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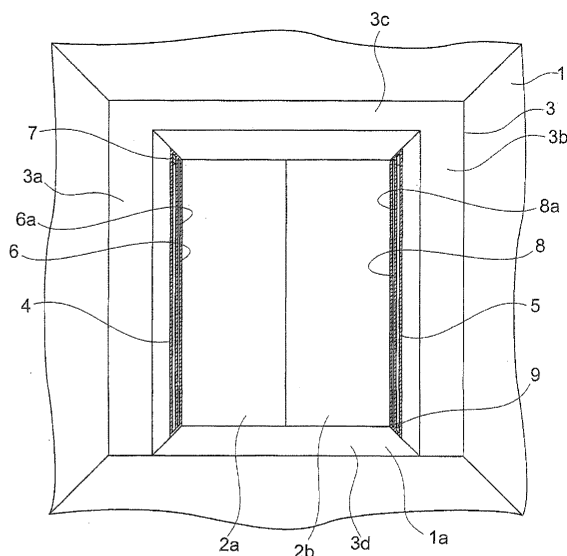
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(54) **SLIDE DOOR DEVICE AND ELEVATOR**

(57) In a sliding door apparatus, a first housing is disposed on a first vertical frame of a doorway frame, and a second housing is disposed on a second vertical frame. A first light emitter that includes a vertically long and continuous first light-emitting surface is disposed in the first housing. A second light emitter that includes a

vertically long and continuous second light-emitting surface is disposed in the second housing. A first imaging means that captures an image of the second light-emitting surface is disposed in the first housing. In addition, a second imaging means that captures an image of the first light-emitting surface is disposed in the second housing.

FIG. 1



Description

TECHNICAL FIELD

[0001] The present invention relates to a sliding door apparatus that automatically moves a door horizontally, and to an elevator that makes use thereof.

BACKGROUND ART

[0002] In conventional sliding door apparatuses, a pair of light emitters that have long and continuous light-emitting surfaces, and a pair of cameras that capture images of the light-emitting surfaces of facing light emitters are disposed in left and right vertical frames of a doorway, and the entire doorway is thereby covered as a monitored region (see Patent Literature 1, for example).

[Patent Literature 1]

[0003] Japanese Patent Laid-Open No. 2004-338846 (Gazette)

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] In conventional sliding door apparatuses such as that described above, since it is necessary to dispose an opening portion for the light emitter and an opening portion for the camera on respective left and right vertical frames of a doorway frame, and mount the respective light emitter and camera separately, on-site sensor installation work is time-consuming.

[0005] The present invention aims to solve the above problems and an object of the present invention is to provide a sliding door apparatus that can facilitate sensor installation for detecting doorway obstructions, and an elevator that uses the same.

MEANS FOR SOLVING THE PROBLEM

[0006] A sliding door apparatus according to the present invention includes: a door that opens and closes a doorway by being moved horizontally; a vertically elongated first housing that is disposed on a first vertical frame of a doorway frame; a vertically elongated second housing that is disposed on a second vertical frame of the doorway frame; a first light emitter that is disposed in the first housing, and that includes a vertically long and continuous first light-emitting surface; a second light emitter that is disposed in the second housing, and that includes a vertically long and continuous second light-emitting surface; a first imaging means that is disposed in the first housing, and that captures an image of the second light-emitting surface; a second imaging means that is disposed in the second housing, and that captures an image of the first light-emitting surface; and an image process-

ing portion that determines presence or absence of an object in the doorway based on a signal from the first and second imaging means.

An elevator according to the present invention includes: a car that is raised and lowered inside a hoistway; an elevator door that opens and closes a doorway that is disposed between the car and a landing by being moved horizontally; a vertically elongated first housing that is disposed on a first vertical frame of a doorway frame; a vertically elongated second housing that is disposed on a second vertical frame of the doorway frame; a first light emitter that is disposed in the first housing, and that includes a vertically long and continuous first light-emitting surface; a second light emitter that is disposed in the second housing, and that includes a vertically long and continuous second light-emitting surface; a first imaging means that is disposed in the first housing, and that captures an image of the second light-emitting surface; a second imaging means that is disposed in the second housing, and that captures an image of the first light-emitting surface; an image processing portion that determines presence or absence of an object in the doorway based on a signal from the first and second imaging means; and a car controlling portion that controls opening and closing of the elevator door based on information from the image processing portion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

Figure 1 is a front elevation that shows an elevator car door apparatus according to Embodiment 1 of the present invention from inside a car;

Figure 2 is a block diagram that shows a controlling circuit of the car door apparatus from Figure 1;

Figure 3 is a perspective that shows a second housing from Figure 1;

Figure 4 is a longitudinal cross section of a light emitter chamber of the second housing from Figure 3;

Figure 5 is a longitudinal cross section of an imaging means chamber of the second housing from Figure 3;

Figure 6 is a cross section of the second housing that is taken along Line VI - VI in Figure 5; and

Figure 7 is a cross section of the second housing that is taken along Line VII - VII in Figure 5.

BEST MODE FOR CARRYING OUT THE INVENTION

[0008] A preferred embodiment of the present invention will now be explained with reference to the drawings.

Embodiment 1

[0009] Figure 1 is a front elevation that shows an elevator car door apparatus (a sliding door apparatus) according to Embodiment 1 of the present invention from

inside a car. In the figure, a car doorway 1a is disposed on a car 1 that can be raised and lowered inside a hoistway. The car doorway 1a can be opened and closed by first and second car doors 2a and 2b that function as an elevator door that can be moved horizontally. A car doorway frame 3 is disposed around the car doorway 1a.

[0010] The car doorway frame 3 has: first and second vertical frames 3a and 3b that are disposed to the left and right of the car doorway 1a; an upper portion horizontal frame 3c that is disposed between upper end portions of the first and second vertical frames 3a and 3b; and a lower portion horizontal frame 3d that is disposed on a floor portion of the car doorway 1a. A car control panel (not shown) is disposed on a front surface of the second vertical frame 3b.

[0011] A first housing 4 is mounted to the first vertical frame 3a. A second housing 5 is mounted to the second vertical frame 3b. The first and second housings 4 and 5 have vertically elongated shapes, and are disposed over entire heights of side surfaces of the first and second vertical frames 3a and 3b that face each other. The first and second housings 4 and 5 are installed so as to face the car doorway 1a such that front surfaces thereof are positioned opposite each other. In addition, the front surfaces of the first and second housings 4 and 5 are coplanar with the side surfaces of the first and second housings 4 and 5 so as not to protrude from the side surfaces of the first and second vertical frames 3a and 3b.

[0012] Furthermore, the first and second housings 4 and 5 are disposed so as to be closer to the car doors 2a and 2b than intermediate portions of the vertical frames 3a and 3b in the depth direction of the car doorway 1a. In this example in particular, the first and second housings 4 and 5 are disposed on end portions of the vertical frames 3a and 3b near the car doors 2a and 2b.

[0013] A first light emitter 6 and a first camera 7 that functions as a first imaging means are mounted internally into the first housing 4. A second light emitter 8 and a second camera 9 that functions as a second imaging means are mounted internally into the second housing 5.

[0014] The first light emitter 6 has a vertically long and continuous first light-emitting surface 6a. The second light emitter 8 has a vertically long and continuous second light-emitting surface 8a. The first and second light-emitting surfaces 6a and 8a are disposed over approximately an entire height of the car doorway 1a, and face each other from opposite sides of the car doorway 1a.

[0015] The first camera 7 is disposed in an upper end portion of the first housing 4 (in a vicinity of the upper portion horizontal frame 3c) so as to be adjacent to the upper end portion of the first light-emitting surface 6a, and captures images of the second light-emitting surface 8a. The second camera 9 is disposed in a lower end portion of the second housing 5 (in a vicinity of the lower portion horizontal frame 3d) so as to be adjacent to the lower end portion of the second light-emitting surface 8a, and captures images of the first light-emitting surface 6a.

[0016] Figure 2 is a block diagram that shows a con-

trolling circuit of the car door apparatus from Figure 1. The first light emitter 6, the first camera 7, and a first object sensing controlling portion 11 are accommodated inside the first housing 4. The first object sensing controlling portion 11 controls switching on of the first light emitter 6.

[0017] The first object sensing controlling portion 11 has a first image processing portion 11a. The first image processing portion 11a performs image processing based on image signals that are captured and output by the first camera 7, and determines whether or not an object (an obstruction) is present between the second light emitter 8 and the first camera 7. If it is determined by the first image processing portion 11a that an object is present, the first object sensing controlling portion 11 outputs a detection signal to a car controlling portion 10.

[0018] The second light emitter 8, the second camera 9, and a second object sensing controlling portion 12 are accommodated inside the second housing 5. The second object sensing controlling portion 12 controls switching on of the second light emitter 8.

[0019] The second object sensing controlling portion 12 has a second image processing portion 12a. The second image processing portion 12a performs image processing based on image signals that are captured and output by the second camera 9, and determines whether or not an object is present between the first light emitter 6 and the second camera 9. If it is determined by the second image processing portion 12a that an object is present, the second object sensing controlling portion 12 outputs a detection signal to the car controlling portion 10.

[0020] The first and second object sensing controlling portions 11 and 12 can access the respective timings of the switching on and off of the second and first light emitters 8 and 6 by transmitting and receiving signals to and from each other via the car controlling portion 10.

[0021] An alarm device 13 is disposed on the car control panel. The alarm device 13 is controlled by the car controlling portion 10, and issues warning announcements and warning sounds to the passengers inside the car 1, and performs warning displays, etc.

[0022] The car controlling portion 10 outputs opening and closing commands to an opening and closing controlling portion 14 that controls opening and closing of the car doors 2a and 2b. According to this kind of configuration, the car controlling portion 10 operates the alarm device 13, and controls the opening and closing of the car doors 2a and 2b, etc., in response to detection signals from the object sensing controlling portions 11 and 12.

[0023] Moreover, the car controlling portion 10, the first object sensing controlling portion 11, the second object sensing controlling portion 12, and the opening and closing controlling portion 14 each have microcomputers, and can execute their respective functions based on programs that are stored in the microcomputers.

[0024] Figure 3 is a perspective that shows the second housing 5 from Figure 1. The second housing 5 has: a

housing main body (a structural body) 21 that has an opening on a front surface; and a partitioning plate 22 that is disposed at an intermediate portion in a width direction inside the housing main body 21. An upper portion cap 23 is disposed on an upper end portion of the housing main body 21, and a lower portion cap 24 is disposed on a lower end portion of the housing main body 21.

[0025] The space inside the housing main body 21 is divided by the partitioning plate 22 left and right into two spaces, i.e., a light emitter chamber 21 a and an imaging means chamber 21b. The second light emitter 8 is disposed in the light emitter chamber 21 a. The second camera 9 is disposed in a lower end portion of the imaging means chamber 21 b. The partitioning plate 22 does not transmit the light that the second light emitter 8 emits, and is configured such that light does not leak between the light emitter chamber 21 a and the imaging means chamber 21 b.

[0026] A transmitting diffusing plate 25 that transmits and diffuses light is disposed on a front surface of the light emitter chamber 21a. A front surface opening of the light emitter chamber 21a is covered by the transmitting diffusing plate 25. A semitransparent opalescent resin plate or a transparent resin plate or glass plate in which a surface has been diffusion treated can be used as the transmitting diffusing plate 25, for example. The second light-emitting surface 8a is formed by the transmitting diffusing plate 25.

[0027] A filter cover 26 is disposed on the front surface of the imaging means chamber 21 b. The filter cover 26 transmits light from the first light emitter 6 which is the facing light emitter, and blocks at least a portion of light other than that wavelength of light. In other words, the filter cover 26 functions as an optical filter to block light at wavelengths that are not required for object sensing, and selectively transmit the light from the first light emitter 6. A resin plate or a glass plate can be used as the filter cover 26, for example.

[0028] Figure 4 is a longitudinal cross section of the light emitter chamber 21 a of the second housing 5 from Figure 3, Figure 5 is a longitudinal cross section of the imaging means chamber 21 b of the second housing 5 from Figure 3, Figure 6 is a cross section of the second housing 5 that is taken along Line VI - VI in Figure 5, and Figure 7 is a cross section of the second housing 5 that is taken along Line VII - VII in Figure 5.

[0029] The second light emitter 8 include: a circuit board 27 that is disposed inside the light emitter chamber 21a so as to face the transmitting diffusing plate 25; a plurality of light sources (point light sources) 28 that are mounted to the circuit board 27 so as to be spaced apart from each other vertically; and the transmitting diffusing plate 25. All of the light sources 28 face the transmitting diffusing plate 25 so as to have a predetermined spacing from the transmitting diffusing plate 25.

[0030] Light-emitting diodes, semiconductor lasers, lamps, or electroluminescent elements, for example, can be used as the light sources 28. It is desirable for the

light sources 28 to emit single-frequency visible light or infrared light.

[0031] The second camera 9 is disposed in a lower end portion of the imaging means chamber 21b so as to be inclined obliquely upward. The second object sensing controlling portion 12 is accommodated in a vicinity of the second camera 9 above the second camera 9 inside the imaging means chamber 21 b.

[0032] The construction of the first housing 4 is similar to that of the second housing 5. In the first housing 4, the filter cover 26 transmits light from the second light emitter 8 which is the facing light emitter, and blocks at least a portion of light other than that wavelength of light. In a similar manner to the second light emitter 8, the first light emitter 6 includes a circuit board 27, light sources 28, and a transmitting diffusing plate 25, and is disposed in the light emitter chamber 21a.

[0033] The first camera 7 is disposed in an upper end portion of the imaging means chamber 21 b so as to be inclined obliquely downward. The first object sensing controlling portion 11 is accommodated in a vicinity of the first camera 7 below the first camera 7 inside the imaging means chamber 21 b.

[0034] Next, a method for detecting objects will be explained. First, image data α from the cameras 7 and 9 when the light emitters 6 and 8 are not switched on, and image data β when the light emitters 6 and 8 are switched on are imported into the image processing portions 11a and 12a. Then, a differential image γ is calculated by subtracting the image data α from the image data β . An operation of this kind is repeated whenever executing object monitoring.

[0035] When differential processing of this kind is performed, only an image of the light-emitting surfaces 6a and 8a from which ambient external light has been removed remains in the differential image γ . Consequently, if no object that blocks light is present inside two triangular monitored regions that have the cameras 7 and 9 as apexes and the light-emitting surfaces 6a and 8a as base sides, a single continuous rectilinear light-emitting surface image will remain in the differential image γ .

[0036] In contrast to that, if an object that blocks light is present inside the monitored regions, light-emitting surface images in the differential image γ will be divided plurally and be discontinuous, or the length of the light-emitting surface image will be shorter than normal. If the image processing portions 11a and 12a detect that the light-emitting surface image has become discontinuous or has become shorter or that the light-emitting surface image has disappeared, then they determine that an object is present between the vertical frames 3a and 3b and send a signal to that effect to the car controlling portion 10.

[0037] In an elevator car door apparatus of this kind, because the first light emitter 6 and the first camera 7 are disposed in the common first housing 4, and the second light emitter 8 and the second camera 9 are disposed in the common second housing 5, on-site sensor installation work requires only mounting the housings 4 and 5

onto the vertical frames 3a and 3b, enabling sensor installation work to be facilitated.

[0038] Because the housing main bodies 21 are divided internally into light emitter chambers 21 a and imaging means chambers 21 b by the partitioning plates 22, and the light emitter 6 and 8 and the cameras 7 and 9 are disposed separately, light that is not required by the cameras 7 and 9 is prevented from entering, enabling detecting precision to be improved.

[0039] In addition, because the filter covers 26 are disposed on the front surfaces of the imaging means chambers 21 b, wavelengths of light that are not required by the cameras 7 and 9 are prevented from entering, enabling detecting precision to be improved.

Furthermore, because the first and second object sensing controlling portions 11 and 12 are accommodated in the imaging means chambers 21b, space can be used effectively, and the cameras 7 and 9 and the object sensing controlling portions 11 and 12 are also disposed close to each other, enabling reliability to be improved.

[0040] Moreover, the first and second object sensing controlling portions may also be integrated.

In the above example, objects are detected by light being blocked by an object and a light-emitting surface image being interrupted, or becoming shorter, etc., but are not limited to this method for detecting objects. For example, a time differential image that is a difference between a newest differential image and a differential image from a predetermined amount of time before may also be found, and a determination made as to whether or not a value that is greater than or equal to a predetermined value is present in the time differential image. In such methods, if no object is present, the time differential image has a value of approximately zero over an entire surface. If a moving object is present, portions that are greater than or equal to the predetermined value appear in the time differential image. For this reason, it can be determined that an object is present if there is a portion that is greater than or equal to the predetermined value. Using a method of this kind, dust that has adhered to the light-emitting surfaces 6a and 8a and does not move is excluded, and only moving objects such as passengers, etc., can be detected efficiently.

[0041] In addition, in the above example, a sliding door apparatus that opens to two sides has been explained, but the present invention can also be applied to doors that open to one side, and car doors and landing doors are not limited to a particular number of leaves.

Furthermore, in the above example, the present invention has been applied to an elevator car door apparatus, but can also be applied to landing door apparatuses. A sliding door apparatus according to the present invention can also be applied to a doorway that is disposed in a building, a boarding gate for a passenger vehicle such as a train, etc., or a boarding gate on a train platform, for example.

Claims

1. A sliding door apparatus comprising:

a door that opens and closes a doorway by being moved horizontally;
a vertically elongated first housing that is disposed on a first vertical frame of a doorway frame;
a vertically elongated second housing that is disposed on a second vertical frame of the doorway frame;
a first light emitter that is disposed in the first housing, and that comprises a vertically long and continuous first light-emitting surface;
a second light emitter that is disposed in the second housing, and that comprises a vertically long and continuous second light-emitting surface;
a first imaging means that is disposed in the first housing, and that captures an image of the second light-emitting surface;
a second imaging means that is disposed in the second housing, and that captures an image of the first light-emitting surface; and
an image processing portion that determines presence or absence of an object in the doorway based on a signal from the first and second imaging means.

2. A sliding door apparatus according to Claim 1, wherein:

the first and second housings each comprise:

a housing main body that has an opening on a front surface; and
a partitioning plate that is disposed at an intermediate portion in a width direction inside the housing main body;

the housing main body is divided internally into a light emitter chamber and an imaging means chamber by the partitioning plate;
the first and second light emitters are disposed in the light emitter chambers; and
the first and second imaging means are disposed in the imaging means chambers.

3. A sliding door apparatus according to Claim 2, wherein a filter cover that transmits light from a facing light emitter among the first and second light emitters and that blocks at least a portion of light other than a wavelength of the light is disposed on a front surface of the imaging means chambers.

4. A sliding door apparatus according to Claim 2, wherein the first and second light emitters comprise:

a plurality of light sources that are disposed so as to be spaced apart from each other vertically inside the light emitter chamber; and
 a transmitting diffusing plate that is disposed on a front surface of the light emitter chamber, and that transmits and diffuses light from the light sources.

5. A sliding door apparatus according to Claim 2, wherein:

the image processing portion comprises:

a first image processing portion that processes a signal from the first imaging means; and
 a second image processing portion that processes a signal from the second imaging means; and

the first and second image processing portions are disposed inside the imaging means chambers.

6. An elevator comprising:

a car that is raised and lowered inside a hoistway;
 an elevator door that opens and closes a doorway that is disposed between the car and a landing by being moved horizontally;
 a vertically elongated first housing that is disposed on a first vertical frame of a doorway frame;
 a vertically elongated second housing that is disposed on a second vertical frame of the doorway frame;
 a first light emitter that is disposed in the first housing, and that comprises a vertically long and continuous first light-emitting surface;
 a second light emitter that is disposed in the second housing, and that comprises a vertically long and continuous second light-emitting surface;
 a first imaging means that is disposed in the first housing, and that captures an image of the second light-emitting surface;
 a second imaging means that is disposed in the second housing, and that captures an image of the first light-emitting surface;
 an image processing portion that determines presence or absence of an object in the doorway based on a signal from the first and second imaging means; and
 a car controlling portion that controls opening and closing of the elevator door based on information from the image processing portion.

FIG. 1

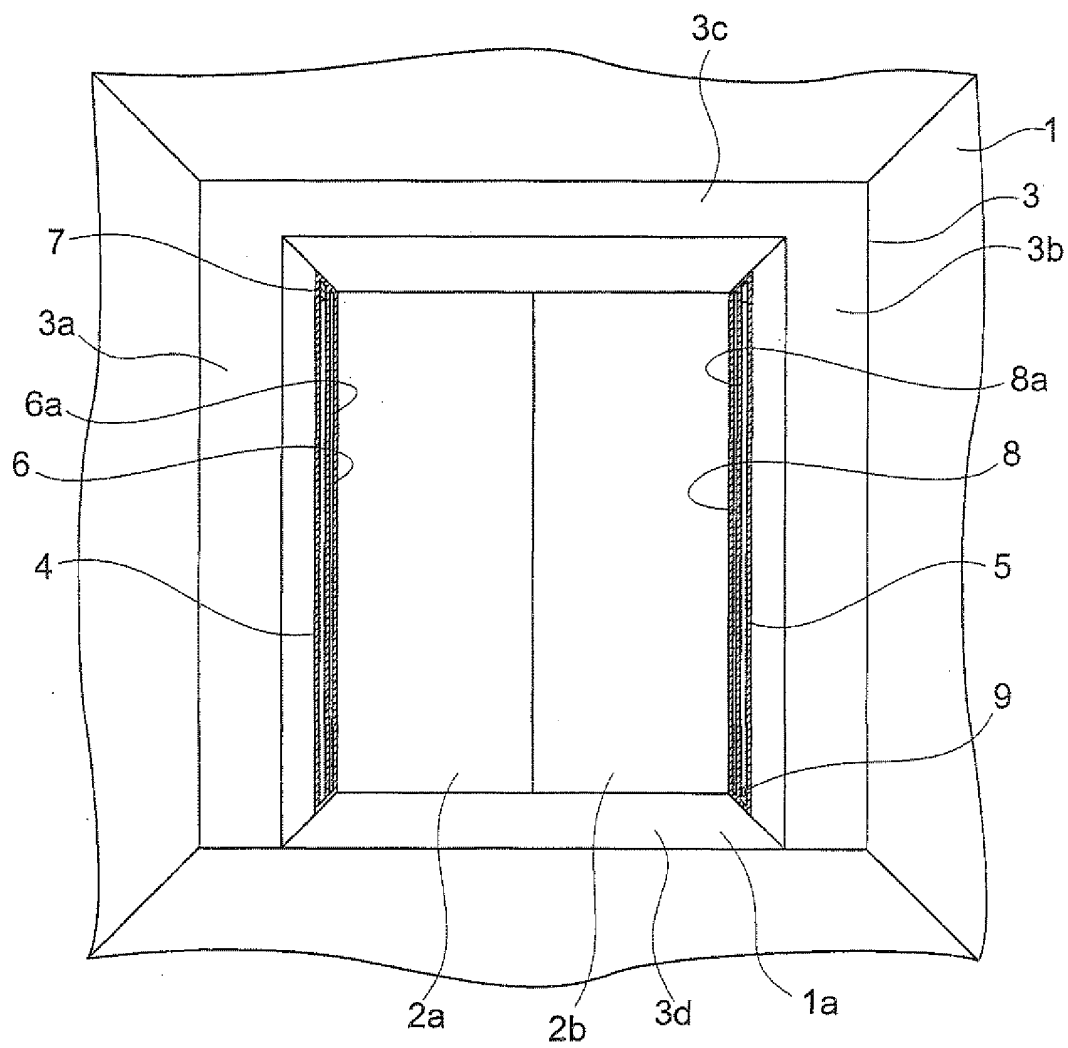


FIG. 2

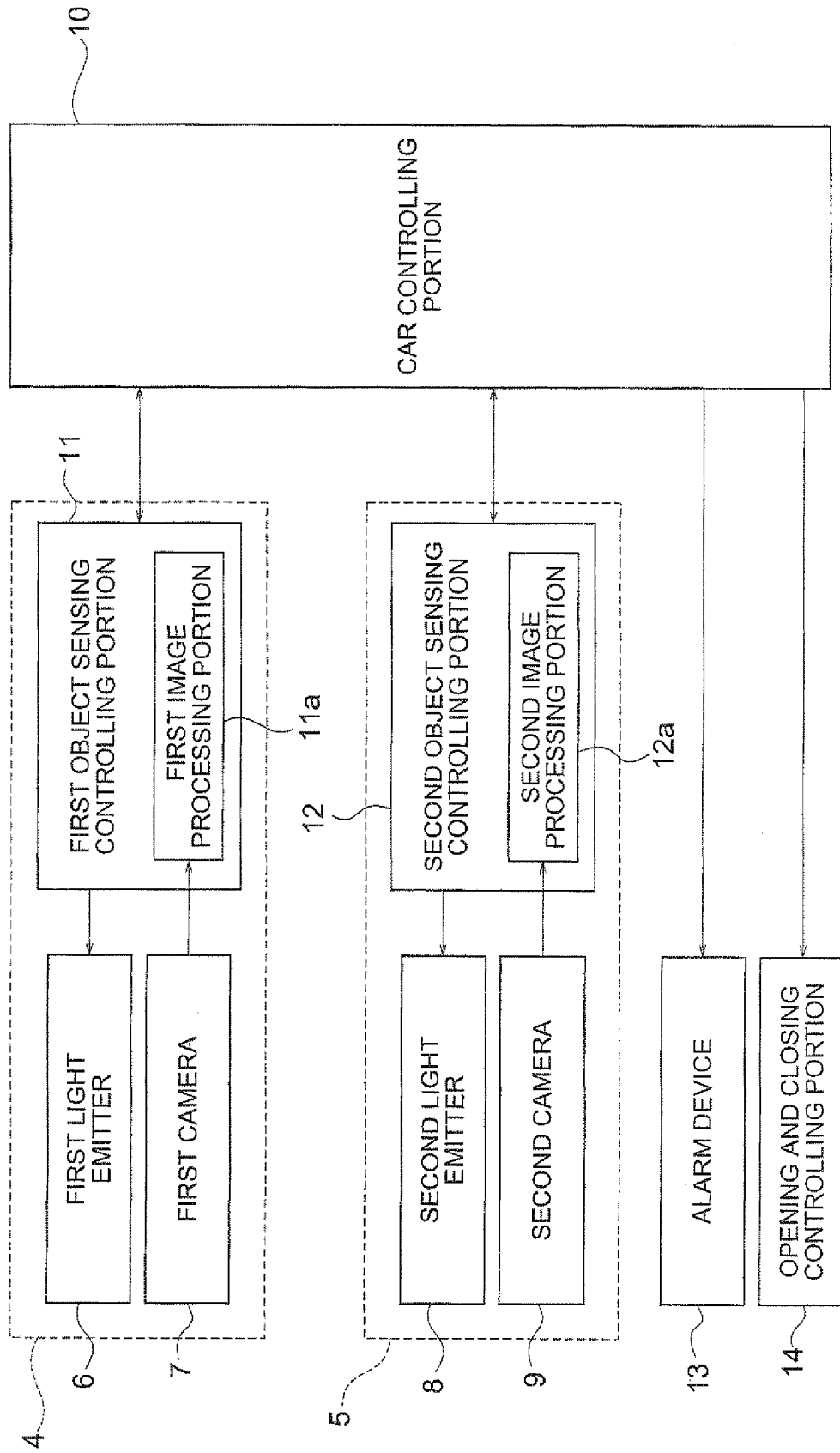


FIG. 3

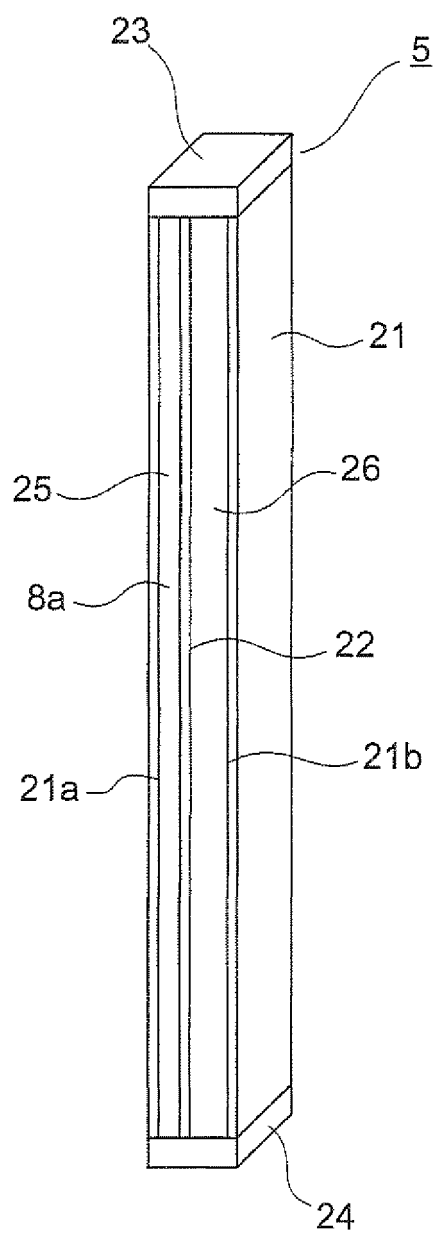


FIG. 4

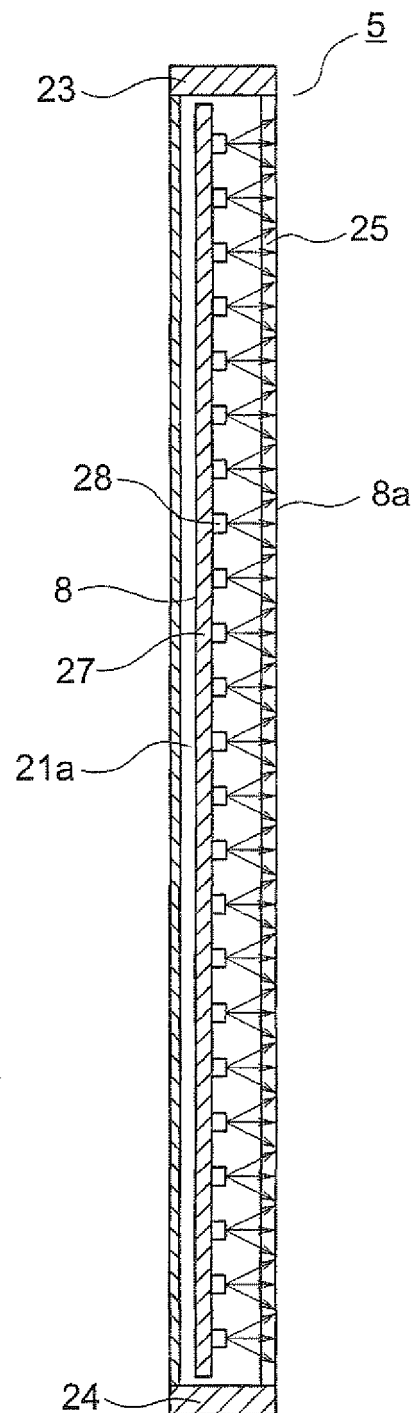


FIG. 5

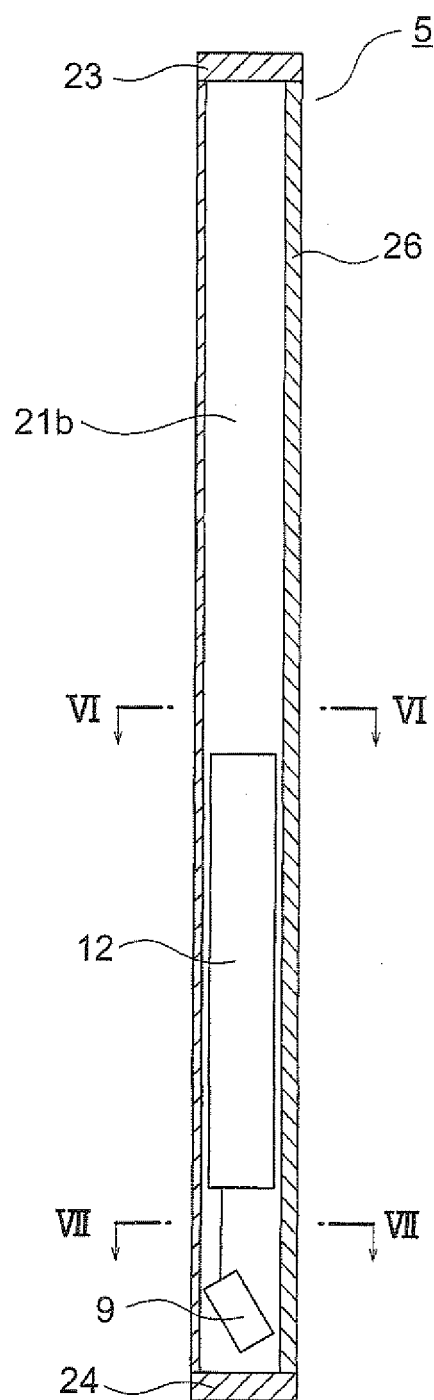


FIG. 6

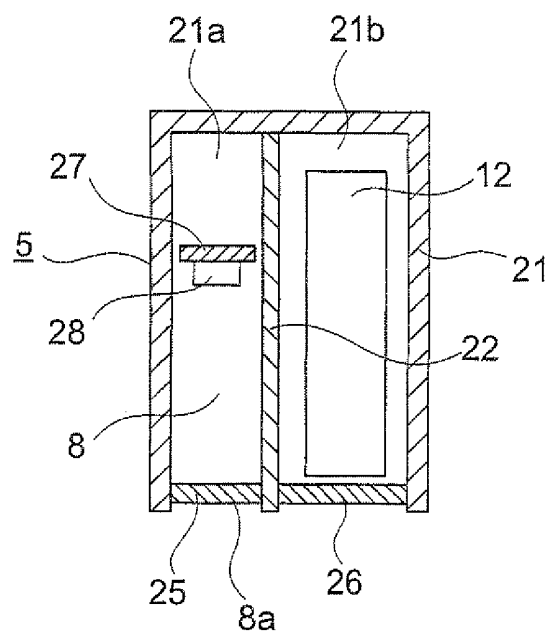
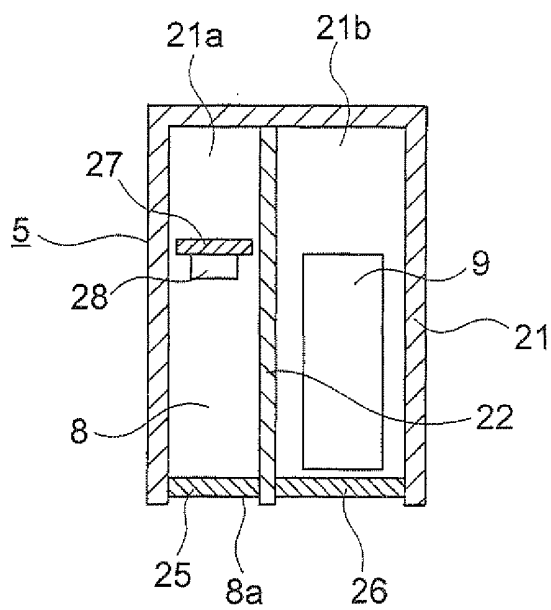


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/073797

A. CLASSIFICATION OF SUBJECT MATTER

B66B13/26 (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)

B66B13/00-B66B13/30

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 1996-2009
 Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

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 2004-338846 A (Mitsubishi Electric Corp.), 02 December, 2004 (02.12.04), Par. Nos. [0007] to [0024], [0027] to [0028]; Figs. 1 to 11, 15 (Family: none)	1, 6 2-5
Y A	JP 2005-194085 A (Mitsubishi Hitachi Home Elevator Corp.), 21 July, 2005 (21.07.05), Par. Nos. [0016] to [0025]; Figs. 1 to 3 (Family: none)	1, 6 2-5
Y A	JP 11-228059 A (Hitachi Building Systems Co., Ltd.), 24 August, 1999 (24.08.99), Par. Nos. [0011] to [0018]; Figs. 1 to 3 (Family: none)	1, 6 2-5

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

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

Date of the actual completion of the international search
30 March, 2009 (30.03.09)Date of mailing of the international search report
07 April, 2009 (07.04.09)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2008/073797

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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REFERENCES CITED IN THE DESCRIPTION

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