(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 096 365 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.09.2009 Bulletin 2009/36

(51) Int Cl.:
F24F 1/00 *(2006.01)*

(21) Application number: **09002187.4**

(22) Date of filing: **17.02.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA RS

(30) Priority: **29.02.2008 JP 2008048993**
26.03.2008 JP 2008079497

(71) Applicant: **Hitachi Appliances, Inc.**
Minato-ku
Tokyo (JP)

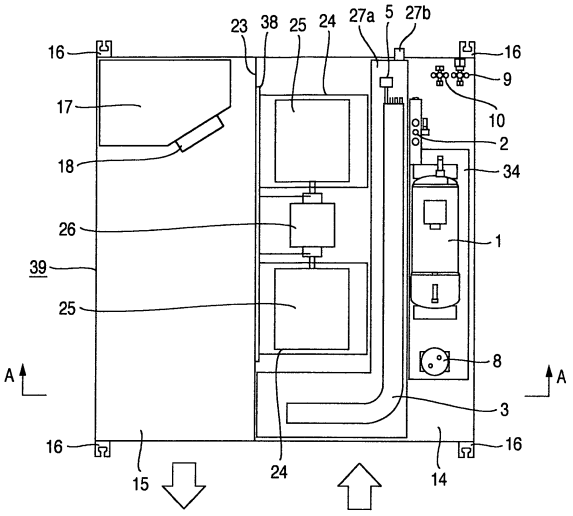
(72) Inventors:
- **Kosugi, Shinichi**
  Shizuoka-shi
  Shizuoka (JP)
- **Oishi, Kenichi**
  Shizuoka-shi
  Shizuoka (JP)
- **Sato, Ryoji**
  Shizuoka-shi
  Shizuoka (JP)
- **Kishitani, Tetsushi**
  Shizuoka-shi
  Shizuoka (JP)
- **Nagahashi, Katsuaki**
  Shizuoka-shi
  Shizuoka (JP)
- **Endo, Michiko**
  Shizuoka-shi
  Shizuoka (JP)

(74) Representative: **Beetz & Partner**
Patentanwälte
Steinsdorfstrasse 10
80538 München (DE)

(54) Heat source unit installed inside building

(57) Provided is an indoor built-in type heat source unit which is thin and compact, which is highly reliable, which has a high heat-exchange ability, and which is capable of reducing the pressure loss of blown-off fluid so as to materialize reduction of noise and saving of energy. The indoor built-in type heat source unit comprises a separation plate (23) partitioning a housing (39) into an inlet space and an outlet space, an air inlet (14) formed in a surface of the housing (39) for sucking air into the inlet space, an air outlet (15) formed in a surface of the housing for blowing off air from the air outlet space, a fan (25) provided in the inlet space on a separation plate (23) side for blowing off air from the inlet space into the outlet space, a fan motor (26) coupled to the fan (25), a horizontal type compressor (1) provided in the inlet space and arranged in a direction the same as the rotating axis of the fan, and a heat-exchanger (3) provided between the fan and the horizontal type compressor.

FIG.1A



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Description

TECHNICAL FIELD

[0001] The present invention relates to a heat source unit of indoor built-in type, that is, a heat source unit installed inside buildings for heat-exchange with outdoor air, and in particular to a housing structure thereof or an arrangement and an attachment of refrigerating cycle components.

BACKGROUND ART

[0002] In general, an outdoor unit (heat source unit) of an air-conditioner is installed on the outside of a building. Accordingly, the outdoor unit may possibly hinder the appearance of the building since the outdoor unit falls in the human's visible sight from the road. Certain cities in European countries, due to the requirements of landscape rules for old towns and cultural designated areas, regulate the position of an outdoor unit so as to restrain the positioning of the outdoor unit in a place which is noticeable by a person, such as the roof top or a veranda of a building. Thus, there has been desired an air-conditioner having an outdoor unit arranged in the inside of a building.

[0003] For example, JP-A-62-218745 discloses, as the prior art, an air-conditioner with an outdoor unit which incorporates therein a compressor, a heat-exchanger, a blower and electronic components and which is formed therein with inlets of air passages connected to a suction port, on opposite sides of a heat-exchanger and the blower which are arranged at the center thereof, having the feature that there is provided a machine room which is defined by side panels adjacent to the air passages, and in which the compressor and the electric components are arranged.

[0004] However the structure disclosed in JP-A-62-218745 has two narrow inlet passages and one wide outlet passage, and it requires working for the provision of three ducts. Further, in this structure, no sufficient consideration is paid for enhancement of the reliability against heat generation in the machine room incorporating therein electric components, and the like, and as well further for miniaturization of the outer casing (housing) of the outdoor unit.

[0005] As stated above, it has been required, for a heat source unit located indoors, to have a thin and lightweight housing, and to facilitate the installation and the service therefor in order that it can be installed in any of recently widespread buildings having a less distance between the ceiling and the roof. Further, in view of the problem of global warming, there have been desired the provision of air-conditioners which are power-saving and highly efficient. Further, since the indoor side is shielded against the outdoor side, it is required to have a housing structure with low noise and less vibration.

SUMMARY OF INVENTION

[0006] An objected of the present invention is to provide an indoor built-in type heat source unit which is thin and compact.

[0007] Another object of the invention is to provide an indoor built-in type heat source unit which is highly reliable.

[0008] Further another object of the invention is to provide an indoor built-in type heat source unit which has a high heat-exchange function.

[0009] Further, another object of the invention is to provide an indoor built-in type heat source unit which is capable of reducing the pressure loss of blow-off fluid even with a thin and compact housing, thereby it is possible to materialize lowering of noise and saving of power.

[0010] To the end, according to an aspect of the invention, there is provided an indoors built-in type heat source unit comprising a housing, a separation plate partitioning the housing into an inlet space and an outlet space, an air inlet formed in the surface of the housing for sucking air into the inlet space, an air outlet formed in the surface of the housing for blowing off the air from the outlet space, a fan provided in the inlet space on the separation plate side for blowing the air from the inlet space side into the outlet space, a fan motor coupled to the fan, a horizontal type compressor provided in the inlet space and arranged in a direction the same as the rotating axis of the fan, and a heat-exchanger provided between the fan and the horizontal type compressor.

[0011] According to another aspect of the invention, there is provided an indoor built-in type heat source unit comprising a housing, a separation plate partitioning the housing into an inlet space and an outlet space, an air inlet formed in a surface of the housing for sucking air into the inlet space, an air outlet formed in a surface of the housing for blowing off the air from the outlet space, two centrifugal fans provided in the inlet space on the separation plate side for blowing off the air from the inlet space into the outlet space, a fan motor provided between the centrifugal fans, a horizontal type compressor provided in the inlet space and arranged in a direction the same as the rotating axis of the centrifugal fans, a heat-exchanger provided between the centrifugal fans and the horizontal type compressor, and an electric box provided in the outlet space into which the air is blown from the inlet space side.

[0012] Further, according to another aspect of the invention, there is provided an indoor built-in type heat source unit comprising a housing, a separation plate partitioning the housing into an inlet space and an outlet space, an air inlet formed in a surface of the housing for sucking air into the inlet space, an air outlet formed in the surface of the housing which is the same as that formed therein with the air inlet, for blowing off air from the outlet space, two centrifugal fans provided in the inlet space along the separation plate for blowing off air into the outlet space, a fan motor provided between the two

centrifugal fans, a horizontal type compressor provided in the inlet space and arranged in a direction of the same as the rotating axis of the centrifugal fans, and a heat-exchanger provided between the centrifugal fans and the horizontal compressor, wherein the air inlet is provided in the surface of the housing which is located on the suction side of the centrifugal fans, and the heat-exchanger is arranged so as to have its one end which is extended into a space between the centrifugal fans and the air inlet.

[0013] According to further another aspect of the invention, there is provided an indoor built-in type heat source unit comprising a housing, a separation plate partitioning the inside of the housing into an inlet space and an outlet space, an air inlet formed in a side surface of the housing, an air outlet formed in the same surface of the housing as that formed therein with the air inlet, a centrifugal fan provided in the inlet space of the housing for blowing off air into the outlet space, a fan outlet formed in the separation plate, a horizontal type compressor provided upstream of the centrifugal compressor, a heat-exchanger provided between the centrifugal fan and the horizontal type compressor, and a fluid separation plate provided between the upper side and the bottom side of the outlet space of the housing for guiding air blown off from the fan outlet in a blow-off direction.

[0014] It is noted here that the air inlet is formed in the surface of the housing on the suction side of the centrifugal fan, and the heat-exchanger has one end part which is extended up to a space between the centrifugal fan and the air inlet.

[0015] It is noted here that an electric box may be provided in the outlet space into which air is blown off from the inlet space side.

[0016] Further, in the case of the provision of an inverter for driving the horizontal type compressor, the inverter is preferably incorporated in the electric box.

[0017] Further, the housing may be in combination of an inlet space side housing defining therein the inlet space, and an outlet side housing defining therein the outlet space, which are integrally incorporated with each other.

[0018] It is preferable that the fluid separation plate is extended from the fan outlet up to a position in the outlet space of the housing which is substantially half of the outlet space, and that the separation plate has a length which is at least not less than the width of the fan outlet in the axial direction of the centrifugal fan.

[0019] Further, it is preferable to bend the separation plate at one end part thereof on the side remote from the fan outlet, in a flowing direction of fluid which is blown off from the fan outlet.

[0020] According to the present invention, since the housing is partitioned into the inlet space and the outlet space, and since there are arranged the fan provided in the inlet space for blowing off air into the outlet space, the horizontal type compressor arranged in the direction the same as the rotating axis of the fan, and the heat-exchanger located between the fan and the horizontal type compressor, it is possible to provide a compact indoor built-in type heat source unit having a thin housing.

[0021] Further, since the electric box is arranged in the middle of the air passage of the outlet space so as to eliminate the necessity of ensuring a large space within the inlet space, it is possible to make the heat source unit more compact, and as well since the heated electric box can be cooled, it is possible to enhance the reliability of the indoor built-in type heat source unit.

[0022] Further, since one end part of the heat-exchanger is extended up to a position between the fan and the air inlet, the heat transfer area of the heart-exchanger can be enlarged, and as well, since the heat-exchanger is located adjacent to the air inlet, the ambient air can be efficiently introduced. Thus, it is possible to further enhance the heat-exchange ability.

[0023] Further, since the fluid separation plate is provide between the top panel and the bottom panel of the outlet space in the housing, for guiding the air blown off from the fan outlet in the blow-off direction so as to cause the fluid separation plate to straighten the fluid blown off from the fan, the pressure loss of the blown-off fluid in the outlet space can be reduced, thereby it is possible to exhibit the technical effects that noise can be reduced and energy can be saved.

BRIEF DESCRIPTION OF DRAWNINGS

[0024]

Fig. 1A is a top view illustrating the configuration of an indoor built-in type heat source unit in an embodiment 1 of the present invention.

Fig. 1B is a sectional view along line A-A in Fig. 1A, as viewed in the direction of arrows.

Fig. 2 is a view illustrating a refrigerating cycle system in embodiment 1 of the invention.

Fig. 3A is a front view illustrating the heat source unit shown in Fig. 1, in the case that it is suspended from the ceiling.

Fig. 3B is a front view illustrating the heat source unit set at a panel of the ceiling.

Fig. 4A is a view illustrating the heat source unit which is connected to an opening in an exterior wall of a building through the intermediary of a duct.

Fig. 4B is a view illustrating a modification of the configuration shown in Fig. 4A.

Fig. 5A is a view illustrating the structure of a bottom base of a housing shown in Fig. 1.

Fig. 5B is a view illustrating a bottom plate set on the bottom base.

Fig. 6 is a view illustrating the structure of covers of the housing shown in Fig. 1.

Fig. 7A is a top view illustrating the configuration and the arrangement of an indoor built-in type heat source unit in embodiment 3 of the invention.

Fig. 7B is a sectional view along line B-B in Fig. 7A, as viewed in the direction of arrows.

Fig. 8 is a view for explaining the locus of air flow in the fan outlet side space of the indoor built-in type heat source unit in embodiment 3 of the invention.
Fig. 9 is a view for explaining the effect that pressure loss can be reduced in the fan blow-off side space of the indoor built-in type heat source unit in the embodiment 3 of the present invention.
Fig. 10 is a longitudinal sectional view illustrating an indoor built-in type heat source unit in embodiment 4 of the invention.
Fig. 11 is a longitudinal sectional view illustrating an indoor built-in type heat source unit in embodiment 5 of the invention.

DESCRIPTION OF EMBODIMENTS

[0025] Explanation will be hereinbelow made of the preferred embodiments of the invention with reference to the accompanying drawings.

[Embodiment 1]

[0026] An indoor built-in type heat source unit according to this embodiment is installed inside a building, more specifically, it is installed substantially between a ceiling 20 and a ceiling panel 21 in the building. As shown in Fig. 3A, as to the installed configuration of the indoor built-in type heat source unit, it is suspended from the ceiling by hooking suspension stays 16 attached to the indoor built-in heat source unit, onto four suspension bolts 19 suspended from the ceiling 20.

[0027] Alternatively, in the case that the ceiling is strong, as shown in Fig. 3B, a vibration proofing material 36 is laid on the ceiling panel 21, and the indoor built-in type heat source unit is directly mounted on the vibration proofing material. Accordingly, the indoor built-in type heat source unit has a horizontal flat bottom surface without provision of any protrusion such as screws.

[0028] Further, as shown in Fig. 4A, an air inlet 14 and an air outlet 15 of the indoor built-in type heat source unit are both formed in one and the same side surface thereof. Since the indoor built-in type heat source unit is attached in the vicinity of an exterior wall 33 of the building, and since the ambient air is taken into the heat source unit, in the most of cases, through a grating 32 provided in the building, for introduction of the ambient air, the air inlet 14 and the air outlet 15 are preferably formed in one and same surface.

[0029] In the case that the indoor built-in type heat source unit is installed, more or less, remote from the exterior wall 33 of the building, the air inlet 14 and the air outlet 15 are connected to an opening formed in the wall of the building, through the intermediary of air ducts 22, and accordingly, the air ducts can be easily installed during installation working. Further, the indoor built-in type heat source unit is capable of withstanding the static pressure outside thereof, which is as high as about 50Pa, thereby it is possible to enhance the freedom of positional installation.

[0030] Further, as shown in Fig.4B, the indoor built-in type heat source unit may be installed in a corner part of the building. The air inlet 14 is formed in a cover adjacent to a cover in which the air outlet 15 is formed (that is, in the surface of the housing on the side where a compressor is mounted). The position of the air inlet 14 can be thus changed in order to enhance the freedom of the installation of the unit.

[0031] The indoor built-in type heat source unit has a structure as shown in Figs. 1A and 1B. An inlet space having the air inlet 14 and an outlet space having the air outlet 15 are partitioned from each other by a separation plate 23. In the inlet space, there are incorporated a horizontal type compressor 1, a receiver 8, a heat exchanger for an outdoor unit (a heat-exchanger for a heat source unit) 3, a fan motor 26, sirocco fans 25 coupled to opposite ends of the shaft of the fan motor 26, and fan casings 24 which are provided so as to surround respectively these sirocco fans 25, and which are fastened to the separation plate 23. Further, a reversing valve 2, an expansion valve 5 for the outdoor unit (an expansion valve for the heat source unit), pipe lines for refrigerating cycle components, which constitute a refrigerating cycle, are also arranged in the inlet space. Meanwhile, an electric box 17 is arranged in the outlet space.

[0032] Since the indoor built-in type heat source unit is mounted in the space under the roof of the building, it has a height which is preferably as low as possible, it is possible to install the indoor built-in type heat source unit in any of relatively various buildings. Thus, the dimensions of the heat source unit are set so as to have a height which is not greater than 450 mm of a distance between the roof and the ceiling of a building in view of Building Standards in a specially designated district in European countries and a width which allows three heat source units to be installed being horizontally laid successively in view of the Building Standards, for designated districts in European countries, that a distance between adjacent beams of the ceiling is 4,000 mm. For example, it's height is not greater than 430 mm while its width and depth are from 500 to 1,300 mm.

[0033] Fig. 2 shows the refrigerating cycle system of the indoor built-in type heat source unit. The refrigerating cycle is constituted by connecting the outdoor unit (heat source unit) 12 to the indoor unit 13 through refrigerating pipes.

[0034] The outdoor unit 12 is attached thereto with the expansion valve 5 for the outdoor unit for regulating the quantity of refrigerant. The heat-exchanger 3 for the outdoor unit is provided with a subcooler 7 so as to ensure a larger degree of super cooling in order to aim at enhancing its performance. Further, the refrigerant quantity regulator 8 is provided so as to regulate a surplus coolant. Further, the refrigerant quantity regulator 8 is provided so as to regulate excessive refrigerant. Moreover, a circuit for bypassing between the suction side and the discharge side of the horizontal type compressor 1 is con-

nected therein with a capillary 37 and a solenoid valve 11. These are incorporated in order to prevent a liquid refrigerant from being returned into the horizontal type compressor 1 during a transition period such a starting period of the compressor.

[0035] Meanwhile, the indoor unit 13 is attached thereto with a heat-exchanger 4 for the indoor unit and an expansion valve 6 for the indoor unit.

[0036] In order to minimize the height of the indoor built-in type heat source unit, the horizontal type compressor is used. Further, the centrifugal sirocco fans 25 are used as a blower. Should a single sirocco fan be used for delivering an air volume of a 60 m^3 in the case of a heat source unit having a cooling capacity of 12.5 kW, the sirocco fan and its casing should have a large bore size, resulting in hindrance to thinning of the heat source unit. Thus, in this embodiment, the two sirocco fans 25 having a small bore are used so as to thin the fan casings thereof in order to reduce the height of the indoor built-in type heat source unit.

[0037] Although the sirocco fans are used in this embodiment, any other kind of fans may be also used. Circulating fans may be also used if the structures of fun casings thereof are appropriate.

[0038] Further, it is also necessary to lower the height of the heat-exchanger 3 for the outdoor unit in order to thin the heat source unit. However, it is also necessary to increase the heat transfer area of the heat-exchanger 3 for the outdoor unit as large as possible in order to ensure a high cooling capacity and the like. Accordingly, the heat-exchanger 3 for the outdoor unit is formed in an L-like shape in order to ensure the heat transfer area thereof as large as possible within a narrow space. Further, the heat-exchanger 3 for the outdoor unit has four rows of refrigerant pipes in order to maximize the heat-exchange capacity. The more the number of these rows is increased, the larger the heat transfer area increases, and the heat-exchange capacity can be increased. However, the air flow resistance would be increased so as to lower the air volume, and as a result, the heat-exchange capacity would be lowered. In view of the relationship between the air flow resistance and the number of rows with respect to the heat-exchange capacity, the number of the rows is set to 4 as an optimum value.

[0039] A horizontal type inverter compressor is used as the compressor. In the case of using a constant speed compressor, since the horizontal type compressor 1 is operated under ON-OFF control in order to control the room temperature, the comfort of a room to be air-conditioned would be lower, and as well, the power consumption would be high, resulting in lower efficiency. On the contrary, with the use of the inverter compressor, optimum operation can be made under frequency control. An inverter can change its frequency over a range from about 15 to 115 Hz, and accordingly, it is possible to offer the merits of enhancing the rise-up characteristics of air-conditioning and of lowering the power consumption.

[0040] Since the horizontal type compressor is heavy, having a weight not less than 30 kg, it is arranged in a corner part of the housing 39, in the vicinity of suspension stays 16. It is thereby possible to restrain the housing 39 from bending, and as well to allow vibration to smoothly transmit from the horizontal type compressor 1 to suspension bolts 19. The housing 39 may be provided with members for reinforcing its bottom surface in order to restrain the housing from being deformed. Further in order to isolate abnormal noise generated from the horizontal type compressor 1, the horizontal type compressor 1 is provided at its lower surface with a compressor fixing plate 34 so as to restrain sounds from being transmitted into a room of a building.

[0041] The heat-exchanger 3 for the outdoor unit is located between one side where the fan casing 24 and the fan motor 26 are arranged, and the other side where the horizontal compressor 1 and the receiver 8 are arranged. The short side of the L-like heat-exchanger 3 for the outdoor unit is arranged near to the air inlet 14 in order to promote its heat-exchange. The long side of the L-like heat-exchanger 3 is arranged so as to cause the horizontal type compressor 1 and the receiver 8 to be remote from the air inlet 14 in order to reduce the suction resistance, and thereby it is possible to enhance the heat-exchange function. A gas header and a liquid header for the heat-exchanger 3 for the outdoor unit are attached on the long side of the latter in order to decrease the lengths of the refrigerating cycle pipes connected thereto.

[0042] The blower composed of the fan casings 24, the sirocco fans 25 and the fan motor 26 is secured to the separation plate 23 partitioning between the inlet space and the outlet space. The two sirocco fans 25 are used, between which the fan motor 26 having opposite shaft ends is arranged. Meanwhile, the fan motor 25 may have one shaft end while the two sirocco fans 25 are arranged adjacent to each other. In this case, it is necessary to use couplings for connecting them to this one shaft end. The rotary shaft of the fan motor 26 and the rotary shaft of the horizontal type compressor 1 are arranged in directions which are juxtaposed. With this configuration in which, for example, the rotary shaft of the fan motor 26 and the rotary shaft of the horizontal type compressor 1 are laid in parallel with each other, the projection area thereof onto the air inlet 14 is minimized, and accordingly, the resistance to the intake air from the air inlet 14 can be minimized, thereby it is possible to contribute to noise reduction on the air suction side.

[0043] The quantity of suction air into the sirocco fan 25 on the side near to the air inlet 14 is larger so that the work volume of this sirocco fan 25 is larger. However, the internal resistance of the sirocco fan 25 on the side remote from the air inlet 14 is larger so that the quantity of suction air is less, and accordingly, the work volume thereof is less. The ratio of both work volumes is about 7 to 3 or 6 to 4 between the sirocco fan 25 on the side near the air inlet 14 and that on the side remote from the air inlet 14 although it depending upon a condition. As to the sirocco fans 25 shown in Fig. 1, there are used those

having the same bore diameter. However, there may be used sirocco fans having different bore diameters, that is, the sirocco fan 25 on the side near the air inlet 14 may have a larger bore diameter, but the sirocco fan 25 on the side remote from the air inlet 14 may have a smaller bore diameter.

[0044] An AC motor is used as the fan motor for the blower, and thyristor control is used for controlling the fan. In comparison with tap control, the thyristor control can carry out multistage control, and the changer-over among fan steps can be made depending upon a control factor. Further, there may also be used a highly efficient DC motor in order to reduce fan inputs. By reducing the input power, it is expectable to further enhance the air-conditioning COP.

[0045] The electric box 17 is located in the outlet space of the housing 39. Since the motor of the horizontal type compressor 1 is operated under inverter control, an inverter drive device is incorporated in the electric box 17. Since the heat value of the inverter drive device is high, there are incorporated inverter fins 18 for heat radiation. In order to enhance the function of heat radiation from the inverter fins 18, the inverter fins 18 are exposed to the outside of the electric box 17 so that the air blown off from the sirocco fans 25 is directly blown onto the inverter fins 18, thereby it is possible to enhance the heat radiation function.

[0046] Further, the electric box 17 has a trapezoidal shape in order to straighten the air stream in the housing 39 so as to reduce the pressure loss. Thus, it is possible to improve the resistance in the housing.

[0047] The volume ratio and the width ratio between the inlet space and the outlet space of the housing 39 are set desirably to 5 to 5 and 6 to 4, respectively. Should either one of both spaces be narrower, the opening area of the air inlet 14 or the air outlet 15 would become narrower so as to cause the air passing therethrough to have an excessively high speed, resulting in higher pressure loss. As a result, there would be increased the input power of the fan motor 26, causing lowering of air-conditioning COP. Further, wind break sounds due the air having an excessively high speed, would cause noise to be increased.

[0048] Service and maintenance to the indoor built-in type heat source unit, as shown in Fig. 6, are usually made through service covers 28a, 28b in the surface opposed to the surface where an inlet side cover 29a and an outlet side cover 29b are provided, because the servicing space above the indoor built-in type heat source unit is limited in the case of a low ceiling height, and because the servicing space at each of the left and right side surface is also limited due the case that a plurality of indoor built-in type heat source units are successively juxtaposed or due to the case that the indoor built-in type heat source unit is arranged close to the wall surface of a building. Further, any service opening cannot be formed in the lower surface of the indoor built-in type heat source unit in view of its structure and strength since there are provided heavy components including the compressor at the lower surface thereof.

[0049] Thus, the electric box 17 is arranged on the rear side (inside) of the service cover 28a so as to facilitate the wiring connection. Further, in order to enable access to the indoor built-in type heat source unit through the service space when the cooling pipe arrangement and the drain pipe arrangement are carried out during installation of the indoor built in type heat source unit, a gas line stop valve 9 a liquid line stop valve 10 for the refrigerating pipe line, and a drain boss 27b for the drain pipe line are all located on the service cover 28b side, that is, the service space side of the indoor built-in type heat source unit.

[0050] Since the indoor built-in type heat source unit is mounted therein with heavy components such as the horizontal type compressor 1, the heat-exchanger 3 for the outdoor unit and the fan motor 26, and since the housing 39 incorporating them is suspended from the ceiling 20, it require to have a sufficient strength. Further, it has to have a structure for suppressing vibration transmitted from the horizontal type compressor 1 and the fan motor 26. Accordingly, as shown in Fig. 5A, the bottom base of the housing 39 has a parallel crosses-like frame structure using two L-like suspension stays 16 and two suspension stays 16b. Each of the L-like suspension stays 16a is formed in its opposite ends with cut-outs for receiving suspension bolts. Further, as shown in Fig. 5B, reinforcing stays 16c are arranged in a grid-like pattern on the bottom plate 35 of the housing 39.

[0051] The L-like suspension stays 16a, 16b are carried thereon with the bottom plate 35 having a box-like shape so as to constitute the bottom base. The bottom plate 35 also has a role of a secondary drain pan which can retain therein dripping water in the case of possible leakage of water from a drain pan 27a.

[0052] In general, the outdoor unit of an air-conditioner carries out defrosting cycle in order to improve the heat-exchange function against frosting and freezing to the heat-exchanger 3 for the outdoor unit during heating operation. Thus, the heat-exchanger 3 for the outdoor unit produces a large volume of condensed water during the defrosting operation. Since the indoor built-in type heat-source unit is installed in the space under the roof of a building, there is provided the drain pan 27a for retaining the condensed water. The drain pan 27a is inclined in order to enhance the discharge of drainage. There is provided the drain boss 27b in the lowest part of the drain pan 27a. The train boss 27b is connected thereto with a drain hose (which is not shown) during installation of the indoor built-in type heat source unit, and thereby it is possible to discharge the condensed water, outside of the heat source unit.

[0053] The positions at which blower components including the fan casing 24 and the sirocco fans 24 secured to the opposite ends of the rotary shaft of the fan motor 26 are set in the air passage of the heat-exchanger 3 for the outdoor unit, on the downstream side thereof. Since

the blower components are located downstream of the heat-exchanger 3, the distribution of velocities of air flowing into the heat-exchanger 3 for the outdoor unit can be made to be substantially uniform. Thus, the heat-exchange capacities of paths in the heat-exchanger for the outdoor unit can be uniformed thereamong. As a result, the overall heat-exchange capacity of the heat-exchanger 3 for the outdoor unit can be increased, thereby it is possible to enhance the cooling/heating performance.

[0054] In this embodiment, in order to enhance the so-called serviceability as to, for example, replacement of parts in the fan motor 26 of the indoor built-in type heat source unit, the blower components are integrally incorporated with one another. The blower components include the sirocco fans 25, the fan casing 24, the fan motor 26 and a fan fixing plate 38 to which these components are attached.

[0055] In order to enable the blower components to be pulled out in one unit, guide rails (which are not shown) are provided at the top panel and the separation plate 23 of the housing 39. The blower components are attached to the separation plate 23 by means of fasteners such as screws. During service for replacement of, for example, the fan motor 26, the fasteners such as the screws are removed, and then the blower components are pulled out from the heat source unit so as to remove the blower components. Thus, the replacement of the fan motor 26 or the like can be facilitated. But for the above-configuration, the working for removing the overall heat source unit would be required every time when the fan motor 26 or the like is replaced.

[Embodiment 2]

[0056] Although explanation has been made, in the above-mentioned embodiment, of the indoor built-in type heat source unit in which the inlet space and the outlet space are partitioned from each other by the separation plate 23, since no components other than the electric box 17 are present in the outlet space, the part which constitutes the outlet space and the electric box 17 may be those different from the part which constitutes the inlet space. There are provided two separate units, that is, a unit constituting the inlet space (inlet unit) and a unit constituting the outlet space (outlet unit) are used, that is, two separate units are used, and the electric box 17 is externally attached to the inlet unit. Accordingly, all components other than those of the outlet unit can be integrated in the inlet unit. Thus, the indoor built-in type heat source unit may substantially consist of the inlet unit alone while the outlet unit may be optionally manufactured in accordance with a situation of an installation place during installation of the indoor built-in type heat source unit since the outlet unit has a role of defining a passage for the air blown off from a blower. Thus, in this embodiment, the indoor built-in type heat source unit can be small-sized, thereby it is possible to greatly enhance the freedom of installation thereof.

[0057] It is noted that the indoor built-in type heat source units as stated above are particularly useful in a district where an outdoor unit (heat source unit) is inhibited from being installed outdoor due to urban environmental laws or the like. Further, they are effective in the case that there is no extra space for installation of an outdoor heat-source unit, such as a veranda, that is, it may be installed not only at the ceiling but also underneath the floor or at a wall of a building.

[Embodiment 3]

[0058] Referring to Fig. 7A which is a plan view illustrating an indoor built-in type heat source unit according to embodiment 3 of the invention, and Fig. 7B which is a sectional view along line B-B in Fig. 7A, as viewed in the direction of the arrows, the sirocco fans 25 are arranged so that the direction of the fan rotating axes are identical with a housing blow-off direction 103. The housing blow-off direction 103 from the air outlet 15 is orthogonal to a fan blow-off direction 102 from a first fan outlet 105 and a second fan outlet 106. Thus, the outlet space for the sirocco fans 25 is constituted so that the flow of air blown off from the first fan outlet 105 and the second fan outlet 106 impinge at first upon the cover 30 for the outlet space, and thereafter, it is blown off from the air outlet 15.

[0059] In the outlet space for the sirocco fans 25, a fluid separation plate 101 is arranged between the bottom plate 35 and a top panel 110, and the length of the fluid separation plate 101 in the fan blow-off direction 102 is set to about one-half of the distance from the separation plate 23 to the cover 30 for the outlet space in the fan blow-off direction 102. Further, the length of the fluid separation plate 101 in the housing blow-off direction 103 is set so that it extends from the first fan outlet 105 near the air outlet 15 to a position around the servicing cover 28.

[0060] Fig. 8 shows a locus of the air stream in the fan outlet side space of the indoor built-in type heat source unit in embodiment 3 of the invention. The fluid separation plate 101 has a role of partitioning a first air stream 107 blown off from the first fan outlet 105, from a second air stream 108 blown off from the second fan outlet 106 and spiraling as shown in the figure so as to exhibit a vortex flow. The second air stream 108 blown off from the second fan outlet 106 is directed to the cover 30 for the outlet space, impinging upon the cover 30 for the outlet space, and is then directed toward the bottom plate 35. After impinging upon the bottom plate 35, it is directed toward the separation plate 23, further impinging thereupon, and thereafter, is turned into an upward vortex flow. Meanwhile, the air is blown off outside from the air outlet 15, and accordingly, the second air stream 108 having turned into a vortex flow is produced while it is directed to the air outlet 15. Thus, the second air stream 108 blown off from the second fan outlet 106 spirally flows so as to again merges with the second air stream 108, and simultaneously, it merges with the first air stream 107 blown

off from the first fan outlet 105. Should the vortex flow portion of the second air stream 108 collide against the first air stream 107, there would be caused a pressure loss. Thus, these air streams are partitioned from each other in order to restrain the pressure loss from increasing.

[0061] Fig. 9 is a view for explaining the effect of reducing the pressure loss in the fan outlet side space in the indoor built-in type heat source unit in embodiment 3 of the invention. This figure shows the effect of the fluid separation plate 101 in this embodiment, which is obtained by calculation. From this figure, it can be understood that the pressure loss on the blow-off side of the indoor built-in type heat source unit having the fluid separation plate 101 in this embodiment can be reduced by 32% in comparison with the indoor built-in type heat source unit having no fluid separation plate 101.

[Embodiment 4]

[0062] Fig. 10 is a longitudinal sectional view which shows an indoor built-in type heat source unit according to embodiment 4 of the invention, that is, the indoor built-in type heat source unit has sirocco fans 25 which are arranged to be vertically reversed or upside down in comparison with the former embodiments as stated hereinabove. With the configuration of this embodiment, the vortex flow is directed reverse to the direction shown in Fig. 8. Even in this embodiment, the fluid separation plate 101 is provided similar to the above-mentioned embodiment in order to reduce the pressure loss on the fan outlet side.

[Embodiment 5]

[0063] Fig. 11 is a longitudinal sectional view illustrating an indoor built-in type heat source unit according to embodiment 5 of the invention in which the fluid separation plate 101 is bent in its one end near the side panel 30 for the outlet space, toward the bottom plate 35 by a right angle. In embodiment 3, as shown in Fig. 8, the first air stream 107 blown off from the first fan outlet 105 and the second air stream 108 blow-off from the second fan outlet 106 and then having a vortex flow along the fluid separation plate 101 flow toward the bottom plate 35, creating vortices after they merge with each other at a position where the fluid separation plate 101 is no more present (as indicated by 109 in Fig. 8). On the contrary, in this embodiment, in view of the fact that the air flows toward the bottom plate 35 just after both streams merge together, the one end of the fluid separation plate 101 is bent in this direction. This one end of the separation plate 101 has a role of guiding the air stream directed toward the bottom plate 35. it is thereby possible to expect the effect that the pressure loss can be further reduced greatly, in view of the pressure loss on the fan outlet side, in comparison with embodiment 3.

[0064] Further, since the fluid separation plate 101 in embodiment 3 is planar, it would be possibly deformed under its dead weight or the like after it is installed. However, the fluid separation plate 101 explained in embodiment 5 is bent so as to enhance its strength in order to prevent deformation thereof under its dead weight or the like.

[0065] By the way, in this embodiment, although the one end of the fluid separation plate 101 is bent by a right angle toward the bottom plate 35, it may be bent so as to form a curved surface in view the air stream, instead of bending at a right angle. In the case of having the curved surface, the pressure loss can be further reduced greatly in comparison with this embodiment.

Claims

1. An indoor built-in type heat source unit **characterized by**:

   a housing (39),
   a separation plate (23) partitioning the housing (39) into an inlet space and an outlet space,
   an air inlet (14) formed in a surface of the housing (39) for sucking air into the inlet space,
   an air outlet (15) formed in a surface of the housing (39) for blowing off air from the outlet space,
   a fan (25) provided in the inlet space on the separation plate (23) side for blowing off air from the inlet space into the outlet space,
   a fan motor (26) coupled to the fan (25),
   a horizontal type compressor (1) provided in the inlet space and arranged in a direction the same as a rotating axis of the fan (25), and
   a heat-exchanger (3) provided between the fan (25) and the horizontal type compressor (1).

2. An indoor built-in type heat source unit **characterized by**:

   a housing (39),
   a separation plate (23) partitioning the housing (39) into an inlet space and an outlet space,
   an air inlet (14) formed in a surface of the housing (39) for sucking air into the inlet space,
   an air outlet (15) formed in a surface of the housing (39) for blowing off air from the outlet space,
   two centrifugal fans (25) provided in the inlet space on a separation plate (23) side for blowing off air from the inlet space into the outlet space,
   a fan motor (26) provided between the two centrifugal fans (25),
   a horizontal type compressor (1) provided in the inlet space and arranged in a direction the same as rotating axes of the centrifugal fans (25),
   a heat-exchanger (3) provided between the centrifugal fans (25) and the horizontal type compressor (1), and

an electric box (17) provided in the outlet space into which air is blown from the inlet space.

3. An indoor built-in type heat source unit **characterized by**:

a housing (39),
a separation plate (23) partitioning the housing (39) into an inlet space and an outlet space,
an air inlet (14) formed in a surface of the housing (39) for sucking air into the inlet space,
an air outlet (15) formed in the same surface of the housing (39) as the surface in which the air inlet is formed, for blowing off air from the outlet space,
two centrifugal fans (25) provided in the inlet space along the separation plate (23) for blowing off air into the outlet space,
a fan motor (26) provided between the two centrifugal fans (25),
a horizontal type compressor (1) provided in the inlet space and arranged in a direction the same as rotating axes of the centrifugal fans (25), and
a heat-exchanger (3) provided between the centrifugal fans and the horizontal type compressor (1),

wherein the air inlet (14) is formed in the surface of the housing (39) in a suction side of the centrifugal fans, and the heat-exchanger (3) has an end part which is extended into a space between the centrifugal fans (25) and air inlet (14).

4. An indoor built-in type heat source unit **characterized by**:

a housing (39),
a separation plate (23) partitioning the housing (39) into an inlet space and an outlet space,
an air inlet (14) formed in a side surface of the housing (39) for sucking air into the inlet space,
an air outlet (15) formed in the same side surface as the surface in which the air inlet is formed,
a centrifugal fan (25) provided in the inlet space of the housing for blowing off air into the outlet space of the housing (39),
a fan outlet (105, 106) formed in the separation plate (23),
a horizontal type compressor (1) provided upstream of the centrifugal fan (25),
a heat-exchanger (3) provided between the centrifugal fan (25) and the horizontal type compressor (1), and
a fluid separation plate (101) arranged between a top surface (110) and a bottom surface (35) of the outlet space of the housing for guiding the air blown off from the fan blow-off port (105, 106) in the blow-off direction.

5. The indoor built-in type heat source unit according to claim 2, **characterized in that** the air inlet (14) is formed in the surface of the housing (39) on a suction side of the centrifugal fans (25), and the heat-exchanger (31) has an end part which is extended into a space between the centrifugal fans (25) and the air inlet (14).

6. The indoor built-in type heat source unit according to claim 1 or 3, **characterized in that** an electric box (17) is provided in the outlet space into which air is blown from the inlet space.

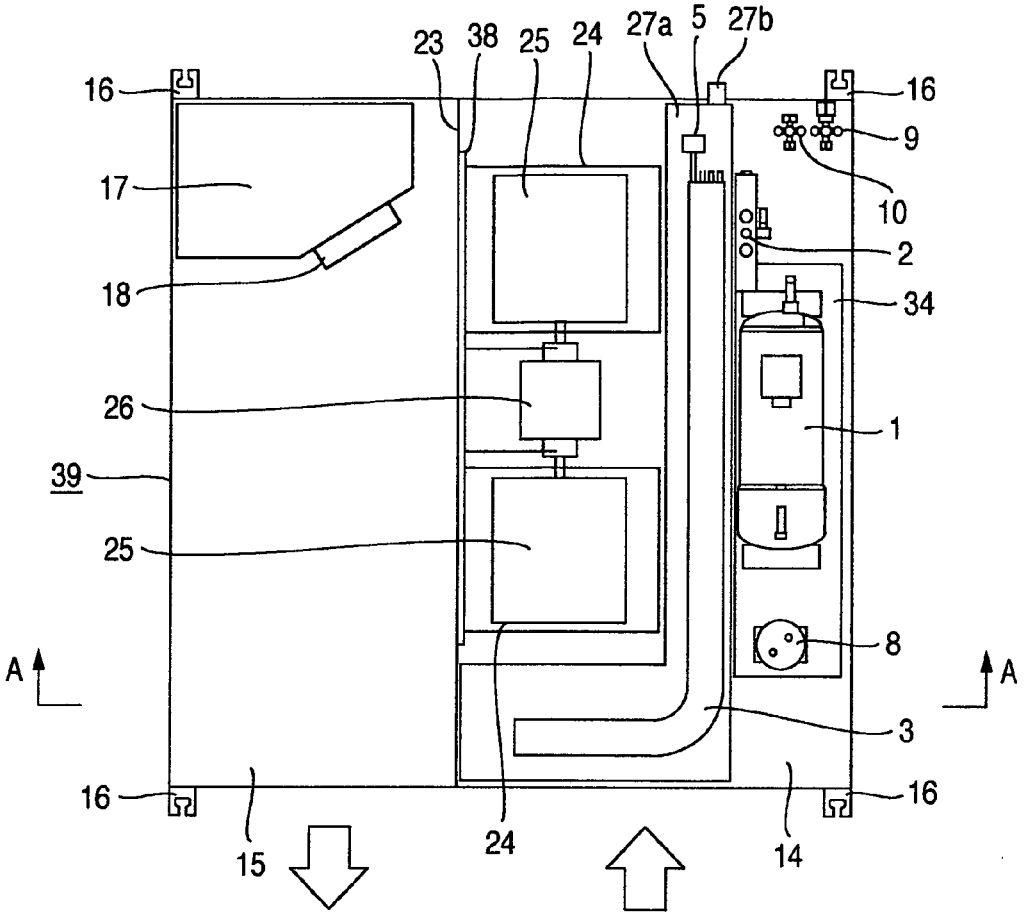
7. The indoor built-in type heat source unit according to claim 2 or 5, **characterized in that** an inverter is provided for driving the horizontal type compressor (1), the inverter being accommodated in the electric box (17).

8. The indoor built-in heat source unit according to any one of claims 1 to 3, **characterized in that** the housing (39) is composed of an inlet space side housing for defining the inlet space and an outlet space side housing for defining the outlet space are combined and integrally incorporated with each other.

9. The indoor built-in type heat source unit according to claim 4, **characterized in that** the fluid separation plate (101) is extended from the fan outlet (105, 106) up to a position which is substantially a half of the outlet space of the housing, and has a length which is at least not less than a width of the fan outlet (105, 106) in an axial direction of the centrifugal fan (25).

10. The indoor built-in type heat source unit according to claim 4 or 9, **characterized in that** the fluid separation plate (101) has an end part on a side remote from the fan outlet (105, 106), which is bent in a flowing direction of fluid blown off from the fan outlet.

FIG.1A


23
38
25
24
27a
5
27b
16
16
9
17
10
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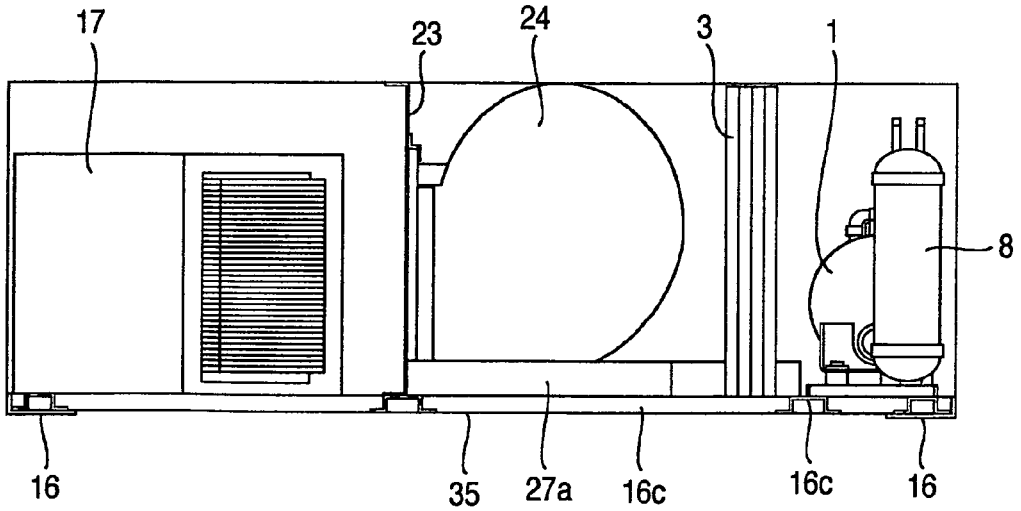
18
34
26
1
39
25
8
A
A
3
16
16
15
24
14

FIG.1B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23
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3
1
8
16
35
27a
16c
16c
16

FIG.2

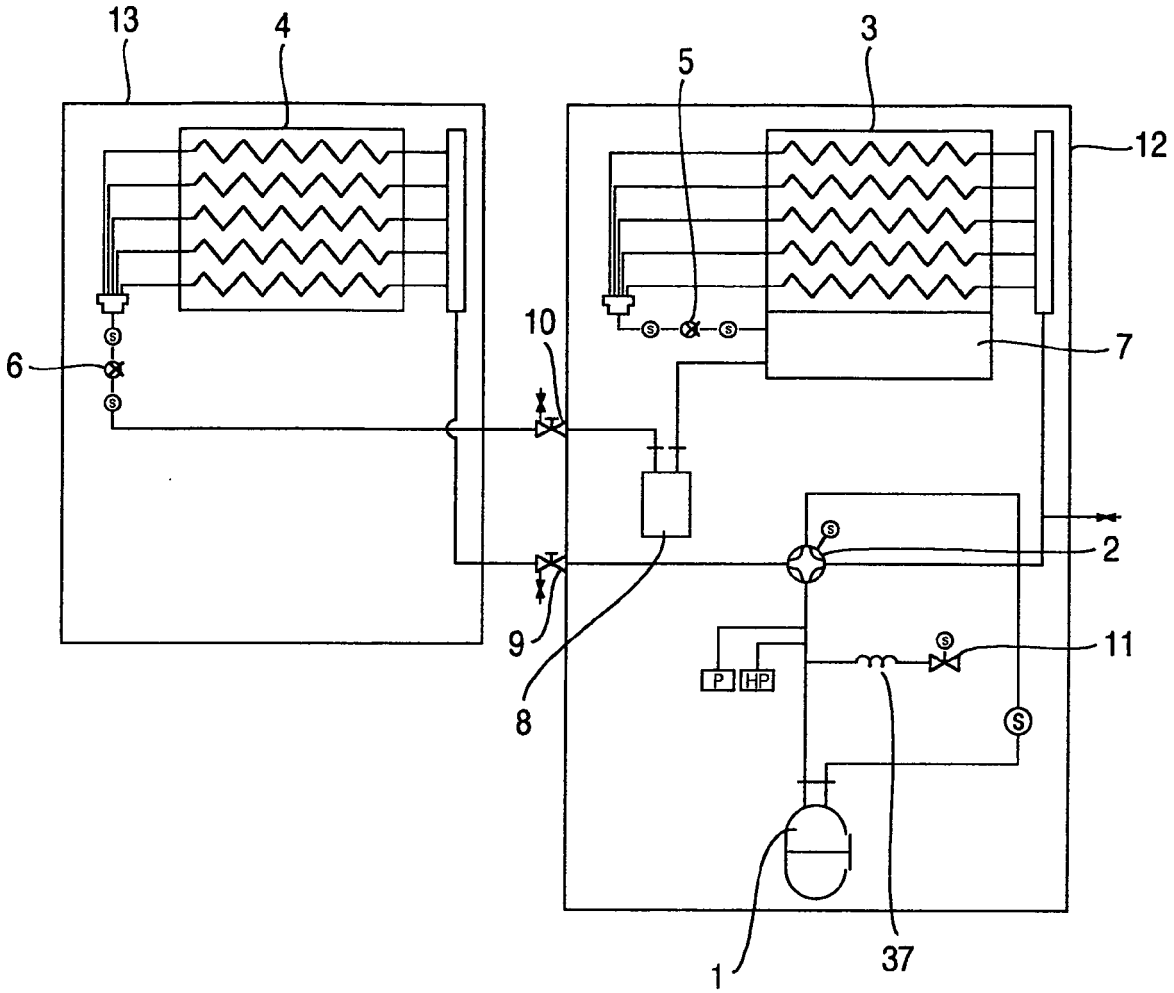


FIG.3A

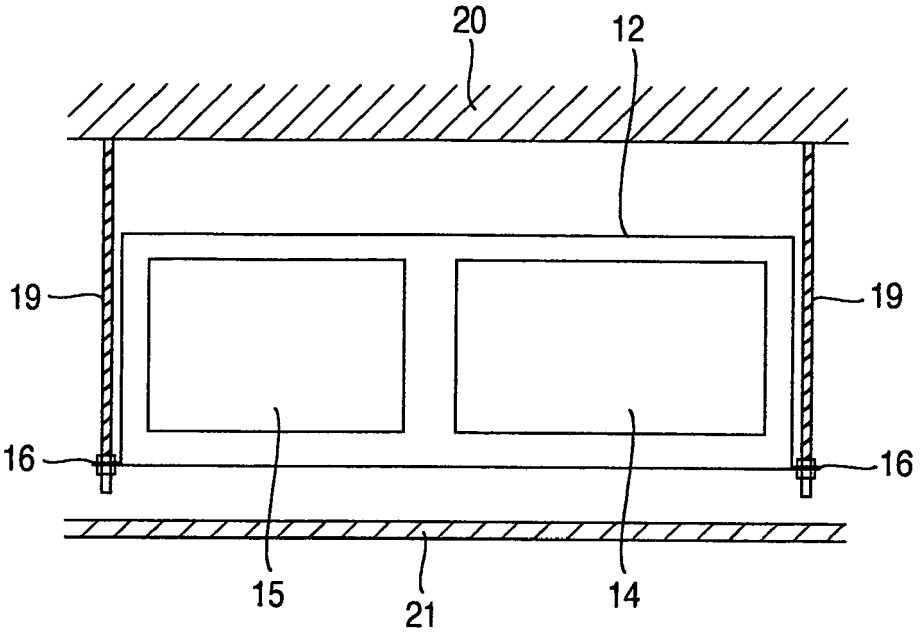


FIG.3B

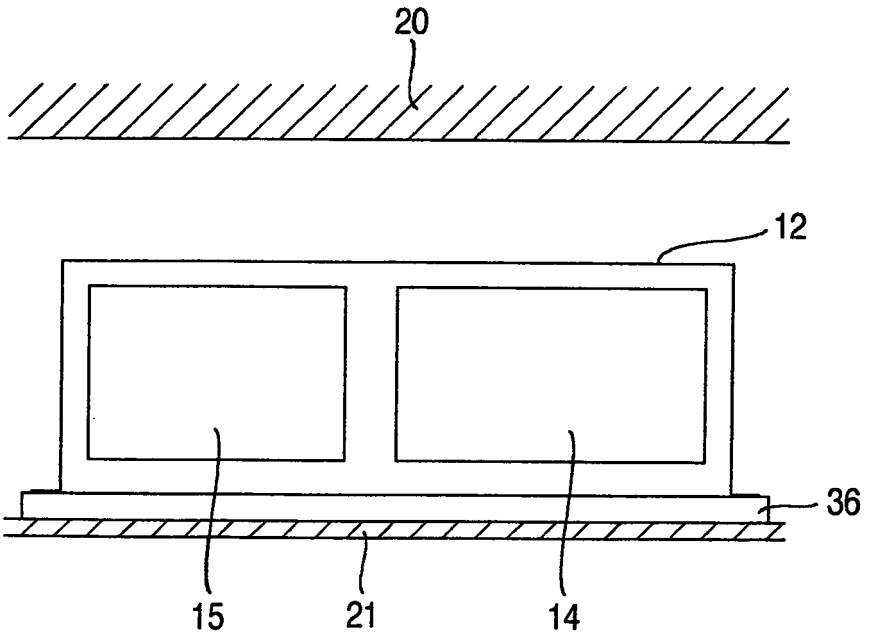


FIG.4A

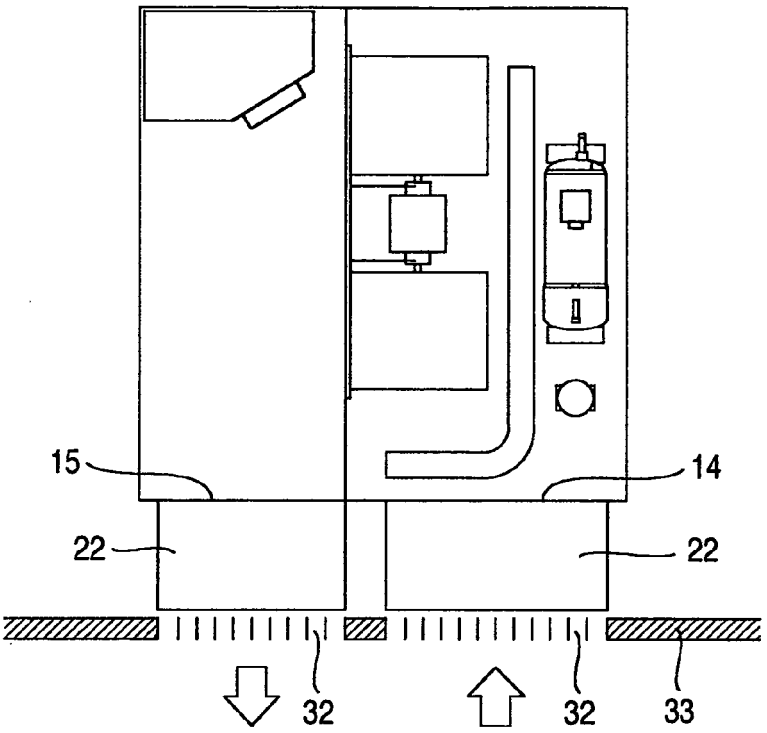


FIG.4B

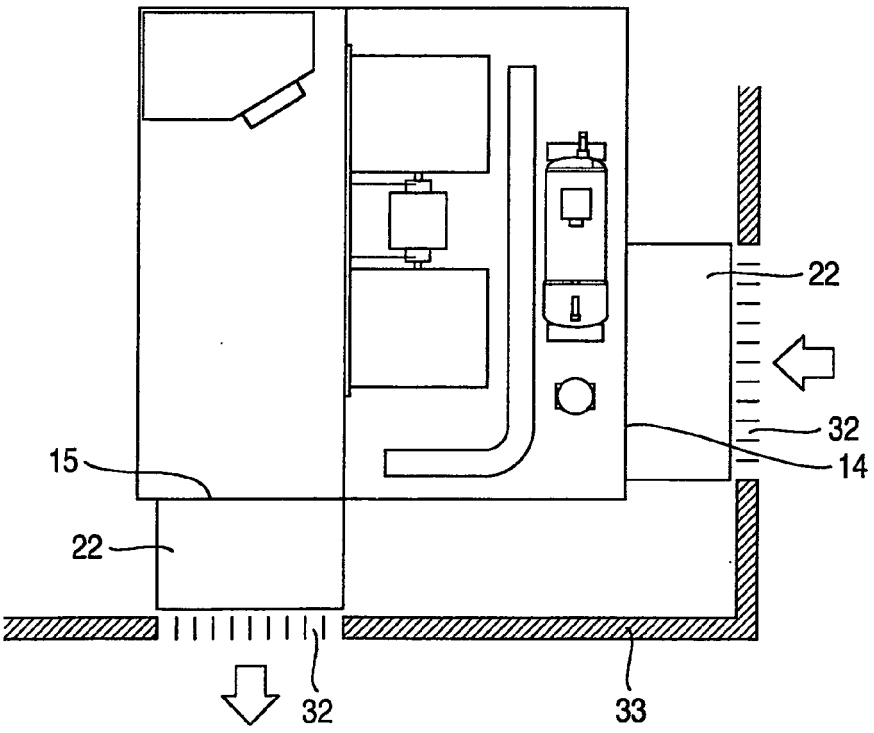


FIG.5A

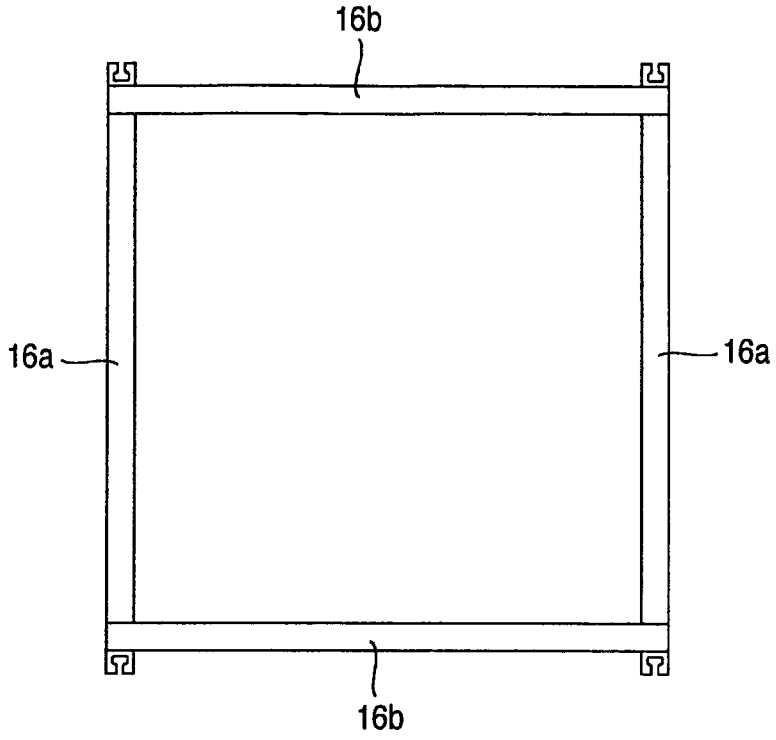


FIG.5B

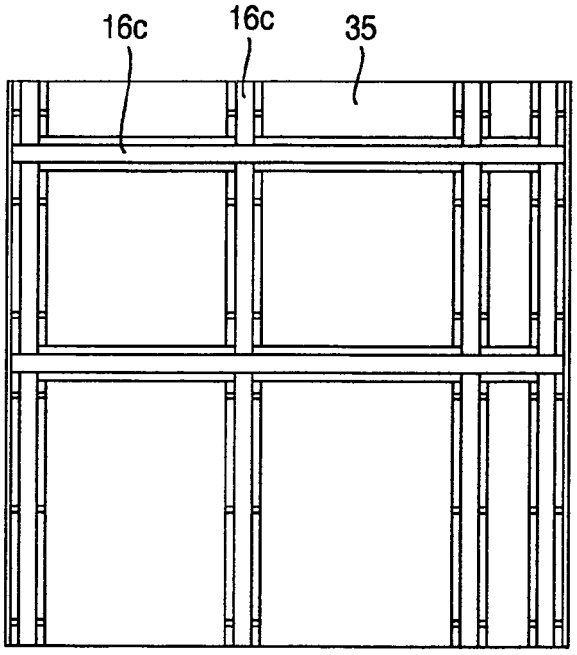


FIG.6

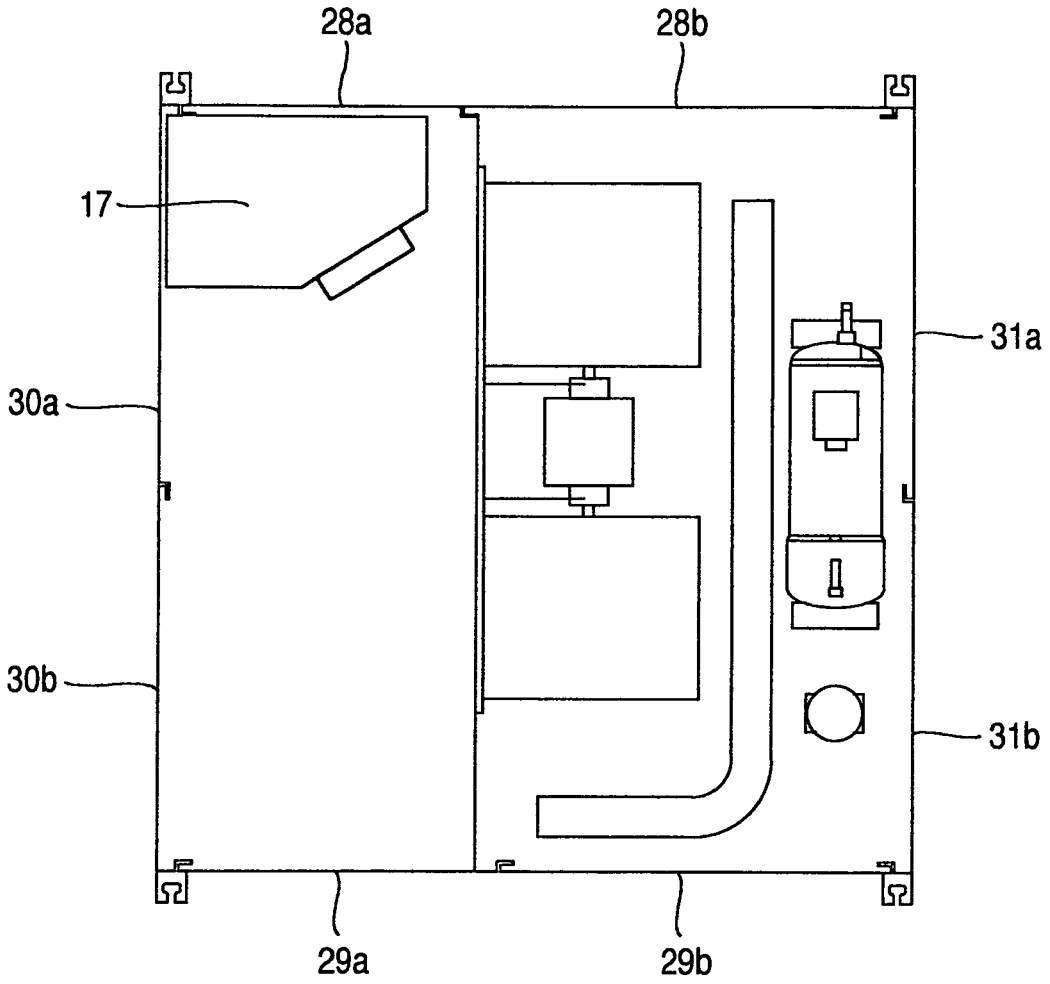


FIG.7A

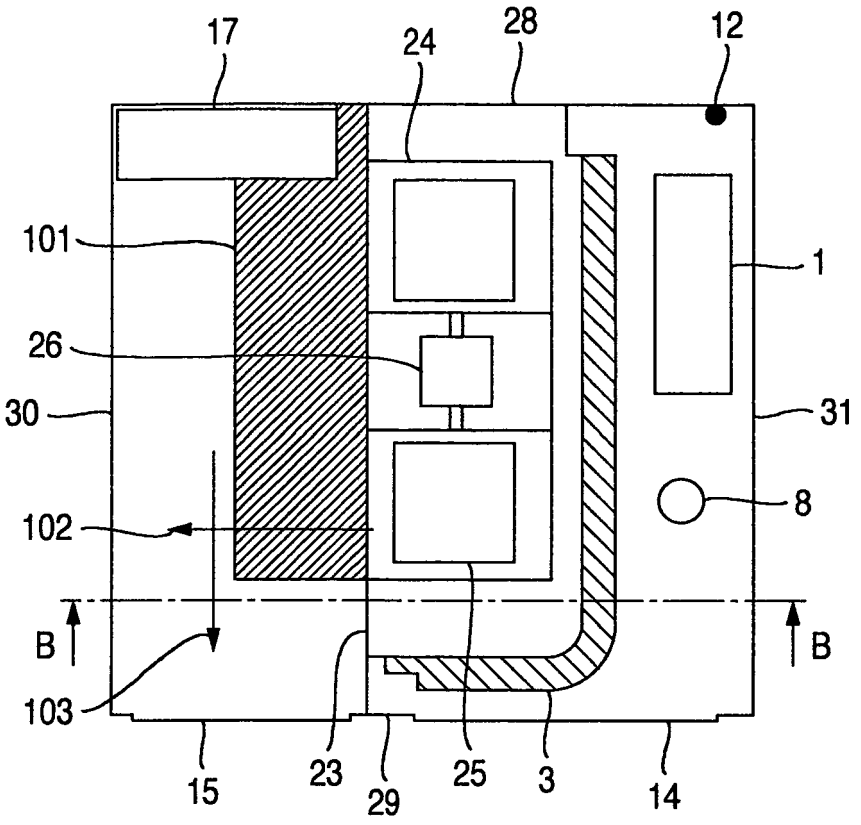
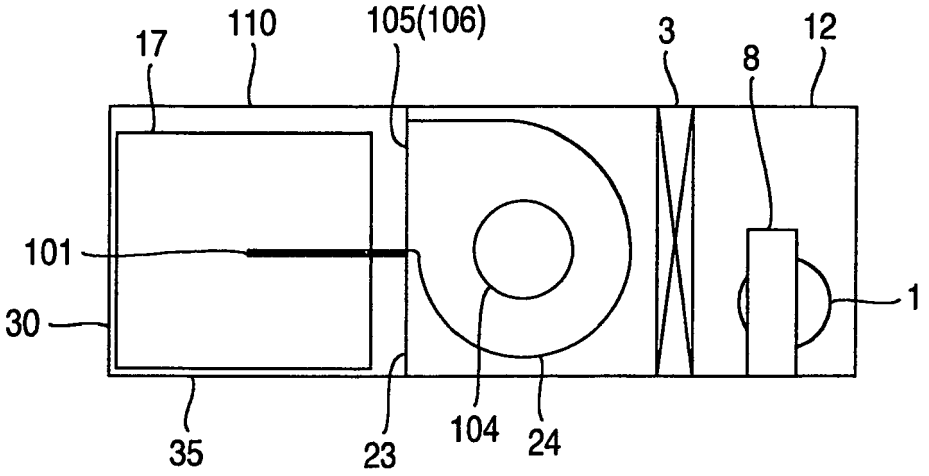

17
24
28
12
101
1
26
30
31
8
102
B
B
103
15
23
29
25
3
14

FIG.7B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110
105(106)
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8
12
101
30
1
35
23
104
24

FIG.8

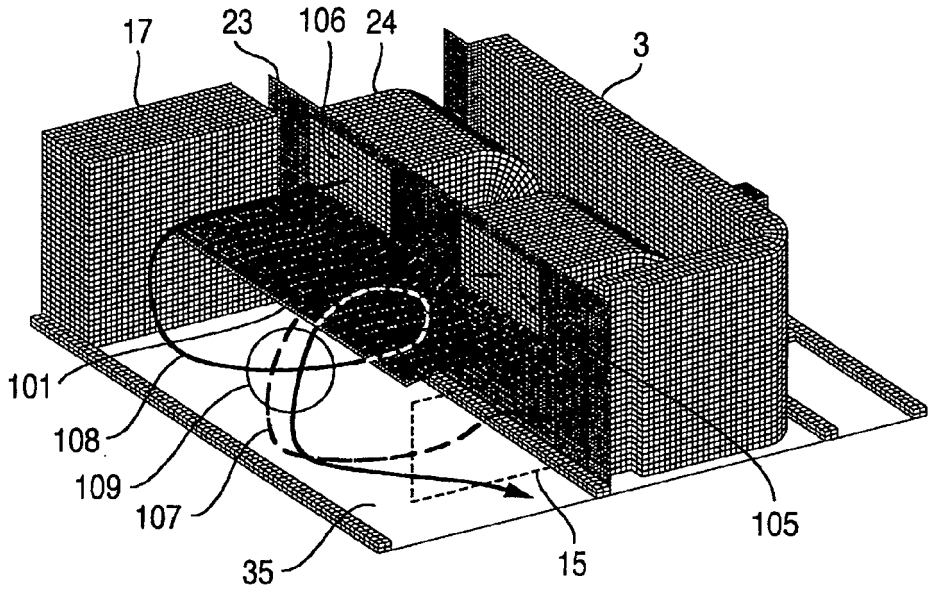
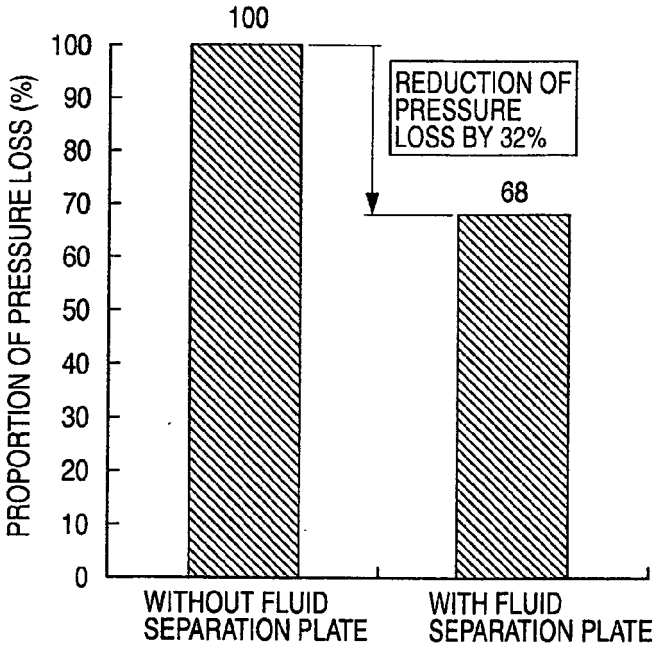
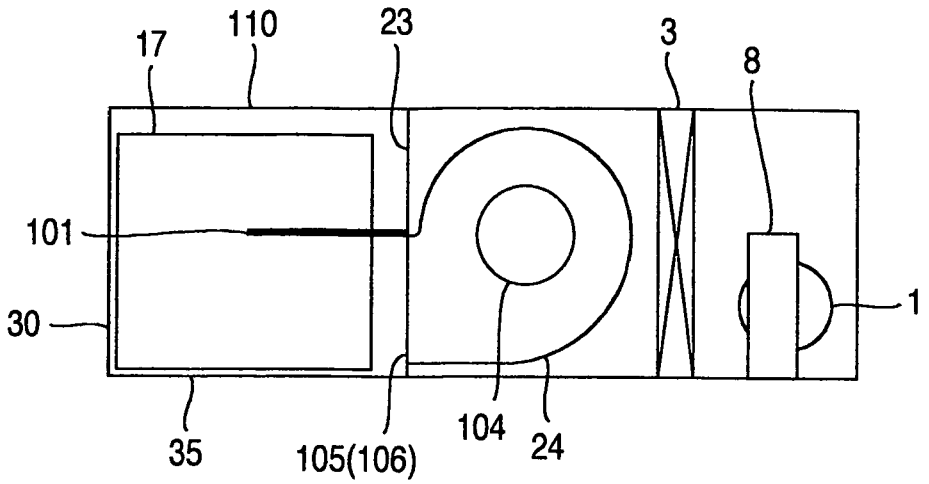


FIG.9



COMPARISON IN PRESSURE LOSS BETWEEN FAN OUTLET AND HOUSING OUTLET

FIG.10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3
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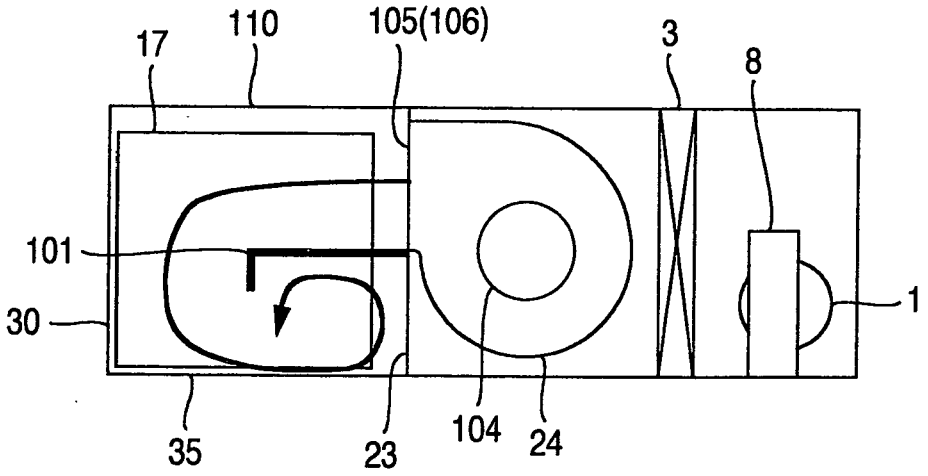
101
30
1
35
105(106)
104
24

FIG.11


17
110
105(106)
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8
101
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1
35
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104
24

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EUROPEAN SEARCH REPORT

Application Number
EP 09 00 2187

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 920 464 A (ALLEN TRASK) 12 January 1960 (1960-01-12) * column 2, line 8 - line 64; figures 1,2 *	1	INV. F24F1/00
D,A	JP 62 218745 A (MITSUBISHI ELECTRIC CORP) 26 September 1987 (1987-09-26) * abstract *	1-10	
A	WO 03/088731 A (LG ELECTRONICS INC [KR]; BAE YOUNG-JU [KR]; KIM IN-GYU [KR]; KOO JA-HY) 30 October 2003 (2003-10-30)	1-10	
A	WO 2004/094919 A (LG ELECTRONICS INC [KR]; KIM IN-GYU [KR]; KOO JA-HYUNG [KR]; PARK BYUN) 4 November 2004 (2004-11-04)	2	
A	WO 2006/129891 A (LG ELECTRONICS INC [KR]; BYUN JAE-BYUNG [KR]; KANG WANSEOK [KR]; NOH W) 7 December 2006 (2006-12-07) * the whole document *	2-10	TECHNICAL FIELDS SEARCHED (IPC)
A	US 2003/122458 A1 (CHOI CHANG-MIN [KR] ET AL) 3 July 2003 (2003-07-03)	2-10	F24F F25B
A	JP 2006 214635 A (DAIKIN IND LTD) 17 August 2006 (2006-08-17) * abstract; figure 10 *	2	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 June 2009	Vuc, Arianda

CATEGORY OF CITED DOCUMENTS

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23-06-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2920464 A	12-01-1960	NONE	
JP 62218745 A	26-09-1987	JP 1816099 C	18-01-1994
		JP 5023337 B	02-04-1993
WO 03088731 A	30-10-2003	AU 2003235183 A1	03-11-2003
		CN 1633574 A	29-06-2005
		EP 1606560 A2	21-12-2005
		WO 2004076936 A2	10-09-2004
		KR 20030036302 A	09-05-2003
		KR 20030089689 A	22-11-2003
		KR 20040096513 A	16-11-2004
		KR 20050008874 A	21-01-2005
		KR 20050012896 A	02-02-2005
		KR 20050023397 A	09-03-2005
		KR 20050012897 A	02-02-2005
		US 2004237559 A1	02-12-2004
WO 2004094919 A	04-11-2004	CN 2669055 Y	05-01-2005
		CN 1774601 A	17-05-2006
		EP 1627188 A1	22-02-2006
		WO 2004094915 A2	04-11-2004
		KR 20030036583 A	09-05-2003
		KR 20040092471 A	03-11-2004
		KR 20050000366 A	03-01-2005
		KR 20050000367 A	03-01-2005
WO 2006129891 A	07-12-2006	AT 432450 T	15-06-2009
		EP 1886070 A2	13-02-2008
US 2003122458 A1	03-07-2003	CN 1428560 A	09-07-2003
		JP 2003202133 A	18-07-2003
		KR 20030057024 A	04-07-2003
JP 2006214635 A	17-08-2006	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

- JP 62218745 A **[0003] [0004]**