

AIR CONDITIONER OUTDOOR UNIT

TECHNICAL FIELD

The present invention relates to an air conditioner outdoor unit, and more particularly to the construction of a printed circuit board which is mounted in a switch box of the air conditioner outdoor unit.

BACKGROUND ART

Conventionally, in an air conditioner outdoor unit the interior of its casing of rectangular parallelepipedic shape is divided into two spaces located adjacent to each other in the horizontal direction, as shown for example Japanese Patent *Kokai* Publication No. 2000-161716. One of these spaces contains a heat exchanger, a fan, and so forth, and this space serves as a heat exchange space. On the other hand, the other space contains, in addition to a compressor and a refrigerant pipe, various components such as for example a control device connected to the refrigerant pipe, and this space serves as a machine space. One of such components disposed in the machine space is a shut-off valve for establishing connection of a connecting pipe to an indoor unit.

Also as shown in the aforementioned publication, a switch box is disposed for example in an upper portion of the interior of the casing in the outdoor unit of the air conditioner. Firmly secured to the switch box is a printed circuit board on which are mounted various electronic components. Each device disposed within the casing is connected to the printed circuit board. In the case a switch box is located in an upper portion of a casing, as in the aforementioned publication, the printed circuit board is, in general, disposed substantially in parallel with a top plate of the casing.

Apart from the above, installation or relocation of an air conditioner outdoor unit may require execution of an operation for connecting a connecting pipe to the shut-off valve of the machine space and execution of an operation for setting the length of the connecting pipe on the printed circuit board. Generally, a DIP switch is mounted on the printed circuit board, so that in such operations, the length of the connecting pipe will be set by adequate switching of the DIP switch.

Since in the outdoor unit the printed circuit board is disposed in the upper portion of the interior of the casing in parallel with the casing top plate, this requires execution of an operation of removing the top plate from the casing at the time of switching of the DIP switch. However, the top plate is firmly secured to upper end portions of the casing with a plurality of bolts, which complicates installation and removal of the top plate. Further, in some installation situations no sufficient working space is available above the outdoor unit. In such a case, operations following removal of the top plate may be difficult to carry out. As described above, it is conventionally impossible for an operator to operate the DIP switch unless a part of the casing (the top plate in the aforementioned example) around the position of the printed circuit board is removed, therefore producing the problem of operation performance at the time of installation.

Further, when installing or relocating the outdoor unit in the aforementioned example, pipe connection to the shut-off valve is carried out from aside of the casing, while on the other hand setting the DIP switch and removing the top plate for such a setting are carried out from above the casing. That is, these operations are carried out from different directions thereby to result in increasing the number of operation steps.

Bearing in mind the above-described problems with the prior art techniques, the present invention was made. Accordingly, an object of the present invention is to improve operation performance while reducing the number of operation steps by

facilitating execution of switching and setting of switch operation parts such as for example a DIP switch at the time of installation or relocation of an air conditioner outdoor unit.

DISCLOSURE OF THE INVENTION

5 In the present invention, a printed circuit board of a switch box is separated into a main board and a sub-board. Switch operation parts including a DIP switch and the like are mounted on the sub-board, and the sub-board can be disposed at any orientation.

More specifically, the present invention provides a solving means which is an air conditioner outdoor unit comprising a casing (2) which contains therein a switch box
10 (10) to which a printed circuit board (11) is firmly secured. In the air conditioner outdoor unit of the present invention, the printed circuit board (11) is made up of a main board (12) and a sub-board (13) separated from the main board (12), and switch operation parts (14, 16) are mounted on the sub-board (13).

In the aforementioned construction, the sub-board (13) can be disposed at a
15 different orientation from that of the main board (12). As a result of such arrangement, even when the main board (12) is disposed at a position providing poor operability, for example in the vicinity of the top plate (23), the sub-board (13) can be disposed and oriented, taking the operability of the switch operation parts (14, 16) into account. This improves the operability.

20 Further, in the aforementioned construction, the switch operation parts (14, 16) mounted on the sub-board (13) may include a DIP switch (14). The use of the DIP switch (14) facilitates for example setting of the length of connecting pipes (9a, 9b).

Furthermore, in the aforementioned construction, when the main board (12) is disposed, in an upper portion of the interior of the casing (2), substantially in parallel
25 with a top plate (23) of the casing (2), the sub-board (13) can be disposed substantially

in parallel with a lateral plate (24c) of the casing (2). Such arrangement makes it possible for the switch operation parts (14, 16) of the sub-board (13) to be operated from the direction of the lateral plate (24c) of the casing (2).

Further, in the aforementioned construction, two spaces (2a, 2b), located adjacent to each other substantially in a horizontal direction, may be defined in the interior of the casing (2), and wherein one of the spaces (2a, 2b) serves as a heat exchange space (2a) whereas the other of the spaces (2a, 2b) serves as a machine space (2b), and the sub-board (13) may be disposed substantially in parallel with the lateral plate (24c) on the side of the machine space (2b) of the casing (2). Such arrangement makes it possible for the switch operation parts (14, 16) of the sub-board (13) to be operated from the side of the machine space (2b) of the casing (2). Further, since shut-off valves (8a, 8b) are mounted in the machine space (2b), connection of the connecting pipes (9a, 9b) to these shut-off valves (8a, 8b) and operation of the switch operation parts (14, 16) can be carried out at the same time at the time of installation.

Furthermore, in the aforementioned construction, at least a part of the lateral plate (24c) on the side of the machine space (2b) of the casing (2) may be formed into an opening, and the casing (2) may be provided with a removable cover member (25) for closing the opening. As a result of such arrangement, the switch operation parts (14, 16) of the sub-board (13) can be operated at the same time that the shut-off valves (8a, 8b) are operated, by removal of the cover member (25) for closing the opening of the lateral plate (24c) on the side of the machine space (2b).

In the aforementioned construction, the main board (12) may be provided with a drive circuit and a control circuit for each device within the casing (2).

Further, in such a construction, the main board (12) may include a driving board (12a) provided with a drive circuit and a controlling board (12b) provided with a

control circuit and the driving board (12a) and the controlling board (12b) may be firmly secured in the switch box (10) so as to be located substantially in parallel with the top plate (23) of the casing (2).

EFFECTS

5 In accordance with the solving means of the present invention, the printed circuit board (11) is made up of the main board (12) and the sub-board (13). This allows the sub-board (13) to be disposed at a different orientation from that of the main board (12). Therefore the switch operation parts (14, 16) such as a DIP switch mounted on the sub-board (13) can be disposed freely at an easy-to-operate orientation. This therefore
10 improves operation performance in operating the switch operation parts (14, 16).

Further, the main board (12) is disposed, in the upper portion of the interior of the casing (2), substantially in parallel with the top plate (23) of the casing (2), while the sub-board (13) is disposed substantially in parallel with the lateral plate (24c) of the casing (2), as a result of which arrangement the switch operation parts (14, 16) can be
15 operated from the side of the lateral plate (24c). Therefore, operation performance can be improved in such a situation that the operation of the switch operation parts (14, 16) is difficult to carry out from above the casing (2).

Furthermore, the sub-board (13) is disposed substantially in parallel with the lateral plate (24c) on the side of the machine space (2b) of the casing (2), and the shut-off
20 valves (8a, 8b) are mounted in the machine space (2b). Therefore, connecting the connecting pipes (9a, 9b) to the shut-off valves (8a, 8b) and operating the switch operation parts (14, 16) can be carried out at the same time, thereby making the operations considerably easy. This therefore makes it possible to reduce the number of operation steps as well as to reduce costs.

Further, the opening of the lateral plate (24c) on the side of the machine space (2b) is provided with the cover member (25). The cover member (25) is removably mounted on the casing (2). As a result of such arrangement, it is possible to perform installation and removal of the cover member (25) in an easier manner in comparison with removal of the top plate (23) from the casing (2), thereby making it possible to further improve the operability of the switch operation parts (14, 16) mounted on the sub-board (13).

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a front view schematically showing an arrangement of devices housed in a casing, in an air conditioner outdoor unit according to an embodiment of the present invention.

Figure 2 is a top plan view schematically showing an arrangement of devices, in the outdoor unit of Figure 1.

Figure 3 is a front view of the outdoor unit.

Figure 4 is a right side view of the outdoor unit.

Figure 5 is a right side view of the outdoor unit, with a cover member on the side of a machine space removed away.

Figure 6 is a partially broken perspective view of the outdoor unit.

Figure 7 is a partially enlarged view of Figure 5.

Figure 8 is an exploded perspective view schematically showing shapes of a sub-board and a sub-board holder.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, an embodiment of the present invention will be described with reference to the accompanying drawings. The present embodiment relates to an outdoor unit (1) of a separate type air conditioner.

Figure 1 is a front view schematically showing an arrangement of devices of the outdoor unit (1) and Figure 2 is a plan view schematically showing the devices arrangement. As shown in these figures, the outdoor unit (1) includes a casing (2) (marked with contour lines) in which are disposed devices such as: an outdoor heat
5 exchanger (3), a blower (4), a compressor (5), an electric expansion valve (6), a receiver (7), shut-off valves (i.e., a gas side shut-off valve (8a) and a liquid side shut-off valve (8b)), and so forth.

The outdoor heat exchanger (3) is a cross fin coil type heat exchanger, the construction of which is not shown in detail. The outdoor heat exchanger (3) when
10 viewed from above is substantially L-shaped and is firmly secured to the casing (2). The blower (4) is made up of a fan motor (42) firmly secured to a fan motor mounting base (41) and a propeller fan (43) firmly secured to an output shaft of the fan motor (42), and in the figure the fan motor mounting base (41) is firmly secured to the central part of a front side of the outdoor heat exchanger (3).

15 A tube plate (31), which is formed into a so-called channel shape, is firmly secured to the right end of the outdoor heat exchanger (3), extending along the vertical direction. Firmly secured to the tube plate (31) is a partition plate (21). And the partition plate (21) is connected to the front face of the casing (2), and the interior of the casing (2) is divided into two spaces located adjacent to each other in the horizontal direction, i.e., a
20 large size space (2a) and a small size space (2b).

In the figure the outdoor heat exchanger (3) and the blower (4) are disposed in the large size space (2a) located on the left-hand side of the partition plate (21), and the space (2a) serves as a heat exchange space for heat exchange between a refrigerant flowing in a heat transfer pipe of the outdoor heat exchanger (3) and outdoor air. On the
25 other hand, the compressor (5), the electric expansion valve (6), the receiver (7), the

shut-off valves (8a, 8b), and so forth are disposed in the small size space (2b) located on the right-hand side of the partition plate (21), and the space (2b) serves as a machine space.

The compressor (5), the receiver (7), and the shut-off valves (8a, 8b) are firmly
5 secured to the casing (2) with securing members (not shown). Further, the electric expansion valve (6), connected in the pass of a refrigerant pipe (not shown), is disposed at a specified location. The gas side shut-off valve (8a) and the liquid side shut-off valve (8b) for connection of connecting pipes (9a, 9b) (see Figure 5) are disposed in
10 lower portions of the machine space (2b), being located at the right end of the machine space (2b) in Figure 1. The shut-off valves (8a, 8b) are each placed in the closed state until completion of the installation, for keeping the interior of the refrigerant pipe on the side of the outdoor unit (1) clean.

Figures 3 and 4 show a front and a right side view of the casing (2), respectively. As shown in the figure, a blowout opening (22) is formed in the front face of the casing
15 (2) and a suction opening (not shown) is formed in the opposite face thereof. Further, a top plate (23) is mounted on the upper end of the casing (2). The top plate (23) is firmly secured to upper end portions of front and rear lateral plates (24a, 24b) of the casing (2) with a plurality of bolts.

In the casing (2) the widthwise central part of a lateral plate (24c) on the side of the
20 machine space (2b) is formed as an opening from top to bottom. Further, the casing (2) is provided with a cover member (25) for closing the opening of the lateral plate (24c). The cover member (25), which is a plastic molding product, is constructed so that it can be removed readily from the lateral plate (24c) on the side of the machine space (2b) of the casing (2).

The cover member (25) is constructed so as to be vertically slidable along the casing (2). The cover member (25) may be constructed as follows. For example, guide grooves (not shown) running vertically are formed in the casing (2) and right and left edges of the cover member (25) are inserted in their corresponding guide grooves so that the cover member (25) is allowed to vertically move. Further, the cover member (25) can firmly be secured to the casing (2) by tightening a single screw (not shown), with the opening of the casing (2) on the side of the machine space (2b) closed by the cover member (25).

A lower portion of the cover member (25) projects, at a position (25a) when mounted onto the casing (2) corresponding to where the shut-off valves (8a, 8b) are located, outwardly from the lateral plate (24c) on the side of the machine space (2b). An opening (not shown) is formed in the projecting portion (25a) and the connecting pipes (9a, 9b) are passed through the opening. Note that Figure 5 shows a side view of the outdoor unit (1), with the cover member (25) removed from the casing (2). In Figure 5, the internal structure of the outdoor unit (1) other than some components such as the shut-off valves (8a, 8b) is omitted.

On the other hand, a switch box (10) is disposed in an upper portion of the interior of the casing (2), as indicated by imaginary lines of Figures 1 and 2. The switch box (10) is a box-like case made of plastic which opens upward, as shown in Figure 6 which is a partially broken perspective view of the outdoor unit (1). Firmly secured to the switch box (10) is a printed circuit board (11) on which are mounted various electronic components, and each of the devices disposed in the casing (2) is electrically connected to the printed circuit board (11).

The printed circuit board (11) is divided into a main board (12) provided with driving circuits and control circuits for each device and a sub-board (13) provided with

a DIP switch (14), and the main board (12) and the sub-board (13) are interconnected by lead lines and flat cables (not shown).

The DIP switch (14) is a switch operation part which is set according to the length of the connecting pipes (9a, 9b) connected to the shut-off valves (8a, 8b). In the present embodiment the DIP switch (14) is used to perform a switching operation according to the length of the connecting pipes (9a, 9b) at the time of installation and relocation of the outdoor unit (1). Further, the DIP switch (14) is used to perform setting of the quiet operation of the outdoor unit (1). More specifically, it is possible to perform switching between a setting in which the quiet operation is carried out only during the cooling and another setting in which the quiet operation is carried out both during the cooling and during the heating.

For the setting of three types of pipe lengths (SHORT, INTERMEDIATE, and LONG), on/off combinations of two switch armatures (i.e., three combinations: on/off, on/on, and off/off) are used. Also for the setting of the quiet operation, two switch armatures are used. Because of this, the DIP switch (14) of the present embodiment has four switch armatures (14a-14d) as shown in Figures 7 and 8.

The main board (12) is divided into a driving board (12a) having a drive circuit and a controlling board (12b) having a control circuit, each of which is firmly secured in position in the switch box (10) so as to be located substantially in parallel with the top plate (23) of the casing (2). On the other hand, the sub-board (13) on which is mounted the DIP switch (14) is firmly secured to the switch box (10) at a different orientation from that of the main board (12). More specifically, the sub-board (13) is disposed face to face with the opening of the lateral plate (24c) on the side of the machine space (2b) of the casing (2). That is, the sub-board (13) is disposed at an orientation approximately at right angles with respect to the main board (12). As shown in Figure 7 which is a

partially enlarged view of Figure 5, the DIP switch (14) is located so that it can be operated through the opening of the lateral plate (24).

The sub-board (13) is mounted onto a sub-board holder (15) the shape of which is schematically shown in Figure 8. The sub-board holder (15) is a plastic molding product and has, as its integral portions, a holder main body (15a) formed into a
5 rectangular shape and mounting pieces (15b) projecting backwardly from right and left ends of the holder main body (15a), respectively. The sub-board (13) is fitted into the holder main body (15a) from the rear, so that the sub-board (13) is held in an interfitting manner. The holder main body (15a) has a front face opening (15c) through which the
10 DIP switch (14) can be operated, with the sub-board (13) assembled to the holder main body (15a).

The mounting piece (15b) of the sub-board holder (15) made of a narrow plate has flexibility in the direction of the thickness thereof. The mounting piece (15b) has, at its leading end portion, leading-end engaging portions (15d) laterally outwardly projecting
15 from the sub-board holder (15). As shown in Figure 7, a mounting hole (10b), into which the mounting piece (15b) of the sub-board holder (15) is inserted for mounting thereof, is formed in the lateral surface (10a) on the side of the machine space (2b) in the switch box (10). The mounting hole (10b) of the switch box (10), when the leading-end engaging portion (15d) passes therethrough at the time of insertion of the mounting
20 piece (15b) of the sub-board holder (15), causes the mounting piece (15b) to bend toward the inside of the sub-board holder (15). Having passed through the mounting hole (10b), the leading-end engaging portion (15d) is restored to its original shape prior to the deformation, thereby preventing the sub-board holder (15) from slipping off the switch box (10).

The sub-board (13) is provided with a push button switch (16) for pump-down, and a front face opening (15e) for operating the push button switch (16) is formed in the holder main body (15a). The sub-board holder (15) is so constructed as to prevent the push button switch (16) for pump-down from being depressed accidentally. More specifically, the circumference portion of the front face opening (15e) is located slightly ahead of the push button switch (16).

The push button switch (16) for pump-down is a switch used to collect refrigerant when the outdoor unit (1) is relocated. The push button switch (16) is operated prior to disconnecting the connecting pipes (9a, 9b) from the shut-off valves (8a, 8b) during the relocation operation. The push button switch (16) is disposed side by side with the DIP switch (14), on the lateral surface (10a) of the switch box (10).

Further, the switch box (10) has terminal bases (17) at the side of the sub-board (13). The terminal base (17) is connected to the main board (12) by a flat cable or the like. And when an electric wire (17a) such as power supply is connected to the terminal base (17), this provides a supply of power supply current to each device from the main board (12). In Figure 6, the reference numeral (18) represents a terminal base for quiet operation.

INSTALLATION OPERATION OF THE OUTDOOR UNIT

At the time of installation of the outdoor unit, first the outdoor unit (1) and the indoor unit (not shown) are installed in their respective given locations. Thereafter, the cover member (25) is removed from the casing (2) of the outdoor unit (1), and the connecting pipes (9a, 9b) are connected to the gas side shut-off valve (8a) and to the liquid side shut-off valve (8b), respectively. Further, an electric wire such as power supply is connected to the terminal base (17) of the lateral surface (10a) of the switch box (10).

After the cover member (25) is removed from the casing (2), the DIP switch (14) is exposed in the opening of the lateral plate (24c) on the side of the machine space (2b) of the casing (2). During the installation, the DIP switch (14) is switched according to the length of the connecting pipes (9a, 9b), for example after establishing connection for the connecting pipes (9a, 9b), and settings on the side of the printed circuit board (11) are carried out for performing adequate control operations according to the pipe length. Further, in the present embodiment, switching of the DIP switch (14) is also carried out according to the type of quiet operation to be set.

After establishing connection of the connecting pipes (9a, 9b) and the wire (17a) and performing switching of the DIP switch (14) in the way described above, each of the shut-off valves (8a, 8b) is opened and the cover member (25) is mounted to the casing (2). Finally, the cover member (25) is firmly secured to the casing (2) by tightening a single screw and the installation is completed.

EFFECTS OF THE EMBODIMENT

According to the present embodiment, the printed circuit board (11) is divided into the main board (12) and the sub-board (13). As a result of such arrangement, the sub-board (13) can be disposed sideways, even when operability with respect to the main board (12) is poor because no sufficient working space is available above the casing (2).

And the sub-board (13) separated from the main board (12) is disposed so that the DIP switch (14) is located on the lateral surface (10a) of the switch box (10) which can be exposed by removing the cover member (25) from the casing (2). As a result of such arrangement, switching of the DIP switch (14) can be carried out easily from aside, with the cover member (25) removed from the casing (2) at the time of installation.

Conventionally the DIP switch (14) is mounted on the printed circuit board (the main board (12)) disposed in parallel with the top plate (23) of the casing (2), so that in

addition to piping work and wiring work which are carried out from aside of the casing (2), the DIP switch (14) must be operated from above after removing the top plate (23) from the casing (2). This is troublesome. On the other hand, according to the present embodiment, the DIP switch (14) can be operated while carrying out piping work and wiring work. Because of this, it is possible to reduce the number of operation steps, thereby reducing the cost of manufacture.

OTHER EMBODIMENTS OF THE PRESENT INVENTION

The following are other arrangements of the aforementioned embodiment of the present invention.

For example, in the aforementioned embodiment the DIP switch (14) and the push button switch (16) are mounted on the sub-board (13) separated from the main board (12). However, any other switch operation parts may be mounted on the sub-board (13) as long as they are operated at the time of installation. Of the switch operation parts one that is not operated at the time of installation may be mounted on the main board (12).

Further, in the aforementioned embodiment the main board (12) is disposed in parallel with the top plate (23) of the casing (2), whereas the sub-board (13) is disposed in parallel with the lateral plate (24c) on the side of the machine space (2b) of the casing (2). The disposition of the sub-board (13) is not limited to such arrangement that it is disposed at an orientation in parallel with the lateral plate (24c). The sub-board (13) may be disposed according to a concrete arrangement or installation circumstance of the outdoor unit (1) so that the DIP switch (14) and the other switch can be operated easily. Also the disposition of the main board (12) is not limited to the aforesaid arrangement that it is disposed in parallel with the top plate (23) of the casing (2).

To sum up, in the present invention the DIP switch (14) and the other switch operation part are mounted on the sub-board (13) separated from the main board (12).

Therefore, when the mounting of the DIP switch (14) and the other switch operation part on the main board (12) results in poor operability, the sub-board (13) can be disposed at a different orientation from that of the main board (12). This improves the DIP switch (14) and the other switch operation part in operability.

- 5 Further, in the aforementioned embodiment, the DIP switch (14) is mounted at a lower left-hand portion of the lateral surface (10a) on the side of the machine space (2b) of the switch box (10). However, such a mounting location may be changed to meet a concrete structure of the switch box (10).

CLAIMS

What is claimed is:

1. An air conditioner outdoor unit comprising a casing (2) which contains therein a switch board (10) to which a printed circuit board (11) is firmly secured,
wherein said printed circuit board (11) is made up of a main board (12) and a sub-board (13) separated from said main board (12), and wherein switch operation parts (14, 16) are mounted on said sub-board (13), and
wherein said sub-board (13) is disposed at a different orientation from that of said main board (12).
2. The air conditioner outdoor unit of claim 1,
wherein said switch operation parts (14, 16) mounted on said sub-board (13) includes a DIP switch (14).
3. The air conditioner outdoor unit of claim 1,
wherein said main board (12) is disposed, in an upper portion of the interior of said casing (2), substantially in parallel with a top plate (23) of said casing (2), and
wherein said sub-board (13) is disposed substantially in parallel with a lateral plate (24c) of said casing (2).
4. The air conditioner outdoor unit of claim 3,
wherein two spaces (2a, 2b), located adjacent to each other substantially in a horizontal direction, are defined in the interior of said casing (2), and wherein one of said spaces (2a, 2b) serves a heat exchange space (2a) whereas the other of said spaces (2a, 2b) serves a machine space (2b), and
wherein said sub-board (13) is disposed substantially in parallel with said lateral plate (24c) on the side of said machine space (2b) of said casing (2).
5. The air conditioner outdoor unit of claim 4,
wherein at least a part of said lateral plate (24c) on the side of said machine space (2b) of said casing (2) is formed into an opening, and wherein said casing (2) is provided with a removable cover member (25) for closing said opening.

6. The air conditioner outdoor unit of any one of claims 1-5,
wherein said main board (12) is provided with a drive circuit and a control circuit for each device within said casing (2).

7. The air conditioner outdoor unit of claim 6,
wherein said main board (12) includes a driving board (12a) provided with a drive circuit and a controlling board (12b) provided with a control circuit, and
wherein said driving board (12a) and said controlling board (12b) are firmly secured in said switch board (10) so as to be located substantially in parallel with said top plate (23) of said casing (2).