



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.05.2006 Bulletin 2006/20

(51) Int Cl.:
F04B 39/02 (2006.01) **F04B 39/12** (2006.01)
F04B 53/22 (2006.01) **F04B 49/06** (2006.01)

(21) Application number: **05024575.2**

(22) Date of filing: **10.11.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR
Designated Extension States:
AL BA HR MK YU

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(30) Priority: **11.11.2004 JP 2004327441**

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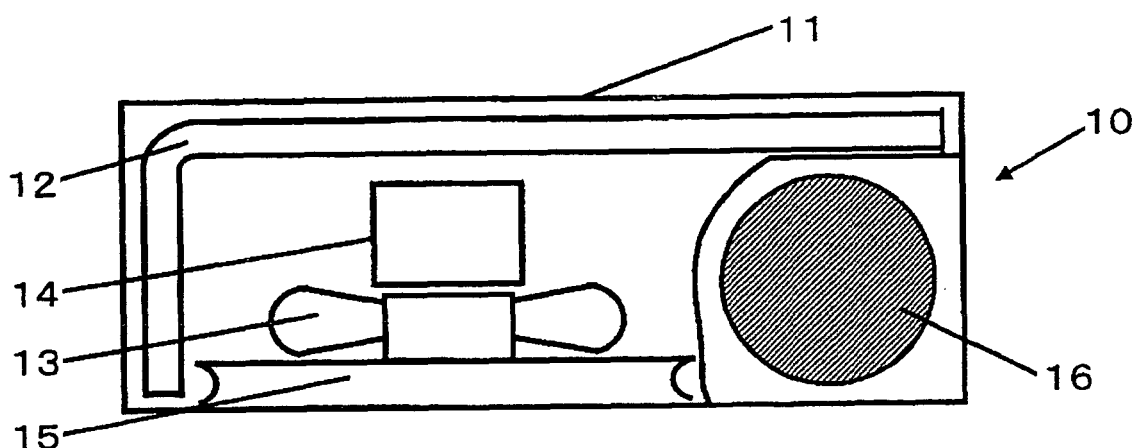
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(54) **Sealed type electric compressor**

(57) A sealed type electric compressor includes a control unit including a driving circuit unit in a housing; and a compressor housing including a compressing mechanism and a motor unit driven and controlled by the control unit. The control unit is mounted on the compres-

sor housing, and a first connection portion supported in the housing of the control unit and a second connection portion supported in the compressor housing are engaged with each other to realize an electric and/or a signal connection therebetween.

FIG. 1A



Description

[0001] The present invention relates to a sealed type electric compressor employed in a cooling device or an air conditioner; and, more particularly, to a sealed type electric compressor incorporating therein a compressor control unit as a single body, for controlling a driving unit by inverter control using an AC power source.

[0002] Recently, there has been strong tendency emphasizing on compactness and energy conservation in a household air conditioner or the like. To this purpose, an indoor unit of the air conditioner needs to have a heat exchanger with an enlarged heat transfer area, and the size of an outdoor unit should be reduced while a heat transfer area of a heat exchanger thereof is increased. Further, compactness and high efficiency of a compressor incorporated in the outdoor unit is also required. As for the compressor, a compressor main body and a compressor control unit need to be integrated as one body to thereby reduce the total volume of components of the compressor and at the same time facilitate the assembly thereof during fabrication.

[0003] Commonly used as a compressor in a household air conditioner is a type employing an inverter control mechanism. In this type of compressor, both a compressor and a compressor control unit for controlling the compressor are accommodated in an outdoor unit of the air conditioner to run a cooling cycle.

[0004] Fig. 8 provides a perspective view describing a schematic configuration of an outdoor unit of a conventional split-type air conditioner. As shown in Fig. 8, outdoor unit main body 100 includes compressor 110 having a compressing mechanism (not shown) and a motor unit (not shown) for driving the compressing mechanism; outdoor heat exchanger 120 for performing a heat exchange operation with exterior air; and blower 130 for blowing exterior air for the heat exchange operation. The compressing mechanism and the motor unit are accommodated in a sealed vessel of compressor 110. Further, these components are accommodated in a casing (not shown). Also, driving circuit unit 140 for driving the components in outdoor unit main body 100 is provided in an upper space above outdoor unit main body 100 to be located away from compressor 110.

[0005] Driving circuit unit 140 has a compressor control unit for controlling compressor 110, a blower control unit for controlling blower 130, a cooling cycle control unit for controlling a cooling cycle and a wiring portion connected to an indoor unit. Here, the compressor control unit is a major component of driving circuit unit 140.

[0006] Fig. 9 sets forth a driving circuit diagram for driving compressor 110 by an inverter control. As shown in Fig. 9, a driving circuit includes rectifier circuit unit 210 serving as a converter circuit unit for converting commercial AC power source 200 into a DC power; switching circuit unit 230 serving as an inverter circuit unit for converting the DC power into a three-phase AC power to drive motor 220 of compressor 110; gate drive circuit unit

240 for driving switching circuit unit 230; and operator unit 250 for generating an energization signal. Here, rectifier circuit unit 210 has reactor 260, capacitor 270, diode 280, and so forth. Further, switching circuit unit 230 has switching elements 290 formed of an insulated gate bipolar transistor (IGBT), a power transistor, or the like which is switchable at a high speed.

[0007] Returning to Fig. 8, driving circuit unit 140 is provided as an independent unit from other driving elements, and it is configured to be connected with the other driving elements by wiring when they are assembled.

[0008] Meanwhile, recently, the compressor with an inverter control is also employed in an air conditioner for use in a car, and to make the air conditioner compact and light-weighted, the compressor and the compressor control circuit unit are integrated as one body (see, for example, Japanese Patent Laid-open Application Nos. 2002-174178 and 2003-13859).

[0009] In the conventional air conditioner equipped with the inverter driving compressor using a commercial AC power source, the compressor main body and the compressor control unit are provided separately. For the reason, the volume occupied by the compressor control unit in the outdoor unit increases, resulting in a reduction of the heat transfer area of the outdoor heat exchanger, which in turn deteriorates the efficiency of the air conditioner.

[0010] Meanwhile, if the compressor control unit and the compressor are integrated as one body by reducing the size of the compressor control unit to be accommodated in an upper portion of the compressor to reduce the volume occupied by the compressor and the control unit in the outdoor unit, there give rise to following problems. That is, if an electric connection or a signal connection between the motor unit of the compressor and the compressor control unit is made, an extra space is needed for the wiring connection therebetween. Besides, in such a case, there is a likelihood that a wiring connection error may be made, and the time required for the wiring assembly would be long. Moreover, in case the length of the wiring is longer than a predetermined value, noise is highly likely to be introduced.

[0011] It is, therefore, an object of the present invention to provide a sealed type electric compressor whose volume is reduced by installing a control unit with a driving control circuit on a compressor housing as one body, wherein an electric connection or a signal connection between the control unit and the compressor is facilitated and the quality of the connection is improved.

[0012] In accordance with the present invention, there is provided a sealed type electric compressor including: a control unit including a driving circuit unit in a housing; and a compressor housing including a compressing mechanism and a motor unit driven and controlled by the control unit, wherein the control unit is mounted on the compressor housing, and a first connection portion supported in the housing of the control unit and a second connection portion supported in the compressor housing

are engaged with each other to realize an electric and/or a signal connection therebetween.

[0013] The above and other objects and features of the present invention will become apparent from the following description of preferred embodiments given in conjunction with the accompanying drawings, in which:

Figs. 1A and 1B show a plan view and a front view of an outdoor unit of an air conditioner accommodating therein a sealed type electric compressor in accordance with a first preferred embodiment of the present invention respectively;

Fig. 2 sets forth a schematic front view of the sealed type electric compressor in accordance with the first preferred embodiment;

Fig. 3 provides a plan view to illustrate an internal configuration of a control unit of the sealed type electric compressor in accordance with the first preferred embodiment;

Fig. 4 is a cross sectional view taken along a line A-A of Fig. 3;

Fig. 5 depicts a bottom view of the control unit of the sealed type electric compressor in accordance with the first preferred embodiment, which is viewed from a bottom plate portion of the control unit;

Figs. 6A and 6B present perspective views to describe installation of the control unit on a main body of the sealed type electric compressor in accordance with the first preferred embodiment;

Fig. 7 provides a cross sectional view to show a configuration of a connector portion of a control unit and a connector portion of a compressor main body in a sealed type electric compressor in accordance with a second preferred embodiment of the present invention;

Fig. 8 depicts a perspective view to describe a schematic configuration of an outdoor unit of a conventional split-type air conditioner; and

Fig. 9 is a driving circuit diagram for driving a compressor by inverter control.

[0014] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings.

(First preferred embodiment)

[0015] Figs. 1A and 1B illustrate a plan view and a front view of an outdoor unit of an air conditioner accommodating therein a sealed type electric compressor in accordance with a first preferred embodiment of the present invention, respectively. Outdoor unit main body 10 includes casing 11, outdoor heat exchanger 12, blower 13, blower motor 14, bellmouth 15 serving as an air flow guide, and compressor 16. Compressor 16 has compressor main body 17 and control unit 18 disposed on an upper portion of compressor main body 17 as one body therewith.

[0016] The difference between outdoor unit main body 10 of the first preferred embodiment and the conventional outdoor unit main body 110 shown in Fig. 8 lies in the overall configuration of the compressor and, also, in the configuration of a driving circuit unit. That is, compressor control unit 18 occupying most of the volume of the driving circuit unit is reduced in its size, and thus obtained compact control unit 18 is mounted on the upper portion of compressor main body 17 as one body therewith. Accordingly, shaded area 19 shown in Fig. 1B, which used to be left conventionally as an ineffective heat transfer area occupied by a conventional driving circuit unit, can be utilized as an effective heat transfer area. Consequently, the capacity of the air conditioner can be increased.

[0017] Moreover, since compressor main body 17 and control unit 18 of compressor 16 are integrated as one body in accordance with the first preferred embodiment, the assembly of outdoor unit main body 10 becomes easier, and a maintenance work therefor can also be facilitated because compressor 16 and control unit 18 can be treated as a single unit.

[0018] Fig. 2 sets forth a schematic front view of compressor 16 in accordance with the first preferred embodiment. As shown in the figure, compressor main body 17 formed of a sealed housing includes compressing mechanism 22 for compressing a coolant drawn through coolant suction pipe 21; and motor unit 23 for driving compressing mechanism 22. The rotary power generated by motor unit 23 is transferred to compressing mechanism 22 via a rotating shaft (not shown), to make a compressing element (not shown) rotate or reciprocate. As a result of the rotation or the reciprocating movement of the compressing element, the coolant is compressed, and the compressed coolant is supplied into a cooling cycle via coolant discharge pipe 24 provided at an upper portion of compressor 16. Further, compressor main body 17 is installed in outdoor unit main body 10 fixed via base 25.

[0019] Fig. 3 provides a plan view to illustrate an exemplary internal configuration of the control unit of the sealed type electric compressor in accordance with the first preferred embodiment, and Fig. 4 is a cross sectional view taken along a line A-A in Fig. 3. Control unit 18 will be described in detail with reference to Figs. 3 and 4. Control unit 18 includes driving circuit components for driving and controlling compressing mechanism 22 and motor unit 23 of compressor main body 17, wherein the driving circuit components are accommodated in housing 35 of a cylindrical sealed vessel structure including side plate portion 32, bottom plate portion 33 and ceiling plate portion 34. Specifically, as shown by long dashed double-dotted lines in Fig. 3, the driving circuit components are accommodated in housing 35, wherein the driving circuit components are largely divided into three blocks of rectifier circuit unit 36 serving as a converter for converting a commercial AC power source into a DC power, switching circuit unit 37 for converting the DC power into an AC power and control circuit unit 38. Further, formed in a

central portion of control unit 18 is discharge pipe accommodating portion 39 through which coolant discharge pipe 24 is to be inserted from compressor main body 17. Rectifier circuit unit 36 has diode 40, capacitor 41, reactor 42, and so forth. Switching circuit unit 37 has IGBT device 43 which can be switched at a high speed, driving circuit 44 for driving IGBT device 43, and so on. Further, control circuit unit 38 has control circuit components such as control signal generator 45 and microcomputer 46.

[0020] As shown in Fig. 4, the driving circuit components accommodated in housing 35 are mounted on substrate 49 serving as a circuit board which is horizontally installed on a bottom portion of housing 35. Installed on side plate portion 32 of housing 35 are power supply unit 47 for supplying power to control unit 18 and a control terminal (not shown) for transmitting a control signal to an indoor unit of the air conditioner or blower motor 14 of outdoor unit main body 10 thereof. Meanwhile, disposed in bottom plate portion 33 of housing 35 is control unit connector portion 55 serving as a first connection portion for supplying power to compressor main body 17 from the driving circuit components of control unit 18 and also supplying a driving control signal thereto. Further, control unit connector portion 55 provided with female terminal portion 56 is connected to bottom plate portion 33 of housing 35 via an elastic member such as rubber plate 57 to be supported by it. Also, female terminal portion 56 is flexibly connected to wiring 70 extracted from substrate 49.

[0021] Fig. 5 is a bottom view of control unit 18 viewed from bottom plate portion 33. As shown in Figs. 4 and 5, bottom plate portion 33 is provided with groove 59 of a predetermined depth, and control unit connector portion 55 and control unit stopper 58 are buried in groove 59.

[0022] Referring to Figs. 6A and 6B, there are provided perspective views to describe a method of mounting control unit 18 on compressor main body 17. To be specific, Fig. 6A depicts a perspective view to explain the mounting method, while Fig. 6B sets forth a perspective view to show control unit 18 after having been mounted on compressor main body 17. As illustrated in Fig. 6A, compressor main body connector portion 60 serving as a second connection portion and compressor stopper 61 radially protruding from the coolant discharge pipe 24 are located at positions corresponding to control unit connector portion 55 and control unit stopper 58 of control unit 18, respectively. Compressor main body connector portion 60 is provided with male terminal portion 63 and is connected to and supported on compressor main body 17 via an elastic member, as in the case of control unit connector portion 55.

[0023] Below, the method of mounting control unit 18 on compressor main body 17 will be explained in conjunction with Fig. 6A. First, coolant discharge pipe 24 of compressor main body 17 is inserted into discharge pipe accommodating portion 39 of control unit 18 so that control unit 18 is mounted on the top surface of compressor main body 17 (as indicated by an arrow A). At this time,

compressor main body connector portion 60 and compressor stopper 61 provided on compressor main body 17 are fitted into groove 59 of bottom plate portion 33 of control unit 18. Thereafter, as indicated by an arrow B, control unit 18 is rotated so that male terminal portion 63 of compressor main body connector portion 60 positioned in groove 59 of bottom plate portion 33 is tightly fitted into female terminal portion 56 of control unit connector portion 55. When male terminal portion 63 is fixedly inserted into female terminal portion 56, compressor stopper 61 and control unit stopper 58 are made to contact each other to thereby restrain control unit 18 from being rotated any further. Moreover, in the first preferred embodiment, control unit 18 is mounted on the top surface of compressor main body 17 via, for example, a sheet-type thermal insulator (not shown).

[0024] Fig. 6B shows compressor 16 having control unit 18 mounted on compressor main body 17, wherein power supply unit 47 for supplying power to control unit 18 and control terminal portion 64 for transmitting a control signal to the indoor unit or blower motor 14 of outdoor unit main body 10 of the air conditioner are only provided on the periphery of control unit 18. In accordance with the first preferred embodiment of the present invention described above, by mounting control unit 18 on the top surface of compressor main body 17 as one body, a compact sealed type electric compressor including control unit 18 and compressor main body 17 can be realized. Besides, since the connection of a power supply terminal for driving the compressor or the connection of the control terminal need not be made by using wiring such as a lead line, a power supply connection or a signal connection can be securely made in a limited space. Moreover, since there is no lead line or the like exposed outside, any noise introduction can be prevented, thus improving the quality of signal transmission.

[0025] Further, connector portions 55 and 60 of control unit 18 and compressor main body 17, respectively, can be simply engaged with each other by rotating control unit 18 mounted on compressor main body 17. Thus, wiring connection is simplified so that the assembly of the compressor can be facilitated. Also, by allowing stoppers 58 and 61 provided at control unit 18 and compressor main body 17, respectively, which serve as movement position determining portions, to contact each other, an extra rotation of control unit 18 can be prevented, so that damages that might be caused on connector portions 55 and 60 due to an excessive load exerted thereon as a result of an excessive rotation of control unit 18 can be avoided. Further, since exact position determination can be made by stoppers 58 and 61, a correct wiring connection can be secured.

[0026] Moreover, when control unit connector portion 55 and compressor main body connector 60 are installed in housing 35 of control unit 18 and on compressor main body 17, respectively, at least one of them is supported thereat via rubber plate 57 which is an elastic member. Accordingly, vibration that might occur due to the rota-

tional or reciprocating movements of compressor 16 can be absorbed by the elastic member, thus preventing damages on connector portions 55 and 60 or disengagement of them from each other. As a result, stable and exact wiring connection can be secured.

[0027] Further, temperature of compressor main body 17 becomes high due to a compression coolant, and, in particular, the temperature of the top surface portion of compressor main body 17 on which coolant discharge pipe 24 is provided is very high. In the configuration in accordance with the present invention, since an insulating material is interposed between compressor main body 17 and control unit 18, the influence of high temperature on control unit 18 is prevented, so that reliability of control unit 18 can be improved and transfer of vibrations of the compressor to control unit 18 can be restrained.

(Second preferred embodiment)

[0028] Fig. 7 provides a cross sectional view to illustrate a configuration of a control unit connector portion and a compressor main body connector portion of a sealed type electric compressor in accordance with a second preferred embodiment of the present invention. Though major components of compressor main body 17 and control unit 18 in the second preferred embodiment are identical to those described in the first preferred embodiment, and a mechanism of mounting control unit 18 on the top surface of compressor main body 17 for an electric or a signal connection therebetween is also identical to that described in the first preferred embodiment, the configuration of the signal connection, i.e., the configuration of each connector portion is different from that of the first preferred embodiment.

[0029] In Fig. 7, control unit connector portion 71 provided on control unit 18 and compressor main body connector portion 72 provided on compressor main body 17 are shown when they are engaged with each other by rotating control unit 18, as explained in the first preferred embodiment. Further, a terminal portion for supplying power to compressor main body 17 from control unit 18 is configured to include a male terminal portion fitted into a female terminal portion. However, detailed description thereof will be omitted, for the configuration is identical to that described in the first preferred embodiment. Fig. 7 illustrates a detailed configuration of the connector portions that are relevant to a transception of a control signal between control unit 18 and compressor main body 17.

[0030] In the second preferred embodiment of the present invention, a signal transception between the connector portions is made through an optical signal mechanism. As shown in Fig. 7, an end part of control unit connector portion 71 is inserted into compressor main body connector portion 72 to be fitted therewith. Control unit connector portion 71 includes connector main body 73; and control unit transceiver 76 having converter 74 and transceiver terminal 75, wherein wiring 84 from con-

trol unit 18 is connected to converter 74. Further, compressor main body connector portion 72 includes connector main body 77; and compressor unit transceiver 80 having converter 78 and transceiver terminal 79, wherein wiring 81 from compressor main body 17 is connected to converter 78.

[0031] Also, connector main body 73 of control unit connector portion 71 is coupled to and supported in bottom plate portion 33 of control unit 18 via elastic member 82, and connector main body 77 of compressor main body connector portion 72 is connected to and supported in compressor main body 17 via elastic member 83.

[0032] Optical axes of transceiver terminals 75 and 79 of control unit 18 and compressor main body 17 are aligned with each other, and a distance between transceiver terminals 75 and 79 is also controlled. The transceiver terminals 75 and 79 serve as couplers for inputting/outputting optical signals, and the optical signals are transferred therebetween. An electric signal such as an operation stop signal of the compressor, a frequency control signal or a temperature (thermistor) information is inputted to converter 74 from control unit 18 to be converted into an optical signal. Then, the optical signal is transmitted from transceiver terminal 75 to be received at transceiver terminal 79 of compressor main body 17. Thus received optical signal is converted into an electric signal by converter 78 to be used to control the operation of compressor 16. Meanwhile, an electric signal containing information on such as internal temperatures or operation currents of compressing mechanism 22 and motor unit 23 disposed in compressor 16 is converted into an optical signal by converter 78 and is transmitted from transceiver terminal 79 to be received by control unit 18.

[0033] In accordance with the second preferred embodiment as described above, the transfer of control signals between control unit 18 and compressor main body 17 is carried out through an electrically non-contact type connection mechanism, i.e., by a transception of optical signals. Accordingly, without having to use a signal line or the like, a secure signal connection of a high reliability can be realized by preventing an occurrence of noise and electrical insulation due to the signal line or an influence from ambient environment such as a vibration, a temperature condition, installation circumference, e.g., dirt particles.

[0034] Further, though the optical signal mechanism is adopted as a signal transceiving method in the second preferred embodiment, other mechanisms not using signal lines can be employed instead. For example, a magnetic mechanism or a vibration transmission mechanism can be employed.

[0035] In accordance with the present invention as described above, a compact sealed type electric compressor can be obtained by mounting the control unit on an upper portion of the compressor housing as a single body. Further, the electric connection or the signal connection between the control unit and the compressor is facilitated and the quality of the connection is improved.

In addition, the electric connection or the signal connection between the control unit and the compressor can be realized securely in a limited space, while preventing an occurrence of noise. Thus, the present invention can be applied to an air conditioner, a refrigerator, a vending machine, and so forth.

[0036] While the invention has been shown and described with respect to the preferred embodiments, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

Claims

1. A sealed type electric compressor comprising:

a control unit including a driving circuit unit in a housing; and
 a compressor housing including a compressing mechanism and a motor unit driven and controlled by the control unit,
 wherein the control unit is mounted on the compressor housing, and a first connection portion supported by the housing of the control unit and a second connection portion supported by the compressor housing are engaged with each other to realize at least one of an electric connection and a signal connection therebetween.

2. The compressor of claim 1, wherein at least one of the first connection portion and the second connection portion is supported via an elastic member.

3. The compressor of any one of claims 1 and 2, wherein the signal connection between the first and the second connection portions is carried out through an electrically non-contact type signal connection mechanism.

4. The compressor of claim 3, wherein the signal connection mechanism is an optical signal transmission mechanism.

5. The compressor of claim 1, wherein the control unit is movable on the compressor housing so as to engage the first and the second connection portions with each other.

6. The compressor of claim 5, wherein a rotation position determining portion is provided on at least one of the housing of the control unit and the compressor housing.

7. The compressor of any one of claims 1 to 6, wherein an insulating material is interposed between the compressor housing and the housing of the control

FIG. 1A

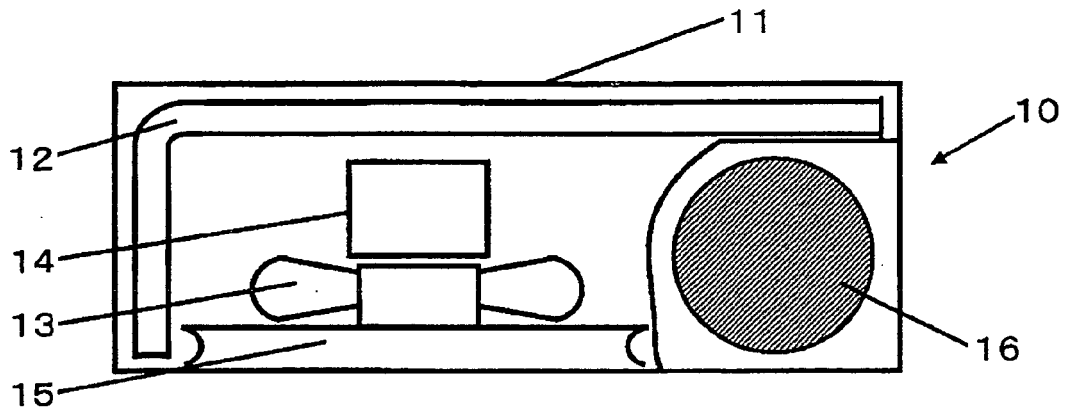


FIG. 1B

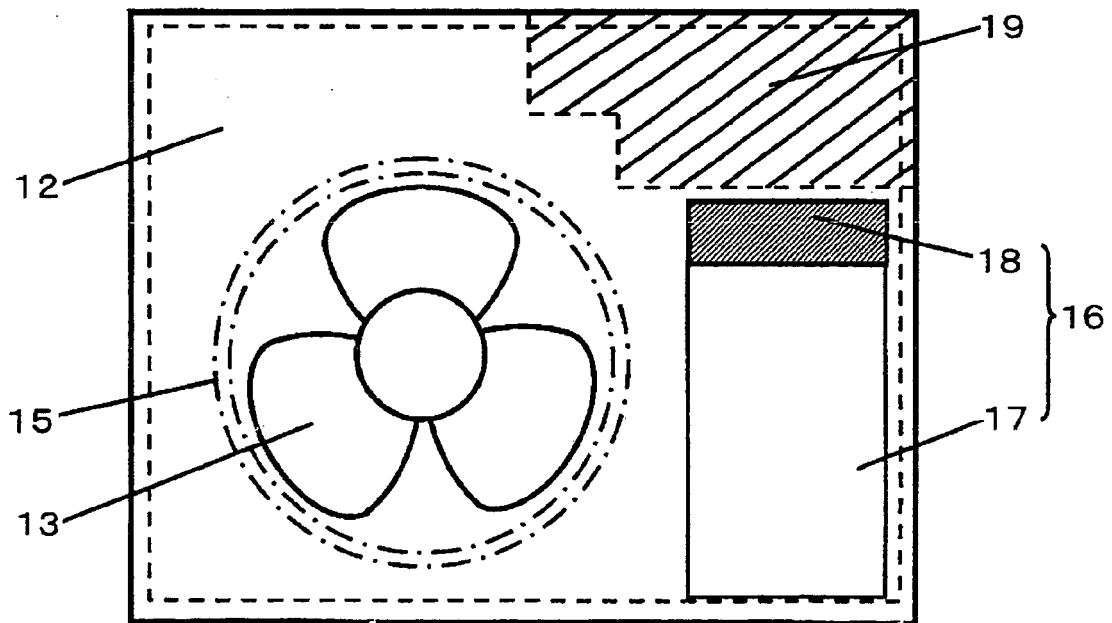


FIG.2

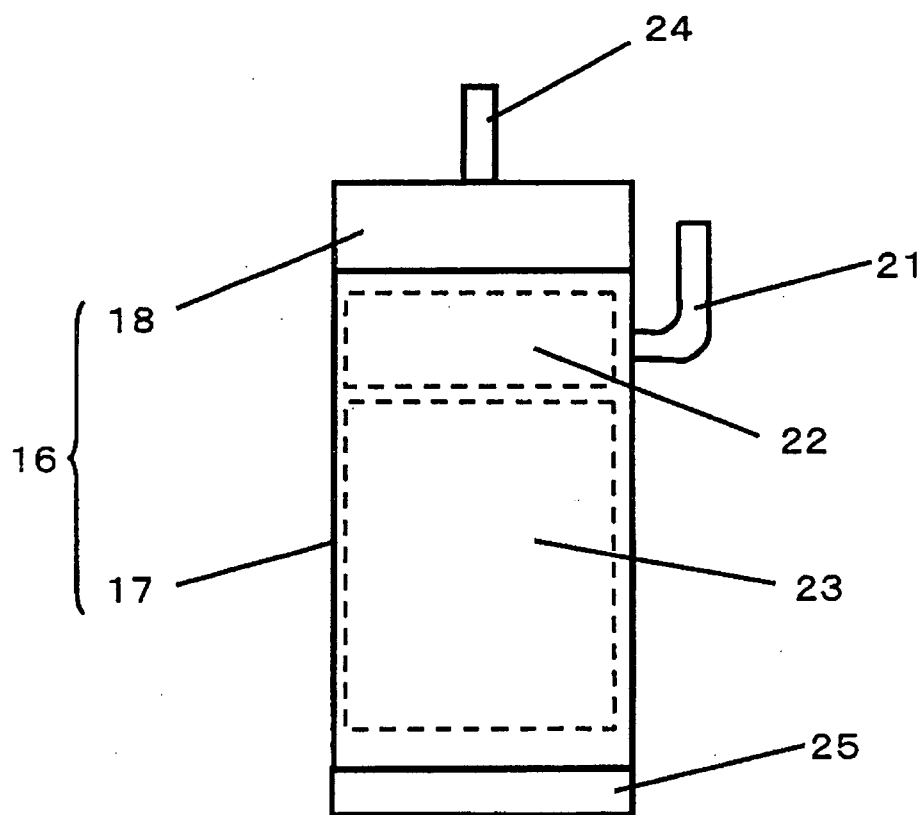


FIG. 3

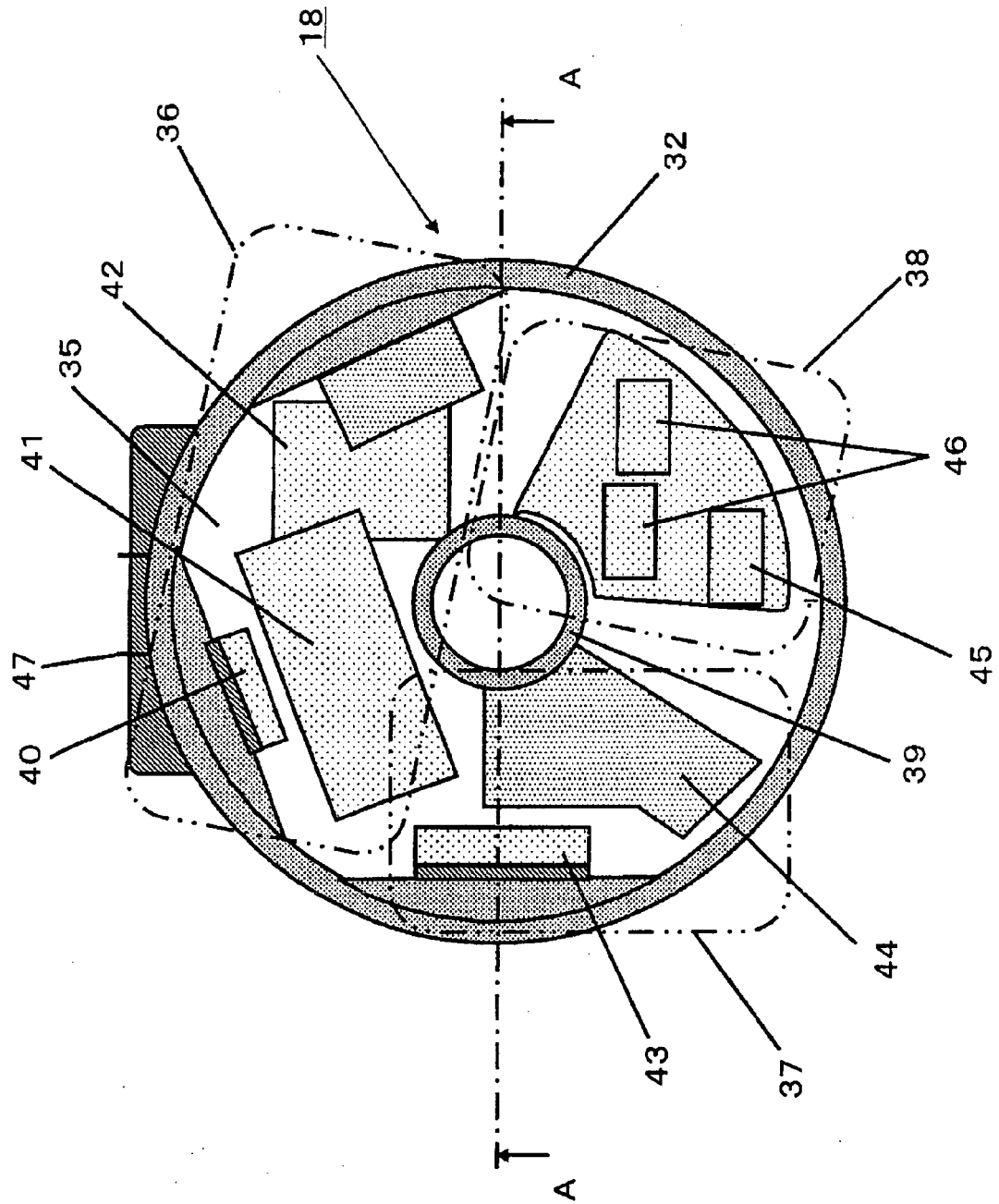


FIG. 4

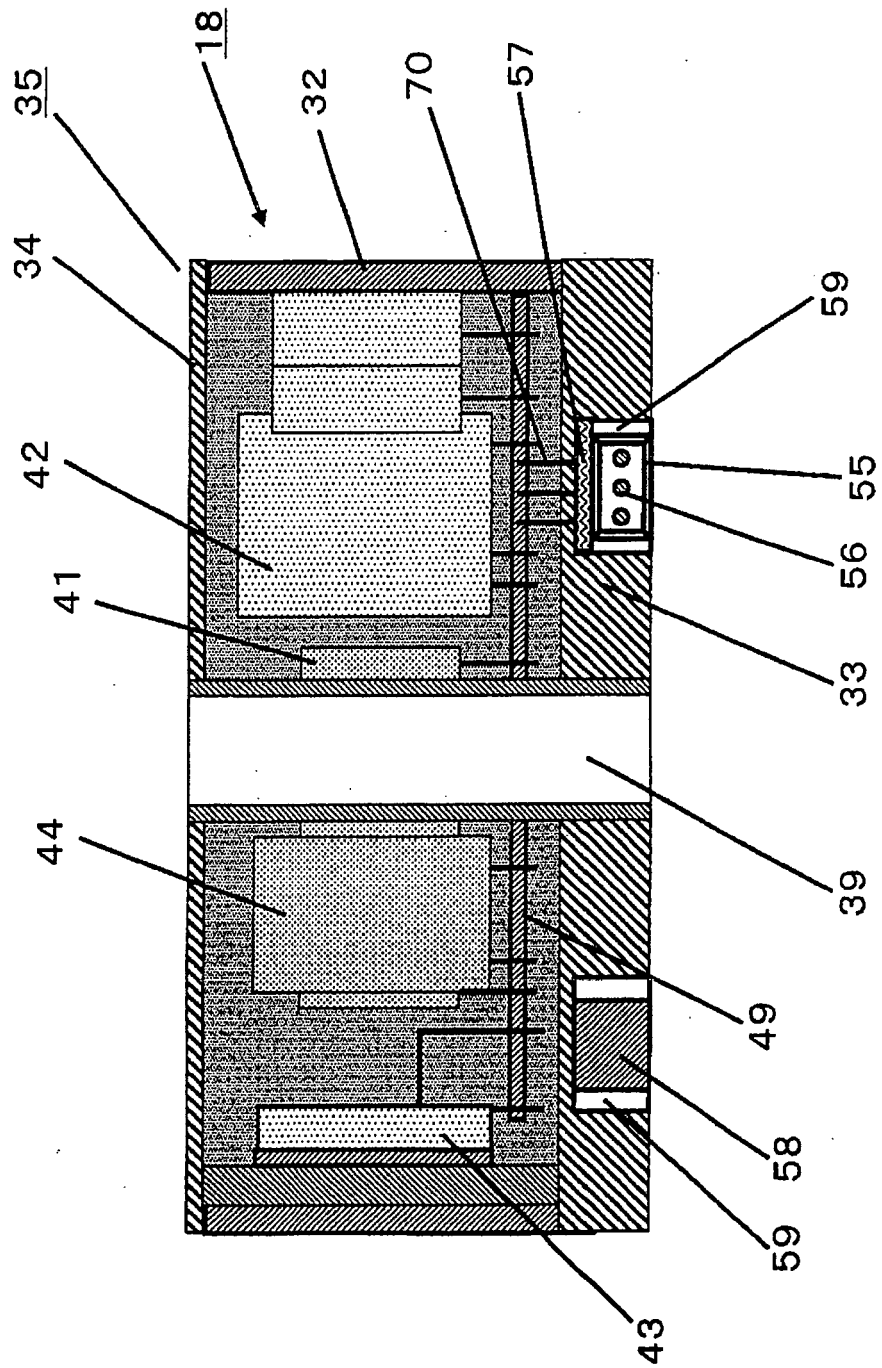


FIG.5

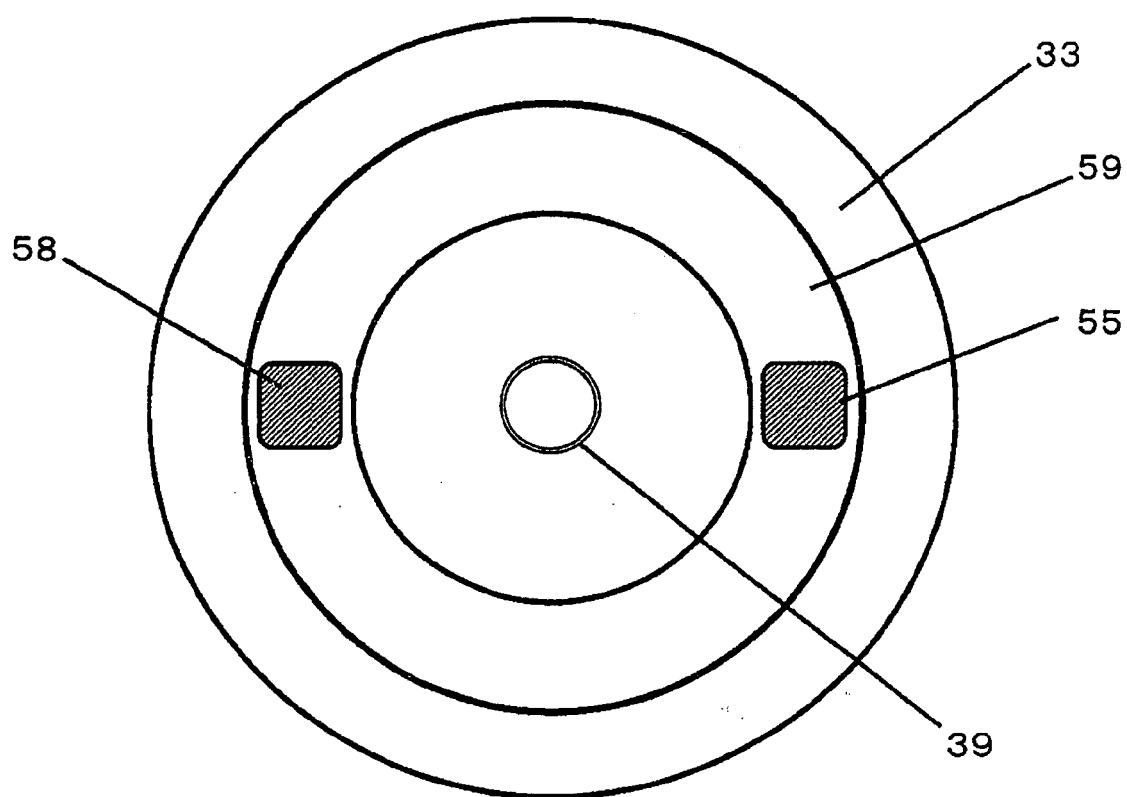


FIG. 6A

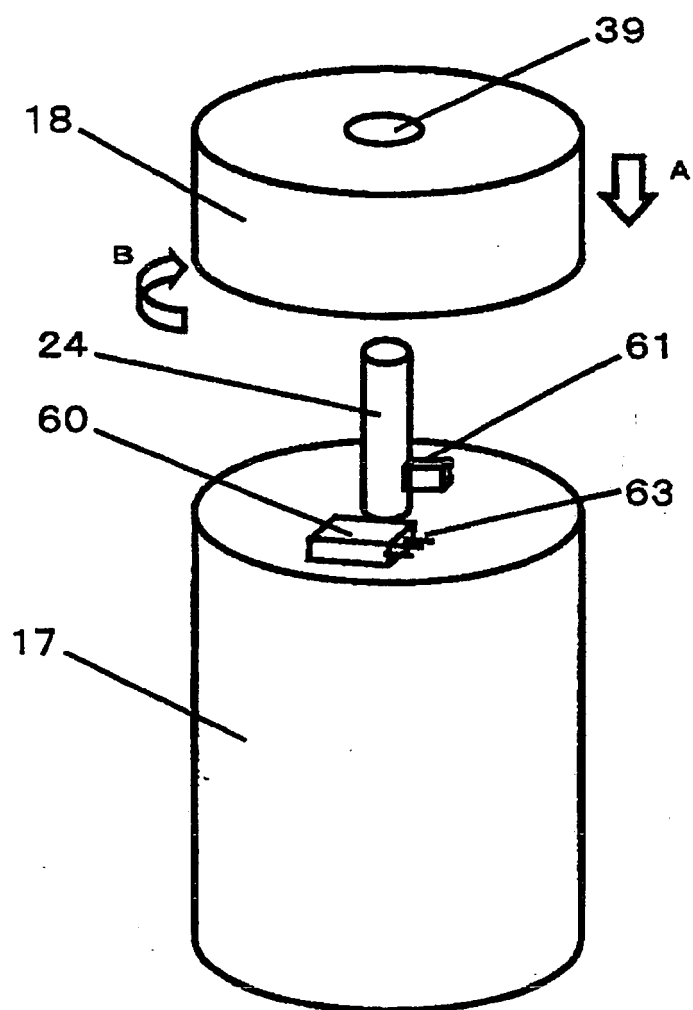


FIG. 6B

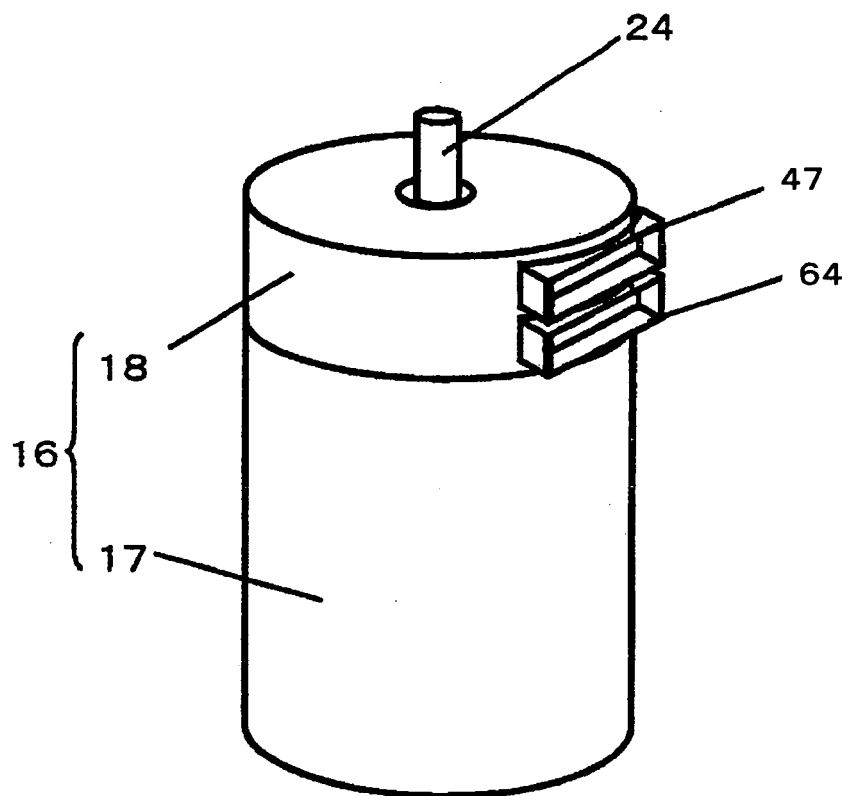


FIG. 7

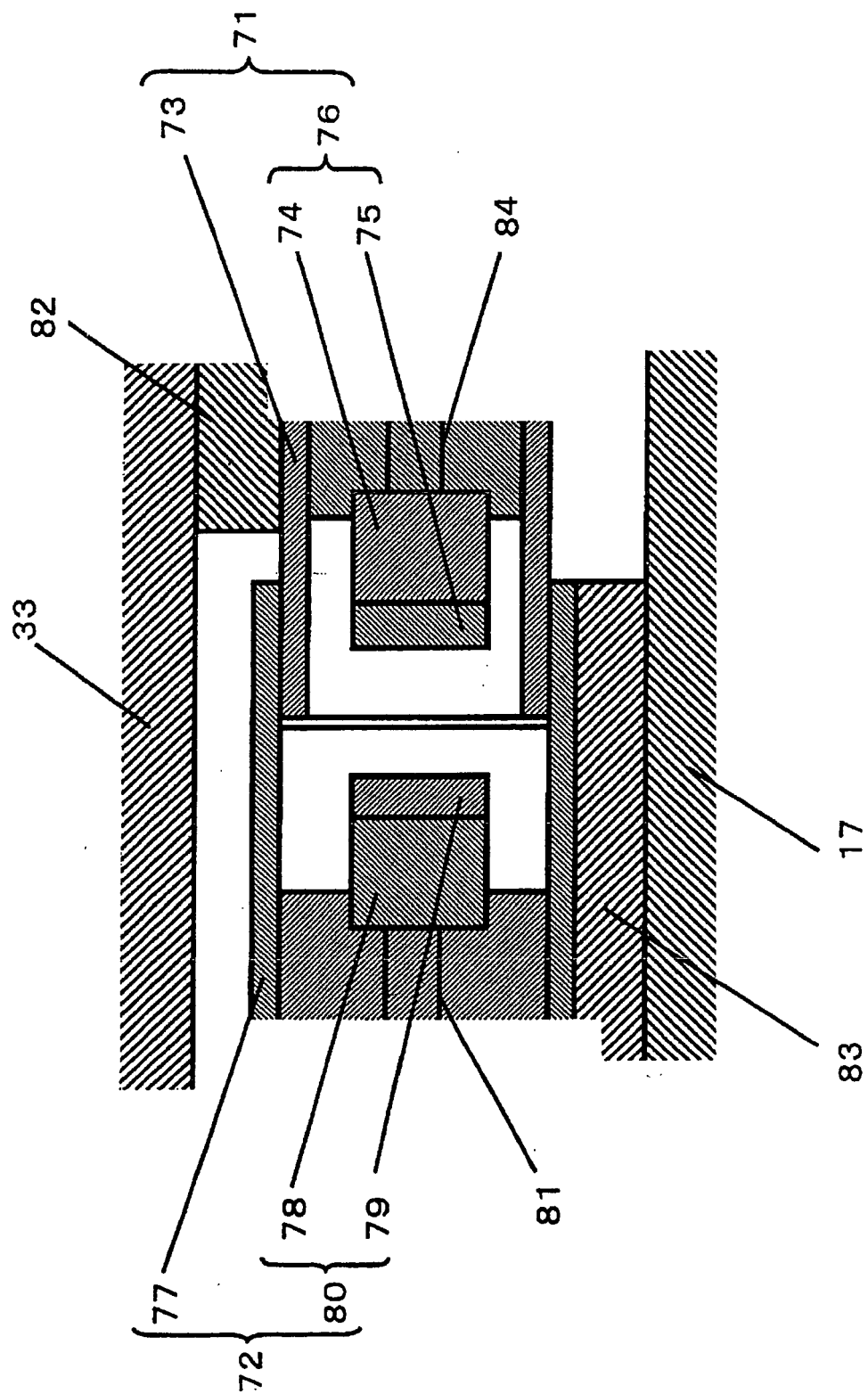


FIG. 8
(PRIOR ART)

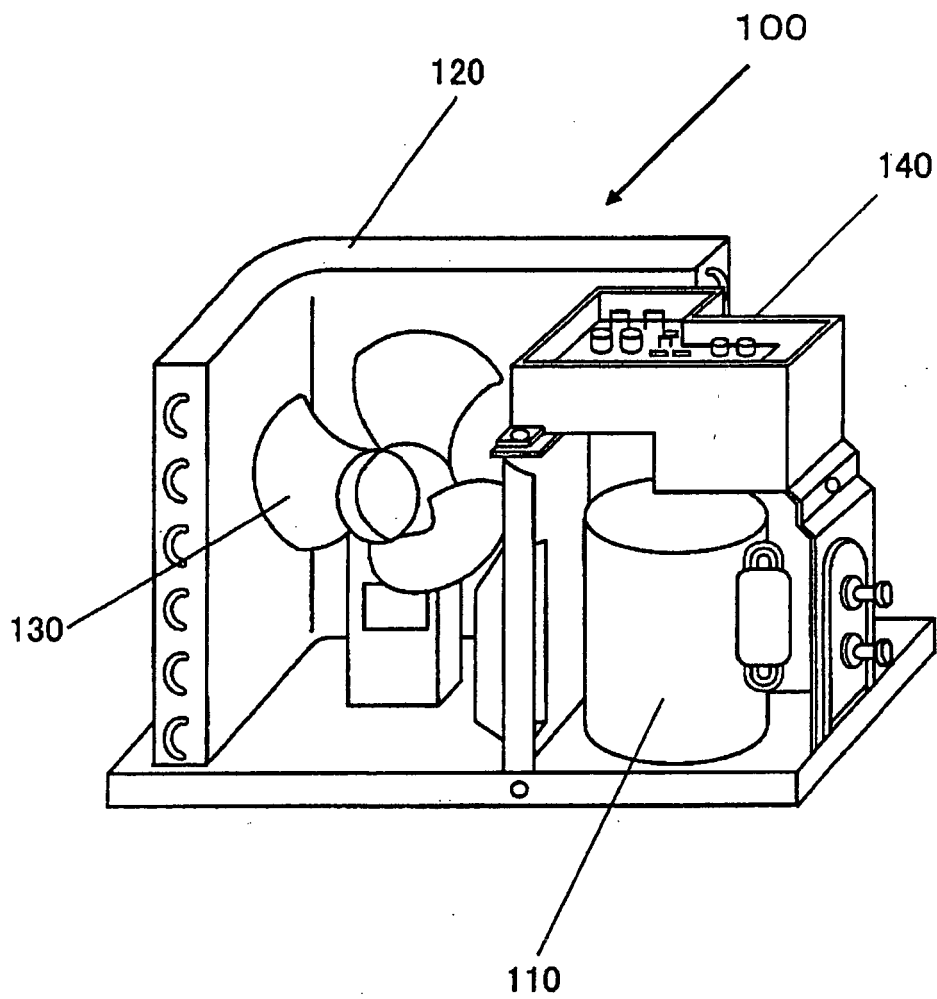
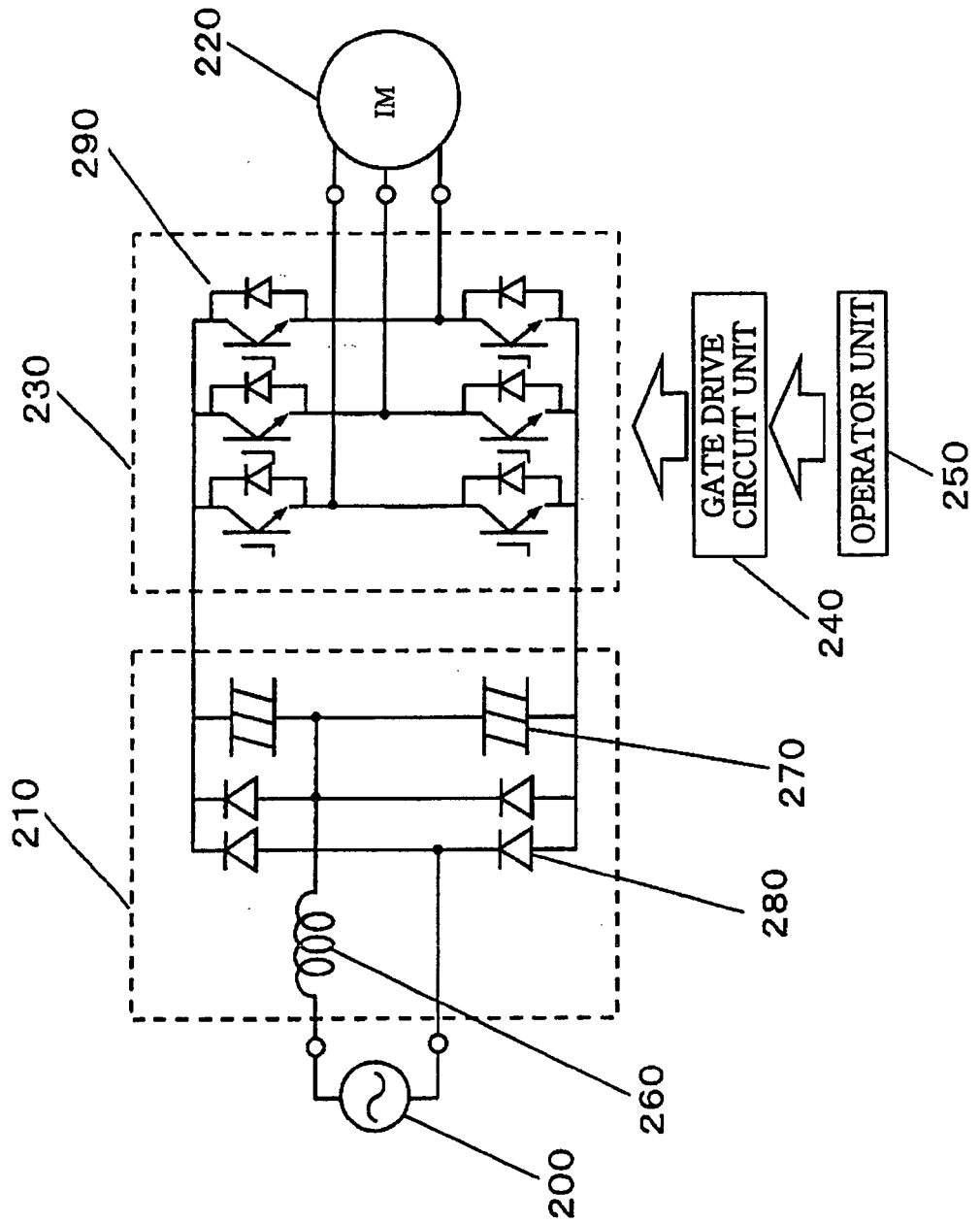


FIG. 9
(PRIOR ART)





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 02 4575

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 31 January 2006	Examiner Pinna, S
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 02 4575

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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