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(54) OUTDOOR UNIT FOR AIR CONDITIONER

(57) An outdoor unit capable of reducing pressure loss due to the presence of a fan guard and improving the performance of an air conditioner is provided. An outdoor unit of an air conditioner includes an outdoor fan, an air discharge port, and a fan guard (30). The fan guard (30) covers the air discharge port, and has a spaced away portion (31) that is at least 100 mm away from the outdoor fan. In addition, the spaced away portion (31) has a first opening (OP1) whose minimum width is at least 15 mm.

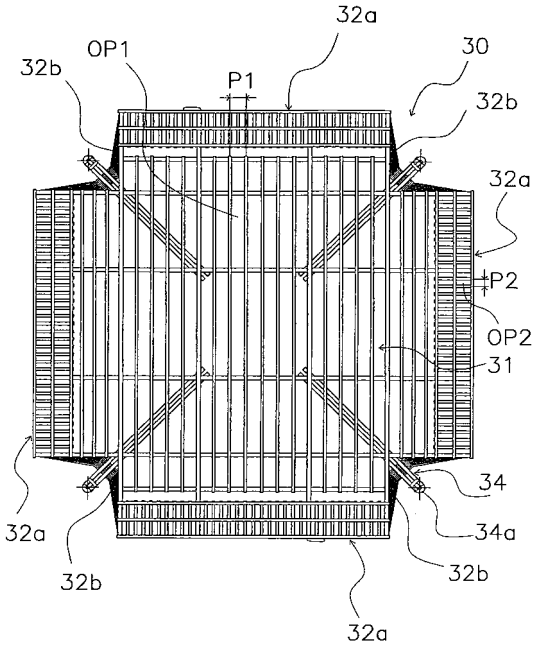

Fig. 6

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Description

TECHNICAL FIELD

[0001] The present invention relates to an outdoor unit of an air conditioner. More specifically, the present invention relates to a type of outdoor unit of an air conditioner that blows out air from a ceiling.

BACKGROUND ART

[0002] A conventional type of outdoor unit of an air conditioner that blows out air from a ceiling includes an air discharge port formed on a top panel of a casing, and a fan guard (also called a fan grille) is disposed so as to cover the air discharge port (for example, see Patent Document 1).

<Patent Document 1>

Japanese Patent Application Publication No. 2004-156828

DISCLOSE OF THE PRESENT INVENTION

<OBJECT TO BE ACHIEVED BY THE PRESENT INVENTION>

[0003] With this type of outdoor unit of an air conditioner, it is desired to improve the performance while maintaining the compact size. Also for the fan that blows out air, it is desired to increase the air volume while maintaining the size equal to that of the conventional fan.

[0004] However, conventionally, the fan guard mounted so as to cover the air discharge port disposed with an impeller of the fan becomes a resistance at the time of air blowing, causing a pressure loss. For the safety reason, it is unthinkable to remove the fan guard for a purpose of eliminating such pressure loss. However, if pressure loss is reduced as much as possible, it is possible to increase the air volume by a corresponding amount.

[0005] A purpose of the present invention is to provide an outdoor unit capable of reducing pressure loss due to the presence of a fan guard and improving the performance of an air conditioner.

<MEANS TO ACHIEVE THE OBJECT>

[0006] An outdoor unit of an air conditioner according to a first aspect of the present invention includes a fan, an air discharge port, and a fan guard. The air discharge port is an opening for discharging air blown out from the fan to the outside. The fan guard covers the air discharge port and includes a spaced away portion disposed away from the fan by a distance greater than the length of a test finger. In addition, the spaced away portion has a first opening formed therein into which the test finger can be inserted.

[0007] With a conventional outdoor unit of an air conditioner, a resin fan guard has a large number of slits formed therein through which air passes. The maximum width of each slit is limited to be below 12 mm so as to prevent the test finger from being inserted.

[0008] Contrarily, with the outdoor unit according to the first aspect of the present invention, the fan guard is provided with the spaced away portion at a position away from the fan by a distance greater than the length of the test finger. With such spaced away portion, even when a finger is inserted therein, the finger tip is prevented from touching the rotating fan. Thus, the first opening at the spaced away portion is formed large (wide width) enough for the test finger to be inserted therein. As described above, the first opening of a large size is formed at the spaced away portion of the fan guard. Thus, a state is achieved in which air blown out from the air discharge port is discharged to the outside of the outdoor unit, without being subjected to large resistance by the fan guard, and the pressure loss due to the presence of the fan guard is reduced. Accordingly, with the outdoor unit according to the first aspect of the present invention, it is possible to increase the air volume and raise the static pressure by the fan, and thus the performance of the air conditioner can be improved.

[0009] An outdoor unit of an air conditioner according to a second aspect of the present invention is the outdoor unit according to the first aspect of the present invention, wherein the spaced away portion is disposed away from the fan by 80 mm or more, and the minimum width of the first opening of the spaced away portion is 12 mm or more.

[0010] An outdoor unit of an air conditioner according to a third aspect of the present invention is the outdoor unit according to the first or second aspect of the present invention, wherein the spaced away portion is disposed away from the fan by 100 mm or more, and the minimum width of the first opening of the spaced away portion is 15 mm or more.

[0011] An outdoor unit of an air conditioner according to a fourth aspect of the present invention is the outdoor unit according to any one of the first through third aspects of the present invention, wherein the fan guard further includes a near-fan portion that is closer to the fan than the spaced away portion is. Also, the near-fan portion has a second opening formed therein into which the test finger cannot be inserted.

[0012] When an opening is provided only at the spaced away portion disposed sufficiently away from the fan and an opening is not provided to a portion near the fan, there is a case where a sufficient amount of reduced pressure loss cannot be ensured. Therefore, here, in view of such a case, the near-fan portion is also provided with the second opening whose size is small (narrow width) enough to prevent the test finger from being inserted therein. Accordingly, it is possible to further reduce pressure loss.

[0013] An outdoor unit of an air conditioner according to a fifth aspect of the present invention is the outdoor unit according to the fourth aspect of the present invention, wherein the maximum width of the second opening

is smaller than 12 mm.

[0014] An outdoor unit of an air conditioner according to a sixth aspect of the present invention is the outdoor unit according to the fourth or fifth aspect of the present invention, wherein the spaced away portion faces the air discharge port. Also, the near-fan portion extends toward the periphery of the air discharge port from the periphery of the spaced away portion.

[0015] Here, the spaced away portion facing the air discharge port is disposed sufficiently away from the fan. Also, within the portion which prevents the contact with the fan between the spaced away portion and the peripheral portion of air discharge port, the near-fan portion which is close to the fan is disposed with the second opening so as to reduce pressure loss while securing the safety.

[0016] Note that, in the present invention, when the spaced away portion is disposed too far from the fan, the outdoor unit becomes unnecessarily large. Thus, the distance between the spaced away portion and the fan should be equal to or smaller than 500 mm, preferably equal to or smaller than 300 mm. In addition, when the minimum width of the first opening of the spaced away portion is too large, a hand can be inserted toward the fan side through the first opening. Thus, in order to prevent this, the minimum width of the first opening should be equal to or smaller than 60 mm, preferably equal to or smaller than 50 mm. In addition, as for the second opening whose maximum width is set to be smaller than 12 mm so as to prevent the finger from being inserted therein, when such maximum width is too small, the air resistance by the near-fan portion becomes large, and thus the maximum width should be equal to or greater than 3 mm, preferably equal to or greater than 5 mm.

<EFFECT OF THE PRESENT INVENTION>

[0017] According to the present invention, it is possible to reduce the pressure loss due to the presence of the fan guard while ensuring a safety function by the fan guard to prevent the contact with the fan, thus improving the performance of the air conditioner compared to the conventional air conditioner.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

Figure 1 is a refrigerant circuit diagram of an air conditioner including an outdoor unit according to an embodiment of the present invention.
Figure 2(a) is a plan schematic view of a 5-horsepower outdoor unit.
Figure 2(b) is a plan schematic view of an 8, 10, 12-horsepower outdoor unit.
Figure 2(c) is a plan schematic view of a 14, 16, 18-horsepower outdoor unit.
Figure 3 is an external view of an outdoor unit having a double outdoor fan.
Figure 4 is a perspective view of the outdoor unit with a casing removed.
Figure 5 is a perspective view of a top surface inside the outdoor unit.
Figure 6 is a plan view of a fan guard.
Figure 7 is a lateral view of the fan guard.
Figure 8 is a view to show the optimization of the outdoor fan.
Figure 9 is a view to show the optimization of the outdoor fan.
Figure 10 is a schematic view of a control board.
Figure 11 is a schematic view of a display unit.
Figure 12 is a view of a test finger.
Figure 13 is a cross sectional view of a motor support table according to an alternative embodiment.
Figure 14 is a view of a mounting structure of a shut-off valve according to the alternative embodiment.

DESCRIPTION OF THE REFERENCE SYMBOLS

[0019]

1	Air conditioner
2	Outdoor unit
29	Outdoor fan
30	Fan guard
31	Spaced away portion
32	Near-fan portion
100	Test finger
OP 1	First opening
OP2	Second opening

BEST MODE FOR CARRYING OUT THE INVENTION

<STRUCTURE OF THE AIR CONDITIONER>

[0020] Figure 1 shows a refrigerant circuit diagram of an air conditioner including an outdoor unit according to an embodiment of the present invention. An air conditioner 1 is a multi-type air conditioner to be used in a building, and has a structure in which a plurality of indoor units 3 are connected in parallel to one or a plurality of outdoor units 2. A refrigerant circuit 10 of the air conditioner 1 mainly includes a compressor 11, a four way switching valve 12, an outdoor heat exchanger 13, an outdoor expansion valve 14, an indoor expansion valve 15, and an indoor heat exchanger 16, which are sequentially connected, constituting a vapor compression refrigeration cycle.

[0021] The compressor 11, the four way switching valve 12, the outdoor heat exchanger 13, and the outdoor expansion valve 14 are included in each outdoor unit 2, and the indoor expansion valve 15 and the indoor heat exchanger 16 are included in each indoor unit 3. In addition, the four way switching valve 12 and the indoor heat exchanger 16 are connected by a gas-side refrigerant communication pipe 17a, and the outdoor expan-

sion valve 14 and the indoor expansion valve 15 are connected by a liquid-side refrigerant communication pipe 17b. The refrigerant communication pipes 17a, 17b are disposed between the outdoor unit 2 and the indoor unit 3. In addition, although not shown, an accumulator and other auxiliary components are also provided in the outdoor unit 2.

[0022] A gas-side shut-off valve 18 and a liquid-side shut-off valve 19 are provided at a terminal portion of the refrigerant circuit inside of the outdoor unit 2. The gas-side shut-off valve 18 is disposed on the four way switching valve 12 side, and the liquid-side shut-off valve 19 is disposed on the outdoor expansion valve 14 side. The gas-side refrigerant communication pipe 17a is connected to the gas-side shut-off valve 18, and the liquid-side refrigerant communication pipe 17b is connected to the liquid-side shut-off valve 19. These shut-off valves 18, 19 are in a closed state when the outdoor units 2 and the indoor units 3 are installed. Also, after each of the units 2 and 3 are installed onsite and the gas-side refrigerant communication pipe 17a and the liquid-side refrigerant communication pipe 17b are connected to the shut-off valves 18, 19, the shut-off valves 18, 19 are put into an opened state.

[0023] The refrigerant circuit of the air conditioner 1 shown in Figure 1 is a simplified drawing of an actual circuit. For example, for the actual compressor 11, a capacity variable compressor whose rotation speed is controlled by an inverter (hereinafter referred to as an inverter compressor) and a fixed capacity compressor which is on/off controlled (hereinafter referred to as a fixed capacity compressor) are often used in combination. In order to be able to accommodate both large and small sizes of buildings for installation, a 5-horsepower (HP) unit as shown in Figure 2(a), an 8, 10, 12-horsepower unit as shown in Figure 2(b), and a 14, 16, 18-horsepower unit as shown in Figure 2(c) are provided as the outdoor units 2. The unit in Figure 2(a) houses one inverter compressor, the unit in Figure 2(b) houses one inverter compressor and one fixed capacity compressor, and the unit in Figure 2(c) houses one inverter compressor and two fixed capacity compressors. In the outdoor unit 2 of the air conditioner 1, an electric wire of the inverter compressor and an electric wire of the fixed capacity compressor are bound together at a crossing portion by a tie wrap. By so doing, here, the noise leakage to the surrounding area is reduced.

[0024] In addition, each outdoor unit 2 is provided with an outdoor fan 29 that blows air to the outdoor heat exchanger 13 and promotes heat exchange between refrigerant and air (see Figure 2). As the outdoor fan 29, the outdoor unit 2 shown in Figure 2(a) uses a fan with a diameter of 680 mm having four blades instead of the conventional fan with a diameter of 700 mm having three blades (see Figure 8), and the outdoor unit 2 shown in Figure 2(c) uses a double fan with a diameter of 540 mm having three blades instead of the fan with a diameter of 700 mm having three blades (see Figure 9). With these outdoor fans 29, optimization of the fan is performed for each casing. The blade area is made larger than that of the conventional fan by 20 - 25%. Also, the blade pitch is made irregular and thereby the NZ noise is reduced and the noise level is reduced by approximately 1 dB.

<OPERATION OF AIR CONDITIONER>

[0025] Next, the operation of this air conditioner is described.

[0026] First, during cooling operation, the four way switching valve 12 is held in a state shown by the solid lines in Figure 1. A high-temperature high-pressure gas refrigerant discharged from the compressor 11 flows into the outdoor heat exchanger 13 via the four way switching valve 12, exchanges heat with outdoor air, and becomes condensed/liquefied. The liquefied refrigerant passes through the outdoor expansion valve 14 in a fully opened state, and flows into each indoor unit 3 via the liquid-side refrigerant communication pipe 17b. In the indoor unit 3, the pressure of the refrigerant is reduced to a predetermined low pressure in the indoor expansion valve 15. Further, the refrigerant exchanges heat with indoor air in the indoor heat exchanger 16 and becomes evaporated. Then, the indoor air that is cooled by the evaporation of the refrigerant is blown out into the room by an indoor fan (not shown), and cools the room. In addition, the refrigerant that is evaporated and gasified in the indoor heat exchanger 16 returns to the outdoor unit 2 via the gas-side refrigerant communication pipe 17a and is sucked into the compressor 11.

[0027] On the other hand, during heating operation, the four way switching valve 12 is held in a state shown by the dashed lines in Figure 1. A high-temperature high-pressure gas refrigerant discharged from the compressor 11 flows into the indoor heat exchanger 16 of each indoor unit 3 via the four way switching valve 12, exchanges heat with indoor air, and becomes condensed/liquefied. The indoor air that is heated by the condensation of the refrigerant is blown out into the room by the indoor fan and heats the room. The refrigerant liquefied in the indoor heat exchanger 16 returns to the outdoor unit 2 from the indoor expansion valve 15 in a fully opened state via the liquid-side refrigerant communication pipe 17b. The pressure of the refrigerant that returned to the outdoor unit 2 is reduced to a predetermined pressure in the outdoor expansion valve 14. Further, the refrigerant exchanges heat with outdoor air in the outdoor heat exchanger 13, and becomes evaporated. Then, the refrigerant that is evaporated and gasified in the outdoor heat exchanger 13 is sucked into the compressor 11 via the four way switching valve 12.

[0028] Note that in either case of cooling operation and heating operation, the indoor expansion valve 15 of the indoor unit 3 during non-operation is in a closed state, and hardly any refrigerant flows in the indoor heat exchanger 16 of such indoor unit 3.

<CONFIGURATION OF OUTDOOR UNIT>

[0029] Next, the outdoor unit 2 is described in detail with reference to Figures 3 to 5. Figure 3 is an external view of the outdoor unit 2 having the double outdoor fan 29 shown in Figure 2(c). Figure 4 is a perspective view of the outdoor unit 2 with the casing and the outdoor fan 29 removed. Here, for the simplicity of understanding, the one shown in Figure 2(b), instead of the one shown in Figure 2(c), is described. Figure 5 is a plan view of the outdoor unit 2 viewed from the center in a height direction. In Figure 3, the drawings of the shut-off valves 18, 19 are omitted. In addition, the drawings of the refrigerant pipe and the like inside are also omitted.

(CASING AND OTHER COMPONENTS)

[0030] Side plates 22 and a back plate 23 of the casing are integrally formed with support pillars 51, 52, 53, and 54. A front plate 21 of the casing is mounted to the outside of the support pillars 52, 53. In addition, four support pillars 51 to 54 that vertically extend are mutually connected by a bottom frame 61 in the vicinity of the lower end, and a cross stay 62 and a motor support table 63 at the upper portion. The motor support table 63 is equipped with a motor 70 having an impeller shown in Figure 2(b) which drives the outdoor fan 29. A top panel 24 shown by the two-dot chain lines in Figure 7 is disposed at a position which is immediately above and around a bellmouth 29a (a member which, along with the top panel 24, forms the air discharge port of the outdoor unit 2) disposed around the impeller of the outdoor fan 29. The outer periphery of the top panel 24 is fixed to the support pillars 51, 52, 53, and 54 or the side plates 22 and the back plate 23. A circular hole that corresponds to the bellmouth 29a is opened in the top panel 24, and an inner circumferential end that forms the circular hole is bent upward.

(BOTTOM FRAME AND SHUT-OFF VALVE)

[0031] The bottom frame 61 supports the compressor 11, the outdoor heat exchanger 13, and the like, and fulfills a role for fixing the shut-off valves 18, 19 via a mounting structure 64. In addition, the bottom frame 61 has an opening at a portion below the shut-off valves 18, 19.

[0032] As shown in Figure 5, the gas-side shut-off valve 18 and the liquid-side shut-off valve 19 of the outdoor unit 2 are arranged side by side. Further, a direction of arrangement of the gas-side shut-off valve 18 and the liquid-side shut-off valve 19 is approximately 45 degrees with respect to both of the front plate 21 and the side plates 22 of the casing. In other words, the gas-side shut-off valve 18 and the liquid-side shut-off valve 19 are arranged separately, and at the same time, they are offset in a left-right direction (direction along the front plate 21) and are also offset in a front-back direction (direction along the side plates 22). Accordingly, the pipes can be easily pulled out in a front-back direction and also in a left-right direction. Also, lagging the refrigerant communication pipes 17a, 17b (winding a thermally insulated tape around the both pipes or covering the both pipes with a decorative metal plate) can be easily performed, and the thickness of the pipes can be made thin, which improves the appearance.

(STRUCTURE BELOW SHUT-OFF VALVE)

[0033] In addition, both of a pipe connection port 18a of the gas-side shut-off valve 18 and a pipe connection port 19a of the liquid-side shut-off valve 19 face downward in the same manner. In the drawing, the structures of the shut-off valves 18, 19 are simplified. However, the shut-off valves 18, 19 do not have a conventional structure in which they are joined to the refrigerant communication pipes 17a, 17b with a flare nut or a flange, but have a structure in which brazing (a metal are joined to a metal by using wax with heat) can be performed. Accordingly, when performing the joining work of the shut-off valves 18, 19 and the refrigerant communication pipes 17a, 17b onsite, there is no need for a screw tightening work. Thus, the construction performance is improved and the possibility of refrigerant leakage can be reduced.

(STRUCTURE OF FAN GUARD)

[0034] A fan guard 30 is a three-dimensional integrated grille of a low carbon steel wire, and the entire surface thereof is coated with a resin coating. The strength is increased compared to a conventional resin grille, and the load capacity is 60 kgf. In addition, as described below, the blow out area (opening ratio) is larger compared to the conventional resin grille.

[0035] More specifically, the fan guard 30 is formed by a steel wire with a diameter of 2.0 mm and a steel wire with a diameter of 3.5 mm, and a crossing portion is welded. The fan guard 30 is formed by a spaced away portion 31 in a quadrilateral shape which is approximately 110 mm away from the outdoor fan 29 in a height direction, and a lateral side portion 32 that surrounds a gap between the spaced away portion 31 and the top panel 24 in a height direction. A dimension H1 in Figure 7 is 110 mm. Of the lateral side portion 32, portions that extend diagonally downward from the four sides of the spaced away portion 31 are near-fan portions 32a that are relatively close to the outdoor fan 29. In addition, connecting portions 32b are formed between the four near-fan portions 32a of the lateral side portion 32. Further, four members 34 whose lower portions extend from the spaced away portion 31 to be in contact with the top panel 24 through the connecting portion 32b are welded to the spaced away portion 31 and the connecting portion 32b. Lower portions 34a of these four members 34 are screwed to the top panel 24. In addition, in order to prevent displacement of the near-fan portions 32a of the lateral side portion 32, steel wires 33 that are also members that constitute the spaced away portion 31 and the

near-fan portions 32a extend downward so as to be inserted in a hole (not shown) in the top panel 24 as shown in Figure 7.

[0036] The spaced away portion 31 has a large number of first openings OP1 formed therein by a steel wire in a grid pattern. The width of the narrow side of each first opening OP 1 is equal to or greater than 20 mm. Specifically, a pitch P1 of the steel wire that forms the first openings OP1 is 22 mm and the diameter of the steel wire is 2 mm. Therefore, the width of each first opening OP 1 is 20 mm. The size of the first opening OP 1 is such that a test finger 100 shown in Figure 12 can be inserted therein. However, it is not large enough for a person to insert his hand therein, and the spaced away portion 31 is away from the outdoor fan 29 by 100 mm or more. Thus, a person is prevented from touching the rotating outdoor fan 29 with his fingertip.

[0037] On the other hand, the size of a second opening OP2 formed in each near-fan portion 32a of the lateral side portion 32 is limited to a small size, in view of that the distance between a portion of the near-fan portion 32a closest to the outdoor fan 29 and the outdoor fan 29 is less than 50 mm. Specifically, a steel wire pitch P2 on the narrow side of the steel wire in a grid pattern is 11 mm, and consequently the width of the second opening OP2 is reduced to approximately 9 mm. Accordingly, a situation where the test finger 100 shown in Figure 12 penetrates through the second opening OP2 and reaches the outdoor fan 29 is avoided. In other words, even if a person tries to insert his finger from the near-fan portions 32a of the lateral side portion 32 into the inside, the finger hardly goes inside of the fan guard 30. Thus, a person is prevented from touching the rotating outdoor fan 29 with his finger.

[0038] The connecting portions 32b of the lateral side portion 32 are further away from the outdoor fan 29 than the near-fan portions 32a are, but the steel wire pitch is set in accordance with the steel wire pitch of the near-fan portions 32a.

[0039] Note that, as shown in Figure 12, the test finger 100 mainly includes a stop plate 101 in a circular disk shape, a first cylindrical portion 102 extending from the stop plate 101, a second cylindrical portion 103 extending from the first cylindrical portion 102, and a false fingertip portion 104 extending from the second cylindrical portion 103, and two joint portions are formed so as to be bent at a predetermined angle. The dimensions in Figure 12 are as follows: L1 = 80 mm, L2 = 60 mm, L3 = 20 mm, L4 = 75 mm, and D = 12 mm. In other words, the diameter (D) of the second cylindrical portion 103 is 12 mm.

[0040] As described above, with the fan guard 30, the spaced away portion 31 is provided at a position away from the outdoor fan 29 (a position approximately 110 mm away) by a distance longer than the length of the test finger 100 (80 mm). With such spaced away portion 31, a person is prevented from touching the rotating outdoor fan 29 with his fingertip even if he inserts his finger. Consequently, each first opening OP1 of the spaced away portion 31 is formed to be large enough for the test finger 100 to be inserted (i.e., the width of the narrow side is equal to or greater than 20 mm). Because such large first openings OP1 as described above are formed at the spaced away portion 31 of the fan guard 30, air blown out from the air discharge port formed by the bellmouth 29a and the circular hole of the top panel 24 is discharged to the outside of the outdoor unit 2 without being subjected to great resistance from the fan guard 30, and pressure loss due to the presence of the fan guard 30 is reduced.

[0041] In addition, with the fan guard 30, the lateral side portion 32 that surrounds the gap between the spaced away portion 31 and the top panel 24 in a height direction also has an opening formed therein for air ventilation, which is small enough to prevent a person from inserting his finger. With this opening, resistance against airflow blown out upward from the bellmouth 29a is reduced as much as possible. Also in this manner, pressure loss due to the presence of the fan guard 30 is reduced.

[0042] In these manners, the air conditioner 1 in which the fan guard 30 is adopted can increase the air volume and raise the static pressure by the outdoor fan 29, thus significantly improving the performance. Specifically, pressure loss due to the fan guard 30 is reduced to half or less, compared to the case where the conventional fan guard in which a person cannot insert his finger in any portion and which covers the air discharge port in a manner adjacent to the outdoor fan is used.

<CONTROL BOARD BUTTON AND HIGH LUMINANCE DISPLAY OF OUTDOOR UNIT AND USAGE THEREOF>

[0043] What is indicated by the dotted lines in Figure 3 is a control board 42 disposed inside of a switch box 41 (see Figure 4) arranged on the back of the front plate 21. As shown in Figure 10, a plurality of push buttons 43 are provided on the control board 42.

[0044] In addition, as shown in Figure 3, a display unit 45 which is a display capable of performing high luminance display is provided at the front plate 21 of the outdoor unit 2. This display unit 45 is formed by two display plates disposed above and below, which can display three digit numbers (see Figure 11).

(DISPLAY OF INFORMATION ON PRESSURE AND TEMPERATURE OF REFRIGERANT)

[0045] This air conditioner 1 is configured such that, a pressure sensor and an electronic pressure gauge of brazed type are installed when a pressure gauge is installed as an option, unlike a conventional manner in which a Bourdon tube pressure gauge is connected to a gauge port of a refrigerant pipe with a flare. A pressure measured by such electronic pressure gauge with high precision is displayed on the display unit 45 along with the temperature of refrigerant.

(AUTOMATIC REFRIGERANT CHARGING OPERATION)

[0046] The air conditioner 1 is equipped with an automatic refrigerant charging operation function. Here, refrigerant can be charged to obtain an appropriate amount with a high precision of 500 grams. When a refrigerant canister is connected to a charging port and one of the push buttons 43 on the control board 42 is pressed, the automatic refrigerant charging operation is started, and the operation automatically stops when the appropriate amount is added. In addition, when the canister becomes empty, a display indicating an "empty" state appears on the display unit 45.

[0047] Accordingly, with the air conditioner 1, conventional onsite work such as manually calculating an additional amount of refrigerant to be charged, manually charging additional refrigerant, and manually determining charging by using a canister-scale and/or a pressure gauge has become extremely simple.

(AUTOMATIC TEST RUN)

[0048] The air conditioner 1 is equipped with an automatic test run function that is performed after the automatic refrigerant charging operation. When one of the push buttons 43 on the control board 42 is pressed after the automatic refrigerant charging operation, a check for an erroneous connection of pipes in the refrigerant system, a check to see if the gas-side shut-off valve 18 and the liquid-side shut-off valve 19 are left closed, a sensor check, and a check for the amount of refrigerant are performed, and the trial run is automatically finished.

(REFRIGERANT LEAKAGE DETECTION OPERATION)

[0049] The air conditioner 1 is equipped with a refrigerant leakage detection operation function. The refrigerant leakage detection has a precision of 500 grams, and the refrigerant leakage detection operation is started when one of the push buttons 43 on the control board 42 is pressed. When the push button 43 is pressed, all the indoor units 3 automatically start cooling operation, detect the amount of refrigerant leakage within approximately 30 minutes, and stop the operation. Then, a display by LED on the control board 42 is performed or an indicator is displayed on the display unit 45. Also, for example, when only 0.6 kg of refrigerant has leaked from the initial charging amount of refrigerant, a number "0.6" is displayed on the display unit 45.

(AUTOMATIC DIAGNOSTIC OPERATION)

[0050] The air conditioner 1 starts an automatic diagnostic operation when one of the push buttons 43 on the control board 42 is pressed. This automatic diagnostic operation contributes to acceleration of inspection work, and enables quick diagnostics of problems. Specifically, the automatic diagnostic operation helps to guess where the problems are, such as unplugged connectors and malfunction of a thermistor, solenoid valve, and motor-operated expansion valve, compressor failure, a communication error between the outdoor units 2 and the indoor units 3, and the like.

[0051] In addition, the automatic diagnostic operation can be used for checking whether or not maintenance work was appropriate, by performing the automatic diagnostic operation after repair and checking. Here, unexpected maintenance failure such as that a thermistor is erroneously mounted and the like can be prevented.

[0052] Note that a result of the automatic diagnostic operation can also be displayed in a simple manner by using the display unit 45.

<ALTERNATIVE EMBODIMENT>

(A)

[0053] As shown in Figure 13, the pair of motor support tables 63 preferably has a structure in which the resistance against the airflow from down to up is reduced.

[0054] Here, as each motor support table 63 that extends across the cross stays 62 in Figure 4, a channel member 63a whose cross section is in an angular U-shape is used, and a member 63b to make the lower surface of the channel member 63a into a downward convex shape is welded to the channel member 63a. Each motor support table 63 formed by the channel member 63a and the member 63b has a cross section as shown in Figure 13. The cross sectional view has a downward convex shape in which the center of the lower surface protrudes further downward than the both ends. Accordingly, the airflow flowing from down to up becomes as indicated by arrow A1 in Figure 13, and the resistance from the motor support table 63 is reduced.

[0055] Note that the shape of the lower surface of the motor support table 63 is not limited to the inverted triangular cross sectional shape shown in Figure 13. The lower surface of the member 63a may be in a circular arc shape.

(B)

[0056] As shown in Figure 14, the mounting structure 64 that extends upward from the bottom frame 61 and supports the shut-off valves 18, 19 preferably has a gate shape.

[0057] The mounting structure 64 is formed by a pair of pillars 91, 91 that extend upward from the bottom frame 61 and a horizontal beam 92 that connects upper end portions of the pillars 91, 91. A concave-convex pattern is formed or the drawing process is performed on the pillars 91, 91 and the horizontal beam 92 in order to ensure the strength of each of them. In addition, the horizontal beam 92 is used to support the shut-off valves 18,

19, and an opening OP3 is formed below the shut-off valves 18, 19. Accordingly, when performing brazing below the shut-off valves 18, 19 to join the refrigerant communication pipes 17a, 17b to each other, a space for such work can be secured. In addition, it is possible to install the refrigerant communication pipes 17a, 17b such that refrigerant communication pipes 17a, 17b are laid through the opening OP3.

[0058] In addition, as shown in Figure 14, the horizontal beam 92 is preferably provided in two types so as to be capable of supporting an exclusive component 99 in the case of an air conditioner for simultaneous heating and cooling.

(C)

[0059] The outdoor unit 2 of the air conditioner 1 is preferably configured, in case of a breakdown, such that operation data (high pressure, low pressure, various setting values, subcool, and the like) ten minutes before the occurrence of a breakdown is stored in a memory in the switch box 41. By so doing, data can be analyzed in detail after the breakdown, and the cause of the breakdown can be determined, which allows a countermeasure to be easily taken and the cause of the breakdown to be easily removed.

Claims

1. An outdoor unit (2) of an air conditioner comprising:

a fan (29);
an air discharge port configured to discharge air blown out from the fan to the outside; and
a fan guard (30) configured to cover the air discharge port,

wherein
the fan guard (30) includes a spaced away portion (31) disposed away from the fan by a distance greater than the length of a test finger (100), and
the spaced away portion (31) has a first opening (OP1) formed therein into which the test finger can be inserted.

2. The outdoor unit (2) of an air conditioner according to claim 1, wherein
the spaced away portion (31) is disposed away from the fan by 80 mm or more, and the minimum width of the first opening (OP1) is 12 mm or more.

3. The outdoor unit (2) of an air conditioner according to claim 2, wherein
the spaced away portion (31) is disposed away from the fan by 100 mm or more, and
the minimum width of the first opening (OP1) is 15 mm or more.

4. The outdoor unit (2) of an air conditioner according to any one of claims 1 through 3, wherein
the fan guard (30) further includes a near-fan portion (32) whose distance from the fan is shorter than the distance of the spaced away portion (31) from the fan, and
the near-fan portion (32) has a second opening (OP2) formed therein into which the test finger cannot be inserted.

5. The outdoor unit (2) of an air conditioner according to claim 4, wherein
the width of the second opening (OP2) is smaller than 12 mm.

6. The outdoor unit (2) of an air conditioner according to claim 4 or 5, wherein
the spaced away portion (31) faces the air discharge port, and
the near-fan portion (32) extends toward the periphery of the air discharge port from the periphery of the spaced away portion.

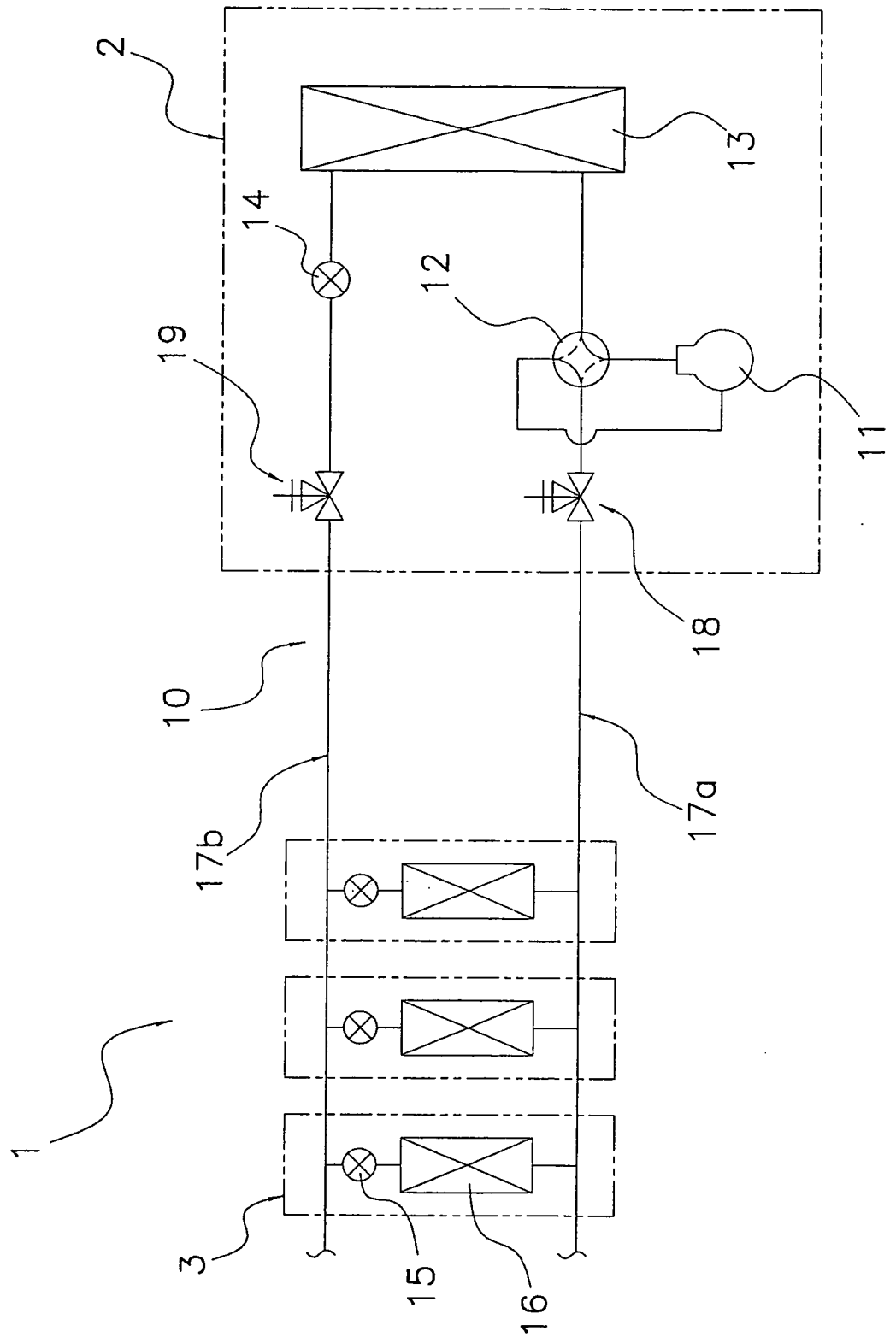

Fig. 1

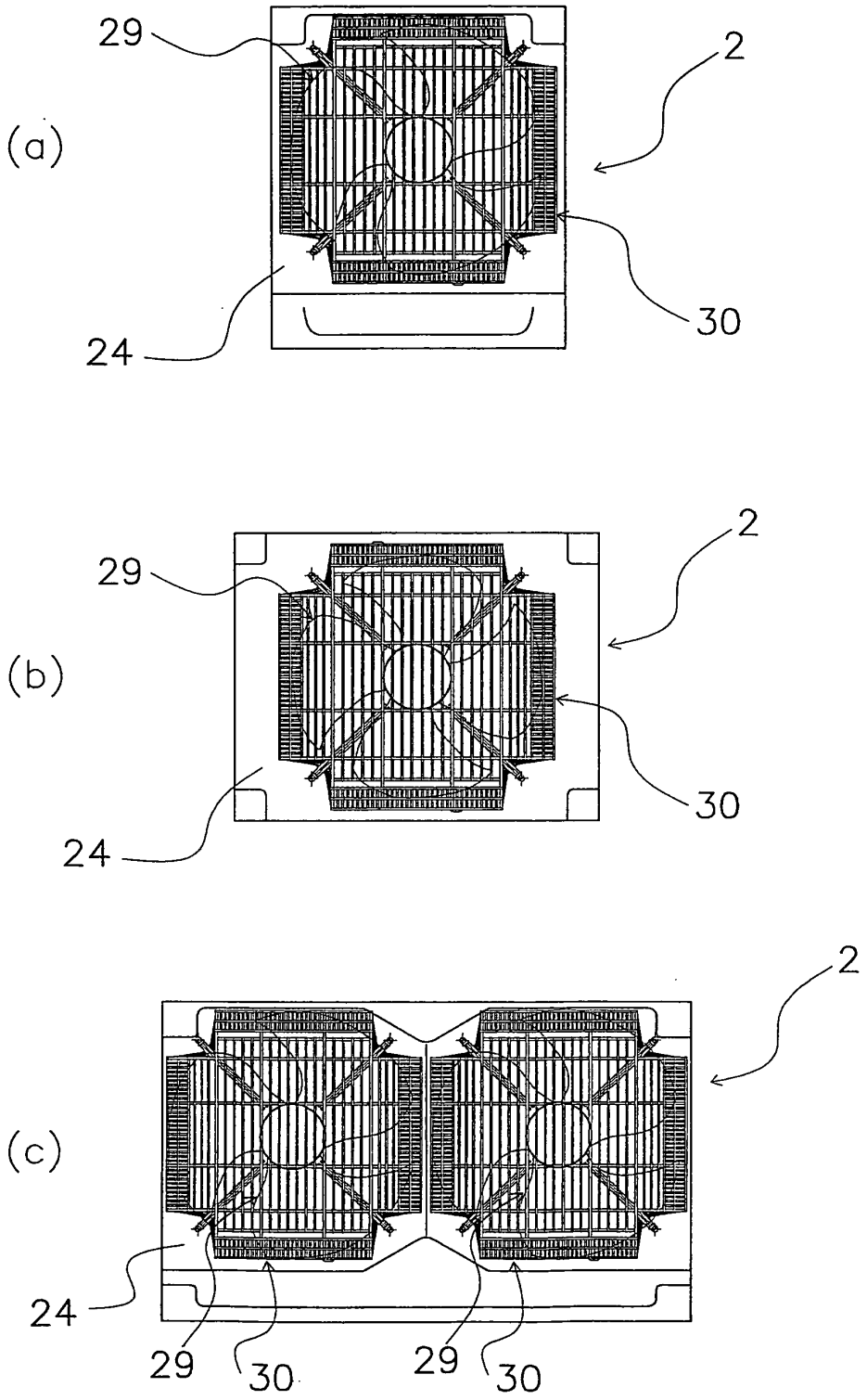

Fig. 2

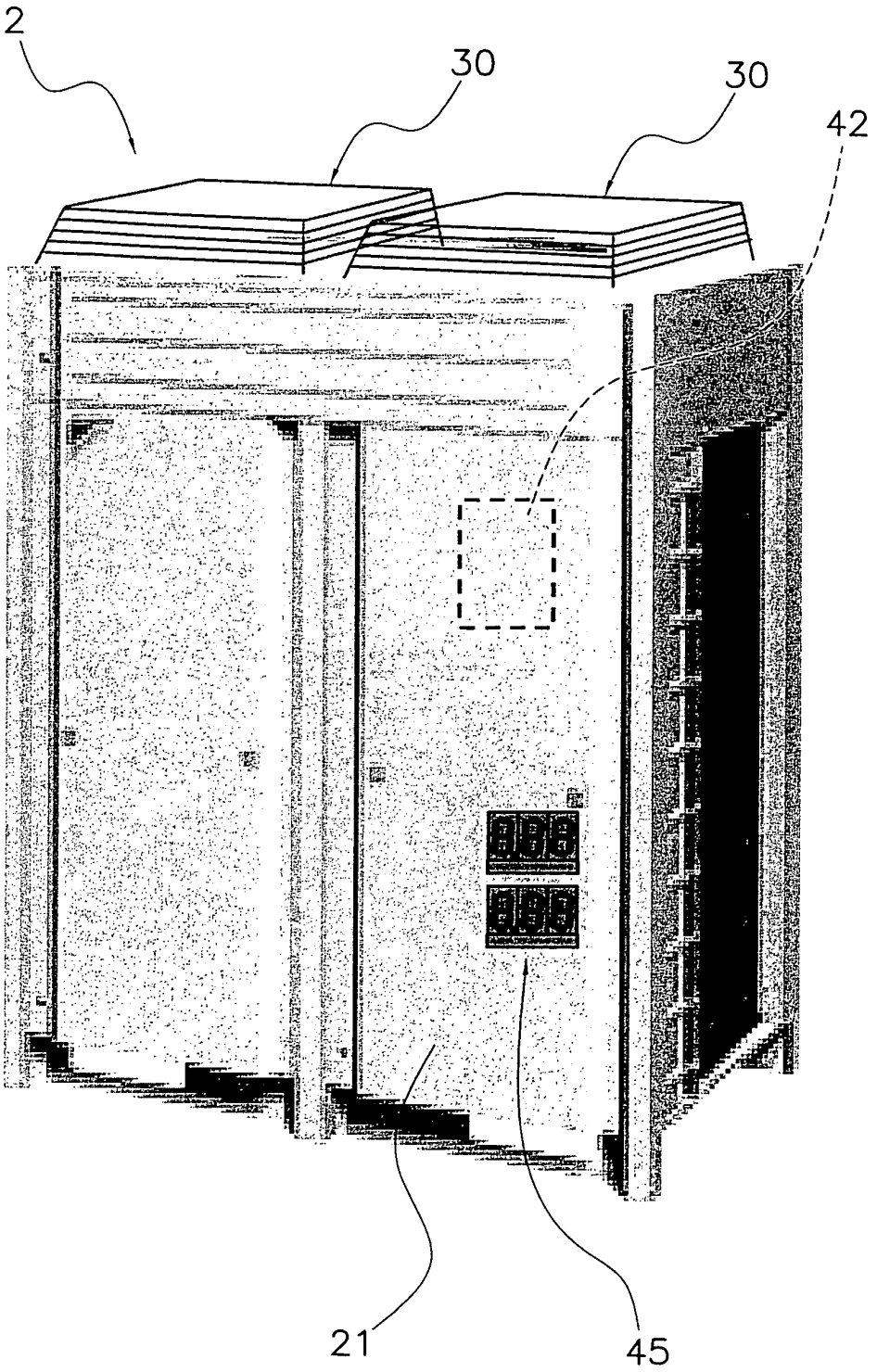

Fig. 3

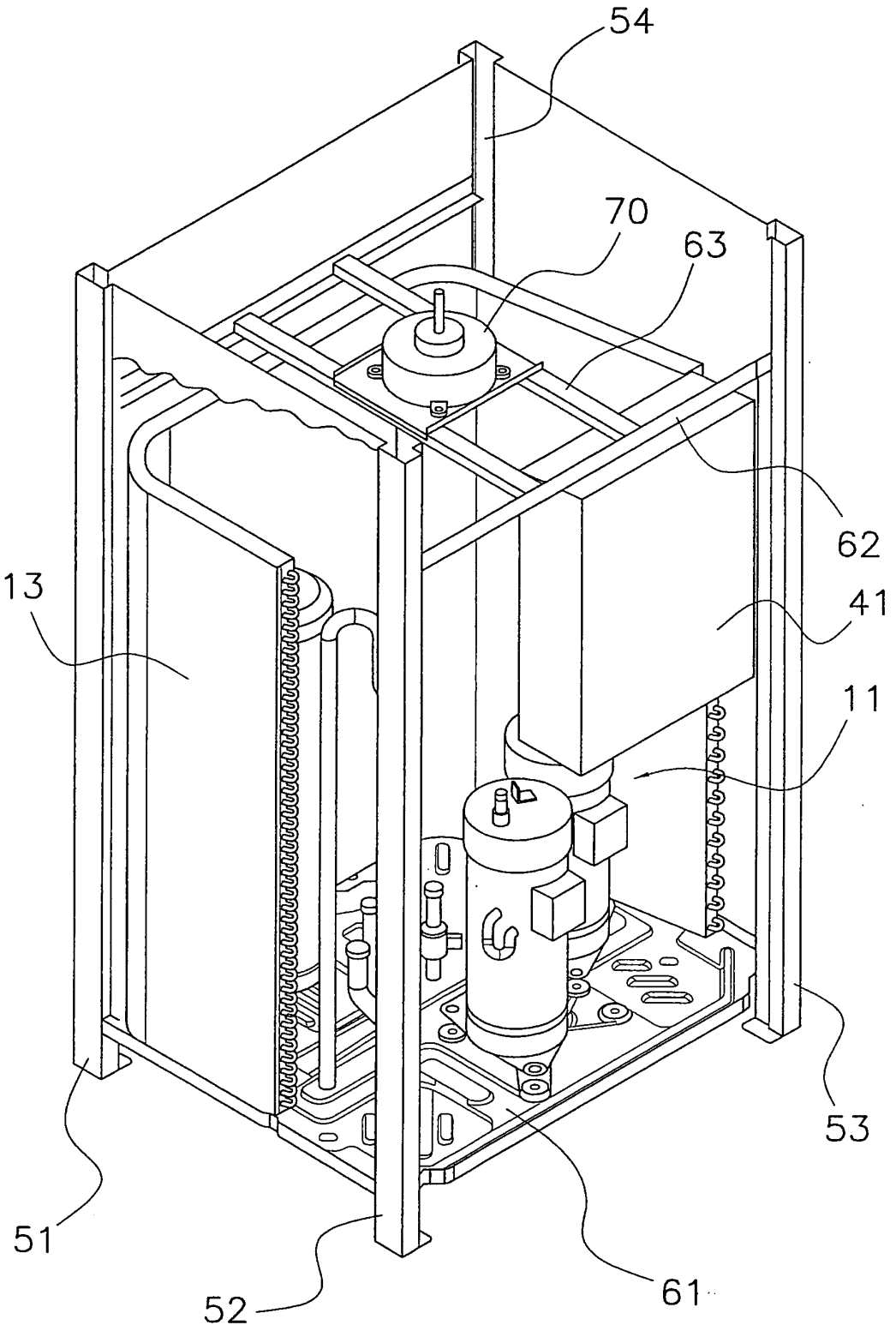

Fig. 4

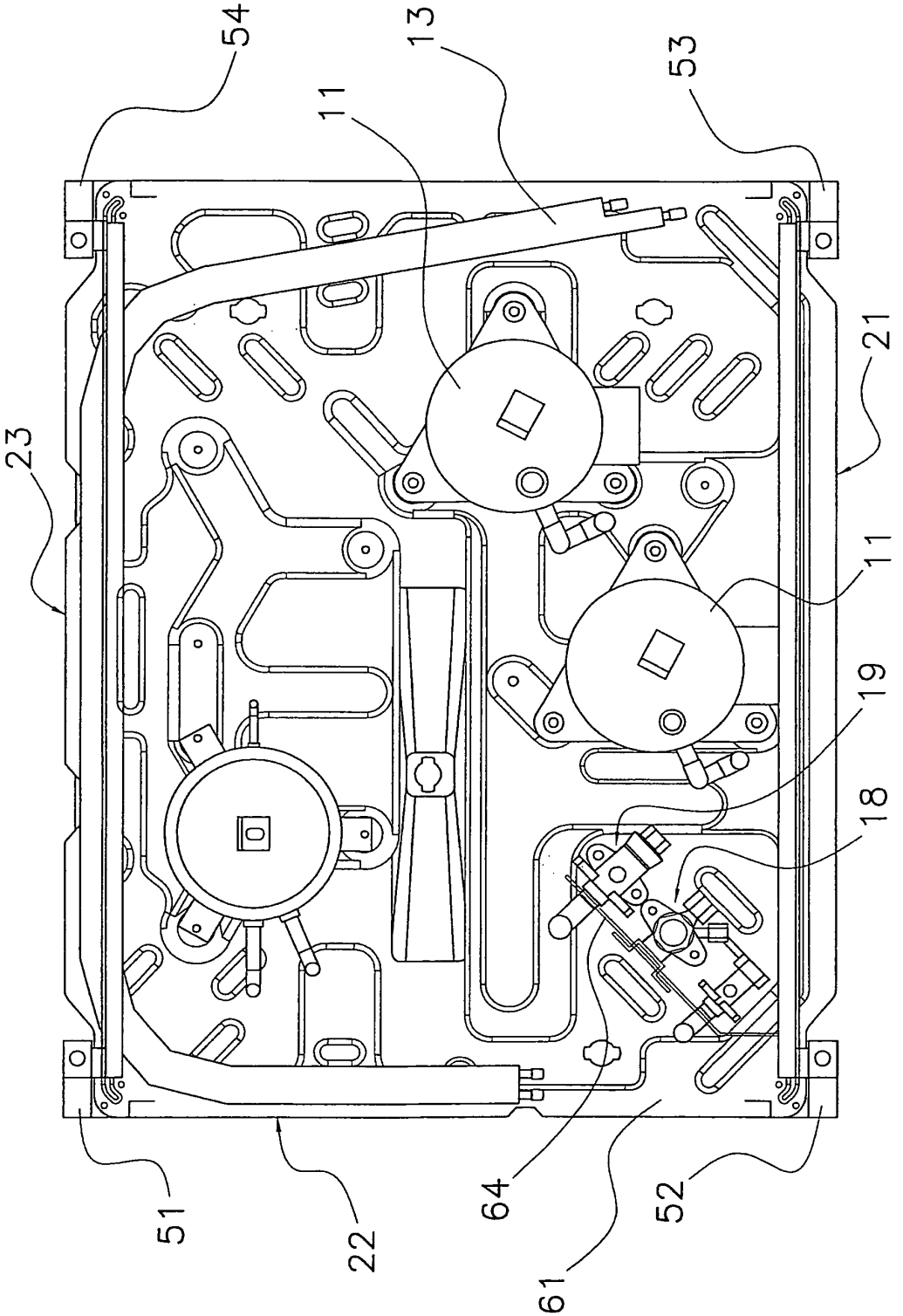

Fig. 5

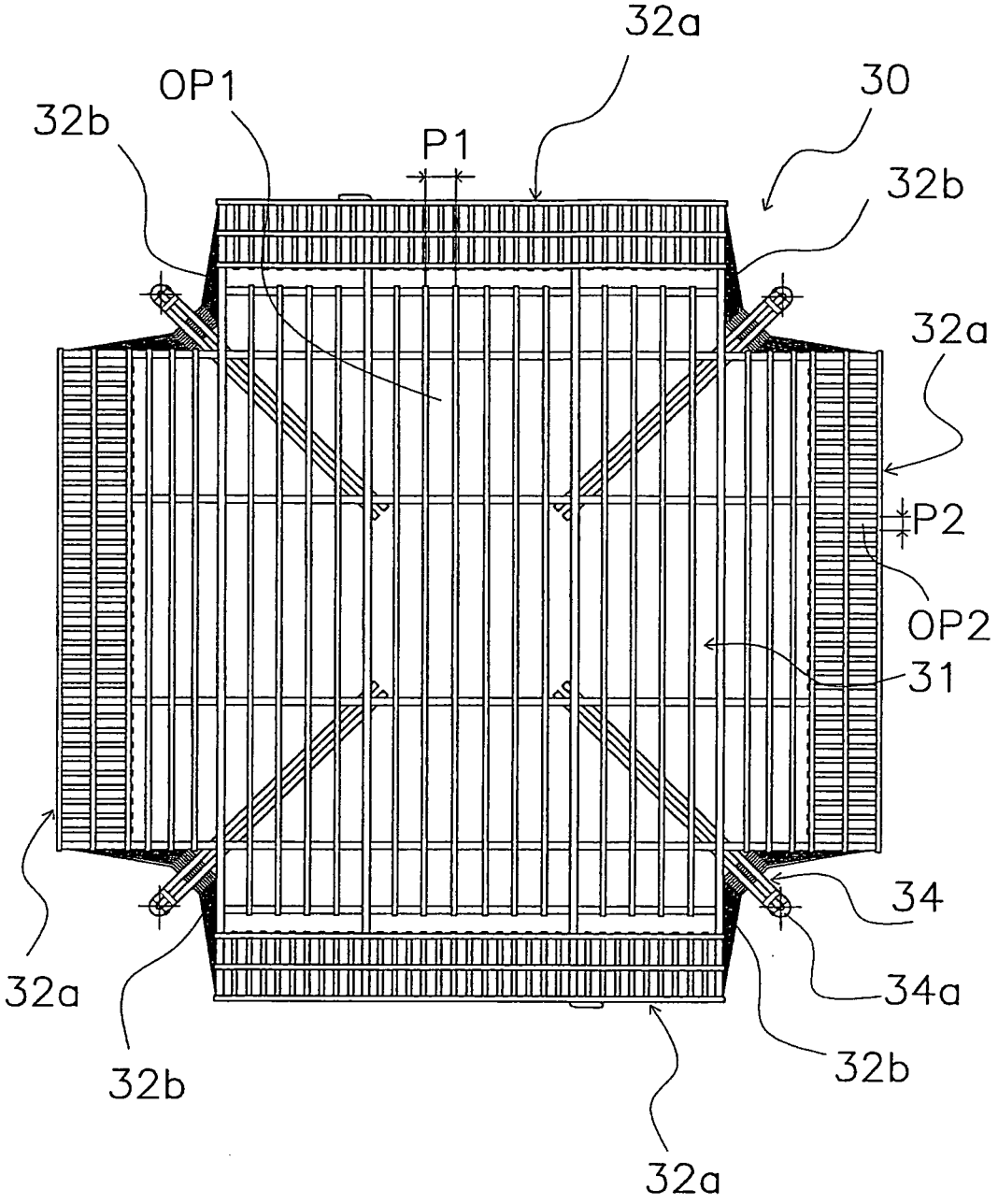

Fig. 6

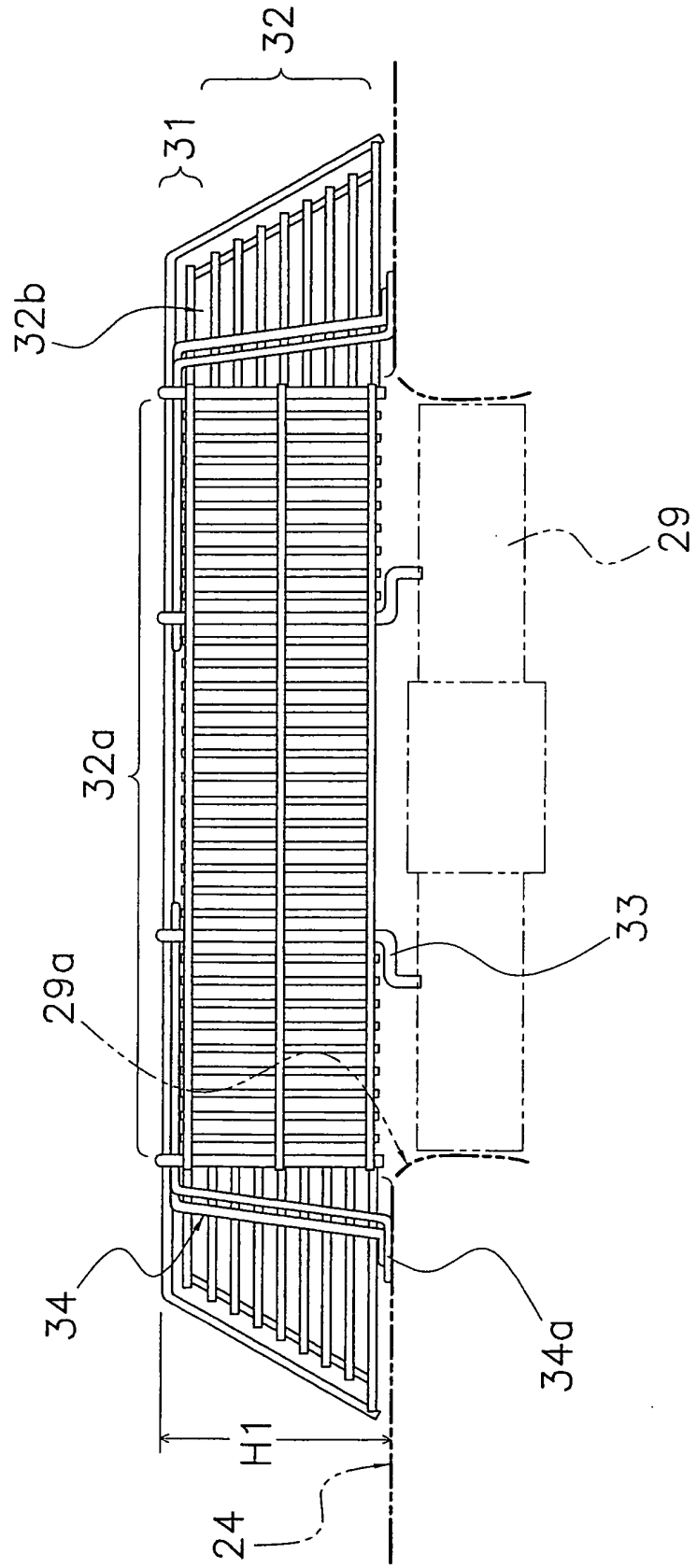

Fig. 7

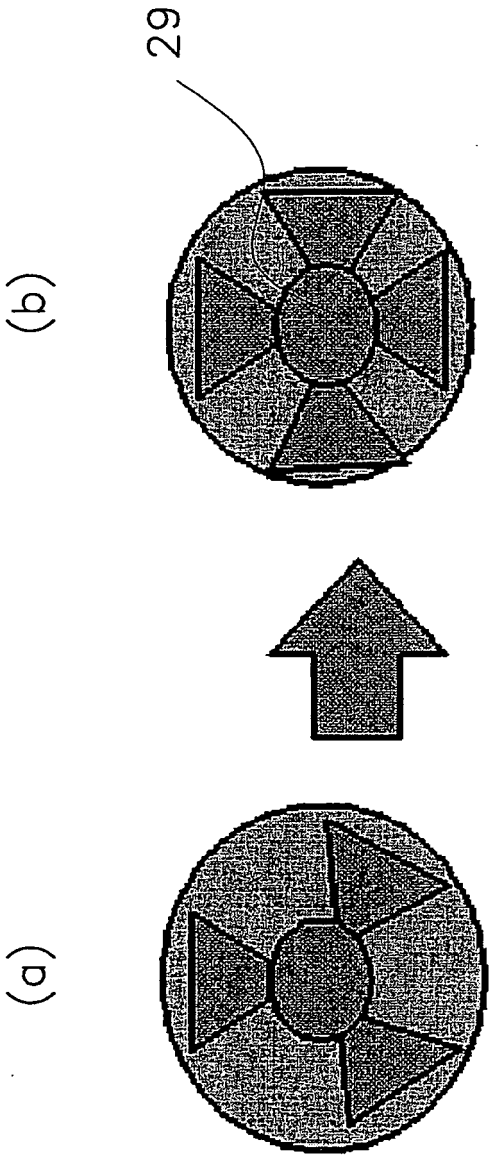

Fig. 8

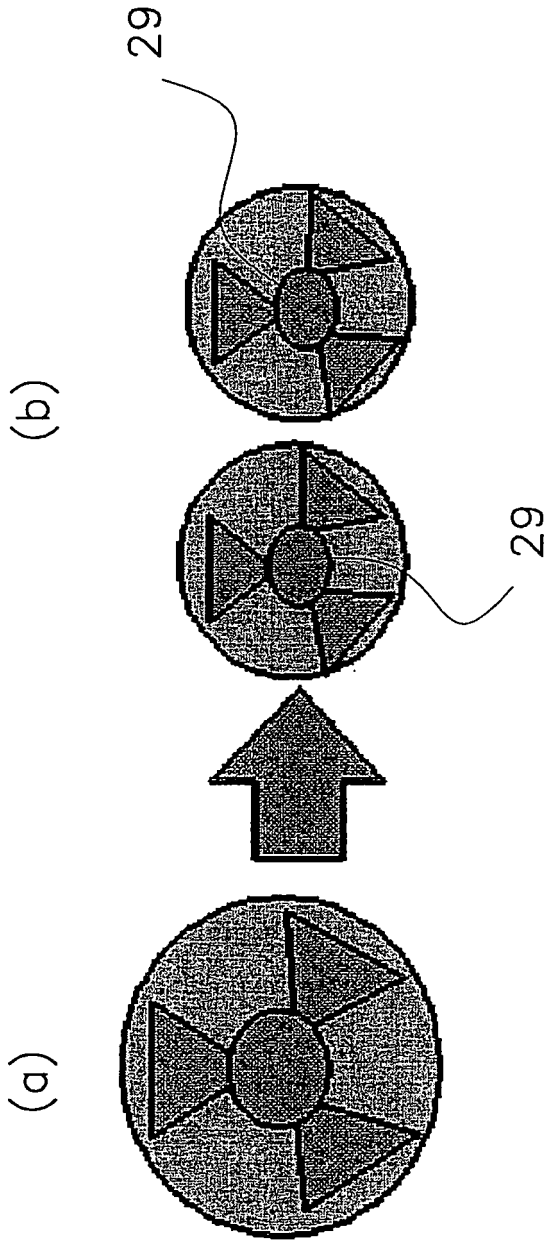

Fig. 9

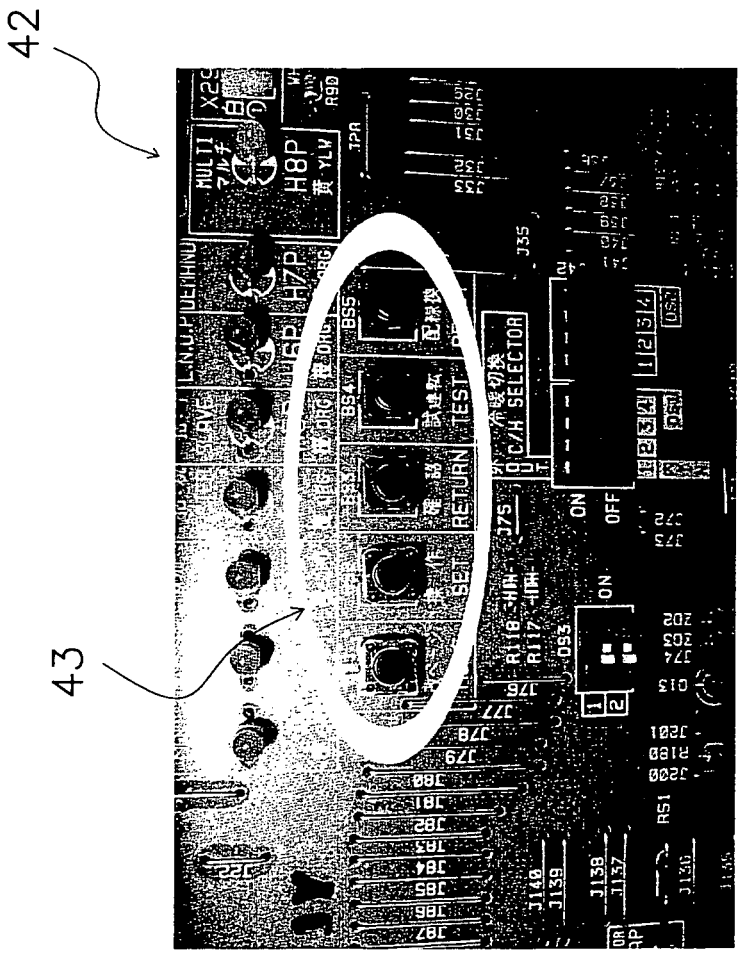

Fig. 10

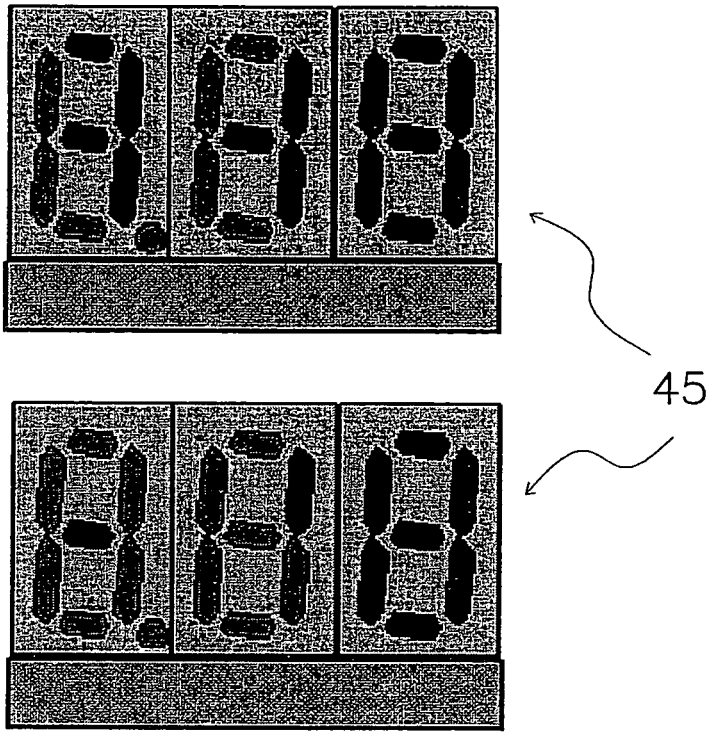

Fig. 11

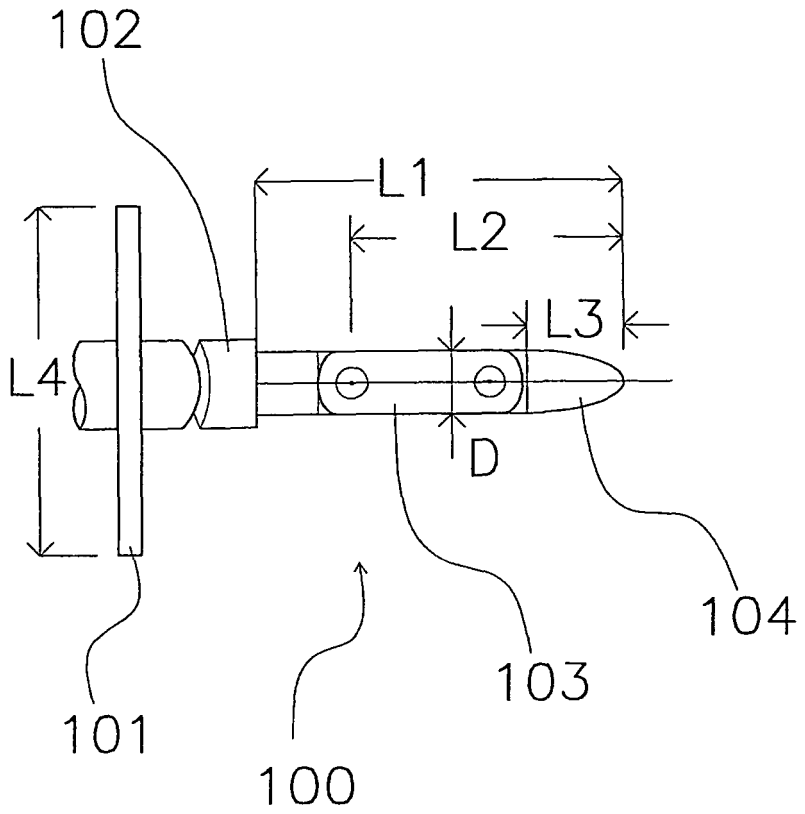

Fig. 12

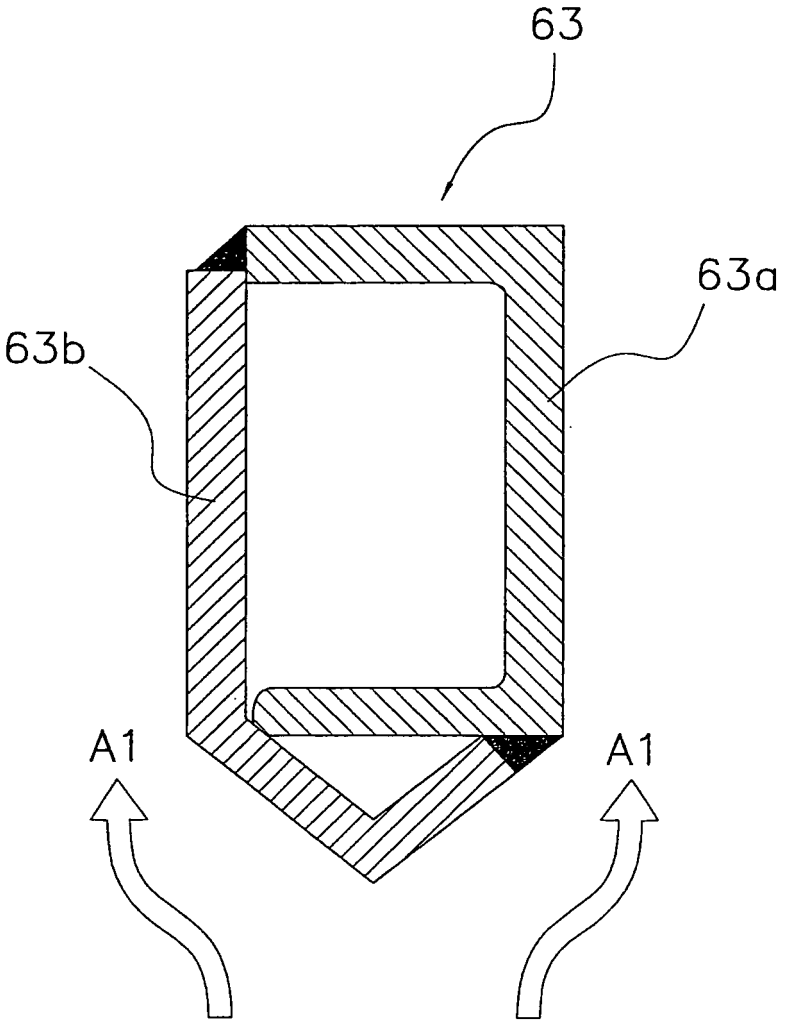

Fig. 13

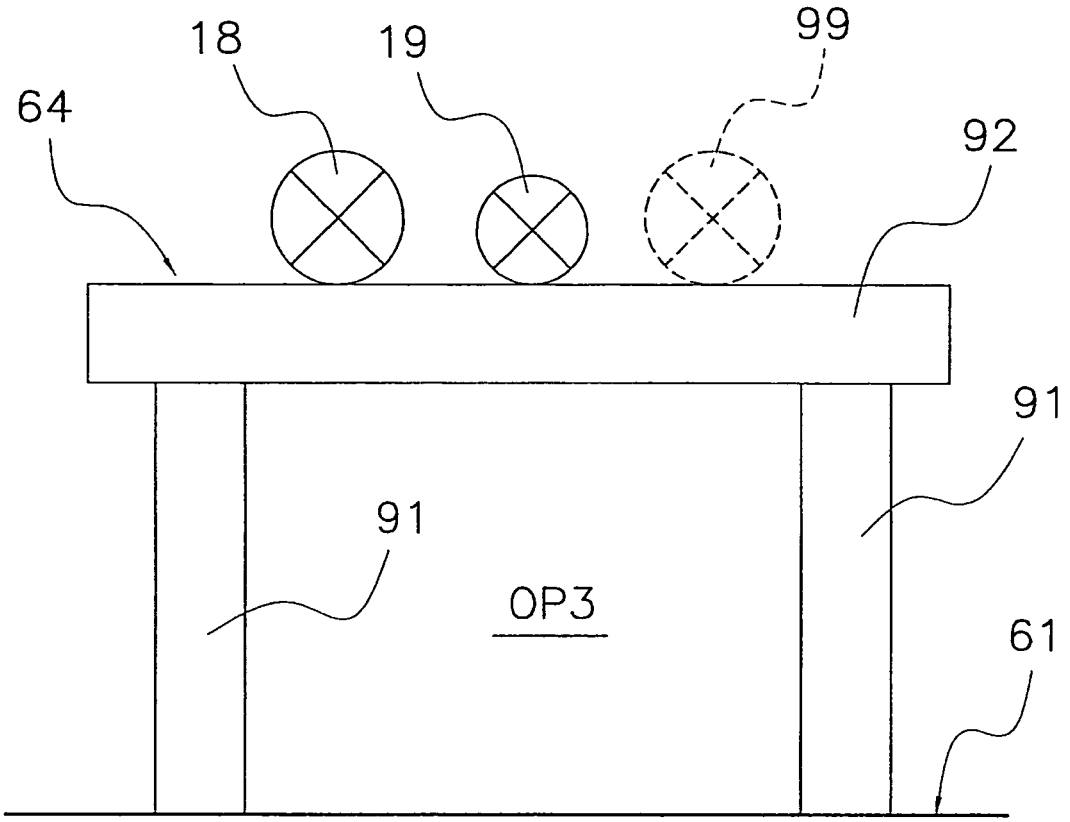

Fig. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/321522

A. CLASSIFICATION OF SUBJECT MATTER
F24F5/00(2006.01)i, *F24F11/02*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F5/00, F24F11/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2006
Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 55601/1985(Laid-open No. 172973/1986) (Mitsubishi Electric Corp.), 27 October, 1986 (27.10.86), Page 4, lines 10 to 13; Fig. 4 (Family: none)	1-6
Y	JP 2002-195637 A (Ricoh Elemex Corp.), 10 July, 2002 (10.07.02), Par. No. [0026] (Family: none)	1-6

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 November, 2006 (13.11.06)	12 December, 2006 (12.12.06)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/321522

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 5-215367 A (Mitsubishi Electric Corp.), 24 August, 1993 (24.08.93), Par. No. [0022]; Figs. 10, 11 (Family: none)	4-6

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2004156828 A **[0002]**