

(21) Application No: 1721105.3  
(22) Date of Filing: 03.07.2015  
Date Lodged: 18.12.2017  
(86) International Application Data:  
PCT/JP2015/069231 Ja 03.07.2015  
(87) International Publication Data:  
WO2017/006378 Ja 12.01.2017

(51) INT CL:  
B66B 1/18 (2006.01)

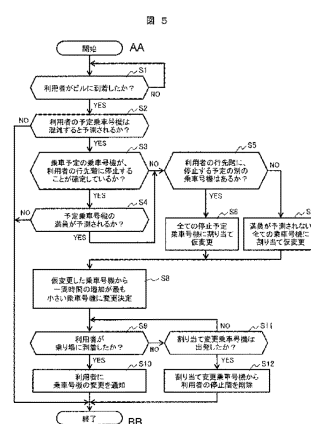
(56) Documents Cited:  
JP 2635128 B2  
JP 5660142 B2  
JP 2666776 B2  
JP 52/101551 A

(58) Field of Search:  
INT CL B66B

(71) Applicant(s):  
Hitachi, Ltd.  
6-6, Marunouchi 1-chome, Chiyoda-ku,  
Tokyo 100-8280, Japan  
(72) Inventor(s):  
Tomoaki Maehara  
Takehisa Nishida  
Takahiro Hatori  
Takamichi Hoshino  
(74) Agent and/or Address for Service:  
Mewburn Ellis LLP  
City Tower, 40 Basinghall Street, LONDON,  
Greater London, EC2V 5DE, United Kingdom

(54) Title of the Invention: **Group-control elevator device, and method for assigning boarding car numbers using group control**  
Abstract Title: **Group-control elevator device, and method for assigning boarding car numbers using group control**

(57) The purpose of the present invention is to provide a novel group-control elevator device which is capable of suppressing long waits, and which is capable of avoiding the occurrence of situations in which passengers of a number equal to or greater than passenger capacity converge on one car and cannot board the car. A destination floor is obtained from personal identification information of a user, and a boarding car number serving the obtained destination floor is un-signed. When the boarding car number assigned to the user is predicted to be congested, a boarding-car-number change request is generated for the user, and when it has not been confirmed that the boarding car number predicted to be congested will stop at the destination floor of the user, or when said boarding car number is predicted to be full even though stoppage at the destination floor has been confirmed, a boarding car number to which the aforementioned boarding car number is be changed is determined from among boarding car numbers other than the aforementioned boarding car number.



S1 Has user arrived at building?  
S2 Scheduled boarding car number of user predicted to be congested?  
S3 Has it been confirmed that boarding car number scheduled to be boarded will stop at destination floor of user?  
S4 Is scheduled boarding car number predicted to be full?  
S5 Is there another boarding car number scheduled to stop at destination floor of user?  
S6 Temporarily change assignment to all boarding car numbers scheduled to stop at destination floor  
S7 Temporarily change assignment to all boarding car numbers not predicted to be full  
S8 Determine change from temporarily changed boarding car number to boarding car number having smallest increase in round-trip time  
S9 Has user arrived at landing?  
S10 Notify user of change to boarding car number  
S11 Has changed assigned boarding car number departed?  
S12 Delete floor stop of user from changed assigned boarding car number  
AA Start  
BB End

FIG. 1

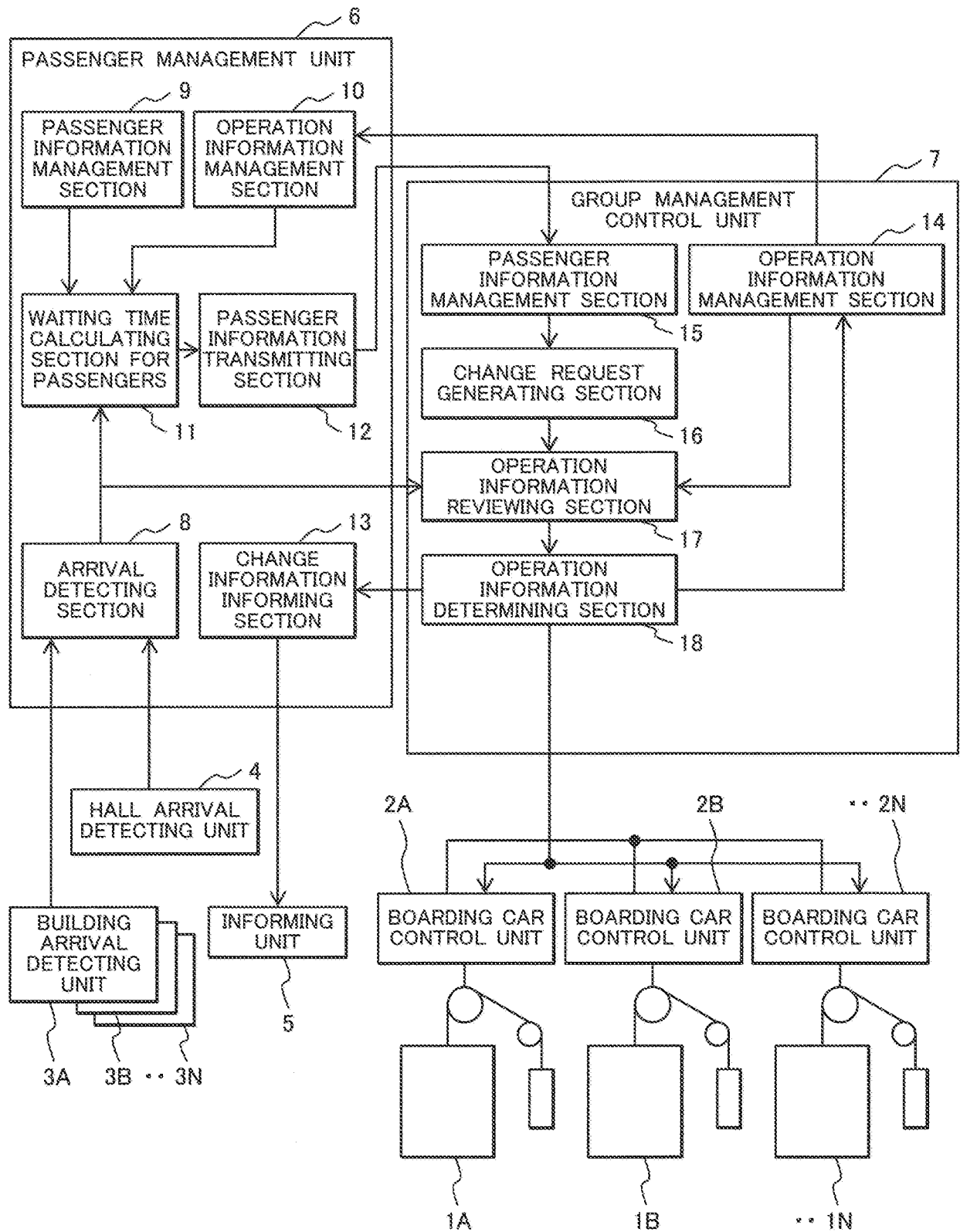


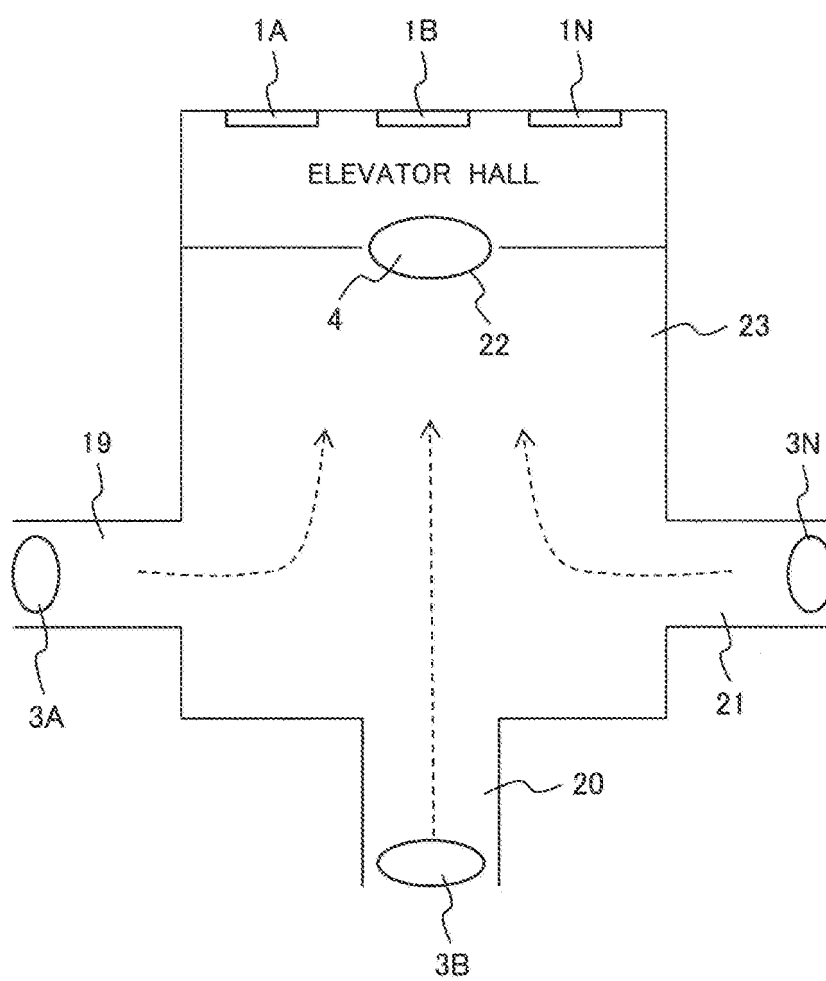
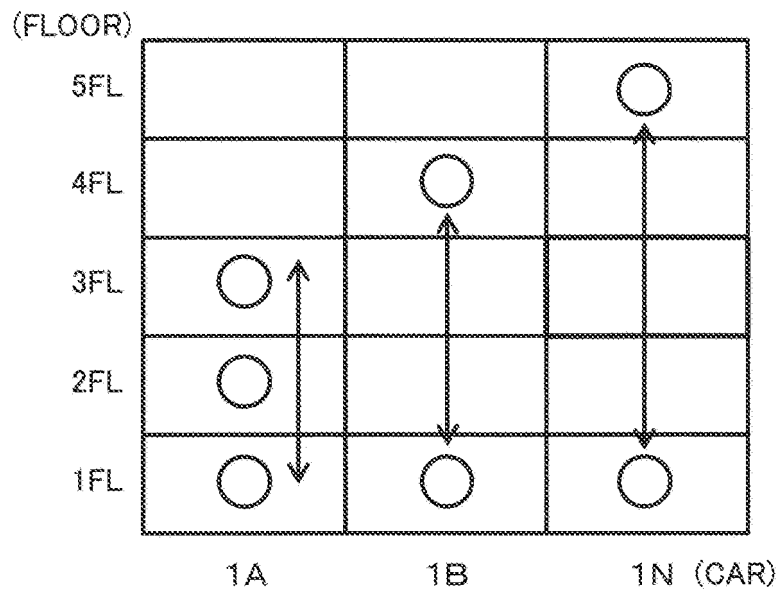
**FIG. 2**

*FIG. 3**FIG. 4*

| PASSENGER | BOARDING CAR |
|-----------|--------------|
| A         | 1A           |
| B         | 1A           |
| ⋮         | ⋮            |
| Y         | 1B           |
| Z         | 1N           |

FIG. 5

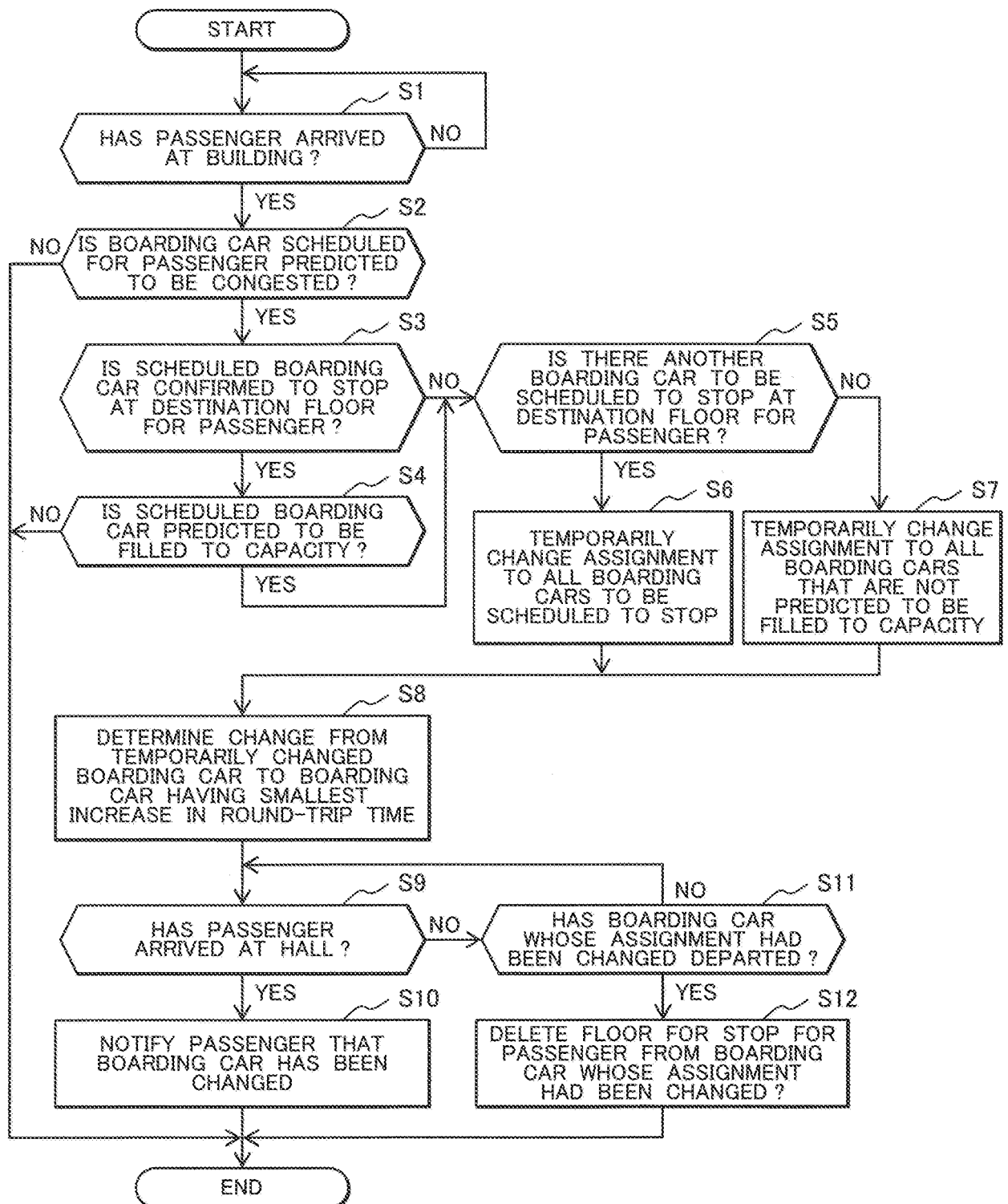


FIG. 6

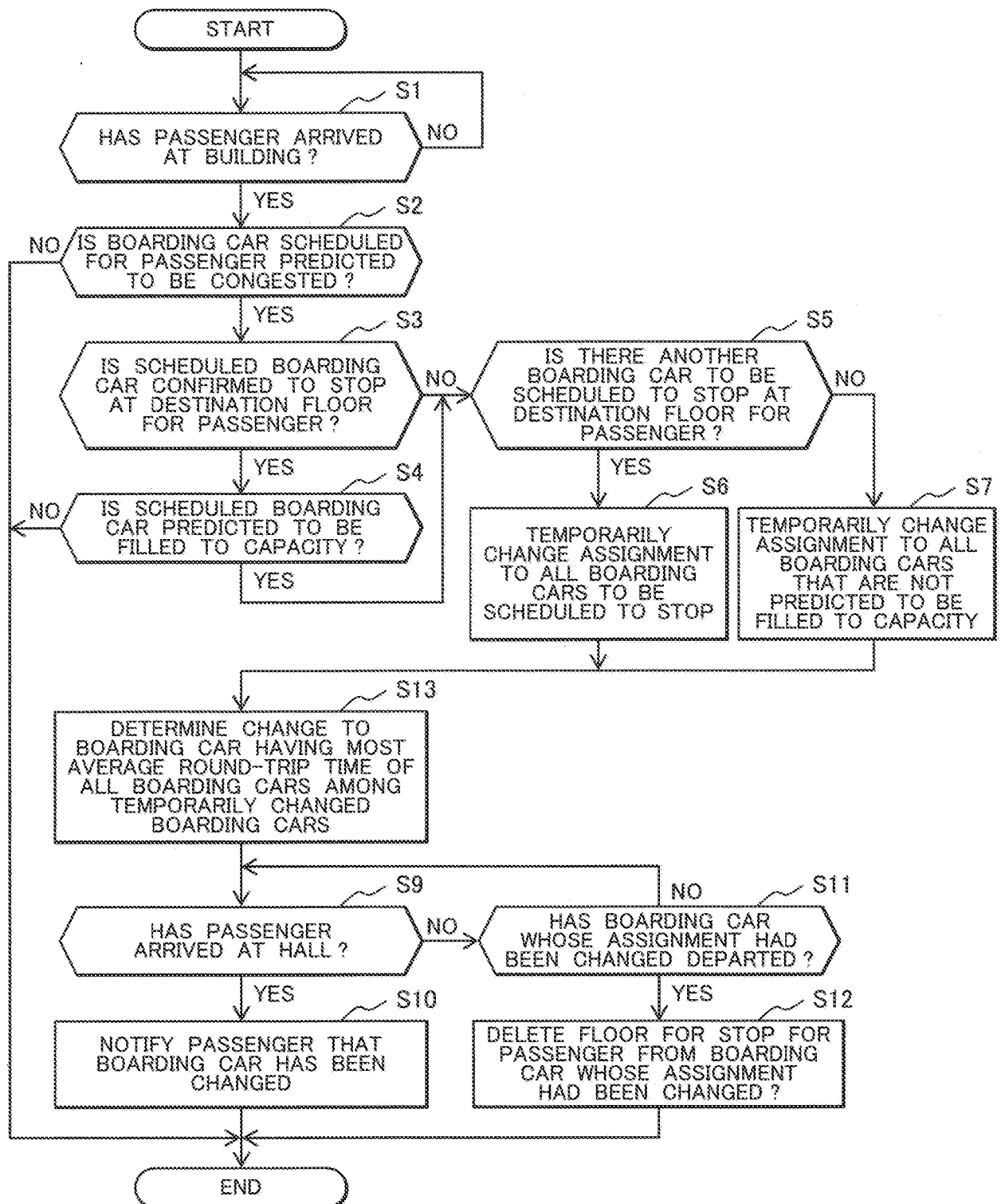


FIG. 7

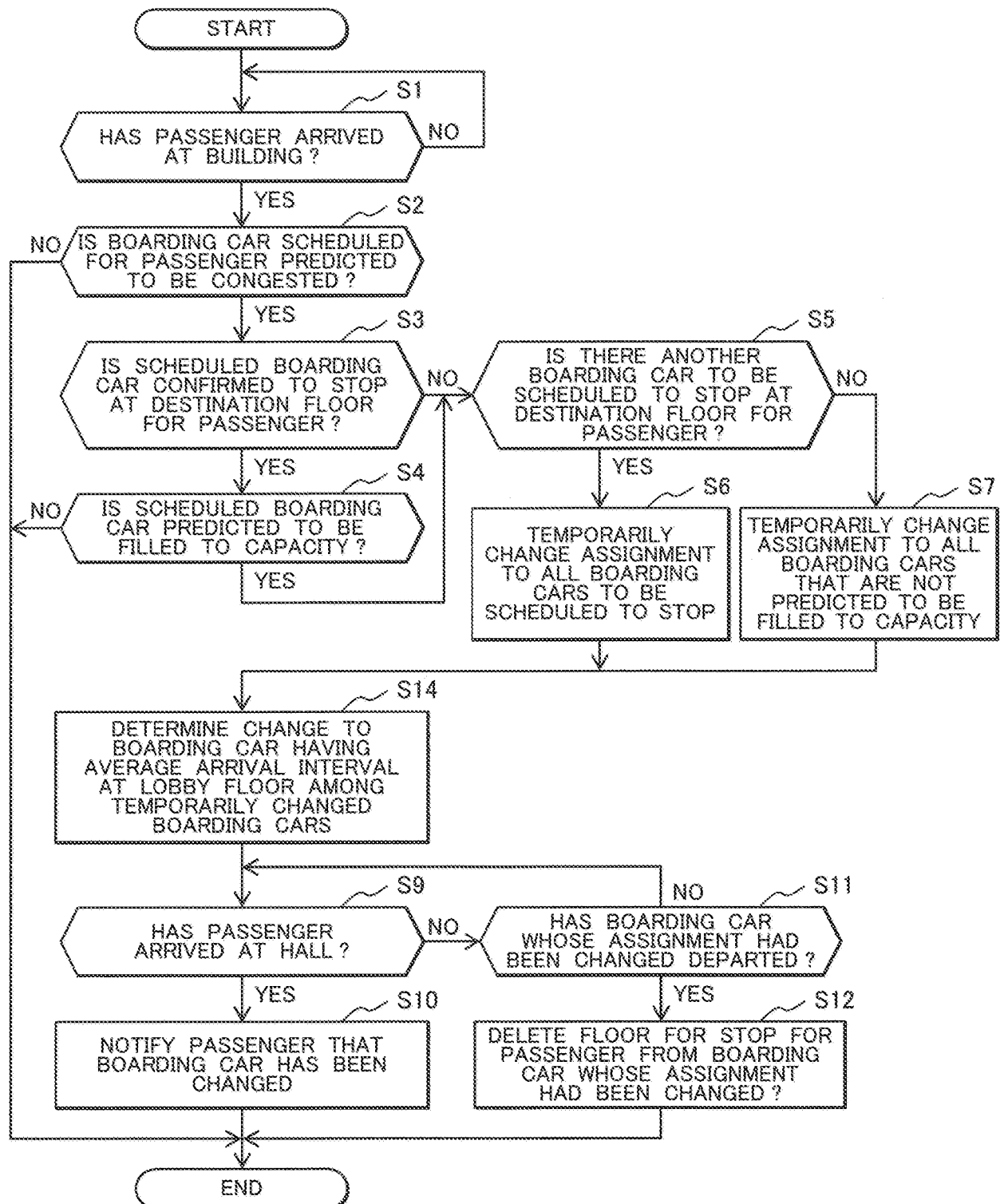
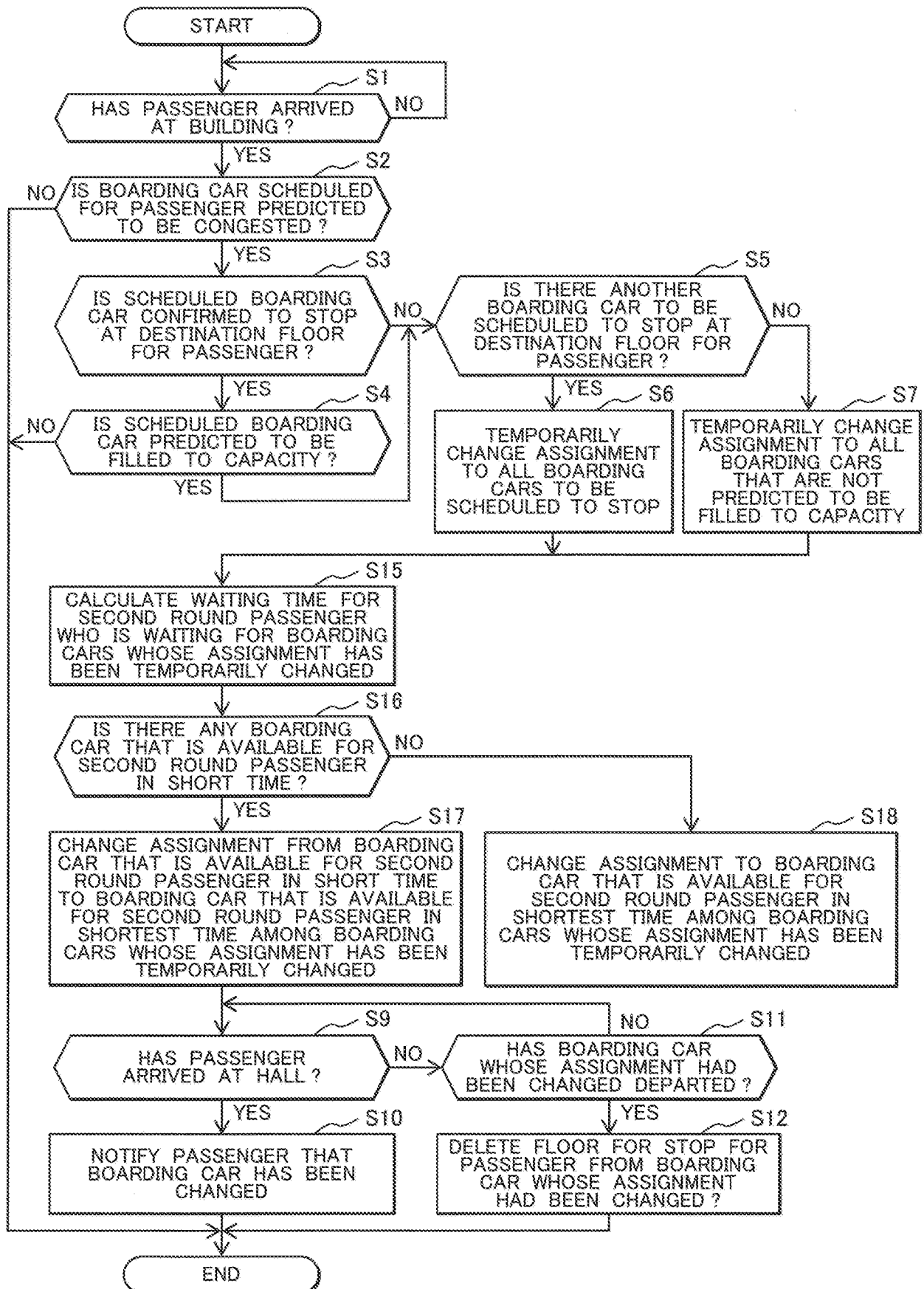


FIG. 8



## DESCRIPTION

Title of Invention

GROUP-CONTROL ELEVATOR DEVICE, AND METHOD FOR ASSIGNING

5 BOARDING CAR NUMBERS USING GROUP CONTROL

Technical Field

[0001]

The present invention relates a controller for group-  
10 controlled elevators, and more specifically to a group-  
control elevator device to shorten waiting time at an  
elevator hall and a method of assigning a boarding car by  
group control.

15 Background Art

[0002]

In relatively large-scale buildings, a system is  
introduced in which a plurality of elevators are provided in  
order to improve the performance of elevators to transport  
20 passengers and the optimum elevator car is selected for  
providing services in elevator call registration at a hall.  
With an increase in the scale of buildings, the number of  
elevators provided is increased. These multiple elevators  
are appropriately controlled using a group control device

for improving services, such as a reduction in passenger waiting time.

[0003]

Regarding such group-control elevator devices,  
5 various systems are proposed in Japanese Patent Application Laid-Open No. Hei5(1993)-78045 (PTL 1), Japanese Patent Application Laid-Open No. 2003-81541 (PTL 2), and any other patent literature, for example.

[0004]

10 PTL 1 describes an elevator allocation device including an individual identifying device that distinguishes between individual passengers and identifies the individual passengers manipulating a hall button, a measurement unit that measures passenger-specific waiting  
15 time for individual passengers from the registration of a hall call by a passenger to the arrival of a car, a first storage unit that stores the passenger-specific waiting time, a second storage unit that averages and stores waiting time for the same passenger, a third storage unit that averages  
20 and stores waiting time for all the passengers, and a priority service providing unit that prioritizes a hall call made by a passenger having passenger-specific average waiting time longer than the total average waiting time.

[0005]

According to this system, the system enables the elimination of a problem in that a passenger who often waits for elevators for a long time increasingly feels distrust and irritation about elevators and has complaints about elevators.

[0006]

PTL 2 describes a group-control elevator device including a destination floor-specific hall device, a call registration information detecting unit that detects a floor where a hall call is made and a destination floor from the destination floor-specific hall device, an assignment evaluation value operating unit that operates an assignment evaluation value based on information from the call registration information detecting unit, for example, an assignment candidate car selecting unit that selects a candidate car for assignment, a preferred service type detecting unit that detects a preferred service type from the destination floor-specific hall device, a call-specific evaluation function parameter setting unit that sets an assignment evaluation function and parameters of the assignment evaluation function suitable for a preferred service type, a call-specific assignment evaluation function operating unit that operates the assignment evaluation function, a comprehensive evaluation function operating unit that operates a comprehensive evaluation function, and a

comprehensive evaluation assignment car determining unit  
that determines an assigned car based on the value of the  
comprehensive evaluation function.

[0007]

5           According to this device, the device enables the  
elimination of a problem in that even though the qualities  
of the services preferred by passengers making individual  
calls vary because operation control methods are changed in  
accordance with schedules and with the results of  
10 statistical processing, changing the quality of the service  
is not enabled for each call in response to the passenger's  
request.

#### Citation List

#### 15 Patent Literature

[0008]

PTL 1: Japanese Patent Application Laid-Open No.  
H5(1993)-78045

PTL 2: Japanese Patent Application Laid-Open No.  
20 2003-81541

#### Summary of Invention

#### Technical Problem

[0009]

The group-control elevator device described in PTL 1 prioritizes a service for the passenger having passenger-specific average waiting time longer than the total average waiting time obtained by averaging waiting time for all the passengers. The group-control elevator device described in PTL 2 provides services, which are varied for every call, preferred by individual passengers.

[0010]

More specifically, in the group-control elevator device of PTL 1, passenger-specific average waiting time is stored, and a service is provided in priority when a passenger having waiting time longer than total average waiting time registers a hall call. However, in the case in which passengers over the capacity are already present in the hall at the arrival of a passenger at the hall and the passenger has short average waiting time, which is stored, the case sometimes occurs in which the passenger is regarded as a passenger who is not waiting for a long time, the passenger is not provided with a replacement boarding car, and the passenger has to wait for a long time in consequence.

[0011]

That is, group control as described in PTL 1 controls passengers who are waiting for a long time. When a passenger who is waiting for a long time is detected, a boarding car to be assigned for the passenger is changed to

a boarding car that is available for the passenger in a short time. However, in the case in which a passenger is not waiting for a long time, the passenger is determined as a passenger who is not waiting for a long time. Thus, a  
5 problem arises in that the boarding car is not changed, and the passenger has to wait for a long time in consequence. Therefore, in such a case, PTL 1 and PTL 2 are inadequate to meet the problems.

[0012]

10 An object of the present invention is to provide a novel group-control elevator device that can avoid the occurrence of a situation in which passengers over the capacity crowd toward a boarding car and fail to enter the car and can prevent passengers from waiting for elevators  
15 for a long time.

#### Solution to Problem

[0013]

In an aspect of the present invention, a destination  
20 floor is determined based on personal identification information about a passenger. A boarding car that provides services at the determined destination floor is assigned. When the boarding car assigned for the passenger is predicted to be congested, a request for changing the  
25 boarding car assigned for the passenger is generated. When

the boarding car that is predicted to be congested is not confirmed to stop at the destination floor for the passenger, or when the boarding car is predicted to be filled to capacity even though the boarding car is confirmed to stop at the destination floor for the passenger, a boarding car that has to be changed is assigned among the other boarding cars except the predicted boarding car.

#### Advantageous Effects of Invention

[0014]

According to the present invention, the occurrence of a situation can be avoided in which passengers over the capacity crowd toward one car and fail to enter the car, and passengers can be prevented from waiting for elevators for a long time.

#### Brief Description of Drawings

[0015]

Figure 1 is a block diagram of the main components of a group-control elevator device according to a first embodiment of the present invention.

Figure 2 is a plan view of an area including a hall and its vicinity illustrating places where building arrival detecting units and a hall arrival detecting unit are installed.

Figure 3 is an illustration of floors and services of boarding cars of the group-control elevator device.

Figure 4 is an illustration of the relationship between passengers and boarding cars.

5        Figure 5 is a flowchart of a boarding car changing process according to the first embodiment of the present invention performed by the group-control elevator device.

Figure 6 is a flowchart of a boarding car changing process according to a second embodiment of the present  
10    invention performed by the group-control elevator device.

Figure 7 is a flowchart of a boarding car changing process according to a third embodiment of the present invention performed by the group-control elevator device.

Figure 8 is a flowchart of the boarding car changing  
15    process according to a fourth embodiment of the present invention performed by the group-control elevator device.

#### Description of Embodiments

[0016]

20        Next, embodiments of the present invention will be described in detail with reference to the drawings. However, the present invention is not limited to the embodiments below. The present invention also includes various exemplary modifications and exemplary applications in the  
25    technical concept of the present invention.

[0017]

In these years, office buildings are being scaled up, and the elevator equipment of the scaled-up office buildings becomes under group control. From the viewpoint of security management, an ID authentication code that is personal identification information is assigned to a passenger in the office building. An ID authentication code is stored on an IC card, for example, and the ID authentication code is read in a wireless manner, or using a touch sensor.

10 [0018]

Therefore, in the group-control elevator device, a system is proposed in which an ID authentication code, which has been read, provides information that a passenger is coming to the elevator hall, and hence an elevator car is assigned to stand by for the passenger in advance at the lobby floor for shortening waiting time. Such a system aims to shorten waiting time by standing by elevator cars on the lobby floor basically in busy hours. The embodiment is made based on such a system on the background.

20

First Embodiment

[0019]

Fig. 1 is a block diagram of the main components of a group-control elevator device according to an embodiment of the present invention. The group-control elevator device

25

includes boarding cars 1A to 1N, which are a plurality of elevators, boarding car control units 2A to 2N configured to control the boarding cars 1A to 1N, respectively, building arrival detecting units 3A to 3N disposed at places apart  
5 from a hall, a hall arrival detecting unit 4 and an informing unit 5 disposed at the hall, a passenger management unit 6 connected to the building arrival detecting units 3A to 3N, the hall arrival detecting unit 4, and the informing unit 5 and configured to manage  
10 information about passengers, and a group management control unit 7 configured to take various pieces of information from the passenger management unit 6 and the boarding car control units 2A to 2N and to control the boarding cars 1A to 1N by group control. Here, the passenger management unit 6 and  
15 the group management control unit 7 are collectively described as a group management unit GM.

[0020]

The boarding cars 1A to 1N, which are a plurality of elevators, each have service floors set for providing  
20 services. Some boarding cars directly go to the top floor, for example. Some boarding cars directly go to the middle floor, and then stop at the individual floors. Some boarding cars stop all floors. Some boarding cars stop floors up to a predetermined floor.

25 [0021]

The building arrival detecting units 3A to 3N, which are disposed at the entrances to a building where the elevators are installed, detect both of the arrival of a passenger at the building and personal identification

5 information about the passenger before the passenger arrives at the hall. The hall arrival detecting unit 4 is disposed at a place in the hall nearer to elevator entrances than the places where the building arrival detecting units 3A to 3N are disposed, and detects the arrival of passengers at the  
10 hall.

[0022]

The informing unit 5 is disposed near the hall arrival detecting unit 4 to specifically guide, about the assigned boarding car that is changed, a passenger whose  
15 boarding car having been assigned for the passenger is determined to be changed to another. Note that, the informing unit 5 can adopt an informing method using a display screen, an informing method by speech using a device like a speaker, and an informing method in combination of  
20 these methods.

[0023]

The passenger management unit 6 includes an arrival detecting section 8 configured to take arrival information from the building arrival detecting units 3A to 3N and from  
25 the hall arrival detecting unit 4, a passenger information

management section 9 configured to store pieces of information, such as waiting time information, boarding car information, and personal identification information about all the passengers registered in the building in association with one another, and an operation information management section 10 configured to acquire present operation information and future operation information about boarding cars from the group management control unit 7 to manage the pieces of information, described later in detail.

10 [0024]

The passenger management unit 6 includes a waiting time calculating section 11 configured to acquire, when detecting the arrival of a passenger at the inside of the building from the building arrival detecting units 3A to 3N, past waiting time information about the passenger from the passenger information management section 9 using the personal identification information about the passenger, and to calculate the long waiting time frequency and predicted waiting time this time, for example.

20 [0025]

The passenger management unit 6 includes a passenger information transmitting section 12 configured to transmit information about arithmetic operation results and any other result, such as the long waiting time frequency and the predicted waiting time, calculated at the waiting time

25

calculating section 11 to the group management control unit 7, and a change information notifying section 13 configured to manage boarding car information after changed that is notified to the passenger when the group management control unit 7 determines to change the boarding car, described later in detail.

[0026]

The group management control unit 7 includes an operation information management section 14 configured to take various pieces of information from the boarding car control units 2A to 2N and manage present operation information and future operation information, and a passenger information management section 15 configured to take information from the passenger information transmitting section 12 of the passenger management unit 6 and manage information about the arithmetic operation results of the passengers and the boarding car information about passengers.

[0027]

The group management control unit 7 includes a change request generating section 16 having a function to generate a request for changing the boarding car for a passenger having a high long waiting time frequency using the long waiting time frequency in the past that is information about the arithmetic operation result calculated at the passenger information management section 15 and the predicted waiting

time, and a function to generate a change request when a boarding car that is predicted to be congested is not confirmed to stop at the destination floor for the passenger, or when a boarding car is predicted to be filled to capacity even though the boarding car is confirmed to stop at the destination floor for the passenger.

[0028]

The group management control unit 7 includes an operation information reviewing section 17 having a function to modify operation information about the original boarding car and operation information about the changed boarding car in the case in which the boarding car is changed, and an operation information determining section 18 having a function to determine a change and notify the change to the change information notifying section 13, the operation information management section 14, and the boarding car control units 2A to 2N.

[0029]

Fig. 2 is a plan view of the area including the hall and its vicinity illustrating an exemplary installation of the building arrival detecting unit 3 and the hall arrival detecting unit 4 described above.

[0030]

At a lobby floor, entrances 19, 20, and 21 to the building leading to the elevator entrances are formed. At

the entrances 19 to 21, the building arrival detecting units 3A to 3N are respectively disposed to detect the arrival of a passenger at the building and personal identification information.

5 [0031]

At a hall entrance 22 through which passengers having entered the entrances 19 to 21 then pass to the elevator entrances, the hall arrival detecting unit 4 is installed to detect the arrival of a passenger at the hall 23. In the  
10 vicinity of the hall arrival detecting unit 4, the informing unit 5 is disposed to notify the content of a change in the case in which the boarding car is changed.

[0032]

The hall arrival detecting unit 4 may be a unit that  
15 detects the arrival of a passenger at the hall and personal identification information similarly to the building arrival detecting units 3A to 3N, or may be a unit that is configured as a call registration unit to detect the arrival of a passenger at the hall when the passenger makes call  
20 registration manipulation.

[0033]

As described above, personal identification information about passengers and the traveling states of passengers can be monitored using the hall arrival detecting  
25 unit 4 and the building arrival detecting units 3A to 3N.

With the utilization of these pieces of information, the group management unit GM manages the operation of the boarding cars 1A to 1N so that no passenger waits for an elevator for a long time.

5 [0034]

Fig. 3 is an illustration of the relationship between the floors in the building and the floors at which the boarding cars stop. The boarding cars 1A to 1N provide services from the first floor to the fifth floor. However,  
10 in the normal operation state, the boarding car 1A is limited to provide services only at the first floor, the second floor, and the third floor. The boarding car 1B is limited to provide services only at the first floor and the fourth floor. The boarding car 1N is limited to provide  
15 services only at the first floor and the fifth floor. Note that, the boarding cars 1A to 1N each sometimes include some boarding cars to provide the same services.

[0035]

With this configuration, the passenger who is going  
20 to the upper floor can go to the upper floor in a short time using the boarding car 1B or the boarding car 1C. The passenger who is going to the lower floor goes to the first floor, the second floor, and the third floor using the boarding car 1A. The passengers may go to any floor in a  
25 short time by shortening the operation intervals between the

other boarding cars. Naturally, services are not limited to such services, and the other services may be adopted. As described above, when once service floors are determined to the individual boarding cars, the operation efficiency of the elevators can be improved.

[0036]

Fig. 4 is an illustration of the relationship between the boarding cars and passengers. As illustrated in Fig. 4, for passengers A to Z, boarding cars suitable for their destination floors are assigned in advance. In office buildings, in some cases, different companies reside in an office building, or different company organizations or departments, even in the same company, reside in an office building.

[0037]

With this being the situation, the floors are determined corresponding to a company, a company organization, or a department to which a passenger belongs, and hence a suitable boarding car is assigned for the passenger accordingly. For suitable assignment, personal identification information is detected at the hall arrival detecting unit 4 and the building arrival detecting units 3A to 3N.

[0038]

In correspondence with Fig. 3, for example, for passenger A, the boarding car 1A is preassigned corresponding to the destination floor for passenger A (in this case, the destination floor is any one of the first floor, the second floor, and the third floor). For passenger B, the boarding car 1A is also preassigned corresponding to the destination floor for passenger B (also in this case, any one of the first floor, the second floor, and the third floor). For passengers Y and Z, the boarding car 1B or the boarding car 1N is preassigned corresponding to the destination floors for passengers Y and Z, (in this case, the fourth floor or the fifth floor).

[0039]

Consequently, the passengers individually pass through the building arrival detecting units 3A to 3N and the hall arrival detecting unit 4, and hence the boarding cars suitable for the passengers are preassigned every moment. The informing unit 5 informs the passenger of the assigned boarding car. Such a method is defined as a passenger-specific boarding car fixing method.

[0040]

In the passenger-specific boarding car fixing method, the elevator cars used by the passengers on a daily basis are rarely changed. Thus, the method can achieve more smooth movement of passengers to elevator entrances,

compared with a method of instructing boarding cars every time. Also for passengers, the method can minimize opportunities to again register their destination floors because they forget instructed boarding car names while walking.

[0041]

The passenger-specific boarding car fixing method can also improve operation efficiency all day by performing the method only at busy hours, such as the time of arrival at a job or a lunch hour, and by prioritizing waiting time, without performing the method under an uncrowded situation, such as at usual hours and at off-peak hours.

[0042]

In the case in which there are elevators that are out of service because of changing the boarding cars for passengers depending on the learning situation on a daily basis, maintenance checkups, failure, and any other reason, the boarding cars for the passengers may be changed in advance.

Next, a method of assigning a boarding car will be described according to the passenger-specific boarding car fixing method.

[0043]

Fig. 5 is a flowchart of a boarding car changing process in the above-described group-control elevator device.

Note that, a control step described below may be replaced by a control function, and hence the boarding car changing process is sometimes expressed as a function in claims.

[0044]

5           First, in Step S1, the arrival detecting section 8 monitors the arrival of a passenger. The arrival detecting section 8 detects the arrival of passenger A at the building entrance 19, for example, with the building arrival detecting unit 3A. Note that, in the case in which the  
10 arrival detecting section 8 fails to detect any passenger with the building arrival detecting unit 3A, the arrival detecting section 8 again returns to Step S1 and continues the monitoring operation. The arrival detecting section 8 takes arrival information about passenger A detected at the  
15 building arrival detecting unit 3A and personal identification information about passenger A, and outputs the pieces of information to the waiting time calculating section 11.

[0045]

20           The waiting time calculating section 11 acquires boarding car information illustrated in Fig. 4, destination floor information, long waiting information in the past, and any other information about passenger A from a table stored on the passenger information management section 9, acquires  
25 present operation information and future operation

information about boarding cars from the operation  
information management section 10, and calculates predicted  
waiting time this time for passenger A. Note that, the past  
long waiting information process has no relation in the  
5 embodiment, and the description is omitted. Processes using  
boarding car information, personal identification  
information, and destination floor information will be  
described.

[0046]

10           The waiting time calculating section 11 transmits the  
boarding car information, the personal identification  
information, and the destination floor information from the  
passenger information transmitting section 12 to the  
passenger information management section 15 of the group  
15 management control unit 7. This process is performed every  
time when passengers A to Z are detected at the building  
arrival detecting units 3A to 3N. The passenger information  
management section 15 stores a plurality of pieces of  
information about these passengers until the departure of  
20 the boarding cars actually assigned for the passengers.  
After this process is finished, the process goes to Step S2.  
The control steps in Step S2 and later steps are the control  
steps performed at the group management control unit 7.

[0047]

Note that, in the following description, a plurality of passengers including passenger A who is going to the third floor on the boarding car 1A is already detected, and the building arrival detecting unit 3A then detects

5 passenger B who is going to the second floor on the boarding car 1A. At this point in time, a state is expected in which the passenger load factor of the boarding car 1A exceeds a predetermined set value and a situation arises in which congestion is predicted. Consequently, passenger B is in  
10 the situation in which passenger B is difficult to get on the boarding car 1A.

[0048]

In Step S2, the change request generating section 16 has a function to determine whether a state arises in which  
15 congestion is predicted on the corresponding boarding car 1A using boarding car information about passenger B stored on the passenger information management section 15.

[0049]

In the case in which congestion is not predicted in  
20 Step S2, a normal process is performed to assign the boarding car 1A for passenger B. The process goes to the end, and then the process is ended. Note that, also in this case, the informing unit 5 informs passenger B that the boarding car 1A is assigned.

25 [0050]

However, as a result of this determination, when a state is predicted in which the boarding car 1A is congested, the change request generating section 16 notifies the operation information reviewing section 17 of a boarding car changing request signal. Here, although the detailed description is omitted, the change request generating section 16 may set a threshold to determine whether to generate a boarding car changing request signal with the addition of long waiting information in the past.

10 [0051]

Upon receiving the boarding car changing request signal, the operation information reviewing section 17 reviews, in Step S3 to Step S8 described below, operation information about the original boarding car and operation information about the changed boarding car in the case in which the boarding car is changed based on various pieces of information taken from the operation information management section 14.

[0052]

20 First, in Step S3, a destination floor stop confirmation determination function of the operation information reviewing section 17 determines whether the boarding car 1A is confirmed to stop at the second floor, which is the destination floor for passenger B.

25 [0053]

When the function determines that the boarding car 1A is confirmed to stop at the second floor in Step S3, the process goes to Step S4. In Step S4, a full passenger capacity prediction determination function of the operation information reviewing section 17 determines whether the boarding car 1A, which passenger B is scheduled to board, is predicted to be filled to capacity. In the case in which the boarding car 1A is confirmed to stop at the destination floor for passenger B in Step S3 and the boarding car 1A is not predicted to be filled to capacity in Step S4, passenger B can go to the destination floor, which is the second floor, on the boarding car 1A as usual. Thus, the process goes to the end as well, and the process is ended.

[0054]

In contrast to this, in the case in which the destination floor stop confirmation determination function determines that the boarding car 1A is not confirmed to stop at the second floor, which is the destination floor for passenger B, in Step S3, and in the case in which the full passenger capacity prediction determination function predicts that the boarding car 1A is not filled to capacity in Step 4, the process goes to Step S5. Here, the prediction accuracy of full passenger capacity can be improved by prediction with the utilization of not only use information collected from the detecting units but also

learning elevator use situations on a daily basis, the present use situations in the inside of the building using sensors, passenger flow simulation based on passenger flow information on a daily basis, and any other information.

5 [0055]

In Step S5, the destination floor stop confirmation determination function of the operation information reviewing section 17 determines whether there is another boarding car (1B to 1N) scheduled to stop at the destination  
10 floor for passenger B (the second floor). As a result, in the case in which there is a boarding car to stop at the destination floor, the process goes to Step S6, whereas in the case in which there is no boarding car to stop at the destination floor, the process goes to Step S7.

15 [0056]

In Step S6, a temporary change function of the operation information reviewing section 17 temporarily changes assignment to all the boarding cars scheduled to stop at the destination floor for passenger B (the second  
20 floor). On the other hand, in Step S7, the function temporarily changes assignment to all the boarding cars that are not scheduled to stop at the second floor and are not predicted to be filled to capacity. With this configuration, the assignment candidates for the boarding car are  
25 determined except the boarding car 1A for passenger B. A

boarding car suitable for passenger B who will not wait for an elevator for a long time is selected from the assignment candidates.

[0057]

5           As described above, passenger A who is going to the third floor on the boarding car 1A is already detected, and passenger B who is going to the second floor on the boarding car 1A is then detected. At this point in time, in the case in which a situation arises in which the passenger load  
10 factor of the boarding car 1A exceeds a predetermined set value, 80%, for example, and congestion is predicted, passenger A is to use the boarding car 1A according to the passenger-specific boarding car fixing method with no change. However, for passenger B who is going to the second floor,  
15 the boarding car is changed to at least one boarding car, which is not the boarding car 1A according to the passenger-specific boarding car fixing method, for split dispatching elevators. After the candidates for the boarding car for passenger B are determined, the process goes to Step S8.  
20 Here, a predetermined set value for the passenger load factor is changed according to hours or traffic flows, and hence convenience or operation efficiency can be further improved.

[0058]

After that, in Step S8, a round-trip time determination function of the operation information reviewing section 17 generates the predicted operation routes of the boarding cars having been temporarily changed and calculates the round-trip time for the boarding cars. The function takes into account of predicted operation route information about a boarding car having the smallest increase in round-trip time from the boarding cars, and determines a change to the boarding car that is suitable.

10 [0059]

Here, the term "round-trip time" means required time from the departure of a boarding car at the departure floor for providing services to the return of the boarding car again at the departure floor. The required time for all the boarding cars whose assignment has been temporarily changed in Steps S6 and S7 is calculated. When it is supposed that the boarding car 1B is determined here, for example, the boarding car 1B is to stop at the second floor that is the destination floor for passenger B, although the boarding car 1B does not stop at the second floor in normal operation.

20

[0060]

The boarding car control unit 2B adjusts the operation route of the boarding car 1B traveling between the first floor and the fourth floor before changed, and changes the operation route to the operation route after changed for

25

providing services at the first floor, the second floor, and the fourth floor. With this change, passenger B can get on the boarding car 1B, and hence passenger B does not have to wait for an elevator for a long time. Note that, after

5 passenger B gets off the boarding car 1B at the second floor, the boarding car control unit 2B again returns the operation route to the original operation route before changed.

Naturally, when a boarding car to stop at the second floor is available, the service to stop at the second floor can be  
10 provided for passenger B without changing any operation route.

[0061]

As apparent from the description of the processes, the operation information reviewing section 17 is the  
15 function to determine a suitable boarding car among boarding cars except the boarding car 1A according to the passenger-specific boarding car fixing method when the boarding car 1A, which is predicted to be congested, is not confirmed to stop at the destination floor for passenger B or when a situation  
20 is predicted in which the boarding car 1A is filled to capacity even though the boarding car 1A is confirmed to stop at the destination floor for passenger B. After the boarding car is changed to the boarding car having the smallest increase in round-trip time in Step S8, the process  
25 goes to Step S9.

[0062]

Here, the operation information reviewing section 17 monitors whether passenger B arrives at the hall based on information provided from the arrival detecting section 8 of the passenger management unit 3. Consequently, when the  
5 hall arrival detecting unit 4 detects passenger B in Step S9, the detection information is notified to the operation information reviewing section 17, and at this point in time, the operation information reviewing section 17 sends review  
10 information to the operation information determining section 18. After the review information is sent, the process goes to Step S10. Note that, the operability of the elevator cars at equal intervals based on a predetermined estimated interval is also used as an evaluation index, and hence  
15 waiting time is made much shorter.

[0063]

In Step S10, upon receiving the review information, the operation information determining section 18 sends change information to the change information notifying  
20 section 13 of the passenger management unit 6. The change information notifying section 13 informs passenger B of boarding car change information and any other information that the boarding car after changed is the boarding car 1B by display, speech, or the combination of display and speech  
25 through the informing unit 5 illustrated in Fig. 2.

[0064]

On the other hand, in the case in which the arrival of passenger B is not detected in Step S9, the process goes to Steps S11 and 12 to delete the changed route. In Step  
5 S11, it is determined whether the assigned boarding car 1B has departed. In the case in which the boarding car 1B does not depart yet, the process returns to Step S9, and waits for the arrival of passenger B. That is, the operation information reviewing section 17 continues monitoring until  
10 the boarding car whose assignment has been changed departs the hall floor in Step S11. When it is determined that the assigned boarding car 1B has already departed in Step S11, the process goes to Step S12.

[0065]

15 In Step S12, in the case in which the changed boarding car 1B has already departed at the arrival of passenger B at the hall, or in the case in which the changed boarding car 1B has already departed with no arrival of passenger B at the hall, information about the floor for  
20 stop (the second floor), which is a stop floor for passenger B, is deleted from the boarding car control unit 2B.

[0066]

As described above, suppose that passenger A who is going to the third floor on the boarding car 1A is already  
25 detected, passenger B who is going to the second floor on

the boarding car 1A is then detected, and at this point in time, a situation arises in which the passenger load factor of the boarding car 1A exceeds a predetermined set value and congestion is predicted. Passenger A is to use the boarding  
5 car 1A with no change. However, for passenger B who is going to the second floor, the boarding car is changed to the boarding car 1B, for example, for split dispatching elevators. The operation route of the boarding car 1B is changed to provide services to stop at the second floor for  
10 passenger B. Naturally, when a boarding car to stop at the second floor is available, services to stop at the second floor for passenger B are enabled with no change in the operation route.

[0067]

15 Passenger B usually goes to the second floor using the boarding car 1A according to the passenger-specific boarding car fixing method. However, in the case in which by the above-described process, the round-trip time determination function of the operation information  
20 reviewing section 17 selects the boarding car 1B, for example, which is a boarding car having the smallest increase in round-trip time, the boarding car 1B illustrated in Fig. 3 stops at the second floor, and passenger B gets off the boarding car 1B at the second floor.

25 [0068]

Therefore, even though the boarding car 1A is congested, the passengers using the boarding car 1A do not have to wait for elevators for a long time as well as passenger B who changes to the boarding car 1B does not have to wait for an elevator for a long time. Thus, the operation efficiency of the entire building can be improved.

[0069]

Here, an increase in round-trip time can be more accurately calculated by a method with which passengers are predicted to enter the back of the car in order of arrival of the passengers at the entrance of the boarding car and disembarking time and re-embarking time are calculated based on the disembarking floors to the embarking positions in the elevator car.

[0070]

A congestion prediction determination function of the change request generating section 16 determines the prediction of congestion. In the case in which congestion is predicted, the function can change the boarding car assigned for passenger B so as to prevent the passengers on the boarding car from waiting for a long time. This configuration can avoid the occurrence of a situation in which passengers over the capacity crowd toward a boarding car and fail to enter the car, and can prevent passengers from waiting for elevators for a long time.

[0071]

Moreover, since the access of passenger B to the boarding car 1A in congestion is changed, the boarding car 1A provides services to stop at the scheduled destination floors for passengers except passenger B. Thus, an increase in round-trip time can be prevented. Here, the prediction of congestion situations can be more accurately calculated using the occupancy of persons in the car in association with personal data.

10 [0072]

The informing unit 5 configured to inform the first passenger B of the content of the change is installed at the hall as illustrated in Fig. 1. Thus, boarding car change information can be provided at the timing at which passenger B is detected at the hall arrival detecting unit 4, and information can be reliably notified with no confusion even though the operation is different from normal operation.

[0073]

When the information provided by the informing unit 5 is limited to information about changing the boarding car, more smooth operation is enabled with no confusion. Here, sending the content of the change to the portable terminal owned by each person also enables the elimination of the informing unit 5. With the combination use of the portable terminal and the informing unit 5, the portable terminal can

20

25

be used as an auxiliary device in the case in which confirmation of the content of the change is difficult using the informing unit 5 in busy hours, for example.

## 5 Second Embodiment

[0074]

Next, a second embodiment of the present invention will be described. The embodiment is different from the first embodiment in that Step 8 shown in Fig. 5 is changed.

10 The control steps except Step 8 are the same, and the description is omitted. Fig. 6 is a flowchart of a boarding car changing process according to the second embodiment performed by the group-control elevator device.

[0075]

15 In the embodiment described above, in Step S8, round-trip time is calculated for each of the temporarily changed boarding cars, and it is determined that assignment is changed to the boarding car having the smallest increase in round-trip time among the temporarily changed boarding cars.

20 [0076]

In contrast to this, in the embodiment, in Step S13 that is the replaced step from Step S8, the predicted operation routes of the temporarily changed boarding cars are generated, round-trip time is calculated for each of the  
25 temporarily changed boarding cars, and the boarding car

having the most average round-trip time of all the boarding cars is determined as a boarding car whose assignment is to be changed among the temporarily changed boarding cars.

[0077]

5           According to the boarding car changing process as described above, the waiting time for each of the boarding cars can be averaged, and hence operation services, as the entire device, can be further improved as well.

#### 10   Third Embodiment

[0078]

Next, a third embodiment of the present invention will be described. Also in the embodiment, the embodiment is different from the first embodiment in that Step 8 shown  
15   in Fig. 5 is changed. The control steps except Step 8 are the same, and the description is omitted. Fig. 7 is a flowchart of a boarding car changing process according to the third embodiment performed by the group-control elevator device.

20   [0079]

In the embodiment described above, in Step S8, round-trip time is calculated for each of the temporarily changed boarding cars, and it is determined that assignment is changed to the boarding car having the smallest increase in  
25   round-trip time among the temporarily changed boarding cars.

[0080]

In contrast to this, in the embodiment, in Step S14 that is the replaced step from Step S8, the predicted operation routes of the temporarily changed boarding cars are generated, and a boarding car having the average interval of arrival at the lobby floor is determined as a boarding car whose assignment is to be changed based on predicted operation route information.

[0081]

10 According to the boarding car changing process as described above, the arrival intervals are averaged based on the lobby floor that is the reference floor. Thus, waiting time at the reference floor where congestion is predicted is averaged, and operation services, as the entire device, can  
15 be further improved as well.

Forth Embodiment

[0082]

Next, a fourth embodiment of the present invention  
20 will be described. Also in the embodiment, the embodiment is different from the first embodiment in that Step 8 shown in Fig. 5 is changed. The control steps except Step 8 are the same, and the description is omitted. Fig. 8 is a flowchart of a boarding car changing process according to

the fourth embodiment performed by the group-control elevator device.

[0083]

In the embodiment described above, in Step S5, round-trip time is calculated for each of the temporarily changed boarding cars, and it is determined that assignment is changed to the boarding car having the smallest increase in round-trip time among the temporarily changed boarding cars. In the embodiment, Step S8 is replaced by Steps S15 to S18.

10 [0084]

In Step S15, a second round waiting time determination function of the operation information reviewing section 17 calculates, based on operation scheduled route information, waiting time for each of second round passengers who are getting on boarding cars whose assignment has been temporarily changed. In Step S16, the second round waiting time determination function determines whether there are boarding cars available for second round passengers in a short time using the calculated waiting time.

20 As a result of this determination, in the case in which there are boarding cars available in a short time, in Step S17, the second round waiting time determination function changes assignment from the boarding cars available for the second round passenger in a short time to a boarding car  
25 available for passenger B in the shortest waiting time among

the boarding cars whose assignment has been temporarily changed.

[0085]

On the other hand, as a result of determination in  
5 Step S16, in the case in which there is no boarding car  
available in a short time, in Step S18, the second round  
waiting time determination function changes assignment to  
the boarding car available for passenger B in the shortest  
waiting time among the boarding cars whose assignment has  
10 been temporarily changed.

[0086]

According to the boarding car changing process as  
described above, assignment is changed while waiting time  
for the second round passenger is shortened. Thus,  
15 operation services, as the entire device, can be further  
improved as well while the influence of long waiting time  
caused by changing assignment is minimized.

[0087]

As described above, according to the present  
20 invention, the destination floor is determined based on  
personal identification information about a passenger. A  
boarding car that provides services at the determined  
destination floor is assigned. When the boarding car  
assigned for the passenger is predicted to be congested, a  
25 request for changing the boarding car assigned for the

passenger is generated. When the boarding car that is predicted to be congested is not confirmed to stop at the destination floor for the passenger, or when the boarding car is predicted to be filled to capacity even though the boarding car is confirmed to stop at the destination floor for the passenger, a boarding car whose assignment is to be changed can be determined among boarding cars except the predicted boarding car.

[0088]

With this configuration, the boarding car assigned for the passenger is changed so as not to generate long waiting time caused by unbalanced use while the operation efficiency of the entire building is improved. The configuration can avoid the occurrence of a situation in which passengers over the capacity crowd toward one car and fail to enter the car, and can prevent passengers from waiting for elevators for a long time.

[0089]

In the embodiment, a configuration may be provided in which as described in Step S10, for example, in order to match temporal timing with the arrival of passenger B at the hall, predicted time from the building arrival detecting units 3A to 5N to the hall arrival detecting unit 4 or to the elevator entrances is stored in advance, and assignment is changed with these temporal elements reflected.

[0090]

The present invention is not limited to the above-described embodiments, and includes various exemplary modifications. The above-described embodiments are  
5 described in detail for easily understanding the present invention, for example. The present invention is not necessarily limited to configurations having all the configurations described so far. A unit of the configuration of an embodiment can be replaced by the  
10 configuration of another embodiment. The configuration of another embodiment can also be added to the configuration of an embodiment. A unit of the configurations of the embodiments can include the addition, removal, or replacement of another configuration.

15

#### Reference Signs List

[0091]

1A to 1N...boarding car

2A to 2N...boarding car control unit

20 3A to 3N...building arrival detecting unit

4...hall arrival detecting unit

5...informing unit

6...passenger management unit

7...group management control unit

25 9...passenger information management section

- 13...change information notifying section
- 16...change request generating section
- 17...operation information reviewing section
- 18...operation information determining section

{CLAIMS}

1. A group-control elevator device comprising:

a plurality of boarding cars configured to provide a  
5 service to a preset floor; and

a group management unit configured to identify a  
passenger and assign the boarding car to provide a service  
at a floor corresponding to the passenger,

wherein the group management unit includes

10 a change request generating section configured  
to assign, for the passenger, the boarding car to provide a  
service at a destination floor determined from personal  
identification information about the passenger, the change  
request generating section being configured to generate a  
15 request for changing the boarding car assigned for the  
passenger when the boarding car assigned for the passenger  
is predicted to be congested,

an operation information reviewing section  
configured to assign, when the boarding car predicted to be  
20 congested is not confirmed to stop at the destination floor  
for the passenger or when the boarding car is predicted to  
be filled to capacity even though the boarding car is  
confirmed to stop at the destination floor for the passenger,  
the boarding car that has to be changed among the boarding  
25 cars except the boarding car, and

an operation information determining section configured to determine the boarding car after changed as the boarding car for the passenger and inform the passenger.

5    2.        The group-control elevator device according to claim 1,

             wherein the operation information reviewing section includes

             a floor stop determination function configured to  
10    determine whether another boarding car of the boarding cars to stop at the destination floor for the passenger is present when the boarding car predicted to be congested is not confirmed to stop at the destination floor for the passenger, or when the boarding car is predicted to be  
15    filled to capacity even though the boarding car is confirmed to stop at the destination floor for the passenger,

             a temporary assignment function configured to temporarily assign the boarding car to stop at the destination floor when the other boarding car to stop at the  
20    destination floor for the passenger is present, and to temporarily assign all the boarding cars except the boarding car to be filled to capacity when the other boarding car to stop at the destination floor for the passenger is not present, and

a boarding car determination function configured to determine one boarding car that has to be changed among the temporarily assigned boarding cars based on a predetermined condition.

5

3. The group-control elevator device according to claim 1,

wherein: the group management unit receives an input of information from a hall arrival detecting unit installed at a hall, the hall arrival detecting unit being configured to detect arrival of the passenger at the hall and an input of information from a building arrival detecting unit configured to detect personal identification information about the passenger going to the hall, the building arrival detecting unit being configured to detect the personal identification information before the detection of the arrival of the passenger at the hall at the hall arrival detecting unit; and

the group management unit extracts pre-stored destination floor information from the personal identification information detected at the building arrival detecting unit.

4. The group-control elevator device according to claim 3,

25

wherein: when the hall arrival detecting unit detects the passenger, the operation information reviewing section sends information about the boarding car that has to be changed to the operation information determining section;

5 and

the operation information determining section informs the passenger of information about the changed boarding car through an informing unit installed at the hall.

10 5. The group-control elevator device according to claim 3,

wherein when the changed boarding car does not stop at the destination floor for the passenger, the operation information determining section changes an operation route  
15 so that the changed boarding car stops at the destination floor for the passenger.

6. The group-control elevator device according to claim 3,

20 wherein the boarding car determination function of the operation information reviewing section selects the boarding car having a smallest increase in round-trip time, or the boarding car having a most average round-trip time, or the boarding car having an average interval of arrival at

a lobby floor, or the boarding car having a short second round waiting using operation route information.

7. The group-control elevator device according to claim

5 5,

wherein when the changed boarding car has already departed at arrival of the passenger at the hall, or when the changed boarding car has already departed before arrival of the passenger at the hall, the operation information  
10 determining section deletes floor stop information about a floor at which the changed boarding car is scheduled to stop for the passenger from an operation route of the changed boarding car.

15 8. A method of assigning a boarding car by group control for a group-control elevator device, the device including a plurality of boarding cars configured to provide a service to a preset floor, and

a group management unit configured to identify a  
20 passenger and assign the boarding car to provide a service at a floor corresponding to the passenger,

wherein: the group management unit assigns, for the passenger, the boarding car to provide a service at a destination floor determined from personal identification  
25 information about the passenger, and the group management

unit generates a request for changing the boarding car assigned for the passenger when the boarding car assigned for the passenger is predicted to be congested;

when the boarding car predicted to be congested is  
5 not confirmed to stop at the destination floor for the passenger, or when the boarding car is predicted to be filled to capacity even though the boarding car is confirmed to stop at the destination floor for the passenger, the group management unit assigns the boarding car that has to  
10 be changed among the boarding cars except the boarding car;  
and

the group management unit determines the boarding car after changed as the boarding car for the passenger and inform the passenger.

15

9. The method of assigning a boarding car by group control according to claim 8,

wherein: when the boarding car predicted to be congested is not confirmed to stop at the destination floor  
20 for the passenger, or when the boarding car is predicted to be filled to capacity even though the boarding car is confirmed to stop at the destination floor for the passenger, the group management unit determines whether another boarding car of the boarding cars to stop at the destination  
25 floor for the passenger is present;

when the other boarding car to stop at the destination floor for the passenger is present, the group management unit temporarily assigns the boarding car to stop at the destination floor, and when the other boarding car to stop at the destination floor for the passenger is not present, the group management unit temporarily assigns all the boarding cars except the boarding car to be filled to capacity; and

the group management unit determines one boarding car that has to be changed among the temporarily assigned boarding cars based on a predetermined condition.

10. The method of assigning a boarding car by group control according to claim 9,

wherein when a hall arrival detecting unit detects the passenger, the group management unit informs the passenger of information about the changed boarding car through an informing unit installed at the hall.

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/069231

## A. CLASSIFICATION OF SUBJECT MATTER

B66B1/18 (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)

B66B1/18

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 | 1996-2015 |
| Kokai Jitsuyo Shinan Koho | 1971-2015 | Toroku Jitsuyo Shinan Koho | 1994-2015 |

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 2635128 B2 (Hitachi, Ltd.),<br>30 July 1997 (30.07.1997),<br>page 2, right column, line 21 to page 4, right<br>column, line 6; fig. 1 to 17<br>(Family: none)                                     | 1-10                  |
| A         | JP 5660142 B2 (Mitsubishi Electric Corp.),<br>28 January 2015 (28.01.2015),<br>paragraphs [0013] to [0040]; fig. 1 to 2<br>& US 2013264150 A1 & KR 20130126689 A<br>& EP 2669231 A1 & CN 103269964 B | 1-10                  |
| A         | JP 2666776 B2 (Hitachi, Ltd.),<br>22 October 1997 (22.10.1997),<br>paragraphs [0010] to [0037]; fig. 1 to 7<br>(Family: none)                                                                        | 1-10                  |



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

14 September 2015 (14.09.15)

Date of mailing of the international search report

29 September 2015 (29.09.15)

Name and mailing address of the ISA/

Japan Patent Office  
3-4-3, Kasumigaseki, Chiyoda-ku,  
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/JP2015/069231

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                           | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | JP 52-101551 A (Hitachi, Ltd.),<br>25 August 1977 (25.08.1977),<br>page 2, lower left column, line 9 to page 4,<br>upper left column, line 16; fig. 1 to 4<br>(Family: none) | 1-10                  |