

DESCRIPTION

Title of Invention: ELEVATOR GROUP CONTROL SYSTEM

Technical Field

5 [0001]

The present invention relates to an elevator group control system that supervises a plurality of elevators.

Background Art

[0002]

10 An elevator system is a transportation system in the vertical direction in a building, and in particular, in a large building, is configured of a system including a plurality of elevators and elevator group control that supervises these as one group. The purpose of such
15 elevator system is to transport as many users as possible to the target floors per predetermined time, and in particular, this is important at times of use congestion e.g. during the time of office-going and at lunchtime.

[0003]

20 For example, for the technique described in Patent Literature 1, there is described the example of control in which the number of waiting passengers on a particular floor is detected, and a car in door-closed standby mode in the state where the number of waiting passengers is
25 maximum car rider occupancy is selected to the next car in

door-open standby mode.

[0004]

Also, for the technique described in Patent Literature 2, there is described a group control system that controls a plurality of elevators, in which the degree of demand is determined from statistical data, and to a call that exceeds a threshold value corresponding to the rated number of persons equal to maximum car rider occupancy, a plurality of cars are allocated.

10 Citation List

Patent Literature

[0005]

PTL 1: Japanese Patent Application Laid-Open No. Hei 3-256980

15 PTL 2: Japanese Patent Application Laid-Open No. 2011-195280

Summary of Invention

Technical Problem

[0006]

20 However, in the technique described in Patent Literature 1, only the number of waiting passengers at the landing is considered, but the state of the car already in door-open standby mode is not considered, with the result that the timing for opening the car in door-closed standby mode to be the next car in door-open standby mode is not

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recognized, and after all, there is a problem that until the car in door-open standby mode has the predetermined load or the predetermined time elapses, the door of the car in door-closed standby mode to be the next car in door-open standby mode cannot be opened. As a result, even when the number of waiting passengers is large at times of congestion, the door of the car in door-closed standby mode cannot be opened until the above conditions are satisfied, and it thus takes long time to open the door, with the result that the waiting time until boarding onto the car becomes long. Also, when at times of congestion, the door of the car is simply opened to a large number of waiting passengers, there is a possibility that due to an insufficient number of cars, an excessive number of passengers are caused for boarding, and consequently, there is a fear that the number of persons transported cannot be increased.

[0007]

Also, the technique described in Patent Literature 2 has the idea to allocate, only on the basis of the degree of demand at a certain point of time, a plurality of cars according to it, and when the time has elapsed and the cars have already been delivered, it is not possible to recognize, only on the basis of the degree of demand at that time, whether the number of cars is appropriate, so

that the states of the cars that have already been delivered are also required to be considered. The elevator demand is changed every minute at the short time level per minute, and further, unless in consideration of
5 the riding states of the elevator cars, the control further responding to state is executed, it is difficult to deliver the appropriate number of cars.

Solution to Problem

[0008]

10 To achieve the above object, the present invention provides an elevator group control system that controls the operation of a plurality of cars including means for detecting the number of users present at an elevator landing on a predetermined floor, means for detecting the
15 number of riders in cars that are stopped with opened doors on the predetermined floor, means for calculating, on the basis of the number of users at the landing and the number of riders in the cars, the number of cars to be stopped with closed doors on the predetermined floor, and
20 means for opening the doors of any cars that are stopped with closed doors on the predetermined floor.

Advantageous Effects of Invention

[0009]

According to the present invention, the users are
25 enabled to efficiently board the cars and to be

transported, and the waiting time of all the users with respect to the elevators can be shortened.

Brief Description of Drawings

[0010]

5 Figure 1 is a block diagram of the entire system according to Example 1.

 Figure 2 is a functional block diagram of the entire system according to Example 1.

 Figure 3 is a diagram illustrating the idea of door-
10 open standby mode control according to Example 1.

 Figure 4 is a flowchart for controlling the door-open standby mode of cars according to Example 1.

 Figures 5 are diagrams illustrating the examples of the operation of the door-open standby mode control
15 according to Example 1.

 Figures 6 are diagrams illustrating the examples of the operation of the door-open standby mode control according to Example 1.

 Figures 7 are diagrams illustrating the examples of
20 the operation of the door-open standby mode control according to Example 1.

 Figure 8 is a diagram illustrating the example of the operation of the door-open standby mode control according to Example 1.

25 Figure 9 is a flowchart for selecting the car in

door-open standby mode according to Example 1.

Figure 10 is a flowchart for generating the guidance information of the car in door-open standby mode according to Example 1.

5 Figure 11 is a diagram illustrating the examples of information guidance concerning the cars in door-open standby mode according to Example 1.

Figure 12 is a diagram illustrating the examples of information guidance concerning the cars in door-open
10 standby mode according to Example 1.

Figure 13 is a diagram illustrating the installation examples of the information guidance concerning the cars in door-open standby mode according to Example 1.

Figure 14 is a functional block diagram of the
15 entire system according to Example 2.

Figure 15 is a flowchart for controlling the door-open standby mode of cars according to Example 2.

Description of Embodiments

[0011]

20 An elevator group control system of Example 1 will be described.

<Example 1>

[0012]

As means for moving in the vertical direction in a
25 building, an elevator system smoothly and safely

transports a large number of users every day. In particular, in a large building, the number of users is large, so that a plurality of elevators are installed, and a group control system supervises these elevators as one
5 group.

[0013]

One of the most important performance indexes of the elevator system is transport capacity that represents the number of persons transported per predetermined time (that
10 is calculated by the number of persons transported / the predetermined time), and at times of use congestion e.g. during the time of office-going and at lunchtime, in an office building, measures of how to improve the transport capacity are important. To improve the transport capacity,
15 the point is that a larger number of persons are transported for a shorter time, and a solution thereof focuses on the effective use of elevator cars standing by at an elevator landing on a congested floor, such as a lobby floor.

20 [0014]

Here, first, the control of elevator cars in standby mode in the typical elevator group control system will be described. Executed is the operation in which when there are a plurality of elevator cars in standby mode at an
25 elevator landing on a certain floor, in principle, the

door of only one car is opened (or the door of the car and the landing is opened), and the remaining cars are brought into standby mode with closed doors. This is done so as to avoid the lowering of the operation efficiency since
5 when a plurality of cars are brought into door-open standby mode on the same floor, the users who have boarded the cars earlier press the door close buttons in the cars to allow the cars to leave, and the cars with a few number of persons therein leave successively.

10 [0015]

For this, the operation is executed in such a manner that even when there are a large number of users at the elevator landing at times of congestion, in principle, only one car is brought into door-open standby mode, and
15 the users are allowed to board the one car in door-open standby mode first. Here, at times of congestion, basically, many elevator cars are running with the users therein, and the number of cases where a plurality of elevators in standby mode are caused is small, so that
20 typically, there are no problems in such operation.

[0016]

However, when the number of elevators group-controlled is large (for example, 8 or more), and further, when one cycle time for moving up and down is short e.g.
25 due to a small number of service floors, the possibility

that a plurality of elevators in standby mode are caused at the landing even at times of congestion arises. In particular, it is considered that as the number of elevators is larger, the number of such cases is increased.

5 [0017]

The example of this embodiment has an aim in which in the state where the users successively come to an elevator landing on a particular floor e.g. during the time of office-going and in the latter half of lunchtime, when in particular, by targeting the group control of a large number of elevators, there are a plurality of elevators in standby mode at the landing on that floor, they are effectively used to improve the transport capacity. In the state where there are a plurality of elevators in standby mode at an elevator landing on a predetermined floor, such as a lobby floor and a restaurant floor, and the users successively come to the landing at times of congestion, the basic ideas of the effective use of the elevators in standby mode are as follows.

20

[0018]

(1) The number of users present at the elevator landing and the number of riders in the elevator cars already in door-open standby mode are detected, and the elevator car to be brought into door-open standby mode in

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real-time (from moment to moment and successively) is set so as to be suitable for the use state of these (the number of users) (or a plurality of cars are selected according to state), and is controlled.

5 [0019]

(2) Each user is guided to each of a plurality of elevator cars brought into door-open standby mode so that the user is enabled to smoothly board the car without wasting time and that the car is prevented from leaving
10 with a few number of persons therein.

[0020]

In particular, the idea of (1) is primarily important, and when the number of cars whose doors are to be opened is small with respect to the number of users,
15 the users unnecessarily waiting at the landing are caused, and on the contrary, when the number of cars whose doors are to be opened is large with respect to the number of users, the cars with a small number of persons therein are allowed to leave, or the cars are brought into standby
20 mode for a long time, so that in any case, the transport capacity is lowered.

[0021]

The example of the embodiment on the basis of the ideas of the effective use of the cars in door-open
25 standby mode of (1) and (2) will be described below with

reference to Figures 1 and 2.

[0022]

First, Figure 1 illustrates a functional block diagram of the entire system. From the left of the drawing, the entire configuration includes input information (landing call, the number of persons at the entrance of a building, in the building, at an elevator landing, and in cars, and time), means 100 for controlling elevator group control, means 200 for controlling elevator (This means is provided in each of a plurality of elevators, but in this drawing, one of the means 200 for controlling elevator is illustrated as a representative.), an elevator 300 (This means is also provided in each of the plurality of elevators, but in this drawing, one of the elevators 300 is illustrated as a representative.), and means 400 for providing guidance information concerning cars in door-open standby mode. In the flow of control, the means 100 for controlling elevator group control supervises each means 200 for controlling elevator, and the means 200 for controlling elevator controls each elevator 300 according to this.

[0023]

The means 100 for controlling elevator group control includes means 110 for controlling landing call allocation, means 120 for controlling delivery of car to predetermined

floor, means 130 for detecting traffic state in building,
and means 140 for controlling door-open standby mode in
response to use state in real-time. The means 110 for
controlling landing call allocation allocates the elevator
5 car providing service with respect to a landing call, and
the means 120 for controlling delivery of car to
predetermined floor executes, at times of congestion e.g.
during the time of office-going, control to deliver the
elevator car (the car that has completed the service with
10 respect to the call) to a congested floor (e.g. during the
time of office-going, a lobby floor). For the means 110
for controlling landing call allocation, the allocation of
a plurality of cars is present, and for the means 120 for
controlling delivery of car to predetermined floor, the
15 control to deliver a plurality of cars is present. The
means 130 for detecting traffic state in building detects,
from the information of time and the number of persons,
the traffic state e.g. during the time of office-going and
at lunchtime, and the car delivery control is executed on
20 the basis of the detection information.

[0024]

The means 140 for controlling door-open standby mode
in response to use state in real-time executes the main
control of this example. Here, in the state where a
25 plurality of elevator cars are stopped (standby) on a

particular floor by the landing call allocation and the car delivery control, the elevator cars to be brought into door-open standby mode are controlled in response to the number of users at the landing and the number of persons in the elevator cars in real-time. The feature here is that the cars in number according to the state of the number of users are brought into door-open standby mode. The input information of the control includes the information of the number of persons at the entrance of the building, in the building, at the elevator landing, and in the cars, and the state information of each car (door-open state, door-closed state, stop, and the like) obtained from the means 200 for controlling elevator. The means 400 for providing guidance information concerning cars in door-open standby mode provides the information concerning the cars in door-open standby mode to the users at the elevator landing, and guides the users to smoothly board the car in door-open state.

[0025]

As described above, when a plurality of cars are stopped on the predetermined floor at times of congestion by the landing call allocation and the car delivery control, the means 140 for controlling door-open standby mode in response to use state in real-time effectively uses the cars according to the state of the users (or

opens the doors to allow the users to board the cars), thereby increasing the transport efficiency. The detail of the means for controlling the door-open standby mode will be described below with reference to Figure 2.

5 [0026]

Figure 2 illustrates a functional block diagram of the entire system mainly executing the door-open standby mode control. In the entire configuration, the means 200 for controlling each elevator, each elevator 300, and the
10 means 400 for providing guidance information concerning cars in door-open standby mode that gives output information from the group control toward the users are the same as Figure 1, and the description thereof is omitted. Portions other than this correspond to the means
15 for controlling door-open standby mode in response to use state in real-time in Figure 1. This portion will be described below.

[0027]

The portion that configures the door-open standby
20 mode control in Figure 2 is largely divided into three means: means 141 for determining, in real-time, to execute door-open standby mode, means 142 for selecting car in door-open standby mode, and means 143 for controlling car in door-open standby mode. From the input information of
25 the number of users at the elevator landing, the number of

riders in the cars already in door-open standby mode, and the like, the means 141 for determining, in real-time, to execute door-open standby mode determines whether or not the doors of any cars in door-closed standby mode on a target floor are opened. The point is that necessary information is calculated and determined inside the means 141 for determining, in real-time, to execute door-open standby mode so as to be capable of responding to the use state in real-time. When it is determined that the doors of any cars in door-closed standby mode are opened, the means 142 for selecting car in door-open standby mode selects, from among the cars in door-closed standby mode, the car in door-closed standby mode to be brought into door-open standby mode. The means 143 for controlling car in door-open standby mode outputs the instruction to open the door of the selected car (in door-closed standby mode) to the means 200 for controlling elevator of the car. As a result, the car opens the door so as to be brought into door-open standby mode, and the users present at the landing can board the car.

[0028]

In the configuration of the control of the cars in door-open standby mode, essential is the means 141 for determining, in real-time, to execute door-open standby mode, and the detail of this will be described below. The

means 141 for determining, in real-time, to execute door-open standby mode includes means 1411 for calculating number of persons able to board cars already in door-open standby mode, means 1412 for calculating number of users
 5 unable to board cars already in door-open standby mode, and means 1413 for determining whether to open doors of cars in door-closed standby mode.

[0029]

First, the means 1411 for calculating number of
 10 persons able to board cars already in door-open standby mode uses the number of riders in the car already in door-open standby mode that is detected by means 502 for detecting number of riders in cars already in door-open standby mode, the number of cars already in door-open
 15 standby mode that is detected by means 201 for detecting number of cars already in door-open standby mode, and maximum car rider occupancy that is set by means 150 for setting maximum car rider occupancy, thereby calculating the number of persons able to board the car already in
 20 door-open standby mode (in the case of a plurality of cars, the total number of persons) by the following equation.

[0030] [Expression 1]

$$\begin{array}{l} \text{The number of} \\ \text{persons able to board} \end{array} = \sum_{\substack{\text{The number of cars} \\ \text{already in door-open standby mode}}} \begin{array}{l} (\text{The maximum car rider occupancy} - \\ \text{The number of riders in the car} \\ \text{already in door-open standby mode}) \end{array}$$

.. Equation 1

[0031]

In Equation 1, with respect to each car with an opened door, the number of riders in the car at that point is subtracted from the maximum car rider occupancy of the car, and the number of persons able to board the car from now is calculated, so that by totaling such numbers of persons able to board, the number of persons able to board all the cars in door-open standby mode is calculated.

Here, the means 502 for detecting number of riders in cars already in door-open standby mode includes a load sensor in the car and an image sensor (a camera and the like) in the car. Also, the means 201 for detecting number of cars already in door-open standby mode detects the number of cars already in door-open standby mode from the data in the means 200 for controlling elevator (Actually, the means 201 for detecting number of cars already in door-open standby mode uses the data in the means for controlling elevator as is rather than detects the number of cars already in door-open standby mode from the data in the means 200 for controlling elevator.). The means 150 for setting maximum car rider occupancy sets the substantial maximum occupancy value of the number of persons riding the car. This value is the value of 60% to 80% of the rated number of riders in the car, and is set

to the value according to the state of the building (This is executed by automatic setting by machine learning, setting by the operator, and the like.). The means 150 for setting maximum car rider occupancy provides the
5 function of the means 100 for controlling elevator group control (Figure 1).

[0032]

Next, the means 1412 for calculating number of users unable to board cars already in door-open standby mode
10 uses the number of persons able to board the cars already in door-open standby mode that is calculated by the means 1411 for calculating number of persons able to board cars already in door-open standby mode and the number of users at the elevator landing and in vicinity thereof that is
15 detected by means 501 for detecting number of users at elevator landing and in vicinity thereof, thereby calculating the number of users unable to board the cars already in door-open standby mode. This is, in another representation, the same meaning as the number of users
20 that is excessive with respect to the cars already in door-open standby mode, and this is, in a further representation, the same meaning as the number of users left at the elevator landing and in vicinity thereof with respect to the cars already in door-open standby mode.
25 The calculation equation is as follows.

[0033]

The number of users unable to board = the number of users at the landing and in vicinity thereof - The number of persons able to board .. Equation (2)

5 Here, the means 501 for detecting number of users at elevator landing and in vicinity thereof includes an image sensor and a laser sensor that are installed at the elevator landing and in vicinity thereof on the target floor, and a sensor detecting an ID (personal
10 identification) that the user carries and the like.

[0034]

From the number of users unable to board the cars already in door-open standby mode that is calculated by the means 1412 for calculating number of users unable to
15 board cars already in door-open standby mode, the information of the presence or absence of the cars in door-closed standby mode and the number of cars in door-closed standby mode that is detected by means 202 for detecting cars in door-closed standby mode, and the
20 maximum car rider occupancy by the means 150 for setting maximum car rider occupancy, the means 1413 for determining whether to open doors of cars in door-closed standby mode determines whether or not the doors of any cars in door-closed standby mode at that point in time are
25 opened. This determination is executed according to the

following equations (3) and (4).

[0035]

The number of users unable to board the cars already
in door-open standby mode $\geq$ the maximum car rider
5 occupancy .. Equation (3); and

The number of cars in door-closed standby mode on
the floor > 0 .. Equation (4)

Here, the means 202 for detecting cars in door-
closed standby mode detects the cars in door-closed
10 standby mode from the data in the means 200 for
controlling elevator (This is ditto for the means 201 for
detecting number of cars already in door-open standby
mode.).

[0036]

15 The meaning of the determination equations of
Equations (3) and (4) means that when the number of users
present at the landing unable to board the cars already in
door-open standby mode is more than the maximum car rider
occupancy, the doors of any cars in door-closed standby
20 mode present on the target floor are opened. Here, the
number of persons unable to board is more than the maximum
car rider occupancy in order to increase the car riding
rate (the rate of the actual number of riders with respect
to the maximum car rider occupancy). For example, in the
25 state where the number of persons unable to board is small,

when the door of each car in door-closed standby mode is newly opened, the car with a small number of persons therein leaves, so that there is a risk that the users who come to the landing later wait for a long time. Therefore, 5 the door is not opened until the number of users at the landing becomes exactly the maximum car rider occupancy, the door is opened when the number of users at the landing has reached the maximum car rider occupancy, and then, all the persons board the car for a short time, so that the 10 riding rate is increased, the time for boarding can be short, and the transport efficiency is considered to be increased.

[0037]

That is, the elevator group control system that 15 controls a plurality of cars includes a detection unit detecting the number of users present at an elevator landing on a predetermined floor (the means 130 for detecting traffic state in building), a number-of-persons calculation unit calculating the number of riders in cars 20 that are stopped with opened doors on the predetermined floor (the means 1411 for calculating number of persons able to board), a number-of-cars calculation unit calculating, on the basis of the number of users at the landing and the number of riders in the cars, the number 25 of cars to be stopped with closed doors on the

predetermined floor (the means 110 for controlling landing call allocation), and a car control unit opening the doors of any cars that are stopped with closed doors on the predetermined floor (the means 140 for controlling door-
5 open standby mode).

[0038]

Also, from the number of riders in the cars that are stopped with opened doors, the number-of-persons calculation unit calculates the number of persons able to
10 board the cars, and on the basis of the detected number of users at the landing and the calculated number of persons able to board, the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

15 [0039]

Also, when the number of users at the landing is more than the number of persons able to board, the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

20 [0040]

Also, the elevator group control system includes a storage unit previously setting maximum car rider occupancy (the means 150 for setting maximum car rider occupancy), and when the difference between the number of
25 users at the landing and the number of persons able to

board is more than the maximum car rider occupancy, the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

[0041]

5 Also, on the basis of the number of users at the landing and the number of riders in the cars that are stopped with opened doors, the number-of-persons calculation unit calculates the number of persons unable to board the cars that are stopped with opened doors among
10 the users at the landing, and on the basis of the calculated number of persons unable to board the cars, the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

[0042]

15 Also, when it is determined, for the number of persons unable to board the cars, that there any persons unable to board, the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

20 [0043]

 Also, it is determined that the number of persons unable to board the cars is more than the maximum car rider occupancy, the car control unit opens the doors of any cars that are stopped with closed doors on the
25 predetermined floor.

[0044]

Also, when selecting, from among the cars that are stopped with closed doors, the car to be newly stopped with an opened door, the car control unit (the means 142
5 for selecting car in door-open standby mode) selects the car at the position far from the entrance of the elevator landing first with respect to any cars that have already been stopped with opened doors.

[0045]

10 Also, the elevator group control system includes a display unit displaying position information at the landing of each car whose door has been opened (the means 400 for providing guidance information).

[0046]

15 Also, the elevator group control system includes a stop time calculation unit setting stop time with respect to the car that is stopped with an opened door, and when any one of the condition in which the elevator that is stopped with an opened door has completed the stop time
20 and the condition in which the number of riders in the car has reached a predetermined value or more or a load value has reached a predetermined value or more is satisfied, the car control unit closes the door of the car and allows the car to leave.

25 [0047]

Also, from the set stop time and the elapsed time of the elevator that is stopped with an opened door, the stop time calculation unit calculates the time remaining until the completion of the standby mode, and from the detected
5 number of riders in the car or the detected load value, the number-of-persons calculation unit calculates the number of persons able to board the car that is stopped with an opened door, and the display unit displays position information at the landing of the car that is
10 stopped with an opened door, the calculated remaining time, and the number of persons able to board. The above is the control processing contents of the means 141 for determining, in real-time, to execute door-open standby mode that is essential in this example. The idea of the
15 control process will be described below again with reference to Figure 3.

[0048]

Figure 3 is a diagram of assistance in explaining the idea of the control process for determining, in real-
20 time, to execute door-open standby mode. First, the number of users present at an elevator landing on a target floor (Y01) and the number of users going to the landing are present. The users going to the landing correspond to the users who will be present at the landing at the time
25 of several minutes later. At the landing, the car already

in door-open standby mode (Y02) and the number of persons who have already been in the car (Y03) are present.

Further, from the maximum car rider occupancy of each car, the number of persons who have already been in the car (Y03) is subtracted, thereby obtaining the number of persons able to board the car in door-open standby mode (Y04). The users present at the landing successively board this boardable place. Then, when the number of persons in the car has reached the maximum car rider occupancy, or when the predetermined time has elapsed, the car leaves (The riders in number equal to the number of riders in the car leave.). The above is a series of continuous processes in which the users enter the elevator landing and board the car from the landing, and the car leaves.

[0049]

The feature of the control to determine the cars in door-open standby mode in real-time of this example is that such determination is sequentially executed on the basis of this process in such a manner that when the number of users present at the landing (Y01) and the number of persons able to board the car in door-open standby mode (Y04) are detected in real-time and the relation of both is brought into the predetermined conditions (the conditions of Equations (2) and (3)), the

number of cars in door-open standby mode is further increased. From this idea, according to the state of the number of users present at the landing (Y01) and the number of persons able to board the car in door-open
5 standby mode (Y04), the start timing of the car in door-open standby mode and the number of cars in door-open standby mode are appropriately controlled. As a result, the appropriate number of cars in door-open standby mode are prepared for the users successively coming to the
10 elevator landing, thereby allowing the users to board the cars, so that the transport efficiency can be increased by preventing delay due to waste time and improving the riding rate.

[0050]

15 The contents of the functional block of the entire system mainly executing the door-open standby mode control will be described below by returning to Figure 2.

[0051]

Other than the opening of the door of each car in
20 door-closed standby mode, the means 143 for controlling car in door-open standby mode controls the car in door-open standby mode. Specifically, the number of riders in each car in door-open standby mode and the standby mode elapsed time are controlled, and when the number of riders
25 in the car has reached the maximum car rider occupancy

(that is set by the means 150 for setting maximum car rider occupancy), or when the standby mode elapsed time has reached the door-open standby mode time (that is set by means 160 for setting door-open standby mode time), it
5 is determined that the door-open standby mode has been completed, and the door of the car is closed and the car is allowed to leave. Here, like the means 150 for setting maximum car rider occupancy, the means 160 for setting door-open standby mode time is the controlling means in
10 the means 100 for controlling elevator group control. The door-open standby mode time is set in the range of 10 to 20 seconds, which is set by the operator.

[0052]

The means 400 for providing guidance information
15 concerning cars in door-open standby mode guides and provides the information concerning the cars in door-open standby mode to the users at the landing in order for the users at the landing to smoothly board the cars in door-open standby mode. The information to be guided includes
20 the information of the position (layout) information of each car in door-open standby mode at the landing, the number of persons able to board each car in door-open standby mode, the departure order of each car in door-open standby mode, the time remaining until departure, and the
25 destination floor information of each car (when the

destination floor is previously allocated to each car e.g. at time of express operation). The input to the means 400 for providing guidance information includes the elevator name information of the car in door-open standby mode
 5 obtained from the means 143 for controlling car in door-open standby mode (that is used for the position information), the number of persons able to board each car in door-open standby mode obtained from the means 1411 for calculating number of persons able to board cars already
 10 in door-open standby mode, and the time remaining until the departure of each car obtained from means 145 for calculating time remaining until car in door-open standby mode will leave.

[0053]

15 The means 145 for calculating time remaining until car in door-open standby mode will leave calculates the time remaining until each car in door-open standby mode will leave, from the difference between the door-open standby mode time by the means 160 for setting door-open
 20 standby mode time and the standby mode elapsed time by means 144 for calculating time elapsed in standby mode of car in door-open standby mode. Also, the means 144 for calculating time elapsed in standby mode of car in door-open standby mode measures the time elapsed from the start
 25 of the opening of the door of each car in door-open

standby mode, and here, for simplification, the means 144
for calculating time elapsed in standby mode of car in
door-open standby mode is illustrated outside of the means
143 for controlling car in door-open standby mode, but the
5 time elapsed is measured by the means 143 for controlling
car in door-open standby mode, and it may be used as is.

[0054]

Finally, means 111 for determining additional
allocation of Figure. 2 will be described. When there is
10 at least one user unable to board the car already in door-
open standby mode (The number of persons is more than
zero.), and when there are no cars in door-closed standby
mode on that floor, the means for determining additional
allocation determines that the additional allocation of a
15 new car is executed on that floor. This determination
result is outputted to means for selecting allocated car
(the process in the reference numeral 110 in Figure 1),
and when the additional allocation is executed, the
appropriate allocated car is selected there.

20 [0055]

For example, the means for determining additional
allocation assumes the case where a very large number of
elevator users are caused from a particular floor e.g. at
times of the completion of a large meeting and the
25 completion of an event, and has an aim in which it is

determined by the means 1412 for calculating number of users unable to board cars already in door-open standby mode that there are any users unable to board and when there are no cars in door-closed standby mode on that floor, the car on which the users are allowed to board is allocated first, and is delivered. By allocating the car first, the allocated car is delivered to the target floor, and the car is brought into door-closed standby mode or the door of the car is opened, so that the boarding of the users can be immediately executed.

[0056]

Figure 4 illustrates an operation flowchart with respect to the functional block diagram of the entire system mainly executing the door-open standby mode control illustrated in Figure 2. The contents of this flowchart will be described below.

First, it is determined whether the target floor is a floor where the door-open standby mode of a plurality of cars is executed (process F01). Only one car is typically brought into door-open standby mode, but when as illustrated in Figures 1 and 2, the door-open standby mode control is executed in response to the use state in real-time, the door-open standby mode of a plurality of cars is caused, so that as described above, it is determined whether the target floor is a floor where the door-open

standby mode of a plurality of cars is executed.

Therefore, the door-open standby mode of a plurality of cars and the execution of the door-open standby mode in response to the use state in real-time have the same

5 meaning. Also, such floor is a floor where a large number of persons use the elevators from that floor, such as a lobby floor, a restaurant floor, and a floor having a large meeting room.

[0057]

10 In the case of Yes on the floor where the door-open standby mode of a plurality of cars is executed, then, it is determined whether or not it is time to execute the door-open standby mode of the plurality of cars (or the traffic flow conditions) (process F02). For example, the
15 times of office-going, the latter half of lunchtime, the completion of a large meeting, and the like correspond to the time to execute the door-open standby mode.

[0058]

In the case of Yes for the time to execute the door-
20 open standby mode of the plurality of cars, then, the following data with respect to the target car are detected or calculated from the sensor or past data (process F03): the number of users at an elevator landing and in vicinity of the landing, the number of riders in the cars already
25 in door-open standby mode, the number of cars already in

door-open standby mode, and the number of cars in door-closed standby mode. Here, the vicinity of the elevator landing is referred to as the entrance of the landing and the region from the entrance of the building to the
 5 elevator landing.

[0059]

After the above data are detected or calculated, the number of persons able to board the cars already in door-open standby mode from the following equation (process
 10 F04).

[0060]

(The number of cars already in door-open standby mode × the maximum car rider occupancy) - The total value of the number of riders in the cars already in door-open
 15 standby mode .. Equation 5

or

[0061] [Expression 2]

$$\sum \frac{\text{(The maximum car rider occupancy - The number of riders in the car already in door-open standby mode)}}{\text{The number of cars already in door-open standby mode}}$$

.. Equation 6

20 [0062]

Here, Equations (5) and (6) are the same, and both calculate the number of persons able to board the cars already in door-open standby mode. Also, Equation (6) is

the same equation as Equation (1).

[0063]

After from the above, the number of persons able to board the cars already in door-open standby mode is calculated, the number of users unable to board the cars already in door-open standby mode is calculated by Equation (2) that has already been described (process F05). Here, when the value of Equation (2) is negative, the value is zero.

10 [0064]

By using the calculated number of users unable to board the cars already in door-open standby mode, the determination of Equation (3) that has already been described is executed, and it is determined whether the number of persons is large enough to satisfy the predetermined condition (process F06). In the case of Yes in Equation (3), further, the determination of Equation (4) that has already been described is executed, and the presence or absence of the cars in door-closed standby mode is determined (process F07).

20

[0065]

Finally, in the case of Yes in Equation (4), it is determined that the door-open standby mode is executed with respect to the car in door-open standby mode, the car to be newly brought into door-closed standby mode is

25

selected, and the car is brought into door-open standby mode (process F08).

[0066]

The above is the flow of the operation with respect
5 to the functional block diagram of the entire system
mainly executing the door-open standby mode control
illustrated in Figure 2, and with this, according to the
state of the number of users at the landing and the number
of riders in the cars already in door-open standby mode,
10 the new cars in door-open standby mode can be set
sequentially. With this, there is also a possibility that
the door-open standby mode of, not only one car, but also
two, three or more cars, is executed. That is, according
to the use state, the number of cars in door-open standby
15 mode and the door opening timing can be controlled in
real-time, so that the transport efficiency at times of
congestion can be increased.

[0067]

Referring to Figures 5 to 8, the examples of the
20 operation of the door-open standby mode control in
response to the use state in real-time that has been
described with reference to Figures 2, 3, and 4 will be
described below. Each of Figures 5 to 8 illustrates the
state of the users at an elevator landing and in vicinity
25 thereof on a floor where the door-open standby mode is to

be controlled (a lobby floor) and the state of the number of riders in each car, and illustrates the state where the door-open standby mode control is executed in real-time according to the number of users at the landing and the number of riders in each car in door-open standby mode. The operation will be described below with reference to each drawing.

[0068]

Each of Figures 5(a), 5(b), 6(a), and 6(b) illustrates the states of a landing on a floor where control is to be executed by the group control elevator system for six elevators group-controlled and the users in the cars of the six elevators, and illustrates, in this order, the state according to the elapse of time and the operation of the door-open control. The arrangement of the landing and the elevator cars is shared among the respective drawings, and the same portions are indicated by the same reference numerals.

[0069]

First, Figure 5(a) will be described. Figure 5(a) illustrates the states of an elevator landing and in vicinity thereof on a floor where door opening is to be controlled by the group control elevator system for six elevators (e.g. a lobby floor). The states of the elevator landing and in vicinity thereof respectively

illustrate a landing A01, the vicinity of the landing A011 including the entrance of the landing, and the cars of the respective elevators or elevating paths thereof (a first elevator A02, a second elevator A03, a fourth elevator A04, and a fifth elevator A05).

[0070]

The first elevator A02 is in the state where the car is in door-closed standby mode, the state where the car is in standby mode is indicated by a white background, and the state where the door is closed (The door of the landing and the car is closed.) is indicated by the state where a door A021 is closed. The second elevator A03 is in the state where the car is not present on that floor and is in the state of running through other floors, and such state is indicated by a black background. The third elevator and the sixth elevator are in the same state as the second elevator (The cars are running through other floors.). The fourth elevator A04 is in the state of the door-open standby mode (The car is indicated by a white background.), and is in the state where a door (the door of the landing and the car) A041 is opened, and the users at the landing are boarding this car. The circle indicated by the reference numeral A061 represents one of the users who have boarded the car, and the fourth elevator A04 is in the state where the number of riders in

the car is six. Like the first elevator A02, in the fifth
elevator A05, the car is in door-closed standby mode, and
is in standby mode on this floor, and a door A051 is in
the closed state. Sixteen users in total are present in
5 the elevator landing A01 and in the vicinity of the
entrance A011. For example, the circle indicated by the
reference numeral A062 represents one of the users in the
elevator landing, and the circle indicated by the
reference numeral A063 represents one of the users at the
10 entrance of the elevator landing.

[0071]

Figure 5(a) is in the state as described above, and
the state of the process of the means for determining, in
real-time, to execute door-open standby mode (the
15 reference numeral 141 in Figure 2) in the functional block
illustrated in Figure 2 at this time will be described
below. It should be noted that the flow of the process is
the same as the flowchart in Figure 4, and the description
thereof is omitted.

20 [0072]

First, the respective detection values and the
setting value are as follows.

[0073]

(a) The number of users at the elevator landing and
25 in vicinity thereof: 16 (the means 501 for detecting

number of users at elevator landing and in vicinity thereof in Figure 2)

(b) The total value of the number of riders in the cars already in door-open standby mode: 6 (the means 502
5 for detecting number of riders in cars already in door-open standby mode in Figure 2). Here, only the fourth elevator A04 is the car in door-open standby mode.
[0074]

(c) The number of cars already in door-open standby
10 mode: 1 (the means 201 for detecting number of cars already in door-open standby mode in Figure 2)

(d) The cars in door-closed standby mode: the first elevator A02 and the fifth elevator A05 (the means 202 for detecting cars in door-closed standby mode in Figure 2)

15 (e) The maximum car rider occupancy: The maximum car rider occupancy is set to 10 (the means 150 for setting maximum car rider occupancy in Figure 2). Here, the maximum car rider occupancy is set to 10 when the rated number of persons in the car is 14, and the riding
20 rate of 70% is the actual maximum car rider occupancy.
[0075]

From these detection values or the setting value, the respective calculation values and the determination process are as follows.

25 [0076]

(f) The number of persons able to board the car already in door-open standby mode: From Equation (1), $10 - 6 = 4$ (the means 1411 for calculating number of persons able to board cars already in door-open standby mode in Figure 2)

(g) The number of users unable to board the car already in door-open standby mode: From Equation (2), $16 - 4 = 12$ (the means 1412 for calculating number of users unable to board cars already in door-open standby mode in Figure 2)

(h) The determination of the opening of the door of the car in door-closed standby mode: For Equation (3), the number of users unable to board the car in door-open standby mode of $12 >$ the maximum car rider occupancy of 10. For Equation (4), the number of cars in door-closed standby mode of $2 > 0$. From the above, since the condition of Equation (3) is satisfied, it is determined that the door of the car in door-closed standby mode is opened (the means 1413 for determining whether to open doors of cars in door-closed standby mode in Figure 2). [0077]

As described above, in the state of Figure 5(a), since the number of users at the landing unable to board the car in door-open standby mode exceeds the maximum car rider occupancy, it is determined that the door of the car

in door-closed standby mode is opened. As a result, after the comparison of the first elevator A02 and the fifth elevator A05 of the cars in door-closed standby mode, the fifth elevator is selected to be door-opened by the means 142 for selecting car in door-open standby mode in Figure 2, and the instruction of the door-open standby mode control is transmitted to the means 143 for controlling car in door-open standby mode and the means 200 for controlling elevator in Figure 2, so that the door-open standby mode of the fifth elevator is executed.

[0078]

Figure 5(b) illustrates the state after time has elapsed for a while after the execution of the door-open standby mode of the fifth elevator from the state of Figure 5(a). The same portions as Figure 5(a) are indicated by the same reference numerals, and the description thereof is omitted. As the change from Figure 5(a), the fifth elevator A05 is brought into door-open standby mode (The door A051 is in the opened state.), the users at the landing are boarding the fifth elevator, and two persons are in the car (the reference numeral A064 denotes one of the users in the car). Also, the number of riders in the fourth elevator A04 already in door-open standby mode is increased from 6 to 8. The number of users present in the landing and in vicinity thereof is

changed to the total number of 14 due to the persons who have boarded the car (subtraction) and the persons who newly have come to the landing (addition).

[0079]

5 In this state, like the case of Figure 5(a), the state of the process of the means for determining, in real-time, to execute door-open standby mode (the reference numeral 141 in Figure 2) in the functional block illustrated in Figure 2 will be described below.

10 [0080]

First, the respective detection values and the setting value are as follows.

[0081]

(a) The number of users at the elevator landing and
15 in vicinity thereof: 14

(b) The total value of the number of riders in the cars already in door-open standby mode: 10. Here, the fourth elevator and the fifth elevator are the cars in door-open standby mode.

20 [0082]

(c) The number of cars already in door-open standby mode: 2

(d) The car in door-closed standby mode: the first elevator

25 (e) The maximum car rider occupancy: 10

From these detection values or the setting value, the respective calculation values and the determination process are as follows.

[0083]

5 (f) The number of persons able to board the cars already in door-open standby mode: From Equation (1), $20 - 10 = 10$

 (g) The number of users unable to board the cars already in door-open standby mode: From Equation (2), $14 -$
10 $10 = 4$

 (h) The determination of the opening of the door of the car in door-closed standby mode: For Equation (3), the number of users unable to board the cars in door-open standby mode of $4 < \text{the maximum car rider occupancy of } 10$.
15 From this, the condition of Equation (3) is not satisfied, and it is determined that the door of the car in door-closed standby mode is not opened.

[0084]

 Figure 6(a) illustrates the state after time has
20 further elapsed from the state of Figure 5(b). The same portions as Figure 5(b) are indicated by the same reference numerals, and the description thereof is omitted. As the change from Figure 5(b), first, the number of riders in the car of the fourth elevator A04 has reached
25 the maximum car rider occupancy of 10, and it is

determined by the means 143 for controlling car in door-open standby mode in Figure 2 that the door-open standby mode has been completed. As a result, the fourth elevator closes the door A041, and the car leaves. The fifth
5 elevator A05 is in door-open standby mode, and the number of persons who have boarded in the car is increased to 6. The total number of users in the landing and in vicinity thereof is 10.

[0085]

10 In this state, like the case of Figure 5(b), the state of the process of the means for determining, in real-time, to execute door-open standby mode (the reference numeral 141 in Figure 2) in the functional block illustrated in Figure 2 will be described below.

15 [0086]

First, the respective detection values and the setting value are as follows.

[0087]

(a) The number of users at the elevator landing and
20 in vicinity thereof: 10 (the means 501 for detecting number of users at elevator landing and in vicinity thereof in Figure 2)

(b) The total value of the number or riders in the cars already in door-open standby mode: 6 (the means 502
25 for detecting number of riders in cars already in door-

open standby mode in Figure 2). Here, only the fifth elevator A05 is the car in door-open standby mode. The fourth elevator A04 that has been in door-open standby mode so far closes the door, and is ready for leaving.

5 [0088]

(c) The number of cars already in door-open standby mode: 1 (the means 201 for detecting number of cars already in door-open standby mode in Figure 2)

(d) The car in door-closed standby mode: the first
10 elevator A02 (the means 202 for detecting cars in door-closed standby mode in Figure 2)

(e) The maximum car rider occupancy: 10 (the means 150 for setting maximum car rider occupancy in Figure 2)

From these detection values or the setting value,
15 the respective calculation values and the determination process are as follows.

[0089]

(f) The number of persons able to board the car already in door-open standby mode: From Equation (1), 10 -
20 $6 = 4$ (the means 1411 for calculating number of persons able to board cars already in door-open standby mode in Figure 2)

(g) The number of users unable to board the car already in door-open standby mode: From Equation (2), 10 -
25 $4 = 6$ (the means 1412 for calculating number of users

unable to board cars already in door-open standby mode in Figure 2)

(h) The determination of the opening of the door of the car in door-closed standby mode: For Equation (3), the number of users unable to board the car in door-open standby mode of 6 > the maximum car rider occupancy of 10. From this, the condition of Equation (3) is not satisfied, and it is determined that the door of the car in door-closed standby mode is not opened (the means 1413 for determining whether to open doors of cars in door-closed standby mode in Figure 2).

[0090]

Figure 6(b) illustrates the state after time has further elapsed from the state of Figure 6(a). The same portions as Figure 6(a) are indicated by the same reference numerals, and the description thereof is omitted. As the change from Figure 6(a), first, the car of the fourth elevator A04 has leaved this floor and is running through other floors, and the number of riders in the car A05 of the fifth elevator is increased to 9. Further, as described later, the number of users at the landing is increased, and it is determined that the number of cars to be newly brought into door-open standby mode is increased, so that the car A02 in door-closed standby mode starts to open the door (A021). The total number of users in the

landing and in vicinity thereof is 11.

[0091]

In this state, like the case of Figure 6(a), the state of the process of the means for determining, in
5 real-time, to execute door-open standby mode (the reference numeral 141 in Figure 2) in the functional block illustrated in Figure 2 will be described below.

[0092]

First, the respective detection values and the
10 setting value are as follows.

[0093]

(a) The number of users at the elevator landing and in vicinity thereof: 11

(b) The total value of the number of riders in the
15 cars already in door-open standby mode: 9. Here, only the fifth elevator A05 is the car in door-open standby mode.

[0094]

(c) The number of cars already in door-open standby mode: 1

20 (d) The car in door-closed standby mode: the first elevator A02. It should be noted that in Figure 6(b), the opening of the door has already been started, but here, the car in door-closed standby mode is considered to be in the state just before the start of the opening of the door.

25 [0095]

(e) The maximum car rider occupancy: 10

From these detection values or the setting value, the respective calculation values and the determination process are as follows.

5 [0096]

(f) The number of persons able to board the car already in door-open standby mode: From Equation (1), $10 - 9 = 1$

(g) The number of users unable to board the car already in door-open standby mode: From Equation (2), $11 - 1 = 10$

(h) The determination of the opening of the door of the car in door-closed standby mode: For Equation (3), the number of users unable to board the car in door-open standby mode of $10 \geq$ the maximum car rider occupancy of 10. For Equation (4), the number of cars in door-closed standby mode > 0 . From the above, since the condition of Equation (3) is satisfied, it is determined that the door of the car in door-closed standby mode is opened.

20 [0097]

From the above determination result, in the state of Figure 6(b), it is determined that the door of the first elevator A02 of the car in door-closed standby mode is opened, and the opening of the door A021 of the first elevator has been started.

25

[0098]

In the flow of Figures 5(a), 5(b), 6(a), and 6(b), the operation to control each car in door-open standby mode in response to the state of the users at the elevator landing and the state of the number of riders in the car in door-open standby mode in real-time has been described above. From the control as described here, at times of congestion e.g. during the time of office-going and at lunchtime, in consideration of the moving state of the users successively coming to the elevator landing and the persons boarding the elevator cars in door-open standby mode from the landing, the appropriate number of cars in door-open standby mode can be controlled at the appropriate timing, so that even at times of congestion, the users can smoothly board the elevator cars from the landing, waste time is prevented, and the number of riders can also be appropriately controlled, so that the transport efficiency of the group control elevator system can be improved.

20 [0099]

Like Figures 5 and 6, Figures 7 and 8 illustrate the operation of the door-open standby mode control by the functional block illustrated in Figure 2. Figures 7 and 8 are different from Figures 5 and 6 in that in front of the entrance of the elevator landing, there are entering and

exiting gates (the reference numeral A07 in Figures 7(a) and 7(b), and the reference numeral A08 in Figure 8), and for example, a lobby floor (a gate floor) is assumed. The point is that persons entering the elevator landing are
5 previously detected at the entering and exiting gate. The contents of the operation in each of Figures 7 and 8 will be described below.

[0100]

Like Figure 5(a), each of Figures 7(a) and 7(b)
10 illustrates the states of the landing on a floor where control is to be executed by the group control elevator system for six elevators group-controlled and the users in the cars of the six elevators, and illustrates, in this order, the state according to the elapse of time and the
15 operation of the door-open control. The arrangement of the landing and the elevator cars is the same as Figure 5(a), and the same portions are indicated by the same reference numerals. Figures 7(a) and 7(b) are different from Figure 5(a) in that the entering and exiting gate A07
20 is present, and here, the number of users going to the elevator landing A01 is previously detected. Although described later, the entering and exiting gate A07 corresponds to the means 501 for detecting number of users at elevator landing and in vicinity thereof in Figure 2.
25 Also, the entering and exiting gate A07 may be a security

gate or an entering and exiting door.

[0101]

First, Figure 7(a) will be described below. Here,
the same portions as Figure 5(a) are indicated by the same
5 reference numerals, and the description thereof is omitted.
As the state of this drawing, first, the fourth elevator
A04 and the fifth elevator A05 are in door-open standby
mode, nine persons are in the fourth elevator, and three
persons are in the fifth elevator. Only the first
10 elevator A02 is the car in door-closed standby mode, and
the second, third, and sixth elevators are not present on
this floor, and are running through other floors. The
total number of users at the elevator landing A01 is 9,
and further, there are two users passing through the
15 entering and exiting gate A07 and entering the elevator
landing.

[0102]

The point here is that the number of users present
at the elevator landing is calculated by the summation of
20 the number of persons entering the elevator landing from
the entering and exiting gate. The number of users
present at the elevator landing is obtained by adding the
number of persons entering the elevator landing from the
entering and exiting gate to the number of users present
25 at the elevator landing slightly before the point of time

at which such persons enter the elevator landing from the entering and exiting gate, and the number of persons who have boarded the elevators in door-open standby mode is subtracted. In this way, by the means for detecting the
5 number of persons from the entering and exiting gate and for detecting the number of riders in the elevator cars, the number of users at the elevator landing can be detected by calculation. For this, the entering and exiting gate A07 in Figure 7(a) corresponds to the means
10 501 for detecting number of users at elevator landing and in vicinity thereof in Figure 2.

[0103]

On the basis of this method, then, like the case of Figure 5(a), the process of the means for determining, in
15 real-time, to execute door-open standby mode (the reference numeral 141 in Figure 2) in the functional block illustrated in Figure 2 can be executed. This will be described below.

[0104]

20 First, the respective detection values and the setting value are as follows.

[0105]

(a) The number of users at the elevator landing and in vicinity thereof: 9 (that is detected by the above
25 described method)

(b) The total value of the number of riders in the cars already in door-open standby mode: $9 + 3 = 12$ (the means 502 for detecting number of riders in cars already in door-open standby mode in Figure 2). Here, the fourth
 5 elevator A04 and the fifth elevator A05 are the cars in door-open standby mode.

[0106]

(c) The number of cars already in door-open standby mode: 2 (the means 201 for detecting number of cars
 10 already in door-open standby mode in Figure 2)

(d) The car in door-closed standby mode: the first elevator A02 (the means 202 for detecting cars in door-closed standby mode in Figure 2)

[0107]

15 (e) The maximum car rider occupancy: 10 (the means 150 for setting maximum car rider occupancy in Figure 2)

From the calculation value, the detection values, and the setting value, the respective calculation values
 20 and the determination process are as follows.

[0108]

(f) The number of persons able to board the cars already in door-open standby mode: From Equation (1), $20 - 12 = 8$ (the means 1411 for calculating number of persons
 25 able to board cars already in door-open standby mode in

Figure 2)

(g) The number of users unable to board the cars already in door-open standby mode: From Equation (2), $9 - 8 = 1$ (the means 1412 for calculating number of users
 5 unable to board cars already in door-open standby mode in Figure 2)

(h) The determination of the opening of the door of the car in door-closed standby mode: For Equation (3), the number of users unable to board the cars in door-open
 10 standby mode of $1 >$ the maximum car rider occupancy of 10. From this, the condition of Equation (3) is not satisfied, and it is determined that the door of the car in door-closed standby mode is not opened (the means 1413 for determining whether to open doors of cars in door-closed
 15 standby mode in Figure 2).

[0109]

Figure 7(b) illustrates the state after time has further elapsed from the state of Figure 7(a). The same portions as Figure 7(a) are indicated by the same
 20 reference numerals, and the description thereof is omitted. As the change from Figure 7(a), first, the number of riders in the car of the fourth elevator A04 has reached the maximum car rider occupancy of 10, and it is determined by the means 143 for controlling car in door-
 25 open standby mode in Figure 2 that the door-open standby

mode has been completed. As a result, the fourth elevator closes the door A041 and the car leaves. The fifth elevator A05 is in door-open standby mode, and the number of persons have boarded in the car is increased to 5. The
5 total number of users present in the landing and in vicinity thereof is 8.

[0110]

By the above-described calculation method, from the state in Figure 7(a), the number of users present in the
10 landing and in vicinity thereof can be calculated as $9 + 2 - 3 = 8$ where the number of users in the landing is 9, the number of persons entering the landing is 2 (addition), and the number of persons who have boarded the fourth and fifth elevator cars in door-open standby mode during the
15 elapse of time from Figure 7(a) to Figure 7(b) is 3 (subtraction).

[0111]

The processes for detecting and calculating the respective numbers of persons below are the same as the
20 above-described processes, and the description thereof is omitted.

[0112]

With respect to Figure 7(a), in Figure 8, in the configuration of the building, the entering and exiting
25 gate A08 is present at the entrance of the building, and a

distance (A08) to the elevator landing A01 is long.
Therefore, as persons entering from the entering and
exiting gate A08 (A066), there are, not only persons going
to the elevator landing A01 (A067), but also persons
5 moving in other directions (A068). Like the case of
Figure 7(a), also in the case of Figure 8, from the number
of persons entering the inside of the building from the
entering and exiting gate A08, the number of persons going
to the elevator landing on the basis of the number of
10 persons entering the inside of the building from the
entering and exiting gate, and the number of persons who
have boarded each car in door-open standby mode, the
number of users present at the elevator landing can be
estimated. Specifically, when the number of persons going
15 to the elevator landing can be calculated from the number
of persons entering the inside of the building from the
entering and exiting gate, then, by using the number of
persons going to the elevator landing, the number of users
present at the elevator landing can be calculated by the
20 same method as Figure 7(a). Here, as the method for
calculating the number of persons going to the elevator
landing from the number of persons entering the inside of
the building from the entering and exiting gate, a method
for statistically estimating the number of persons going
25 to the elevator landing from past data (including machine

learning) and a method for directly detecting the number of persons going to the elevator landing by providing a sensor are considered. Therefore, it is considered that the entering and exiting gate A08 in Figure 8 corresponds
5 to the means 501 for detecting number of users at elevator landing and in vicinity thereof in Figure 2.

[0113]

When the number of users at the landing can be calculated, like the contents described in Figures 5(a)
10 and 7(a), the number of persons able to board the cars already in door-open standby mode and the number of users unable to board the cars already in door-open standby mode are calculated, and it can be determined whether the door of the car in door-closed standby mode is opened.

15 [0114]

Figure 9 illustrates a flowchart illustrating the process for selecting the car in door-open standby mode in the flowchart for controlling the number of cars in door-open standby mode illustrated in Figure 4 (the process for
20 selecting, from among the cars in door-closed standby mode on the target floor in Figure 4, the car to be newly brought into door-open standby mode (F08)). In Figure 9, the processes different from Figure 4 are indicated by different reference numerals. The portions of the
25 processes different from Figure 4 will be described below.

[0115]

When there are any cars in door-closed standby mode on the floor (in the case of YES after the process F07), it is determined whether from among the cars in door-

5 closed standby mode, the car in door-closed standby mode having a longer distance from the entrance of the landing than any cars already in door-open standby mode is present (F081). When such car in door-closed standby mode having a longer distance from the entrance of the landing than

10 any cars already in door-open standby mode is present, the car is set to the next car in door-open standby mode (F082). Here, when there are a plurality of such cars in door-closed standby mode, from among them, the car that is closer to the entrance of the landing is set to the next

15 car in door-open standby mode.

[0116]

If such car in door-closed standby mode satisfying the condition it has a longer distance from the entrance of the landing than any cars already in door-open standby

20 mode is not present, from among the cars in door-closed standby mode, the car having the longest distance from the entrance of the landing is set to the next car in door-open standby mode (F083).

[0117]

25 By the above-described method for selecting the car

in door-open standby mode illustrated in Figure 9, the users who have come to the landing board the car already in door-open standby mode more easily since the car already in door-open standby mode is closer to the landing in terms of distance with respect to the car that is newly brought into door-open standby mode. In this way, by allowing the users to board the car already in door-open standby mode more easily, the riding rate of the car in door-open standby mode can be increased, so that the entire transport capacity can be increased. On the contrary, when such selection method is not executed, the users board the car newly brought into door-open standby mode first, and the car already in door-open standby mode leaves with a low riding rate, so that the possibility leading to the lowering of the transport capacity arises.

[0118]

Figure 10 illustrates a flowchart for generating the guidance information of each car in door-open standby mode according to the one embodiment illustrated in Figure 2 (the means indicated by the reference numeral 400 in Figure 2). This is guidance information in order for the users who have arrived at the landing to smoothly board a plurality of cars in door-open standby mode.

[0119]

First, the means 143 for controlling car in door-

open standby mode (Figure 2) determines whether or not on the floor where the door-open standby mode of a plurality of cars is executed, there are any cars in door-open standby mode now (F09). In the case of Yes, the routine
5 goes to the next process, and in the case of No, the routine exits from this process.

[0120]

When there are any cars in door-open standby mode, the means 1411 for calculating number of persons able to
10 board cars already in door-open standby mode (Figure 2) calculates the number of persons able to board each car in door-open standby mode from now (F10).

This value can be calculated by determining the difference between the maximum car rider occupancy and the
15 number of persons who have already been in the car.

[0121]

Then, the means 145 for calculating time remaining until car in door-open standby mode will leave (Figure 2) calculates the time remaining until the completion of the
20 door-open standby mode with respect to each car in door-open standby mode (F11). This value can be calculated from the difference between the setting value of the door-open standby mode time and the time elapsed from the start of the door-open standby mode of the car.

25 [0122]

Further, the means 145 for calculating time remaining until car in door-open standby mode will leave (Figure 2) determines the departure order of the car in door-open standby mode from the calculated time remaining until the completion of the door-open standby mode (F12). This can be determined that the car that has the shorter remaining time leaves earlier.

[0123]

Then, the means 143 for controlling car in door-open standby mode (Figure 2) determines whether a destination floor is previously designated with respect to each car in door-open standby mode (F13). The control of e.g. division express during the time of off-going corresponds to this case.

[0124]

When the destination floor is previously designated, the means 400 for providing guidance information (Figure 2) guides and provides the following information concerning each car in door-open standby mode toward the users at the landing (F14):

[0125]

1) The departure order of the car, 2) the time remaining until the completion of the door-open standby mode (departure) of the car, 3) the number of persons able to board the car, and 4) the destination floor of the car.

[0126]

When the destination floor is not previously designated, the information obtained by removing the destination floor information from the information items
5 of F14 is guided and provided (F15).

[0127]

That is, the elevator group control system includes an order determination unit determining, from the calculated remaining stop time of the car that is stopped
10 with an opened door, an order in which stopping with an opened door is completed to allow the elevator to leave (the means 143 for controlling car in door-open standby mode), and the display unit displays the departure order.

[0128]

15 Figure 11 is a diagram illustrating the example of information guidance concerning the cars in door-open standby mode according to the one embodiment illustrated in Figures 2 and 10. Here, a device, such as a large information displaying display device, is assumed. In a
20 displaying display portion B01, together with a simulation image B02 of the elevator landing, information concerning the elevator cars in door-open standby mode is displayed. Images representing the respective cars on the landing (The total number of cars is 6 in such a manner that three
25 cars faces other three cars.) are B03 to B08, and the

elevators corresponding to the images of the respective cars of the B03, B06, and B07 having the display "Boarding is possible" (the respective elevators No. 1, No. 4, and No. 5) represent the elevators that are in door-open
5 standby mode and are boardable. By viewing this display, the users at the landing can immediately confirm the cars in door-open standby mode and their positions at the landing. It should be noted that the blacked out elevators (No. 2, No. 3, and No. 6) represent the door-
10 closed state (The elevators that are not to be boarded, for example, since they are running.).

[0129]

To the respective images B03, B06, and B07 of the cars of the respective elevators that are in door-open
15 standby mode and are boardable, respective information (B09, B10, and B11) that is necessary and referred to when the users board the cars is shown. Specifically, for each car, information B091 of the time remaining until the car will leave and information B092 of the number of persons
20 able to board the car are displayed. By viewing this information, the user in a hurry selects the elevator in which it will leave sooner (The time until departure is shorter.), and the user not in a hurry selects the elevator having time until the car will leave. Also, by
25 viewing the number of persons able to board the cars, it

can be determined whether the users can board the cars.
Also, when as many users as possible are allowed to board
the cars (or the riding rate is increased), the transport
capacity can be improved, so that the side controlling
5 group control also has an aim to promote boarding by
representing the information of the number of persons able
to board.

[0130]

As described above, by the information guidance
10 concerning the cars in door-open standby mode illustrated
in Figure 11, the users at the elevator landing
immediately recognize the cars in door-open standby mode
and their positions, and from the information of the time
until departure and the number of persons able to board,
15 the elevator car desired by each user can be selected.
Also, at times of congestion, the number of users in a
hurry is basically large, so that by displaying these, the
improvement in the car riding rate and the shortening of
the time until boarding can be achieved. As a result,
20 this leads to the improvement in the elevator transport
capacity decided by the number of persons transported per
time.

[0131]

Figure 12 illustrates the example of information
25 guidance concerning the cars in door-open standby mode

according to the one embodiment illustrated in Figure 10,
and is a diagram illustrating the example different from
Figure 11. In Figure 12, portions different from Figure
11 are indicated by different reference numerals, and here,
5 only the portions will be described. Figure 12 is
different from Figure 11 is in that in guidance
information with respect to the car in door-open standby
mode, a departure order B093 and destination floor
information B094 are added. By adding these information,
10 the user enables more precise determination. Also, the
destination floor information is essential when the
operation in which the destination floor is different
depending on elevator e.g. at time of division express is
executed.

15 [0132]

Figure 13 illustrates a diagram illustrating the
installation example of information guidance concerning
the cars in door-open standby mode according to the one
embodiment illustrated in Figures 11, 12, and the like.
20 The information provided here has the contents described
in Figures 11 and 12. Figure 13 illustrates the state of
a landing (C01) of four group-control elevators in which
two elevators face other two elevators. In respective
landing doors of the four elevators (C02, C03, C04, and
25 C05), there are two cars in door-open standby mode, and

the elevators indicated by C02 and C04 correspond to them. The information displaying display device that provides the information is preferably installed at the position where the users who have arrived at the elevator landing
5 can immediately and easily view the information displaying display device, and preferably, such position is the position on the wall surface of the entrance of the landing (positions C06 and C07), and the position where the information displaying display device is hung from the
10 ceiling in the landing (C08).

<Example 2>

[0133]

The elevator group control system of Example 2 will be described. It should be noted that the description of
15 the points shared with Example 1 is omitted.

[0134]

Figure 14 illustrates a functional block diagram of the entire system mainly executing the door-open standby mode control, and illustrates an embodiment different from
20 Figure 2. In Figure 14, the same portions as Figure 2 are indicated by the same reference numerals, and here, the description thereof is omitted.

[0135]

Figure 14 is different from Figure 2 in the internal
25 process of the means 141 for determining, in real-time, to

execute door-open standby mode and means 146 for calculating number of persons able to board cars in door-open standby mode. Here, the means 146 for calculating number of persons able to board cars in door-open standby mode is the same process as the means 1411 for calculating number of persons able to board cars already in door-open standby mode in Figure 2, and since the position of the process is simply changed, the description of the contents of the process is omitted. The internal process of the means 141 for determining, in real-time, to execute door-open standby mode will be described below.

[0136]

The internal process of the means 141 for determining, in real-time, to execute door-open standby mode in Figure 14 includes means 1414 for calculating necessary number of cars in door-open standby state, and means 1415 for determining whether to open doors of cars in door-closed standby mode.

[0137]

First, the means 1414 for calculating necessary number of cars in door-open standby state calculates the necessary number of cars in door-open standby mode by using the following equation from the detected number of persons by the means 501 for detecting number of users at elevator landing and in vicinity thereof, the detected

number of persons by the means 502 for detecting number of riders in cars already in door-open standby mode, and the set number of persons by the means 150 for setting maximum car rider occupancy.

5 [0138]

The necessary number of cars in door-open standby mode = $\text{INT}[(\text{the number of users at the elevator landing and in vicinity thereof} + \text{the total value of the number of riders in the cars already in door-open standby mode}) /$
 10 the maximum car rider occupancy] .. Equation (7)

In Equation (7), INT represents the function process of rounding in which the operation result in the bracket is rounded down after the decimal. By calculating the necessary number of cars in standby mode by using Equation
 15 (7), the number of users and the number of cars suitable for the riding state can be determined. Further, by the rounding process, the number of cars in standby mode can be calculated so as to have a value that provides the necessary number of cars in standby mode and the non-
 20 excessive number of cars in standby mode.

[0139]

Next, the means 1415 for determining whether to open doors of cars in door-closed standby mode determines, by the following two equations, whether the new cars in door-
 25 open standby mode are necessary and there are any cars in

door-closed standby mode.

[0140]

The necessary number of cars in door-open standby mode > the number of cars already in door-open standby

5 mode .. Equation (8)

and

The number of cars in door-closed standby mode > 0 .. Equation (9)

When the conditions of the two equations are
 10 satisfied, it is determined that the car to be newly brought into door-open standby mode is necessary, and from among the cars in door-closed standby mode, the appropriate car is selected by the means 142 for selecting car in door-open standby mode, and becomes the new car
 15 door-open standby mode. The following process is the same as the functional block diagram in Figure 2.

[0141]

The feature of the functional block in Figure 14 is in that the necessary number of cars is calculated by
 20 using the number of cars in door-open standby mode as an index, and according to this, the number of cars in door-open standby mode is set. In particular, in this method, when the number of users abruptly is increased, the doors of a plurality of cars can also be opened at the same time
 25 so that the cars can be brought into door-open standby

mode, and for example, when in Equation (8), the necessary number of cars in door-open standby mode is two more than the number of cars already in door-open standby mode, and when there are two or more cars in door-closed standby mode, the control to bring two cars into door-open standby mode at a time is also enabled.

[0142]

As a result, for example, on a floor where there is a large meeting room, the elevators are previously brought into standby mode on that floor, and even when after the completion of a meeting, a large number of users gather to the elevator landing, the doors of a plurality of cars are opened at the same time according to the number of persons, so that a large number of users can be transported for a short time.

[0143]

That is, on the basis of the number of users at the car landing, the number of riders in the cars that are stopped with opened doors, and the maximum car rider occupancy, the number-of-cars calculation unit calculates the necessary number of cars to be stopped with opened doors on the predetermined floor, and on the basis of the necessary number of cars, the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

[0144]

Also, when the calculated necessary number of cars is more than the number of cars that are stopped with opened doors at that time, the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

[0145]

Figure 15 illustrates an operation flowchart with respect to the functional block diagram of the entire system mainly executing the door-open standby mode control illustrated in Figure 14, and changes the operation flowchart in Figure 4. In the operation flowchart in Figure 15, the same processes as Figure 4 are indicated by the same reference numerals, and the description thereof is omitted.

[0146]

The operation flowchart in Figure 15 is different from Figure 4 in two points of a process for calculating the necessary number of cars in door-open standby mode by Equation (7) (F16) and a process for determining by Equation (8) whether the necessary number of cars in door-open standby mode is more than the number of cars already in door-open standby mode (F17).

[0147]

The effect of the control by the operation flowchart

in Figure 15 is the same as Figure 14, and is in that the necessary number of cars in door-open standby mode is calculated according to the state of the users, and is compared with the number of cars already in door-open standby mode, thereby calculating the number of cars to be newly brought into door-open standby mode, so that the door-open standby mode control of a plurality of cars at the same time is also enabled according to the use state. [0148]

10 The control of the elevator car in door-open standby mode in response to the use state in real-time that has been described so far exhibits the higher effect as the elevator group control system includes a larger number of elevators, as already described. Specifically, it is
15 considered to be effective for the group control for eight or more cars, and its reason will be described below. [0149]

Typically, one cycle time for moving up and down of the elevator is set to approximately 60 seconds to 120
20 seconds. If the one cycle time is 60 seconds, when the number of group-control elevators is large and is eight or more, the average of the interval of the arriving of the car at a predetermined floor (for example, a lobby floor) is 60 seconds / the number of cars of 8 = 7.5 seconds.
25 The standby mode time of the elevator car (the stop time

in door-open standby mode) is assumed to be 10 to 15 seconds in consideration of the time for the boarding of a large number of persons, and the possibility that while one car is in door-open standby mode on the lobby floor, other cars arrive at the lobby floor becomes high. Therefore, the number of opportunities to execute the door-open standby mode of a plurality of cars, which has been described so far in this example is increased. Further, as the number of cars is increased, the number of such opportunities is increased, and for example, when the number of cars is 12 and the one cycle time is 60 seconds, the average of the interval of the arriving at the lobby floor is 5 seconds, and when the standby mode time is approximately 15 seconds, there is a possibility that the number of cars in standby mode on the lobby floor is increased up to three, so that when the number of elevator users is large, two or three elevator cars in standby mode are brought into door-open standby mode according to it, thereby allowing such many persons to board the cars and to be transported for the same time. In this way, the idea to control a plurality of cars to be brought into door-open standby mode according to the one embodiment illustrated in Figures 1, 2, 14, and the like is particularly effective for the elevator group control of a large number of cars, e.g., eight or more cars, and

further, it is considered that such number of cars is larger, the effect is increased.

Reference Signs List

[0150]

- 5 100...means for controlling elevator group control
- 110...means for controlling landing call allocation
- 111...means for determining additional allocation
- 120...means for controlling delivery of car to
predetermined floor
- 10 130...means for detecting traffic state in building
- 140...means for controlling door-open standby mode
in response to use state in real-time
- 141...means for determining, in real-time, to
execute door-open standby mode
- 15 1411...means for calculating number of persons able
to board cars already in door-open standby mode
- 1412...means for calculating number of users unable
to board cars already in door-open standby mode
- 1413...means for determining whether to open doors
20 of cars in door-closed standby mode
- 142...means for selecting car in door-open standby
mode
- 143...means for controlling car in door-open standby
mode
- 25 144...means for calculating time elapsed in standby

mode of car in door-open standby mode

150...means for setting maximum car rider occupancy

160...means for setting door-open standby mode time

200...means for controlling elevator

5 201...means for detecting number of cars already in
door-open standby mode

202...means for detecting cars in door-closed
standby mode

300...elevator

10 400...means for providing guidance information
concerning cars in door-open standby mode

501...means for detecting number of users at
elevator landing and in vicinity thereof

15 502...means for detecting number of riders in cars
already in door-open standby mode

CLAIMS

[Claim 1]

An elevator group control system that controls a plurality of cars comprising:

- 5 a detection unit detecting the number of users present at an elevator landing on a predetermined floor;
- a number-of-persons calculation unit calculating the number of riders in cars that are stopped with opened doors on the predetermined floor;
- 10 a number-of-cars calculation unit calculating, on the basis of the number of users at the elevator landing and the number of riders in the cars, the number of cars to be stopped with closed doors on the predetermined floor; and
- 15 a car control unit opening the doors of any cars that are stopped with closed doors on the predetermined floor.

[Claim 2]

- The elevator group control system according to claim
- 20 1,
- wherein from the number of riders in the cars that are stopped with opened doors, the number-of-persons calculation unit calculates the number of persons able to board the cars, and
- 25 wherein on the basis of the detected number of users

at the landing and the calculated number of persons able to board, the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

5 [Claim 3]

The elevator group control system according to claim 2,

wherein when the number of users at the elevator landing is more than the number of persons able to board,
10 the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

[Claim 4]

The elevator group control system according to claim 2,

15 wherein the elevator group control system includes a storage unit previously setting maximum car rider occupancy, and

wherein when the difference between the number of users at the elevator landing and the number of persons
20 able to board is more than the maximum car rider occupancy, the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

[Claim 5]

The elevator group control system according to claim
25 1,

wherein on the basis of the number of users at the elevator landing and the number of riders in the cars that are stopped with opened doors, the number-of-persons calculation unit calculates the number of persons unable
5 to board the cars that are stopped with opened doors among the users at the elevator landing, and

wherein on the basis of the calculated number of persons unable to board the cars (the excessive number of persons for boarding), the car control unit opens the
10 doors of any cars that are stopped (in standby mode) with closed doors on the predetermined floor.

[Claim 6]

The elevator group control system according to claim
5,

15 wherein when it is determined, for the number of persons unable to board the cars, that there are any persons unable to board, the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

20 [Claim 7]

The elevator group control system according to claim
5,

wherein the elevator group control system includes a storage unit previously setting maximum car rider
25 occupancy, and

wherein when it is determined that the number of persons unable to board the cars is more than the maximum car rider occupancy, the car control unit opens the doors of any cars that are stopped with closed doors on the
5 predetermined floor.

[Claim 8]

The elevator group control system according to claim
1,

wherein on the basis of the number of users at the
10 elevator landing, the number of riders in the cars that are stopped with opened doors, and the maximum car rider occupancy, the number-of-cars calculation unit calculates the necessary number of cars to be stopped with opened doors on the predetermined floor, and

15 wherein on the basis of the necessary number of cars, the car control unit opens the doors of any cars that are stopped with closed doors on the predetermined floor.

[Claim 9]

The elevator group control system according to claim
20 8,

wherein when the calculated necessary number of cars is more than the number of cars that are stopped with opened doors at that time, the car control unit opens the doors of any cars that are stopped with closed doors on
25 the predetermined floor.

[Claim 10]

The elevator group control system according to claim 8,

wherein the elevator group control system includes a
5 storage unit previously setting maximum car rider
occupancy, and

wherein the number-of-cars calculation unit
calculates the necessary number of cars by a quotient
obtained by dividing the sum of the number of users at the
10 elevator landing and the number of riders in the cars that
are stopped with opened doors by the maximum car rider
occupancy.

[Claim 11]

The elevator group control system according to any
15 one of claims 1, 2, 5, and 8,

wherein when selecting, from among the cars that are
stopped with closed doors, the car to be newly stopped
with an opened door, the car control unit selects the car
at the position far from the entrance of the elevator
20 landing first with respect to any cars that have already
been stopped with opened doors.

[Claim 12]

The elevator group control system according to any
one of claims 1, 2, 5, and 8,
25 wherein the elevator group control system includes a

display unit displaying position information at the landing of each car whose door has been opened.

[Claim 13]

The elevator group control system according to any
5 one of claims 1, 2, 5, and 8,

wherein the elevator group control system includes a stop time calculation unit setting stop time with respect to the car that is stopped with an opened door, and

wherein when one of the condition in which the
10 elevator that is stopped with an opened door has completed the stop time and the condition in which the number of riders in the car has reached a predetermined value or more or a load value has reached a predetermined value or more is satisfied, the car control unit closes the door of
15 the car and allows the car to leave.

[Claim 14]

The elevator group control system according to claim
13,

wherein the elevator group control system further
20 includes a display unit,

wherein from the set stop time and the elapsed time of the elevator that is stopped with an opened door, the stop time calculation unit calculates the time remaining until the completion of the standby mode, and

25 wherein from the detected number of riders in the

car or the detected load value, the number-of-persons calculation unit calculates the number of persons able to board the car that is stopped with an opened door, and the display unit displays position information at the landing
5 of the car that is stopped with an opened door, the calculated remaining time, and the number of persons able to board.

[Claim 15]

The elevator group control system according to claim
10 14,

wherein the elevator group control system includes an order determination unit determining, from the calculated remaining stop time of the car that is stopped with an opened door, an order in which stopping with an
15 opened door is completed to allow the elevator to leave, and

wherein the display unit displays the departure order.