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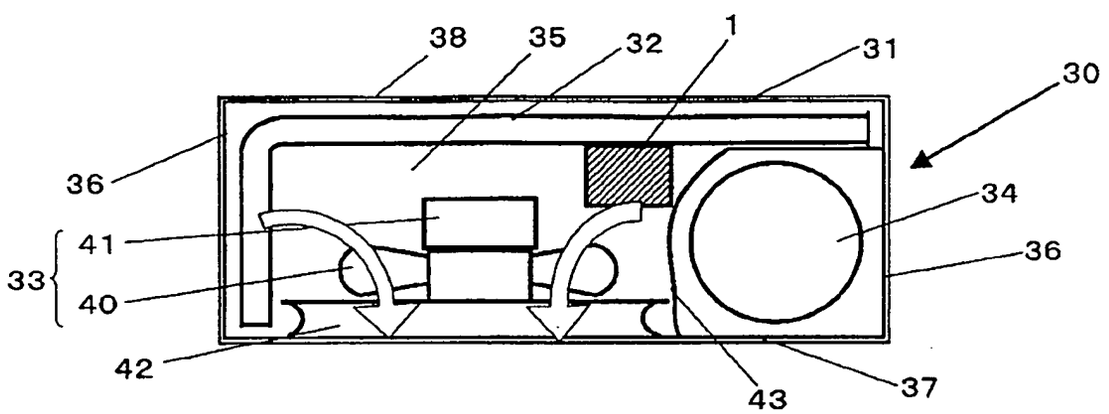
(54) Outdoor unit for use in air conditioner

(57) An outdoor unit of an air conditioner includes an outdoor blower, a compressor for compressing a coolant and an electronic module having circuit components incorporated in a sealed housing. The circuit components have at least a converter circuit unit for driving the compressor, an inverter circuit unit and a control circuit unit, and the electronic module is disposed in an airflow path formed by the outdoor blower.

FIG. 2A



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Description

[0001] The present invention relates to an air conditioner; and, more particularly to an outdoor unit of a split type air conditioner.

[0002] Recently, most widely employed as a compressor of a household air conditioner is one operated by an inverter control. The compressor and a control unit for controlling the compressor are installed in an outdoor unit of the air conditioner to operate a cooling cycle.

[0003] Referring to Fig. 7, there is provided a perspective view showing a schematic configuration of an outdoor unit of a conventional split type air conditioner. As shown therein, outdoor unit main body 100 includes at least compressor 110 having a compressor unit and a motor unit for driving the compressor unit, both of which are incorporated in a sealed vessel; outdoor radiator 120 for performing a heat exchange with the ambient air; and blower 130 for blowing the ambient air through the outdoor unit 100 for a heat exchange. All of these components, i.e., compressor 110, outdoor radiator 120 and blower 130 are incorporated in an outer frame body (not shown). Further, provided in an upper space of outdoor unit 100 is driving circuit unit 140 for driving the components of outdoor unit 100.

[0004] Driving circuit unit 140 includes a compressor control unit for controlling compressor 110, a blower control unit for controlling blower 130, cooling cycle control unit for controlling the cooling cycle, a wiring unit coupled to an indoor unit, and so forth. Among these components, the compressor control unit occupies most space of driving circuit unit 140.

[0005] The driving circuit for driving compressor 110 through an inverter control includes a converter circuit unit for converting a commercial AC power source into a DC; an inverter circuit unit for driving the motor unit of compressor 110 by way of converting the DC into a three-phase AC; a control circuit unit for controlling the converter circuit and the inverter circuit; and so forth.

[0006] Disclosed in Japanese Patent Laid-Open Publication No. 2002-22209 and in European Patent Laid-Open No. 1416230 are outdoor units capable of efficiently cooling a driving circuit unit incorporated therein for operating a compressor by an inverter control.

[0007] Recently, it has been demanded to miniaturize household appliances, particularly an air conditioner and improve energy efficiency thereof. For this reason, it is needed to increase a heat transfer area of a radiator of an outdoor unit of the air conditioner, just as a heat transfer area of a radiator in an indoor unit thereof has been increased, while reducing the outdoor unit in size.

[0008] In the conventional outdoor unit, however, the control unit occupies a great volume of the outdoor unit, whereby a effective heat transfer area of the outdoor radiator is reduced, resulting in a deterioration of efficiency of the air conditioner.

[0009] It is, therefore, an object of the present invention to provide an air conditioner including an outdoor unit with a reduced size and an increased effective heat transfer area of a radiator by way of efficiently disposing a scaled-down motor control unit, which is inverter-controlled by using a commercial AC power source, in the outdoor unit.

[0010] In accordance with a preferred embodiment of the present invention, there is provided an outdoor unit of an air conditioner including: a unit main body; an outdoor radiator; an outdoor blower; a compressor for compressing a coolant; and an electronic module including circuit components incorporated in a sealed housing, wherein the circuit components have at least a converter circuit unit for driving the compressor, an inverter circuit unit and a control circuit unit.

[0011] Under such configuration, the electronic module operated by an inverter control using a commercial AC power source can be integrated within a housing to obtain a compact size and a water drip-proof structure. Further, since the electronic module can be independently disposed at any desired place within the outdoor unit, efficient use of the inner space of the outdoor unit is enabled and an effective heat transfer area of the outdoor radiator can be increased, thereby enhancing air conditioning efficiency.

[0012] Further, the electronic module is disposed in an airflow path formed by the outdoor blower. Therefore, the electronic module can be efficiently cooled, thereby improving reliability of the circuit components within the electronic module.

[0013] Moreover, the unit main body has a bottom plate, and the electronic module is mounted on the bottom plate. As a result, the bottom plate can be utilized as a heat radiation plate of exothermic circuit elements within the electronic module, thereby further improving the reliability of the circuit components.

[0014] In addition, the electronic module is mounted on the bottom plate to be located below the compressor. Thus, efficient use of the inner space of the outdoor unit is enabled, thereby contributing to a size-reduction of the outdoor unit.

[0015] Further, the electronic module is disposed in a dead water region of an airflow path formed by the outdoor blower. Therefore, efficient use of the inner space of the outdoor unit is enabled and a size-reduction of the outdoor unit can be achieved without deteriorating heat transfer efficiency.

[0016] Furthermore, the airflow path is formed by the outdoor blower with a bell mouth portion at least serving as an air guide, and the electronic module is installed at a peripheral portion of the bell mouth portion. Resultantly, efficient use of the inner space of the outdoor unit is enabled.

[0017] Still further, the outdoor blower includes a fan unit and a fan motor for driving the fan unit, and the electronic module is disposed at a rear side of the fan motor. Therefore, efficient use of the inner space of the outdoor unit is enabled, and a size reduction thereof can be achieved.

[0018] Moreover, the electronic module includes a power supply terminal and the unit main body includes a side plate, wherein the electronic module is disposed on the side plate and the power supply terminal is disposed to be exposed to the outside of the outdoor unit. Accordingly, it becomes possible to use the side plate as a heat radiation plate of exothermic elements within the electronic module, which in turn enhances reliability of the circuit components. In addition, a connection of the power supply terminal to the outside gets easier.

[0019] 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:

Fig. 1 is a cross sectional view of an electronic module in accordance with the present invention;

Figs. 2A and 2B show a plan and a front view of an outdoor unit of an air conditioner in accordance with a first preferred embodiment of the present invention;

Figs. 3A and 3B illustrate a plan and a front view of an outdoor unit of another air conditioner in accordance with the first preferred embodiment of the present invention;

Figs. 4A and 4B describes a plan and a front view of an outdoor unit of an air conditioner in accordance with a second preferred embodiment of the present invention;

Figs. 5A and 5B show a plan and a front view of an outdoor unit of another air conditioner in accordance with the second preferred embodiment of the present invention;

Figs. 6A and 6B illustrate a plan and a front view of an outdoor unit of an air conditioner in accordance with a third preferred embodiment of the present invention; and

Fig. 7 sets forth a perspective view describing a schematic configuration of an outdoor unit for use in a conventional split type air conditioner.

[0020] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings, in which like reference numerals designate like parts in the various drawings.

(First preferred embodiment)

[0021] Referring to Fig. 1, there is provided a cross sectional view of an electronic module in accordance with a first preferred embodiment of the present invention.

[0022] Electronic module main body 1 includes housing 5 formed by side plates 2, bottom plate 3 and ceiling plate 4. Incorporated within housing 5 is a plurality of circuit components for driving a compressor. The circuit components are accommodated by being grouped into three blocks: a converter circuit unit for converting a commercial AC power source into a DC, an inverter circuit unit for inverting a DC into an AC, and a control circuit unit. Side plates 2, ceiling plate 4 and bottom plate 4 of housing 5 are made of, e.g., a metallic material having a high heat conductivity, and build up a water drip-proof structure. Disposed in the converter circuit unit are diode 6 and circuit components 7 such as a capacitor and an inductor. Installed in the inverter circuit unit are IGBT (Insulated Gate Bipolar Transistor) device 8 for performing a high-speed switching and driving circuit 9 for driving IGBT device 8 and the like. Further, mounted in the control circuit unit are control circuit components such as a control signal generator and a microcomputer. Respectively installed on side plates 2 of housing 5 are power supply terminal 11 of a commercial AC power source and output terminal 12 for supplying the power to the compressor. Further, the circuit components (diode 6, circuit component 7, IGBT device 8, driving circuit 9 and control circuit component 10) are installed on circuit substrate 13, which is flatly placed on a bottom portion of housing 5. Exothermic circuit elements such as diode 6 of the converter circuit unit and IGBT device 8 of the inverter circuit unit are located to face side plates 2, and thermal conductors 14 made of a material with a high heat conductivity are intervened between side plates 2 and the exothermic circuit elements. Thermal conductors 14 serve to emit the heat generated from diode 6 and IGBT device 8 to the outside. In this case, adhesive resin layer 15 may be disposed closely adhered to the exothermic circuit elements, e.g., the IGBT device 8.

[0023] Moreover, resin 16 is charged between the circuit components within housing 5, thereby insulating the circuit components (diode 6, circuit component 7, IGBT device 8, driving circuit 9, and control circuit component 10) from each other and, at the same time, obtaining vibration resistance and moisture resistance.

[0024] As described, since electronic module main body 1 has the water drip-proof structure by forming housing 5 as a sealed one body, reliability of the circuit components within electronic module main body 1 can be improved. Moreover, since the circuit components disposed in housing 5 are protected by resin 16 charged therebetween, insulating property and vibration resistance can be obtained. Therefore, it becomes possible to secure the reliability of the circuit components even in case they are directly mounted on a vibration-generating source such as a compressor.

[0025] In addition, electronic module main body 1 can be of any shape, e.g., a cylindrical shape or a rectangular parellelopiped shape, depending on its location in an outdoor unit.

[0026] Referring to Figs. 2A and 2B, there are shown a plan and a front view of an outdoor unit of the air conditioner in accordance with the first preferred embodiment of the present invention. Outdoor unit main body 30 includes casing 31, outdoor radiator 32, outdoor

blower 32, and compressor 34. Casing 31 is of a box shape formed by bottom plate 35, left and right side plates 36, front plate 37, rear plate 38 and ceiling plate 39. Outdoor blower 33 has fan unit 40 and fan motor 41 for driving fan unit 40. Furthermore, installed at a portion of front plate 37 corresponding to fan unit 40 is bell mouth 42 serving as an air-guiding opening. Mounted on rear plate 38 or left and right side plates 36 are an air suction filter and a grill through which ambient air is suctioned by a rotation of fan unit 40, thereby forming an airflow path as indicated by arrows. Outdoor radiator 32 is installed in an L shape along left side plate 36 and rear plate 38, as show in Fig. 2A to obtain a predetermined heat transfer area. Further, compressor 34 is isolated from the airflow path by cover 43.

[0027] In the first preferred embodiment, electronic module main body 1 shown in Fig. 1, for driving at least compressor 34 is mounted on bottom plate 35 of casing 31 as shown in Figs. 2A and 2B. Since reduction in the size of electronic module main body 1 can be readily achieved as described in Fig. 1, it can be disposed at any available position on bottom plate 35. Further, though the exothermic elements such as diode 6 of the converter circuit unit and IGBT device 8 of the inverter circuit unit are disposed to face side plates 2 in electronic module main body 1 shown in Fig. 1, the first preferred embodiment employs a configuration where the exothermic elements are mounted on bottom plate 3 of electronic module main body 1, which is in turn disposed on bottom plate 35 of casing 31.

[0028] Therefore, it becomes possible to use bottom plate 35 with a large radiation area as a heat radiation plate of the exothermic elements in electronic module main body 1. Further, since the vicinity of bottom plate 35 of casing 31 forms the airflow path described above, electronic module main body 1 may be forcibly cooled down by the wind in the airflow path. As a result, the inner space of outdoor unit main body 30 can be efficiently utilized while improving the reliability of the circuit components.

[0029] Furthermore, though parts other than electronic module main body 1 for driving compressor 34, e.g., electrical component for driving fan motor 41, may be disposed at their conventional positions with further reduced sizes, it is also possible to dispose them inside electronic module main body 1 or elsewhere. In any of such possible cases, the conventional problem that electrical component 44 reduces the effective heat transfer area of outdoor radiator 32 can be solved, thereby improving a radiation performance thereof and enhancing the efficiency of the air conditioner.

[0030] Figs. 3A and 3B illustrate a plan and a front view of an outdoor unit of another air conditioner in accordance with the first preferred embodiment of the present invention. As shown, electronic module main body 1 is mounted on bottom plate 35 of casing 31 of outdoor unit main body 30, and compressor 34 is disposed on electronic module main body 1.

[0031] Such configuration has advantages in addition to the above-cited effects of the first preferred embodiment. Specifically, since compressor 34 can be integrated as one body with electronic module main body 1, assembling outdoor unit main body 30 may become easier and more efficient. Furthermore, the integration of compressor 34 and electronic module main body 1 as one unit also eases the maintenance thereof.

(Second Preferred Embodiment)

[0032] Referring to Figs. 4A and 4B, there are illustrated a plan and a front view of an outdoor unit of an air conditioner in accordance with a second preferred embodiment of the present invention. The distinctiveness of the second preferred embodiment resides in that electronic module main body 1 is disposed in a dead water region of an airflow path within outdoor unit main body 1, the airflow path being formed by outdoor blower 33. The term 'dead water region' herein used refers to a region where a wind does not blow at all or hardly blows.

[0033] In Figs. 4A and 4B, electronic module main body 1 is disposed at a peripheral portion of bell mouth 42 which is provided at front plate 37 of casing 31 to serve as an air guide. The peripheral portion of bell mouth 42, which hardly involves a wind blow or features a very low wind velocity, forms a useless space in outdoor unit main body 30. In accordance with the second preferred embodiment, since electronic module main body 1 is disposed in this space, it is possible to efficiently use the inner space of outdoor unit main body 30, thereby realizing a size reduction thereof. Moreover, by way of installing electronic module main body 1 in such a dead water region, an increase of an air flow resistance and a resultant increase of power consumption of fan motor 41 can be prevented.

[0034] Meanwhile, a high velocity air current is formed in a rotation region of fan unit 40, i.e., a peripheral portion of bell mouth 42. Accordingly, if a desired fin unit is installed at a part of housing 5 of electronic module main body 1 where the high velocity air current flows, it may serve to facilitate a radiation of exothermic circuit elements.

[0035] Referring to Figs. 5A and 5B, there are shown a plan and a front view of an outdoor unit of another air conditioner in accordance with the second preferred embodiment. As shown therein, electronic module main body 1 is disposed at a rear plate 38 side of fan motor 41. The region around the rear plate 38 side of fan motor 41 is an area where a wind suctioned by fan unit 40 does not blow, forming a useless space in outdoor unit main body 30. In the second preferred embodiment, electronic module main body 1 is disposed in this region, thereby enabling an efficient use of the inner space of outdoor unit main body 30 while realizing a size reduction thereof. Meanwhile, a high velocity air current suctioned by fan unit 40 is formed around an outer peripheral portion

of fan motor 41. Accordingly, if a desired fin unit is installed at a part of housing 5 of electronic module main body 1 in a manner that it corresponds to the high velocity current area, it may serve to facilitate a radiation of exothermic circuit elements.

(Third Preferred Embodiment)

[0036] Figs. 6A and 6B describe a plan and a front view of an outdoor unit of an air conditioner in accordance with a third preferred embodiment of the present invention.

[0037] As shown, electronic module main body 1 is mounted on side plate 36 of casing 31 of outdoor unit main body 30 to be located above compressor 34 with its power supply terminal 47 exposed to the outside. Accordingly, side plate 36 having a large area can be utilized as a heat radiation plate of exothermic circuit elements in electronic module main body 1. Furthermore, by disposing electronic module main body 1 near compressor 34, a wiring connection therebetween becomes easier. Still further, by way of installing power supply terminal 47 of electronic module main body 1 to be exposed to the outside, a connection between power supply terminal 30 and an external power source can be readily accomplished. Consequently, an efficient use of the inner space of outdoor unit main body 30 is enabled while improving reliability of circuit components.

[0038] In accordance with the present invention, by employing a compact electronic module incorporating therein circuit components with further improved reliability, and efficiently disposing the electronic module in an outdoor unit, the outdoor unit can improve air conditioning efficiency. Therefore, the outdoor unit of the present invention can be used in various split type air conditioners for use in household and commercial environment.

[0039] 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. An outdoor unit of an air conditioner, comprising:

a unit main body;
an outdoor radiator;
an outdoor blower;
a compressor for compressing a coolant; and
an electronic module including circuit components incorporated in a sealed housing,

wherein the circuit components have at least a converter circuit unit for driving the compressor, an inverter circuit unit and a control circuit unit.

2. The outdoor unit of claim 1, wherein the electronic module is disposed in an airflow path formed by the outdoor blower.

3. The outdoor unit of claim 1, wherein the unit main body has a bottom plate and the electronic module is mounted on the bottom plate.

4. The outdoor unit of claim 3, wherein the compressor is located above the electronic module.

5. The outdoor unit of claim 1, wherein the electronic module is disposed in a dead water region of an airflow path formed by the outdoor blower.

6. The outdoor unit of claim 5, wherein the airflow path is formed by the outdoor blower with a bell mouth portion at least serving as an air guide, and the electronic module is installed at a peripheral portion of the bell mouth portion.

7. The outdoor unit of claim 5, wherein the outdoor blower includes a fan unit and a fan motor for driving the fan unit, and the electronic module is disposed at a rear side of the fan motor.

8. The outdoor unit of claim 1, wherein the unit main body has a side plate and the electronic module includes a power supply terminal, and wherein the electronic module is disposed on the side plate and the power supply terminal is disposed to face the outside of the outdoor unit.

FIG. 1

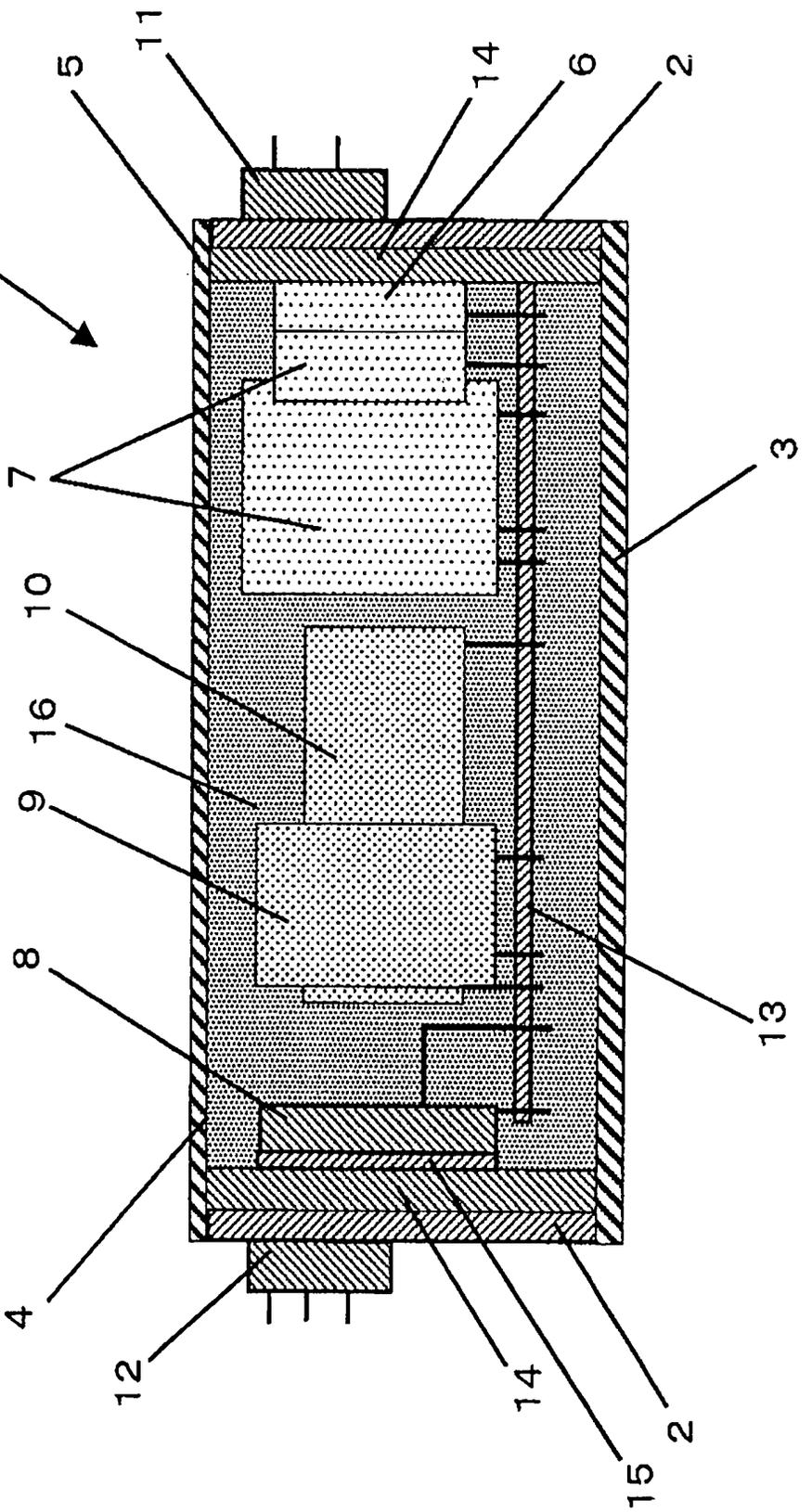

FIG.2A

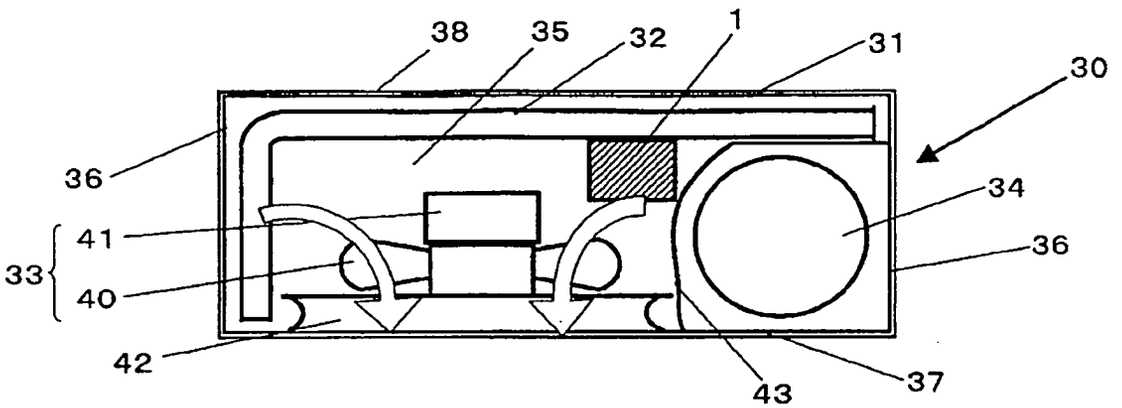

FIG.2B

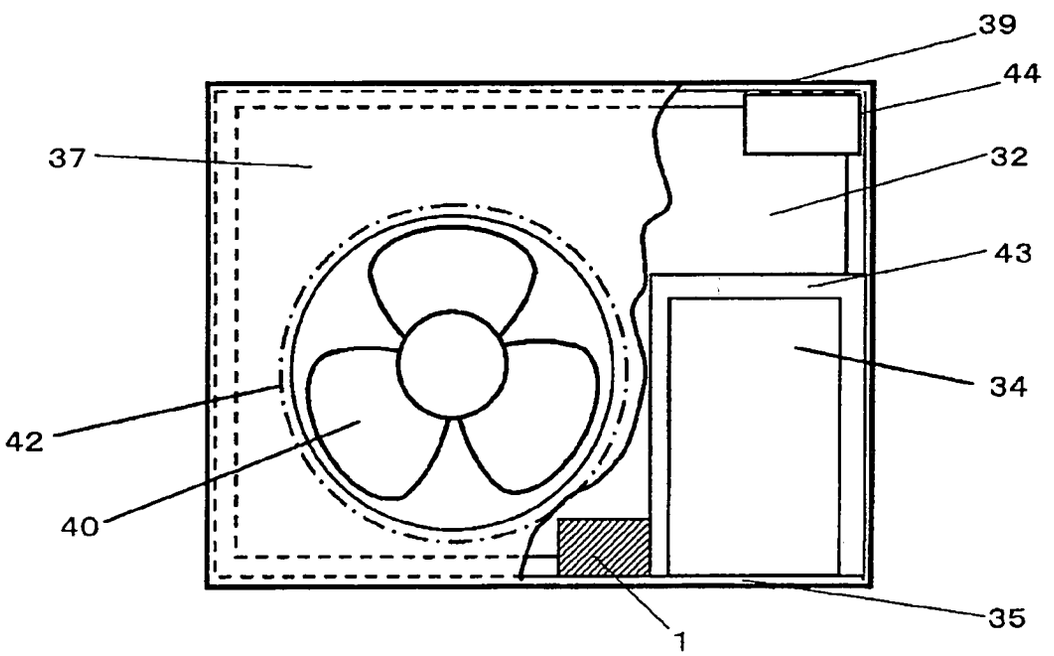

FIG. 3A

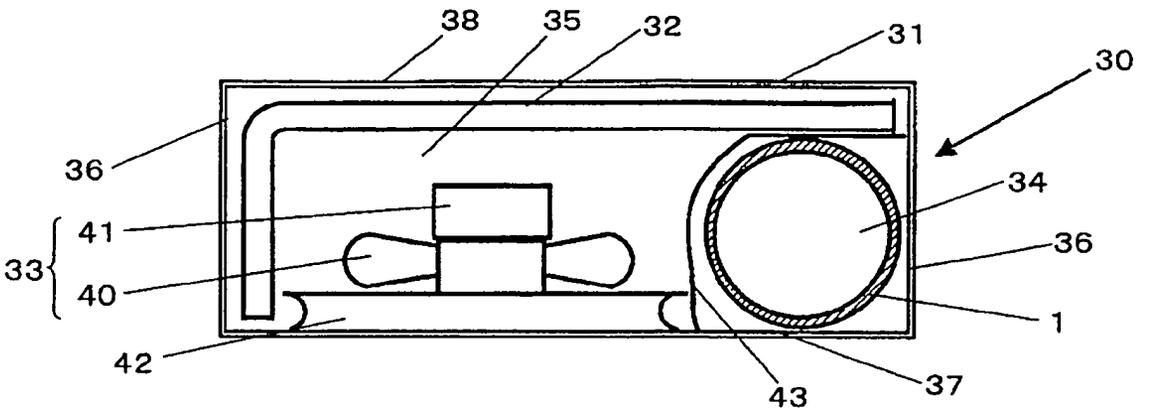

FIG. 3B

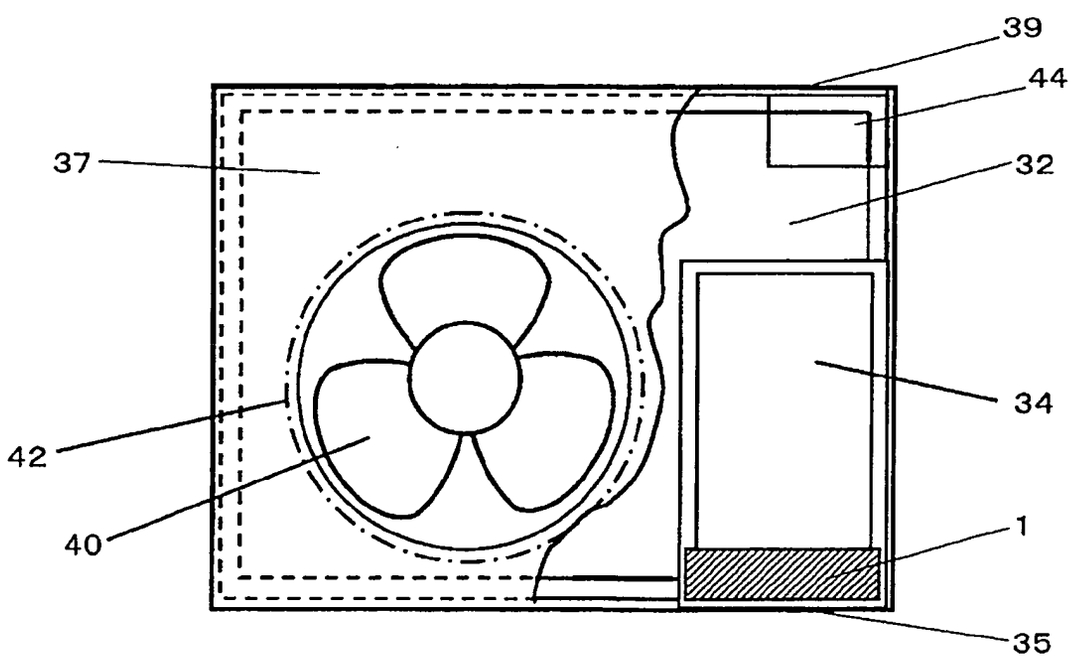

FIG. 4A

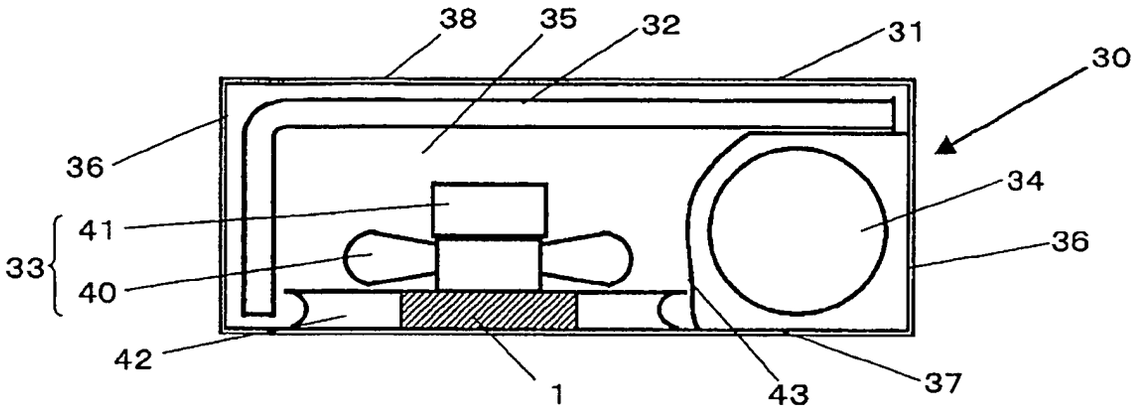

FIG. 4B

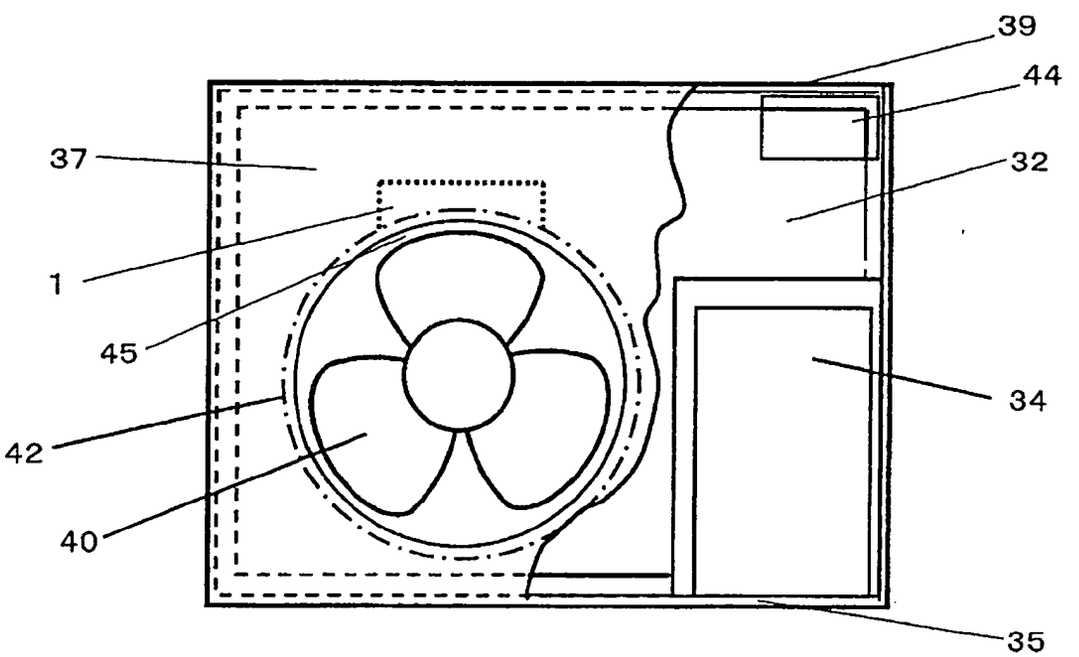

FIG.5A

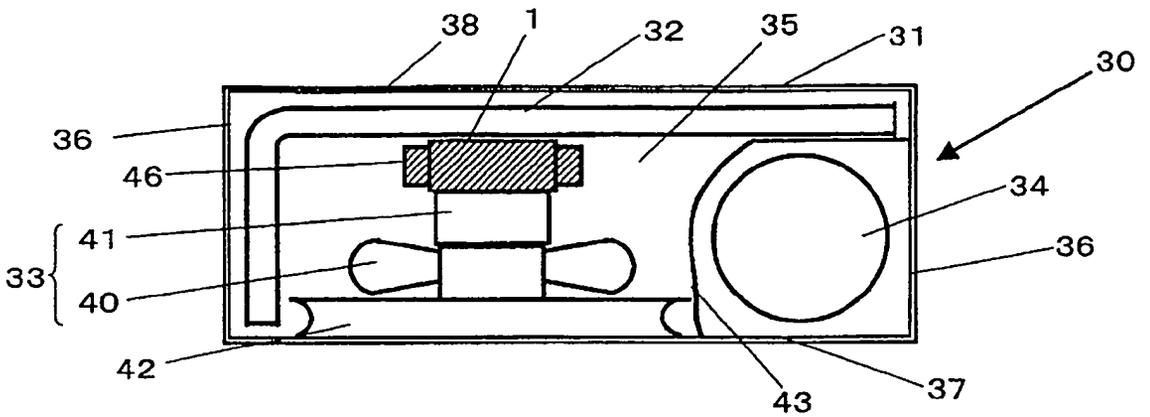

FIG.5B

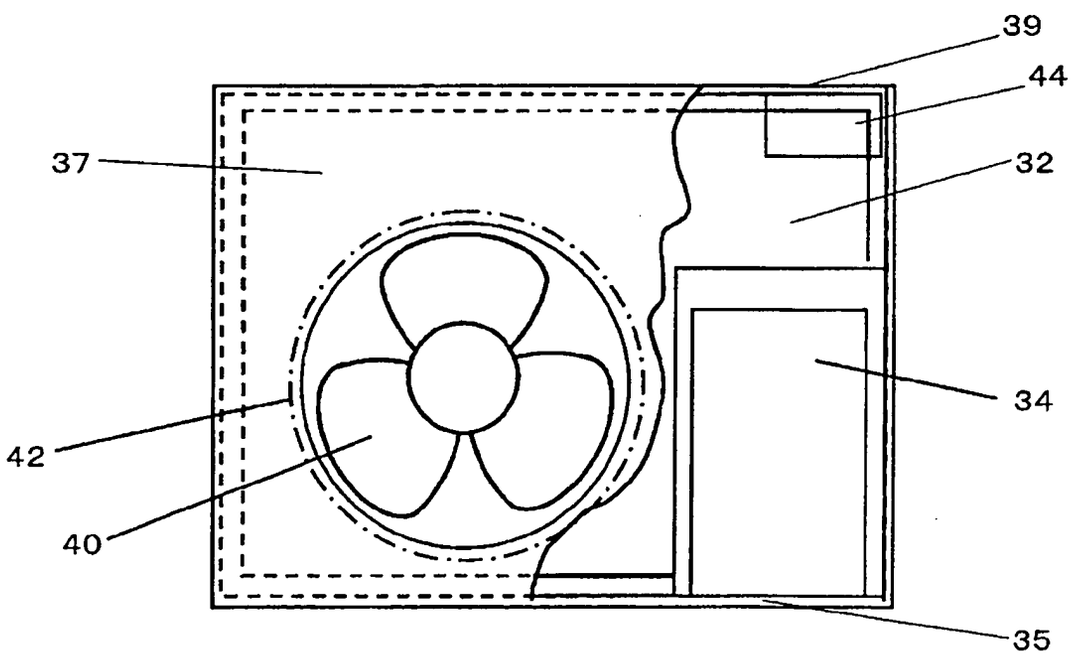

FIG.6A

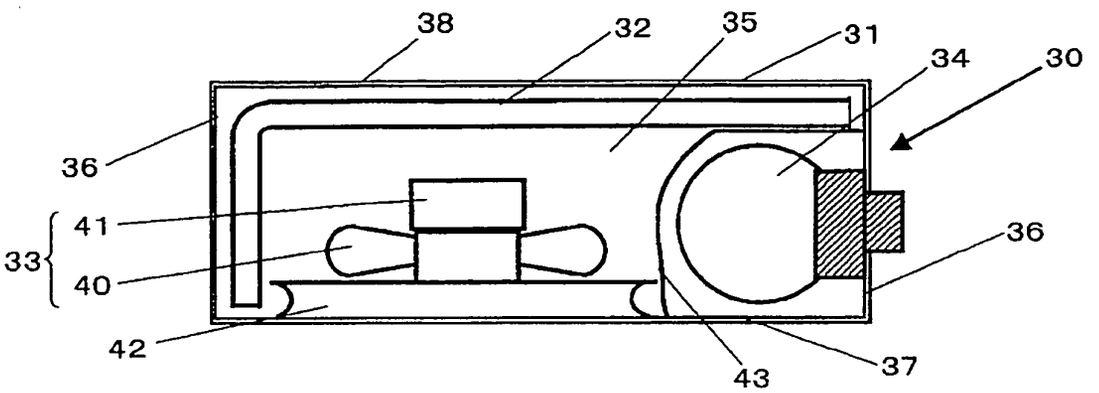

FIG.6B

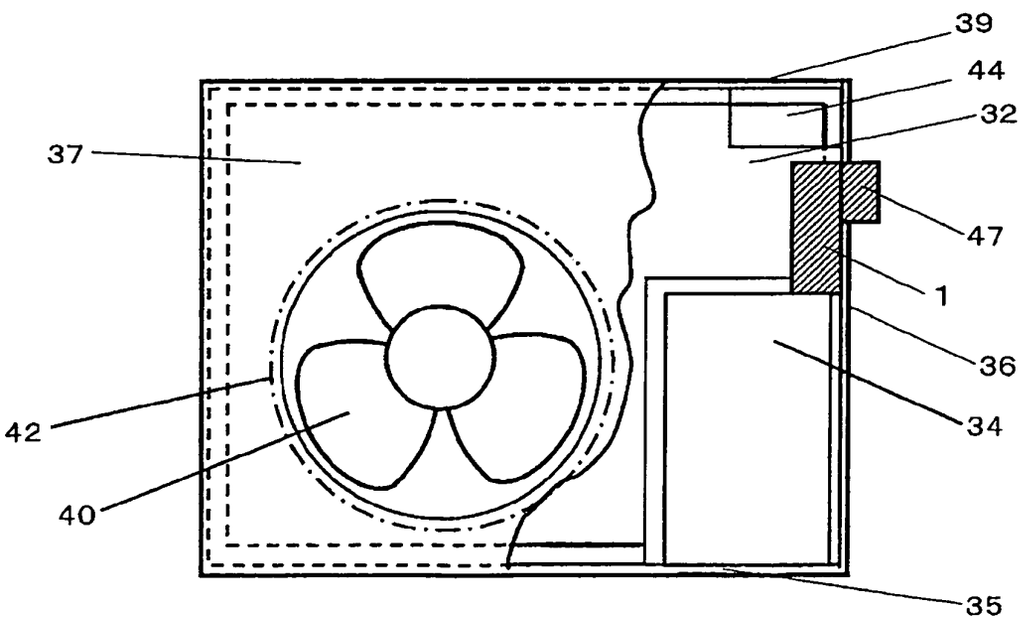

FIG. 7
(PRIOR ART)