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

(11) **EP 1 939 126 A1**

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

(43) Date of publication:
02.07.2008 Bulletin 2008/27

(21) Application number: **05795845.6**

(22) Date of filing: **20.10.2005**

(51) Int Cl.:
B66B 13/14 *(2006.01)* ***B66B 3/00*** *(2006.01)*
B66B 13/08 *(2006.01)*

(86) International application number:
PCT/JP2005/019303

(87) International publication number:
WO 2007/046149 (26.04.2007 Gazette 2007/17)

(84) Designated Contracting States:
DE

(71) Applicant: **MITSUBISHI DENKI KABUSHIKI KAISHA**
Chiyoda-ku, Tokyo 100-8310 (JP)

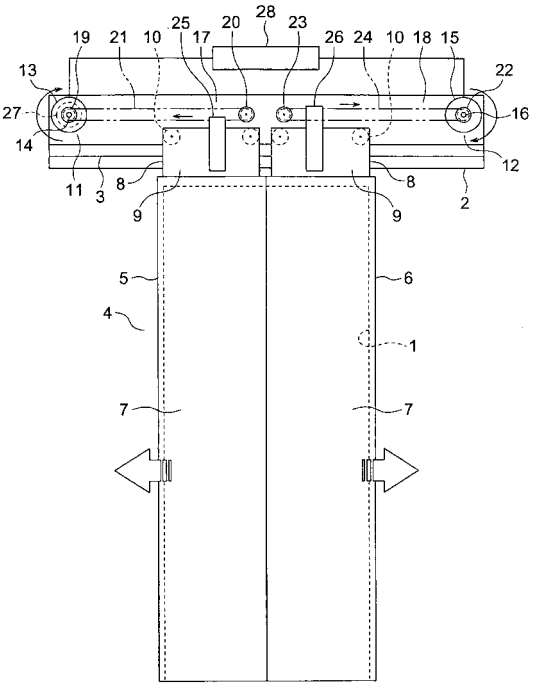
(72) Inventors:
- **KOIZUMI, Yoshihiko**
  Chiyoda-ku, Tokyo 1008310 (JP)
- **FUJIKI, Takeshi**
  Chiyoda-ku, Tokyo 1008310 (JP)

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

(54) DOOR DEVICE FOR ELEVATOR

(57) A door device for an elevator includes: an elevator door having first and second doors; first and second door driving devices having first and second rotary shafts, respectively; a first power transmission mechanism for moving the first door in response to rotation of the first rotary shaft; a second power transmission mechanism for moving the second door in response to rotation of the second rotary shaft; a position detector for generating a signal corresponding to the rotation of the first rotary shaft; and a door control device for controlling the second door driving device based on information from the position detector such that the rotation of the second rotary shaft follows the rotation of the first rotary shaft. With this structure, movement speeds of the first and second doors are synchronized according to information from the single position detector.

FIG. 1



EP 1 939 126 A1

Description

Technical Field

[0001] The present invention relates to a door device for an elevator, which serves to open/close an elevator doorway.

Background Art

[0002] Conventionally, in view for the sake of a reduction in size, a door device for an elevator having an outer-rotor-type motor disposed inside one of a pair of pulleys has been proposed. A belt is wound between the pair of the pulleys. A door for opening/closing a doorway is coupled to the belt. When the one of the pulleys is rotated due to a driving force of the motor, the belt is orbitally moved, so the other pulley is rotated as well. Thus, the door is displaced to open/close the doorway (see Patent Document 1).

[0003] Patent Document 1: JP 2001-226058 A

Disclosure of the Invention

Problems to be solved by the Invention

[0004] However, in the conventional door device for an elevator, the door is displaced due to the driving force of the single motor, so the motor itself is large in size. Even if the respective pulleys are rotated independently of each other due to driving forces of two motors, a distance between the respective pulleys is increased when, for example, the doorway has a large width. Therefore, tensile force applied to the belt is increased as well. Thus, not only the life of the belt cannot be prolonged, but also the burdens on rotary shafts, bearings, and the like of the respective pulleys are increased. As a result, the motors cannot be substantially reduced in size either. In addition, when the dimension of the belt becomes too long, a standard-sized belt cannot be applied, so a dedicated-sized belt needs to be manufactured. As a result, the cost of manufacturing is increased as well.

[0005] The present invention has been made to solve the above-mentionedproblems, and it is therefore an object of the present invention to obtain a door device for an elevator which makes it possible to prevent an increase in cost of manufacturing while achieving a reduction in size and a prolongation of life.

Means for solving the Problem

[0006] A door device for an elevator according to the present invention includes: an elevator door having a first door and a second door that are movable in a direction of a frontage of an elevator doorway, for closing the elevator doorway through movements of the first door and the second door into abutment on each other and opening the elevator doorway through movements of the first door and the second door out of abutment on each other; a first door driving device having a first driving device main body and a first rotary shaft that is rotated due to a driving force of the first driving device main body; a first power transmission mechanism to which only the first door of the first door and the second door is coupled, for moving the first door in response to rotation of the first rotary shaft; a second door driving device having a second driving device main body and a second rotary shaft that is rotated due to a driving force of the second driving device main body; a second power transmission mechanism to which only the second door of the first door and the second door is coupled, for moving the second door in response to rotation of the second rotary shaft; a position detector for generating a signal corresponding to the rotation of the first rotary shaft; and a door control device for controlling the second door driving device based on information from the position detector such that the rotation of the second rotary shaft follows the rotation of the first rotary shaft.

Brief Description of the Drawings

[0007]

Fig. 1 is a front view showing a door device for an elevator according to Embodiment 1 of the present invention.
Fig. 2 is a front view showing another example of the door device for an elevator shown in Fig. 1.
Fig. 3 is a front view showing a door device for an elevator according to Embodiment 2 of the present invention.
Fig. 4 is a plan view showing a part of the door device for an elevator of Fig. 3.
Fig. 5 is a front view showing a door device for an elevator according to Embodiment 3 of the present invention.
Fig. 6 is a flowchart showing the operation of the door device for an elevator shown in Fig. 5.
Fig. 7 is a flowchart showing another example of the operation of the door device for an elevator shown in Fig. 5.

Best Mode 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 front view showing a door device for an elevator according to Embodiment 1 of the present invention. In Fig. 1, a car (not shown) is provided with a car doorway (elevator doorway) 1. A hanger case 2, which is provided above the car doorway 1, is fixed to the car.

[0010] A hanger rail (support rail) 3 extending in a direction of a frontage of the car doorway 1 is fixed to the hanger case 2. An elevator door 4 for opening/closing the car doorway 1 is suspended from the hanger rail 3.

[0011] The elevator door 4 has a first door 5 and a second door 6, which are movable in the direction of the frontage of the car doorway 1. The first door 5 and the second door 6 are provided side by side in the direction of the frontage of the car doorway 1. The car doorway 1 is closed when the first door 5 and the second door 6 abut against each other. The car doorway 1 is opened when the abutment of the first door 5 and the second door 6 is released.

[0012] The first door 5 is movable between a first door door-closed position where the first door 5 can abut against the second door 6, and a first door door-open position located on a door opening side (a side in which the car doorway 1 is opened) with respect to the first door door-closed position. The second door 6 is movable between a second door door-closed position where the second door 6 can abut against the first door 5, and a second door door-open position located on a door opening side (a side in which the car doorway 1 is opened) with respect to the second door door-closed position.

[0013] The car doorway 1 is fully closed when the first door 5 is at the first door door-closed position and the second door 6 is at the second door door-closed position. The car doorway 1 is fully opened when the first door 5 is at the first door door-open position and the second door 6 is at the second door door-open position.

[0014] Each of the first door 5 and the second door 6 is also designed as a panel door having a door panel 7, which is used to open/close the car doorway 1, and a roller hanger 8, which is provided on an upper portion of the door panel 7, and can move along the hanger rail 3.

[0015] Each of the hanger rollers 8 has a hanger plate 9 fixed to the upper portion of one of the door panels 7, and a plurality of rollers 10 provided to the hanger plate 9 to be rolled on the hanger rail 3 in accordance with the movement of each one of the first door 5 and the second door 6.

[0016] The hanger case 2 is provided with a first door driving device 11 and a second door driving device 12, which are disposed apart from each other in the direction of the frontage of the car doorway 1. In this example, the first door driving device 11 is provided to one end of the hanger case 2, and the second door driving device 12 is provided to the other end of the hanger case 2.

[0017] The first door driving device 11 has a first driving device main body 13 including a motor, and a first rotary shaft 14 that is rotated due to a driving force of the first driving device main body 13. The second door driving device 12 has a second driving device main body 15 including a motor, and a second rotary shaft 16 that is rotated due to a driving force of the second driving device main body 15.

[0018] In addition, the hanger case 2 is provided with a first power transmission mechanism 17 for moving the first door 5 in response to rotation of the first rotary shaft 14, and a second power transmission mechanism 18 for moving the second door 6 in response to rotation of the second rotary shaft 16. The first power transmission mechanism 17 and the second power transmission mechanism 18 are disposed side by side in the direction of the frontage of the car doorway 1.

[0019] The first power transmission mechanism 17 has a first driving pulley 19 fixed to the first rotary shaft 14, a first driven pulley 20 provided to an inner side than the first driving pulley 19 in the direction of the frontage of the car doorway 1, and a first transmission strip body 21 of an endless type wound between the first driving pulley 19 and the first driven pulley 20.

[0020] The first transmission strip body 21 is orbitally moved through rotation of the first driving pulley 19. The first driven pulley 20 is rotated through the orbital movement of the first transmission strip body 21.

[0021] The first door 5 is coupled to the first transmission strip body 21 via a coupling member 25 so as to be moved in the direction of the frontage of the car doorway 1 through the orbital movement of the first transmission strip body 21. Thus, the first door 5 is moved between the first door door-open position and the first door door-closed position in accordance with the rotation of the first driving pulley 19.

[0022] The second power transmission mechanism 18 has a second driving pulley 22 fixed to the second rotary shaft 16, a second driven pulley 23 provided to an inner side than the second driving pulley 22 in the direction of the frontage of the car doorway 1, and a second transmission strip body 24 of an endless type wound between the second driving pulley 22 and the second driven pulley 23.

[0023] The second transmission strip body 24 is orbitally moved through rotation of the second driving pulley 22. The second driven pulley 23 is rotated through the orbital movement of the second transmission strip body 24.

[0024] The second door 6 is coupled to the second transmission strip body 24 via a coupling member 26 so as to be moved in the direction of the frontage of the car doorway 1 through the orbital movement of the second transmission strip body 24. Thus, the second door 6 is moved between the second door door-open position and the second door door-closed position in accordance with rotation of the second driving pulley 22. Examples of the first transmission strip body 21 and the second transmission strip body 24 include timing belts (synchronous belts), wires, or the like.

[0025] That is, of the first door 5 and the second door 6, only the first door 5 is coupled to the first power transmission mechanism 17, and only the second door 6 is coupled to the second power transmission mechanism 18. In addition, in the direction of the frontage of the car doorway 1, the first power transmission mechanism 17 has a minimum required dimension for moving the first door 5 between the first door door-closed position and

the first door door-open position. Further, in the direction of the frontage of the car doorway 1, the second power transmission mechanism 18 has a minimum required dimension for moving the second door 6 between the second door door-closed position and the second door door-open position.

[0026] The first door driving device 11 is provided with an encoder (position detector) 27 for generating a signal (pulse signal) corresponding to the rotation of the first rotary shaft 14. The car is mounted with a door control device 28 for controlling the first door driving device 11 and the second door driving device 12. When an opening/closing command is input from an operation control device (not shown) installed within a hoistway, the door control device 28 drives the first door driving device 11 and the second door driving device 12 to open/close the car doorway 1.

[0027] The door control device 28 controls the first door driving device 11 based on the opening/closing command from the operation control device. Thus, the rotation of the first rotary shaft 14 is controlled by the door control device 28. The door control device 28 also controls the second door driving device 12 based on information from the encoder 27, such that the rotation of the second rotary shaft 16 follows the rotation of the first rotary shaft 14. Thus, the first door 5 and the second door 6 are moved in opposite directions in synchronization with each other.

[0028] Note that the door control device 28 is constituted by a computer having a calculation processing portion (CPU), a storage portion (ROM, RAM, or the like), and a signal input/output portion. The function of the door control device 28 is realized by the computer constituting the door control device 28.

[0029] Next, an operation will be described. A signal corresponding to the rotation of the first rotary shaft 14 is transmitted from the encoder 27 to the door control device 28. When an opening/closing command from the operation control device is input to the door control device 28, the door control device 28 performs control to drive the first door driving device 11 and the second door driving device 12. At this moment, the rotation of the second rotary shaft 16 is controlled by the door control device 28 based on information from the encoder 27. Thus, the second rotary shaft 16 is rotated in accordance with the rotation of the first rotary shaft 14.

[0030] When the first rotary shaft 14 is rotated, the first transmission strip body 21 is orbitally moved. Thus, the first door 5 is moved in the direction of the frontage of the car doorway 1. In addition, when the second rotary shaft 16 is rotated, the second transmission strip body 24 is orbitally moved. Thus, the second door 6 is moved in the direction of the frontage of the car doorway

1. The second rotary shaft 16 is rotated in accordance with the rotation of the first rotary shaft 14, so the first door 5 and the second door 6 are moved in synchronization with each other. As a result, the car doorway 1 is opened/closed.

[0031] In the door device for an elevator as described above, the first power transmission mechanism 17 moves the first door 5 in response to the rotation of the first rotary shaft 14, and the second power transmission mechanism 18 moves the second door 6 in response to the rotation of the second rotary shaft 16. Therefore, the first power transmission mechanism 17 and the second power transmissionmechanism 18 can be disposed side by side in the direction of the frontage of the car doorway 1, and the respective dimensions of the first power transmission mechanism 17 and the second power transmission mechanism 18 can be reduced with respect to the dimension of the frontage of the car doorway 1. Thus, the lengths of the first transmission strip body 21 and the second transmission strip body 24 can be reduced when the first transmission strip body 21 and the second transmission strip body 24 are designed to be moved together with the first door 5 and the second door 6 in the first power transmission mechanism 17 and the second power transmission mechanism 18, respectively. As the first transmission strip body 21 and the second transmission strip body 24 standard components can be employed even when the dimension of the frontage of the car doorway 1 is too large. In consequence, the cost of manufacturing can be prevented from increasing.

[0032] In addition, the lengths of the first transmission strip body 21 and the second transmission strip body 24 can be reduced, so the tensile forces applied to the first transmission strip body 21 and the second transmission strip body 24 can be reduced as well. Thus, the lives of the first transmission strip body 21 and the second transmission strip body 24 can be prolonged, and the first door driving device 11 and the second door driving device 12, which receive the tensile forces applied to the first transmission strip body 21 and the second transmission strip body 24, respectively, can be reduced in size as well.

[0033] Further, the second rotary shaft 16 is controlled by the door control device 28 so as to be rotated in accordance with the rotation of the first rotary shaft 14, so the first door 5 and the second door 6 can be moved in synchronization with each other. In addition, there is no need to provide the second door driving device 12 with an encoder for measuring the rotation of the second rotary shaft 16, so the number of components can be reduced. As a result, the cost of manufacturing can further be reduced.

[0034] Note that in the foregoing example, each of the first door 5 and the second door 6 is assumed to be a single panel door. However, each of the first door 5 and the second door 6 may have a plurality of panel doors.

[0035] That is, Fig. 2 is a front view showing another example of the door device for an elevator shown in Fig. 1. In Fig. 2, each of the first door 5 and the second door 6 has a high-speed door (panel door) 31 and a low-speed door (panel door) 32. The low-speed door 32 is displaced with respect to the high-speed door 31 in accordance

with the movement of the high-speed door 31. Each one of the high-speed doors 31 and the low-speed doors 32 has the door panel 7 and the roller hanger 8.

[0036] A first displacement mechanism 33 for displacing the low-speed door 32 with respect to the high-speed door 31 is provided on the upper portion of the first door 5. A second displacement mechanism 34 for displacing the low-speed door 32 with respect to the high-speed door 31 is provided on the upper portion of the second door 6.

[0037] Each of the first displacement mechanism 33 and the second displacement mechanism 34 has a pair of displacement pulleys 35 and 36 provided to both ends of a horizontal bar fixed to the low-speed door 32, and a displacement strip body 37 of an endless type wound between the respective displacement pulleys 35 and 36.

[0038] The high-speed door 31 and the low-speed door 32 are connected to the displacement strip body 37. The displacement strip body 37 is orbitally moved through the movement of the high-speed door 31. The low-speed door 32 is displaced with respect to the high-speed door 31 oppositely to a moving direction thereof through the orbital movement of the displacement strip body 37. That is, the high-speed door 31 and the low-speed door 32 are connected to the displacement strip body 37 so as to be moved in opposite directions through the orbital movement of the displacement strip body 37. Other constructions are identical to those of the foregoing example.

[0039] As described above, the respective dimensions of the first power transmission mechanism 17 and the second power transmission mechanism 18 can be reduced even when each of the first door 5 and the second door 6 has the plurality of panel doors. Therefore, an effect similar to that of the foregoing example can be achieved.

Embodiment 2

[0040] Fig. 3 is a front view showing a door device for an elevator according to Embodiment 2 of the present invention. In addition, Fig. 4 is a plan view showing a part of the door device for an elevator of Fig. 3. In the figures, an interlock mechanism 41 for synchronizing the moving speed of the first door 5 with the moving speed of the second door 6 is provided between the first power transmission mechanism 17 and the second power transmission mechanism 18.

[0041] The interlock mechanism 41 has a first interlock pulley 42 that is rotated integrally with the first driven pulley 20, a second interlock pulley 43 that is rotated integrally with the second driven pulley 23, and an interlock strip body 44 of an endless type wound between the first interlock pulley 42 and the second interlock pulley 43.

[0042] The first interlock pulley 42 is provided coaxially with the first driven pulley 20, and the second interlock pulley 43 is provided coaxially with the second driven pulley 23. The interlock strip body 44 is orbitally moved through rotation of the first interlock pulley 42 and rotation of the second interlock pulley 43. Employed as the interlock strip body 44 is, for example, a timing belt (cogged belt), or a wire. Other constructions are identical to those of Embodiment 1.

[0043] In the door device for an elevator constructed as described above, the interlock mechanism 41 is provided between the first power transmission mechanism 17 and the second power transmission mechanism 18, so the first power transmission mechanism 17 and the second power transmission mechanism 18 can be mechanically interlocked with each other. As a result, the moving speed of the first door 5 and the moving speed of the second door 6 can be more reliably synchronized with each other.

[0044] Note that in each of the foregoing examples, the first door driving device 11 and the second door driving device 12 are disposed at both the ends of the car doorway 1 in the direction of the frontage thereof, respectively. However, the position of the first door driving device 11 and the first driving pulley 19 may be changed with the position of the first driven pulley 20, and the position of the second door driving device 12 and the second driving pulley 22 may be changed with the position of the second driven pulley 23. In the case where the position of the first door driving device 11 is changed, the first interlock pulley 42 is provided coaxially with the first driving pulley 19. In the case where the position of the second door driving device 12 is changed, the second interlock pulley 43 is provided coaxially with the second driving pulley 22.

Embodiment 3

[0045] Fig. 5 is a front view showing a door device for an elevator according to Embodiment 3 of the present invention. In Fig. 5, the encoder 27 for generating a signal according to the rotation of the first rotary shaft 14 is provided as a first position detector to the first door driving device 11. An encoder 51 for generating a signal according to the rotation of the second rotary shaft 16 is provided as a second position detector to the second door driving device 12.

[0046] Information from the encoder 27 and information from the encoder 51 are input to the door control device 28. The door control device 28 has a first door control portion 52 for controlling the first door driving device 11 based on the information from the encoder 27, and a second door control portion 53 for controlling the second door driving device 12 based on the information from the encoder 51. That is, the door control device 28 has the first door control portion 52 and the second door control portion 53 which independently control the first door driving device 11 and the second door driving device 12, respectively.

[0047] The car is provided with a car passenger load detecting device 54 for measuring a passenger load within the car. A weighing device for measuring the total weight of passengers within the car as a passenger load

within the car, an image processing device for measuring the area of a heat source generated by passengers within the car as a passenger load within the car, or the like can be employed as the car passenger load detecting device 54.

[0048] In a case where the image processing device is adopted as the car passenger load detecting device 54, temperature distribution within the car at the time when the inside of the car is empty (when there is no passenger on board) is recognized in advance as an image in the image processing device. When a passenger gets on the car, a great change is caused, with respect to the temperature distribution recognized in advance as an image, only in a region corresponding to the passenger being the heat source. Thus, the image processing device measures current temperature distribution within the car, and compares the measured temperature distribution within the car with the temperature distribution recognized in advance as an image to calculate the area of the heat source generated by the passenger.

[0049] A landing is provided with a landing passenger load detecting device 55 for measuring a passenger load at the landing. A pressure sensing mat laid within a predetermined region of a floor of the landing (e.g., within a region located in front of a landing doorway) to measure a quantity corresponding to a pressure sensed upon the boarding of passengers as a passenger load at the landing, an image processing device for measuring an area of a heat source within a predetermined range in the landing (e.g., within the range of a space located in front of the landing doorway) as a passenger load at the landing in the same manner as the aforementioned image processing device, or the like can be employed as the landing passenger load detecting device 55.

[0050] A car reference value to be compared with the passenger load within the car which is obtained from the car passenger load detecting device 54, and a landing reference value to be compared with the passenger load at the landing which is obtained from the landing passenger load detecting device 55 are set in advance in the door control device 28.

[0051] In addition, the door control device 28 controls the first door driving device 11 and the second door driving device 12 to move only one of the first door 5 and the second door 6 when the passenger load within the car is equal to or smaller than the car reference value and the passenger load at the landing is equal to or smaller than the landing reference value. The door control device 28 controls the first door driving device 11 and the second door driving device 12 to move both the first door 5 and the second door 6 at least one of when the passenger load within the car is larger than the car reference value and when the passenger load at the landing is larger than the landing reference value.

[0052] That is, the door control device 28 determines whether to move each of the first door 5 and the second door 6 or not in opening/closing the elevator doorway, based on the passenger load within the car and the passenger load at the landing.

[0053] Next, an operation will be described. Fig. 6 is a flowchart showing the operation of the door device for an elevator shown in Fig. 5. As shown in Fig. 6, when the operation of the elevator is activated (the movement of the car is started) (S1), a passenger load $\alpha 1$ within the car is measured by the car passenger load detecting device 54 (S2), and information on the passenger load $\alpha 1$ within the car is transmitted to the door control device 28. A passenger load $\alpha 2$ at the landing of a destination floor where a registration of a call for the car has been made is measured by the landing passenger load detecting device 55 (S3), and information on the passenger load $\alpha 2$ at the landing is transmitted to the door control device 28.

[0054] After receiving the passenger load $\alpha 1$ within the car and the passenger load $\alpha 2$ at the landing, the door control device 28 determines whether or not the passenger load $\alpha 1$ within the car is equal to or smaller than a car reference value $\beta 1$ set in advance (S4) . When the passenger load $\alpha 1$ within the car is larger than the car reference value $\beta 1$, the number of users within the car is considered to be large, so the door control device 28 drives both the first door driving device 11 and the second door driving device 12 upon stoppage of the car at the destination floor. Thus, both the first door 5 and the second door 6 are moved in respective door opening directions (S5).

[0055] When the passenger load $\alpha 1$ within the car is equal to or smaller than the car reference value $\beta 1$, in the door control device 28, the number of users within the car is considered to be small, and it is determined whether or not the passenger load $\alpha 2$ at the landing is equal to or smaller than a landing reference value $\beta 2$ set in advance (S6). When the passenger load $\alpha 2$ at the landing is larger than the landing reference value $\beta 2$, the number of users at the landing is considered to be large, so the door control device 28 drives both the first door driving device 11 and the second door driving device 12 upon stoppage of the car at the destination floor, as in the case where the passenger load $\alpha 1$ within the car is larger than the car reference value $\beta 1$. Thus, both the first door 5 and the second door 6 are moved in the respective door opening directions (S5) .

[0056] When the passenger load $\alpha 2$ at the landing is equal to or smaller than the landing reference value $\beta 2$, not only the number of users within the car but also the number of users at the landing are considered to be small, so the door control device 28 performs control to drive only one of the first door driving device 11 and the second door driving device 12. Thus, only one of the first door 5 and the second door 6 is moved in the door opening direction (S7) .

[0057] In the door device for an elevator constructed as described above as well, the first power transmission mechanism 17 moves the first door 5 in response to the rotation of the first rotary shaft 14, and the second power transmission mechanism 18 moves the second door 6 in

response to the rotation of the second rotary shaft 16. Therefore, as in the case of the foregoing Embodiment 1 of the present invention, the first power transmission mechanism 17 and the second power transmission mechanism 18 can be reduced in size, the lives thereof can be prolonged, and the cost of manufacturing can be prevented from increasing.

[0058] In addition, the door control device 28 has the first door control portion 52 for controlling the first door driving device 11 and the second door control portion 53 for controlling the second door driving device 12 so as to independently control the first door driving device 11 and the second door driving device 12, respectively. Therefore, the operations of opening/closing the elevator doorway can be performed in accordance with the situation in which the elevator is used.

[0059] For example, in an office building or the like, a large number of users flock to an elevator at clock-in time in the morning, at clock-out time in the evening, and at lunchtime. The time zones in which a large number of users flock to the elevator are limited, and the number of users of the elevator may be small during off-peak periods other than the above-mentioned time zones. Considering the installation of an elevator, however, the width of an elevator doorway is determined on the basis of the peak number of users of the elevator, so the elevator is designed to have an exaggerated specification for the number of users during the off-peak periods. Accordingly, when, for example, the number of passengers getting on and off the car is small and there is hence no need to fully open the elevator doorway during a door opening operation, only one of the first door 5 and the second door 6 can be moved in the door opening direction. Therefore, the amount of energy consumption can be reduced, and the saving of energy can be achieved.

[0060] The door control device 28, in which the car reference value to be compared with the passenger load within the car is set in advance, moves, based on information from the car passenger load detecting device 54, only one of the first door 5 and the second door 6 when the passenger load within the car is equal to or smaller than the car reference value. Therefore, the operations of opening/closing the elevator doorway can be performed in accordance with the situation of use within the car. Thus, the saving of energy can be achieved.

[0061] The door control device 28, in which the landing reference value to be compared with the passenger load at the landing is set in advance, moves, based on information from the landing passenger load detecting device 55, only one of the first door 5 and the second door 6 when the passenger load at the landing is equal to or smaller than the landing reference value. Therefore, the elevator doorway can be opened/closed in accordance with the situation in which the landing is used. In this manner as well, the saving of energy can be achieved.

[0062] In each of the foregoing examples, the door control device 28 controls only the movements of the first door 5 and the second door 6 in opening/closing the elevator doorway. However, reporting devices for reporting whether or not each of the first door 5 and the second door 6 is to be moved in opening/closing the elevator doorway may be provided within the car and at the landing, respectively. In this case, the reporting devices are controlled by the door control device 28. As the reporting devices, for example, light emitters provided to a pair of vertical pillars of the elevator doorway, respectively, display devices for displaying characters and charts, or speakers for generating a sound can be employed.

[0063] In the case where the light emitters are adopted as the reporting devices, each of the light emitters, which is disposed beside a corresponding one of the doors 5 and 6, emits light only when that door is to be moved in opening/closing the elevator doorway. In the case where the display devices are adopted as the reporting devices, the display devices display the contents of an operation of specifying whether or not each of the doors 5 and 6 is to be moved in opening/closing the elevator doorway. In the case where the speakers are adopted as the reporting devices, the speakers report the contents of an operation thereof as a sound.

[0064] That is, Fig. 7 is a flowchart showing another example of the operation of the door device for an elevator shown in Fig. 5. As shown in Fig. 7, the same procedure as in the foregoing example is performed until the passenger load $\alpha 1$ within the car and the passenger load $\alpha 2$ at the landing are transmitted to the door control device 28 after activation of the elevator.

[0065] After receiving the passenger load $\alpha 1$ within the car and the passenger load $\alpha 2$ at the landing, the door control device 28 determines whether or not the passenger load $\alpha 1$ within the car is equal to or smaller than the car reference value $\beta 1$ (S4). When the passenger load $\alpha 1$ within the car is larger than the car reference value $\beta 1$, the number of users within the car is considered to be large, and the reporting devices report to the inside of the car and the landing that both the first door 5 and the second door 6 are to be moved in the respective door opening directions, upon stoppage of the car at the destination floor (S11).

[0066] After that, the door control device 28 performs control to drive both the first door driving device 11 and the second door driving device 12, so both the first door 5 and the second door 6 are moved in the respective door opening directions (S5).

[0067] When the passenger load $\alpha 1$ within the car is equal to or smaller than the car reference value $\beta 1$, in the door control device 28, the number of users within the car is considered to be small, and it is determined whether or not the passenger load $\alpha 2$ at the landing is equal to or smaller than the landing reference value $\beta 2$ (S6) . When the passenger load $\alpha 2$ at the landing is larger than the landing reference value $\beta 2$, the number of users at the landing is considered to be large, so both the first door 5 and the second door 6 are moved in the respective door opening directions upon stoppage of the car at the destination floor, as in the case where the passenger

load $\alpha 1$ within the car is larger than the car reference value $\beta 1$ (S5) .

[0068] When the passenger load $\alpha 2$ at the landing is equal to or smaller than the landing reference value $\beta 2$, not only the number of users within the car but also the number of users at the landing are considered to be small, so the reporting devices report to the inside of the car and the landing that one of the first door 5 and the second door 6, for example, only the first door 5, is to be moved in the door opening direction, upon stoppage of the car at the destination floor (S12).

[0069] After that, the door control device 28 performs control to drive, for example, only the first door driving device 11. Thus, for example, only the first door 5 is moved in the door opening direction (S7).

[0070] In this manner, a passenger can realize in advance whether or not each of the door or doors to be moved when the elevator doorway is opened/closed. As a result, the passengers are allowed to get on and off the car smoothly.

[0071] In each of the foregoing examples, both the passenger load $\alpha 1$ within the car and the passenger load $\alpha 2$ at the landing are measured, and the operations of opening/closing the elevator doorway are performed based on a result of the measurement. However, it is also appropriate to measure only one of the passenger load $\alpha 1$ within the car and the passenger load $\alpha 2$ at the landing, and to perform the operations of opening/closing the elevator doorway based on a result of the measurement.

[0072] In each of Embodiments 2 and 3 of the present invention, each of the first door 5 and the second door 6 is designed as a single panel door. However, each of the first door 5 and the second door 6 may have a plurality of panel doors.

Claims

1. A door device for an elevator, comprising:

an elevator door having a first door and a second door that are movable in a direction of a frontage of an elevator doorway, for closing the elevator doorway through movements of the first door and the second door into abutment on each other and opening the elevator doorway through movements of the first door and the second door out of abutment on each other;

a first door driving device having a first driving device main body and a first rotary shaft that is rotated due to a driving force of the first driving device main body;

a first power transmission mechanism to which only the first door of the first door and the second door is coupled, for moving the first door in response to rotation of the first rotary shaft;

a second door driving device having a second driving device main body and a second rotary shaft that is rotated due to a driving force of the second driving device main body;

a second power transmission mechanism to which only the second door of the first door and the second door is coupled, for moving the second door in response to rotation of the second rotary shaft;

a position detector for generating a signal corresponding to the rotation of the first rotary shaft; and

a door control device for controlling the second door driving device based on information from the position detector such that the rotation of the second rotary shaft follows the rotation of the first rotary shaft.

2. A door device for an elevator according to Claim 1, wherein the first power transmission mechanism and the second power transmission mechanism have provided therebetween an interlock mechanism for synchronizing a moving speed of the first door and a moving speed of the second door with each other.

3. A door device for an elevator, comprising:

an elevator door having a first door and a second door that are movable in a direction of a frontage of an elevator doorway, for closing the elevator doorway through movements of the first door and the second door into abutment on each other and opening the elevator doorway through movements of the first door and the second door out of abutment on each other;

a first door driving device having a first driving device main body and a first rotary shaft that is rotated due to a driving force of the first driving device main body;

a first power transmission mechanism to which only the first door of the first door and the second door is coupled, for moving the first door in response to rotation of the first rotary shaft;

a second door driving device having a second driving device main body and a second rotary shaft that is rotated due to a driving force of the second driving device main body;

a second power transmission mechanism to which only the second door of the first door and the second door is coupled, for moving the second door in response to rotation of the second rotary shaft;

a first position detector for generating a signal corresponding to the rotation of the first rotary shaft;

a second position detector for generating a signal corresponding to the rotation of the second rotary shaft; and

a door control device having a first door control portion for controlling the first door driving device

based on information from the first position detector, and a second door control portion for controlling the second door driving device based on information from the second position detector, for controlling the first door driving device and the second door driving device independently of each other.

4. A door device for an elevator according to Claim 3, further comprising a car passenger load detecting device for measuring a passenger load within a car, wherein the door control device controls the first door driving device and the second door driving device to move only one of the first door and the second door when the passenger load is equal to or smaller than a car reference value set in advance.

5. A door device for an elevator according to Claim 3, further comprising a landing passenger load detecting device for measuring a passenger load at a landing,
wherein the door control device controls the first door driving device and the second door driving device to move only one of the first door and the second door when the passenger load is equal to or smaller than a landing reference value set in advance.

6. A door device for an elevator according to Claim 4 or 5, further comprising a reporting device for reporting, based on information from the door control device, to an inside of the car or the landing whether or not each of the first door and the second door is to be moved in opening/closing the elevator doorway.

7. A door device for an elevator according to any one of Claims 1 to 6, wherein each of the first door and the second door has a high-speed door and a low-speed door that is displaced with respect to the high-speed door in accordance with a movement of the high-speed door.

FIG. 1

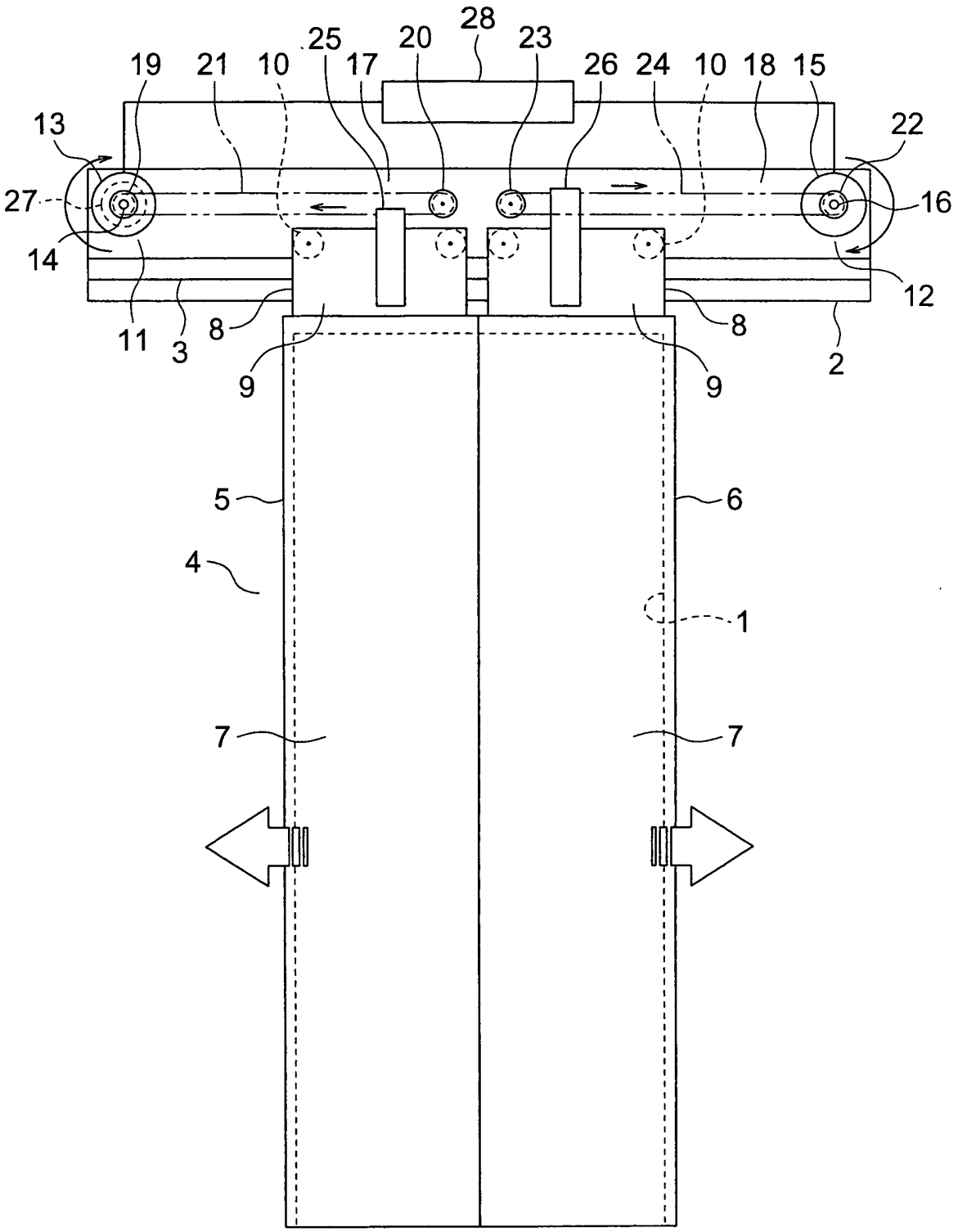

28
25
20
23
19
21
10
17
26
24
10
18
15
13
22
27
16
14
12
11
3
8
8
2
9
9
5
6
4
1
7
7

FIG. 2

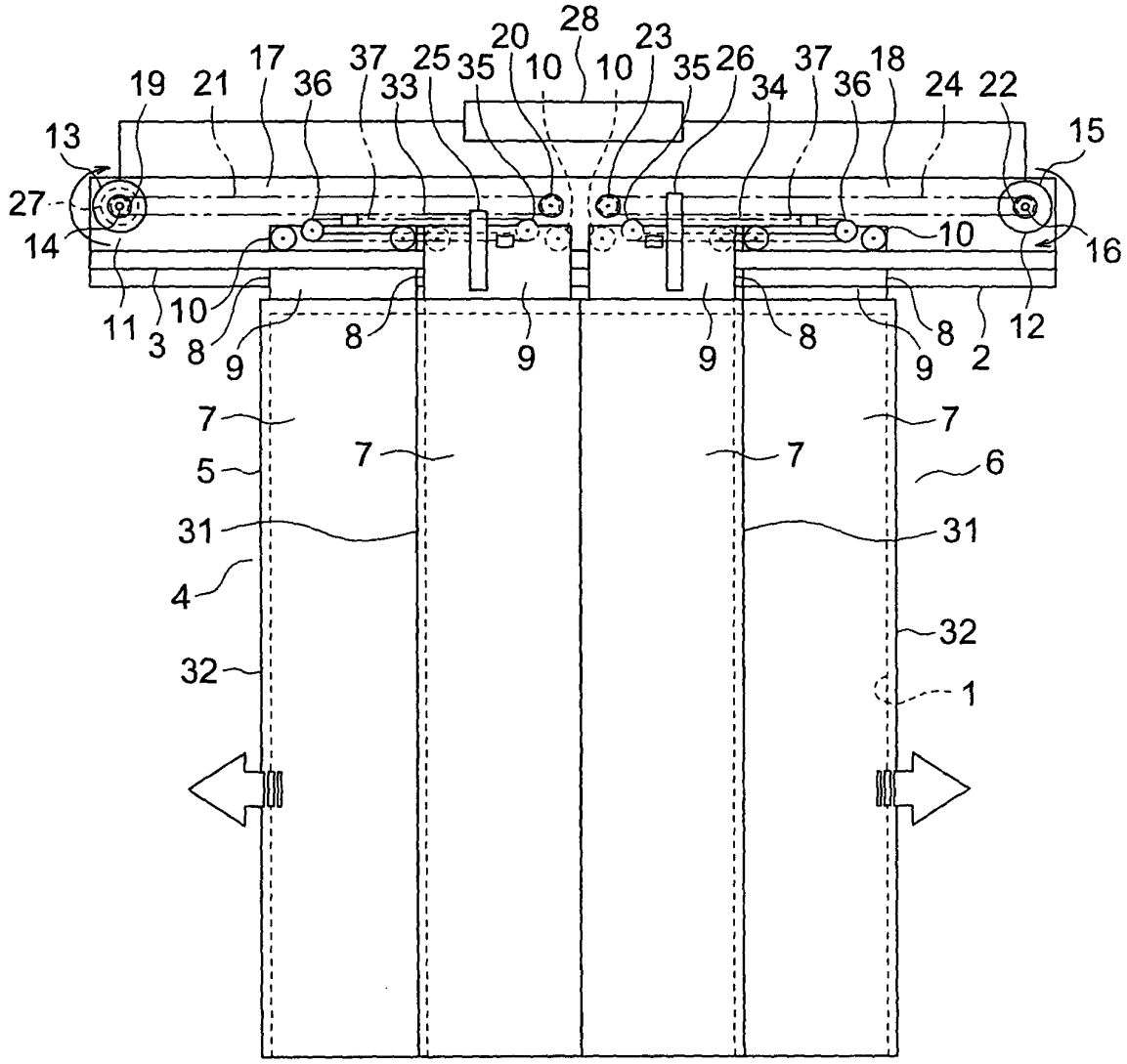

28
20
23
17
37
25
35
10
10
35
26
37
18
19
21
36
33
34
36
24
22
13
15
27
14
16
10
11
3
10
8
9
8
9
9
8
8
9
12
2
7
7
7
7
5
6
31
31
4
32
32
1

FIG. 3

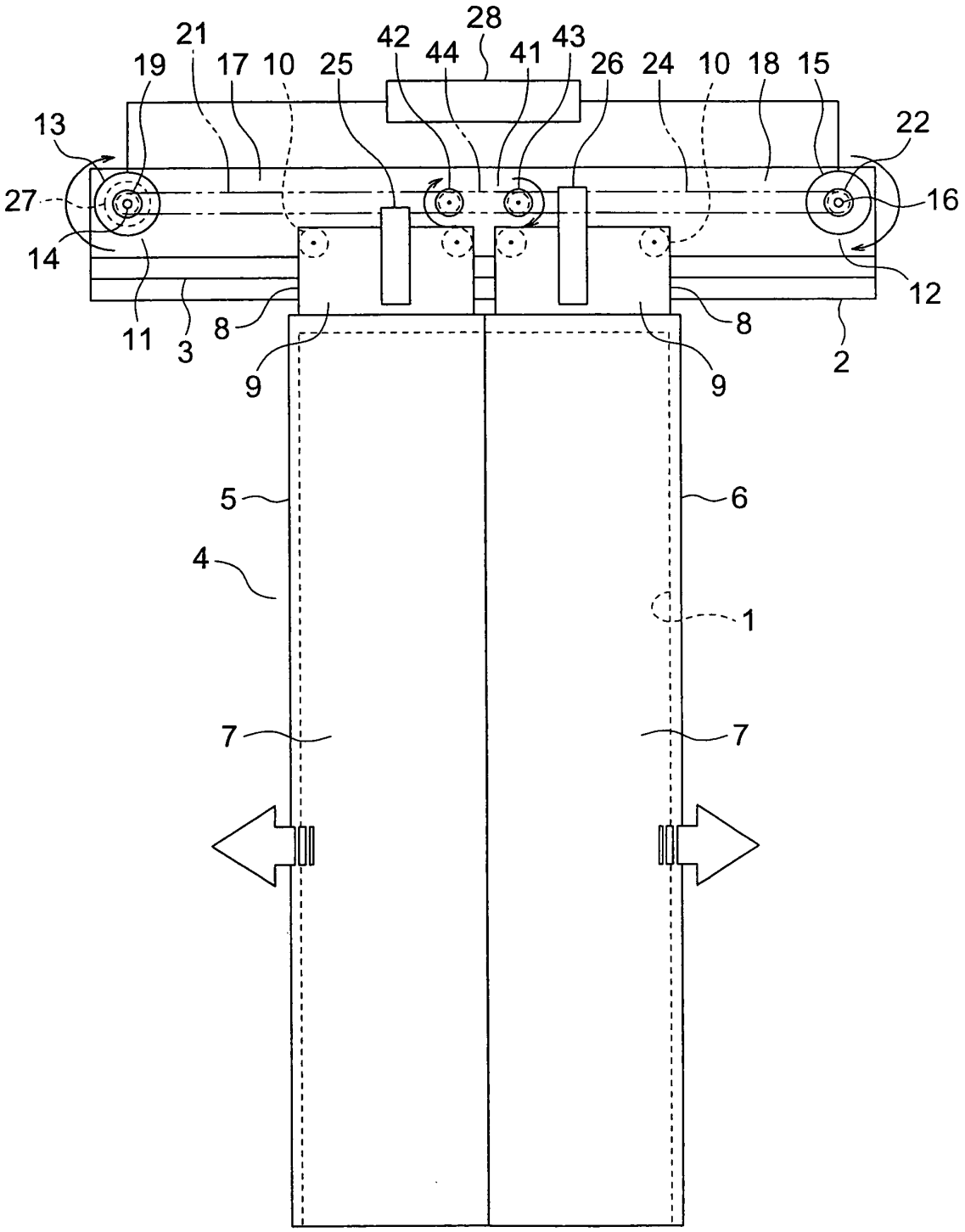

28
21
42
44
41
43
19
17
10
25
26
24
10
18
15
13
22
27
16
14
12
11
3
8
8
2
9
9
5
6
4
1
7
7

FIG. 4

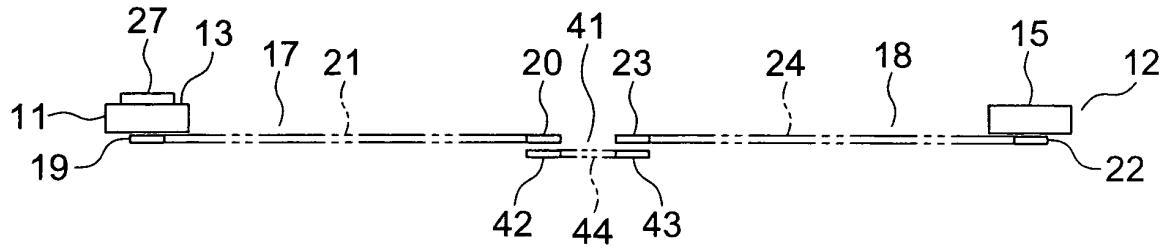


FIG. 5

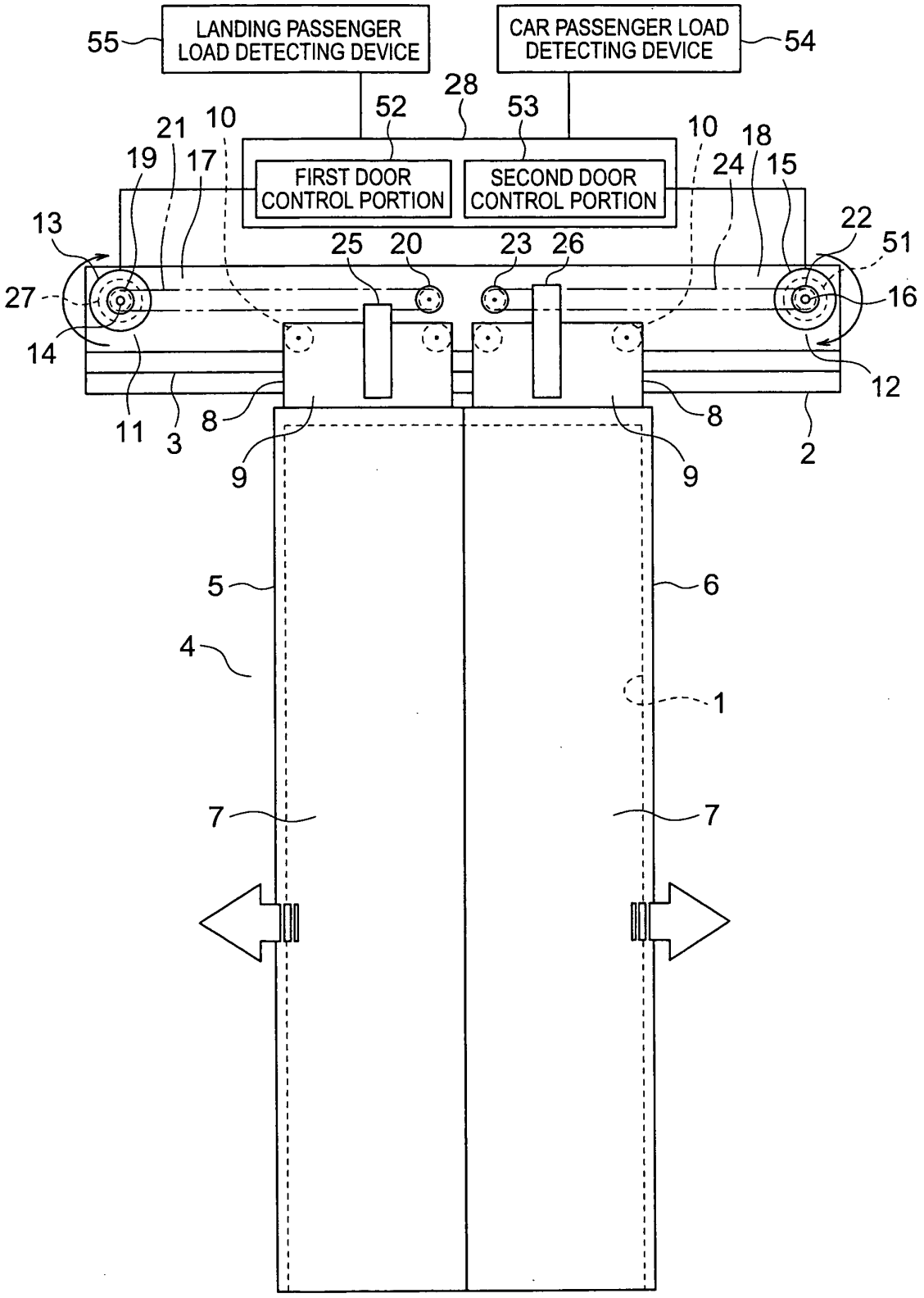

LANDING PASSENGER LOAD DETECTING DEVICE
CAR PASSENGER LOAD DETECTING DEVICE
FIRST DOOR CONTROL PORTION
SECOND DOOR CONTROL PORTION
55
54
28
52
53
10
21
19
17
18
24
15
13
22
51
25
20
23
26
27
16
14
12
11
3
8
2
9
5
6
4
1
7

FIG. 6

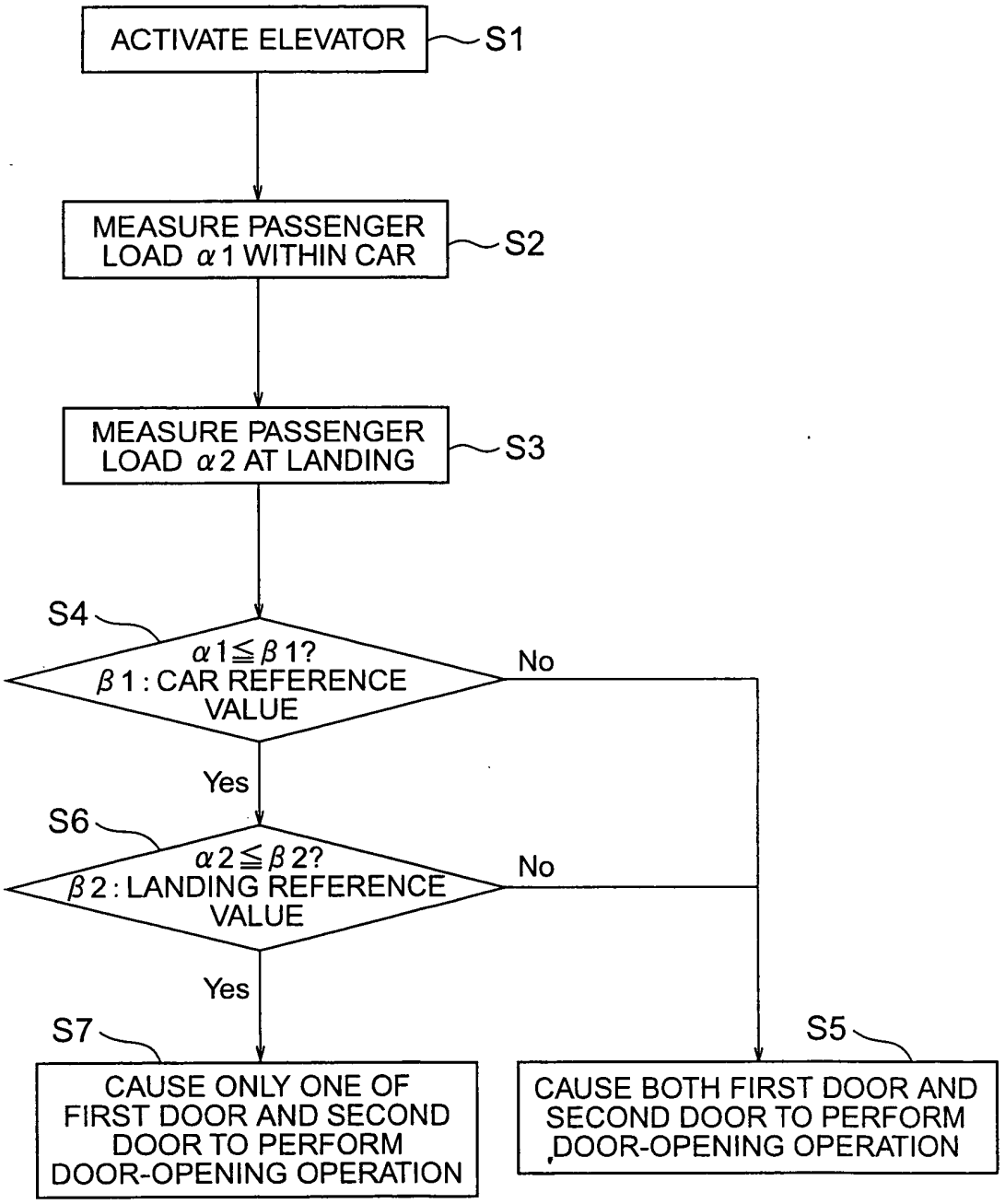
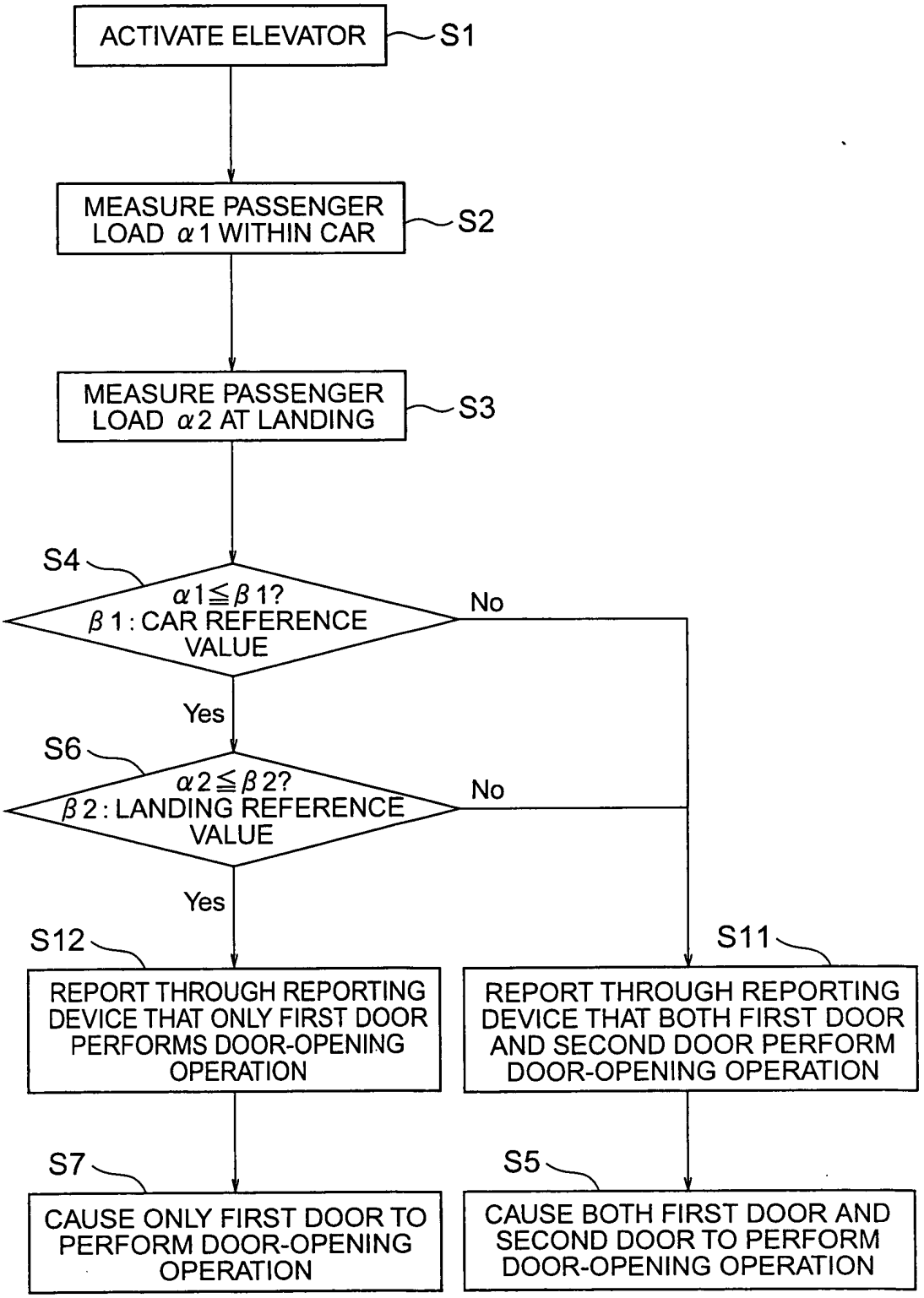

ACTIVATE ELEVATOR
S1
MEASURE PASSENGER LOAD α1 WITHIN CAR
S2
MEASURE PASSENGER LOAD α2 AT LANDING
S3
S4
α1≦β1?
β1 : CAR REFERENCE VALUE
No
Yes
S6
α2≦β2?
β2 : LANDING REFERENCE VALUE
No
Yes
S7
CAUSE ONLY ONE OF FIRST DOOR AND SECOND DOOR TO PERFORM DOOR-OPENING OPERATION
S5
CAUSE BOTH FIRST DOOR AND SECOND DOOR TO PERFORM DOOR-OPENING OPERATION

FIG. 7


ACTIVATE ELEVATOR
S1
MEASURE PASSENGER LOAD α1 WITHIN CAR
S2
MEASURE PASSENGER LOAD α2 AT LANDING
S3
S4
α1≦β1?
β1 : CAR REFERENCE VALUE
No
Yes
S6
α2≦β2?
β2 : LANDING REFERENCE VALUE
No
Yes
S12
REPORT THROUGH REPORTING DEVICE THAT ONLY FIRST DOOR PERFORMS DOOR-OPENING OPERATION
S11
REPORT THROUGH REPORTING DEVICE THAT BOTH FIRST DOOR AND SECOND DOOR PERFORM DOOR-OPENING OPERATION
S7
CAUSE ONLY FIRST DOOR TO PERFORM DOOR-OPENING OPERATION
S5
CAUSE BOTH FIRST DOOR AND SECOND DOOR TO PERFORM DOOR-OPENING OPERATION

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2005/019303

A. CLASSIFICATION OF SUBJECT MATTER
B66B13/14(2006.01)i, *B66B3/00*(2006.01)i, *B66B13/08*(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 1996-2006
Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006

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 A	JP 2003-026381 A (Hitachi Building Systems Co., Ltd.), 29 January, 2003 (29.01.03), Abstracts (Family: none)	3 1,4-7 2
Y A	JP 2004-116283 A (Otis Elevator Co.), 15 April, 2004 (15.04.04), Claims 1, 5 to 6 & US 2004/0055829 A1	1 2
Y A	JP 56-103084 A (Mitsubishi Electric Corp.), 17 August, 1981 (17.08.81), Column 4, line 4 to column 9, line 18 (Family: none)	4-6 3

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
19 July, 2006 (19.07.06)	01 August, 2006 (01.08.06)
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/JP2005/019303

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 113684/1981(Laid-open No. 020277/1983) (Fujitec Co., Ltd.), 08 February, 1983 (08.02.83), Description; page 1, line 17 to page 5, line 4 (Family: none)	4-6 3
Y A	JP 57-067490 A (Mitsubishi Electric Corp.), 24 April, 1982 (24.04.82), Claims 1 to 2 (Family: none)	4-6 3
Y A	JP 56-039282 A (Mitsubishi Electric Corp.), 14 April, 1981 (14.04.81), Column 5, line 20 to column 9, line 6 (Family: none)	7 1
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 025748/1985(Laid-open No. 142774/1986) (Mitsubishi Electric Corp.), 03 September, 1986 (03.09.86), Description; page 6, line 5 to page 7, line 8 (Family: none)	2

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

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2001226058 A **[0003]**