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

(11) EP 2 644 556 A1

(12) # EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
02.10.2013 Bulletin 2013/40

(21) Application number: **10860020.6**

(22) Date of filing: **26.11.2010**

(51) Int Cl.:
B66B 11/02 *(2006.01)* ***B66B 1/34*** *(2006.01)*

(86) International application number:
PCT/JP2010/071113

(87) International publication number:
WO 2012/070145 (31.05.2012 Gazette 2012/22)

(84) Designated Contracting States:
AL 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 RS SE SI SK SM TR

(71) Applicant: **Mitsubishi Electric Corporation**
Tokyo 100-8310 (JP)

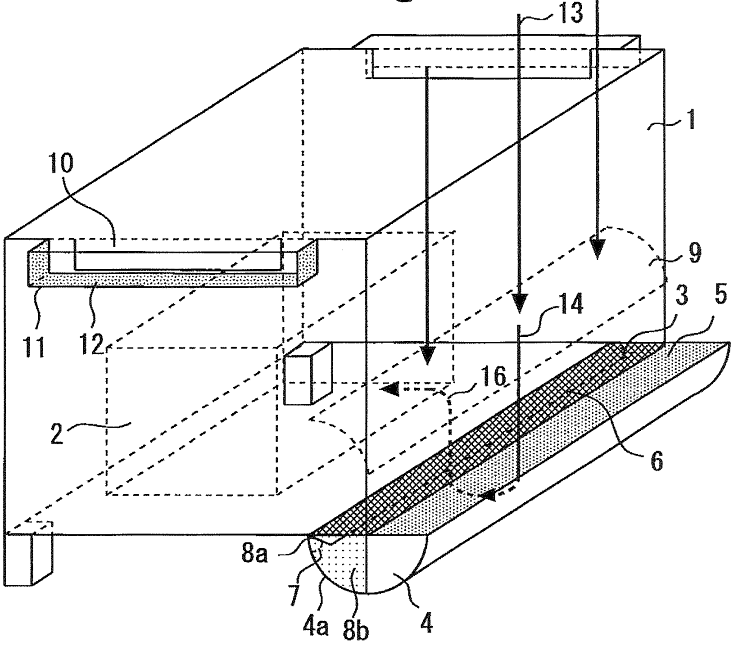
(72) Inventor: **UCHIDA, Yoshiyuki**
Tokyo 100-8310 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) **COOLING DEVICE FOR ELEVATOR**

(57) Provided is a cooling device of an elevator which makes complicated maintenance work unnecessary and can obtain a necessary cooling effect. For this purpose, a cooling device of an elevator which cools apparatus provided in a car of the elevator includes an air intake section which introduces an airflow caused by the running wind during the ascent and descent of the car into the interior of the apparatus, an air discharge section which discharges the air in the interior of the apparatus to outside the apparatus, and foreign matter separating means which is provided in the air intake section and separates foreign matter contained in the airflow by using at least either a centrifugal force or gravitational force which acts on the foreign matter. The air intake section is configured in such a manner that the airflow whose foreign matter is separated by the foreign matter separating means and whose foreign matter content is lowered from the foreign matter content before the separation, is introduced into the interior of the apparatus.

fig. 1



EP 2 644 556 A1

Description

Technical Field

[0001] The present invention relates to a cooling device of an elevator.

Background Art

[0002] As a conventional cooling device of an elevator which cools apparatus installed in a car of an elevator, such as a control board, there is, for example, a cooling device in which a radiating fin, a cooling fan or a duct for taking in the running wind during a run of the car and the like are used.

[0003] A typical example of such a conventional cooling device of an elevator is shown in Figure 12. In Figure 12, reference numeral 1 denotes a cabinet provided, for example, in an upper part of a car of the elevator, which is not shown. An object of cooling 2, which is a heat generating apparatus, such as a circuit board, is accommodated in this cabinet 1. An air intake port 3 is provided on one side surface of the cabinet 1. An intake air filter 21 for removing foreign matter in the air, such as dust, is attached to this air intake port 3. An air discharge fan 22 which serves also as an air discharge port is attached to the other side surface of the cabinet 1. In general, this air discharge fan 22 is rotatably driven by an electric motor. And when this air discharge fan 22 rotates, the air whose temperature rises due to the heat generated by the object of cooling 2 is discharged from the cabinet 1. Then, the atmospheric pressure in the cabinet 1 drops and, therefore, the outside air is sucked into the cabinet 1 from the air intake port 3. On this occasion, the foreign matter contained in the sucked air is captured.

[0004] As another example of a conventional cooling device of an elevator, the cooling device described in Patent Literature 1 is known. Patent Literature 1 describes a radiating device of an elevator which is such that a fan device which cools a circuit board mounted on a car is provided in the car and this fan device is rotated by mechanically transmitting the rotation of a roller guide which rolls along a guide rail and guides the ascent and descent of the car. Patent Literature 1 describes also a cooling device in which there are provided a plurality of air intake/discharge ports which take in the running wind during the ascent and descent of the car and discharge the taken-in running wind and a ventilation duct which guides the running wind to a circuit board mounted on the car.

Citation List

Patent Literature

[0005]

Patent Literature 1: Japanese Patent Laid-Open No. 2001-341962

Summary of Invention

Technical Problem

[0006] However, in such conventional cooling devices of an elevator, those in which a radiating fan is used dissipate the heat of an object of cooling by the diffusion of heat by thermal conduction and by the natural convection of the air surrounding the radiating fin. Therefore, it is necessary to use a cooling fan having a volume suited to the calorific value of the object of cooling and when the calorific value of the object of cooling is large, the size of a cooling fan increases, posing the problem that a wide installation space is necessary.

[0007] Also, in conventional cooling devices of an elevator, those in which a cooling fan is used forcedly take in the air from outside the car. Foreign matter, such as sand and dust, may sometimes be contained in the air taken in from outside the car. For this reason, the foreign matter, such as sand and dust, contained in the air taken in from outside the car is blown onto an object of cooling. Therefore, this poses the problem that the foreign matter adheres to the fan and deposits thereon, reducing the cooling capacity. Furthermore, in the case where foreign matter adheres to a circuit board, which is an object of cooling, and deposits thereon, tracking of an electric circuit occurs due to the dust and moisture, carbides and the like, inducing failures in the apparatus.

[0008] In order to prevent troubles by the foreign matter, such as sand and dust, contained in the air taken in from outside the car, for example, as shown in Figure 12, a filter for removing the foreign matter in the air may sometimes be arranged in an air intake port. However, in this case, clogging occurs if much foreign matter adheres to the filter, posing the problem that the inflow volume of the air decreases, resulting in a decrease in the cooling capacity. In order to prevent this clogging of the filter, it is necessary to carry out maintenance, such as periodic replacement and cleaning of the filter, posing the problem that complicated troublesome work is required.

[0009] In the conventional cooling device of an elevator described in Patent Literature 1, the rotation of the roller guide is mechanically transmitted to the cooling fan via a rotation transmission mechanism and is used as the power for rotating the cooling fan. For this reason, many moving parts exist in the cooling fan and the rotation transmission mechanism and wear occurs in these moving parts. Therefore, maintenance such as the replacement of worn parts is necessary, posing the problem that complicated troublesome work is required. Patent Literature 1 contains a description to the effect that there is also provided a ventilation duct having a plurality of air intake/discharge ports for taking in the running wind during the ascent and descent of the car. However, such a ventilation duct requires many members, posing the problem that the car weight increases and the problem that manufacturing requires high costs.

[0010] The present invention was made to solve such problems and provides a cooling device of an elevator which makes complicated maintenance work unnecessary and can obtain a necessary cooling effect.

Means for Solving the Problems

[0011] A cooling device of an elevator according to the present invention, which cools apparatus provided in a car of the elevator, comprises: an air intake section which introduces an airflow caused by the running wind during the ascent and descent of the car into the interior of the apparatus; an air discharge section which discharges the air in the interior of the apparatus to outside the apparatus; and foreign matter separating means which is provided in the air intake section and separates foreign matter contained in the airflow by using at least either a centrifugal force or gravitational force which acts on the foreign matter, wherein the air intake section is configured in such a manner that the airflow whose foreign matter is separated by the foreign matter separating means and whose foreign matter content is lowered from the foreign matter content before the separation, is introduced into the interior of the apparatus.

Advantageous Effect of Invention

[0012] The cooling device of an elevator of the present invention provides the effect that a necessary cooling effect can be obtained without requiring complicated maintenance work.

Brief Description of the Drawings

[0013]

Figure 1 is a perspective view of a cabinet to which the cooling device of an elevator of Embodiment 1 of the present invention is applied.

Figure 2 is a front view of a cabinet to which the cooling device of an elevator of Embodiment 1 of the present invention is applied, the view explaining the flow of the air, during a run of a car.

Figure 3 is a front view of a cabinet to which the cooling device of an elevator of Embodiment 1 of the present invention is applied, the view explaining the flow of the air, during a standstill of a car.

Figure 4 are diagrams to explain the configuration conditions under which temperature changes of an object of cooling were measured when the cooling device of an elevator of Embodiment 1 of the present invention was actually mounted on an elevator in operation.

Figure 5 are graph charts to show the results of measurements under the configuration conditions of Figure 4.

Figure 6 is a perspective view of a cabinet to which the cooling device of an elevator of Embodiment 2 of the present invention is applied.

Figure 7 is a front view of a cabinet to which the cooling device of an elevator of Embodiment 2 of the present invention is applied, the view explaining the flow of the air, during a run of a car.

Figure 8 is a front view of a cabinet to which the cooling device of an elevator of Embodiment 2 of the present invention is applied, the view explaining the flow of the air, during a standstill of a car.

Figure 9 is a perspective view of a cabinet to which the cooling device of an elevator of Embodiment 3 of the present invention is applied.

Figure 10 is a front view of a cabinet to which the cooling device of an elevator of Embodiment 3 of the present invention is applied, the view explaining the flow of the air, during a run of a car.

Figure 11 is a front view of a cabinet to which the cooling device of an elevator of Embodiment 3 of the present invention is applied, the view explaining the flow of the air, during a standstill of a car.

Figure 12 is a perspective view of a cabinet to which a conventional cooling device of an elevator is applied.

Description of Embodiments

[0014] The present invention will be described with reference to the accompanying drawings. In each of the drawings, like numerals refer to like or corresponding parts and overlaps of description of these parts are appropriately simplified or omitted.

Embodiment 1

[0015] Figures 1 to 5 relate to Embodiment 1 of the present invention. Figure 1 shows a perspective view of a cabinet to which the cooling device of an elevator of this embodiment is applied.

In Figure 1, reference numeral 1 denotes a cabinet installed, for example, in an upper part of an elevator, which is not shown. This cabinet 1 is a box in the shape of a roughly rectangular parallelepiped. And an object of cooling 2 which is a heat generating apparatus, such as a circuit board, is accommodated in this cabinet 1. An air intake port 3 is provided at one side end on the lower surface of the cabinet 1. An air intake hood 4 is attached to this air intake port 3. This air intake hood 4 is formed in the shape of a rough semicircle as seen from the front. The air intake hood 4 has an air intake section baffle plate 4a which is bent in the form of a circular arc.

[0016] The air intake hood 4 is attached to the air intake port 3 area of the cabinet 1 in such a manner that the circular arc part in the shape of a rough semicircle faces downward and the diameter part faces upward. On this occasion, the arrangement is such that in the diameter part of the air intake hood 4 in the shape of a rough semicircle, one radial side is applied to the air intake port 3 and the other radial side is positioned outward from the side surface of the cabinet 1. And the other radial side of the air intake hood 4 arranged in such a manner as to be at a position protruding outward from the side surface of this cabinet 1 is open upward. This opening forms an inflow surface 5.

[0017] A foreign matter separating plate 6 is provided at the end in the air intake hood 4 on the air intake port 3 side. Here, the straight-plate like foreign matter separating plate 6 is provided in a protruding manner from the circular arc side of the air intake hood 4 to the inner side in such a manner that the angle 7 formed by the air intake section baffle plate and the foreign matter separating plate becomes an acute angle. And an airflow moving direction discharge port 8a, which is an opening, is provided in the air intake section baffle plate 4a in the area nearest to the foreign matter separating plate 6 in the space formed by being sandwiched by this foreign matter separating plate 6 and the air intake section baffle plate 4a. Also, a half of the air intake hood 4 on the air intake port 3 side on both sides of the air intake hood 4 (the front side and the back side of the cabinet 1) provides a lateral-to-airflow moving direction discharge port 8b.

[0018] An inner baffle plate 9 is attached to a side surface of the interior of the cabinet 1 in such a manner as to be positioned above the air intake port 3. Here, this inner baffle plate 9 is formed in such a manner that the section thereof provides a circular arc which is 1/4 of a full circle.

[0019] An air discharge port 10, which is an opening, is provided each at the upper end of each of the front and back surfaces of the cabinet 1. And an air discharge hood 11 is provided on the outer side of each of these air discharge ports 10. These air discharge hoods 11 are each composed of two surfaces, i.e., an upper surface covering the upper side of each air discharge port 10 and a surface parallel to the opening surface of each air discharge port 10. The two right and left sides and lower side of each air discharge port 10 are open, and a discharge surface 12 is formed. These air discharge hoods 11 have the flow regulating action of preventing the running wind 13 from above from flowing directly through the air discharge port 10, losing the directionality of airflow (the unidirectionality of airflow). In addition, the air discharge hoods 11 have also the function of ensuring that foreign matter is less apt to be taken into the interior of the cabinet 1 from the air discharge port 10.

[0020] Figure 2 explains the flow of the air, during a run of a car, in the cabinet to which the cooling device of an elevator thus configured is applied. When the car ascends, also the cabinet 1 installed in the car ascends with the car. Therefore, the running wind 13 flows relatively from up to down with respect to the cabinet 1. When this running wind 13 strikes against the inflow surface 5 of the air intake hood 4, due to a difference in atmospheric pressure the airflow is guided along the circular arc shape of the air intake section baffle plate 4a of the air intake hood 4. On that occasion, due to the weight of foreign matter and centrifugal force, the trajectory of the foreign matter contained in the airflow having a larger mass than the air, such as sand, dust, and waste, deviates from a circular arc trajectory to the outer side (the centrifugal separation action). That is, the foreign matter in a flow of the flowing-in air 14 turns along an inner wall of the air intake section baffle plate 4a and is guided to the space formed by being sandwiched by the foreign matter separating plate 6 and the air intake section baffle plate 4a.

[0021] The air having a high foreign matter content which has been introduced in this manner into the space formed by being sandwiched by the foreign matter separating plate 6 and the air intake section baffle plate 4a is discharged mainly from the airflow moving direction discharge port 8a (the flow of the air in the moving direction from the discharge port 15). Most of the airflow not discharged from the airflow moving direction discharge port 8a moves upward and enters the interior of the cabinet 1 from the air intake port 3 (the wind introduced into the cabinet 16). On the other hand, the remaining airflow not introduced to the airflow moving direction discharge port 8a or the air intake port 3 is discharged from the lateral-to-airflow moving direction discharge port 8b (the flow of the air in the direction of the side surface of the discharge port 17). On that occasion, the air is discharged while the foreign matter which has accumulated under gravitational force on the bottoms of the air intake hood 4 and the air intake section baffle plate 4a is being discharged (the foreign matter discharge action). The airflow which has entered the interior of the cabinet 1 from the air intake port 3 changes the moving direction thereof by use of the inner baffle plate 9 and is blown onto the object of cooling 2. In this manner, the object of cooling 2 can be cooled efficiently using the airflow introduced into the interior of the cabinet 1.

[0022] And the air warmed by the object of cooling 2 is discharged from an air discharge port 10 having a lower atmospheric pressure. The air discharged from the air discharge hood 11 joins an external running wind 13 from the air discharge hood 11 (the flow of the air which flows out 18).

[0023] In this manner, first, the running wind 13 during the ascent of the elevator car is introduced into the interior of the cabinet 1 by the air intake hood 4 which takes in the wind which strikes from above and the air intake port 3 which takes in the wind into the interior of the cabinet 1. In this process of introduction, the direction of the airflow is changed to an upward direction by the air intake section baffle plate 4a having the shape of a circular arc, and the foreign matter in the air is separated by using the principle of centrifugal separation. And finally, the foreign matter is removed by the foreign matter separating plate 6 from the air which is introduced into the cabinet 1. The foreign matter which has been removed by the foreign matter separating plate 6 is discharged by part of the airflow which has entered from the inflow surface 5 of the air intake hood 4 from the airflow moving direction discharge port 8a, which is in the main moving direction of the airflow, and the lateral-to-airflow moving direction discharge port 8b, which is in a direction orthogonal to the main moving direction of the airflow. That is, the air intake section baffle plate 4a having the shape of a circular arc, the foreign matter separating plate 6 as well as the airflow moving direction discharge port 8a and the lateral-to-airflow moving direction discharge port 8b constitute the foreign matter separating means.

[0024] In this manner, in the interior of the cabinet 1, the air whose foreign matter has been removed in the process of introduction of the running wind 13 is blown by the inner baffle plate 9 onto the object of cooling 2. And the air which has become warm due to the cooling of the object of cooling 2 is discharged to outside the cabinet 1 from the air discharge port 10 positioned near the upper side of the cabinet 1. Cooling is performed by these series of forced flows of the air.

[0025] On the other hand, Figure 3 shows the flow of the air, during a standstill of the car, in the cabinet to which the cooling device of an elevator thus configured is applied. In the case where the car is at a standstill and there is no running wind, heat discharge is performed by the natural convection which occurs by the heat generation from the object of cooling 2 in the interior of the cabinet 1. Although the air volume is small compared to the case where a forced flow of the air is formed by receiving the running wind, the outside air is introduced from the air intake port 3 in the lower part (the flow of the air flowing in at a standstill 19) and the flow of the air discharged from the air discharge port 10 in the upper part (the flow of the air flowing out at a standstill 20) is ensured, whereby it is possible to prevent heat from accumulating. Because during a standstill of the car the running wind does not strike from above, the warm air discharged from the air discharge port 10 rises upward. Here, the air discharge hood 11 is configured in such a manner that the two right and left sides of each of the air discharge ports 10 are open. For this reason, it is possible to ensure that the warm air by the natural convention occurring in the case where there is no running wind rises upward immediately after discharge and that the warm air is less apt to accumulate in the interior of the cabinet 1.

[0026] In order to obtain a desired heat discharge effect by using the running wind or natural convection, it is necessary to make a design which ensures an air passage having a certain sectional area in a series of paths from the air intake port 3 to the air discharge port 10. For example, in Figure 1, this air passage refers to a series of air passages from the inflow surface 5 formed by the cabinet 1 into which the running wind flows and the air intake hood 4 to the discharge surface 12 formed by the cabinet 1 and the air discharge hood 11. A necessary sectional area can be derived by means of thermo-fluid analyses and experiments on the basis of parameters, such as the number and area of the air intake ports 3 and air discharge ports 10 as well as the calorific value, shape, arrangement and the like of the object of cooling 2.

[0027] Figures 4(a) to 4(c) are diagrams to explain the configuration conditions under which temperature changes of an object of cooling were measured when the cooling device of an elevator of this embodiment was actually mounted on an elevator in operation. In the cooling device of an elevator used in this measurement, an air intake section is provided in two places and an air discharge section is provided in four places in order to enhance the cooling effect. To make a comparison of the air passage sectional area and the cooling effect, measurements were made at the same time also in a configuration of condition B whose air passage sectional area is 1.5 times the air passage sectional area of condition A. Condition C is intended for a comparison of the effect caused by a difference in the structure of the air intake section. Under condition C, the air intake section was not provided with the foreign matter separating means of the present invention but only a hood for preventing a back flow of the running wind was provided in the air discharge section, the air passage sectional area being the same as under condition A.

[0028] Figure 5 shows the results of measurements for 24 hours under the configuration conditions of Figure 4. The object of measurement was the surface temperature of a mounted part (an electrolytic capacitor) of a printed-circuit board in the interior of the cabinet. There is no change in the conducting state in the interior of the cabinet and the calorific value of the object of measurement is always constant. The condition of the elevator is indicated by the output of an accelerator sensor. This output of the accelerator sensor is an output curve oscillating with 0.00 (V) as the center. And the first half of approximately 10 hours with a small amplitude of this vibration is the standstill hours, and the latter half of approximately 14 hours with intense vibrations is the running hours.

[0029] In this graph of Figure 5, the reason why there are temperature amplitudes of 3 to 4°C or so in the 24 hours is that in addition to the running wind of the car, there are winds which blow through the shaft at irregular intervals. First, a comparison is made between condition A and condition B. When the comparison is made in terms of the average temperature of measured values, the result was such that during the standstill hours the average temperature was approximately 1°C lower under condition B than under condition A, and during the running hours the average temperature was approximately not less than 2°C lower under condition B than under condition A. That is, it can be said that it was ascertained that when the air passage sectional area is large, the heat discharge effect by the airflow is high and the cooling effect by the taking-in of the running wind is high. The average temperature difference for these 24 hours is not less than 1°C.

[0030] Next, a comparison is made between condition A and condition C. Although a diagrammatic representation is omitted, the result was an intermediate one of the comparison between A and condition B. That is, during the standstill hours the average temperature was approximately 0.5°C lower under condition C than under condition A and during the running hours the average temperature was approximately 1°C lower under condition C than under condition A. It seems that the main reasons for this are the two points: the air intake resistance caused by the curve of the air passage of the air intake section and the foreign matter separating plate is higher under condition A than under condition C; and the air volume striking against the object of cooling decreases under condition A compared to the air volume under condition C because under condition A the airflow including foreign matter is discharged midway. Therefore, it is apparent that in order that a cooling effect equal to or greater than the cooling effect obtained without using the foreign matter separating means of this embodiment is obtained by using the air intake section provided with the foreign matter separating means, it is necessary to set an air passage sectional area in which a decrease in the air volume due to air passage resistance and midway discharge is considered.

[0031] Here, the foreign matter separating plate 6 in the shape of a straight plate was provided in such a manner that the angle 7 formed by the air intake section baffle plate and the foreign matter separating plate becomes an acute angle. In this respect, it is also possible to adopt a configuration in which the foreign matter separating plate 6 which is bent, for example, in the shape of the letter L or in the shape of a circular arc is used and the angle 7 formed by the air intake section baffle plate and the foreign matter separating plate is, for example, of the order of a right angle.

Here, the description was given of the case where the cabinet 1 is installed in the upper part of the car. In the case where the cabinet 1 is installed in the lower part of the car, it is conceivable that the direction of the air intake hood 4 is changed to the direction in which the wind received during the descent of the car is taken in (a downward direction which is reverse to the direction in the case where the cabinet 1 is installed in the upper part) and that the direction of the air discharge hood 11 is changed to the direction in which the running wind during descent is not taken into the cabinet 1 (a downward direction reverse to the direction in the case where the cabinet 1 is installed in the upper part) .

[0032] The cooling device of an elevator configured as described above is a cooling device of an elevator which cools (an object of cooling in) a cabinet, which is an apparatus provided in a car of the elevator, is provided with an air intake section which introduces an airflow caused by the running wind during the ascent and descent of the car into the interior of the apparatus, an air discharge section which discharges the air in the interior of the apparatus to outside the apparatus, and foreign matter separating means which is provided in the air intake section and separates foreign matter contained in the airflow by using at least either a centrifugal force or gravitational force which acts on the foreign matter. The air intake section is intended for introducing the airflow whose foreign matter is separated by the foreign matter separating means and whose foreign matter content is lowered from the foreign matter content before the separation, into the interior of the apparatus.

[0033] The foreign matter separating means is intended for discharging the separated foreign matter together with part of the airflow to outside the apparatus from an airflow moving direction discharge port and a lateral-to-airflow moving direction discharge port without causing the separated foreign matter to go through the interior of the apparatus.

[0034] For this reason, in the forced cooling using the running wind, it is possible to cool the apparatus with the air whose foreign matter content has been reduced without using a filter and the like which require maintenance. On this occasion, because foreign matter, such as separated dust, is discharged to outside the apparatus by a wind pressure, complicated overhauls involving the overhaul of the apparatus is unnecessary or work burden can be reduced. Furthermore, an electric power source for cooling and a source of power having wearing parts are unnecessary and it is possible to obtain a cooling effect equivalent to the cooling effect of natural cooling or more and the cooling effect of forced cooling and hence it is possible to achieve energy savings and resource savings. In addition, because it is possible to configure the wind guide passage for steps from air intake to discharge by adding members only in part of the interior and exterior of the apparatus and hence the number of component members is small compared to the method by which the air is collected by a duct and the like provided outside the apparatus. Therefore, it is possible to reduce the cost required by manufacture and to achieve resource savings.

Embodiment 2

[0035] In Embodiment 2 described here, the foreign matter separating means in Embodiment 1 described above is provided in a plurality of numbers. That is, in Embodiment 2, the foreign matter separating means is provided in a plurality stages (here, three stages) in the air passage from the inflow surface of the running wind to the air intake port to the cabinet.

[0036] Figures 6 to 8 relate Embodiment 2 of the present invention. Figure 6 shows a perspective view of a cabinet to which the cooling device of an elevator of this embodiment is applied. As described above, in Embodiment 2, a plurality of foreign matter separating means are provided. That is, an air intake hood 4 is provided with an air intake section baffle plate 4a, a foreign matter separating plate 6 as well as an airflow moving direction discharge port 8a and a lateral-to-airflow moving direction discharge port 8b are provided in a plurality of sets (here, in three sets). And these sets are connected to other sets to provide a series of air passages. That is, the outflow side of a first set in which an inflow surface

5 is formed and the inflow side of a second set are connected, the outflow side of the second set and the inflow side of a third set are connected, and the outflow side of the third set is connected to an air intake port 3 provided on the lower surface of a cabinet 1.

[0037] Because in this manner the air intake hood 4 is horizontally somewhat long, the air intake port 3 is positioned not near a side of the lower surface of the cabinet 1, but near almost the middle of the lower surface of the cabinet. For this reason, the inner baffle plate 9 provided in Embodiment 1 is not provided in Embodiment 2.

Other configurations are the same as in Embodiment 1 and detailed descriptions thereof are omitted.

[0038] Figure 7 explains the flow of the air, during a run of a car, in the cabinet to which the cooling device of an elevator thus configured. When the car ascends, the running wind 13 flows relatively from up to down with respect to the cabinet 1. And this running wind 13 is taken in from the inflow surface 5 of the air intake hood 4, and the airflow is guided along the circular arc shape of the first air intake section baffle plate 4a. On that occasion, in the same manner as in Embodiment 1, the foreign matter in the airflow is separated by the centrifugal force action and the foreign matter separating plate 6 and is discharged from the airflow moving direction discharge port 8a and the lateral-to-airflow moving direction discharge port 8b.

[0039] The airflow which has not been discharged from the airflow moving direction discharge port 8a or the lateral-to-airflow moving direction discharge port 8b moves once upward and flows into the second set (foreign matter separating means). And in the same manner as in the first set, the foreign matter in the air which was incapable of being removed by the first foreign matter separating means is removed. Also similarly, in the third set (foreign matter separating means), the foreign matter in the air which was incapable of being removed by the two precedent sets (foreign matter separating means) is removed. In this manner, the airflow which has undergone the foreign matter removal step by the three-stage foreign matter separating means is guided from the air intake port 3 to the interior of the cabinet 1.

The step of cooling the object of cooling 2 which follows this foreign matter removal step is the same as in Embodiment 1 and a detailed description thereof is omitted.

[0040] Figure 8 shows the flow of the air, during a standstill of a car, in the cabinet to which the cooling device of an elevator in this embodiment is applied. The flow of the air during a standstill of a car is almost the same as in Embodiment 1. However, because there are lateral-to-airflow moving direction discharge ports 8b (and airflow moving direction discharge ports 8a) corresponding to the number of foreign matter separating means, the flow of the air during a standstill of a car in this embodiment differs from that of Embodiment 1 in the point that the outside air is introduced from these plurality of lateral-to-airflow moving direction discharge ports 8b and the like in addition to the inflow surface 5 of the air intake hood 4.

[0041] The number of the foreign matter separating means in the air intake hood 4, which is the air intake section, may be provided in any number of stages according to the purpose. And in the case where the foreign matter separating means is provided in a plurality of stages, the radius of a circular arc formed by the air intake section baffle plate 4a may be changed according to the kinds of foreign matter which is an object of separation (diameter and weight of dust and the like) for each stage. As shown in Figure 7, it may be ensured that the trajectory of the airflow in the air intake hood 4 becomes the shape of a crank by providing a flow regulating member substantially vertically downward from the center of the circular arc formed by the air intake section baffle plate 4a.

[0042] The cooling device of an elevator configured as described above is provided with a plurality of connected foreign matter separating means. For this reason, it is possible to produce the same effect as in Embodiment 1 and besides it is possible to improve the capacity to separate foreign matter.

Embodiment 3

[0043] Embodiments 1 and 2 described above separate foreign matter from the air by using a centrifugal force and gravitational force. In contrast to this, in Embodiment 3 described here, in the air intake section, foreign matter is separated from the air by using mainly gravitational force without using the action by a centrifugal force.

[0044] Figures 9 to 11 relate to Embodiment 3 of the present invention. Figure 9 shows a perspective view of a cabinet to which the cooling device of an elevator of the present invention is applied. In Embodiment 3, an air intake hood 4 is provided below the lower surface of a cabinet 1 in which an object of cooling 2 is accommodated. This air intake hood 4 has an air intake section baffle plate 4a arranged substantially parallel to the lower surface of the cabinet 1. That is, the air intake section baffle plate 4a is arranged substantially parallel. And an air passage of an air intake section formed by the air intake hood 4 (the air intake section baffle plate 4a) has a structure of a wind guide passage through which the wind blows linearly substantially horizontally. The air intake section baffle plate 4a protrudes outward from both side surfaces of the cabinet 1. When a running wind 13 from above strikes against a protrusion of this air intake section baffle plate 4a, due to a difference in atmospheric pressure the running wind 13 is introduced into the wind guide passage below the cabinet 1 formed by the air intake hood 4.

[0045] An air intake port 3 is provided in the lower surface of the cabinet 1. In the airflow blowing substantially horizontally through the air intake hood 4, the foreign matter in the airflow blows mainly linearly while coming down under the gravitational force acting on the weight of the foreign matter. On the other hand, part of the air having a small foreign matter content near, i.e., above the lower surface of the cabinet 1 flows from the air intake port 3 into the cabinet 1 at a lower atmospheric pressure. In this manner, due to the action of the gravitational force acting on the foreign matter the air containing a large amount of foreign matter is discharged and the air having a relatively small foreign matter content is introduced from the air intake port 3 into the cabinet 1.

Other configurations are almost the same as in Embodiment 1 with the exception that no inner baffle plate 9 is provided, and a detailed description thereof is omitted.

[0046] Figure 10 explains the flow of the air, during a run of a car, in the cabinet to which the cooling device of an elevator thus configured is applied. When the car ascends, the running wind 13 flows relatively from up to down with respect to the cabinet 1. And this running wind 13 strikes against the protrusion of the air intake section baffle plate 4a and is guided by the air intake hood 4 into the wind guide passage below the cabinet 1 formed by the air intake hood 4. And by using the action of the gravitational force acting on the foreign matter as described above, the lower air containing a large amount of foreign matter is discharged and the upper air having a relatively small foreign matter content is introduced from the air intake port 3 into the cabinet 1.

The step of cooling the object of cooling 2 which follows this step is the same as in Embodiment 1 and a detailed description thereof is omitted.

[0047] Figure 11 shows the flow of the air, during a standstill of a car, in the cabinet to which the cooling device of an elevator in this embodiment is applied. The flow of the air during a standstill of a car is almost the same as in Embodiment 1. By natural convention, the outside air is taken in from the air intake hood 4 and the air intake port 3 under the cabinet 1 and warm air is discharged from the air discharge port 10 in the upper part of the cabinet 1.

[0048] In this embodiment, the air intake port 3 may be provided with a screen for separating foreign matter.

[0049] In the cooling device of an elevator configured as described above, in place of the configuration of the foreign matter separating means of Embodiment 1, the foreign matter separating means is configured in such a manner that a baffle plate which forms the path of airflow in the shape of a straight line in a horizontal direction and by using the gravitational force acting on the foreign matter the foreign matter contained in the airflow is guided vertically downward with respect to the path of airflow formed by the baffle plate. For this reason, it is possible to obtain a cooling device of an elevator which enables space savings to be achieved with a simple configuration, with the advantages of the configuration of Embodiment 1 kept as they are.

[0050] In Embodiments 1 and 2 described above, if the area of the series of ventilation passages is the same, the air resistance of the air intake section (the inflow section) is larger in the case of a plurality of foreign matter separation stages than in the case of one stage. For this reason, it is necessary to increase the sectional area in order to lower the air resistance, inducing an increase in the configured space and the consumption of members. In the case of the air intake section of Embodiment 3 through which the air flows linearly, foreign matter may sometimes become apt to enter and leave from the cabinet 1 depending on the flow of the air. However, it is possible to configure the cooling device with a simple shape and a small amount of member consumption. In view of these circumstances, it is possible to make an appropriate selection from the configurations of Embodiments 1 to 3 above according to the purpose as to whether priority is given to the foreign matter separating function, whether priority is given to the space saving, and so on. That is, it is possible to change the capacity to separate foreign matter according to requirements by changing the configuration of the foreign matter separating means of the air intake section.

Industrial Applicability

[0051] The present invention can be applied to a cooling device of an elevator which cools apparatus provided in a car of an elevator.

Description of Symbols

[0052]

1	cabinet
2	object of cooling
3	air intake port
4	air intake hood
4a	air intake section baffle plate
5	inflow surface
6	foreign matter separating plate
7	angle formed by the air intake section baffle plate and the foreign matter separating plate
8a	airflow moving direction discharge port
8b	lateral-to-airflow moving direction discharge port
9	inner baffle plate
10	air discharge port
11	air discharge hood
12	discharge surface
13	running wind
14	flow of the flowing-in air
15	flow of the air in the moving direction from the discharge port
16	wind introduced into the cabinet
17	flow of the air in the direction of the side surface of the discharge port
18	flow of the air which flows out
19	flow of the air flowing in at a standstill
20	flow of the air flowing out at a standstill
21	intake air filter
22	air discharge fan

Claims

1. A cooling device of an elevator which cools apparatus provided in a car of the elevator, comprising:

   an air intake section which introduces an airflow caused by the running wind during the ascent and descent of the car into the interior of the apparatus;
   an air discharge section which discharges the air in the interior of the apparatus to outside the apparatus; and
   foreign matter separating means which is provided in the air intake section and separates foreign matter contained in the airflow by using at least either a centrifugal force or gravitational force which acts on the foreign matter,
   wherein the air intake section is configured in such a manner that the airflow whose foreign matter is separated by the foreign matter separating means and whose foreign matter content is lowered from the foreign matter content before the separation, is introduced into the interior of the apparatus.

2. The cooling device of an elevator according to claim 1, wherein the foreign matter separating means discharges the separated foreign matter together with part of the airflow to outside the apparatus without causing the separated foreign matter to go through the interior of the apparatus.

3. The cooling device of an elevator according to claim 1 or 2, wherein the foreign matter separating means comprises a baffle plate which forms a path of the airflow in the shape of a circular arc curved vertically downward, and separates the foreign matter contained in the airflow by guiding the foreign matter vertically downward and to near an outer circumference with respect to the path of the airflow formed by the baffle plate by using the centrifugal force and gravitational force acting on the foreign matter.

4. The cooling device of an elevator according to claim 3, wherein the air intake section comprises the foreign matter separating means in a plurality of numbers.

5. The cooling device of an elevator according to claim 1 or 2, wherein the foreign matter separating means comprises a baffle plate which forms a path of the airflow in the form of a straight line in a horizontal direction and separates the foreign matter contained in the airflow by guiding the foreign matter vertically downward with respect to the path of the airflow formed by the baffle plate using the gravitational force acting on the foreign matter.

6. The cooling device of an elevator according to any of claims 1 to 4, further comprising:

   baffle means which is provided in the interior of the apparatus and guides the airflow introduced by the air intake section into the interior of the apparatus to an object of cooling in the interior of the apparatus.

7. The cooling device of an elevator according to any of claims 1 to 5, wherein the air discharge section comprises an air discharge hood which prevents the running wind and the foreign matter from entering the interior of the apparatus from the air discharge section and ensures the unidirectionality of the airflow from the air intake section to the air discharge section.

8. The cooling device of an elevator according to any of claims 1 to 6, wherein the air intake section is arranged below the air discharge section.

Fig. 1

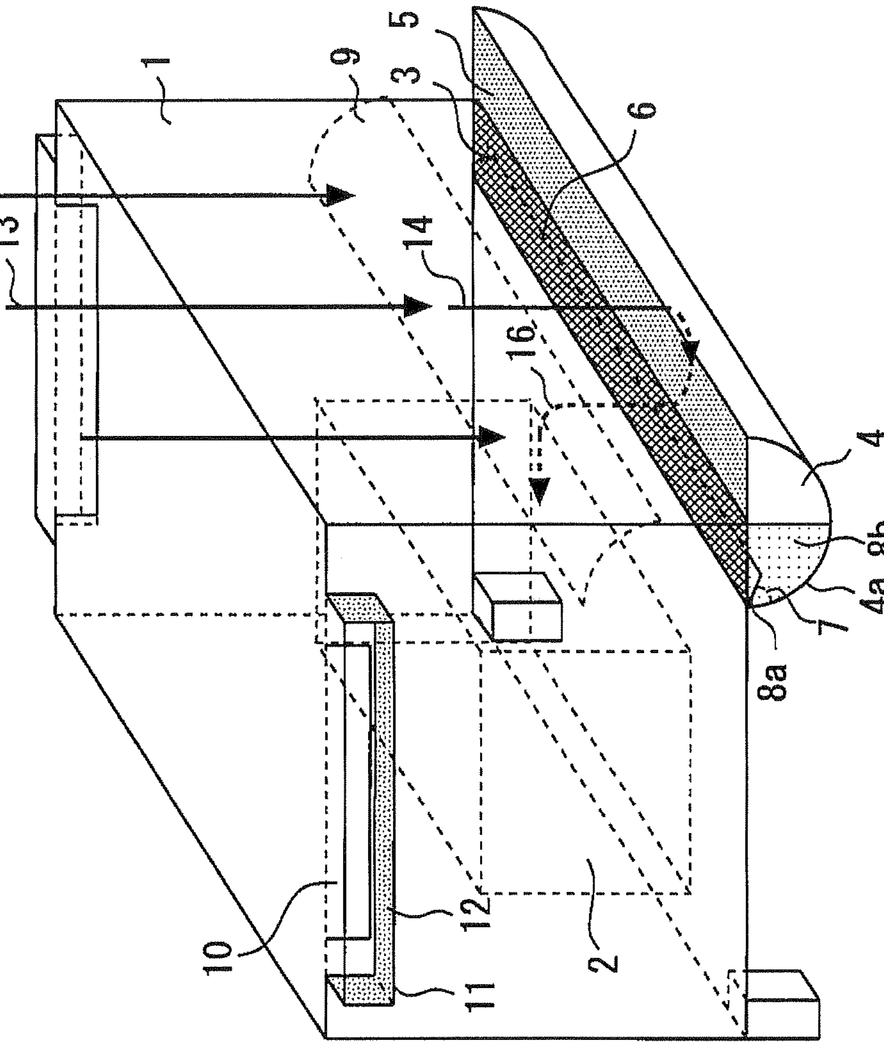


fig. 2

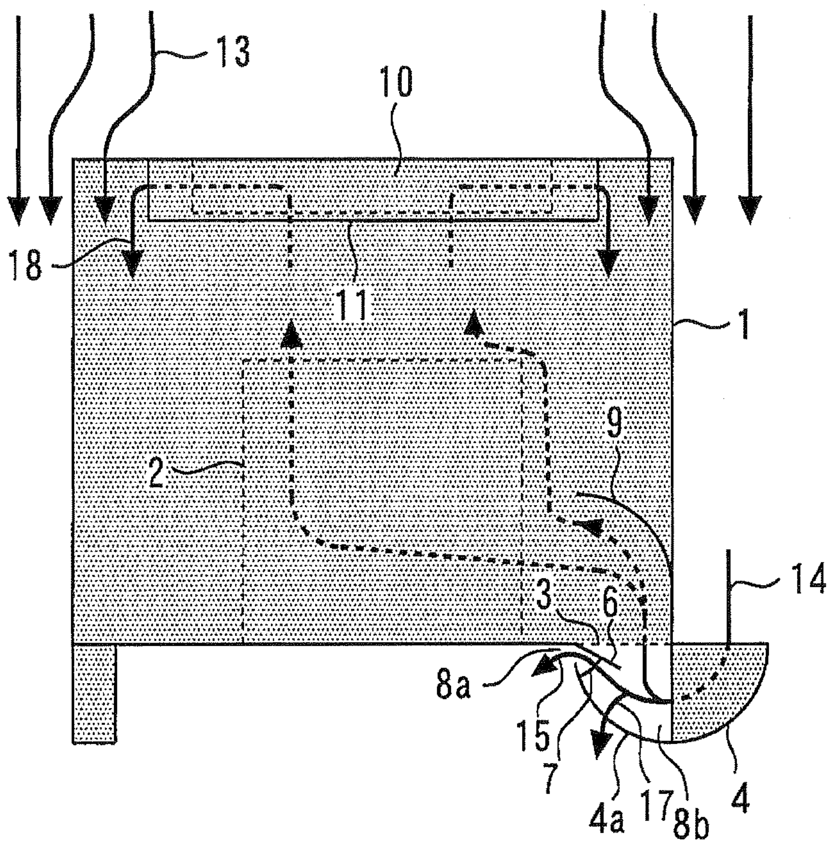


fig. 3

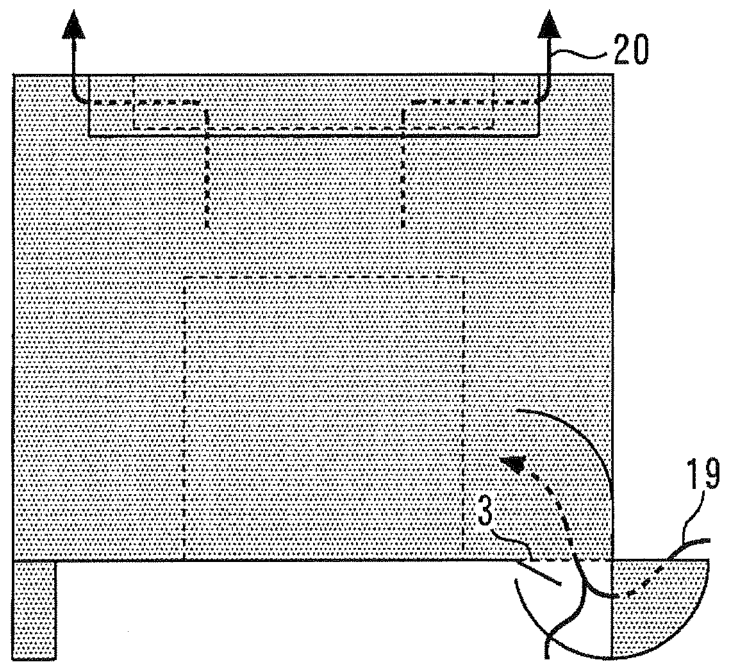
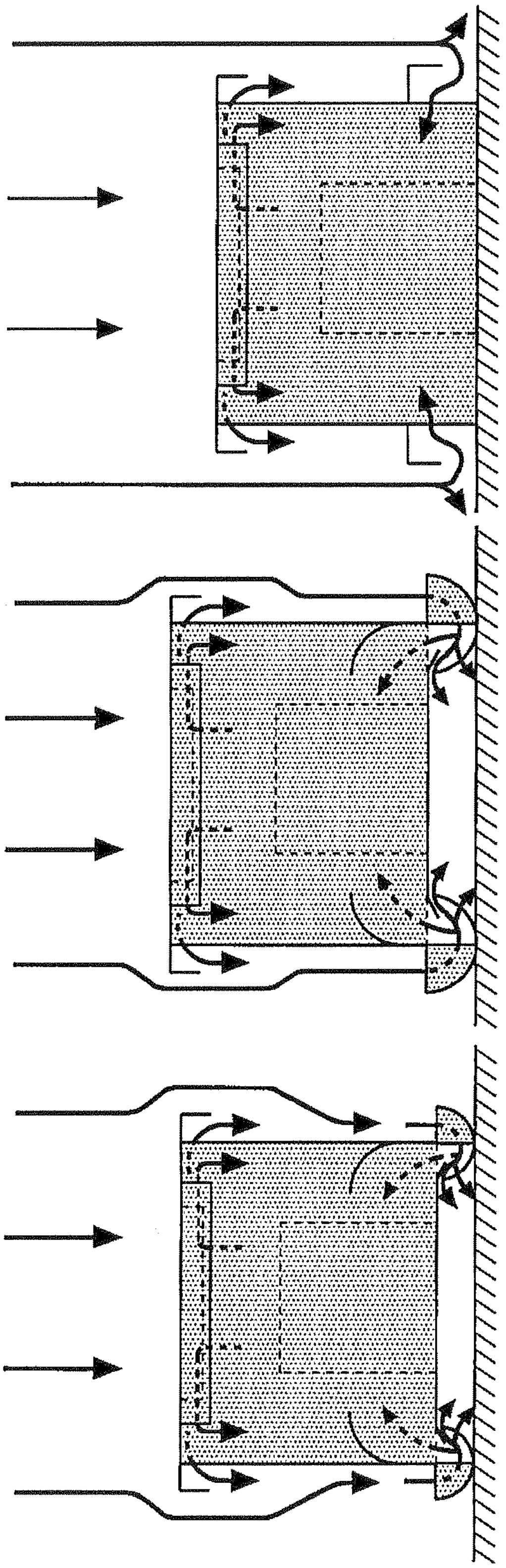


fig. 4



(a) CONDITION A

(b) CONDITION B

(c) CONDITION C

fig. 5

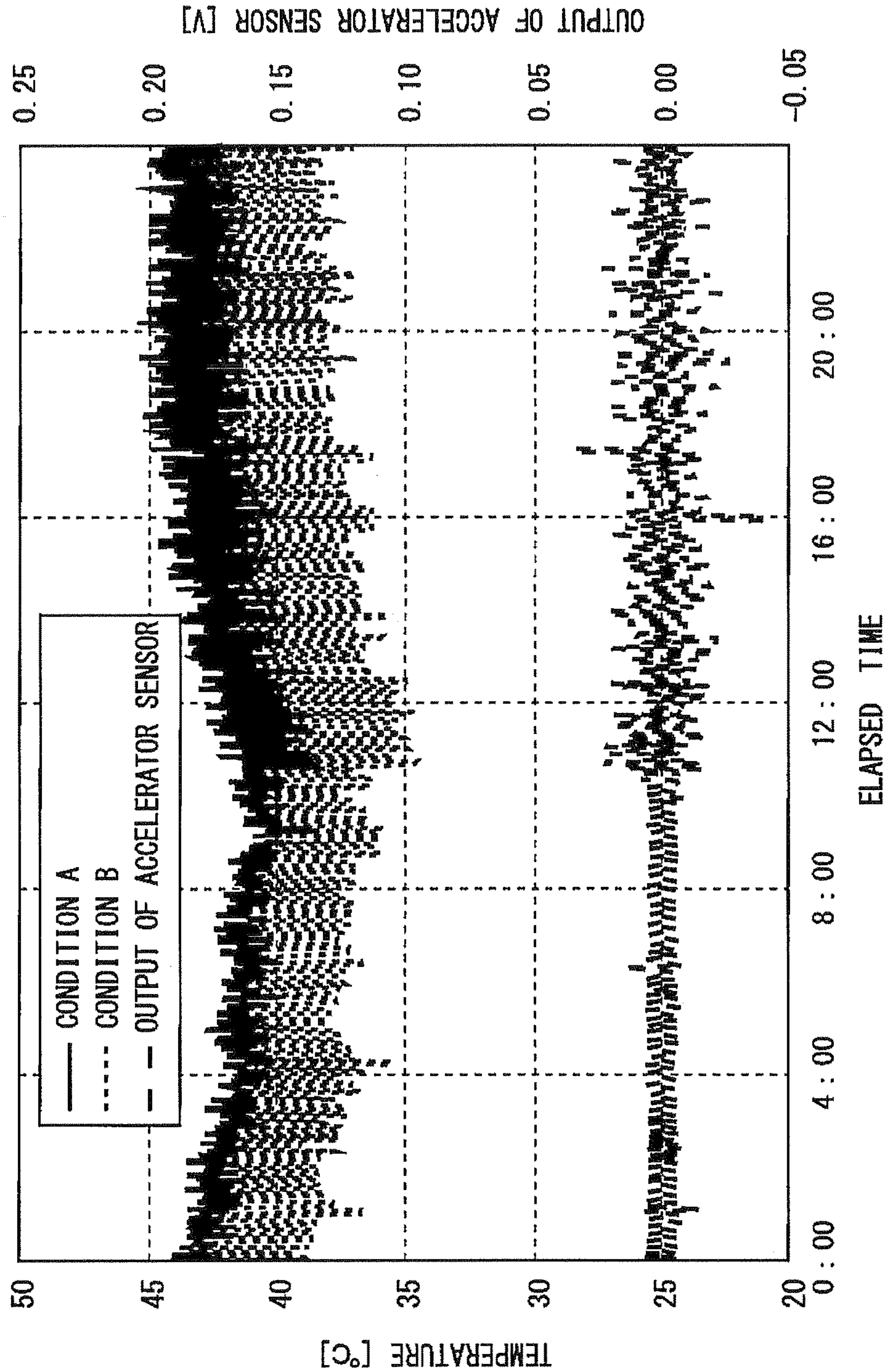

CONDITION A
CONDITION B
OUTPUT OF ACCELERATOR SENSOR
TEMPERATURE [°C]
50
45
40
35
30
25
20
OUTPUT OF ACCELERATOR SENSOR [V]
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
0:00
4:00
8:00
12:00
16:00
20:00
ELAPSED TIME

fig. 6

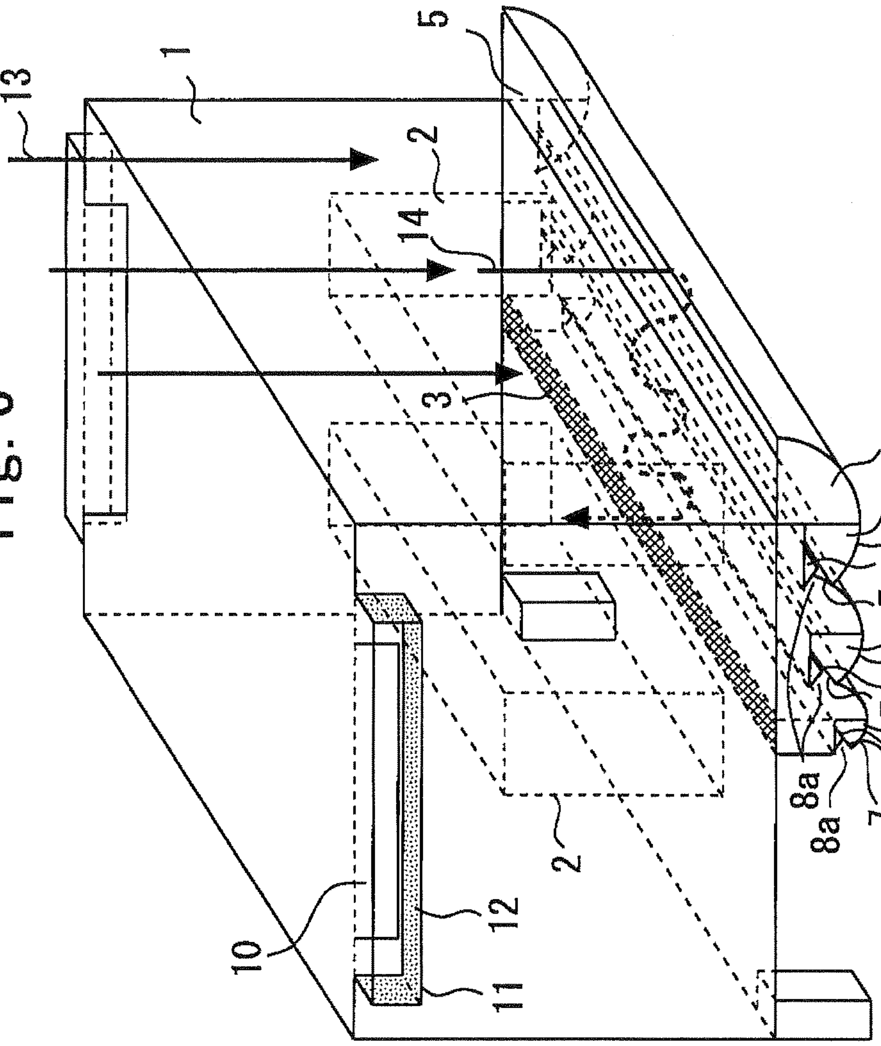


fig. 7

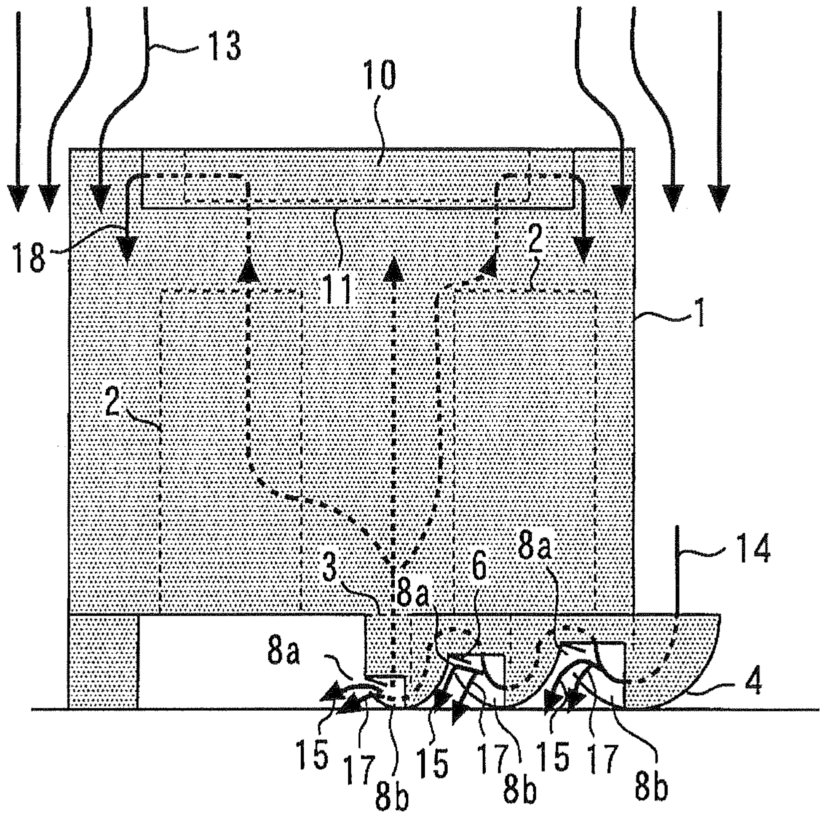


fig. 8

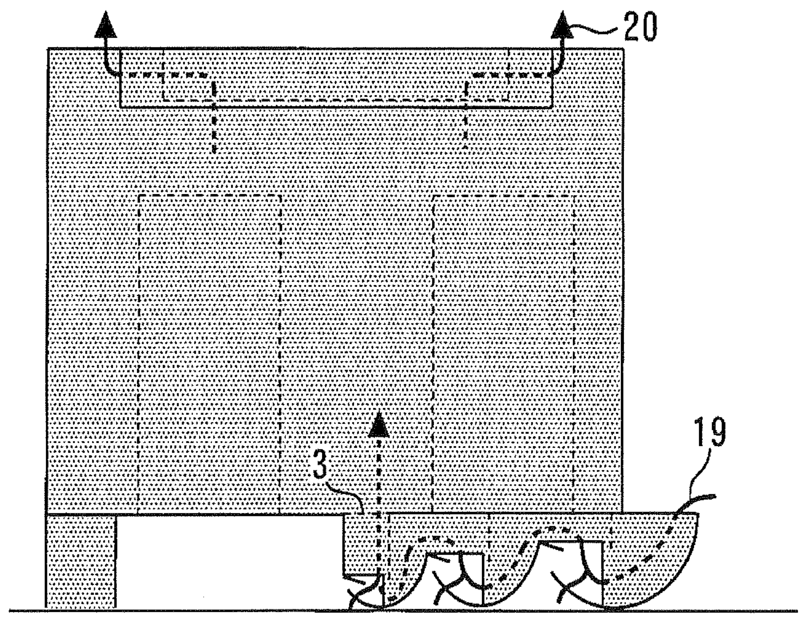


fig. 9

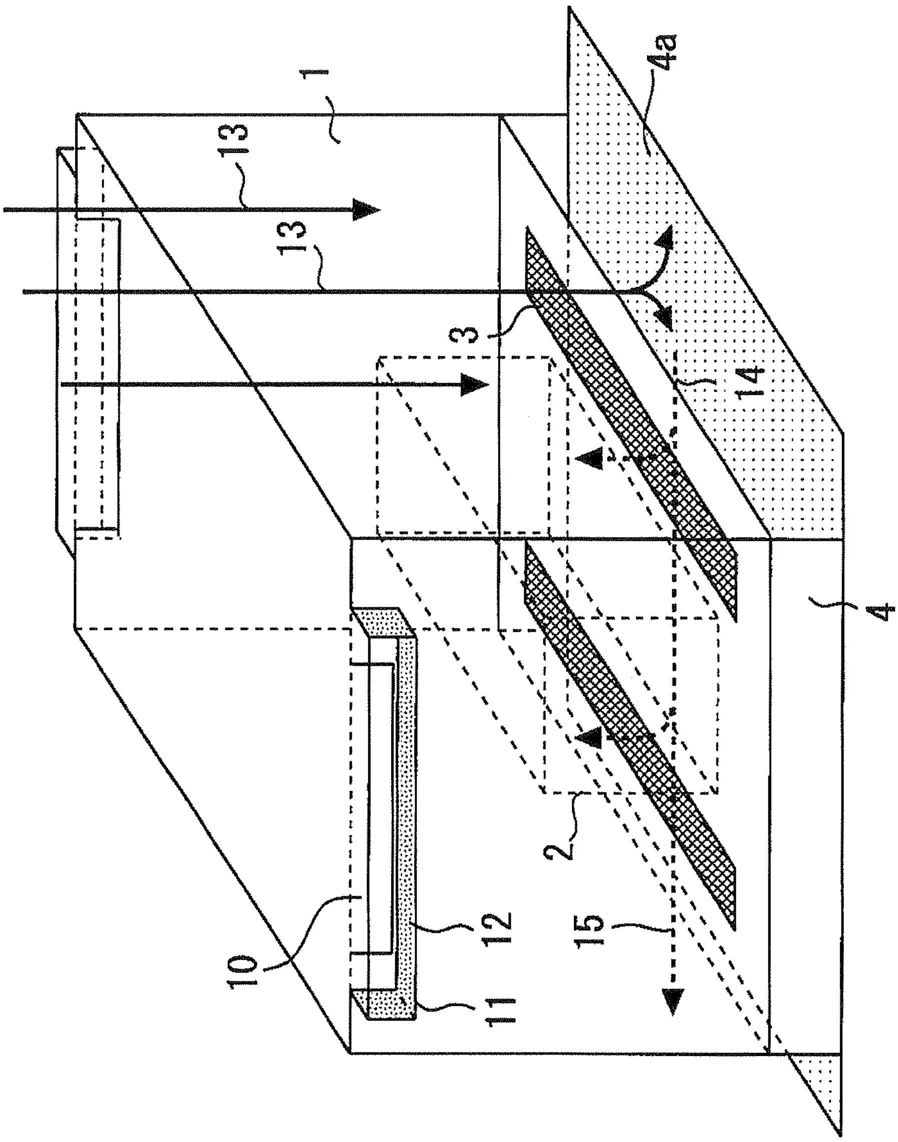


fig. 10

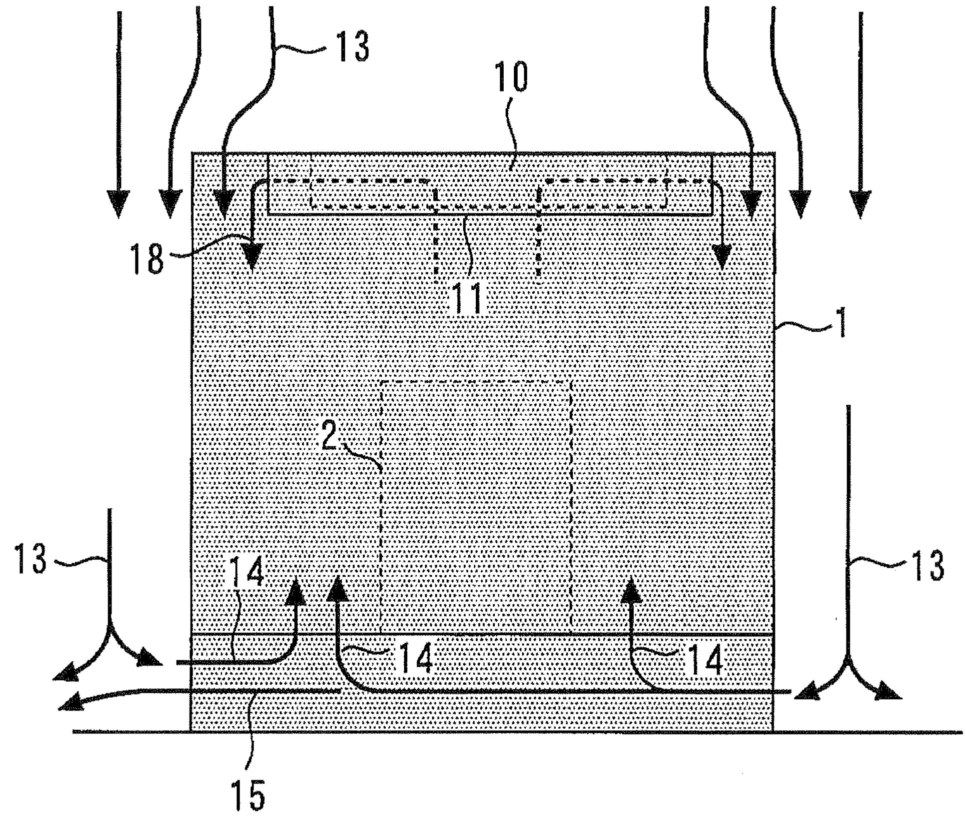


fig. 11

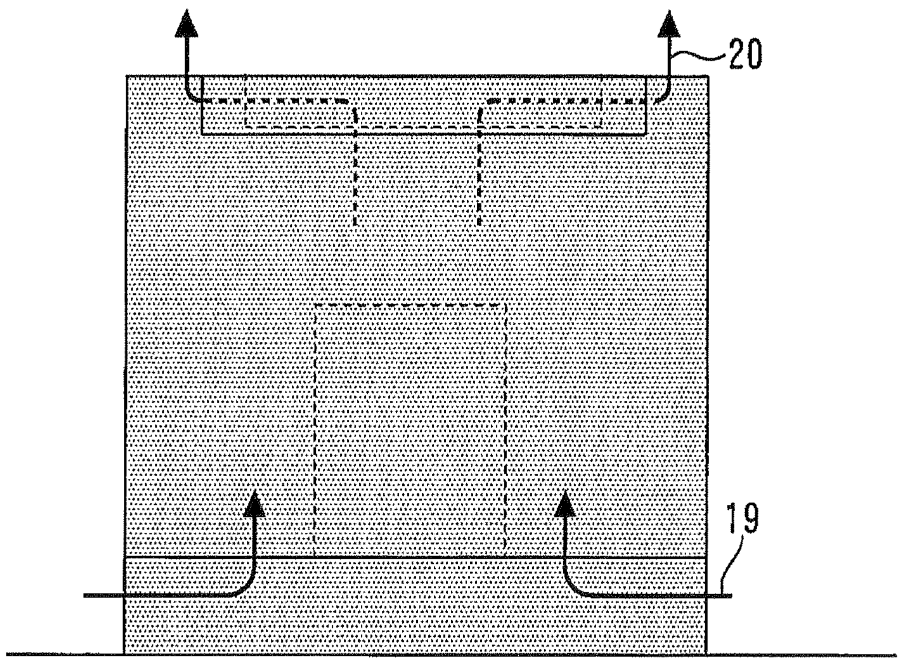
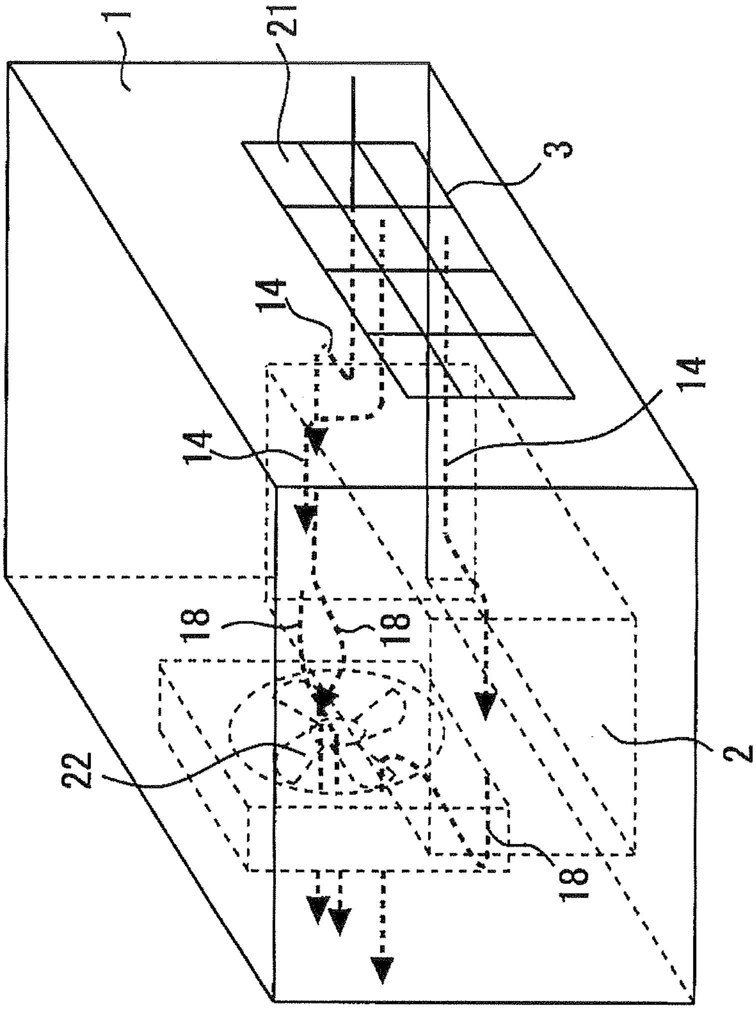


fig. 12



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/071113

A. CLASSIFICATION OF SUBJECT MATTER
B66B11/02(2006.01)i, *B66B1/34*(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)
B66B11/02, B66B1/34

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	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

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 A	JP 2002-128402 A (Mitsubishi Electric Corp.), 09 May 2002 (09.05.2002), paragraphs [0016] to [0019]; fig. 1 to 2 (Family: none)	1-2,6-8 3-5
Y A	JP 2008-36579 A (Air Water Emoto Kabushiki Kaisha, National University Corporation Kitami Institute of Technology), 21 February 2008 (21.02.2008), paragraphs [0023] to [0032]; fig. 1 to 2 (Family: none)	1-2,6-8 3-5
Y A	JP 2004-269244 A (Mitsubishi Electric Corp.), 30 September 2004 (30.09.2004), paragraph [0022]; fig. 7 (Family: none)	6 3-5

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"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
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search 21 April, 2011 (21.04.11)	Date of mailing of the international search report 10 May, 2011 (10.05.11)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/071113

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2006-124070 A (Mitsubishi Electric Corp.), 18 May 2006 (18.05.2006), paragraph [0015]; fig. 3 (Family: none)	6 3-5
Y A	JP 4570198 B2 (Mitsubishi Electric Corp.), 27 October 2010 (27.10.2010), paragraph [0012]; fig. 2 (Family: none)	7 3-5

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2001341962 A **[0005]**