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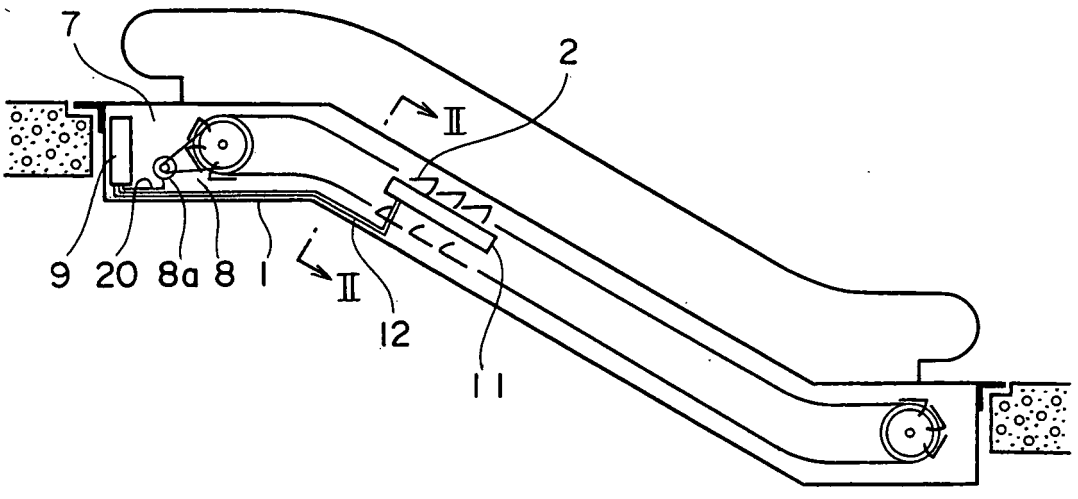
(54) **PASSENGER CONVEYOR**

(57) In a passenger conveyor, a footstep driving device is controlled by an operation control device. The operation control device has an intermediate control portion installed at a lengthwise intermediate portion of a main frame. The intermediate control portion includes heat generating components that generate heat during operation, for example, an inverter, a converter, a reactor, a regenerative resistor, and the like.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a passenger conveyor having footsteps whose operation speed is controlled by an operation control device including heat a generating component such as an inverter.

Background Art

[0002] In a conventional escalator, an inverter box and a relay box for performing inverter control of a driving machine are accommodated within an upper machine room (e.g., see Patent Document 1).

[0003] Patent Document 1: JP 2002-362872 A

Disclosure of the Invention

Problems to be solved by the Invention

[0004] In the conventional escalator constructed as described above, the inverter box and the relay box are accommodated within the upper machine room, so the maintenance space within the upper machine room is small. In the case where heat generating components such as an inverter are installed within the upper machine room, heat discharging means and cooling means need to be provided in the upper machine room. However, due to architectural restrictions, it is difficult to secure a space for installing the heat discharging means and the cooling means.

[0005] The present invention has been made to solve the above-mentioned problems, and it is therefore an obj ect of the present invention to provide a passenger conveyor that makes it possible to dispose heat generating components efficiently and secure a maintenance space within a machine room.

Means for solving the Problems

[0006] A passenger conveyor according to the present invention includes: a main frame; a plurality of footsteps provided on the main frame and coupled to one another endlessly to be rotated; a footstep driving device for driving the footsteps; and an operation control device for controlling the footstep driving device, in which: the operation control device has an intermediate control portion installed at a lengthwise intermediate portion of the main frame; and the intermediate control portion includes heat generating component that generates heat during operation.

Brief Description of the Drawings

[0007]

Fig. 1 is a lateral view showing an escalator according to Embodiment 1 of the present invention.
Fig. 2 is a sectional view taken along the line II-II of Fig. 1.
Fig. 3 is a lateral view showing an escalator according to Embodiment 2 of the present invention.
Fig. 4 is a lateral view showing an escalator according to Embodiment 3 of the present invention.
Fig. 5 is a lateral view showing an escalator according to Embodiment 4 of the present invention.
Fig. 6 is a sectional view taken along the line VI-VI of Fig. 5.
Fig. 7 is a sectional view showing a first example of a case of an intermediate control portion shown in each of Figs. 1 to 6.
Fig. 8 is a sectional view showing a second example of the case of the intermediate control portion shown in each of Figs. 1 to 6.
Fig. 9 is a sectional view showing a third example of the case of the intermediate control portion shown in each of Figs. 1 to 6.
Fig. 10 is a sectional view showing a fourth example of the case of the intermediate control portion shown in each of Figs. 1 to 6.

Best Modes for carrying out the Invention

[0008] Preferred embodiments of the present invention will be described hereinafter with reference to the drawings.

Embodiment 1

[0009] Fig. 1 is a lateral view showing an escalator according to Embodiment 1 of the present invention. Fig. 2 is a sectional view taken along the line II-II of Fig. 1. Referring to Figs. 1 and 2, a main frame (truss) 1 is bridged between an upper floor and a lower floor. The main frame 1 has an upper horizontal portion, an intermediate inclined portion, and a lower horizontal portion. The main frame 1 is provided with a plurality of footsteps 2 coupled to one another endlessly. The footsteps 2 are rotated within the main frame 1. Each of the footsteps 2 is provided with a pair of driving rollers 3a and 3b and a pair of following rollers 4a and 4b.

[0010] A pair of driving rails 5a and 5b for guiding the driving rollers 3a and 3b respectively and a pair of following rails 6a and 6b for guiding the following rollers 4a and 4b respectively are provided within the main frame 1.

[0011] A machine room 7 is provided at an upper end portion of the main frame 1 (below a floor located in the vicinity of an upper platform). A footstep driving device 8 for driving the footsteps 2 and a main control portion (main control panel) 9 are accommodated within the machine room 7. The footstep driving device 8 has a driving motor 8a serving as a driving source.

[0012] A fixation bracket 10 is fixed to a lengthwise intermediate portion of the main frame 1, that is, an intermediate portion of the intermediate inclined portion

thereof. The fixation bracket 10 is parallel and horizontal to a width direction of the footsteps 2. An intermediate control portion (intermediate control panel) 11 is fixed to the fixation bracket 10. The intermediate control portion 11 is disposed between the footsteps 2 on an onward passage side and the footsteps 2 on a backward passage side with an inclination in the same direction as an inclination direction of the intermediate inclined portion of the main frame 1. More specifically, the intermediate control portion 11 is inclined parallel to the intermediate inclined portion of the main frame 1. The intermediate control portion 11 includes components for controlling the operation speed of the footsteps 2, more specifically, an inverter, a converter, a reactor, and a regenerative resistor.

[0013] The inverter creates an alternating current corresponding to an arbitrary voltage and an arbitrary frequency from a direct-current voltage produced by the converter, with a view of controlling the driving motor 8a as an alternating-current motor to generate a required torque efficiently. The inverter creates the alternating current through the switching of the direct-current voltage, and hence generates heat corresponding to a switching loss.

[0014] A diode converter or a transistor converter is used as the converter. The diode converter and the transistor converter each create a direct-current voltage from an alternating current of a commercial power supply (with a constant voltage and a frequency of 50 Hz or 60 Hz). The transistor converter has a function of returning regenerative energy to the power supply. In addition, the converter creates the direct-current voltage through the switching of the alternating current, and hence generates heat corresponding to a switching loss.

[0015] The reactor functions as a filter for preventing the outflow of a harmonic and a surge voltage generated through the operations of the inverter and the converter so that the harmonic and the surge voltage do not adversely affect the commercial power supply or the driving motor 8a. The energy of high-frequency components absorbed by the reactor as the filter is converted into heat, so the reactor generates this heat.

[0016] In the case where the driving motor 8a is turned on by an external force at a speed higher than an intended operation speed, for example, when the escalator is operated downward or stopped with a high on-board ratio, the regenerative resistor converts the energy returned (regenerated) from the driving motor 8a into heat and consumes this heat.

[0017] As described above, the inverter, the converter, the reactor, and the regenerative resistor, which are disposed in the intermediate control portion 11, are all heat generating components that generate heat during operation. Thus, at least one of these heat generating components (e.g., the inverter) is provided with a heat pipe for cooling.

[0018] The operation control device for controlling the footstep driving device 8 has the main control portion 9 and the intermediate control portion 11. The intermediate control portion 11 is connected to the main control portion 9 via a cable 12. The main control portion 9 is connected to the driving motor 8a via a cable 20. That is, a control signal from the intermediate control portion 11 is input to the driving motor 8a via the main control portion 9. However, it is also possible to connect the intermediate control portion 11 to the driving motor 8a via a cable so that a control signal from the intermediate control portion 11 is directly input to the driving motor 8a.

[0019] The main control portion 9 is provided with an interface portion connected communicably to the intermediate control portion 11. The interface portion is provided with an operation portion for inputting changes in the parameters of the inverter and the converter, and a display portion for confirming the states of the inverter and the converter within the machine room 7. The main control portion 9 has a microcomputer.

[0020] In the escalator constructed as described above, the intermediate control portion 11 is installed at the lengthwise intermediate portion of the main frame 1, and the inverter, the converter, the reactor, the regenerative resistor, and the like are disposed in the intermediate control portion 11. Therefore, the heat generating components can be disposed efficiently, and the layout within the machine room 7 allows an extra space. As a result, a sufficient maintenance space can be secured within the machine room 7.

[0021] The heat generated from the heat generating components such as the inverter, the converter, the reactor, the regenerative resistor, and the like can be discharged efficiently from among the footsteps 2 located above the intermediate control portion 11. The air around the intermediate control portion 11 is stirred due to the movement of the footsteps 2, so the efficiency in discharging heat from the heat generating components can be enhanced. Also, the temperature within the machine room 7 is restrained from rising.

[0022] In addition, the intermediate control portion 11 is disposed with an inclination, so the heat pipe provided in at least one of the heat generating components is also disposed with an inclination. Thus, the surface area of a liquid (e.g., distilled water) within the heat pipe is enlarged in comparison with a case where the intermediate control portion 11 is disposed vertically. Accordingly, a reduction in thermal resistance and an improvement in cooling efficiency are achieved.

[0023] Still further, the intermediate control portion 11 is disposed between the footsteps 2 on the onward passage side and the footsteps 2 on the backward passage side, and the intermediate control portion 11 can therefore be exposed simply by removing the footsteps 2 on the onward passage side, so good maintainability is ensured. Also, the intermediate control portion 11 can be disposed without changing the depth of the main frame 1.

[0024] The main control portion 9 within the machine room 7 is provided with the interface portion, so the states of the components in the intermediate control portion 11 can be confirmed and the settings thereof can be

changed without removing the footsteps 2.

Embodiment 2

[0025] Reference will be made next to Fig. 3. Fig. 3 is a lateral view showing an escalator according to Embodiment 2 of the present invention. In this example, a first footstep driving device 13a and a second footstep driving device 13b for driving the footsteps 2 are disposed at the intermediate inclined portion. The footstep driving devices 13a and 13b are disposed between the footsteps 2 on the onward passage side and the footsteps 2 on the backward passage side.

[0026] The intermediate control portion 11 is disposed between the footstep driving devices 13a and 13b. The intermediate control portion 11 is connected to the main control portion 9 via the cable 12, to the first footstep driving device 13a via a cable 14a, and to the second footstep driving device 13b via a cable 14b. That is, the intermediate control portion 11 is directly connected to the footstep driving devices 13a and 13b without the intervention of the main control portion 9. The footstep driving devices 13a and 13b are controlled by the common intermediate control portion 11. Embodiment 2 of the present invention is identical to Embodiment 1 of the present invention in other constructional details.

[0027] With this construction as well, the heat generating components can be disposed efficiently, and a sufficient maintenance space can be secured within the machine room 7.

Embodiment 3

[0028] Reference will be made next to Fig. 4. Fig. 4 is a lateral view showing an escalator according to Embodiment 3 of the present invention. Referring to Fig.4,a first-intermediate controlportion 15a for controlling the first footstep driving device 13a, and a second intermediate control portion 15b for controlling the second footstep driving device 13b are disposed at the intermediate inclined portion. The first intermediate control portion 15a is connected to the main control portion 9 via the cable 12a, and to the first footstep driving device 13a via the cable 14a. The second intermediate control portion 15b is connected to the main control portion 9 via the cable 12b, and to the second footstep driving device 13b via the cable 14b.

[0029] As described above, the intermediate control portions 15a and 15b, which are equal in number to the footstep driving devices 13a and 13b, may be used. In this case as well, the heat generating components can be disposed efficiently, and a sufficient maintenance space can be secured within the machine room 7.

Embodiment 4

[0030] Reference will be made next to Fig. 5. Fig. 5 is a lateral view showing an escalator according to Embodiment 4 of the present invention. Fig. 6 is a sectional view taken along the line VI-VI of Fig. 5. Referring to Figs. 5 and 6, the fixation bracket 10 and the intermediate control portion 11 are disposed below the footsteps 2 on the backward passage side. Thus, the depth dimension of the main frame 1 is larger than that of Embodiment 1 of the present invention. Embodiment 4 of the present invention is identical to Embodiment 1 of the present invention in other constructional details.

[0031] In the escalator constructed as described above, the intermediate control portion 11 is disposed below the footsteps 2 on the backward passage side, so the influences of dust, rain, and the like can further be reduced. Even in the case where other components are disposed between the footsteps 2 on the onward passage side and the footsteps 2 on the backwardpassage side, the intermediate control portion 11 can be disposed at the intermediate inclined portion.

[0032] In the escalator illustrated in each of Embodiments 2 and 3 of the present invention, the intermediate control portion may be disposed below the footsteps on the backward passage side.

The intermediate control portion may be disposed as a plurality of divided components. For example, the inverter, the converter, the reactor, and the regenerative resistor may be constituted by different panels and disposed separately. In this case, some of the components may be disposed between the footsteps 2 on the onward passage side and the footsteps on the backward passage side, and the remaining components may be disposed below the footsteps on the backward passage side.

Further, the heat generating components disposed in the intermediate control portion should not be limited to the inverter, the converter, the reactor, and the regenerative resistor.

Still further, only one or some of the inverter, the converter, the reactor, and the regenerative resistor may be disposed in the intermediate control portion. In this case, from the standpoints of the amount of heat generation and the space for installation, at least the inverter is preferably disposed in the intermediate control portion.

Components that do not generate heat in particular can also be disposed in the intermediate control portion together with the heat generating components.

In addition, although the descriptions of the escalator have been given in each of the foregoing examples, the present invention is also applicable to a moving walkway.

[0033] Each of the intermediate control portions 11, 15a, and 15b illustrated in Embodiments 1 to 4 of the present invention has, for example, one of cases 21 to 24 shown in Figs. 7 to 10, respectively. That is, the heat generating components such as the inverter and the like are accommodated within each of the cases 21 to 24.

[0034] The case 21 shown in Fig. 7 has an intake port 21a and an exhaust port 21b. The intake port 21a is provided to a lower end surface of the case 21 and opens diagonally downward. The exhaust port 21b is provided to an upper end portion of a bottom surface of the case

21 and opens downward. The intake port 21a is arranged at a position lower than the exhaust port 21b when the case 21 is mounted onto the main frame 1.

[0035] The case 22 shown in Fig. 8 has an intake port 22a and an exhaust port 22b. The intake port 22a is provided to a lower end portion of a bottom surface of the case 22 and opens diagonally downward. The exhaust port 22b is provided to an upper end portion of the bottom surface of the case 22 and opens diagonally downward. The intake port 22a is arranged at a position lower than the exhaust port 22b when the case 22 is mounted onto the main frame 1.

[0036] The case 23 shown in Fig. 9 has an intake port 23a and an exhaust port 23b. The intake port 23a is provided to a lower end surface of the case 23 and opens diagonally downward. The exhaust port 23b is provided to an upper end surface of the case 23 and opens diagonally upward. The intake port 23a is arranged at a position lower than the exhaust port 23b when the case 23 is mounted onto the main frame 1. In addition, a hood portion 23c for preventing foreign matters (water, dust, and the like) from entering the exhaust port 23b is provided above the exhaust port 23b.

[0037] The case 24 shown in Fig. 10 has an intake port 24a and an exhaust port 24b. The intake port 24a is provided to a lower end portion of a bottom surface of the case 24 and opens diagonally downward. The exhaust port 24b is provided to an upper end surface of the case 24 and opens diagonally upward. The intake port 24a is arranged at a position lower than the exhaust port 24b when the case 24 is mounted onto the main frame 1. In addition, a hood portion 24c for preventing foreign matters (water, dust, and the like) from entering the exhaust port 24b is provided above the exhaust port 24b.

[0038] In the cases 21 to 24 constructed as described above, the intake ports 21a to 24a are provided at positions lower than the exhaust ports 21b to 24b, respectively, so the air warmed within each of the cases 21 to 24 is swiftly discharged from a corresponding one of the exhaust ports 21b to 24b, and fresh air is hence swiftly taken in from a corresponding one of the intake ports 21a to 24a. As a result, the heat generating components can be cooled efficiently.

[0039] The cases 23 and 24 are provided with the hood portions 23c and 24c, respectively, so the water and dust that have dropped from gaps among the footsteps 2 can be prevented from entering each of the cases 23 and 24 with a simple construction.

[0040] The hood portions may be provided above the intake ports, respectively. Also, hood portions may be provided above both the intake port and the exhaust port, respectively.

Further, a plurality of intake ports and a plurality of exhaust ports may be provided.

Furthermore, each of the cases may be provided with a fan for forced cooling, fins for discharging heat, or the like.

Claims

1. A passenger conveyor comprising:

a main frame;
a plurality of footsteps provided on the main frame and coupled to one another endlessly to be rotated;
a footstep driving device for driving the footsteps; and
an operation control device for controlling the footstep driving device, wherein:

the operation control device has an intermediate control portion installed at a lengthwise intermediate portion of the main frame; and
the intermediate control portion includes heat generating component that generates heat during operation.

2. A passenger conveyor according to Claim 1, wherein the heat generating component included in the intermediate control portion includes at least one of an inverter, a converter, a reactor, and a regenerative resistor.

3. A passenger conveyor according to Claim 1, wherein:

the main frame is provided at one lengthwise end thereof with a machine room; and
the operation control device further has an interface portion provided in the machine room and connected communicably to the intermediate control portion.

4. A passenger conveyor according to Claim 1, wherein:

the main frame has an intermediate inclined portion; and
the intermediate control portion is disposed with an inclination in a same direction as an inclination direction of the intermediate inclined portion.

5. A passenger conveyor according to Claim 1, wherein the intermediate control portion is disposed between the footsteps on an onward passage side and the footsteps on a backward passage side.

6. A passenger conveyor according to Claim 1, wherein the intermediate control portion is disposed below the footsteps on a backward passage side.

7. A passenger conveyor according to Claim 1, wherein:

the intermediate control portion has a case for accommodating the heat generating component;
the case is provided with an intake port and an exhaust port; and
the intake port is provided at a position lower than the exhaust port.

8. A passenger conveyor according to Claim 1, wherein:

the intermediate control portion has a case for accommodating the heat generating component;
the case is provided with an intake port and an exhaust port; and
at least one of the intake port and the exhaust port is provided thereabove with a hood portion for preventing intrusion of foreign matters.

FIG. 1

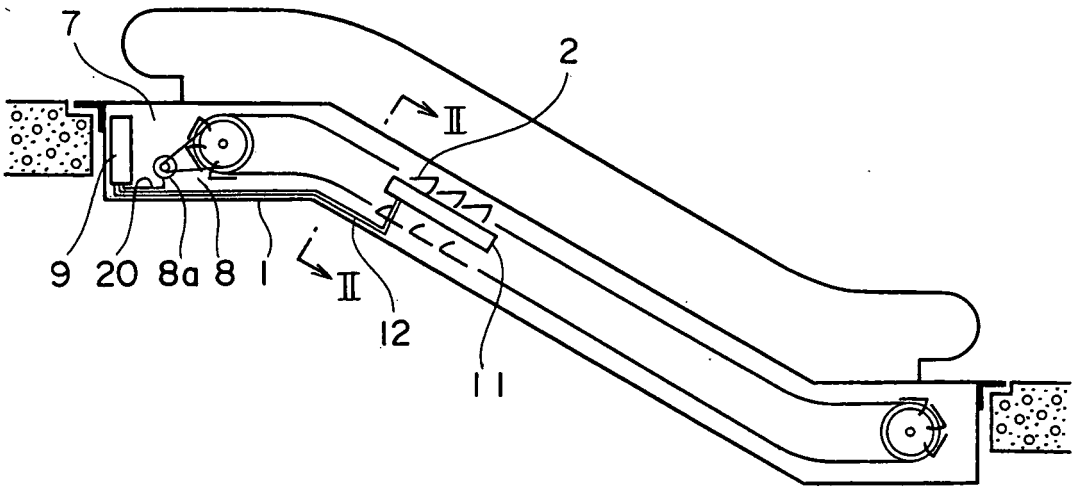


FIG. 2

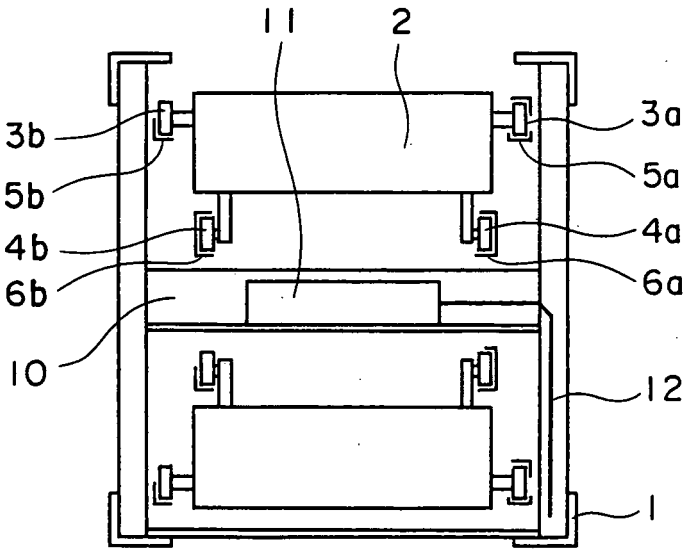


FIG. 3

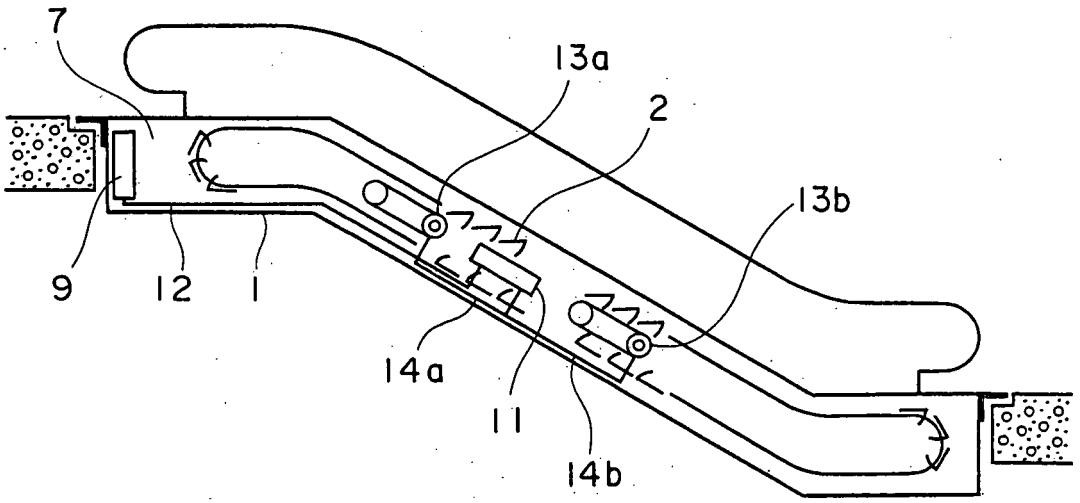


FIG. 4

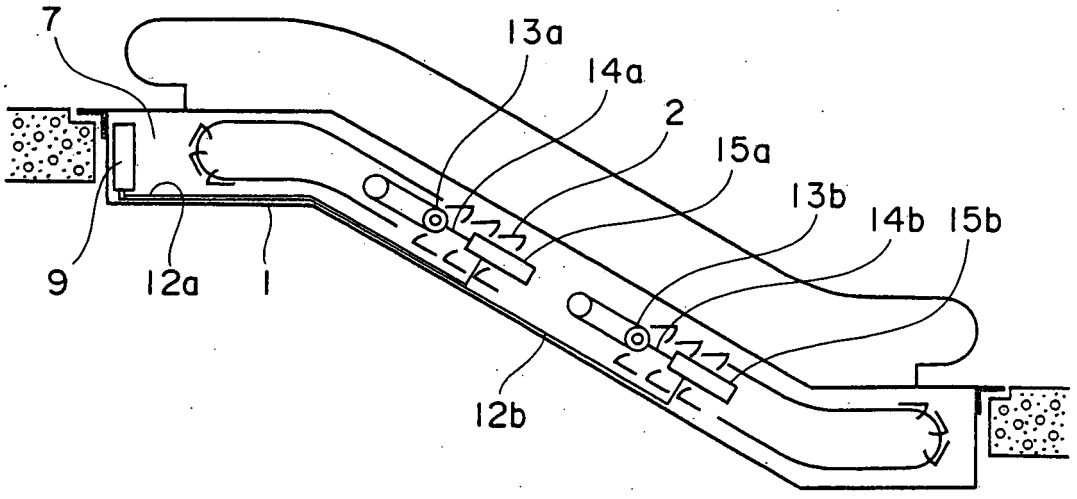


FIG. 5

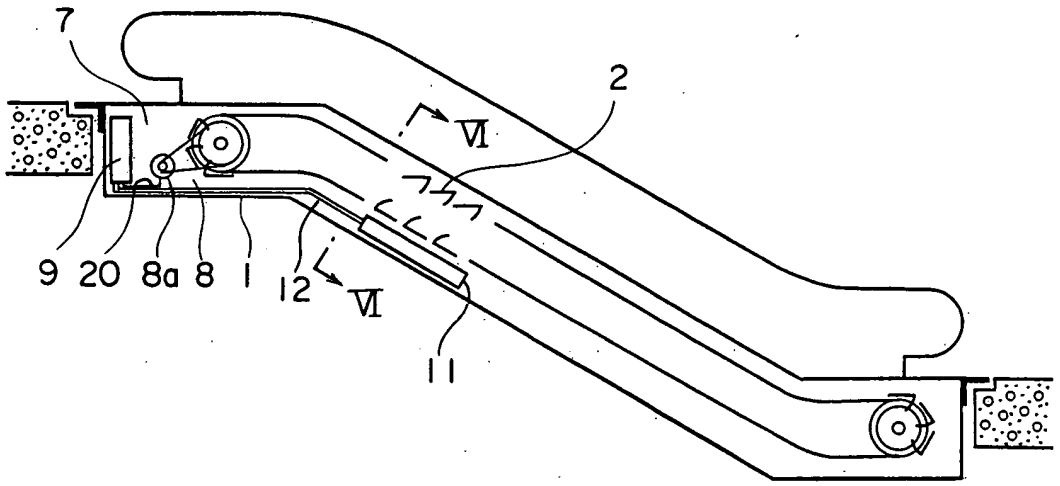


FIG. 6

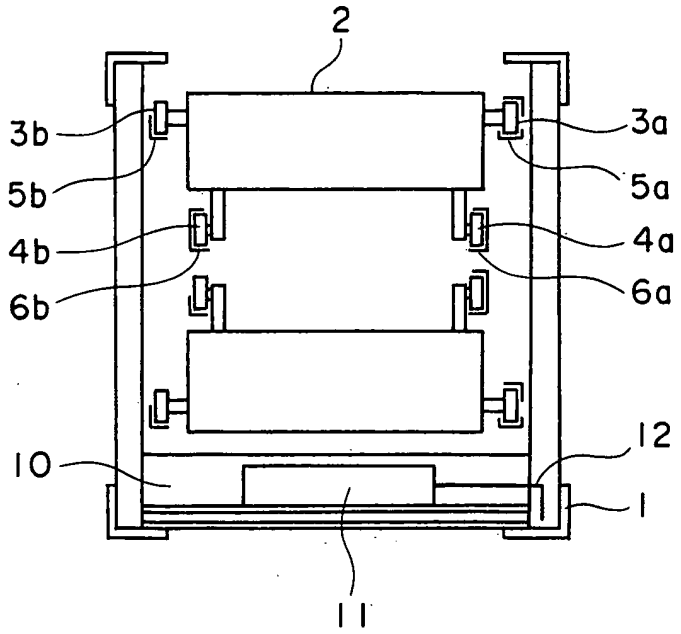


FIG. 7

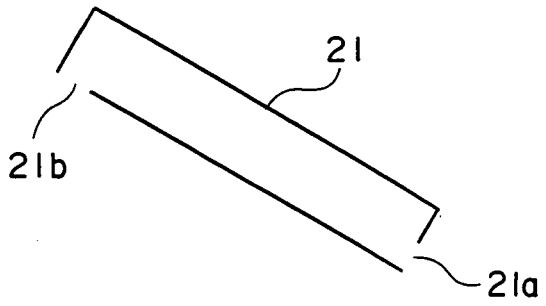


FIG. 8

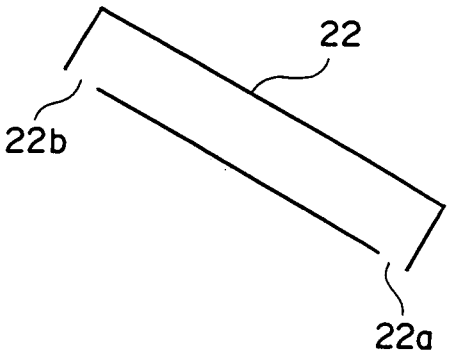


FIG. 9

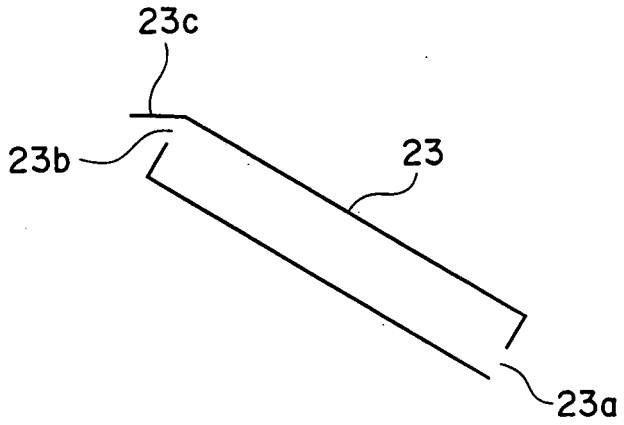
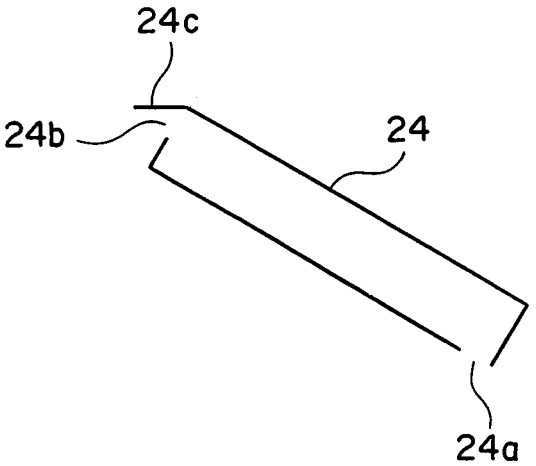


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/313059

A. CLASSIFICATION OF SUBJECT MATTER
B66B25/00(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)
B66B21/00-B66B31/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

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.
X Y	JP 04-032490 A (Hitachi, Ltd.), 04 February, 1992 (04.02.92), & US 5135097 A & GB 2244464 A	1-4,7 5-6,8
Y	JP 48-005431 Y1 (Hitachi, Ltd.), 10 February, 1973 (10.02.73), (Family: none)	5
Y	JP 2001-302161 A (Hitachi Building Systems Co., Ltd.), 31 October, 2001 (31.10.01), (Family: none)	6

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

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Date of the actual completion of the international search	Date of mailing of the international search report
13 March, 2007 (13.03.07)	20 March, 2007 (20.03.07)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/313059

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 023116/1980(Laid-open No. 124667/1981) (Tokyo Shibaura Electric Co., Ltd.), 22 September, 1981 (22.09.81), (Family: none)	8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2002362872 A **[0003]**