repeat the above-described process. When the determined result is NO, the flow advances to step 310. At step 310, it is determined whether or not the 1/f fluctuation function has been canceled. When the determined result is YES, the flow advances to step 312. At step 312, a signal for causing the 1/f fluctuation function to be canceled is output. Thus, this routine is finished.

When the 1/f fluctuation function is executed corresponding to the map shown in Fig. 6 (A), since the ratio of the fluctuation width to each air amount is almost constant, the user can feel almost the same fluctuation effect regardless of any reference air amount being selected.

In this embodiment, the map shown in Fig. 6 (A) is selected. However, in the case that the map shown in Fig. 6 (B) is selected, when the air amount is "weak", the fluctuation width becomes "large". When the air amount is "strong", the fluctuation width becomes "low".

When such a control is performed, the noise can be equalized regardless of the reference air amount.



Thus, the noise can be more reduced than the case of which the fluctuation width is constant.

In the case that the map shown in Fig. 6 (c) is selected, when the air amount is "medium", the fluctuation width is large. Thus, the effect of the $1/f$ fluctuation function can be maximally obtained. At this point, although the noise increases to some extent, when another reference air amount is selected, since the fluctuation width is maximally suppressed, the effect of the $1/f$ fluctuation function cannot be satisfactorily obtained. However, in this case, the noise can be reduced. In this embodiment, the reference air amount that is often used is "medium". However, another air amount can be selected.

According to this embodiment, since the fluctuation width is varied corresponding to the reference air amount, effects that have not accomplished (for example, the emphasis of the $1/f$ fluctuation function, the emphasis of the noise, or the antinomy of the improvement of $1/f$ fluctuation function and the noise reduction) can be accomplished.

For example, when a relatively narrow room of a quiet residence is air-conditioned, the noise reduction can be emphasized (with the map shown in Fig. 6 (B)). When a room of a store or the like that does not relatively require a quiet environment is air-conditioned, the $1/f$ fluctuation function can be



improved so as to save energy (with the map shown in Fig. 6 (A)).

Now consider the case that a large room is normally air-conditioned with a strong constat air amount and a small partitioned area of the room is air-conditioned with a weak air amount. In this case, with the map shown in Fig. 6 (C), when the large room is air-conditioned, the $1/f$ fluctuation function can be emphasized. When the small area is air-conditioned, the noise reduction can be emphasized.

In this embodiment, the three types of fluctuation width designating maps have been stored in the microcomputer 72C. When the air conditioner is installed, one of the maps is selected. However, it should be noted that more than three types of maps may be prepared. In addition, after the air conditioner is installed, the user can select one of the maps. Instead, one of the maps may be stored.

As described above, according to the air conditioner of the present invention, a fluctuation width to each reference air amount is designated so that the ratio of the fluctuation width thereto becomes constant. Thus, the user can feel the comfortableness of the $1/f$ fluctuation regardless of any reference air amount.

When the fluctuation width is decreased corresponding to the increase of the predetermined



reference air amount, the noise of the air supplying means can be kept constant regardless of the predetermined reference air amount. Thus, the discomfortableness of the noise can be removed.

When the $1/f$ fluctuation function is satisfactorily employed with to a reference air amount that is often used and otherwise the $1/f$ fluctuation function is suppressed for noise reduction, both the effects of antinomy can be accomplished.

In other words, when the $1/f$ fluctuation function is employed, the fundamental functions (coolness, warmth, and so forth) of the air conditioner are improved. In addition, the noise of the air conditioner is reduced. Thus, the comfortableness of the user can be totally improved.

Although the present invention has been shown and described with respect to a best mode embodiment thereof, it should be understood by those skilled in the art that the foregoing and various other changes, omissions, and additions in the form and detail thereof may be made therein without departing from the spirit and scope of the present invention.



What is claimed is:

1. An air conditioner having a refrigerating cycle of at least a compressor, a condenser, an expansion device, and an evaporator connected by a refrigerant pipe and adapted for supplying heated or cooled air to an air-conditioned space with an air supplying device, and adjusting the temperature of the air-conditioned space to a desired temperature, comprising:

signal output means for outputting a first signal for designating an air supplying amount of the air supplying device;

control means for adjusting the air supplying amount of the air supplying device corresponding to the first signal;

air supplying amount compensating means for supplying a second signal to said control means, the second signal being adapted for causing the air supplying amount of the air supplying device to be automatically sway in a predetermined range of the air supplying amount designated corresponding to the first signal; and

variable width control means for designating the predetermined range corresponding to the first signal supplied from said signal output means.

2. The air conditioner as set forth in claim 1, wherein said variation width control means is



adapted for designating the predetermined range corresponding to a predetermined ratio of the predetermined air supplying amount corresponding to the first signal supplied from said signal output means.

3. The air conditioner as set forth in claim 1, wherein said variation width control means is adapted for decreasing the predetermined range corresponding to the increase of the predetermined air supplying amount corresponding to the first signal supplied from said signal output means.

4. The air conditioner as set forth in claim 1, wherein said variable width control means is adapted for increasing the predetermined range when the predetermined air supplying amount corresponding to the first signal supplied from said signal output means is in a predetermined range.

5. The air conditioner as set forth in claim 1, wherein said air supplying amount compensating means is adapted for automatically varying the designated air supplying amount corresponding to the first signal supplied from said signal output means in such a manner that power spectrum is inversely proportional to frequency.

6. The air conditioner as set forth in claim 2, wherein said air supplying amount compensating means is adapted for automatically varying the designated air supplying amount corresponding to the

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first signal supplied from said signal output means in such a manner that power spectrum is inversely proportional to frequency.

7. The air conditioner as set forth in claim 3, wherein said air supplying amount compensating means is adapted for automatically varying the designated air supplying amount corresponding to the first signal supplied from said signal output means in such a manner that power spectrum is inversely proportional to frequency.

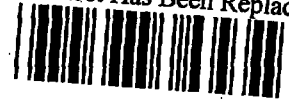
8. The air conditioner as set forth in claim 3, wherein said air supplying amount compensating means is adapted for automatically varying the designated air supplying amount corresponding to the first signal supplied from said signal output means in such a manner that power spectrum is inversely proportional to frequency.

9. An air conditioner substantially as herein described with reference to the accompanying drawings.

10. A method of operating an air conditioner, said method being substantially as herein described with reference to the accompanying drawings.

AIR CONDITIONER

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ABSTRACT

The present invention discloses an air conditioner (12) for exchanging heat from a refrigerant to the outside and adjusting at least one of room temperature and humidity to a desired room temperature and humidity. The air conditioner (12) has a 1/f fluctuation function for controlling an air supplying means (112A, 112B) for supplying conditioned air in multiple levels. An air amount designating means (300) designates a reference air amount of the air supplying means (112A, 112B), an air amount control means (308) controls the air supplying means (112A, 112B) corresponding to the designated reference air amount and a fluctuation width designating means (304) designates a fluctuation width (amplitude of the air amount) corresponding to the designated air amount.

Figs. 4 & 5

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FIG. 1

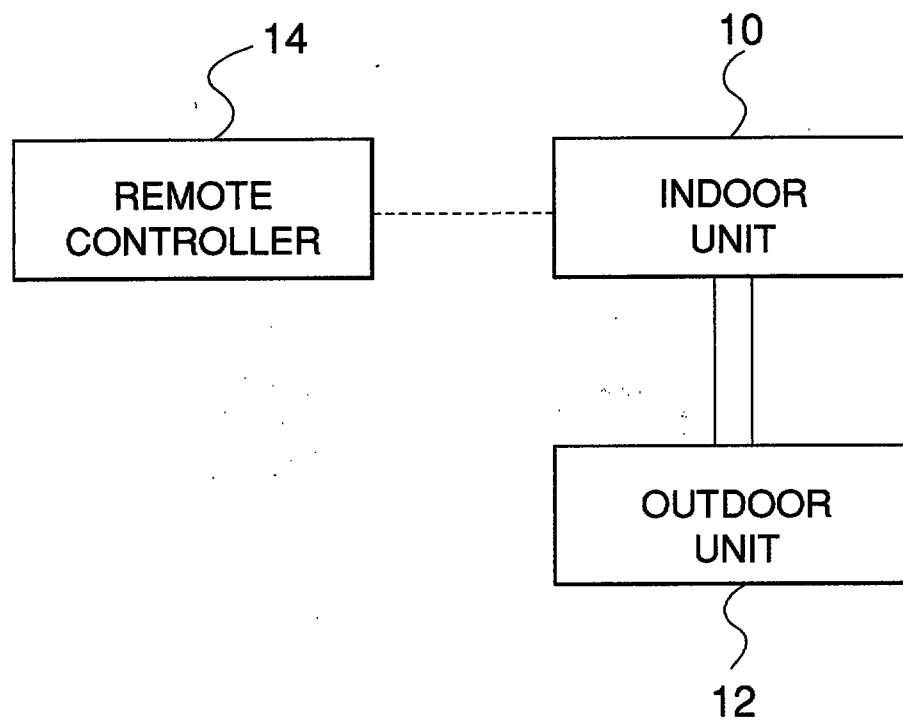


FIG. 2

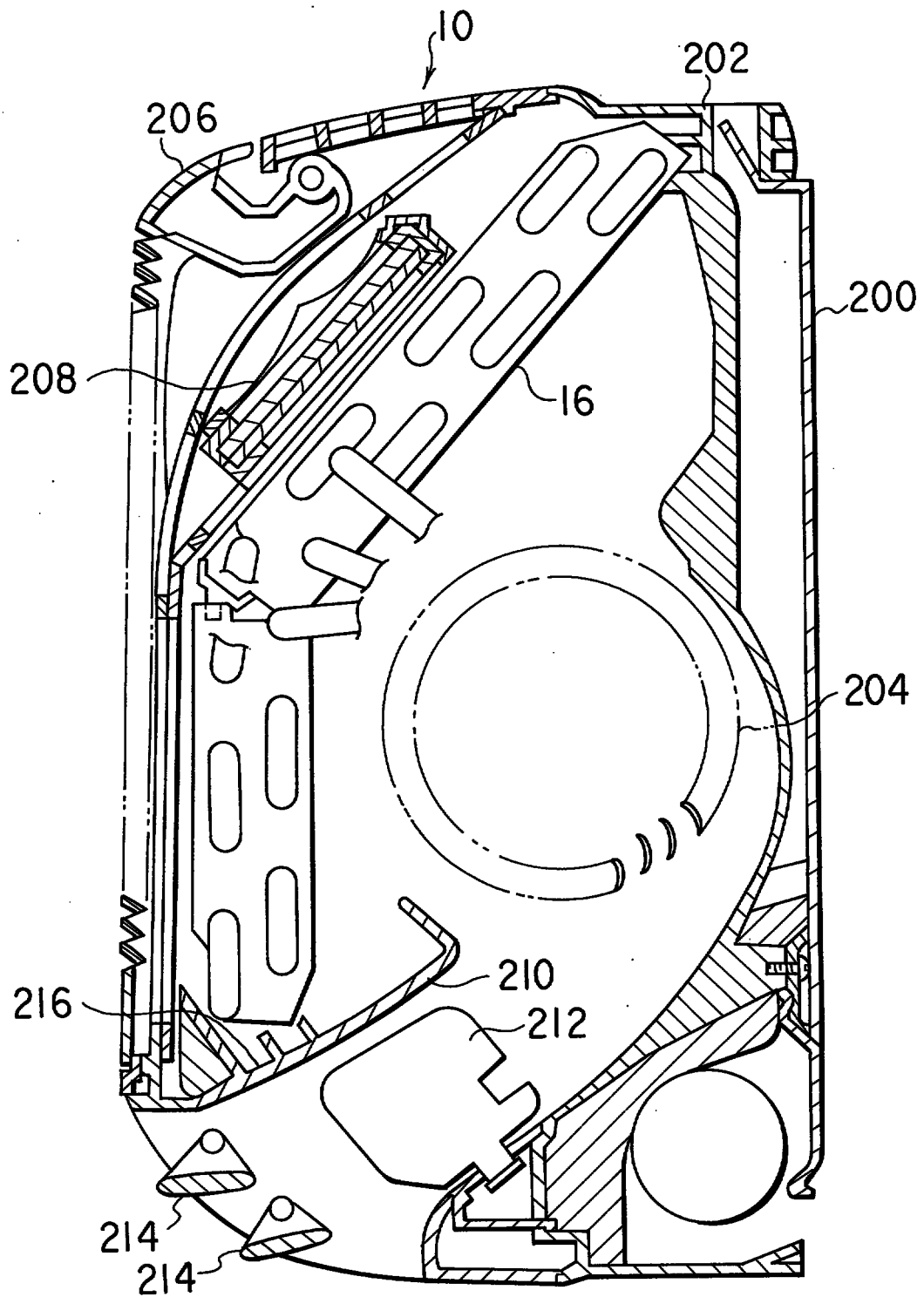


FIG. 3

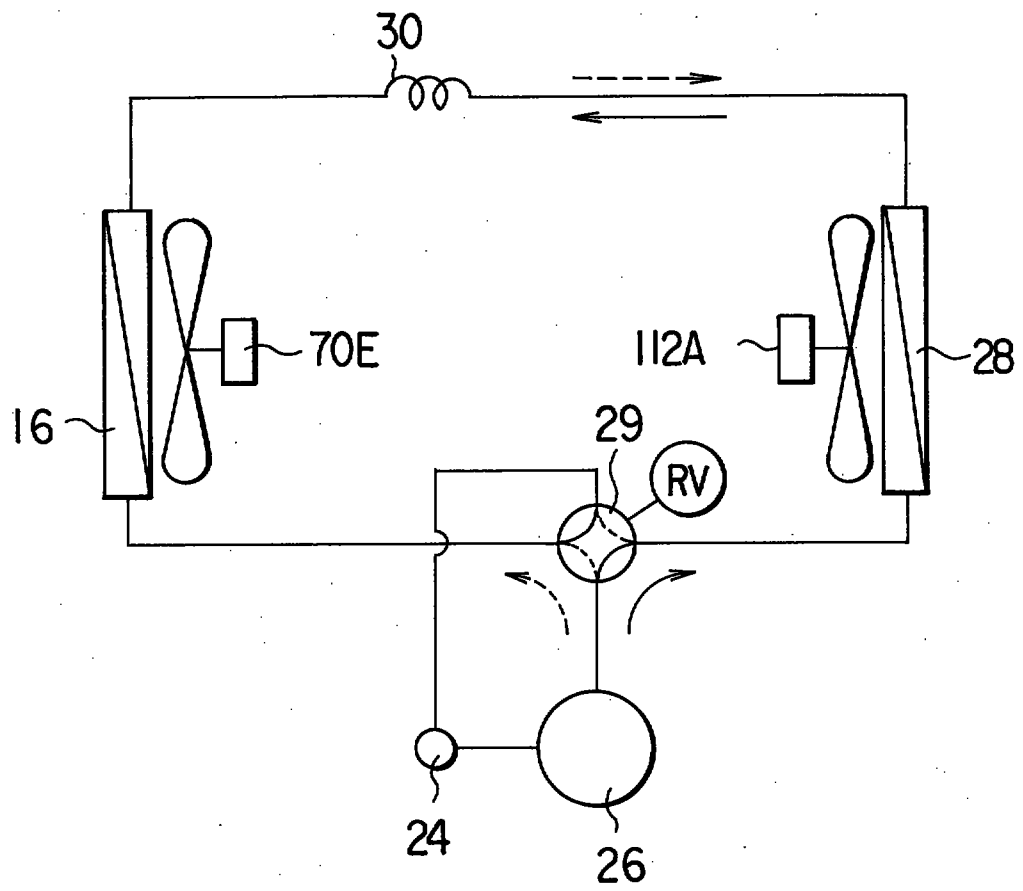
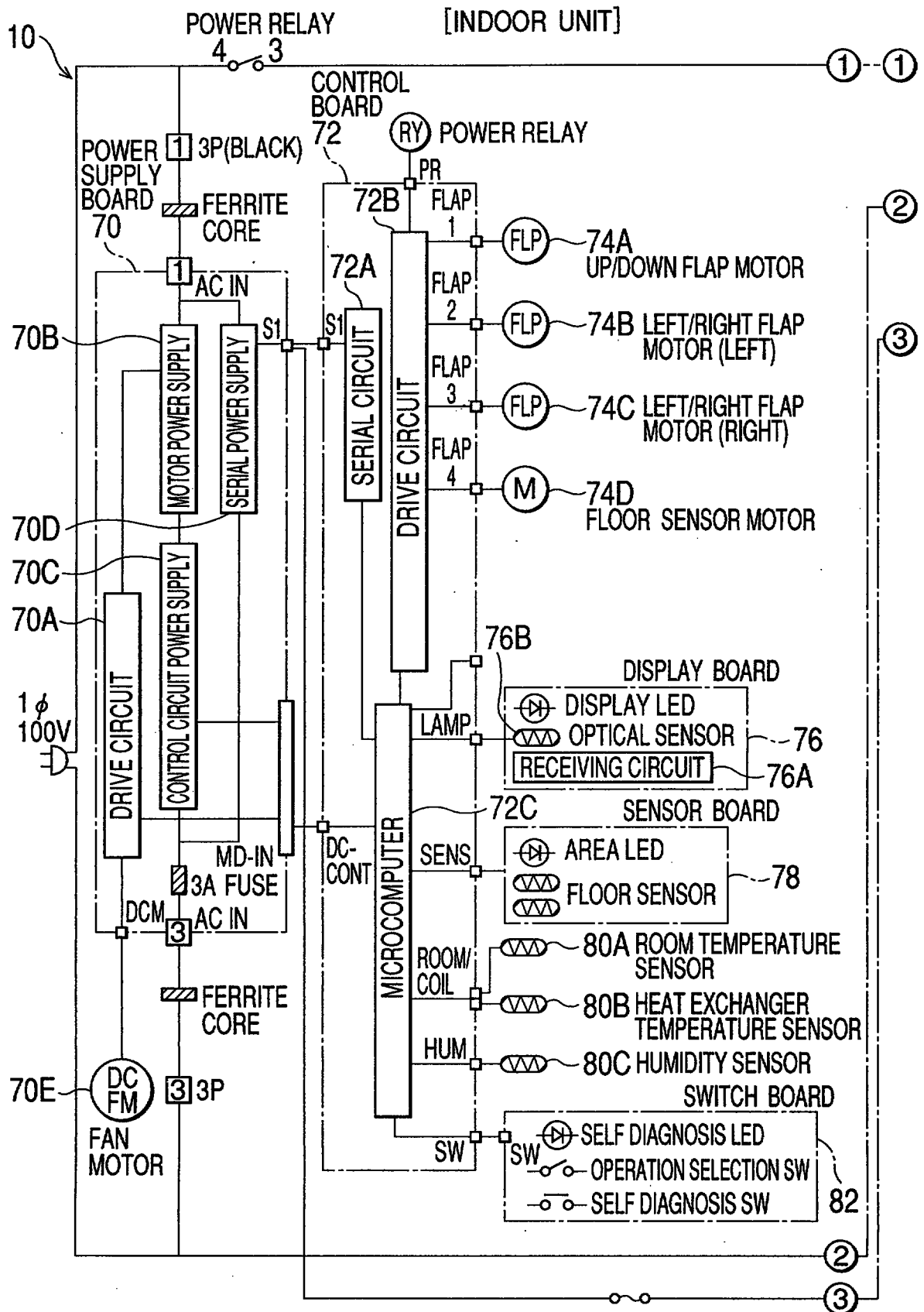
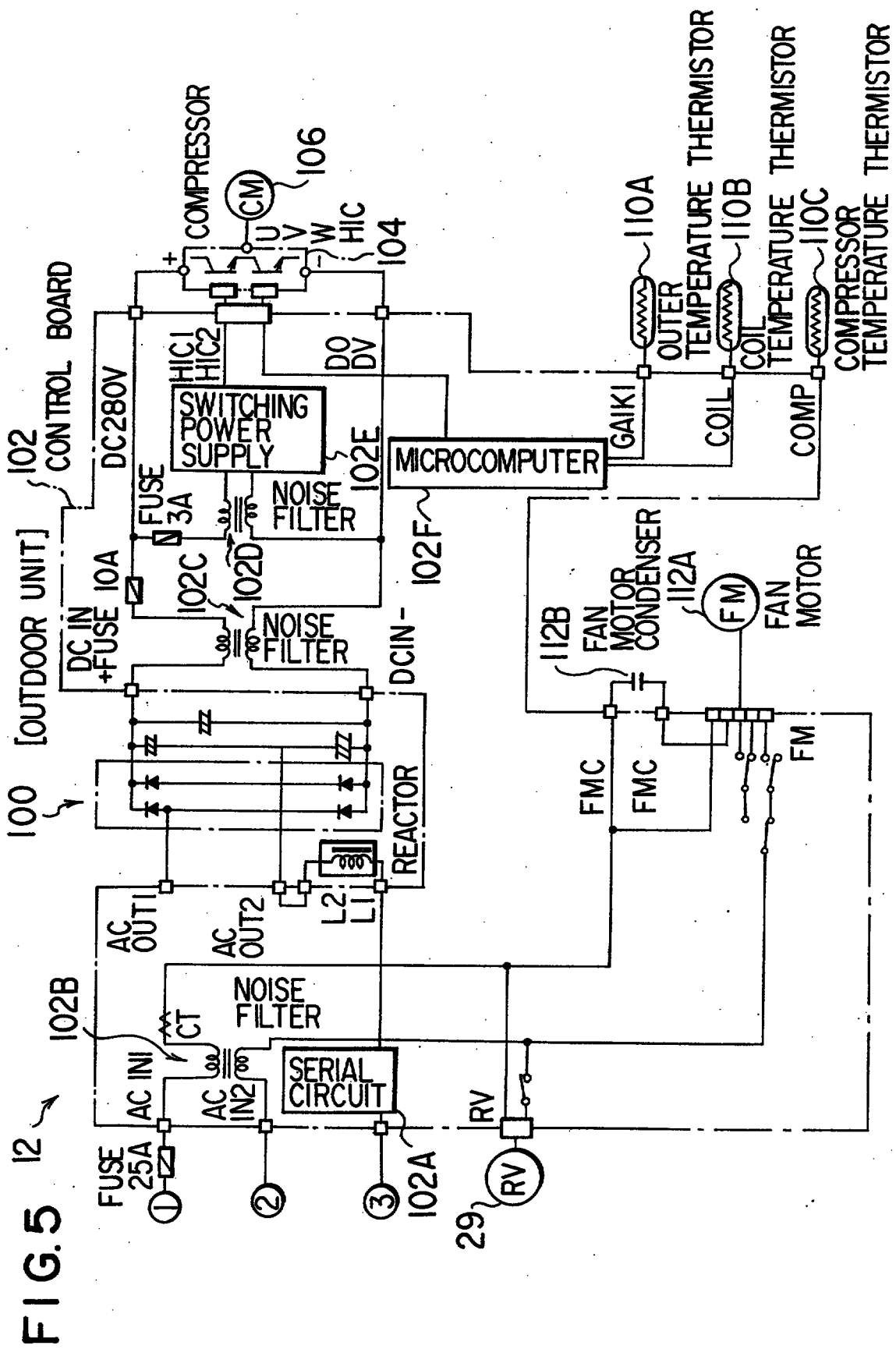


FIG.4





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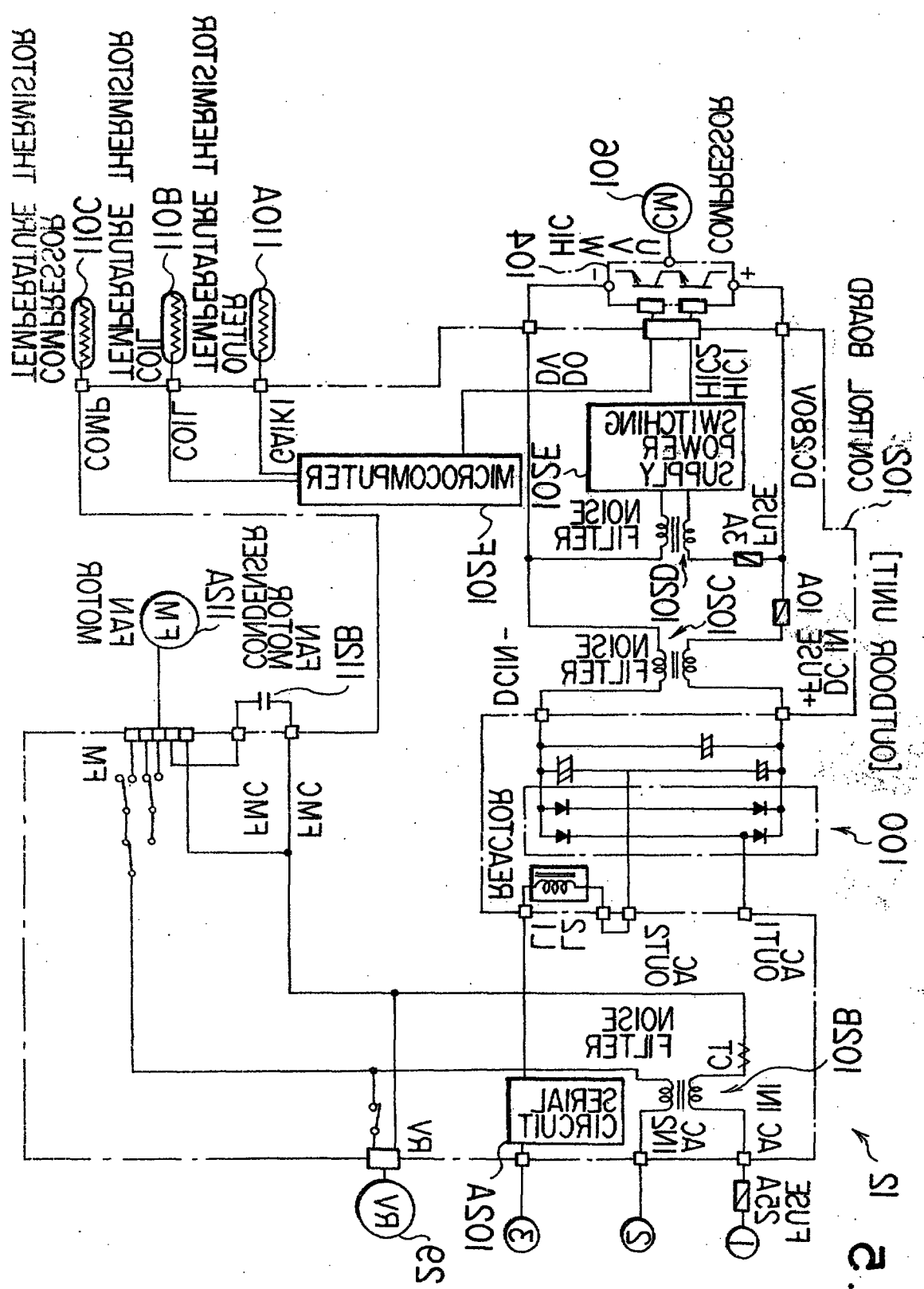


FIG. 6A

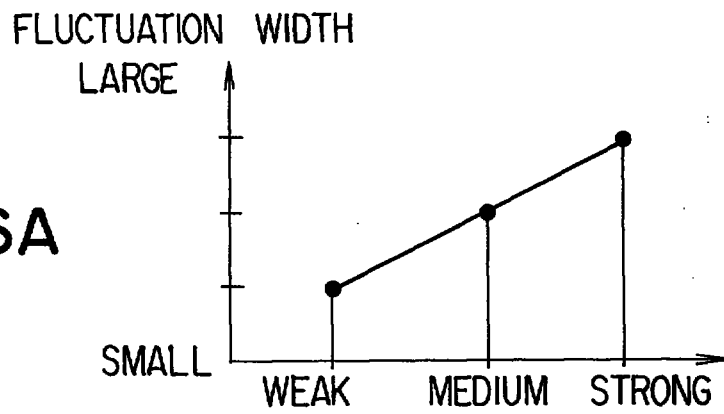


FIG. 6B

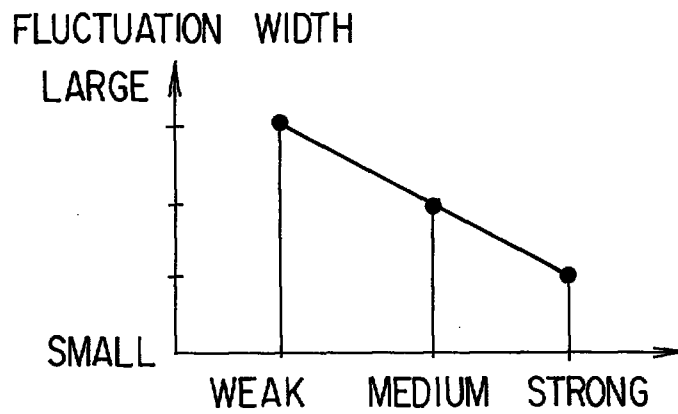


FIG. 6C

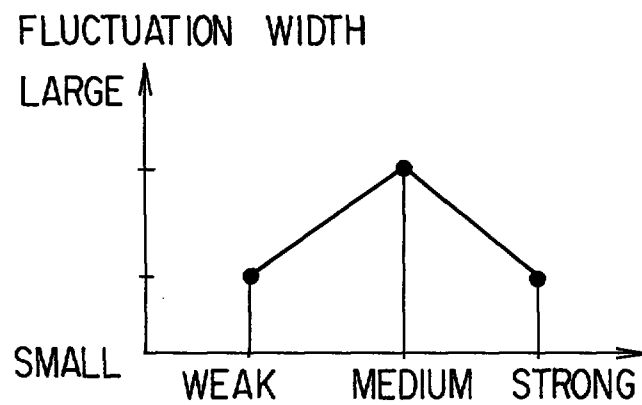
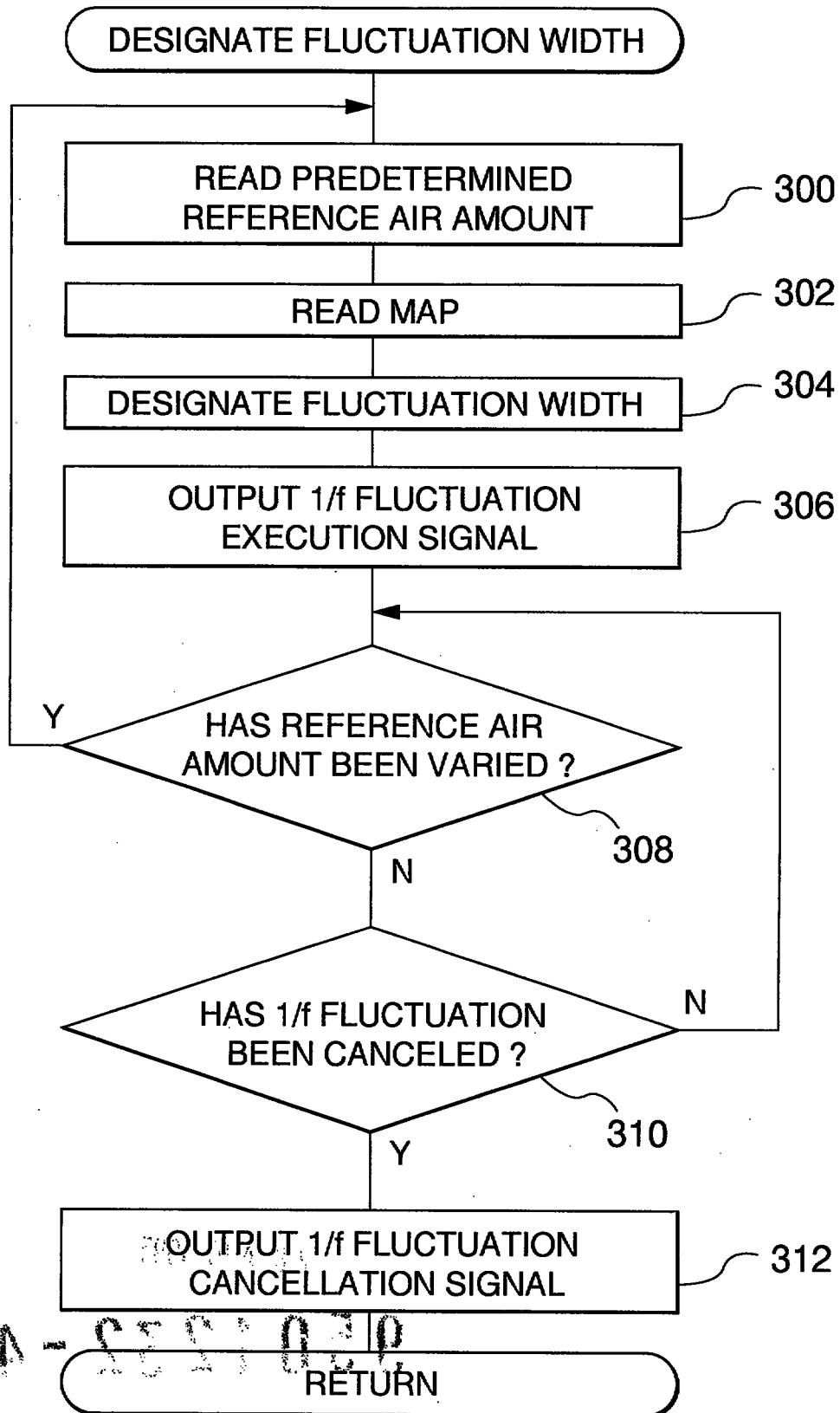


FIG. 7



AIR CONDITIONERABSTRACT

The present invention discloses an air conditioner (12) for exchanging heat from a refrigerant to the outside and adjusting at least one of room temperature and humidity to a desired room temperature and humidity. The air conditioner (12) has a 1/f fluctuation function for controlling an air supplying means (112A, 112B) for supplying conditioned air in multiple levels. An air amount designating means (300) designates a reference air amount of the air supplying means (112A, 112B), an air amount control means (308) controls the air supplying means (112A, 112B) according to the designated reference air amount and a fluctuation width designating means (304) designates a fluctuation width (amplitude of the air amount) according to the designated air amount.

Figs. 4 & 5

TITLE OF THE INVENTION**Air Conditioner****BACKGROUND OF THE INVENTION**

The present invention relates to an air conditioner for exchanging heat from a refrigerant to the outside of a room so as to adjust at least one of the room temperature and the humidity to a desired temperature or humidity, and having a function for controlling an air supplying means that supplies conditioned air to the room so as to vary the amount of air supplied in multiple levels corresponding a selected reference air amount.

A conventional air conditioner exchanges heat from a refrigerant to the outside of an enclosure or room and operates in various modes such as a heating mode, a cooling mode, a drying mode, and an automatic operating mode. In the automatic operating mode, the air conditioner compares a designated temperature and the room temperature and automatically selects the heating mode or the cooling mode corresponding to the desired result. The user can select a desired mode with a remote controller that is an accessory of the air conditioner so as to air-condition the room.

A particular air conditioner has a special cooling function for supplying air while varying the amount of air supplied, e.g., by supplementing it with natural air. In this function, a predetermined fluctuation width (amplitude or variation) in the amount of air supplied is designated regardless of the predetermined reference air amount and the amount of air supplied is varied in irregular periods. When the air amount is controlled in such a manner, the user in the room cannot anticipate the amount or timing of the supply of air. Thus, since he can unexpectedly feel coolness, the comfortableness in the room improves.

In other words, because this function includes a psychological factor of the user, the coolness that the user feels can be improved in comparison with the conventional temperature control method which uses equal air amounts. Since the feeling of coolness is

improved, the designated temperature can be increased over that with the conventional cooling method. Thus, this function contributes to so-called energy saving.

However, in such a function, the fluctuation of the period and amount of the air supply does not accord with the predetermined reference air amount. Thus, the ratio of the fluctuation of the air supplied to the predetermined air amount varies as though there were a change of the predetermined air amount. In other words, when the predetermined reference amount is small (weak), the ratio of the fluctuation width thereto is large. Thus, the user can satisfactorily feel the fluctuation of the air supplying amount. In contrast, when the reference air amount is large (strong), since the ratio of fluctuation width thereto becomes small. The user cannot satisfactorily feel the fluctuation.

To solve this problem, the ratio in the case where the reference air amount is maximum may be designated for the fluctuation width in which the user can satisfactorily feel the fluctuation function. However, when the reference air amount is small, the ratio of the fluctuation width thereto becomes too large, resulting in an increase in the noise from the air supplying device. Thus, the user may feel uncomfortable.

To satisfactorily employ the fluctuation function, the environment in which the air conditioner is used (the efficiency of the air flow and the reference air amount which is often used that depend on the area of the room, the layout of furniture, and so forth) should be considered. Thus, when only the ratio to the reference air amount is considered, the fluctuation function may not be satisfactorily employed.

SUMMARY OF THE INVENTION

The present invention is made from the above-described point of view. An object of the present invention is to provide an air conditioner for improving the fundamental functions (coolness, warmth, and so forth) thereof, reducing noise associated with the operation thereof, and totally improving the comfortableness of the user.

The present invention is an air conditioner having a refrigerating cycle of at least a compressor, a condenser, an expansion device, and an evaporator connected by a refrigerant pipe. The air conditioner is adapted for supplying heated or cooled air to an

air-conditioned space with an air supplying device, and adjusting the temperature of the air-conditioned space to a predetermined temperature. The device comprises a signal output means for generating a first signal for designating an amount of air to be supplied to the air supplying device, a control means for adjusting the air supply amount from the air supplying device according to the first signal, an air supplying amount compensating means for supplying a second signal to the control means, the second signal being adapted for causing the air supply amount from the air supplying device to be automatically varied in a predetermined range about the air supplying amount which is designated accordingly to the first signal, and a variable width control means for designating the predetermined range in accordance with the first signal supplied from the signal output means.

These and other objects, features and advantages of the present invention will become more apparent in light of the following detailed description of a best mode embodiment thereof, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 is a block diagram showing a construction of an air conditioner according to an embodiment of the present invention;

Fig. 2 is a side view showing an internal construction of an indoor unit;

Fig. 3 is a schematic diagram showing a refrigerant circuit of the air conditioner according to the embodiment of the present invention;

Fig. 4 is an electric circuit diagram of the indoor unit of the air conditioner according to the embodiment of the present invention;

Fig. 5 is an electric circuit diagram of an outdoor unit of the air conditioner according to the embodiment of the present invention;

Figs. 6 (A) to (C) are fluctuation width designating maps stored in a microcomputer according to the embodiment of the present invention; Fig. 6 (A) is a map showing an air amount and fluctuation width for emphasizing a $1/f$ fluctuation function, Fig. 6 (B) is a map showing air amount and fluctuation width for emphasizing noise

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reduction, and Fig. 6 (C) is a map showing air amount and fluctuation width for emphasizing the $1/f$ fluctuation function in a predetermined air amount state; and

Fig. 7 is a flow chart for controlling the designation of a fluctuation width for the $1/f$ fluctuation function.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Next, with reference to the accompanying drawings, an embodiment of the present invention will be described. Fig. 1 shows an air conditioner according to the embodiment of the present invention. The air conditioner comprises an indoor unit 10, an outdoor unit 12, and a remote controller 14. The indoor unit 10 and the outdoor unit 12 each have a refrigerant circulating path for circulating a refrigerant. The remote controller 14 sends operational signals as infrared rays to the air conditioner so as to remotely control it.

The remote controller 14 has various operation keys for turning on/off the power, selecting cooling/heating modes, designating temperature, designating time, and so forth. With the operation keys, corresponding operation signals are sent to the air conditioner. The remote controller 14 has air amount or volume designating keys. With the air amount designating keys, the user can select the air volume from "WEAK", "MEDIUM", and "STRONG".

In this embodiment, an air conditioner that has the three levels of air amount will be exemplified. However, the above-described three levels of air volume are fundamental in the embodiment. Thus, the embodiment can be applied to other constructions in which the air amount is varied in several levels (including for example "breeze", "high power", etc.), or in which the air amount is gradually varied rather than being changed in fixed levels.

In addition, the remote controller 14 according to the embodiment has a " $1/f$ fluctuation" designating key. With the " $1/f$ fluctuation" designating key, the $1/f$ fluctuation function is executed.

In the 1/f fluctuation function, a predetermined fluctuation width (amplitude) is designated regardless of the predetermined reference air volume or amount. In addition, the air amount is irregularly varied in the fluctuation width so that the power spectrum is inversely proportional to the frequency. Thus, since the air amount is unexpectedly varied, the comfort of the user is improved in comparison with a fixed air amount.

In this embodiment, as a means for sending operation signals of the remote controller 14 to the indoor unit 10, electromagnetic waves, such as infrared rays, are used. The indoor unit 10 has an optical sensor 76B that receives the infrared rays (Fig. 4). The optical sensor 76B will be described later.

When an operation signal sent from the remote controller 14 is received by the optical sensor 76B of the indoor unit 10, the air conditioner controls the room temperature, humidity, and so forth according to the code in the received operation signal. It should be noted that the remote controller 14 can be connected to the indoor unit with a signal line.

As shown in Fig. 2, the indoor unit 10 is covered by a casing 202. The casing 202 is detachably secured to the upper and lower edges of a mounting base 200. A cross flow fan 204 is disposed at a center portion of the casing 202. The cross flow fan 204 is driven by a fan motor 70E (that will be described later). The cross flow fan 204 sucks air in the room from a vent opening 206 through various filters 208 and an indoor heat exchanger 16 and supplies the resultant air to the inside of a room through an air channel 210. The air channel 210 has a horizontal vane 212 and horizontal flaps 214 so as to adjust the direction of the air supplied to the room.

A drain pan 216 is integrally disposed on the casing 202 at the lower portion of the indoor heat exchanger 16.

Fig. 3 shows a refrigerant circuit of the air conditioner controlled by a control unit according to the embodiment of the present invention. In Fig. 3, reference numeral 26 identifies a compressor. Reference numeral 29 identifies a four-way valve. Reference numeral 28 identifies an outdoor heat exchanger disposed in the outdoor unit 12.

Reference numeral 30 indicates a capillary tube. Reference numeral 16 indicates an indoor heat exchanger disposed in the indoor unit 10. Reference numeral 24 identifies an accumulator. These elements are circularly connected by a refrigerant pipe so as to construct a refrigerant cycle.

In the air conditioner, when the four-way valve 29 is placed in the state denoted by a solid line shown in Fig. 3, the refrigerant supplied from the compressor 26 flows in the direction of an arrow denoted by a solid line. Thus, the refrigerant is compressed in the outdoor heat exchanger 28. The refrigerant is evaporated by the indoor heat exchanger 16. Consequently, the room is cooled. On the other hand, when the four-way valve 29 is placed in the state denoted by a dotted line shown in Fig. 3, the refrigerant supplied from the compressor 26 flows in the direction of an arrow denoted by a dotted line. The refrigerant is compressed by the indoor heat exchanger 16. The refrigerant is evaporated by the outdoor heat exchanger 28. Consequently, the room is heated.

Reference numeral 112A indicates a fan motor that drives an outdoor air supplying device. Reference numeral 70E indicates a fan motor that drives an indoor air supplying device along with the cross flow fan 204. The fan motor 112A and the fan motor 70E cause air to be supplied to the outdoor heat exchanger 28 and the indoor heat exchanger 16, respectively.

Fig. 4 shows the electric circuit of the indoor unit 10. The electric circuit has a power supply board 70 and a control board 72. The power supply board 70 has a drive circuit 70A, a motor power supply circuit 70B, a control circuit power supply circuit 70C, and a serial circuit power supply circuit 70D. The drive circuit 70A is connected to the fan motor 70E that controls the air amount supplied to the room. The motor power supply circuit 70B generates the power for driving various motors. The control circuit power supply circuit 70C generates power for the control circuit. The serial circuit power supply circuit 70D generates the power for the serial circuit.

The fan motor 70E of the embodiment is a DC motor. The voltage supplied to the fan motor 70E is controlled with an eight bit code. Thus, by the voltage control, the

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air amount can be controlled in 256 levels. This voltage control allows the amount of air to be finely controlled for the l/f fluctuation function.

The control board 72 has a serial circuit 72A, a drive circuit 72B, and a microcomputer 72C. The serial circuit 72A is connected to the serial circuit power supply circuit 70D. The drive circuit 72B drives a motor. The microcomputer 72C functions as a control circuit. The drive circuit 72B is connected to an up/down flap motor 74A, left/right flap motors 74B and 74C, and a floor sensor motor 74D. The up/down flap motor 74A vertically moves a flap. The floor sensor motor 74D rotates a floor sensor that detects the temperature of the entire surface of the floor.

The microcomputer 72C is connected to a display LED, an optical sensor 76B, and a receiving circuit 76A. The display LED is disposed on the display board 76 and displays the operation mode and so forth. The receiving circuit 76A receives an operation signal as infrared rays through the optical sensor 76B from the remote controller 14.

In addition, the microcomputer 72C is connected to an area LED and a floor sensor. The area LED is disposed on the sensor plate 78 and displays the temperature detecting area of the floor.

The remote controller 14 causes the air conditioner to drive the flap motors 74A, 74B, and 74C in order to change the flap angles and so forth, thereby selecting each of the heating mode, cooling mode, dry mode, and automatic operating mode, changing the designated temperature, and changing the amount of air supplied.

In addition, the microcomputer 72C is connected to a room temperature sensor 80A, a heat exchanger temperature sensor 80B, and a humidity sensor 80C. The room temperature sensor 80A detects the room temperature. The heat exchanger temperature sensor 80B detects the temperature of the refrigerant coil of the indoor heat exchanger 16. The humidity sensor 80C detects the humidity of the room. In addition, the microcomputer 72C is connected to a self diagnosis LED, an operation selection switch, and a self diagnosis switch that are disposed on the switch board 82. The operation

selection switch selects one of the heating mode, the cooling mode, the dry mode, and the automatic operation mode.

Display LEDs corresponding to the "heating mode", "cooling mode", "dry mode", and "automatic operation mode" are disposed on the display board 76 and light corresponding to the operation modes.

Fig. 5 shows an electric circuit of the outdoor unit 12. This electric circuit has a rectifier circuit 100 and a control board 102. Terminals (1) to (3) of the electric circuit of the outdoor unit 12 are connected to the electric circuit of the indoor unit 10 shown in Fig. 4.

The control board 102 has a serial circuit 102A, noise filters 102B, 102C, and 102D, a switching power supply circuit 102E, and a microcomputer 102F. The serial circuit 102A is connected to the serial circuit power supply circuit 70D of the indoor unit 10. The noise filters 102B, 102C, and 102D remove noise. The switching power supply circuit 102E is connected to and generates power for the inverter 104. The microcomputer 102F functions as a control circuit.

The inverter 104 is connected to a compressor motor 106 which drives the compressor 26 to compress the refrigerant.

The microcomputer 102F is connected to an outer air temperature thermistor 110A, a coil temperature thermistor 110B, and a compressor temperature thermistor 110C. The outer air temperature thermistor 110A is an outer temperature sensor that detects the temperature of the outside air. The coil temperature thermistor 110B is a coil temperature sensor that detects the temperature of the refrigerant coil of the outdoor heat exchanger 28. The compressor temperature thermistor 110C is a temperature sensor that detects the temperature of the compressor 26.

The noise filter 102B is connected to a fan motor 112A and a fan motor condenser 112B. The fan motor 112A supplies air to the outdoor heat exchanger 28. Connected in parallel with the fan motor 112A and the fan motor condenser 112B, are the four-way valve 29 and a solenoid valve 29' as well as the noise filter 102B.

In this embodiment, the fluctuation width (i.e., the variation in the amplitude of the air amount) of the 1/f fluctuation function is varied in correspondence with the designated reference air amount.

In other words, the microcomputer 72C stores fluctuation width designating maps corresponding to the predetermined reference air amount (see Figs. 6 (A) to (C)). One of the fluctuation width designating maps is selected corresponding to the position at which the indoor unit 10 is installed. These maps represent the relation between the reference air amount and fluctuation width corresponding to different installation conditions of the air conditioner.

In this embodiment, the three maps have been stored. However, any one or any two of the maps may be selected and stored. In other words, when the installation condition at which the indoor unit 10 is installed is known, the indoor unit 10 can be operated with only one relationship between reference air amount and fluctuation width.

In the map shown in Fig. 6 (A), the fluctuation width increases with an increase in the amount of air. In other words, when the amount of air is "weak", the fluctuation width is also "small". When the amount of air is "strong", the fluctuation width becomes "large". In the map shown in Fig. 6 (A), the fluctuation width is designated so that the ratio of the fluctuation width to each air amount is constant. Thus, since the varying ratio of the air amount of the 1/f fluctuation function is constant regardless of the air amount, the user in the room can feel the 1/f fluctuation effect regardless of the air amount.

In the map shown in Fig. 6 (B), the fluctuation width decreases with an increase in the amount of air. In other words, when the air amount is "weak", the fluctuation width is "large". When the air amount is "strong", the fluctuation width becomes "weak". Since the air amount and the fluctuation width are controlled in such a manner, when the air amount is "weak", the noise created by the fan in supplying the air amount is low. Thus, so as to satisfactorily employ the 1/f fluctuation function, the fluctuation width is increased. When the air amount is "strong", the noise of the air supplying means in the

air amount is large. Thus, so as to suppress the $1/f$ fluctuation function, the fluctuation width is decreased.

In other words, regardless of the air amount, when the noise is kept almost constant (averaged), the discomfort from the noise can be reduced.

In the map shown in Fig. 6 (C), a fluctuation width is designated so that the $1/f$ fluctuation function can be satisfactorily employed with a predetermined air amount. With other than the predetermined air amount, the fluctuation width is suppressed so as to reduce the noise. In Fig. 6 (C), when the air amount is "medium", the $1/f$ fluctuation function is emphasized. When the air amount is "weak" or "strong", the noise reduction is emphasized. In this embodiment, when the indoor unit is installed, one of (1) $1/f$ fluctuation emphasizing state (Fig. 6 (A)), (2) low reduction emphasizing state (Fig. 6 (B)), and (3) combination state (Fig. 6 (C)) is selected and designated. After the indoor unit is installed, the fluctuation width is controlled corresponding to the selected map. In this embodiment, the $1/f$ fluctuation emphasizing state is designated.

Next, the operation of the air conditioner according to this embodiment will be described. First, the normal operation of the air conditioner will be described.

When the remote controller 14 is operated in the operation stop state and an operation signal is received by the receiving circuit 76A, the code of the received operation signal is analyzed.

It is determined whether or not the analyzed result is a power on command or a timer designating command. In the power off state, some operation signals, for example the temperature designating command and air amount designating command, are cancelled. Thus, when such operation signals are input, they are not accepted and the receiving circuit 7 is kept in the receiving state.

When a timer designating command is detected, the user of the remote controller 14 can designate the timer so that the air conditioner will operate at a predetermined time (for example, two hours later). Thus, the remote controller 14 outputs a corresponding operation signal to the air conditioner and thereby the timer (on time) is designated in the

air conditioner. Thus, the air conditioner automatically turns on and operates two hours later.

When a power on command is detected, the air conditioner starts in the designated mode of the last operation.

Thereafter, when an operation signal is received from the remote controller 14, the code of the received operation signal is analyzed and it is determined whether or not the analyzed signal is a power off command, an air amount designating (changing) command, a temperature designating (changing) command, or a timer designating (changing) command. Corresponding to the determined result, an item corresponding to the analyzed result is selected. Thus, the operation of the air conditioner is stopped or the designated operation mode is executed.

When the 1/f fluctuation function is commanded, the fan motor 70E is controlled. The amount of air is varied with the fluctuation width according to the designated air amount. Next, with reference to the flow chart of Fig. 7, the air amount control of the 1/f fluctuation function will be described.

At step 300, the air amount that has been designated at present is read. In other words, one of "weak", "medium", and "strong" air amounts is selected.

At step 302, one of the maps shown in Figs. 6 (A) to (C) is read. The map that is read is predesignated corresponding to the condition in which the air conditioner is installed. In this embodiment, the map shown in Fig. 6 (A) is selected. At step 304, the fluctuation width is obtained corresponding to the map. In other words, when the air amount is "weak", the fluctuation width is "small". When the air amount is "strong", the fluctuation width becomes "large".

At step 306, a command signal that causes the 1/f fluctuation function to be executed according to the map is output. Thereafter, the program flow advances to step 308.

At step 308, it is determined whether or not the reference air amount has been changed. When the determined result is YES, the flow returns to step 300 so as to repeat

the above-described process. When the determined result is NO, the program flow advances to step 310. At step 310, it is determined whether or not the 1/f fluctuation function has been cancelled. When the determined result is YES, the program advances to step 312. At step 312, a signal for causing the 1/f fluctuation function to be cancelled is output. Thus, this routine is finished.

When the 1/f fluctuation function is executed according to the map shown in Fig. 6 (A), since the ratio of the fluctuation width to each air amount is almost constant, the user can feel almost the same fluctuation effect regardless of any reference air amount that is selected.

In this embodiment, the map shown in Fig. 6 (A) is selected. However, in the case where the map shown in Fig. 6 (B) is selected, when the air amount is "weak", the fluctuation width becomes "large". When the air amount is "strong", the fluctuation width becomes "low".

When such a control is performed, the noise can be equalized regardless of the reference air amount.

Thus, the noise can be more reduced than the case in which the fluctuation width is constant.

In the case where the map shown in Fig. 6 (C) is selected, when the air amount is "medium", the fluctuation width is large. Thus, the effect of the 1/f fluctuation function can be maximally obtained. At this point, although the noise increases to some extent, when another reference air amount is selected, since the fluctuation width is maximally suppressed, the effect of the 1/f fluctuation function cannot be satisfactorily obtained. However, in this case, the noise can be reduced. In this embodiment, the reference air amount that is often used is "medium", However, another air amount can be selected.

According to this embodiment, since the fluctuation width is varied according to the reference air amount, effects that have not accomplished (for example, the emphasis of the 1/f fluctuation function, the emphasis of the noise, or the trade off between the improvement of 1/f fluctuation function and the noise reduction) can be accomplished.

For example, when a relatively narrow room of a quiet residence is air-conditioned, the noise reduction can be emphasized (with the map shown in Fig. 6 (B)). When a room of a store or the like that does not require a relatively quiet environment is air-conditioned, the 1/f fluctuation function can be improved so as to save energy (with the map shown in Fig. 6 (A)).

Now consider the case that a large room is normally air-conditioned with a strong constant air amount and a small partitioned area of the room is air-conditioned with a weak air amount. In this case, with the map shown in Fig. 6 (C), when the large room is air-conditioned, the 1/f fluctuation function can be emphasized. When the small area is air-conditioned, the noise reduction can be emphasized.

In this embodiment, the three types of fluctuation width designating maps have been stored in the microcomputer 72C. When the air conditioner is installed, one of the maps is selected. However, it should be noted that more than three types of maps may be prepared. In addition, after the air conditioner is installed, the user can select one of the maps. Instead, one of the maps may be stored.

As described above, according to the air conditioner of the present invention, a fluctuation width related to each reference air amount is designated so that the ratio of the fluctuation width becomes constant. Thus, the user can feel the comfort of the 1/f fluctuation regardless of any reference air amount.

When the fluctuation width is decreased corresponding to an increase in the predetermined reference air amount, the noise of the air supplying means can be kept constant regardless of the predetermined reference air amount. Thus, the annoyance of the noise can be removed.

When the 1/f fluctuation function is satisfactorily employed with regard to a reference air amount that is often used, and otherwise the 1/f fluctuation function is suppressed for noise reduction, both of these paradoxical effects can be accomplished.

In other words, when the 1/f fluctuation function is employed, the fundamental functions (coolness, warmth, and so forth) of the air conditioner are improved. In

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addition, the noise of the air conditioner is reduced. Thus, the comfort of the user can be totally improved.

Although the present invention has been shown and described with respect to a best mode embodiment thereof, it should be understood by those skilled in the art that the foregoing and various other changes, omissions, and additions in the form and detail thereof may be made therein without departing from the spirit and scope of the present invention.

**CLAIMS**

1. An air conditioner having a refrigerating cycle including at least a compressor, a condenser, an expansion device, and an evaporator connected by a refrigerant pipe and adapted for (i) supplying heated or cooled air to an air-conditioned space by means of an air supplying device, and (ii) adjusting the temperature of the air-conditioned space to a desired temperature, comprising:

signal output means for generating a first signal designating an amount of air to be supplied by the air supplying device;

control means for adjusting the air supply amount from the air supplying device in accordance with the first signal;

air supplying amount compensating means for supplying a second signal to said control means, the second signal being adapted to cause the air supply amount from the air supplying device to be automatically varied in a predetermined range about the air supply amount designated accordingly to the first signal; and

variable width control means for designating the predetermined range in accordance with the first signal supplied from said signal output means.

2. The air conditioner as set forth in claim 1,
wherein said variable width control means is adapted for designating the predetermined range in accordance with a predetermined ratio of the predetermined air supply amount corresponding to the first signal supplied from said signal output means.

3. The air conditioner as set forth in claim 1,
wherein said variable width control means is adapted for decreasing the predetermined range corresponding to an increase in the predetermined air supply amount corresponding to the first signal supplied from said signal output means.

4. The air conditioner as set forth in claim 1,



wherein said variable width control means is adapted for increasing the predetermined range when the predetermined air supply amount corresponding to the first signal supplied from said signal output means is in a predetermined range.

5. The air conditioner as set forth in claim 1,

wherein said air supplying amount compensating means is adapted for automatically varying the designated air supply amount corresponding to the first signal supplied from said signal output means in such a manner that power spectrum is inversely proportional to frequency.

6. The air conditioner as set forth in claim 2,

wherein said air supplying amount compensating means is adapted for automatically varying the designated air supply amount corresponding to the first signal supplied from said signal output means in such a manner that power spectrum is inversely proportional to frequency.

7. The air conditioner as set forth in claim 3, wherein said air supplying amount compensating means is adapted for automatically varying the designated air supply amount corresponding to the first signal supplied from said signal output means in such a manner that power spectrum is inversely proportional to frequency.

8. The air conditioner as set forth in claim 4, wherein said air supplying amount compensating means is adapted for automatically varying the designated air supply amount corresponding to the first signal supplied from said signal output means in such a manner that power spectrum is inversely proportional to frequency.

9. An air conditioner substantially as herein described with reference to the accompanying drawings.

10. A method of operating an air conditioner, said method being substantially as herein described with reference to the accompanying drawings.