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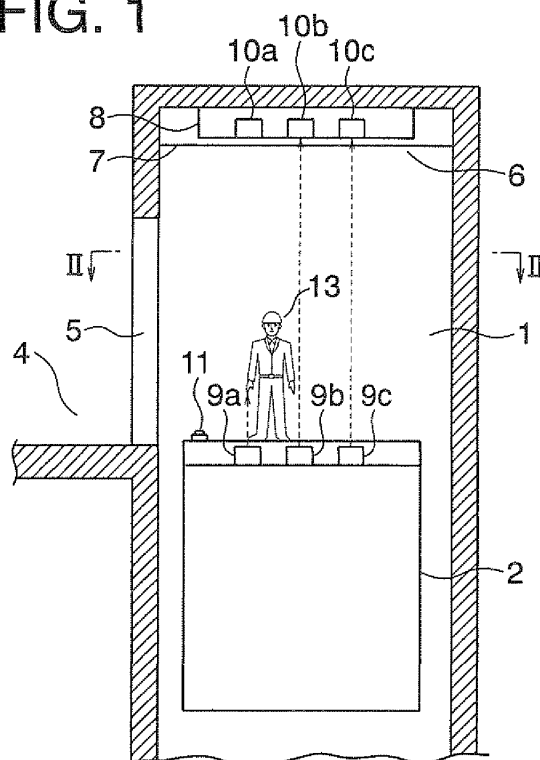
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(54) **ELEVATOR SYSTEM**

(57) A light-emitting device for emitting light is provided to any one of a top of a hoistway and an upper part of a car, and a light-receiving device for receiving the light from the light-emitting device is provided to another one of the top of the hoistway and the upper part of the car. A controller for controlling an operation of an elevator is capable of switching an operation mode of the elevator between a normal operation mode for moving the car at normal speed and an inspection operation mode for moving the car at a speed lower than the normal speed. The controller performs switching from the normal operation mode to the inspection operation mode when detection of light reception by the light-receiving device is stopped.

FIG. 1



Description

Technical Field

[0001] The present invention relates to an elevator apparatus including a car which can be raised and lowered in a hoistway.

Background Art

[0002] Conventionally, there has been proposed a safety device for maintenance of an elevator, including a load weight detecting section for detecting a load weight of a car and a car door passage detecting section for detecting passage through an entrance of an opened car door, for detecting whether or not a maintenance person is present on the car based on information from each of the load weight detecting section and the car door passage detecting section. In the conventional safety device for maintenance of the elevator described above, in the case where the load weight detecting section detects an increase in load weight of the car and, in addition, the car door passage detecting section does not detect the passage, the presence of the maintenance person on the top of the car is detected to inhibit a normal operation of the elevator (see Patent Document 1).

[0003] In addition, there has also conventionally been proposed a safety device provided on a top of an elevator car, including a light-emitting device and a light-receiving device for receiving light from the light-emitting device, the light-emitting device and the light-receiving device being provided on the car, for detecting whether or not a worker is present on the top of the car. On the top of the car, two reflecting mirrors, each for guiding the light emitted from the light-emitting device to the light-receiving device, are provided. One of the reflecting mirrors is located above the light-emitting device, whereas the other reflecting mirror is located above the light-receiving device. The light from the light-emitting device is reflected by one of the reflecting mirrors to horizontally travel above a working area on the car. Thereafter, the light is reflected by the other reflecting mirror to reach the light-receiving device. In the conventional safety device on the top of the elevator car, when the reception of the light by the light-receiving device is stopped, the presence of the worker on the top of the car is detected to issue an alarm and stop the car (see Patent Document 2).

[0004]

Patent Document 1: JP 2004-224542 A

Patent Document 2: JP 2005-96891 A

Disclosure of the Invention

Problems to be solved by the Invention

[0005] In the safety device for maintenance of the elevator, which is described in Patent Document 1, how-

ever, if the maintenance person gets into the car through the entrance of the car door when the operation of the car door passage detecting section is stopped, for example, as in the case of a power failure, the car door passage detecting section does not detect the maintenance person though the maintenance person has actually passed through the entrance of the car door. In this case, when the power comes back, the load weight of the car is increased while the maintenance person is not detected by the car door passage detecting section. Therefore, the presence of the maintenance person on the top of the car is erroneously detected. Therefore, even when the maintenance person is not actually present on the top of the car, there is a fear in that the normal operation of the elevator is erroneously inhibited.

[0006] In the safety device on the top of the elevator car, which is described in Patent Document 2, the direction of the light traveling above the working area on the car is horizontal. Therefore, it is necessary to locate each of the reflecting mirrors at a certain distance above the car in order to detect the maintenance person present on the car. Therefore, a substantial height of the car is increased to disadvantageously increase the overhead dimensions of a hoistway.

[0007] The present invention has been made in order to solve the problems described above, and has an object to obtain an elevator apparatus capable of preventing a height size of a hoistway from being increased and further ensuring the detection of the presence/absence of a maintenance person on a top of a car.

Means for solving the Problems

[0008] An elevator apparatus includes: a car movable in a hoistway; a light-emitting device for emitting light, the light-emitting device being provided to any one of a top of the hoistway and an upper part of the car; a light-receiving device for receiving the light from the light-emitting device, the light-receiving device being provided to another one of the top of the hoistway and the upper part of the car; and a controller capable of switching an operation mode of an elevator between a normal operation mode for moving the car at normal speed and an inspection operation mode for moving the car at a speed lower than the normal speed, the controller performing switching from the normal operation mode to the inspection operation mode when detection of light reception by the light-receiving device is stopped.

Effects of the Invention

[0009] In the elevator apparatus according to the present invention, the light-emitting device is provided to any one of the top of the hoistway and the upper part of the car, whereas the light-receiving device is provided to the other one of the top of the hoistway and the upper part of the car. When the detection of the reception of light by the light-receiving device is stopped, the opera-

tion mode of the elevator is switched by the controller from the normal operation mode to the inspection operation mode. Therefore, when the maintenance person rides on the top of the car, the light from the light-emitting device is blocked by the maintenance person. As a result, the detection of the reception of light by the light-receiving device can be stopped. Therefore, the detection of the presence/absence of the maintenance person on the top of the car can be further ensured. Moreover, it is no longer necessary to cause the light from the light-emitting device to horizontally pass above the car, and hence the members such as the reflecting mirrors provided on the car for the horizontal passage of the light can be eliminated. Thus, the substantial height size of the car can be reduced, thereby preventing the height size of the hoistway from being increased.

Brief Description of the Drawings

[0010]

FIG. 1 is a longitudinal sectional view illustrating an elevator apparatus according to a first embodiment of the present invention.

FIG. 2 is a sectional view taken along the line II-II illustrated in FIG. 1.

FIG. 3 is a longitudinal sectional view illustrating the elevator apparatus according to a second embodiment of the present invention.

FIG. 4 is a longitudinal sectional view illustrating the elevator apparatus according to a third embodiment of the present invention.

FIG. 5 is a horizontal sectional view illustrating the elevator apparatus according to a fourth embodiment of the present invention.

FIG. 6 is a horizontal sectional view illustrating the elevator apparatus according to a fifth embodiment of the present invention.

Best Mode for carrying out the Invention

[0011] Hereinafter, preferred embodiments of the present invention are described referring to the drawings.

First Embodiment

[0012] FIG. 1 is a longitudinal sectional view illustrating an elevator apparatus according to a first embodiment of the present invention. FIG. 2 is a sectional view taken along the line II-II illustrated in FIG. 1. In the drawings, a car 2 and a counterweight 3 which can be vertically moved (raised and lowered) are provided in a hoistway 1. On each floor, a landing entrance 5 for bringing the interior of the hoistway 1 and a landing 4 into communication with each other, and a landing door (not shown) for opening and closing the landing entrance 5 are provided.

[0013] At the top of the hoistway 1, a top unit 6 including

a plurality of devices placed into a unit is provided. The top unit 6 includes a horizontally located mounting frame 7, and a hoisting machine (driving device) 8 and a plurality of driven sheaves (not shown) which are provided on the mounting frame 7. Each of the hoisting machine 8 and the driven sheaves is located at an individually determined position (predetermined position).

[0014] The hoisting machine 8 includes a driving sheave (not shown) rotatably driven about a main shaft of the hoisting machine 8. The hoisting machine 8 is a thin hoisting machine having a size in a direction along the main shaft (axial direction) smaller than its radial size. Further, the hoisting machine 8 is horizontally located so as to cause the direction of the main shaft to be vertical.

[0015] A plurality of main ropes (not shown) are continuously looped around each of the driving sheave and the driven sheaves. The car 2 and the counterweight 3 are suspended by each of the main ropes in the hoistway. The car 2 and the counterweight 3 are moved in the hoistway by the rotation of the driving sheave. Each of the driven sheaves is rotated with the movement of the car 2 and the counterweight 3.

[0016] In an upper part of the car 2, multiple (three in this case) light-emitting devices 9a, 9b, and 9c for emitting light are provided. The light-emitting devices 9a to 9c are located to be horizontally spaced apart from each other. The light-emitting devices 9a to 9c are also embedded in the upper part of the car 2 with their upper parts being exposed. The light is emitted upward from each of the light-emitting devices 9a to 9c along a traveling direction of the car 2. Specifically, the light is emitted from each of the light-emitting devices 9a to 9c toward the top of the hoistway 1.

[0017] At the top of the hoistway 1, multiple (three in this case) light-receiving devices 10a, 10b, and 10c for individually receiving the light emitted from each of the light-emitting devices 9a to 9c are provided. Specifically, at the top of the hoistway 1, the light-receiving devices 10a to 10c which are the same in the number as the light-emitting devices 9a to 9c are provided. The light-receiving devices 10a to 10c are located to be horizontally spaced apart from each other. The light-receiving devices 10a to 10c are arranged in a height direction of the hoistway 1 (traveling direction of car 2) within a dimensional range of the top unit 6. In this case, the light-receiving devices 10a to 10c are mounted to the hoisting machine 8, and are located inside the mounting frame 7. The light-receiving devices 10a to 10c individually detect the presence/absence of the light received respectively from the light-emitting devices 9a to 9c.

[0018] A return switch 11 operable on the top of the car 2 is provided on the car 2. On an inner wall of the hoistway 1, a controller 12 for controlling an operation of the elevator is provided. Information from each of the light-receiving devices 10a to 10c and the return switch 11 is transmitted to the controller 12.

[0019] The operation of the elevator can be switched by the controller 12 between a normal operation mode

for performing a normal operation and an inspection operation mode for performing maintenance and inspection work for the elevator.

[0020] In the normal operation mode, a speed pattern is set by the controller 12 based on a call registration performed by an operation of at least any one of a landing button (not shown) provided at the landing 4 and a destination floor button (not shown) provided in the car 2. The car 2 is moved at normal speed according to the thus set speed pattern.

[0021] In the inspection mode, the car 2 is moved by an operation of a switch for moving the car at low speed (not shown) provided on the top of the car 2. In the inspection operation mode, the car 2 is moved at a speed lower than the speed (normal speed) of the car 2 in the normal operation mode.

[0022] The controller 12 controls the switching from the normal mode to the inspection operation mode based on the information from each of the light-receiving devices 10a to 10c. Specifically, when the detection of the reception of light by at least any one of the light-receiving devices 10a to 10c is stopped, the controller 12 performs the switching from the normal operation mode to the inspection operation mode. Moreover, after the switching from the normal operation mode to the inspection operation mode, the controller 12 inhibits the switching from the inspection operation mode to the normal operation mode in response to the information from each of the light-receiving devices 10a to 10c.

[0023] The controller 12 also controls the switching from the inspection operation mode to the normal operation mode based on information from the return switch 11. Specifically, only when detecting the operation of the return switch 11, the controller 12 performs the switching from the inspection operation mode to the normal operation mode.

[0024] Therefore, once the detection of the reception of light by the light-receiving devices 10a to 10c is stopped to switch the operation mode of the elevator from the normal operation mode to the inspection operation mode, the operation mode of the elevator is not switched to the normal operation mode unless the return switch 11 is operated even if the reception of light is then detected again by all the light-receiving devices 10a to 10c.

[0025] For the maintenance and inspection of the devices provided in the hoistway 1, a maintenance person 13 sometimes rides on the top of the car 2 to perform the maintenance and inspection work. The normal maintenance and inspection are performed for a predetermined device to be maintained, which is installed in the hoistway 1. Therefore, a working position of the maintenance person 13 is determined according to the position of the device to be maintained. As the predetermined device to be maintained, for example, the hoisting machine 8, the controller 12, and the like are given.

[0026] On the car 2, a predetermined working area within which the maintenance person 13 can move for the maintenance and inspection is set. Within the prede-

termined working area, a maintenance space for the device to be maintained is ensured. The maintenance person 13 performs the maintenance and inspection work for the device to be maintained within the maintenance space. The position of the maintenance space for the device to be maintained is set based on the position of the device to be maintained.

[0027] Each of the light-emitting devices 9a to 9c is located with priority within the maintenance space for the device to be maintained. Specifically, the horizontal position of each of the light-emitting devices 9a to 9c is set based on the position of the device to be maintained.

[0028] FIG. 2 illustrates a maintenance space 14 for the controller 12 corresponding to the device to be maintained. The maintenance space 14 for the controller 12 is a space on the car 2, which neighbors the controller 12, in a vertical plane of projection of the hoistway 1. The light-emitting device 9a corresponding to one of the light-emitting devices 9a to 9c is located within the maintenance space 14 for the controller 12. The other light-emitting devices 9b and 9c are located in maintenance spaces for other devices to be maintained (for example, hoisting machine 8 and the like) which are different from the controller 12.

[0029] Next, an operation is described. When the operation mode of the elevator is the normal operation mode, the car 2 is moved at normal speed. At this time, the reception of the light emitted from each of the light-emitting devices 9a to 9c is detected by the light-receiving devices 10a to 10c, respectively. As a result, the normal operation mode is kept.

[0030] For the maintenance and inspection work of the elevator, the maintenance person 13 passes through the landing entrance 5 from the landing 4 to ride on the top of the car 2. As a result, the light from at least any one of the light-emitting devices 9a to 9c is blocked by the maintenance person 13. Consequently, the detection of the reception of light by at least any one of the light-receiving devices 10a to 10c is stopped.

[0031] When the reception of light by at least any one of the light-receiving devices 10a to 10c is stopped, the operation mode of the elevator is switched from the normal operation mode to the inspection operation mode by the control of the controller 12. As a result, the operation of the elevator is switched by the operation of the switch for moving the car at low speed, which is provided on the top of the car 2, to an inspection operation for moving the car 2 at low speed.

[0032] Even when the light is received again by all the light-receiving devices 10a to 10c after the reception of the light by at least any one of the light-receiving devices 10a to 10c is stopped, the inspection operation mode is kept as the operation mode of the elevator. Specifically, the operation mode of the elevator is kept regardless of the information from each of the light-receiving devices 10a to 10c. Therefore, the operation mode of the elevator is not switched from the inspection operation mode to the normal operation mode in response to the information

from each of the light-receiving devices 10a to 10c.

[0033] For returning the operation mode of the elevator back to the normal operation mode, the return switch 11 is operated by the maintenance person 13. As a result, the operation mode of the elevator is switched from the inspection operation mode to the normal operation mode.

[0034] In the elevator apparatus as described above, the light-emitting devices 9a to 9c are provided in the upper part of the car 2, whereas the light-receiving devices 10a to 10c are provided at the top of the hoistway 1. When the detection of the reception of light by any of the light-receiving devices 10a to 10c is stopped, the operation mode of the elevator is switched by the controller 12 from the normal operation mode to the inspection operation mode. Therefore, when the maintenance person 13 rides on the top of the car 2, the light from at least any one of the light-emitting devices 9a to 9c is blocked by the maintenance person 13. In this manner, the detection of the reception of light by at least any one of the light-receiving devices 10a to 10c can be stopped. As a result, the detection of the presence/absence of the maintenance person 13 on the top of the car 2 can be further ensured. Thus, even without a conscious operation for switching the operation mode to the inspection operation mode, which is performed by the maintenance person 13, the ride of the maintenance person 13 on the top of the car 2 is sufficient to enable the switching of the operation mode to the inspection operation mode. As a result, even when the maintenance person 13 forgets to perform the switching operation, the switching from the normal operation mode to the inspection operation mode can be further ensured.

[0035] Moreover, it is no longer necessary to cause the light from each of the light-emitting devices 9a to 9c to pass horizontally above the car 2, and hence the members such as the reflecting mirrors provided on the car 2 for the horizontal passage of the light can be eliminated. Therefore, the substantial height size of the car 2 can be reduced, resulting in prevention of an increase in height size of the hoistway 1.

[0036] Moreover, the multiple light-emitting devices 9a to 9c are located to be horizontally spaced apart from each other, whereas the multiple light-receiving devices 10a to 10c are located to be horizontally spaced apart from each other. Therefore, the presence/absence of the maintenance person 13 can be detected at a plurality of positions on the top of the car 2, thereby further ensuring the detection of the presence/absence of the maintenance person 13 on the top of the car 2.

[0037] The respective horizontal positions of the light-emitting devices 9a to 9c are set based on the positions of the predetermined devices to be maintained, which are provided in the hoistway 1. Therefore, the presence/absence of the maintenance person 13 can be detected at the position with a high possibility of the presence of the maintenance person 13 for the maintenance and inspection. As a result, the detection of the presence/absence of the maintenance person 13 on the top of the

car 2 can be further ensured.

[0038] Further, the controller 12 performs the switching from the inspection operation mode to the normal operation mode only when the operation of the return switch 11 provided on the top of the car 2 is detected, and hence the inspection operation mode can be prevented from being accidentally switched to the normal operation mode against the will of the maintenance person 13.

[0039] The top unit 6 including the hoisting machine 8 is provided at the top of the hoistway 1. The light-receiving devices 10a to 10c are provided within the range of the top unit 6 in the height direction of the hoistway 1. Therefore, each of the light-receiving devices 10a to 10c can be prevented from projecting downward beyond the top unit 6. As a result, the height size of the hoistway 1 can be further prevented from being increased.

[0040] While each of the light-emitting devices 9a to 9c is provided in the upper part of the car 2 and each of the light-receiving devices 10a to 10c is provided at the top of the hoistway 1 in the above-mentioned example, each of the light-receiving devices 10a to 10c may be provided in the upper part of the car 2 and the light-emitting devices 9a to 9c may be provided at the top of the hoistway 1.

[0041] Further, each of the light-emitting devices 9a to 9c may also be replaced by a transmitter for infrared communication, whereas each of the light-receiving devices 10a to 10c may be replaced by a receiver for infrared communication. Specifically, the light from each of the light-emitting devices 9a to 9c is made to be an infrared ray, and the control information transmitted between the car 2 and the controller 12 may be contained in the light from each of the light-emitting devices 9a to 9c. In this case, the control information is transmitted from each of the light-emitting devices 9a to 9c to each of the light-receiving devices 10a to 10c. As the control information, when each of the light-emitting devices 9a to 9c is provided in the upper part of the car 2, information of the call registration or the like is given, for example. When each of the light-emitting devices 9a to 9c is provided at the top of the hoistway 1, information of the position of the car 2 or the like is given, for example.

[0042] Normally, the transmission of the control information between the car 2 and the controller 12 is performed through a control cable (traveling cable) which is suspended in the hoistway 1 to move with the car 2. Therefore, the control information is contained in the light from each of the light-emitting devices 9a to 9c. As a result, the control cable can be partially eliminated. As a result, the control cable can be reduced in weight, thereby lowering the cost of the control cable.

Second Embodiment

[0043] FIG. 3 is a longitudinal sectional view illustrating the elevator apparatus according to a second embodiment of the present invention. In the drawing, at the top

of the hoistway 1, a CCD camera (image recognition device) 21 is provided as the light-receiving device. The CCD camera 21 is capable of detecting the light from each of the light-emitting devices 9a to 9c as an image. In this manner, the light from each of the light-emitting devices 9a to 9c is detected by the same CCD camera 21. The image information detected by the CCD camera 21 is transmitted to the controller 12. In this example, the CCD camera 21 is provided to the hoisting machine 8.

[0044] The controller 12 controls the switching from the normal operation mode to the inspection operation mode based on the image information from the CCD camera 21. Specifically, the controller 12 compares the image information from the CCD camera 21 and set reference information, which is preset, to control the switching from the normal operation mode to the inspection operation mode. The set reference information is image information when the light from the respective light-emitting devices 9a to 9c are all detected by the CCD camera 21 (specifically, the light from each of the light-emitting devices 9a to 9c to the CCD camera 21 is not blocked). When the image information from the CCD camera 21 does not match the set reference information to result in the stop of the detection of the light from at least any one of the light-emitting devices 9a to 9c, the controller 12 performs the switching from the normal operation mode to the inspection operation mode. The other structure is the same as that described in the first embodiment.

[0045] In the elevator device described above, the CCD camera 21 capable of detecting as the image the light from each of the light-emitting devices 9a to 9c is used as the light-receiving device. Therefore, the detection of the light from each of the light-emitting devices 9a to 9c can be further ensured, thereby further ensuring the detection of the presence/absence of the maintenance person 13 on the top of the car 2.

[0046] Note that, in the example described above, each of the light-emitting devices 9a to 9c is provided in the upper part of the car 2 and the CCD camera 21 is provided at the top of the hoistway 1. However, the CCD camera 21 may be provided in the upper part of the car 2, whereas each of the light-emitting devices 9a to 9c may be provided at the top of the hoistway 1.

Third Embodiment

[0047] FIG. 4 is a longitudinal sectional view illustrating the elevator apparatus according to a third embodiment of the present invention. In the drawing, a light-emitting device 31 is provided in the upper part of the car 2. The light-emitting device 31 includes a line light source for linearly emitting light to the CCD camera 21. The line light source of the light-emitting device 31 extends horizontally. As the line light source of the light-emitting device 31, for example, a plurality of LEDs arranged in a linearly continuous manner or the like can be given. The line light source may be either linear or curvilinear.

[0048] The CCD camera 21 is capable of detecting the

light from the light-emitting device 31 as the image. The image information detected by the CCD camera 21 is transmitted to the controller 12.

[0049] The controller 12 compares the image information from the CCD camera 21 and the set reference information, which is preset, to control the switching from the normal operation mode to the inspection operation mode. The set reference information is image information when the light from all parts of the line light source (specifically, the entire line light source) of the light-emitting device 31 is detected by the CCD camera 21 (specifically, the light from the entire line light source to the CCD camera 21 is not blocked). When the image information from the CCD camera 21 does not match the set reference information to result in the stop of the detection of the light from at least a part of the line light source of the light-emitting device 31, the controller 12 performs the switching from the normal operation mode to the inspection operation mode. The other structure is the same as that described in the second embodiment.

[0050] In the elevator apparatus as described above, the light-emitting device 31 has the line light source for linearly emitting the light to the CCD camera 21. Therefore, the range of light emission by the light-emitting device 31 can be continuous. As a result, the detection of the presence/absence of the maintenance person 31 on the top of the car 2 can be further ensured.

[0051] Note that, in the above-mentioned example, the light source of the light-emitting device 31 is the line light source. However, a surface light source for emitting light in a planar manner to the CCD camera 21 may also be the light source of the light-emitting device. In this case, the light-emitting device is provided within a predetermined range of the upper part of the car 2. For the controller 12, the image information when the light from all the parts of the surface light source (specifically, the entire surface light source) of the light-emitting device is detected by the CCD camera 21 is set as the set reference information. In this manner, the range where the light emission by the light-emitting device is continuous can be further increased, thereby further ensuring the detection of the presence/absence of the maintenance person 13 on the top of the car 2.

Fourth Embodiment

[0052] FIG. 5 is a horizontal sectional view illustrating the elevator apparatus according to a fourth embodiment of the present invention. In the drawing, a light-emitting device 41 including a line light source is horizontally provided in the upper part of the car 2. The light-emitting device 41 is provided on the side of the predetermined working area within the area of the car 2 to be closer to the landing entrance 5 in the vertical plane of projection of the hoistway 1. The line light source of the light-emitting device 41 is arranged along a width direction of the landing entrance 5. Further, the line light source of the light-emitting device 41 is arranged over the entire landing

entrance 5 in the width direction of the landing entrance 5. In this example, a length of the line light source of the light-emitting device 41 is set longer than a width dimension of the landing entrance 5. Specifically, the line light source of the light-emitting device 41 is provided between the landing entrance 5 and the predetermined working area on the car 2 in the vertical plane of projection of the hoistway 1. The other structure is the same as that described in the third embodiment.

[0053] In the elevator apparatus as described above, the line light source of the light-emitting device 41 is provided between the landing entrance 5 and the predetermined working area on the car 2 in the vertical plane of projection of the hoistway 1. Therefore, the maintenance person 13 moving between the landing entrance 5 and the top of the car 2 can be detected. As a result, the detection of the presence/absence of the maintenance person 13 on the top of the car 2 can be further ensured.

Fifth Embodiment

[0054] FIG. 6 is a horizontal sectional view illustrating the elevator apparatus according to a fifth embodiment of the present invention. In the drawing, multiple (two in this example) light-emitting devices 51 and 52 are provided in the upper part of the car 2. Each of the light-emitting devices 51 and 52 includes a line light source for linearly emitting the light to the CCD camera 21. Each of the light-emitting devices 51 and 52 is provided within the maintenance space 14 for the controller 12. Further, the line light source of each of the light-emitting devices 51 and 52 is provided along a width direction of the controller 12. Specifically, the horizontal position of each of the light-emitting devices 51 and 52 is set based on the position of the controller 12 corresponding to the device to be maintained. Moreover, the light-emitting devices 51 and 52 are provided to be horizontally spaced apart from each other. Though not shown, the light-emitting devices 51 and 52 are also provided within the maintenance space for the device to be maintained which is different from the controller 12. The other structure is the same as that described in the fourth embodiment.

[0055] In the elevator apparatus as described above, each of the plurality of the light-emitting devices 51 and 52 includes the line light source, and the horizontal position of each of the light-emitting devices 51 and 52 is set based on the position of the controller 12. Therefore, the presence/absence of the maintenance person 13 can be detected at the position with a high possibility of the presence of the maintenance person 13 during the maintenance and inspection. As a result, the detection of the presence/absence of the maintenance person 13 on the top of the car 2 can be further ensured. Moreover, the range of the light emission by the light-emitting devices 51 and 52 can be made continuous, and hence the detection of the presence/absence of the maintenance person 13 on the top of the car 2 can be further ensured.

[0056] While the light source of each of the light-emitting

devices 51 and 52 is the line light source in the example described above, the surface light source for emitting the light in a planar manner to the CCD camera 21 may be used as the light source of the light-emitting device. In this case, the image information when the light from all the parts of the surface light source of the light-emitting device (specifically, entire surface light source) is detected by the CCD camera 21 is set as the set reference information for the controller 12. In this manner, the range where the light emission by the light-emitting devices is continuous can be further increased, thereby further ensuring the detection of the presence/absence of the maintenance person 13 on the top of the car 2.

[0057] While the number of the CCD camera 21 is one in the second to fifth embodiments, the number of the CCD camera 21 may also be plural.

Claims

1. An elevator apparatus comprising:

a car movable in a hoistway;
a light-emitting device for emitting light, the light-emitting device being provided to any one of a top of the hoistway and an upper part of the car;
a light-receiving device for receiving the light from the light-emitting device, the light-receiving device being provided to another one of the top of the hoistway and the upper part of the car; and
a controller capable of switching an operation mode of an elevator between a normal operation mode for moving the car at normal speed and an inspection operation mode for moving the car at a speed lower than the normal speed, the controller performing switching from the normal operation mode to the inspection operation mode when detection of light reception by the light-receiving device is stopped.

2. An elevator apparatus according to Claim 1,

wherein a plurality of the light-emitting devices are located to be horizontally spaced apart from each other and a plurality of the light-receiving devices are located to be horizontally spaced apart from each other, and
wherein the controller performs the switching from the normal operation mode to the inspection operation mode when the detection of the light reception by at least any one of the light-receiving devices is stopped.

3. An elevator apparatus according to Claim 1, wherein a horizontal position of one of the light-emitting device and the light-receiving device, the one being provided in the upper part of the car, is set based on a position of a predetermined device to be main-

tained which is provided in the hoistway.

4. An elevator apparatus according to Claim 1, further comprising a return switch provided to the car, the return switch being operable on the car, wherein the controller performs switching from the inspection operation mode to the normal operation mode only when the controller detects an operation of the return switch.

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5. An elevator apparatus according to Claim 1, further comprising a top unit including a driving device for raising and lowering the car, the top unit being provided at the top of the hoistway, wherein one of the light-emitting device and the light-receiving device, the one being provided at the top of the hoistway, is located within a range of the top unit in a height direction of the hoistway.

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6. An elevator apparatus according to Claim 1, wherein the light from the light-emitting device contains control information to be transmitted between the car and the controller.

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7. An elevator apparatus according to Claim 1, wherein the light-receiving device is an image recognition device capable of detecting the light from the light-emitting device as an image.

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8. An elevator apparatus according to Claim 7, wherein the light-emitting device includes a line light source for linearly emitting light to the light-receiving device.

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9. An elevator apparatus according to Claim 7, wherein the light-emitting device includes a surface light source for emitting light to the light-receiving device in a planar manner.

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10. An elevator apparatus according to Claim 8 or 9, wherein the light-emitting device is provided in the upper part of the car and the light-receiving device is provided at the top of the hoistway, and wherein the light-emitting device has a length of covering a landing entrance for bringing the hoistway and a landing into communication with each other and a predetermined working area on the car in a vertical plane of projection of the hoistway.

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FIG. 1

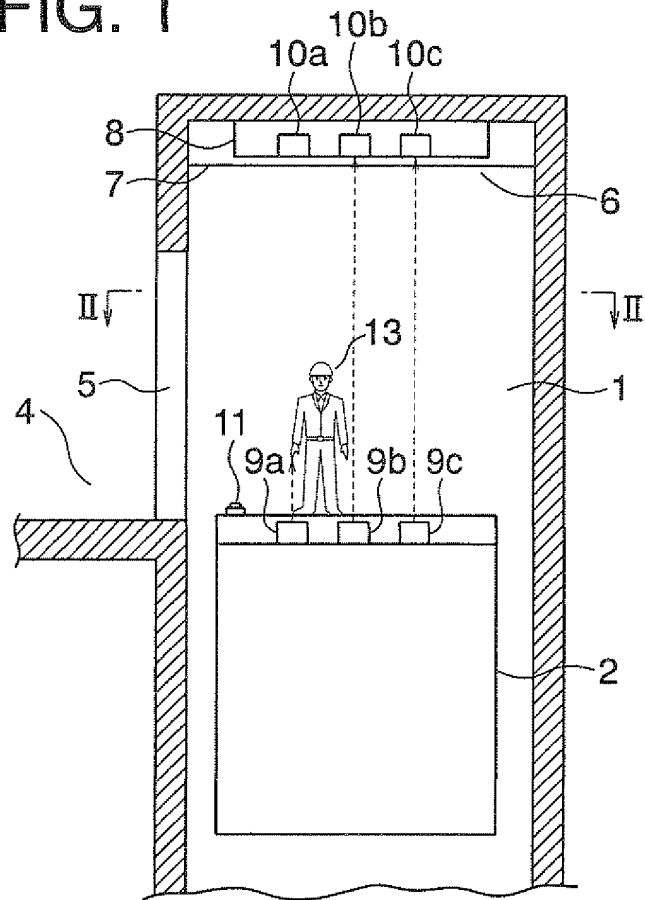


FIG. 2

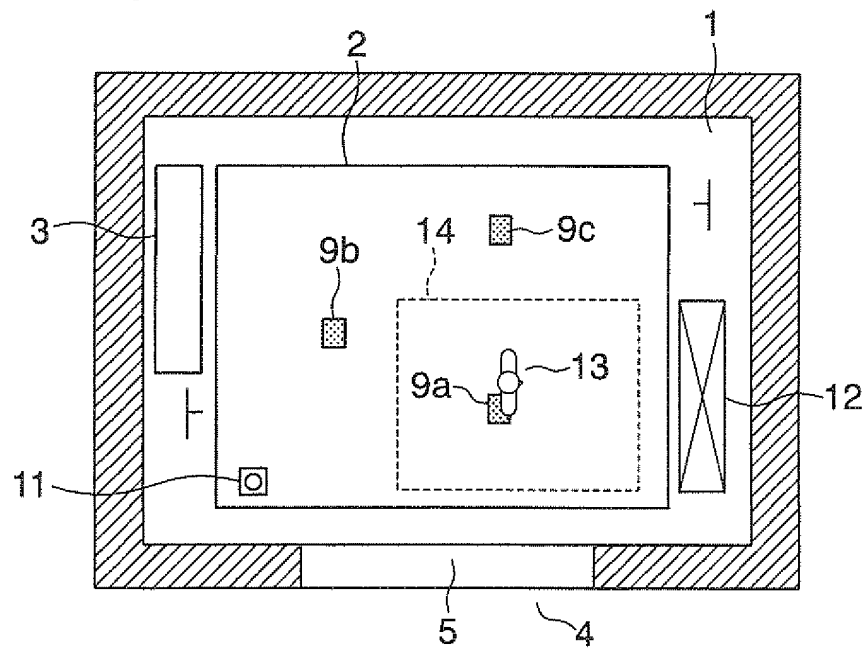


FIG. 3

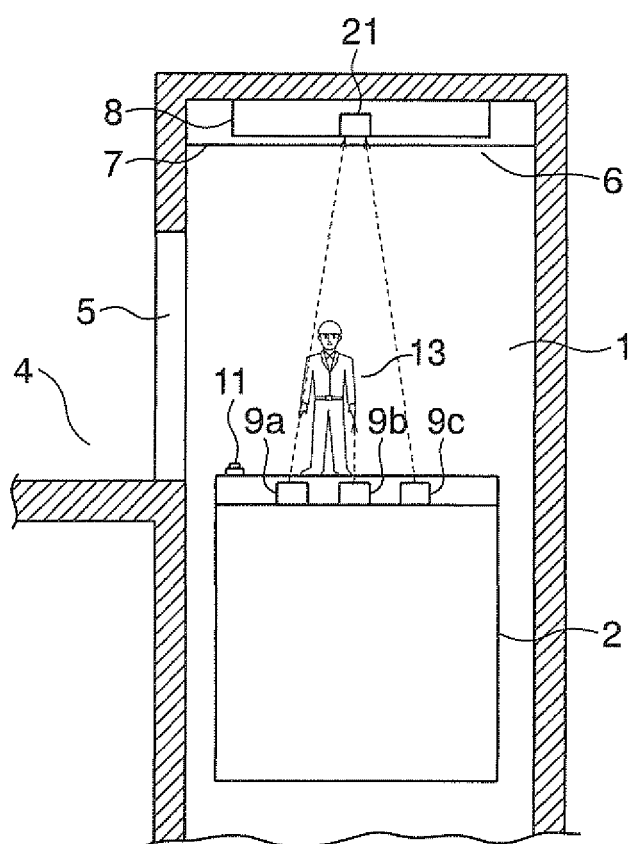


FIG. 4

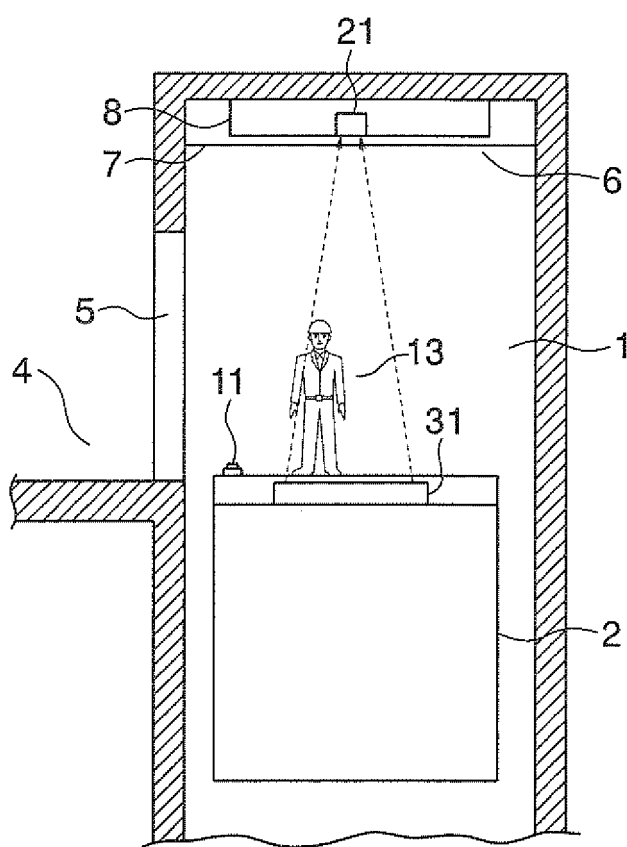


FIG. 5

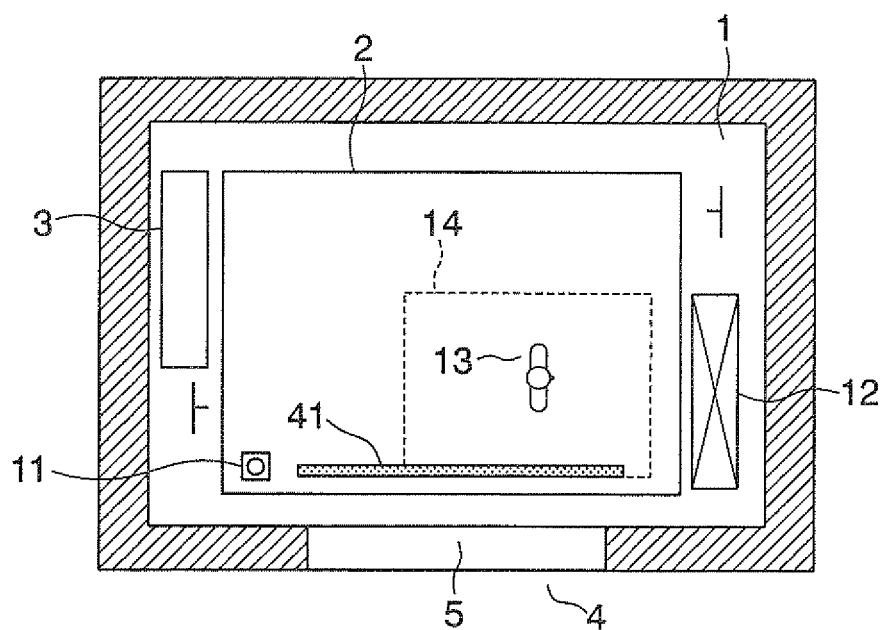
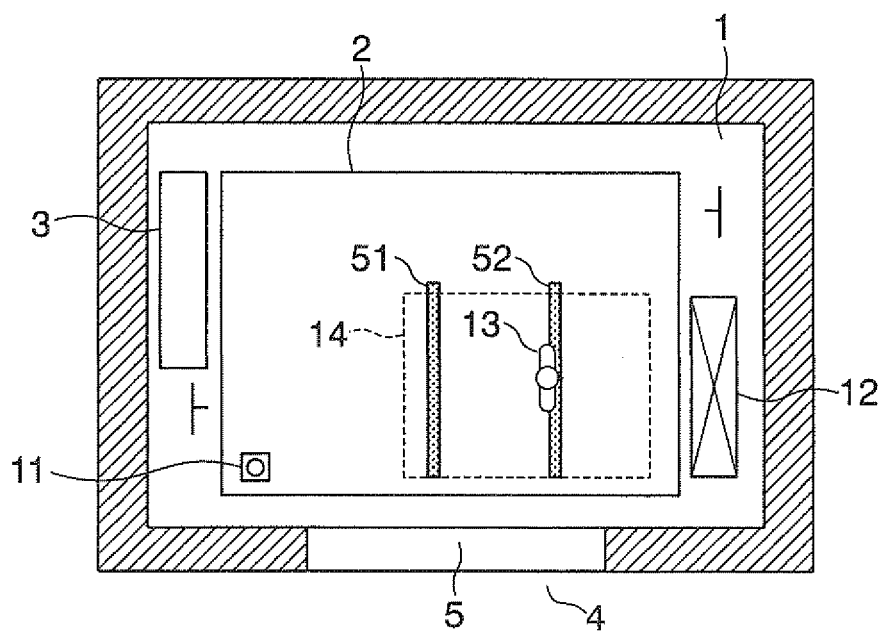


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/322095

A. CLASSIFICATION OF SUBJECT MATTER

B66B5/00(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)

B66B1/00-B66B20/00

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.
A	JP 06-286960 A (Mitsubishi Electric Corp.), 11 October, 1994 (11.10.94), Par. No. [0038]; Fig. 11 (Family: none)	1, 10
A	JP 53-121678 A (Mitsubishi Electric Corp.), 24 October, 1978 (24.10.78), Claims; drawings (Family: none)	1

☒ 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
13 July, 2007 (13.07.07)Date of mailing of the international search report
24 July, 2007 (24.07.07)Name and mailing address of the ISA/
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/322095

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 183393/1987 (Laid-open No. 088686/1989) (Mitsubishi Electric Corp.), 12 June, 1989 (12.06.89), Claims; Fig. 1 (Family: none)	1
A	JP 2003-212448 A (Hitachi Building Systems Co., Ltd.), 30 July, 2003 (30.07.03), Abstract (Family: none)	1, 10
A	JP 2005-193995 A (Mitsubishi Electric Corp.), 21 July, 2005 (21.07.05), Claims 1 to 2 (Family: none)	2, 10
A	JP 62-096285 A (Toshiba Corp.), 02 May, 1987 (02.05.87), Page 2, lower left column, line 13 to page 3, lower left column, line 9; Figs. 2 to 3 (Family: none)	1, 3-4, 10
A	JP 2001-080835 A (Otis Elevator Co.), 27 March, 2001 (27.03.01), Par. No. [0011]; Fig. 1 & US 6202797 B1 & FR 2797860 A1 & CN 1286207 A	1, 4
A	JP 2005-096878 A (Mitsubishi Electric Corp.), 14 April, 2005 (14.04.05), Par. No. [0009]; Fig. 2 (Family: none)	3, 6, 10
A	JP 2004-196428 A (Hitachi, Ltd.), 15 July, 2004 (15.07.04), Par. No. [0019]; Fig. 6 (Family: none)	7-9

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Patent documents cited in the description

- JP 2004224542 A [0004]
- JP 2005096891 A [0004]