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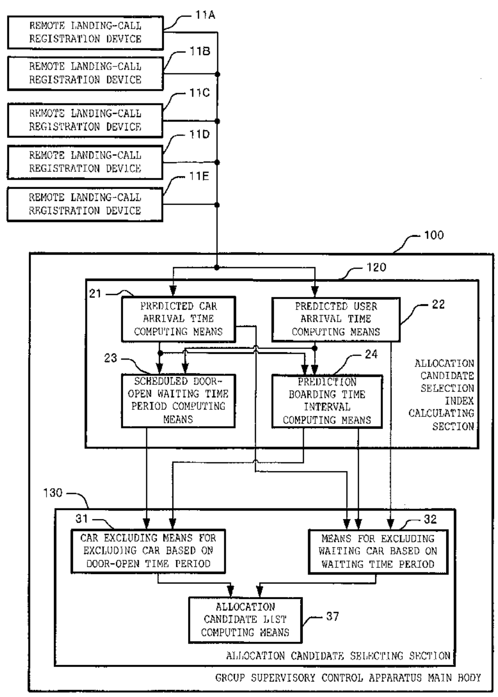
(54) **GROUP MANAGEMENT DEVICE OF ELEVATOR**

(57) In a group supervisory control apparatus for elevators, car excluding means (31) for excluding a car based on door-open time period of an allocation candidate selecting section (130) receives information of a scheduled door-open waiting time period and a prediction boarding time interval with respect to each of a plurality of cars, from an allocation candidate selection index calculating section (120). The car excluding means (31) for excluding a car based on door-open time period uses the prediction boarding time interval and the scheduled door-open waiting time period for determining whether or not to exclude each of the plurality of cars from selection of an allocation candidate for a new landing call performed by a user.

FIG.3



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Description

Technical Field

[0001] The present invention relates to a group supervisory control apparatus for elevators, which supervises a travel of an elevator group composed of a plurality of elevators.

Background Art

[0002] For example, in a conventional group supervising system for elevators as described in Patent Document 1, upon generation of a landing call, a group supervising/controlling apparatus calculates a difference between an arrival time of an allocation candidate car selected from an elevator group at a boarding floor and that of a user (passenger) who has performed a landing call operation.
If the allocation candidate car arrives at the landing a predetermined time or more earlier than the user, the group supervising/controlling apparatus cancels the selection of the car as the allocation candidate in the elevator group so as to prevent a travel efficiency of the elevator group from being lowered. Therefore, the group supervising/controlling apparatus selects a car different from the above-mentioned car as the allocation candidate to determine the allocated car which meets conditions.
[0003] Patent Document 1: JP 2005-112 520 A

Disclosure of the Invention

Problems to be Solved by the Invention

[0004] In some cases, a plurality of continuous landing calls for the same traveling direction are generated on the same boarding floor within a short period time. Specifically, while a car is yet to leave a boarding floor related with a previously registered landing call (that is, registered landing call), a new landing call for the same traveling direction as that of the registered landing call is sometimes generated on the same boarding floor as the boarding floor on which the registered landing call is generated.
[0005] On the other hand, in the conventional group supervising system for the elevators as described above, a criterion for the range of users which may be allocated to the same car is not appropriately given. Therefore, if the new landing call having the same content as that of the registered landing call is generated, the car, which is allocated to the registered landing call, is also allocated to the new landing call. As a result, a door-open waiting time period of the car allocated to the registered landing call is extended.
[0006] With the allocation control method as described above, however, if the number of users increases, the door-open waiting time period of the car on the boarding floor also increases. Therefore, the waiting time period for the user who is the first to perform the landing call operation becomes longer after the arrival of the car. Moreover, it happens that the user who has performed the new landing call operation cannot board the car because a door of the car is closed quickly so that the car leaves the boarding floor or because the car is already fully loaded.
[0007] In addition, in the case where the same car as the car whose door-open waiting time period is extended is allocated to a landing floor different from the boarding floor, the arrival time of the car at the different landing floor is greatly delayed.
[0008] Thus, due to the factors described above, the conventional group supervising system for the elevators as described above has a problem of a lowered travel efficiency of the elevators and a problem of increased discomfort of the users when a plurality of users continuously perform the landing call operations.
[0009] The present invention has been made to solve the problems described above, and therefore has an object to provide a group supervisory control apparatus for elevators, which can improve a travel efficiency of the elevators and reduce discomfort of a user.
[0010] The present invention provides a group supervisory control apparatus for elevators, for supervising a travel of an elevator group including a plurality of cars to allocate, in response to a request to register a landing call from a landing-call registration device, one of the plurality of cars to a boarding floor and a traveling direction as an allocated car, the boarding floor and the traveling direction being related with the landing call, and then to register the landing call, the group supervisory control apparatus for elevators including:

an allocation candidate selection index calculating section for calculating, upon generation of a new request to register the landing call, if the landing call for the same boarding floor and the same traveling direction as a boarding floor and a traveling direction related with the new landing call has already been registered, a difference in time between the prediction boarding time of a user who is a last boarding-predicted user among a plurality of users who have performed the registered landing call and the prediction boarding time of a user who has performed the new landing call as a first index; and

an allocation candidate selecting section for selecting an allocation candidate corresponding to a candidate for the allocated car to be allocated to the new landing call from the plurality of cars, and for excluding the allocated car allocated to the registered landing call from selection of the allocation candidate when the first index calculated by the allocation candidate selection index calculating section is larger than a first allowable value stored in advance.

Brief Description of the Drawings

[0011]

FIG. 1 is a perspective view illustrating the schema of a landing for elevators according to a first embodiment of the present invention;

FIG. 2 is a block diagram illustrating a group supervisory control apparatus for elevators according to the first embodiment of the present invention;

FIG. 3 is a block diagram illustrating an allocation candidate selection index calculating section and an allocation candidate selecting section illustrated in FIG. 2 in a specific manner;

FIG. 4 is an explanatory diagram illustrating a relation between predicted user arrival times and a predicted car arrival time;

FIG. 5 is another explanatory diagram illustrating the relation between the predicted user arrival times and the predicted car arrival time;

FIG. 6 is a further explanatory diagram illustrating the relation between the predicted user arrival times and the predicted car arrival time;

FIG. 7 is a further explanatory diagram illustrating the relation between the predicted user arrival times and the predicted car arrival time;

FIG. 8 is a further explanatory diagram illustrating the relation between the predicted user arrival times and the predicted car arrival time;

FIG. 9 is an explanatory diagram illustrating processing for excluding a car from the selection of an allocation candidate by car excluding means for excluding a car based on door-open time period illustrated in FIG. 3;

FIG. 10 is another explanatory diagram illustrating processing for excluding the car from the selection of the allocation candidate by the car excluding means for excluding the car based on door-open time period illustrated in FIG. 3;

FIG. 11 is a further explanatory diagram illustrating processing for excluding the car from the selection of the allocation candidate by the car excluding means for excluding the car based on door-open time period illustrated in FIG. 3;

FIG. 12 is a further explanatory diagram illustrating processing for excluding the car from the selection of the allocation candidate by the car excluding means for excluding the car based on door-open time period illustrated in FIG. 3;

FIG. 13 is a flowchart illustrating an operation of a group supervisory control apparatus main body illustrated in FIG. 3;

FIG. 14 is an explanatory view illustrating a state in which a plurality of users sequentially arrive at the landing illustrated in FIG. 1;

FIG. 15 is an explanatory diagram illustrating an operation for determining the allocated car with the use of a general allocation method;

FIG. 16 is an explanatory diagram illustrating the operation for determining the allocated car with the use of another general allocation method;

FIG. 17 is a perspective view illustrating the schema of the landing for elevators according to a second embodiment of the present invention;

FIG. 18 is a block diagram illustrating the group supervisory control apparatus for the elevators according to a third embodiment of the present invention;

FIG. 19 is a flowchart illustrating an operation of a group supervisory control apparatus main body illustrated in FIG. 18;

FIG. 20 is a block diagram illustrating the group supervisory control apparatus for the elevators according to a fourth embodiment of the present invention;

FIG. 21 is a flowchart illustrating an operation of a group supervisory control apparatus main body illustrated in FIG. 20;

FIG. 22 is a block diagram illustrating the group supervisory control apparatus for the elevators according to a fifth embodiment of the present invention;

FIG. 23 is a flowchart illustrating an operation of a group supervisory control apparatus main body illustrated in FIG. 22;

FIG. 24 is a block diagram illustrating the group supervisory control apparatus for the elevators according to a sixth embodiment of the present invention; and

FIG. 25 is a flowchart illustrating an operation of a group supervisory control apparatus main body illustrated in FIG. 24.

Best Mode for Carrying Out the Invention

[0012] Hereinafter, preferred embodiments of the present invention are described referring to the drawings.

First Embodiment

[0013] FIG. 1 is a perspective view illustrating the periphery of a landing for elevators according to a first embodiment of the present invention. FIG. 2 is a block diagram illustrating a group supervisory control apparatus for elevators according to the first embodiment of the present invention.
In FIGs. 1 and 2, a plurality of elevators are installed in a building. The plurality of elevators constitute an elevator group. The plurality of elevators respectively have cars 1A to ID.
[0014] Operations of the cars 1A to 1D are respectively controlled by individual car controllers 2A to 2D. The individual car controllers 2A to 2D are connected to a group supervisory control apparatus main body 100. The group supervisory control apparatus main body 100 collectively supervises the operations of the cars 1A to 1D, that is, a travel of the elevator group, via the individual car controllers 2A to 2D.
[0015] Remote landing-call registration devices 11A to 11E are provided on (in an area of) each landing floor of the building so as to be a predetermined distance away from a landing 3 for the elevators (only the remote landing-call registration devices 11A are illustrated in FIG. 1). Further, the remote landing-call registration devices 11A to 11E are located, for example, on a lobby floor, at a boundary between a general zone and a supervised zone (that is, at a zone boundary) in the building or the like. Each of the remote landing-call registration devices 11A to 11E includes an operation section and a display section. Further, the remote landing-call registration devices 11A to 11E are connected to the group supervisory control apparatus main body 100.
[0016] The remote landing-call registration devices 11A to 11E are subjected to a landing call operation performed by a user. The landing call operation includes: an operation for calling the car to a boarding floor which corresponds to the landing floor on which the user boards the car; and an operation for registering an exit floor which corresponds to the landing floor on which the user gets off the car. The remote landing-call registration devices 11A to 11E are operated by almost all the users of the elevators, who pass through the lobby floor, the zone boundary, or the like.
[0017] When the landing call operation is performed by the user, a corresponding one of the remote landing-call registration devices 11A to 11E transmits a content of the landing call operation as (information of) a request to register the landing call, to the group supervisory control apparatus main body 100. In response to the request to register the landing call, the group supervisory control apparatus main body 100 allocates one of the cars 1A to 1D as an allocated car to the boarding floor for which the request to register the landing call is made, and registers the landing call.
[0018] Upon registration of the landing call, the group supervisory control apparatus main body 100 transmits information of a car number of the allocated car as a response to the request to register the landing call to the corresponding one of the remote landing-call registration devices 11A to 11E. Upon reception of the information of the car number of the allocated car, the corresponding one of the remote landing-call registration devices 11A to 11E displays the car number of the allocated car on the display section to inform the user of which is the allocated car.
[0019] Moreover, upon registration of the landing call, the group supervisory control apparatus main body 100 transmits an operation command relating to an operation of the allocated car to one of the individual car controllers 2A to 2D, which controls the allocated car. The corresponding one of the individual car controllers 2A to 2D controls the operation of the allocated car based on the operation command from the group supervisory control apparatus main body 100.
Moreover, the individual car controllers 2A to 2D perform, for example, destination floor registration (car call registration) or door opening/closing control for the cars 1A to ID in response to the operation of each of car operating panels (not shown) respectively provided inside the cars 1A to 1D, which is performed by the user.
[0020] Next, a configuration of the group supervisory control apparatus main body 100 is specifically described. The group supervisory control apparatus main body 100 prestores information of the car numbers of the cars 1A to 1D. Moreover, the group supervisory control apparatus main body 100 receives information relating to operating statuses of the cars 1A to 1D from the individual car controllers 2A to 2D.
The information relating to the operating statuses of the cars 1A to 1D is information of positions of the cars 1A to 1D, running directions of the cars 1A to 1D, running statuses of the cars 1A to 1D (indicating whether the car is running or in a waiting state), door-open/closed statuses of the cars 1A to 1D, the landing calls registered for the cars 1A to 1D, destination floors registered for the cars 1A to 1D, and the like.
[0021] Upon each reception of the request to register the landing call, the group supervisory control apparatus main body 100 selects the allocated car for the landing call. When receiving another request to register a new landing call while the landing call is already registered, the group supervisory control apparatus main body 100 verifies whether the new landing call and the registered landing call are made for the same boarding floor and traveling direction. Specifically, the group supervisory control apparatus main body 100 verifies whether or not there is any registered landing call for the same boarding floor and traveling direction as those of the new landing call.

[0022] When there is a registered landing call for the same boarding floor and traveling direction, the group supervisory control apparatus main body 100 determines whether or not the car allocated to the registered landing call can also be allocated to the new landing call, and then allocates the car, which is already allocated to the registered landing call, or the car other than the allocated car, to the new landing call.

[0023] Moreover, the group supervisory control apparatus main body 100 includes: an allocation candidate selection index calculating section 120; an allocation candidate selecting section 130; a travel constant setting section 140; an allocated car determining section 150; and an operation command section 160. The allocation candidate selection index calculating section 120 calculates allocation candidate selection indices (first index and second index). The allocation candidate selection indices are indices for selecting (extracting), from all the cars 1A to 1D, the allocation candidate corresponding to a candidate for the allocated car to the new landing call.

[0024] The allocation candidate selecting section 130 evaluates all the cars 1A to 1D for the possibility of the allocation based on information of the allocation candidate selection indices from the allocation candidate selection index calculating section 120 and the operating statuses of the cars 1A to 1D (traveling status of the elevator group). Then, the allocation candidate selecting section 130 selects the allocation candidate corresponding to the candidate for the allocated car based on the evaluation result. Moreover, the allocation candidate selecting section 130 stores an allocation candidate list corresponding to a list of the car numbers of the selected allocation candidate cars.

Moreover, upon generation of the landing call, the allocation candidate selecting section 130 selects the allocation candidate from all the cars 1A to 1D and updates the stored allocation candidate list.

[0025] The travel constant setting section 140 prestores information of distances between the remote landing-call registration devices 11A to 11E and boarding/exiting positions for all the cars 1A to 1D (specifically, landing doorways (in front of the cars)) as travel distance information therein. The travel constant setting section 140 also prestores a standard value of traveling rates (walking rates) of the users as traveling rate information therein.

Upon operation of one of the remote landing-call registration devices 11A to 11E by the user, the travel constant setting section 140 transmits the travel distance information between one of the remote landing-call registration devices 11A to 11E, on which the new landing call operation has been performed, and the boarding positions for all the cars 1A to 1D for the new landing call, and the traveling rate information, to the allocation candidate selection index calculating section 120.

[0026] The allocated car determining section 150 refers to the allocation candidate list generated by the allocation candidate selecting section 130 to select the car which provides a minimum increment in a total waiting time period when allocated, from the allocation candidate cars, and determines the selected car as the allocated car.

The allocated car determining section 150 also transmits the information of the car number of the thus selected allocated car to the operation command section 160. The operation command section 160 transmits the operation command relating to the operation of the allocated car to one of the individual controllers 2A to 2D, which controls the allocated car determined by the allocated car determining section 150.

[0027] Next, configurations of the allocation candidate selection index calculating section 120 and the allocation candidate selecting section 130 illustrated in FIG. 2 are specifically described. FIG. 3 is a block diagram illustrating in a specific manner the allocation candidate selection index calculating section 120 and the allocation candidate selecting section 130 illustrated in FIG. 2.

In FIG. 3, the illustration of the individual car controllers 2A to 2D, the travel constant setting section 140, the allocated car determining section 150, and the operation command section 160 is omitted.

[0028] In FIG. 3, the allocation candidate selection index calculating section 120 includes: predicted car arrival time computing means 21; predicted user arrival time computing means 22; scheduled door-open waiting time period computing means 23; and prediction boarding time interval computing means 24. The predicted car arrival time computing means 21 calculates a predicted time of the arrival of each of the cars 1A ta 1D, specifically, a predicted car arrival time, at the boarding floor related with the new landing call based on a time at which the request to register the new landing call is generated.

The predicted car arrival time is calculated by the predicted car arrival time computing means 21 based on the information of the operating statuses of the cars 1A to 1D from the individual car controllers 2A to 2D.

[0029] The predicted user arrival time computing means 22 calculates a predicted time of the arrival of the user, that is, a predicted user arrival time, at each of the boarding positions for the cars 1A to 1D based on the time at which the request to register the landing call is generated. The predicted user arrival time is calculated by the predicted user arrival time computing means 22 based on standard travel distance information and standard traveling rate information from the travel constant setting section 140.

[0030] The scheduled door-open waiting time period computing means 23 receives the information of the predicted car arrival time from the predicted car arrival time computing means 21. The scheduled door-open waiting time period computing means 23 also receives the information of the predicted user arrival time from the predicted user arrival time computing means 22. Further, the scheduled door-open waiting time period computing means 23 stores the predicted user arrival times in the form of a time-sequential list.

[0031] Upon generation of the new landing call, the scheduled door-open waiting time period computing means 23 supposes that each of the cars 1A to 1D is allocated to the boarding floor related with the landing call and calculates a scheduled door-open waiting time period of each of the cars 1A to 1D after the arrival of each of the cars 1A to 1D at the boarding floor as a second index.
The scheduled door-open waiting time period is a scheduled time period during which the car waits with a door open at the landing 3 after the arrival of the car at the landing 3. The scheduled door-open waiting time period is calculated by the scheduled door-open waiting time period computing means 23 based on the predicted car arrival time and the list of the predicted user arrival times.
[0032] The prediction boarding time interval computing means 24 receives the information of the predicted car arrival time from the predicted car arrival time computing means 21. The prediction boarding time interval computing means 24 also receives the information of the predicted user arrival times from the predicted user arrival time computing means 22.
Further, the prediction boarding time interval computing means 24 also stores the information of the predicted user arrival times in the form of a time-sequential list as in the case of the scheduled door-open waiting time period computing means 23.
[0033] Moreover, the prediction boarding time interval computing means 24 calculates a predicted arrival time interval corresponding to a time difference between a prediction boarding time of the user who performs the registered landing call operation immediately before the new landing call operation is performed and a prediction boarding time of the user who makes the new landing call as a first index based on the list of the prediction user arrival times.
[0034] Next, a method of computing the scheduled door-open waiting time period by the scheduled door-open waiting time period computing means 23 illustrated in FIG. 3 and a method of computing the prediction boarding time interval by the prediction boarding time interval computing means 24 are more specifically described. Here, the scheduled door-open waiting time period is tw, the prediction boarding time interval is tint, and the predicted arrival time of the car 1A at the boarding floor is CarPT(A).
[0035] Moreover, the description is given with three users x, y, and z. The users x, y, and z are as follows.

User x: a user who is the first to arrive at the boarding position for the car 1A among a plurality of users who have performed the registered landing call operation.
User y: a user who is the last to arrive at the boarding position for the car 1A among the plurality of users who have performed the registered landing call operation.
User z: a user who has performed the new landing call operation.

[0036] Here, a time at which the user z performs the new landing call operation (current time) is T = 0. Moreover, the predicted arrival times of the users x, y, and z are respectively HT(x),HT(y), and HT(z). Horwever, in the case where the user who boards the car 1A on the different landing floor remains in the car without getting off when the car 1A traveling in the same direction as that for the new landing call arrives at the boarding floor related with the new landing call, HT (x) = (predicted arrival time of the car 1A at the boarding floor).
[0037] In this case, the scheduled door-open waiting time period tw is expressed by the following Expression (1).

Expression (1)

$$\begin{cases} tw = \max(HT(z) - \max(HT(x), CarPT(A)), 0) & HT(z) \geq HT(y) \\ tw = \max(HT(y) - \max(HT(x), CarPT(A)), 0) & HT(x) < HT(z) < HT(y) \\ tw = \max(HT(x) - \max(HT(z), CarPT(A)), 0) & HT(z) \leq HT(x) \end{cases}$$

[0038] Specifically, the scheduled door-open waiting time period tw is based on a relation of three times, that is, the predicted arrival time of the car allocated to the landing call at the boarding floor, the prediction boarding time of the user who makes the registered landing call for the allocated car, and the prediction boarding time of the user who makes the new landing call.
[0039] The prediction boarding time interval tint is expressed by the following Expression (2).

Expression (2)

$$\begin{cases} tint = \max(HT(z) - \max(HT(y), CarPT(A)), 0) & HT(z) \geq HT(y) \\ tint = 0 & HT(z) \leq HT(y) \end{cases}$$

[0040] If there is no user predicted to board (already allocated to) the car 1A on the boarding floor related with the new landing call, the scheduled door-open waiting time period computing means 23 and the prediction boarding time interval computing means 24 respectively calculate the scheduled door-open waiting time period tw and the prediction boarding time interval tint with x = y = z.

If there is only one user predicted to board the car 1A, the scheduled door-open waiting time period computing means 23 and the prediction boarding time interval computing means 24 respectively calculate the scheduled door-open waiting time period tw and the prediction boarding time interval tint with x = y.

[0041] Further, in this example, the prediction boarding time interval computing means 24 calculates the prediction boarding time interval tint as the first index based on the predicted user arrival time. However, the prediction boarding time interval computing means 24 (or the allocation candidate selection index calculating section 120) can calculate an operation time interval corresponding to a time difference between a time at which the user y operates the landing-call registration device 11A and a time at which the user z operates the landing-call registration device 11A based on the above-mentioned operation times so that the calculated operation time interval is used as the first index in place of the prediction boarding time interval tint. The operation time interval in this case can be handled in the same manner as that for the prediction boarding time interval tint in the computation processing described below.

[0042] Here, FIGs. 4 to 7 are explanatory diagrams illustrating the relation between the predicted user arrival times of the users x, y, and z and the predicted car arrival time of the car 1A. FIG. 4 illustrates the case where the car 1A arrives at a target boarding floor before the user x arrives at the boarding position (boarding position for the car 1A). FIG. 5 illustrates the case where the car 1A arrives at the target boarding floor after the user x arrives at the boarding position and before the user y arrives at the boarding position. FIG. 6 illustrates the case where the car 1A arrives at the target boarding floor after the user y arrives at the boarding position and before the user z arrives at the boarding position. FIG. 7 illustrates the case where the car 1A arrives at the target boarding floor after the user z arrives at the boarding position.

[0043] As illustrated in FIGs. 4 to 7, it is understood that the scheduled door-open waiting time period tw and the prediction boarding time interval tint vary according to the predicted user arrival times HT(x), HT(y), and HT(z) of the users x, y, and z and the predicted arrival time CarPT(A) of the car 1A.

Specifically, depending on the registered relation between HT(x), HT(y), HT(z) and CarPT(A), a target with which a difference with HT(z) is computed in a processing of calculating the scheduled door-open waiting time period tw and the prediction boarding time interval tint is determined to be any one of HT(x), HT(y), CarPT(A), and 0. In the case where the operation time interval is used as the first index in place of the prediction boarding time interval tint, the operation time interval is tint2 as illustrated in FIG. 8.

[0044] Next, a configuration of the allocation candidate selecting section 130 of the group supervisory control apparatus main body 1 is described, In FIG. 3 referred to above, the allocation candidate selecting section 130 includes: car excluding means 31 for excluding car based on door-open time period; means 32 for excluding waiting car based on waiting time period; and allocation candidate list computing means (allocation candidate car selecting means) 37.

[0045] The car excluding means 31 for excluding car based on door-open time period receives the information of the scheduled door-open waiting time period tw for each of the cars 1A to 1D from the scheduled door-open waiting time period computing means 23. At the same time, the car excluding means 31 for excluding car based on door-open time period receives the information of the prediction boarding time interval tint for each of the cars 1A to 1D from the prediction boarding time interval computing means 24.

[0046] Here, the scheduled door-open waiting time period tw and the prediction boarding time interval tint for the allocated car which is already allocated to the boarding floor related with the registered landing call are values which are obtained by supposing that the allocated car is also allocated to the new landing call. Specifically, the scheduled door-open waiting time period tw and the prediction boarding time interval tint in this case are values in the case where a response is simultaneously made to the registered landing call and to the new landing call.

[0047] The car excluding means 31 for excluding car based on door-open time period uses the scheduled door-open waiting time period tw and the prediction boarding time interval tint to perform computation expressed by the following Expression (3) for each of the cars 1A to 1D.

Expression (3)

$$(tw \leq TW0 \text{ and } tint \leq TINT0) \text{ or } (tw \leq TWMAX \text{ and } tint \leq TINT1)$$

Each of the parameters TW0, TINT0, TWMAX, and TINT1 is as described below.

TW0: a standard allowable door-open waiting time period,
TINT0: a standard prediction boarding time interval within the standard allowable door-open waiting time period,
TWMAX: a maximum allowable door-open waiting time period, and
T1NT1: a standard prediction boarding time interval after lapse of the standard allowable door-open waiting time period.

The allocation candidate selecting section 130 prestores a plurality of prediction boarding time interval values including TINT0 and TINT1 as first allowable values. The allocation candidate selecting section 130 also prestores a plurality of allowable door-open waiting time period values including TW0 and TWMAX as second allowable values.
[0048] Then, the car excluding means 31 for excluding car based on door-open time period determines whether or not each of the cars 1A to 1D (each car) satisfies Expression (3). As a result, the car excluding means 31 for excluding car based on door-open time period registers the car number of the car which satisfies Expression (3) as the allocation candidate on the allocation candidate list. On the other hand, the car excluding means 31 for excluding car based on door-open time period excludes the car number of the car which does not satisfy Expression (3) from the selection of the allocation candidate to be registered on the allocation candidate list.
[0049] The means 32 for excluding waiting car based on waiting time period receives the information of the predicted car arrival time from the predicted car arrival time computing means 21. The means 32 for excluding waiting car based on waiting time period also receives the information of the predicted user arrival times from the predicted user arrival time computing means 22. Further, the means 32 for excluding waiting car based on waiting time period stores the information of the predicted user arrival times in the form of a time-sequential list.
[0050] Moreover, the means 32 for excluding waiting car based on waiting time period compares the predicted car arrival time and the predicted user arrival time for the car which is not allocated to the boarding floor related with the new landing call. Then, the means 32 for excluding waiting car based on waiting time period excludes the car number of the car whose predicted car arrival time is a limit time Tb or more earlier than the predicted user arrival time from the selection of the allocation candidate to be registered on the allocation candidate list. The limit time Tb is a preset threshold value so as to prevent the travel efficiency of the elevator group from being lowered.
[0051] The allocation candidate list computing means 37 computes, for example, the following Expression (4) for the allocation candidate list to select the allocation candidate from all the cars 1A to 1D.

Expression (4)

$$C37 = ALLCAGE \text{ and } NOT(N31 \text{ or } N32)$$

where ALLCAGE: the car numbers of all the cars,

N31: the car number of the car excluded by the car excluding means 31 for excluding car based on door-open time period,
N32: the car number of the car excluded by the means 32 for excluding waiting car based on waiting time period, and
C37: the car number of the allocation candidate car selected by the allocation candidate list computing means 37.

[0052] Therefore, the car(s) which does(do) not satisfy the conditions is(are) excluded from the selection of the allocation candidate by the car excluding means 31 for excluding car based on door-open time period and the means 32 for excluding waiting car based on waiting time period.
Then, upon reception of the result of the exclusion processing performed by the car excluding means 31 for excluding car based on door-open time period and the means 32 for excluding waiting car based on waiting time period, the allocation candidate list computing means 37 narrows down all the cars 1A to 1D to select the allocation candidate for the new landing call.
If the boarding floor or the exit floor for the new landing call corresponds to a floor which cannot be serviced because the boarding/exit floor is situated in a different service zone or is an unserviced floor (non-stop floor), the allocation

candidate list computing means 37 excludes a car unavailable for the boarding/exit floor from the selection of the allocation candidate.

[0053] Next, the processing of excluding the car from the selection of the allocation candidate by the car excluding means 31 for excluding car based on door-open time period is specifically described. FIGs. 9 to 12 are explanatory diagrams illustrating the processing of excluding the car from the selection of the allocation candidate by the car excluding means 31 for excluding car based on door-open time period illustrated in FIG. 3. In FIGs. 9 to 12, each of the users x and y is in a state in which the landing call made by each is registered and the car 1A is allocated to the landing calls.

[0054] In the case illustrated in FIG. 9, the scheduled door-open waiting time period tw is equal to or less than TW0 for the user z, while the prediction boarding time interval tint between the users z and y is TINT0 or less. Accordingly, Expression (3) is satisfied. As a result, the car excluding means 31 for excluding car based on door-open time period selects the car 1A as the allocation candidate for the new landing call made by the user z.

[0055] In the case illustrated in FIG. 10, the prediction boarding time interval tint between the users z and y is TINT1 or less. As a result, the limit value of the scheduled door-open waiting time period is changed (extended) from TW0 to TWMAX.

Then, the conditions of Expression (3) are satisfied because the scheduled door-open waiting time period tw for the user z is TWMAX or less. As a result, the car excluding means 31 for excluding car based on door-open time period selects the car 1A as the allocation candidate for the new landing call made by the user z as in the case illustrated in FIG. 9.

[0056] On the other hand, in the case illustrated in FIG. 11, the scheduled door-open waiting time period tw for the user z is less than each of TW0 and TWMAX. However, the prediction boarding time interval tint between the users z and y exceeds each of TINT0 and TINT1. Therefore, the conditions of Expression (3) are not satisfied. Accordingly, the car excluding means 31 for excluding car based on door-open time period excludes the car 1A from the selection of the allocation candidate for the new landing call made by the user z.

[0057] On the other hand, in the case illustrated in FIG. 12, the prediction boarding time interval tint between the users z and y is less than each of TINT0 and TINT1. However, the scheduled door-open waiting time period tw for the user z exceeds each of TW0 and TWMAX. Therefore, the conditions of Expression (3) are not satisfied. Accordingly, the car excluding means 31 for excluding car based on door-open time period excludes the car 1A from the selection of the allocation candidate for the new landing call made by the user z as in the case illustrated in FIG. 11.

[0058] Next, an operation of the group supervisory control apparatus main body 100 is described. Here, an operation for selecting the allocation candidate, which is performed by the group supervisory control apparatus main body 100 (allocation candidate selecting index calculating section 120 and allocation candidate selecting section 130), is specifically described.

FIG. 13 is a flowchart illustrating an operation of the group supervisory control apparatus main body 100. In FIG. 13, first, upon reception of the request to register the new landing call from any one of the remote landing-call registration devices 11A to 11E, the group supervisory control apparatus main body 100 selects an arbitrary one of all the cars 1A to 1D as a car to be evaluated (Step S101).

[0059] Then, the group supervisory control apparatus main body 100 calculates a predicted arrival time of the car to be evaluated at a target landing floor based on an operating status of the car to be evaluated (Step S102). At the same time, the group supervisory control apparatus main body 100 calculates a predicted arrival time of the user who has performed the new landing call operation at the boarding position for the car to be evaluated (Step S103).

[0060] Then, the group supervisory control apparatus main body 100 verifies whether or not the car to be evaluated has already been allocated to the same landing floor and the same traveling direction as the boarding floor and the traveling direction related with the new landing call (Step S104).

If the car to be evaluated is not allocated to the same landing floor and the same traveling direction as the boarding floor and the traveling direction related with the new landing call (NO in Step S104), the group supervisory control apparatus main body 100 verifies whether or not the car to be evaluated arrives at the target landing floor the limit time Tb or more earlier than the user (Step S105).

[0061] If the car to be evaluated arrives at the target landing floor the limit time Tb or more earlier than the user, the group supervisory control apparatus main body 100 excludes the car number of the car to be evaluated from the selection of the allocation candidate to be registered on the allocation candidate list (Step S106).

On the other hand, if the car to be evaluated does not arrive at the target landing floor the limit time Tb or more earlier than the user, the group supervisory control apparatus main body 100 sets the car to be evaluated as the allocation candidate and adds the car number of the car to be evaluated to the allocation candidate list (Step S107).

[0062] If the car to be evaluated is allocated to the same landing floor and the same traveling direction as the boarding floor and the traveling direction related with the new landing call (YES in Step S104), the group supervisory control apparatus main body 100 calculates the scheduled door-open waiting time period tw of the car to be evaluated on the target landing floor (Step S108). ^

At the same time, the group supervisory control apparatus main body 100 calculates the prediction boarding time interval tint between the user who has performed the new landing call operation and the last one of the plurality of users who have performed the registered landing call operation (Step S109).

[0063] Then, the group supervisory control apparatus main body 100 verifies whether or not the calculated scheduled door-open waiting time period tw and the calculated prediction boarding time interval tint satisfy the conditions of Expression (3) (Step S110). If the scheduled door-open waiting time period tw and the prediction boarding time interval tint satisfy the conditions of Expression (3), the group supervisory control apparatus main body 100 sets the car to be evaluated as the allocation candidate and adds the car number of the car to be evaluated to the allocation candidate list (Step S107).

On the other hand, if the scheduled door-open waiting time period tw and the prediction boarding time interval tint do not satisfy the conditions of Expression (3), the group supervisory control apparatus main body 100 excludes the car number of the car to be evaluated from the selection of the allocation candidate to be registered on the allocation candidate list (Step S106).

[0064] After determining whether or not to set the car to be evaluated as the allocation candidate (after Steps S106 and S107), the group supervisory control apparatus main body 100 verifies whether or not all the cars 1A to 1D have been evaluated (Step S111), If all the cars 1A to 1D have been evaluated, the operation for selecting the allocation candidate by the group supervisory control apparatus main body 100 is terminated.

On the other hand, if all the cars 1A to 1D have not been evaluated yet, the group supervisory control apparatus main body 100 changes the car to be evaluated to an unevaluated car (Step S112). Then, the group supervisory control apparatus main body 100 calculates the predicted arrival time of the car to be evaluated after changing the car to be evaluated (Step S102) and then repeats the same operation until the evaluation is terminated for all the cars 1A to 1D.

[0065] Through the operation described above, the group supervisory control apparatus main body 100 refers to the allocation candidate list to determine the car providing a minimum total waiting time period when the new landing call is allocated thereto, as the allocated car. Then, the group supervisory control apparatus main body 100 transmits information of the car number of the allocated car to the corresponding one of the remote landing-call registration devices 11A to 11E, on which the landing call operation is performed by the user, while transmitting a command relating to the operation of the allocated car to one of the individual car controllers 2A to 2D, which controls the allocated car.

[0066] Next, an operation for allocating the car by the group supervisory control apparatus main body 100 with the use of a general car allocation method in a situation where a plurality of users sequentially arrive at the landing 3 illustrated in FIG. 1 is described. FIG. 14 is an explanatory diagram illustrating the situation where the plurality of users sequentially arrive at the landing 3 illustrated in FIG. 1.

In FIG. 14, the remote landing-call registration device 11A is operated by the first user to perform the landing call operation. In response to the above-mentioned operation, the group supervisory control apparatus main body 100 allocates the car 1A to the boarding floor to register the landing call as a response to the landing call operation performed by the first user.

[0067] When the landing call operation is performed by the second or subsequent user within a short period of time after the landing call operation is performed by the first user, the group supervisory control apparatus main body 100 makes the previously allocated car 1A wait with a door open on the boarding floor as a response to the landing call operation performed by the second or subsequent user. Specifically, the plurality of users are grouped into one so that only one car 1A is allocated. In this case, the car 1A, which is allocated to the landing call operation performed by the first user, waits with the door open on the boarding floor until there are no more users to board the car on the boarding floor.

[0068] In the case where the allocation method as described above is used, the travel efficiency of the elevator group becomes relatively high because a relatively large number of users can be transported for each round-trip (each reciprocation) of the car 1A. However, there is a problem in that the door-open waiting time period of the car 1A become longer to relatively increase the waiting time period for the user who is in the car to result in increased discomfort of the user.

[0069] On the other hand, according to another general allocation method, when the landing call operation is performed by the second or subsequent user within a short period of time after the landing call operation is performed by the first user, the group supervisory control apparatus main body 100 divides the plurality of users who have performed the landing call operation into a plurality of groups Ga to Gd, as illustrated in FIG. 16.

Then, the group supervisory control apparatus main body 100 allocates the cars 1A to 1D to the groups Ga to Gd in a one-by-one manner. In this case, the waiting time period of the user who is the first to board any one of the cars 1A to 1D becomes shorter as compared with that in the case illustrated in FIG. 15. However, the travel efficiency of the elevator group is lowered as compared with that in the case illustrated in FIG. 15 because the number of users to board each car is as few as about one to three.

[0070] Specifically, in the case where the plurality of users are grouped into one (in the case illustrated in FIG. 15), there is a problem of a longer waiting time period of the user in the car 1A. On the other hand, in the case where the plurality of users are divided into the plurality of groups (in the case illustrated in FIG. 16), there is a problem of impossibility of transporting a large number of users at a time.

In order to solve the problems described above at the same time, it is necessary to appropriately select the allocated car for each user so as to simultaneously realize the reduction of the waiting time period in the car and the improvement of the travel efficiency of the elevators.

[0071] In regard of the problems descried above, in the group supervisory control apparatus for the elevators according to the first embodiment, when the scheduled door-open waiting time period tw calculated by the allocation candidate selection index calculating section 120 exceeds the maximum allowable door-open waiting time period TWMAX, the car allocated to the registered landing call is excluded from the selection of the allocation candidate for the new landing call by the allocation candidate selecting section 130.

In this manner, the car different from the allocated car is selected as the allocation candidate for the new landing call. As a result, the door-open waiting time period of the allocated car to the registered landing call is reduced, and thus it is possible to improve the travel efficiency of the elevator group. At the same time, the in-car waiting time period of the user arriving at the landing earlier is reduced, and thus it is possible to reduce the discomfort of the user.

[0072] Moreover, the allocation candidate is obtained by narrowing down the cars by the allocation car excluding means 31 for excluding car based on door-open time period, based on the scheduled door-open waiting time period tw and the prediction boarding time interval tint respectively calculated by the scheduled door-open waiting time period computing means 23 and the prediction boarding time interval computing means 24.

As a result, the door-open waiting time period of the allocated car can be prevented from being longer than needed. In addition, in the case where there is any user who can board immediately after the scheduled door-open waiting time period tw exceeds TW0, the door-open time period is slightly extended with TINT1 to allow the boarding of the user.

[0073] Further, the allocation candidate is obtained by narrowing down the cars by the allocation car excluding means 31 for excluding car based on door-open time period, based on the scheduled door-open waiting time period tw and the prediction boarding time interval tint respectively calculated by the scheduled door-open waiting time period computing means 23 and the prediction boarding time interval computing means 24. As a result, the travel efficiency of the elevators can be improved because the users to board can be appropriately distributed.

[0074] Moreover, even within the maximum allowable door-open waiting time period TWMAX and the standard allowable door-open waiting time period TW0, the target car can be excluded from the selection of the allocation candidate by using the limit value TINT0 of the prediction boarding time interval.

As a result, the prevention of the operation which provides discomfort, and which increases the door-open waiting time period of the car or the user waiting time period in the car, and the improvement of the travel efficiency of the elevator group, can be realized at the same time.

[0075] Further, in the case where the car arrives at the target landing floor the limit time Tb or more earlier than the user, the means 32 for excluding waiting car based on waiting time period excludes the car from the selection of the allocation candidate. As a result, the car can be prevented from waiting with the door open for a long period of time at a landing floor. Thus, the travel efficiency of the elevator group can be further improved.

[0076] Moreover, the predicted user arrival time computing means 22 predicts the arrival time of the user at the boarding position for each of the cars 1A to 1D from the corresponding one of the remote landing-call registration devices 11A to 11E. With the above-mentioned configuration, hoistways for the cars of the elevator group which is to be supervised by the single group supervisory control apparatus main body 100 and the remote landing-call registration devices can be freely arranged. As a result, the degree of freedom in design can be greatly increased.

[0077] Although the car excluding means 31 for excluding car based on door-open time period uses the above-mentioned Expression (3) to determine whether or not to exclude the car to be evaluated from the selection of the allocation candidate in the first embodiment, whether or not to exclude the car to be evaluated from the selection of the allocation candidate may be determined according to the following Expression (5) without taking the prediction boarding time interval within the standard time period into consideration.

Expression (5)

$$(tw \leq TW0)\ or\ (tw \leq TWMAX\ and\ tint \leq TINT1)$$

[0078] Moreover, in the first embodiment, the processing of excluding the car from the selection of the allocation candidate by the car excluding means 31 for excluding car based on door-open time period is performed based on the scheduled door-open waiting time period tw and the prediction boarding time interval tint respectively from the scheduled door-open waiting time period computing means 23 and the prediction boarding time interval computing means 24.

In contrast to the example described above, the prediction boarding time interval computing means 24 may be omitted so that the processing of excluding the allocation candidate by the car excluding means 31 for excluding car based on door-open time period is performed based only on the scheduled door-open waiting time period tw from the scheduled door-open waiting time period computing means 23.

Similarly, the scheduled door-open waiting time period computing means 23 may be omitted so that the processing of excluding the allocation candidate by the car excluding means 31 for excluding car based on door-open time period is performed based only on the prediction boarding time interval tint from the prediction boarding time interval computing means 24.

[0079] Further, although the parameters TW0, TINT0, TWMAX, and TINT1 used in the above-mentioned Expression (3) are common to all the landing floors in the first embodiment, the values of the parameters may be changed for some landing floor(s). For example, for the landing floor on which there are a large number of users to board the cars such as a lobby floor, at least one of the parameters TW0, TINT0, TWMAX, and TINT1 may be set larger than a standard value. In this case, by increasing the parameter, on the landing floor such as the lobby floor, on which there are a large number of users to board the cars, the users can be grouped into one to board the same car.

[0080] Moreover, Expression (3) described in the first embodiment is an operational expression including two combinations (specifically, two pairs of parentheses in Expression (3)) for the standard allowable door-open waiting time period and the standard prediction boarding time interval.

However, the operational expression used for the computation processing performed by the car excluding means 31 for excluding car based on door-open time period is not limited to the above-mentioned example. An operational expression including three or more combinations for the standard allowable door-open waiting time period and the standard prediction boarding time interval may also be used.

[0081] Here, for example, in the example illustrated in FIG. 11 in the first embodiment, in the case where the car 1A arrives at a floor F after the user y moves to and arrives at the boarding position (after HT(y)), specifically, in the case where there is CarPT(A) between HT(y) and HT(z), a starting point of the door-open waiting time period tw is delayed as compared with that in the example illustrated in FIG. 11.

Therefore, in the case where the above-mentioned car excluding means 31 for excluding car based on door-open time period executes the computation processing expressed by the above-mentioned Expression (3) without any change, the waiting time period of the user y in the car 1A becomes relatively long along with the delayed starting point of the door-open waiting time period tw as compared with that of the example illustrated in FIG. 11 when the user z arrives at the boarding position for the car 1A immediately before the standard allowable door-open waiting time period TW0 or the maximum allowable door-open waiting time period TWMAX ends.

[0082] To cope with the problem described above, the car excluding means 31 for excluding car based on door-open time period may change, the computation processing expressed by the above-mentioned Expression (3), the standard allowable door-open waiting time period TW0 to a smaller value in the case where it is verified that the prediction boarding time interval tint is larger than the standard prediction boarding time interval TINT0.

Alternatively, the car excluding means 31 for excluding car based on door-open time period may change the maximum allowable door-open waiting time period TWMAX to a smaller value in the case where it is verified that the prediction boarding time interval tint is larger than the standard prediction boarding time interval TINT1. In this manner, in the case where the starting point of the door-open waiting time period tw is situated after the arrival time of the user y at the boarding position for the car 1A, the waiting time period of the user y in the car 1A can be prevented from increasing.

Second Embodiment

[0083] In the first embodiment, the target to be supervised by the group supervisory control apparatus main body 100 is the elevator group for which the hoistways are arranged so as to be adjacent to the single landing 3 in the building. On the other hand, in the second embodiment, a plurality of landings 3A and 3B are provided in the building as illustrated in FIG. 17.

The target to be supervised by the group supervisory control apparatus main body 100 according to the second embodiment is an elevator group for which the hoistways are provided so as to be adjacent to the landings 3A and 3B, respectively. Specifically, the group supervisory control apparatus main body 100 according to the second embodiment supervises the travel of the elevator group including cars 1A to 1H illustrated in FIG. 17.

[0084] Moreover, the travel constant setting section 140 included in the group supervisory control apparatus main body 100 of the second embodiment prestores information of boarding positions for the cars 1E to 1H in addition to the information of the boarding positions for the cars 1A to 1D on each landing floor. Further, the allocation candidate selection index calculating section 120 included in the group supervisory control apparatus main body 100 of the second embodiment obtains distance information between the boarding positions for the cars 1A to 1H and the remote landing-call registration devices 11A to 11E.

Then, upon reception of the request to register the new landing call, the allocation candidate selection index calculating section 120 calculates the predicted car arrival time of each of the cars 1A to 1H and the predicted user arrival time at the boarding position for each of the cars 1A to 1H. The other configuration and operation are the same as those of the first embodiment.

[0085] In the group supervisory control apparatus for the elevators as described above, even in the case where the elevators are provided at a plurality of positions which are separated away from each other in the building, the same effects as those of the first embodiment can be obtained.

[0086] The number of cars included in the elevator group is not limited to those of the examples of the first and second embodiments, and can be appropriately determined according to specifications and an environment where the elevator group is installed, and the like.

Third Embodiment

[0087] In the allocation candidate selecting section 130 of the first embodiment, the processing of excluding the car from the selection of the allocation candidate for the new landing call is performed by the car excluding means 31 for excluding car based on door-open time period and the means 32 for excluding waiting car based on waiting time period. On the other hand, in the allocation candidate selecting section 130 of the third embodiment, the processing of excluding the car from the selection of the allocation candidate for the new landing call is performed even with another method.

[0088] FIG. 18 is a block diagram illustrating the group supervisory control apparatus for the elevators according to the third embodiment of the present invention.

In FIG. 18, the illustration of the individual car controllers 2A to 2D, the travel constant setting section 140, the allocated car determining section 150, and the operation command section 160 is omitted, as in the case of FIG. 3 referred to above. In FIG. 18, the allocation candidate selecting section 130 of the third embodiment further includes: fully-loaded car excluding means 33; empty car selecting means 34; car-about-to-leave excluding means 35; means 36 for changing limit value based on traffic flow, which serves as threshold value changing means; and selection condition relaxing means 38.

[0089] The fully-loaded car excluding means 33 excludes one of the cars 1A to 1D, which becomes unavailable by responding to a different landing call on the boarding floor related with the new landing call when the new landing call is made, and then performs the registration on the allocation candidate list.

Specifically, the fully-loaded car excluding means 33 verifies a call registered in a zone between the boarding floor related with the new landing call and a landing floor which is situated one floor before the exit floor (on the side closer to the boarding floor) for which the new landing call is made.

Then, if the car is fully loaded by responding to the already registered landing call, the fully-loaded car excluding means 33 excludes the car number of the fully-loaded car from the selection of the allocation candidate to be registered on the allocation candidate list.

Specifically, in the case where the car would be overloaded if the user who has performed the new landing call boards the car, the fully-loaded car excluding means 33 excludes the car from the selection of the allocation candidate.

[0090] The empty car selecting means 34 registers (adds) the car whose operation is currently stopped, the car whose operation is scheduled to be stopped, or the car which is moving (is being dispatched) to a specific floor among all the cars 1A to 1D on (to) the allocation candidate list as the allocation candidate.

The car whose operation is currently stopped is a car for which the allocated landing call and car call are not set, specifically, a car to which the landing call and the car call are not allocated. The car whose operation is scheduled to be stopped is a car which is now responding to the last set car call and is brought into an operation stop state upon completion of all the services after responding to the car call, specifically, the car from which the landing call and the car call are soon to be deallocated. The car which is moving to the specific floor is, for example, a car which is moving so as to wait on a preset specific floor (waiting floor) according to the traveling status of the elevator group.

[0091] Upon generation of the new landing call, the car-about-to-leave excluding means 35 verifies whether or not there is any car which has started closing the door to leave the same landing floor as the boarding floor related with the new landing call so as to travel in the same direction as the traveling direction for the new landing call among all the cars 1A to 1D.

Then, if there is any car which meets the above-mentioned conditions, the car-about-to-leave excluding means 35 excludes the car number of the car from the selection of the allocation candidate to be registered on the allocation candidate list.

[0092] The means 36 for changing limit value based on traffic flow prestores information of a traffic flow in the building (or measures the traffic flow in the building as needed to create statistics thereof). The traffic flow is information relating to statistics of changes in a flow of the users in the building.

The means 36 for changing limit value based on traffic flow dynamically changes the limit values (or selects one from a plurality of prestored limit values) for the car excluding means 31 for excluding car based on door-open time period and the means 32 for excluding waiting car based on waiting time period according to changes (tendency and pattern) in the traffic flow in the building.

The limit values for the car excluding means 31 for excluding car based on door-open time period are the parameters TW0, TINT0, TWMAX, and TINT1 used in Expression (3) described above. The limit value for the means 32 for excluding waiting car based on waiting time period is the limit time Tb.

[0093] For example, if the remote landing-call registration device 11A is provided on the lobby floor and the traffic flow from the lobby floor to the upper floors is heavy during an up-peak time or the like, the means 36 for changing limit value based on traffic flow changes at least one value of TW0, TINT0, TWMAX, and TINT1 to a value larger than that for the traffic flow during a normal time (off-hours).

[0094] As examples of the traffic flow, an up-peak traffic flow, a down-peak traffic flow, and a lunchtime traffic flow are given. The up-peak traffic flow is a traffic flow with a relatively large number of users (larger than the number of users during the normal time) moving from the lobby floor to general floors.

The down-peak traffic flow is a traffic flow with a relatively large number of users moving from the general floors to the lobby floor. Further, the lunchtime traffic flow is a traffic flow with a relatively large number of users moving from the lobby floor or a restaurant floor to the general floors or moving in the opposite direction.

[0095] The allocation candidate list computing means 37 of the third embodiment computes, for example, the following Expression (6) for the allocation candidate list to extract the allocation candidate from all the cars 1A to 1D.

Expression (6)

$$C37 = \{ALLCAGE \ and \ NOT(N31 \ or \ N32 \ or \ N33 \ or \ N35)\} \ or \ C34$$

where ALLCAGE: the car numbers of all the cars,

N31: the car number of the car excluded by the car excluding means 31 for excluding car based on door-open time period,
N32: the car number of the car excluded by the means 32 for excluding waiting car based on waiting time period,
N33: the car number of the car excluded by the fully-loaded car excluding means 33,
N35: the car number of the car excluded by the car-about-to-leave excluding means 35,
C34: the car number of the car selected by the empty car selecting means 34, and
C37: the car number of the allocation candidate car selected by the allocation candidate list computing means 37.

[0096] The selection condition relaxing means 38 relaxes conditions of selection of the allocation candidate and selects the allocation candidate again when there is no allocation candidate selected by the allocation candidate list computing means 37. If there is still no allocation candidate even after the conditions are relaxed, the selection condition relaxing means 38 sets all the cars 1A to 1D as the allocation candidates.

[0097] Here, a method of selecting the allocation candidate by the selection condition relaxing means 38 is specifically described. First, a selection method in the case where the landing call for the same boarding floor and the same traveling direction as those of the new landing call is not registered is described. In this case, the selection condition relaxing means 38 changes the limit time Tb for the means 32 for excluding waiting car based on waiting time period to a limit time Tc (Tb<Tc).

[0098] Then, under the above-mentioned condition, the selection condition relaxing means 38 performs the same processing as that performed by the means 32 for excluding waiting car based on waiting time period to determine whether or not the car (N32) excluded by the means 32 for excluding waiting car based on waiting time period is allocable to the new landing call.

If a car whose predicted car arrival time is about the limit time Tb earlier than the predicted user arrival time is found as a result of the processing described above, the selection condition relaxing means 38 selects the car excluded by the means 32 for excluding waiting car based on waiting time period as the allocation candidate.

[0099] On the other hand, in the case where there is a registered landing call for the same boarding floor and the same traveling direction as those of the new landing call, the selection condition relaxing means 38 changes the values of TW0, TINT0, TWMAX, and TINT1 for the car excluding means 31 for excluding car based on door-open time period to values larger than the last values thereof.

[0100] Then, under the conditions described above, the selection condition relaxing means 38 performs the same processing as that performed by the car excluding means 31 for excluding car based on door-open time period to determine whether or not the car (N31) excluded by the car excluding means 31 for excluding car based on door-open time period is allocable to the new landing call.

If the car satisfying the conditions relaxed for the door-open waiting time period or the prediction boarding time interval is found as a result of the determination, the selection condition relaxing means 38 selects the car excluded by the car excluding means 31 for excluding car based on door-open time period as the allocation candidate. The other configuration is the same as that of the first embodiment.

[0101] Next, the operation of the group supervisory control apparatus main body 100 according to the third embodiment is described. Here, as in the first embodiment described above, the operation for selecting the allocation candidate by the group supervisory control apparatus main body 100 is specifically described. FIG. 19 is a flowchart illustrating the operation of the group supervisory control apparatus main body 100 illustrated in FIG. 18.

First, upon reception of the request to register the new landing call from any one of the remote landing-call registration devices 11A to 11E, the allocation candidate selecting section 130 verifies the current time and changes each of the limit values according to the traffic flow related with the current time (Step S210). Specifically, the allocation candidate selecting section 130 changes each of the values of TW0, TINT0, TINT1, TWMAX, and Tb according to the traffic flow related with the current time.

[0102] Then, the group supervisory control apparatus main body 100 selects an arbitrary one of all the cars 1A to 1D as the car to be evaluated (Step S202). After the selection of the car to be evaluated, the group supervisory control apparatus main body 100 verifies whether or not the car to be evaluated meets a condition for excluding the fully-loaded car, whether or not the car to be evaluated meets a condition for excluding the car about to leave, and whether or not the car to be evaluated meets a condition for selecting the empty car (Steps S203 to S205).

Here, the condition for excluding the fully-loaded car, the condition for excluding the car about to leave, and the condition for selecting the empty car for the car to be elevated are the conditions respectively corresponding to the exclusion processing performed by the fully-loaded car excluding means 33, that performed by the car-about-to-leave excluding means 35, and the selection processing performed by the empty car selecting means 34.

[0103] If the car to be evaluated does not meet any of the condition for excluding the fully-loaded car, the condition for excluding the car about to leave, and the condition for selecting the empty car, the group supervisory control apparatus main body 100 calculates the predicted arrival time of the car to be evaluated at the target landing floor based on the operating status of the car to be evaluated (Step S206).

At the same time, the group supervisory control apparatus main body 100 calculates the predicted arrival time of the user who has performed the new landing call, at the boarding position for the car to be evaluated (Step S207).

[0104] Then, the group supervisory control apparatus main body 100 verifies whether the car to be evaluated has already been allocated to the call for the same landing floor and the same traveling direction as those of the boarding floor and the traveling direction related with the new landing call (Step S208).

If the car to be evaluated is not allocated to the call for the same landing floor and the same traveling direction as the boarding floor and the traveling direction related with the new landing call (NO in Step S208), the group supervisory control apparatus main body 100 verifies whether or not the car to be evaluated meets a condition for excluding an early-arrival car (Step S209). Specifically, the group supervisory control apparatus main body 100 verifies whether or not the car to be evaluated arrives at the target landing floor the limit time Tb or more earlier than the user.

[0105] On the other hand, if the car to be evaluated has been allocated to the call for the same landing floor and the same traveling direction as the boarding floor and the traveling direction related with the new landing call (YES in Step S208), the group supervisory control apparatus main body 100 calculates the scheduled door-open waiting time period tw of the car to be evaluated at the target landing floor (Step S210).

At the same time, the group supervisory control apparatus main body 100 calculates the prediction boarding time interval tint between the user who has performed the new landing call operation and the user who has performed the registered landing call operation immediately before the new landing call is made (Step S211).

[0106] Then, the group supervisory control apparatus main body 100 verifies whether or not the car to be evaluated meets the condition for excluding the car based on the door-open waiting time period, based on the calculated scheduled door-open waiting time period tw and prediction boarding time interval tint (Step S212).

Specifically, the group supervisory control apparatus main body 100 verifies whether or not the calculated scheduled door-open waiting time period tw prediction boarding time interval tint satisfy the conditions of Expression (3).

[0107] If the car to be evaluated meets any one of the condition for excluding the early-arrival car, the condition for excluding the fully-loaded car, the condition for excluding the car about to leave, and the condition for excluding the car based on the door-open waiting time period as a result of the processing (YES in Steps S203, S204, S209, and S212), the group supervisory control apparatus main body 100 excludes the car number of the car to be evaluated from the selection of the allocation candidate to be registered on the allocation candidate list (Step S213).

On the other hand, if the car to be evaluated meets the condition for selecting the empty car (YES in Step S205) or the car to be evaluated does not meet the condition for excluding the early-arrival car (NO in Step S212), the group supervisory control apparatus main body 100 adds the car number of the car to be evaluated to the allocation candidate list (Step S214).

[0108] Then, after adding the car number of the car to be evaluated to the allocation candidate list or excluding the car number of the car to be evaluated from the selection of the allocation candidate to be registered on the allocation candidate list, the group supervisory control apparatus main body 100 verifies whether or not all the cars 1A to 1D have been evaluated (Step S215).

If all the cars 1A to 1D have not been evaluated, the group supervisory control apparatus main body 100 changes the car to be evaluated to an unevaluated one of the cars (Step S216). Then, the group supervisory control apparatus main body 100 verifies whether or not the predicted arrival time of the thus newly changed car to be evaluated meets the condition for excluding the fully-loaded car (Step S203). Then, the same operation (Steps S203 to S216) is repeated until all the cars 1A to 1D are evaluated.

[0109] Moreover, if all the cars 1A are 1D have been evaluated, the group supervisory control apparatus main body

100 verifies whether or not there is an allocation candidate car on the allocation candidate list (Step S217). If there is an allocation candidate car on the allocation candidate list in this step, the operation for selecting the allocation candidate by the group supervisory control apparatus main body 100 is terminated.

[0110] On the other hand, if there is no allocation candidate car on the allocation candidate list (NO in Step S217), the group supervisory control apparatus main body 100 relaxes the selection conditions and performs processing for re-selecting the allocation candidate (Step S218).

Then, the group supervisory control apparatus main body 100 verifies whether or not the allocation candidate car is found on the allocation candidate list as a result of the re-selection processing (Step S219). If the allocation candidate car is found on the allocation candidate list in this step, the operation for selecting the allocation candidate by the group supervisory control apparatus main body 100 is terminated.

[0111] On the other hand, if there is no allocation candidate car on the allocation candidate list (NO in Step S219), the group supervisory control apparatus main body 100 sets all the cars 1A to 1D as the allocation candidates, and therefore registers the car numbers of the cars 1A to 1D on the allocation candidate list (Step S220). Then, the operation for selecting the allocation candidate by the group supervisory control apparatus main body 100 is terminated. The subsequent operation is the same as that of the first embodiment.

[0112] In the group supervisory control apparatus for the elevators as described above, the car which is unavailable for the new landing call is excluded from the selection of the allocation candidate by the fully-loaded car excluding means 33. As a result, it is possible to avoid an operation which provides discomfort, that is, it is only when the user who operates any one of the remote landing-call registration devices 11A to 11E arrives at the boarding position for the car that the user knows that the allocated car is fully loaded and the user is forced to operate the remote landing-call registration devices 11A to 11E again.

[0113] Moreover, the car which has already completed or is soon to complete the allocated service is selected as the allocation candidate by the empty car selecting means 34. As a result, the travel efficiency of the elevator group can be further improved.

[0114] Further, the car which waits for a long period of time at the boarding floor related with the new landing call is excluded from the selection of the allocation candidate by the car-about-to-leave excluding means 35. Therefore, the travel efficiency of the elevator group can be further improved.

[0115] Moreover, the limit values of the scheduled door-open waiting time period and the prediction boarding time interval are dynamically changed by the means 36 for changing limit value based on traffic flow according to a change in the traffic flow in the building during the up-peak time, the down-peak time, the lunchtime and the like. As a result, the travel of the elevator group according to the change in the traffic flow can be performed. Therefore, the travel efficiency of the elevator group can be further improved.

[0116] Further, even if there is no allocation candidate found by the normal exclusion processing, the selection conditions are relaxed by the selection condition relaxing means 38 to ensure the allocation candidate. As a result, the group supervisory control apparatus main body 100 can be prevented from performing an erroneous operation due to the absence of the allocation candidate.

[0117] Although the same processing as that performed by the car excluding means 31 for excluding car based on door-open time period is performed after the selection condition relaxing means 38 relaxes the selection conditions in the third embodiment, the processing is not limited to the above-mentioned example.

For example, an instruction of performing the processing again under the relaxed conditions may be transmitted to the car excluding means 31 for excluding car based on door-open time period after the selection condition relaxing means 38 relaxes the selection conditions. Similarly, an instruction of performing the processing again under the relaxed conditions may be transmitted to the means 32 for excluding waiting car based on waiting time period after the selection condition relaxing means 38 relaxes the selection conditions.

Fourth Embodiment

[0118] In the first embodiment, the travel constant setting section 140 transmits the travel distance information between the corresponding one of the remote landing-call registration devices 11A to 11E, on which the new landing cal operation has been performed, and the boarding positions for all the cars 1A to 1D for the new landing call, and the standard traveling rate information to the allocation candidate selection index calculating section 120.

On the other hand, in a fourth embodiment, the travel constant setting section 140 transmits information relating to a travel time period of the user in a more detailed fashion to the allocation candidate selection index calculating section 120.

[0119] Moreover, although the remote landing-call registration devices 11A to 11E are located in one area on each landing floor in the building in the first embodiment, the remote landing-call registration devices 11A to 11E are located at a plurality of positions on each landing floor in the building.

The plurality of positions on each landing floor in the building are, for example, doorways of a plurality of residential rooms, those of a plurality of tenant zones, or those of a plurality of office zones.

[0120] Moreover, an operation portion of each of the remote landing-call registration devices 11A to 11E of the fourth embodiment has a plurality of attribute identification buttons (for example, a wheelchair operation button: not shown) for identifying an attribute of a user regarding whether or not the user is a physically impaired.
Moreover, when the new landing call operation is performed, a corresponding one of the remote landing-call registration devices 11A to 11E transmits the information relating to the attribute corresponding to the operated attribute identification button together with the request to register the new landing call to the group supervisory control apparatus main body 100.
[0121] FIG. 20 is a block diagram illustrating the group supervisory control apparatus for the elevators according to the fourth embodiment of the present invention. In FIG. 20, the illustration of the allocation candidate selecting section 130, the allocated car determining section 150, the operation command section 160, and the individual car controllers 2A to 2D is omitted. In FIG. 20, the travel constant setting section 140 includes: travel distance setting means 41; traveling rate setting means 42; and traveling rate reduction parameter setting means 43.
[0122] The travel distance setting means 41 stores information of travel distances (walking distances) between the remote landing-call registration devices 11A to 11E located at the plurality of positions in the building and the boarding positions for the cars 1A to 1D on each landing floor as travel distance information.
Moreover, upon reception of the request to register the new landing call from any one of the remote landing-call registration devices 11A to 11E, the travel distance setting means 41 extracts the travel distance information between the one of the remote landing-call registration devices 11A to 11E, which has issued the registration request, and the boarding positions for all the cars 1A to 1D. Then, the travel distance setting means 41 transmits the extracted travel distance information to (the predicted user arrival time computing means 22 of) the allocation candidate selection index calculating section 120.
[0123] The traveling rate setting means 42 prestores information of a plurality of user traveling rates in association with information of the attributes of the users regarding whether or not the user is physically impaired. The traveling rate for a physically unimpaired person (general user) is, for example, 1.0 m/second, whereas the traveling rate for a physically impaired person is, for example, 0.7 m/second.
Moreover, upon reception of the attribute identification information from any one of the remote landing-call registration devices 11A to 11E, the traveling rate setting means 42 extracts the traveling rate associated with the attribute of the user.
[0124] The traveling rate reduction parameter setting means 43 prestores the information of the traffic flow in the building (or measures the traffic flow in the building as needed to create statistics thereof). Moreover, upon reception of the request to register the new landing call from any one of the remote landing-call registration devices 11A to 11E, the traveling rate reduction parameter setting means 43 refers to the traffic flow related with the current time on the landing floor, on which the new landing call operation is performed, to set a traveling rate reduction parameter.
[0125] Specifically, the traveling rate reduction parameter setting means 43 sets the traveling rate reduction parameter of less than 1.0 based on the degree of congestion with the users who board and get off the cars on the landing floor on which the new landing call operation is performed, the size of the landing 3, and the shape of the landing 3. Then, the traveling rate reduction parameter setting means 43 transmits information of the thus set traveling rate reduction parameter to the traveling rate setting means 42.
[0126] Upon reception of the information of the traveling rate reduction parameter from the traveling rate reduction parameter setting means 43, the traveling rate setting means 42 transmits a value obtained by multiplying the traveling rate of the user by the traveling rate reduction parameter as traveling rate information to (the predicted user arrival time computing means 22 of) the allocation candidate selection index calculating section 120.
The allocation candidate selection index calculating section 120 calculates the predicted user arrival time based on the travel distance information and the traveling rate information. Specifically, the travel distance, the traveling rate of the user, and the traveling rate reduction parameter, which are set for the travel constant setting section 140, are used in the process of calculating the predicted user arrival time. The other configuration is the same as that of the first or third embodiment.
[0127] Next, the operation of the group supervisory control apparatus main body 100 of the fourth embodiment is described. Here, an operation for setting the travel constant by the group supervisory control apparatus main body 100 is specifically described. FIG. 21 is a flowchart illustrating the operation of the group supervisory control apparatus main body 100 illustrated in FIG. 20.
First, upon reception of the request to register the landing call from any one of the remote landing-call registration devices 11A to 11E, the group supervisory control apparatus main body 100 sets the travel distance of the user based on the positional relation between one of the remote landing-call registration devices 11A to 11E, which has issued the registration request, and the boarding positions for all the cars on the target landing floor (Step S3301).
[0128] Then, the group supervisory control apparatus main body 100 sets the traveling rate reduction parameter from the degree of congestion on the boarding floor based on the traffic flow related with the current time (Step S302). Then, the group supervisory control apparatus main body 100 sets the traveling rate based on the traveling rate associated with the attribute of the user and the traveling rate reduction parameter (Step S303).
[0129] Thereafter, the group supervisory control apparatus main body 100 calculates the predicted user arrival time

based on the thus set travel distance and traveling rate (Step S304). In this manner, the operation for setting the travel constant, which is performed by the group supervisory control apparatus main body 100, is terminated. The other operation is the same as that of the first or third embodiment.

[0130] In the group supervisory control apparatus for the elevators as described above, the travel distances from one of the remote landing-call registration devices located at the plurality of positions on each landing floor in the building, which has issued the request for registration, to the boarding positions for all the cars 1A to 1E are extracted by the travel distance setting means 41.

With the above-mentioned configuration, the remote landing-call registration devices 11A to 11E can be provided at the plurality of positions on each landing floor in the building. At the same time, the hoistways for the elevators can be provided not in the vicinity of a specific landing but at various locations.

As a result, the arrangement of the remote landing-call registration devices 11A to 11E and the arrangement of the hoistways for the elevators can be freely designed under the supervision of the group supervisory control apparatus main body 100.

[0131] Moreover, the traveling rate according to the attribute of the user regarding whether or not the user is physically impaired is set by the traveling rate setting means 42. Therefore, an event where the user misses the car or the user arrives at the boarding position for the car earlier than supposed can be avoided.

[0132] Further, the traveling rate according to the degree of congestion in the landing is set by the traveling rate reduction parameter setting means 43. Therefore, an unpleasant event where the user cannot board the allocated car when the landing is crowded can be avoided.

[0133] The travel distance setting means 41 stores the distances between the boarding positions for all the cars 1A to 1D and the positions where the remote landing-call registration devices 11A to 11E are provided as the travel distances in the fourth embodiment.

In contrast to the example described above, when a part or all of the boarding positions for the cars are provided in a single landing in a concentrated manner, the travel distance setting means 41 may store distances between a representative point such as a center of the landing and the remote landing-call registration devices 11A and 11E as the travel distances.

[0134] Moreover, although the traveling rate setting means 42 sets the traveling rate of the user based on the information of the attribute of the user regarding whether or not the user is physically impaired, who has performed the new landing call operation, in the fourth embodiment, the setting of the traveling rate is not limited to the above-mentioned example. For example, the traveling rate of the user may be set based on the information of the attribute regarding whether or not the user is accompanied by a pet (dog or the like). Alternatively, an arbitrary traveling rate may be set for each user.

<u>Fifth Embodiment</u>

[0135] In the first embodiment, the allocated car determining section 150 selects the car, which provides the minimum increment in the total waiting time period when the car is allocated to the boarding floor related with the new landing call, from the allocation candidate list to determine the selected car as the allocated car. On the other hand, in the fifth embodiment, the allocated car determining section 150 determines the allocated car from the allocation candidate list based on a different criterion.

[0136] FIG. 22 is a block diagram illustrating the group supervisory control apparatus for the elevators according to the fifth embodiment of the present invention. In FIG. 22, the illustration of the allocation candidate selection index calculating section 120, the travel constant setting section 140, the remote landing-call registration devices 11A to 11E, and the individual car controllers 2A to 2D is omitted.

In FIG. 22, the allocated car determining section 150 includes: allocation determining means 51 for determining allocation of car with the same boarding floor and destination floor; pre-allocated car selecting means 52; pre-allocated car allocation determining means 53; unallocated car selecting means 54; car allocation determining means 55 for determining car allocation based on waiting time period evaluation index; and scheduled stop number limit value relaxing means 56.

[0137] The allocation determining means 51 for determining allocation of car with the same boarding floor and destination floor receives the car number of at least one allocation candidate car from the allocation candidate list computing means 37 or the selection condition relaxing means 38.

Upon reception of the car numbers of a plurality of allocation candidate cars, the allocation determining means 51 for determining allocation of car with the same boarding floor and destination floor verifies whether or not there is a car which is scheduled to stop at the boarding floor and the destination floor (exit floor), which are related with the new landing call.

[0138] Then, if there is a car scheduled to stop at the boarding floor and the destination floor, which are related with the new landing call, the allocation determining means 51 for determining allocation of car with the same boarding floor and destination floor determines the car as the car allocated to the new landing call.

Moreover, if there are a plurality of the cars scheduled to stop at the boarding floor and the destination floor, which are

related with the new landing call, the allocation determining means 51 for determining allocation of car with the same boarding floor and destination floor randomly selects one of the cars or selects the car which is predicted to be the earliest to arrive at the boarding floor related with the new landing call.
Then, the allocation determining means 51 for determining allocation of car with the same boarding floor and destination floor determines the selected car as the allocated car. Further, upon determination of the allocated car, the allocation determining means 51 for determining allocation of car with the same boarding floor and destination floor transmits information of the car number of the allocated car to the operation command section 160.

[0139] The pre-allocated car selecting means 52 prestores an initial value of a scheduled stop number limit value Nstop. The initial value of the scheduled stop number limit value Nstop is determined by, for example, the following Expression (7).

Expression (7)

$$(Nstop\ \text{initial value}) = 2\times(\text{number of floors present in the traveling direction for the new landing call, at which the car can stop})/(\text{total number of the cars})$$

[0140] Moreover, the pre-allocated car selecting means 52 performs processing of selecting the allocated car in the case where the allocated car is not determined by the allocation determining means 51 for determining allocation of car with the same boarding floor and destination floor.
The pre-allocated car selecting means 52 verifies whether or not there is any car which is scheduled to travel in the traveling direction to the boarding floor related with the new landing call, and has the number of scheduled stops in the direction for which the new landing call is registered after the allocation of the new landing call being equal to or less than the scheduled stop number limit value Nstop, among the allocation candidates.
If there is at least one corresponding car, the pre-allocated car selecting means 52 selects the car from the allocation candidates and transmits information of the car number of the car to the pre-allocated car allocation determining means 53.

[0141] The pre-allocated car allocation determining means 53 determines the car selected by the pre-allocated car selecting means 52 as the allocated car. Here, in the case where the plurality of car numbers of the cars are received from the pre-allocated car selecting means 52, the pre-allocated car allocation determining means 53 determines the car having a minimum absolute value of a difference between the predicted car arrival time at the boarding floor related with the new landing call and the predicted user arrival time of the user who has performed the new landing call as the allocated car.
Upon determination of the allocated car, the pre-allocated car allocation determining means 53 transmits information of the car number of the allocated car to the operation command section 150.

[0142] Similarly to the pre-allocated car selecting means 52, the unallocated car selecting means 54 prestores the initial value of the scheduled stop number limit value Nstop. The unallocated car selection means 54 also performs the processing of selecting the allocated car in the case where the allocated car is not selected by the pre-allocated car selecting means 52.

[0143] Further, the unallocated car selecting means 54 verifies whether or not there is any car which is not scheduled to travel in the traveling direction to the boarding floor related with the new landing call, and has the number of scheduled stops in the direction for which the new landing call is registered after the allocation of the new landing call being equal to or less than the scheduled stop number limit value Nstop, among the allocation candidates.
Then, if there is at least one corresponding car, the unallocated car selecting means 54 selects the car from the allocation candidates and transmits information of the car number of the car to the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index.

[0144] The car allocation determining means 55 for determining car allocation based on waiting time period evaluation index determines the car selected by the unallocated car selecting means 54 as the allocated car. Here, in the case where the information of the plurality of the car numbers of the cars is received from the unallocated car selecting means 54, the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index performs computation processing for the operation schedules of all the cars.

[0145] Specifically, the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index computes the predicted car arrival time of each car at the stop floor for each landing call, for each of the cases before and after the allocation of the new landing call.
Then, the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index performs computation expressed by the following Expression (8) based on the predicted car arrival time of each

car at the stop floor for each landing call and the predicted user arrival time of the user who is predicted to board each car at the stop floor for each landing call.

[0146]

Expression (8)

$$\begin{cases} WVal(k) = \sum_{(f,d)\in HallCall(k)} Twt_k(f,d)^2 \\ wt_k(f,d,j) = \begin{cases} CarPT_k(f,d) - PsgPT_k(f,d,j) & CarPT_k(f,d) \geq PsgPT_k(f,d,j) \\ \alpha(CarPT_k(f,d) - PsgPT_k(f,d,j)) & CarPT_k(f,d) < PsgPT_k(f,d,j) \end{cases} \\ Twt_k(f,d) = \max_j(|wt_k(f,d,j)|) \end{cases}$$

where $WVal_{bef}(k)$: the waiting time period evaluation index of a car k before the allocation to the new landing call,

$WVal_{aft}(k)$: the waiting time period evaluation index of the car k after the allocation to the new landing call,
$CarPT_k(f, d)$: the predicted arrival time of the car k traveling in a direction d to a landing floor f,
$PSGPT_k(f, d, j)$: the predicted user arrival time of the j-th user of the users who are predicted to board the car k traveling in the direction d to the landing floor f, at the boarding position for the car k,
$wt_k(f, d, j)$: a waiting time period of the user j for the car k,
$Twt_k(f, d)$: a maximum waiting time period value for the car k traveling in the direction d to the landing floor f.
HallCall(k): a group of registered landing calls for the car k, and
α: a parameter having a standard value of 1.0.

[0147] In the above-mentioned manner, the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index calculates a waiting time period evaluation index WVal(k) for each of the cases before and after the allocation of the car k to the new landing call, that is, $WVal_{bef}(k)$ and $WVal_{aft}(k)$.
Then, the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index calculates $WVal_{aft}(k)$-$WVal_{bef}(k)$, which corresponds to a difference between $WVal_{aft}(k)$ and $WVal_{bef}(k)$.
From the result described above, the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index determines the car which provides the minimum value of $WVal_{aft}(k)$-$WVal_{bef}(k)$ as the allocated car.
After the determination of the allocated car, the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index transmits the information of the car number of the allocated car to the operation command section 160.

[0148] The scheduled stop number limit value relaxing means 56 increases the scheduled stop number limit value Nstop by one unit in the case where there is no allocated car selected by the unallocated car selecting means 54. Specifically, the scheduled stop number limit value relaxing means 56 sets Nstop = Nstop+1 so as to relax the condition for the scheduled stop number.

[0149] Then, after the scheduled stop number limit value relaxing means 56 relaxes the condition for the scheduled stop number, the pre-allocated car selecting means 52 and the unallocated car selecting means 54 perform the processing of selecting the allocated car under the relaxed condition.
The scheduled stop number limit value relaxing means 56 continues relaxing the condition for the scheduled stop number so that the pre-allocated car selecting means 52 and the unallocated car selecting means 54 repeatedly perform the processing of selecting the allocated car until the allocated car is finally determined. The other configuration is the same as that of any one of the first to fourth embodiments.

[0150] Next, the operation of the group supervisory control apparatus main body 100 according to the fifth embodiment is described. Here, the operation for determining the allocated car by the group supervisory control apparatus main body 100 is specifically described. FIG. 23 is a flowchart illustrating the operation of the group supervisory control apparatus main body 100 illustrated in FIG. 22. In FIG. 23, the group supervisory control apparatus main body 100 first verifies whether or not there is a car, which is scheduled to stop at the boarding floor and the destination floor (exit floor) related with the new landing call, on the allocation candidate list (Step S401).

[0151] If there is a car which is scheduled to stop at the boarding floor and the destination floor related with the new landing call on the allocation candidate list, the group supervisory control apparatus main body 100 verifies whether or not the number of the corresponding car is plural (Step S402).
In this step, if the number of the corresponding car is one, the group supervisory control apparatus main body 100

determines the corresponding car as the allocated car (Step S403), and then terminates the operation for determining the allocated car.

[0152] On the other hand, if the number of the corresponding car is plural (YES in Step S402), the group supervisory control apparatus main body 100 randomly selects one from the plurality of corresponding cars (Step S404). Then, the group supervisory control apparatus main body 100 determines the selected car as the allocated car (Step S403), and then terminates the operation for determining the allocated car.

[0153] If there is no car which is scheduled to stop at the boarding floor and the destination floors related with the new landing call on the allocation candidate list (NO in Step S401), the group supervisory control apparatus main body 100 verifies whether or not there is a car which is scheduled to travel based on the traveling direction and the boarding floor, which are related with the new landing call, on the allocation candidate list (Step S405).

If there is a car which is scheduled to travel based on the traveling direction and the boarding floor, which are related with the new landing call, on the allocation candidate list, the group supervisory control apparatus main body 100 verifies whether or not there is a car which meets the condition for the scheduled stop number limit value Nstop on the allocation candidate list (Step S406).

[0154] If there is a car which meets the condition for the scheduled stop number limit value Nstop on the allocation candidate list (YES in Step S406), the group supervisory control apparatus main body 100 verifies whether or not the number of the corresponding car is plural (Step S407).

If the number of the corresponding car is one in this step, the group supervisory control apparatus main body 100 determines the corresponding car as the allocated car (Step S403), and then terminates the operation for determining the allocated car.

[0155] On the other hand, if the number of the corresponding car is plural (YES in Step S407), the group supervisory control apparatus main body 100 selects the car which provides the minimum absolute value of the difference between the predicted car arrival time and the predicted user arrival time (Step S408). Then, the group supervisory control apparatus main body 100 determines the selected car as the allocated car (Step S403), and then terminates the operation for determining the allocated car.

[0156] Further, if there is no car which is scheduled to travel based on the traveling direction and the boarding floor, which are related with the new landing call, on the allocation candidate list (NO in Step S405), the group supervisory control apparatus main body 100 verifies whether or not there is a car which meets the condition for the scheduled stop number limit value Nstop on the allocation candidate list (Step S409).

[0157] If there is a car which meets the condition for the scheduled stop number limit value Nstop on the allocation candidate list (YES in Step S409), the group supervisory control apparatus main body 100 verifies whether or not the number of the corresponding car is plural (Step S410).

If the number of the corresponding car is one in this step, the group supervisory control apparatus main body 100 determines the corresponding car as the allocated car (Step S403), and then terminates the operation for determining the allocated car.

[0158] On the other hand, if the number of the corresponding car is plural (YES in Step S410), the group supervisory control apparatus main body 100 performs the computation expressed by the above-mentioned Expression (8) to select the car which provides the minimum waiting time period evaluation index (Step S411). Then, the group supervisory control apparatus main body 100 determines the selected car as the allocated car (Step S403), and then terminates the operation for determining the allocated car.

[0159] If there is no car which meets the condition for the scheduled stop number limit value Nstop on the allocation candidate list (NO in Step S406 or S409), the group supervisory control apparatus main body 100 sets the scheduled stop number limit value Nstop to Nstop+1 (Step S412).

Then, the group supervisory control apparatus main body 100 verifies whether or not there is a car which is scheduled to travel based on the traveling direction and the boarding floor, which are related with the new landing call, on the allocation candidate list (Step S405), and repeats the same operation until the allocated car is ultimately selected. The other operation is the same as that of the first to fourth embodiments.

[0160] In the group supervisory control apparatus for the elevators as described above, the pre-allocated car selecting means 52 and the unallocated car selecting means 54 use the scheduled stop number limit value to determine the allocated car. As a result, the number of stops made by each of the cars can be reduced to reduce a round-trip time period of each of the cars 1A to 1D. Therefore, the travel efficiency of the elevator group can be improved.

[0161] Moreover, when the plurality of allocation candidates are selected by the unallocated car selecting means 54, the allocated car is determined based on the waiting time period evaluation index in consideration of the travel time of the user by the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index. As a result, the evaluation according to the waiting time period after the arrival of the user at the boarding position for the car can be performed. Thus, the allocated car can be determined more appropriately.

[0162] The car which provides the minimum square value (absolute value) of the difference between the predicted car arrival time and the predicted user arrival time is determined as the allocated car by the pre-allocated car allocation determining means 53. As a result, the car and the user can be prevented from waiting at the landing longer than needed. Thus, the travel efficiency of the elevator group can be further improved.

[0163] Although the pre-allocated car selecting means 52 and the unallocated car selecting means 54 select the allocated car based on the prestored scheduled stop number limit value in the fifth embodiment, the selection of the allocated car is not limited thereto. The pre-allocated car selecting means 52 and the unallocated car selecting means 54 may select the allocated car by using the scheduled stop number limit value according to the traffic flow or the boarding floor for which the landing call is made.

[0164] The pre-allocated car allocation determining means 53 determines the car which provides the minimum absolute value of the difference between the predicted car arrival time and the predicted user arrival time as the allocated car in the fifth embodiment.

In contrast to the example described above, the cases may be classified based on the magnitude relation between the predicted car arrival time $CarPT_k(f, d)$ of the car traveling in the direction d to the landing floor f and the predicted user arrival time $PsgPt_k(f, d)$ as expressed by the following Expression (9) so that the pre-allocated car allocation determining means 53 selects the allocated car. In the following Expression (9), β is a parameter having a standard value of 1.0.

Expression (9)

$$\begin{cases} CarPT_k(f,d) - PsgPT_k(f,d) & CarPT_k(f,d) \geq PsgPT_k(f,d) \\ \beta\left(CarPT_k(f,d) - PsgPT_k(f,d)\right) & CarPT_k(f,d) < PsgPT_k(f,d) \end{cases}$$

[0165] Further, although the standard value of α in Expression (8) described above is set to 1.0 for the waiting time period evaluation index car allocation determining section 55 in the fifth embodiment, the value of α may be changed according to the type of the floor on which the new landing call is generated, such as the lobby floor or the general floor, or according to the traffic flow during the up-peak time, the down-peak time, the lunchtime or the like.

For example, on the landing floor such as an entrance floor, which is crowded for boarding the car during the up-peak time, the value of α may be set to about 0.5, which is smaller than the standard value.

[0166] Moreover, although the allocated car is determined based on the difference in waiting time period evaluation index $WVal_{aft}(k)$ before the allocation and after the allocation by the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index, the allocated car may be determined based on, for example, an multiobjective evaluation index obtained from the combination of a different index such as an index indicating the degree of congestion in the car, and the waiting time period evaluation index.

[0167] Further, although the sum obtained by the computation for each landing floor and each traveling direction is used as the waiting time period evaluation index in the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index, a square of a difference between the predicted car arrival time and the predicted user arrival time may be computed for each user so that the sum of the squares obtained for each user is used as the waiting time period evaluation index.

[0168] Although the sum of the squares of the differences between the predicted car arrival time and the predicted user arrival time for each landing floor and each traveling direction is used as the waiting time period evaluation index in the car allocation determining means 55 for determining car allocation based on waiting time period evaluation index, the sum of squares of the predicted car arrival times may be used as the waiting time period evaluation index.

Sixth Embodiment

[0169] In the first embodiment, it is the individual car controllers 2A to 2D that mainly perform door opening/closing control for the cars 1A to 1D, respectively. On the other hand, in the sixth embodiment, the group supervisory control apparatus main body 100 generates a door opening/closing command. Based on the door opening/closing command, the individual car controllers 2A to 2D perform the door opening/closing control for the cars 1A to 1D, respectively. Specifically, it is the group supervisory control apparatus main body 100 that mainly performs the door opening/closing control for the cars 1A to 1D in the sixth embodiment.

[0170] FIG. 24 is a block diagram illustrating the group supervisory control apparatus for the elevators according to the sixth embodiment of the present invention. In FIG. 24, the illustration of the allocation candidate selecting section 130 and the travel constant setting section 140 is omitted. In FIG. 24, the operation command section 160 includes boarding-predicted user list storing means 61 and door opening/closing command means 62.

[0171] Upon generation of the new landing call, the boarding-predicted user list storing means 61 receives the information of the predicted user arrival time of the user who has performed the new landing call operation from the allocation candidate selection index calculating section 120. At the same time, the boarding-predicted user list storing means 61 receives the information of the car number of the allocated car which is determined in response to the new landing call, from the allocated car determining section 150.

[0172] Moreover, the boarding-predicted user list storing means 61 associates the information of the predicted user arrival time received from the allocation candidate selection index calculating section 120 and the information of the car number of the allocated car received from the allocated car determining section 150 with each other to store the associated information as a boarding-predicted user list.

Further, after the allocated car arrives (provides service) at the boarding floor related with the landing call and then leaves the boarding floor, the boarding-predicted user list storing means 61 deletes the combination of the information of the predicted user arrival time and the information of the car number of the allocated car which are associated with each other from the boarding-predicted user list.

[0173] When any one of the cars 1A to 1D arrives at the boarding floor related with the landing call as a response to the landing call, the door opening/closing command means 62 generates the door opening/closing command based on the boarding-predicted user list which is stored in the boarding-predicted user list storing means 61.

The door opening/closing command means 62 also transmits the generated door opening/closing command to one of the individual car controllers 2A to 2D, which controls the car arriving at the landing floor. Specifically, the door opening/closing command means 62 controls door opening/closing of the car via the individual car controllers 2A to 2D.

[0174] More specifically, the door opening/closing command means 62 performs computation expressed by the following Expression (10) for any one of the cars 1A to 1D, which arrives at the boarding floor related with the landing call, based on the boarding-predicted user list.

Expression 10

(last predicted user arrival time on the boarding-predicted user list)--(current time)

[0175] Specifically, the door opening/closing command means 62 refers to the boarding-predicted user list of the users who are predicted to board the allocated car traveling in a designated direction to the target landing floor to compare the predicted user arrival time of the last user on the boarding-predicted user list and the current time.

When a value obtained by the result of comparison is equal to or larger than a predetermined time, the door opening/closing command means 62 transmits a door-open continuation command to one of the individual car controllers 2A to 2D, which controls the target car so that the target car keeps the door open until the prediction boarding time of the last user comes.

At the same time, the door opening/closing command means 62 monitors the difference between the predicted user arrival time of the last user and the current time even while continuously keeping the door of the target car open.

[0176] When the value obtained by the result of comparison expressed by Expression (10) becomes less than the predetermined time, the door opening/closing command means 62 transmits the door-open continuation command to one of the individual car controllers 2A to 2D, which controls the car so that the door remains open for a standard door-open continuation time period of, for example, about 4 seconds, which is set in advance.

Then, the door opening/closing command means 62 transmits a door-closing start command to the corresponding one of the individual car controllers 2A to 2D, which controls the car, immediately after the lapse of the door-open continuation time period.

[0177] Moreover, the door opening/closing command means 62 performs computation expressed by the following Expression (11) for the corresponding one of the cars 1A to 1D, which arrives at the landing floor related with the landing call, based on the boarding-predicted user list.

Expression (11)

(predicted user arrival time of the first user on the boarding-predicted user list)-(current time)

[0178] Specifically, the door opening/closing command means 62 refers to the boarding-predicted user list of the users who are predicted to board the allocated car traveling in the designated direction to the target landing floor to compare the predicted user arrival time of the first user on the boarding-predicted user list and the current time with each other.

When a value obtained by the result of comparison is equal to or larger than the predetermined time, the door opening/closing command means 62 transmits a door-opening start command to one of the individual car controllers 2A to 2D, which controls the allocated car, so that the opening of the door of the allocated car is completed by (exactly at) the predicted user arrival time of the first user.
On the other hand, when the value obtained by the result of comparison expressed by Expression (11) is less than the predetermined time, the door opening/closing command means 62 transmits the door opening start command to the corresponding one of the individual car controllers 2A to 2D, which controls the car, immediately after the arrival of the car at the landing floor.

[0179] Therefore, the door opening/closing command means 62 generates the door opening/closing command for the target car based on the predicted user arrival time of the first user or the last user on the boarding-predicted user list. The other configuration is the same as that of any one of the first to fifth embodiments.

[0180] Next, the operation of the group supervisory control apparatus main body 100 according to the sixth embodiment is described. Here, an operation for generating the door-open continuation command and the door-closing start command by the group supervisory control apparatus main body 100 is described.
FIG. 25 is a flowchart illustrating the operation of the group supervisory control apparatus main body 100 illustrated in FIG. 24. In FIG. 25, when the new landing call is generated and the allocated car is determined in response to the new landing call, the group supervisory control apparatus main body 100 associates the predicted user arrival time of the user who performs the new landing call operation and the allocated car with each other and stores the result of association in the boarding-predicted user list.
Then, each time the new landing call is generated and the allocated car is determined in response to the new landing call, the group supervisory control apparatus main body 100 updates the boarding-predicted user list as needed (Step S501).

[0181] Upon arrival of the allocated car at the boarding floor related with the registered landing call, the group supervisory control apparatus main body 100 compares the predicted user arrival time of the last user on the boarding-predicted user list and the current time with each other (Step S502). Then, the group supervisory control apparatus main body 100 verifies whether or not the predicted user arrival time is later by a predetermined time or more than the current time (Step S503).

[0182] If the predicted user arrival time is later by the predetermined time or more than the current time, the group supervisory control apparatus main body 100 generates the door-open continuation command (Step S504) and transmits the door-open continuation command to the corresponding one of the individual car controllers 2A to 2D, which controls the target allocated car.
In this step, the group supervisory control apparatus main body 100 continuously transmits the door-open continuation command to the corresponding one of the individual car controllers 2A to 2D, which controls the target allocated car, until a time period from the current time to the predicted user arrival time becomes less than the predetermined time.

[0183] On the other hand, when the time period from the current time to the predicted user arrival time becomes less than the predetermined time, the group supervisory control apparatus main body 100 transmits the door-open continuation command to the corresponding one of the individual car controllers 2A to 2D, which controls the target allocated car, so that the door of the target allocated car remains open for the door-open continuation time period.
Then, after the lapse of the door-open continuation time period, the group supervisory control apparatus main body 100 generates the door-closing start command (Step S505) and transmits the door-closing start command to the corresponding one of the individual car controllers 2A to 2D, which controls the target allocated car, so that the door of the target allocated car is closed.
As a result, the operation for generating the door-open continuation command and the door-closing start command by the group supervisory control apparatus main body 100 is terminated. The other operation is the same as that of any one of the first to fifth embodiments.

[0184] In the group supervisory control apparatus for the elevators as described above, the opening/closing of the door of the car is controlled according to the predicted user arrival time of the user who is predicted to board.
As a result, the car can start closing the door to leave immediately after the last user boards the car. Therefore, the door-open waiting time period of the car can be reduced to improve the travel efficiency of the elevator. In particular, a travel time of the user from the car boarding to the destination floor can be reduced.

[0185] In the sixth embodiment, the boarding-predicted user list storing means 61 stores the predicted user arrival time of the user who has performed the landing call operation and the car number of the allocated car in association with each other.
In contrast to the abave-mentioned example, the boarding-predicted user list storing means 61 may store only the predicted user arrival time of each of the users who are predicted to be the first and the last to arrive at the boarding position for the target car each time the landing call for each car, each landing floor and each traveling direction is registered.
In this case, if a new user performs the new landing call operation, which is the same as that of the registered landing

call, the stored predicted user arrival times of the first and last users may be updated based on the predicted user arrival time of the new user.

[0186] Moreover, in the sixth embodiment, the door opening/closing command means 62 generates the door-closing start command immediately after the lapse of the predicted user arrival time of the user who is predicted to be the last to board. The generation of the door-closing start command is not limited to the above-mentioned example.
The door opening/closing command means 62 may generate the door-closing start command after lapse of a time period of, for example, about two seconds, which is previously set in consideration of the case where the user misses car.

[0187] Further, in the sixth embodiment, in the case where the predicted car arrival time of the allocated car is earlier than the predicted user arrival time of the user who is predicted to be the first to board, the door opening/closing command means 62 waits for the generation of the door-opening start command until the predicted user arrival time of the user who is predicted to be the first to board comes.
The generation of the door-opening start command is not limited to the above-mentioned example. The door-opening start command may be generated immediately after the arrival of the allocated car at the target boarding floor.

[0188] Further, in the sixth embodiment, the door opening/closing command means 62 generates the door-closing start command immediately after the predicted user arrival time of the user who is predicted to be the last to board. The generation of the door-closing start command is not limited to the above-mentioned example.
The door opening/closing command means 62 may use a minimum door-open continuation time period value which is equal to or larger than the value obtained by Expression (10) among a plurality of preset fixed door-open continuation time values to generate the door-closing start command after the lapse of the door-open continuation time period.

[0189] Further, the group supervisory control apparatus main body 100 according to the first to sixth embodiments may be constituted by a computer (not shown) including a processor unit (CPU), a storage section (ROM, RAM, hard disk, or the like), and a signal input/output suction.
The storage section of the computer of the group supervisory control apparatus main body 100 stores programs for realizing the functions of the allocation candidate selection index calculating section 120, the allocation candidate selecting section 130, the travel constant setting section 140, the allocated car determining section 150, and the operation command section 160 (functions of each means) therein.

[0190] Moreover, in the first to sixth embodiments, when the landing call operation is performed by the user on any one of the remote landing-call registration devices 11A to 11E, the request to register the landing call is transmitted from the corresponding one of the remote landing-call registration devices 11A to 11E to the group supervisory control apparatus main body 100.
On the other hand, the remote landing-call registration devices 11 A to 11E may have a personal authentication function of reading personal identification information stored on a personal identification medium (for example, IC card, RFID, or the like) to perform personal authentication of the user based on the personal identification information.
Further, a reader for the above-mentioned personal identification media (for example, IC card, RFID, and the like) may be incorporated as a part of a gate device such as a security gate. Alternatively, the remote landing-call registration devices 11A to 11E may have a biometric personal authentication function of reading biometric information of the user, such as a fingerprint, a voiceprint or a facial image, to perform personal authentication of the user.
In the above-mentioned cases, the remote landing-call registration devices 11A to 11E may extract information about the landing call which is preset in association with the personal identification information of the personal-authenticated user and then transmit the extracted information to the group supervisory control apparatus main body 100.

[0191] Further, although each of the remote landing-call registration devices 11A to 11E is used as the landing-call registration device in the first to sixth embodiments, the landing-call registration device is not limited to the remote landing-call registration device.
The landing-call registration device may also be provided in the landing or at a position in proximity to the landing. In this case, the prediction boarding time of the user who has performed the new landing call operation is the new landing call operation time.

[0192] Moreover, although the remote landing-call registration devices 11A to 11E transmit the request to register the landing call including the exit floor for the user (destination floor for the car) to the group supervisory control apparatus main body 100 in the first to sixth embodiments, a request to register the traveling direction in place of the exit floor for the user may be transmitted to the group supervisory control apparatus main body 100. In other words, each of the remote landing-call registration devices 11A to 11E may be a landing-call registration device using UP and DOWN buttons.

Claims

1. A group supervisory control apparatus for elevators, for supervising a travel of an elevator group including a plurality of cars to allocate, in response to a request to register a landing call from a landing-call registration device, one of the plurality of cars to a boarding floor and a traveling direction as an allocated car, the boarding floor and the

traveling direction being related with the landing call, and then to register the landing call, the group supervisory control apparatus for elevators comprising:

an allocation candidate selection index calculating section for calculating, upon generation of a new request to register the landing call, if the landing call for the same boarding floor and the same traveling direction as a boarding floor and a traveling direction related with the new landing call has already been registered, a difference in time between the prediction boarding time of a user who is a last boarding-predicted user among a plurality of users who have performed the registered landing call and the prediction boarding time of a user who has performed the new landing call as a first index; and
an allocation candidate selecting section for selecting an allocation candidate corresponding to a candidate for the allocated car to be allocated to the new landing call from the plurality of cars, and for excluding the allocated car allocated to the registered landing call from selection of the allocation candidate when the first index calculated by the allocation candidate selection index calculating section is larger than a first allowable value stored in advance.

2. A group supervisory control apparatus for elevators according to claim 1, wherein the allocation candidate selection index calculating section calculates a difference in time between a time at which the user who is a last user to register the landing call among the plurality of users who have performed the registered landing call operates the landing-call registration device and a time at which the user who has performed the new landing call operates the landing-call registration device as the first index in place of the difference in time between the prediction boarding times of both the users.

3. A group supervisory control apparatus for elevators according to claim 1 or 2, wherein:

upon the generation of the new landing call, the allocation candidate selection index calculating section calculates a second index for allocating the car to the boarding floor related with the new landing call based on a relation among three times of a predicted arrival time of the allocated car at the boarding floor in response to the registered landing call, the prediction boarding time of the user who has performed the registered landing call for the allocated car, and the prediction boarding time of the user who has performed the new landing call; and
the allocation candidate selecting section excludes the allocated car allocated to the registered landing call from the selection of the allocation candidate in at least one of a case where the first index is larger than the first allowable value and a case where the second index is larger than a second allowable value registered in advance.

4. A group supervisory control apparatus for elevators according to claim 3, wherein the allocation candidate selecting section changes the second allowable value to a smaller value when the first index calculated by the allocation candidate selection index calculating section is larger than the first allowable value.

5. A group supervisory control apparatus for elevators according to claim 3 or 4, wherein the allocation candidate selecting section stores at least one set of a plurality of the first allowable values and a plurality of the second allowable values, and can alternatively select one allowable value from the at least one set of the plurality of the first allowable values and the plurality of the second allowable values.

6. A group supervisory control apparatus for elevators according to claim 5, wherein:

the allocation candidate selecting section comprises threshold value changing means which prestores information of a traffic flow in a building in which the elevator group is installed; and
the threshold value changing means dynamically changes at least one of the plurality of the first allowable values and the plurality of the second allowable values according to the traffic flow.

7. A group supervisory control apparatus for elevators according to any one of claims 1 to 6, wherein the allocation candidate selecting section excludes the car from the selection of the allocation candidate when a difference in time between the prediction boarding time of the user who has performed the new landing call and the predicted arrival time of the car at the boarding floor exceeds a limit time stored in advance.

8. A group supervisory control apparatus for elevators according to any one of claims 1 to 7, further comprising a travel constant setting section which prestores information of travel distances between a position where the landing-call registration device is provided and boarding positions for the plurality of cars on the boarding floor related with the landing-call registration device, wherein, upon generation of the request to register the landing call, the allocation candidate selection index calculating section receives the information of the travel distances related with the landing call from the travel constant setting section to use the information of the travel distances in a process of calculating the prediction boarding time of the user who has performed the landing call.

9. A group supervisory control apparatus for elevators according to claim 8, wherein:

the travel constant setting section stores information of traveling rates of the plurality of users for each attribute of the plurality of users; and
upon the generation of the request to register the new landing call, if information for identifying the attribute is externally input, the allocation candidate selection index calculating section receives the information of the traveling rate related with the attribute from the travel constant setting section to use the information of the traveling rate in a process of calculating the predicted arrival time.

10. A group supervisory control apparatus for elevators according to claim 8 or 9, wherein:

the travel constant setting section prestores information of a plurality of traveling rate reduction parameters corresponding to parameters relating to a traveling rate according to an environment of each of a plurality of landing floors in association with the each of the plurality of landing floors; and
upon the generation of the request to register the landing call, the allocation candidate selection index calculating section receives the traveling rate reduction parameter for the boarding floor related with the landing call from the travel constant setting section to use the information of the traveling rate reduction parameter in a process of calculating the predicted arrival time.

11. A group supervisory control apparatus for elevators according to any one of claims 1 to 10, wherein the allocation candidate selecting section counts a number of users predicted to board or being in each of the plurality of cars, and excludes the car which is unavailable for the user who has performed the new landing call because of a fully loaded state of the car when the request to register the new landing call is generated, from the selection of the allocation candidate.

12. A group supervisory control apparatus for elevators according to any one of claims 1 to 11, wherein the allocation candidate selecting section selects, from the plurality of cars, at least one of the car to which none of the landing call and a car call is allocated and a car from which the landing call and the car call are soon to be deallocated as the allocation candidate.

13. A group supervisory control apparatus for elevators according to any one of claims 1 to 12, wherein:

the allocation candidate selecting section comprises selection condition relaxing means for relaxing a selection condition for selecting the allocation candidate from the plurality of cars when the request to register the landing call is generated in a case where all the plurality of cars of the elevator group are excluded from the selection of the allocation candidate; and
the allocation candidate selecting section selects all the plurality of cars of the elevator group as the allocation candidates in a case where all the plurality of cars of the elevator group are excluded from the selection of the allocation candidate even after the selection condition is relaxed by the selection condition relaxing means.

14. A group supervisory control apparatus for elevators according to any one of claims 1 to 13, wherein, upon the generation of the request to register the new landing call, the allocation candidate selecting section excludes the car which starts closing a door to leave the boarding floor related with the new landing call from the selection of the allocation candidate.

15. A group supervisory control apparatus for elevators according to any one of claims 1 to 14, further comprising:

pre-allocated car selecting means for selecting the car scheduled to operate to travel based on the traveling direction and the boarding floor, the traveling direction and the boarding floor being related with the new landing call, and having a scheduled stop number corresponding to a number of floors at which the car is scheduled to stop in the traveling direction, the scheduled stop number being equal to or less than a predetermined limit value, from the allocation candidate so that the car is determined as the allocated car; and
pre-allocated car allocation determining means for determining, in a case where a plurality of the cars are

selected by the pre-allocated car selecting means, the car providing a minimum absolute value of a difference between a predicted arrival time of each of the plurality of the selected cars at the boarding floor and a prediction boarding time of the user who has performed the new landing call for the each of the plurality of the cars as the allocated car.

16. A group supervisory control apparatus for elevators according to claim 15, further comprising:

unallocated car selecting means for selecting the car with the scheduled stop number in the traveling direction being equal to or less than the predetermined limit value from the allocation candidate to determine the car as the allocated car in a case where the car is not selected from the allocation candidate by the pre-allocated car selecting means; and
waiting time period evaluation index car allocation determining means for supposing, in a case where a plurality of the cars are selected by the unallocated car selecting means, that the plurality of the cars are allocated to the boarding floor related with the new landing call, and for determining the car providing a minimum sum of square values of differences between the predicted car arrival times and predicted user arrival times at all stop floors at which the car is scheduled to stop for the landing call as the allocated car.

17. A group supervisory control apparatus for elevators according to claim 15 or 16, further comprising:

boarding-predicted user list storing means for storing information of a car number of the allocated car determined from the allocation candidate and information of the predicted user arrival time of the user predicted to board the allocated car in association with each other as a boarding-predicted user list; and
door opening/closing command means for calculating a prediction boarding time for the user who is the last to board the car on the each of the plurality of landing floors based on the boarding-predicted user list, and, upon arrival of the car at one of the plurality of landing floors, for causing the car to wait with the door open until the prediction boarding time related with the landing floor comes.

18. A group supervisory control apparatus for elevators, for supervising a travel of an elevator group including a plurality of cars to allocate, in response to a request to register a landing call from a landing-call registration device, one of the plurality of cars to a boarding floor and a traveling direction as an allocated car, the boarding floor and the traveling direction being related with the landing call, and then to register the landing call, the group supervisory control apparatus for elevators comprising:

an allocation candidate selection index calculating section for calculating, upon generation of a new request to register the landing call, if the landing call for the same boarding floor and the same traveling direction as a boarding floor and a traveling direction related with the new landing call has already been registered, an index for allocating the car to the boarding floor related with the new landing call based on a relation among three times of a predicted arrival time of the allocated car at the boarding floor in response to the registered landing call, a prediction boarding time of a user who has performed the registered landing call for the allocated car, and a prediction boarding time of a user who has performed the new landing call; and
an allocation candidate selecting section for selecting an allocation candidate corresponding to a candidate for the allocated car to be allocated to the new landing call from the plurality of cars, and for excluding the allocated car allocated to the registered landing call from selection of the allocation candidate when the index calculated by the allocation candidate selection index calculating section is larger than an allowable value stored in advance, wherein the allocation candidate selecting section comprises threshold value changing means which prestores information of a traffic flow in a building in which the elevator group is installed, the threshold value changing means dynamically changing the allowable value according to the traffic flow.

FIG.1

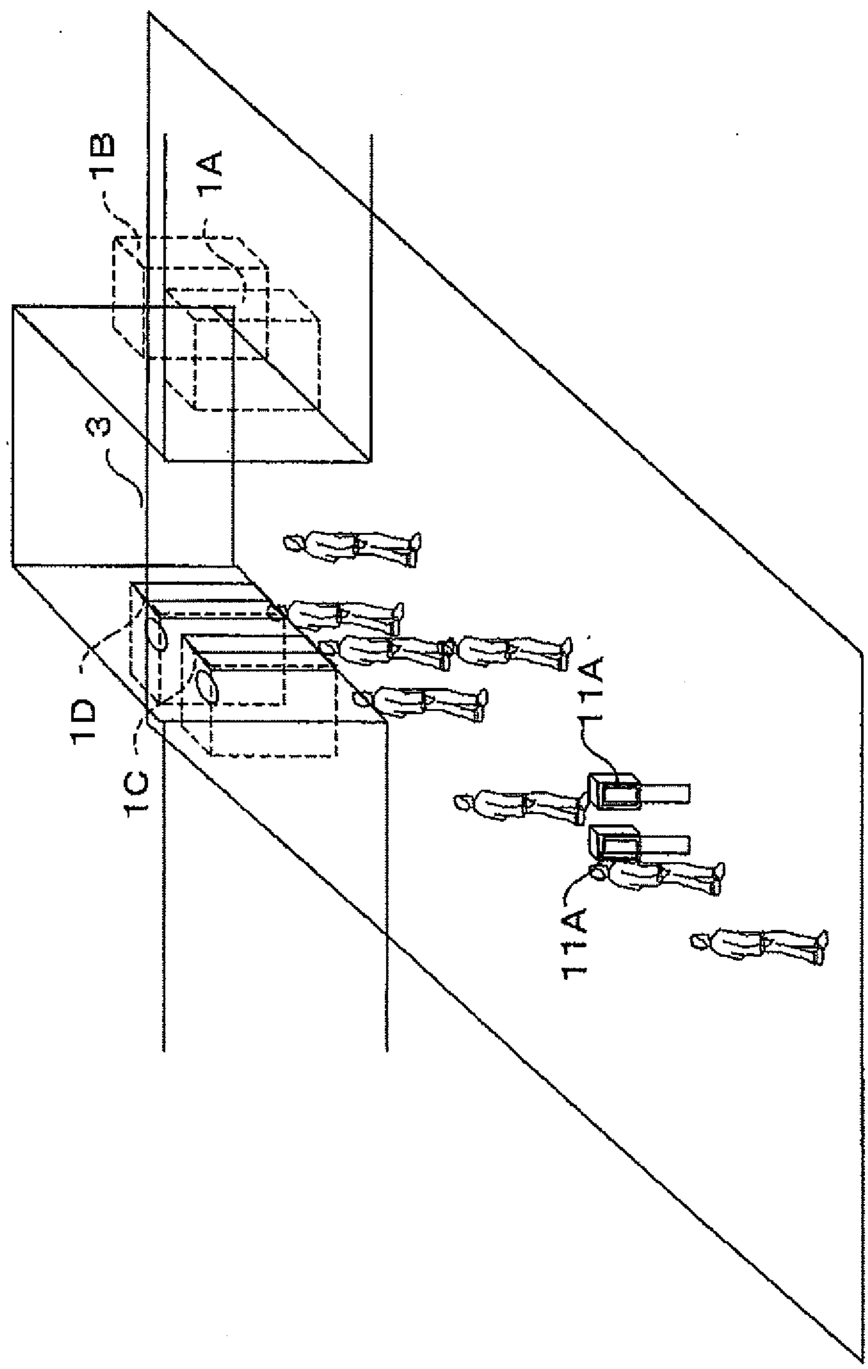


FIG.2

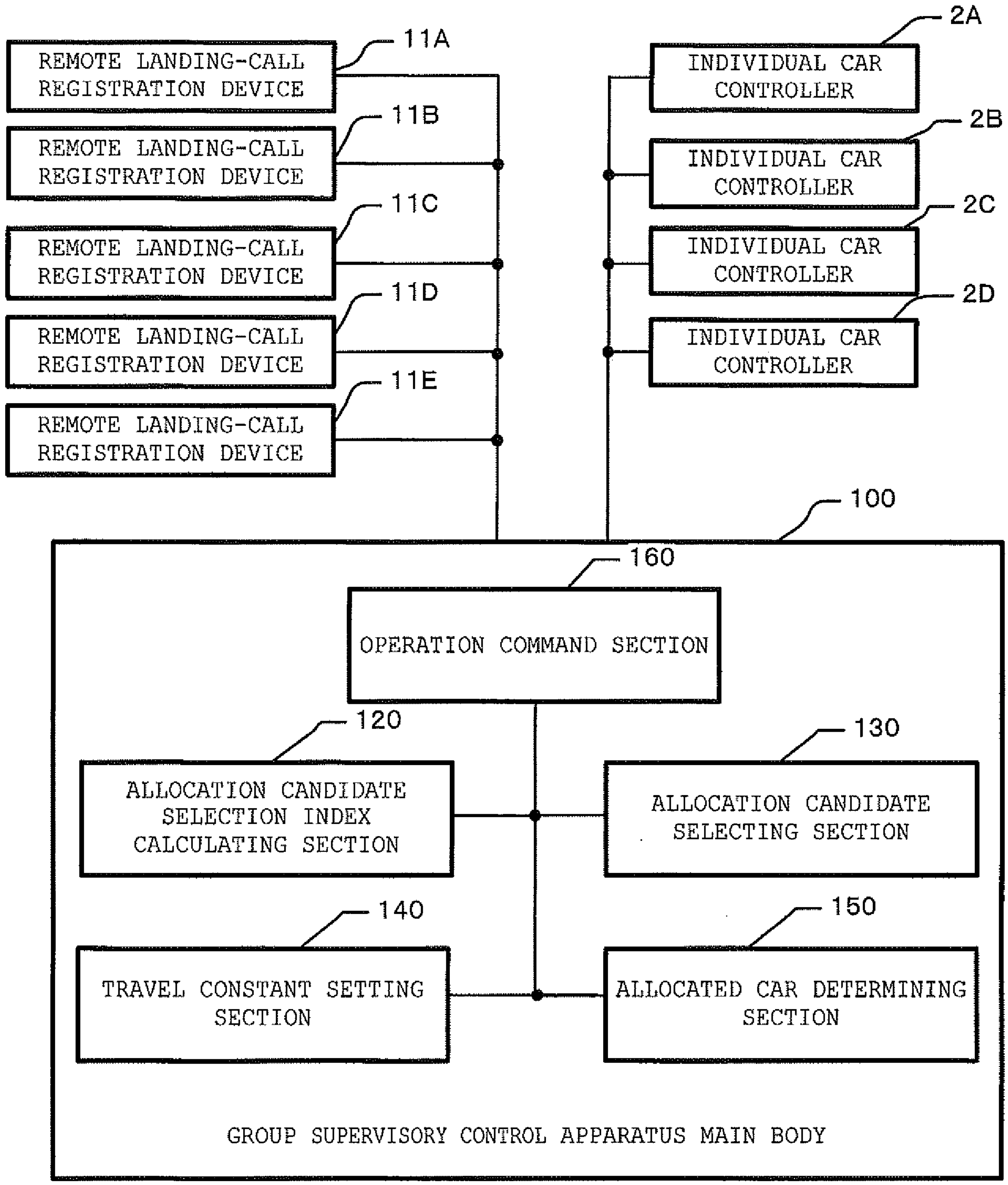
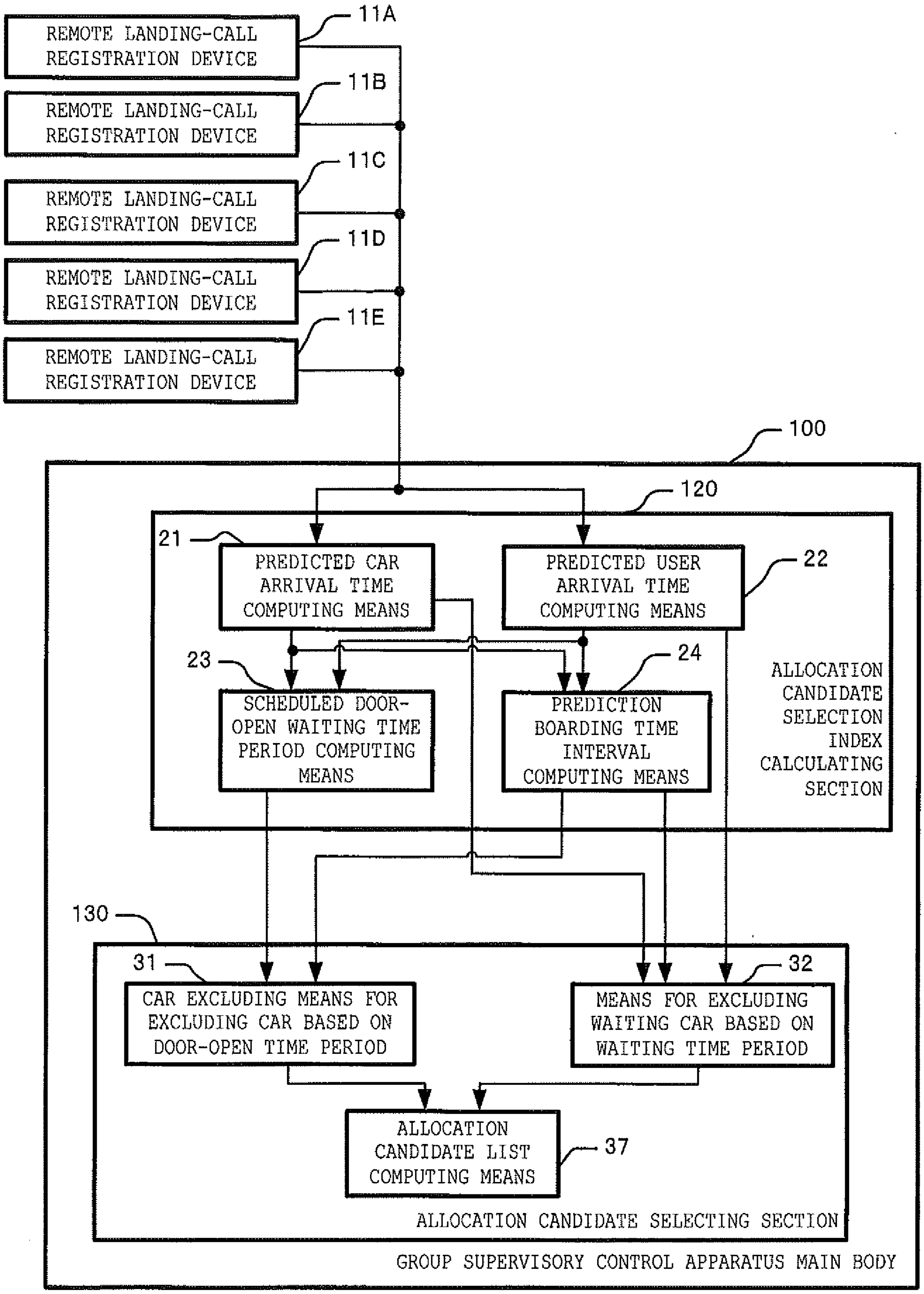

REMOTE LANDING-CALL REGISTRATION DEVICE
11A
REMOTE LANDING-CALL REGISTRATION DEVICE
11B
REMOTE LANDING-CALL REGISTRATION DEVICE
11C
REMOTE LANDING-CALL REGISTRATION DEVICE
11D
REMOTE LANDING-CALL REGISTRATION DEVICE
11E
INDIVIDUAL CAR CONTROLLER
2A
INDIVIDUAL CAR CONTROLLER
2B
INDIVIDUAL CAR CONTROLLER
2C
INDIVIDUAL CAR CONTROLLER
2D
100
160
OPERATION COMMAND SECTION
120
ALLOCATION CANDIDATE SELECTION INDEX CALCULATING SECTION
130
ALLOCATION CANDIDATE SELECTING SECTION
140
TRAVEL CONSTANT SETTING SECTION
150
ALLOCATED CAR DETERMINING SECTION
GROUP SUPERVISORY CONTROL APPARATUS MAIN BODY

FIG.3



11A
REMOTE LANDING-CALL REGISTRATION DEVICE
11B
REMOTE LANDING-CALL REGISTRATION DEVICE
11C
REMOTE LANDING-CALL REGISTRATION DEVICE
11D
REMOTE LANDING-CALL REGISTRATION DEVICE
11E
REMOTE LANDING-CALL REGISTRATION DEVICE
100
120
21
PREDICTED CAR ARRIVAL TIME COMPUTING MEANS
PREDICTED USER ARRIVAL TIME COMPUTING MEANS
22
23
SCHEDULED DOOR-OPEN WAITING TIME PERIOD COMPUTING MEANS
24
PREDICTION BOARDING TIME INTERVAL COMPUTING MEANS
ALLOCATION CANDIDATE SELECTION INDEX CALCULATING SECTION
130
31
CAR EXCLUDING MEANS FOR EXCLUDING CAR BASED ON DOOR-OPEN TIME PERIOD
32
MEANS FOR EXCLUDING WAITING CAR BASED ON WAITING TIME PERIOD
ALLOCATION CANDIDATE LIST COMPUTING MEANS
37
ALLOCATION CANDIDATE SELECTING SECTION
GROUP SUPERVISORY CONTROL APPARATUS MAIN BODY

FIG.4

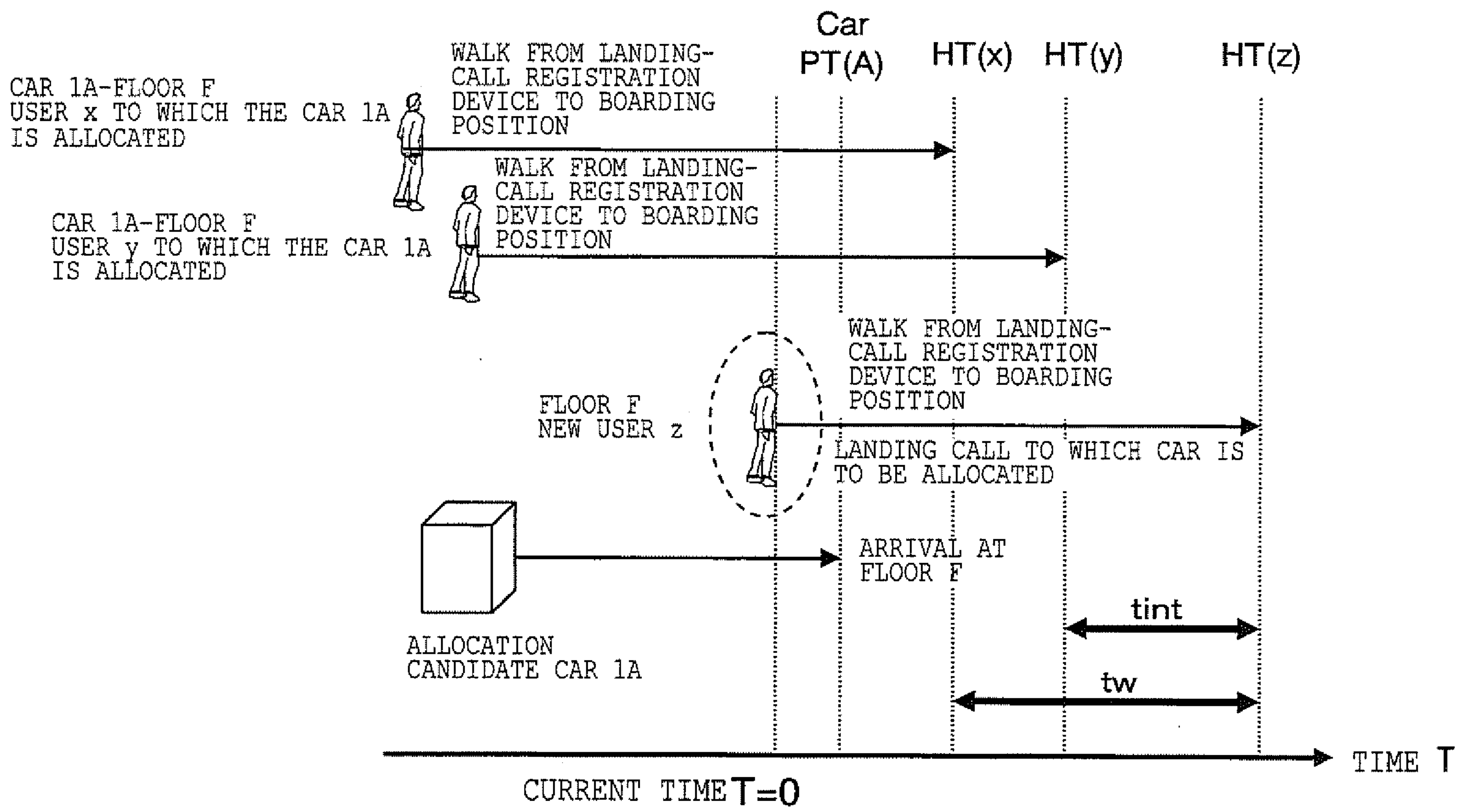

Car
PT(A)
HT(x)
HT(y)
HT(z)
CAR 1A-FLOOR F
USER x TO WHICH THE CAR 1A
IS ALLOCATED
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
CAR 1A-FLOOR F
USER y TO WHICH THE CAR 1A
IS ALLOCATED
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
FLOOR F
NEW USER z
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
LANDING CALL TO WHICH CAR IS
TO BE ALLOCATED
ALLOCATION
CANDIDATE CAR 1A
ARRIVAL AT
FLOOR F
tint
tw
TIME T
CURRENT TIME T=0

FIG.5

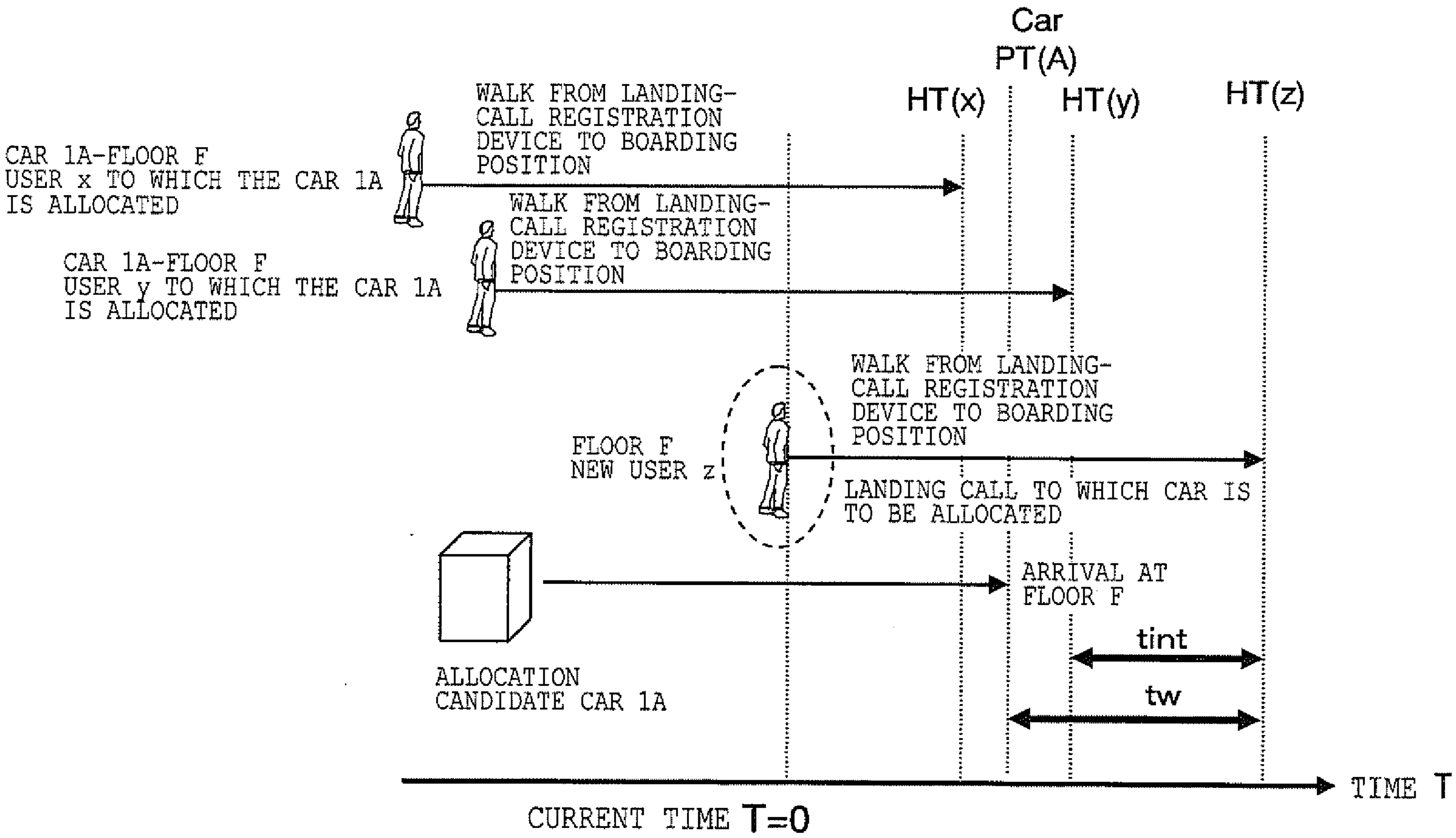

Car
PT(A)
HT(x)
HT(y)
HT(z)
CAR 1A-FLOOR F
USER x TO WHICH THE CAR 1A
IS ALLOCATED
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
CAR 1A-FLOOR F
USER y TO WHICH THE CAR 1A
IS ALLOCATED
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
FLOOR F
NEW USER z
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
LANDING CALL TO WHICH CAR IS
TO BE ALLOCATED
ALLOCATION
CANDIDATE CAR 1A
ARRIVAL AT
FLOOR F
tint
tw
TIME T
CURRENT TIME T=0

FIG.6

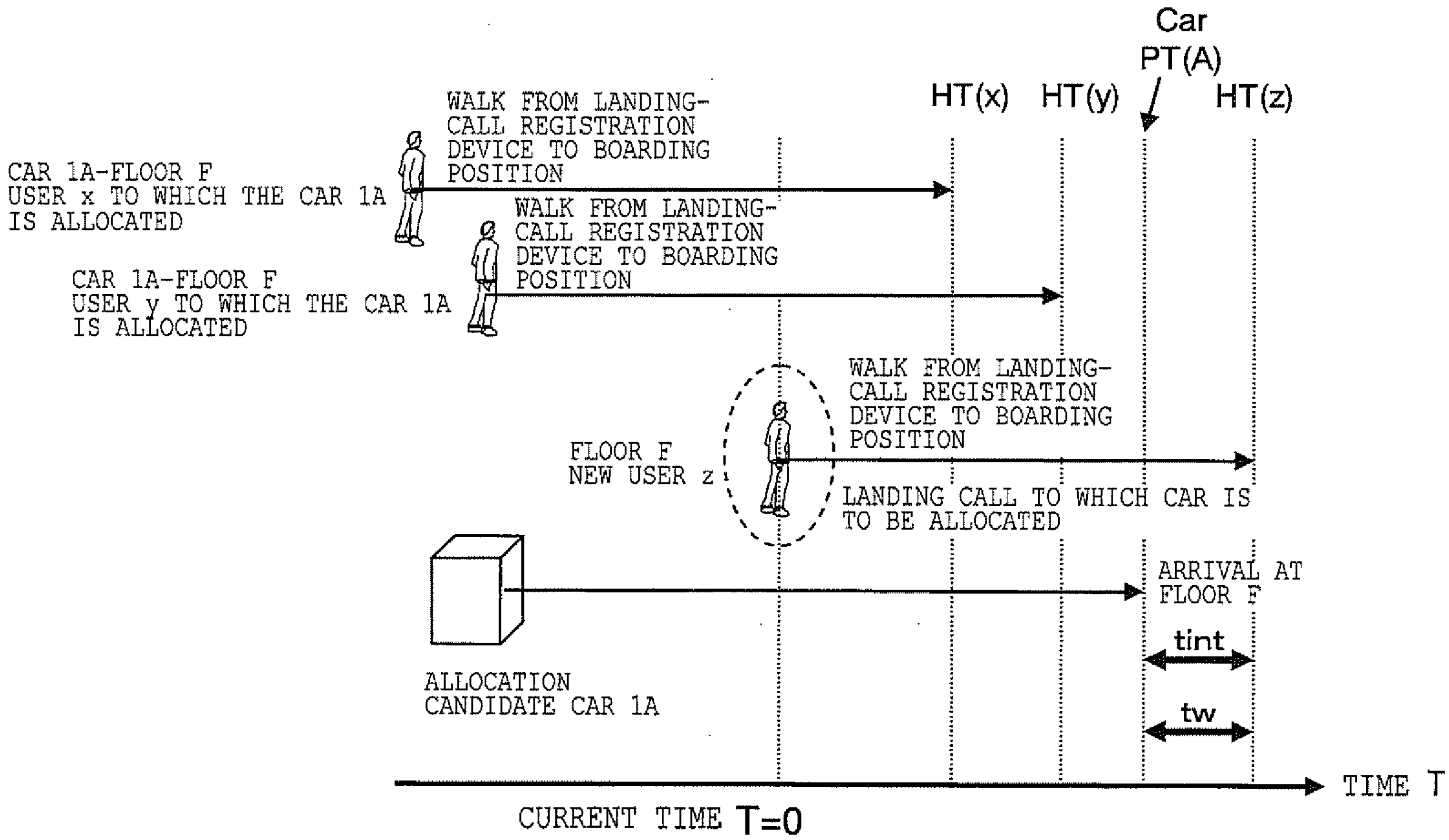
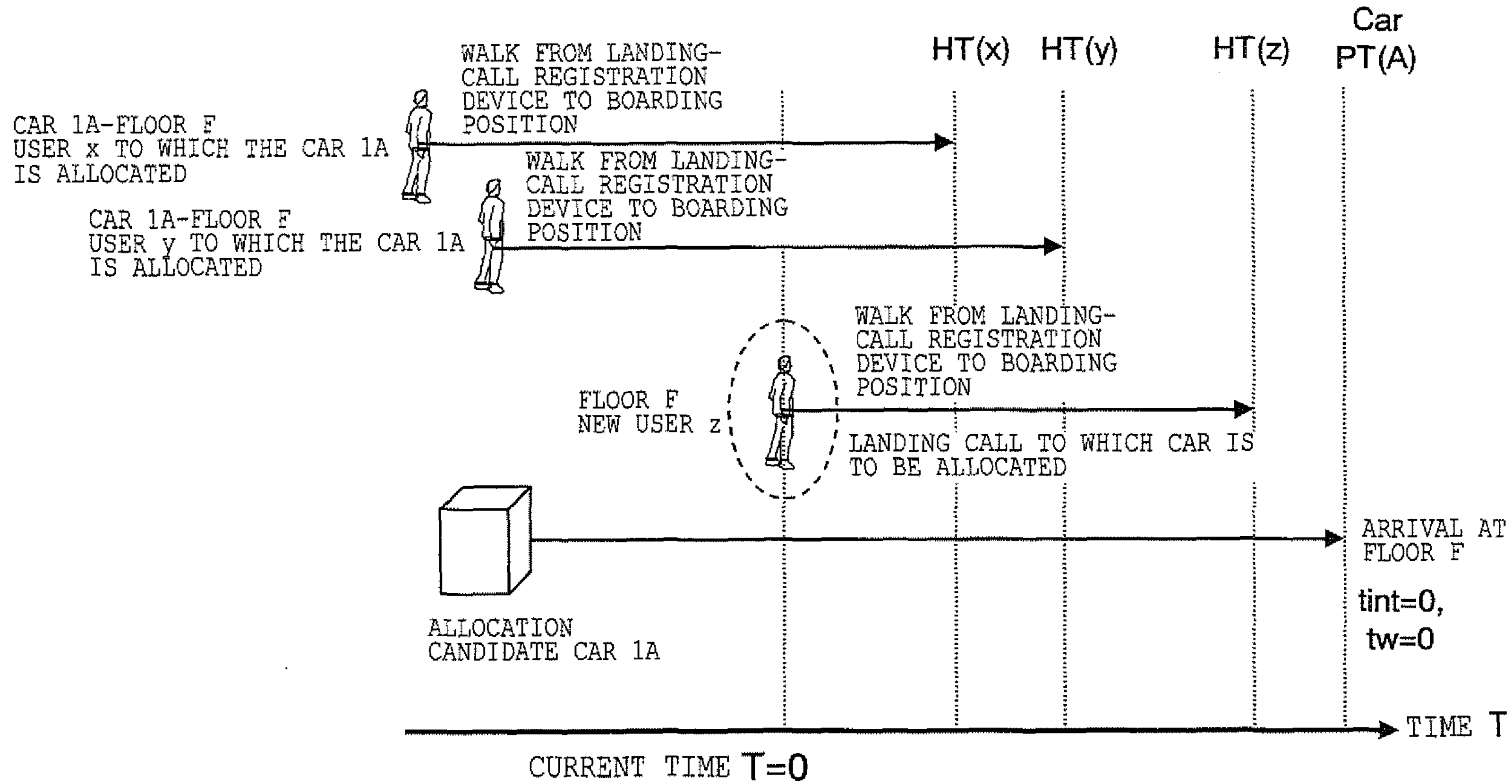

Car
PT(A)
HT(x)
HT(y)
HT(z)
CAR 1A-FLOOR F
USER x TO WHICH THE CAR 1A
IS ALLOCATED
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
CAR 1A-FLOOR F
USER y TO WHICH THE CAR 1A
IS ALLOCATED
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
FLOOR F
NEW USER z
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
LANDING CALL TO WHICH CAR IS
TO BE ALLOCATED
ALLOCATION
CANDIDATE CAR 1A
ARRIVAL AT
FLOOR F
tint
tw
TIME T
CURRENT TIME T=0

FIG.7



HT(x)
HT(y)
HT(z)
Car
PT(A)
CAR 1A-FLOOR F
USER x TO WHICH THE CAR 1A
IS ALLOCATED
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
CAR 1A-FLOOR F
USER y TO WHICH THE CAR 1A
IS ALLOCATED
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
FLOOR F
NEW USER z
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
LANDING CALL TO WHICH CAR IS
TO BE ALLOCATED
ALLOCATION
CANDIDATE CAR 1A
ARRIVAL AT
FLOOR F
tint=0,
tw=0
TIME T
CURRENT TIME T=0

FIG.8

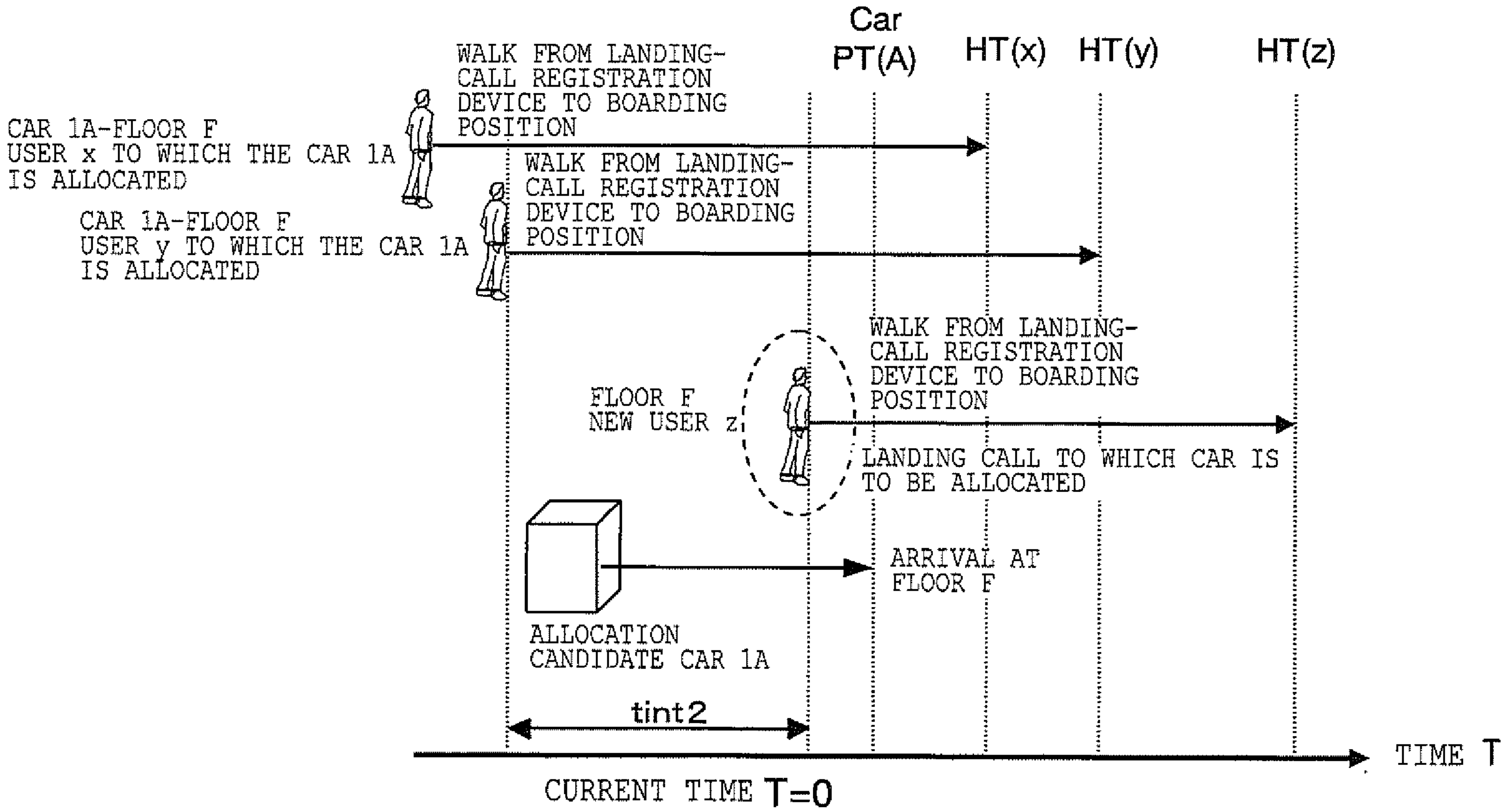

Car
PT(A)
HT(x)
HT(y)
HT(z)
WALK FROM LANDING-CALL REGISTRATION DEVICE TO BOARDING POSITION
CAR 1A-FLOOR F USER x TO WHICH THE CAR 1A IS ALLOCATED
WALK FROM LANDING-CALL REGISTRATION DEVICE TO BOARDING POSITION
CAR 1A-FLOOR F USER y TO WHICH THE CAR 1A IS ALLOCATED
WALK FROM LANDING-CALL REGISTRATION DEVICE TO BOARDING POSITION
FLOOR F NEW USER z
LANDING CALL TO WHICH CAR IS TO BE ALLOCATED
ARRIVAL AT FLOOR F
ALLOCATION CANDIDATE CAR 1A
tint2
TIME T
CURRENT TIME T=0

FIG.9

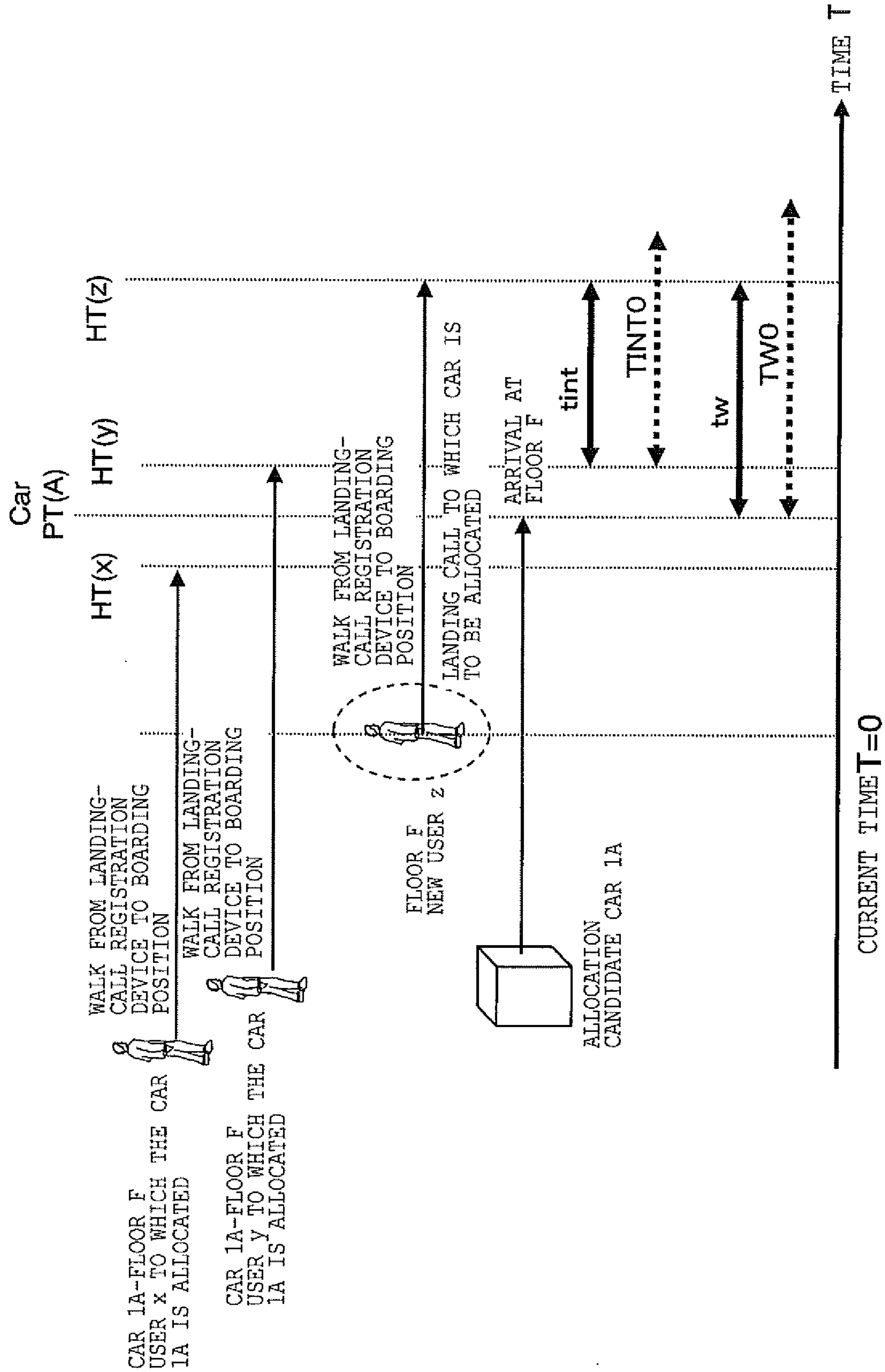

Car
PT(A)
HT(x)
HT(y)
HT(z)
CAR 1A-FLOOR F USER x TO WHICH THE CAR 1A IS ALLOCATED
WALK FROM LANDING-CALL REGISTRATION DEVICE TO BOARDING POSITION
CAR 1A-FLOOR F USER y TO WHICH THE CAR 1A IS ALLOCATED
WALK FROM LANDING-CALL REGISTRATION DEVICE TO BOARDING POSITION
FLOOR F NEW USER z
WALK FROM LANDING-CALL REGISTRATION DEVICE TO BOARDING POSITION
LANDING CALL TO WHICH CAR IS TO BE ALLOCATED
ALLOCATION CANDIDATE CAR 1A
ARRIVAL AT FLOOR F
tint
TINTO
tw
TWO
CURRENT TIME T=0
TIME T

FIG.10

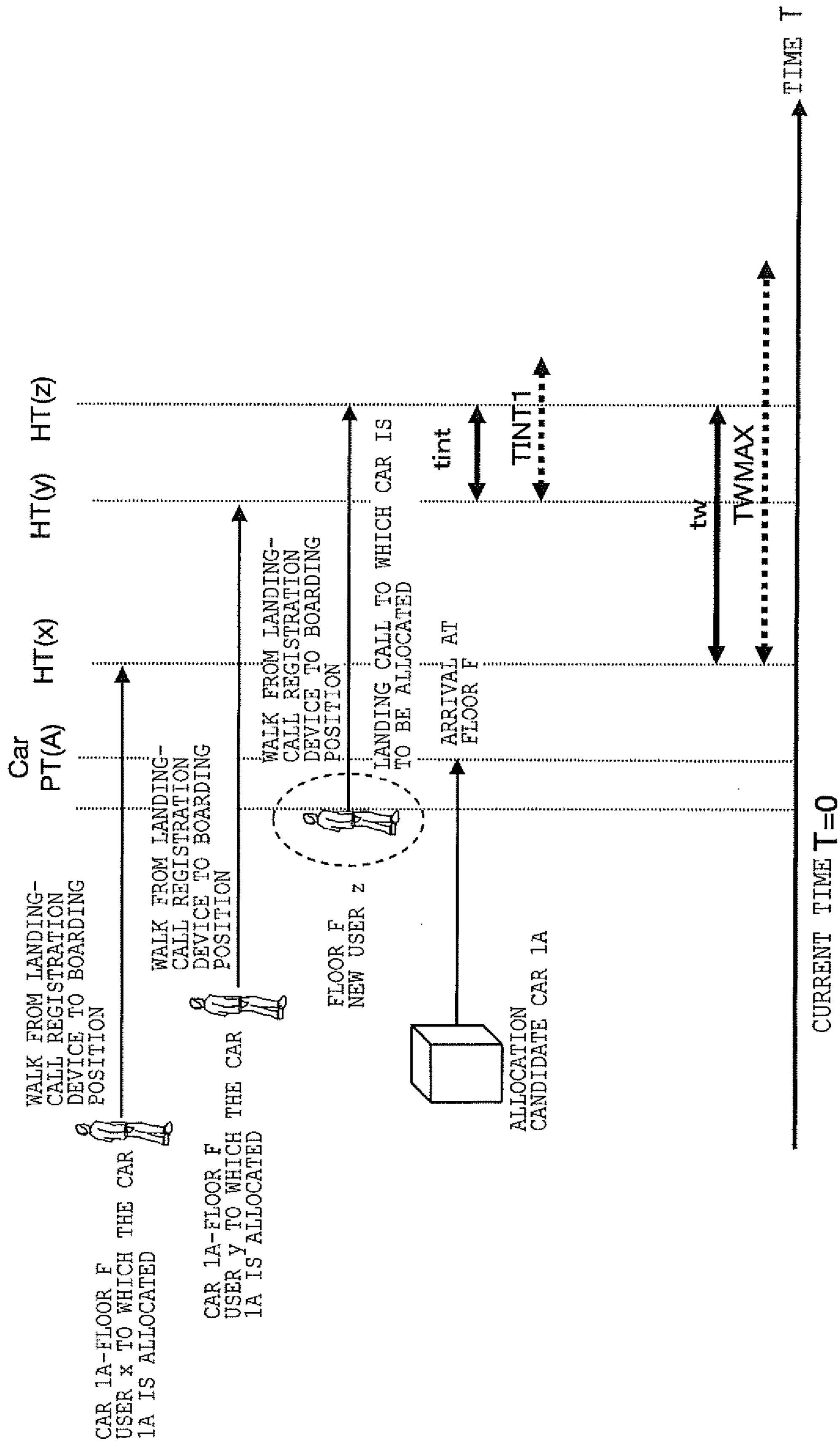

Car
PT(A)
HT(x)
HT(y)
HT(z)
CAR 1A-FLOOR F USER x TO WHICH THE CAR 1A IS ALLOCATED
WALK FROM LANDING-CALL REGISTRATION DEVICE TO BOARDING POSITION
CAR 1A-FLOOR F USER y TO WHICH THE CAR 1A IS ALLOCATED
WALK FROM LANDING-CALL REGISTRATION DEVICE TO BOARDING POSITION
FLOOR F NEW USER z
WALK FROM LANDING-CALL REGISTRATION DEVICE TO BOARDING POSITION
LANDING CALL TO WHICH CAR IS TO BE ALLOCATED
ALLOCATION CANDIDATE CAR 1A
ARRIVAL AT FLOOR F
tint
TINT1
tw
TWMAX
CURRENT TIME T=0
TIME T

FIG.11

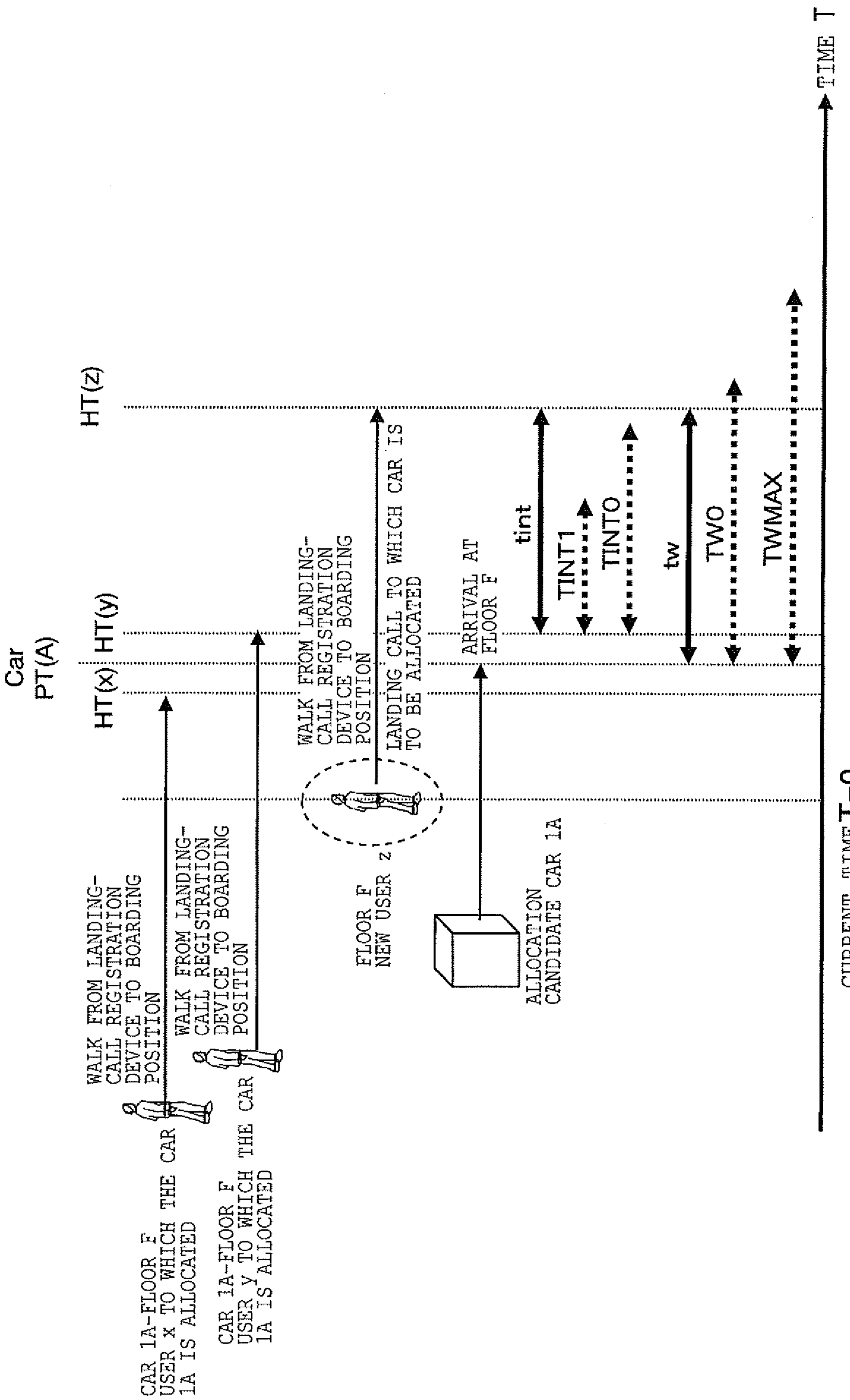

Car
PT(A)
HT(x)
HT(y)
HT(z)
CAR 1A-FLOOR F
USER x TO WHICH THE CAR
1A IS ALLOCATED
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
CAR 1A-FLOOR F
USER y TO WHICH THE CAR
1A IS ALLOCATED
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
FLOOR F
NEW USER z
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
LANDING CALL TO WHICH CAR IS
TO BE ALLOCATED
ALLOCATION
CANDIDATE CAR 1A
ARRIVAL AT
FLOOR F
tint
TINT1
TINTO
tw
TWO
TWMAX
CURRENT TIME T=0
TIME T

FIG.12

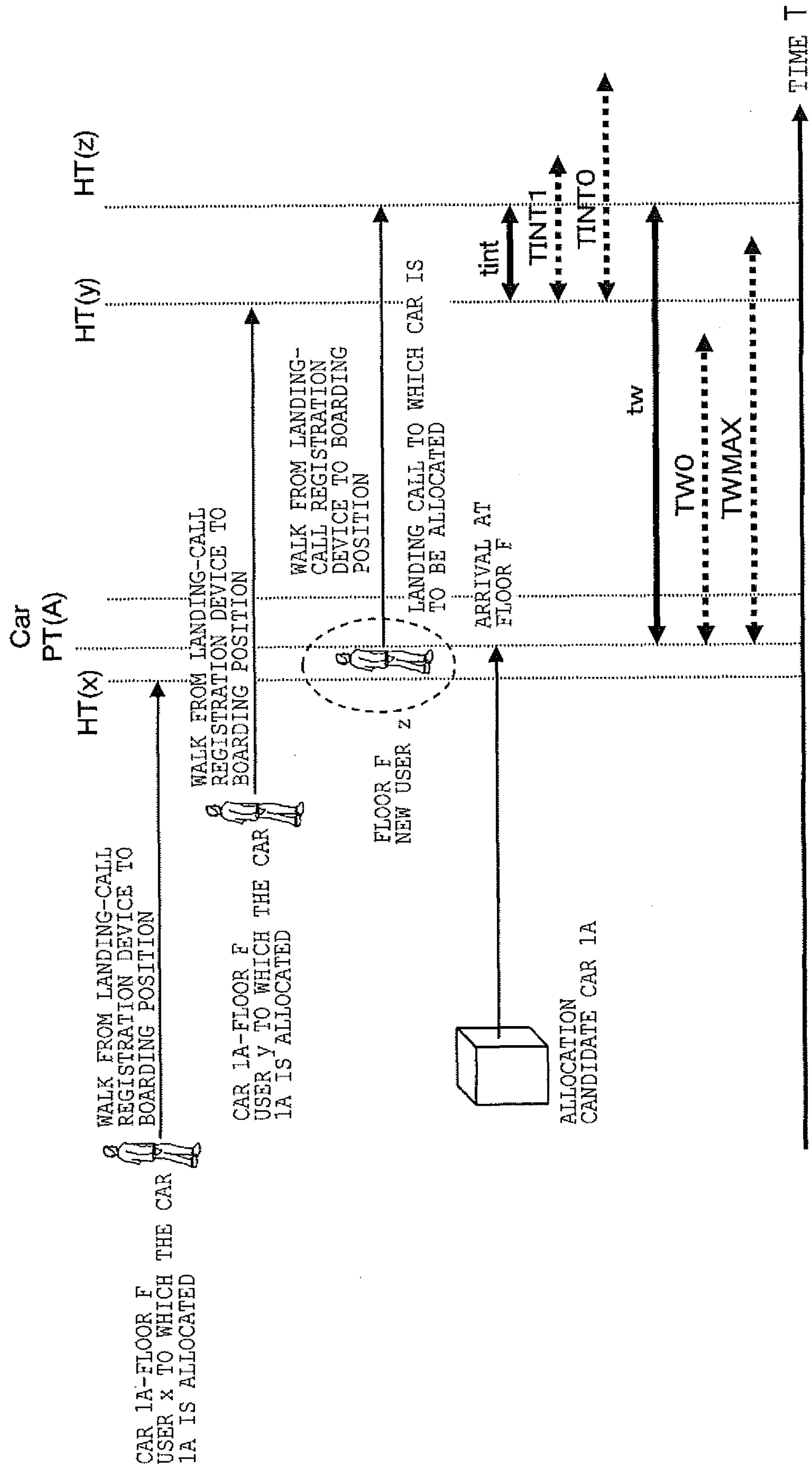

HT(x)
Car
PT(A)
HT(y)
HT(z)
CAR 1A-FLOOR F
USER x TO WHICH THE CAR
1A IS ALLOCATED
WALK FROM LANDING-CALL
REGISTRATION DEVICE TO
BOARDING POSITION
CAR 1A-FLOOR F
USER y TO WHICH THE CAR
1A IS ALLOCATED
WALK FROM LANDING-CALL
REGISTRATION DEVICE TO
BOARDING POSITION
FLOOR F
NEW USER z
WALK FROM LANDING-
CALL REGISTRATION
DEVICE TO BOARDING
POSITION
LANDING CALL TO WHICH CAR IS
TO BE ALLOCATED
ARRIVAL AT
FLOOR F
ALLOCATION
CANDIDATE CAR 1A
tint
TINT1
TINTO
tw
TWO
TWMAX
CURRENT TIME T=0
TIME T

FIG.13

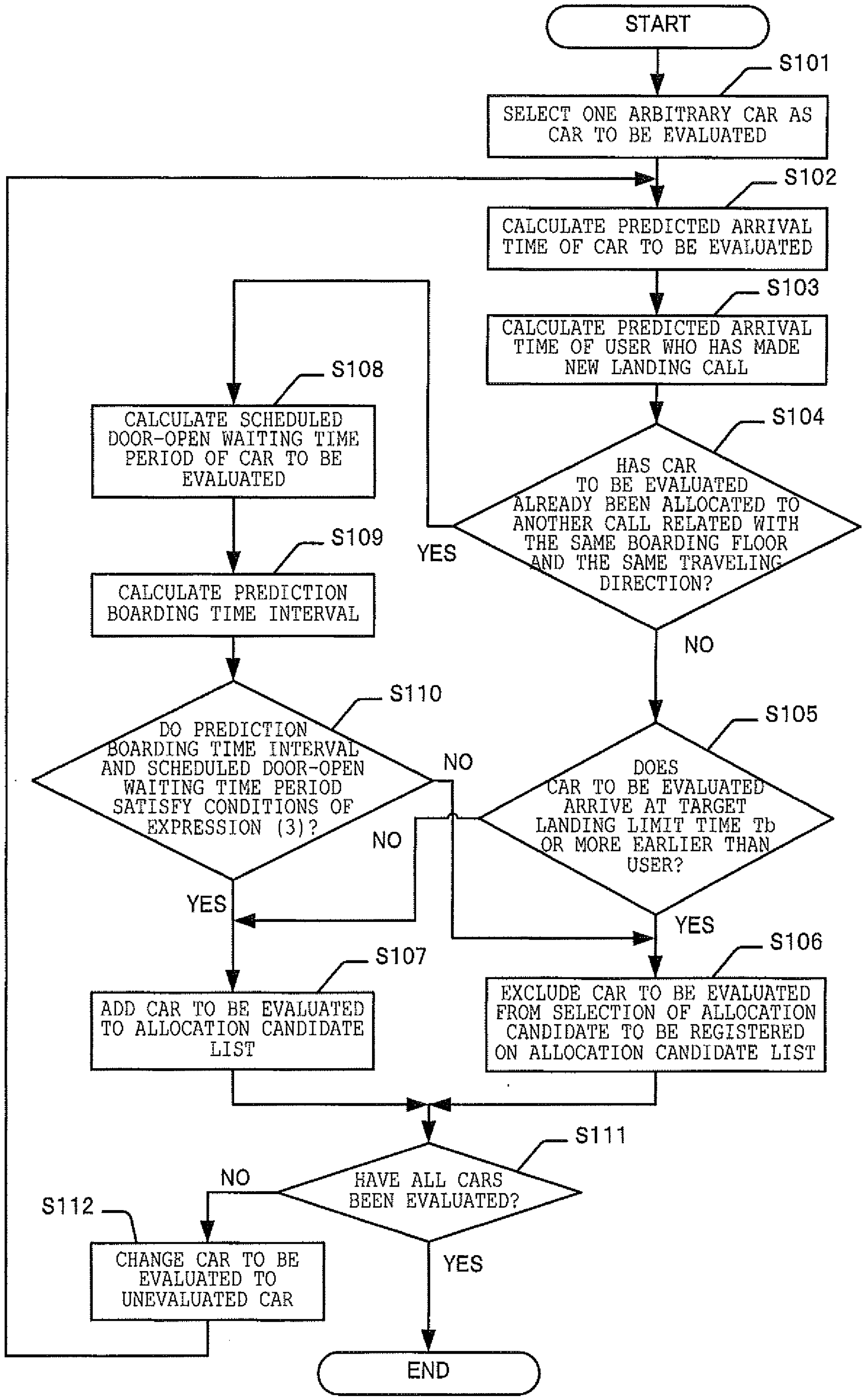

START
S101
SELECT ONE ARBITRARY CAR AS CAR TO BE EVALUATED
S102
CALCULATE PREDICTED ARRIVAL TIME OF CAR TO BE EVALUATED
S103
CALCULATE PREDICTED ARRIVAL TIME OF USER WHO HAS MADE NEW LANDING CALL
S104
HAS CAR TO BE EVALUATED ALREADY BEEN ALLOCATED TO ANOTHER CALL RELATED WITH THE SAME BOARDING FLOOR AND THE SAME TRAVELING DIRECTION?
YES
NO
S108
CALCULATE SCHEDULED DOOR-OPEN WAITING TIME PERIOD OF CAR TO BE EVALUATED
S109
CALCULATE PREDICTION BOARDING TIME INTERVAL
S110
DO PREDICTION BOARDING TIME INTERVAL AND SCHEDULED DOOR-OPEN WAITING TIME PERIOD SATISFY CONDITIONS OF EXPRESSION (3)?
NO
YES
S105
DOES CAR TO BE EVALUATED ARRIVE AT TARGET LANDING LIMIT TIME Tb OR MORE EARLIER THAN USER?
NO
YES
S107
ADD CAR TO BE EVALUATED TO ALLOCATION CANDIDATE LIST
S106
EXCLUDE CAR TO BE EVALUATED FROM SELECTION OF ALLOCATION CANDIDATE TO BE REGISTERED ON ALLOCATION CANDIDATE LIST
S111
HAVE ALL CARS BEEN EVALUATED?
NO
YES
S112
CHANGE CAR TO BE EVALUATED TO UNEVALUATED CAR
END

FIG.14

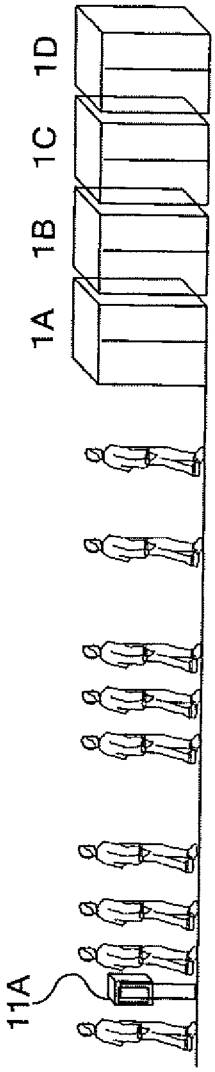


FIG.15

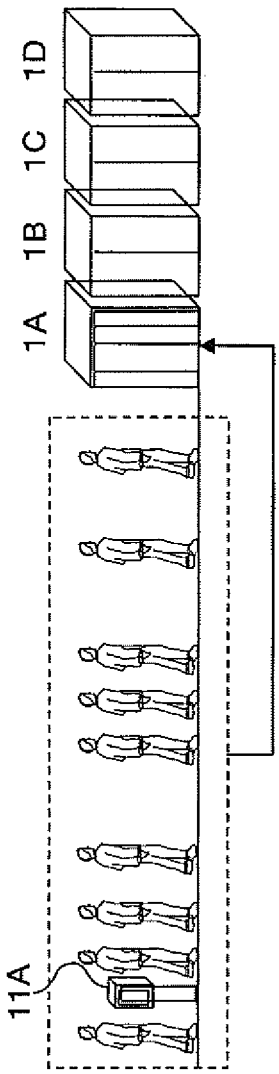


FIG.16

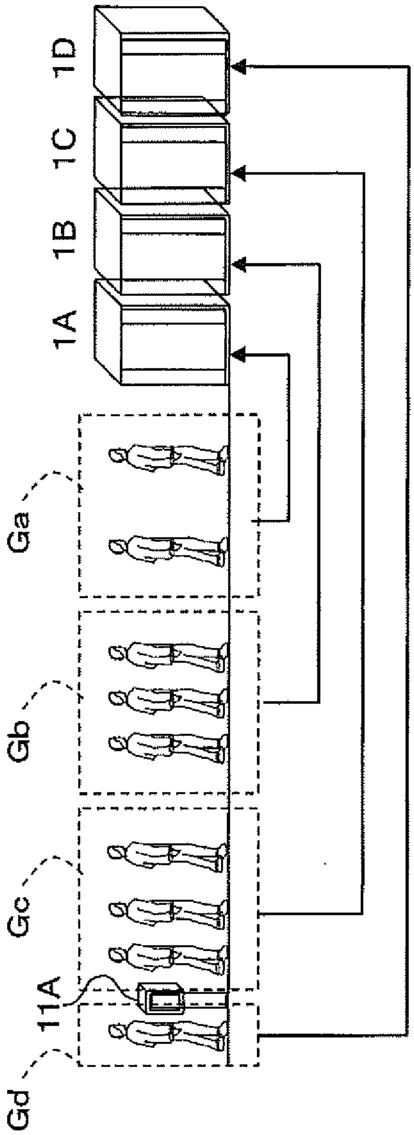


FIG.17

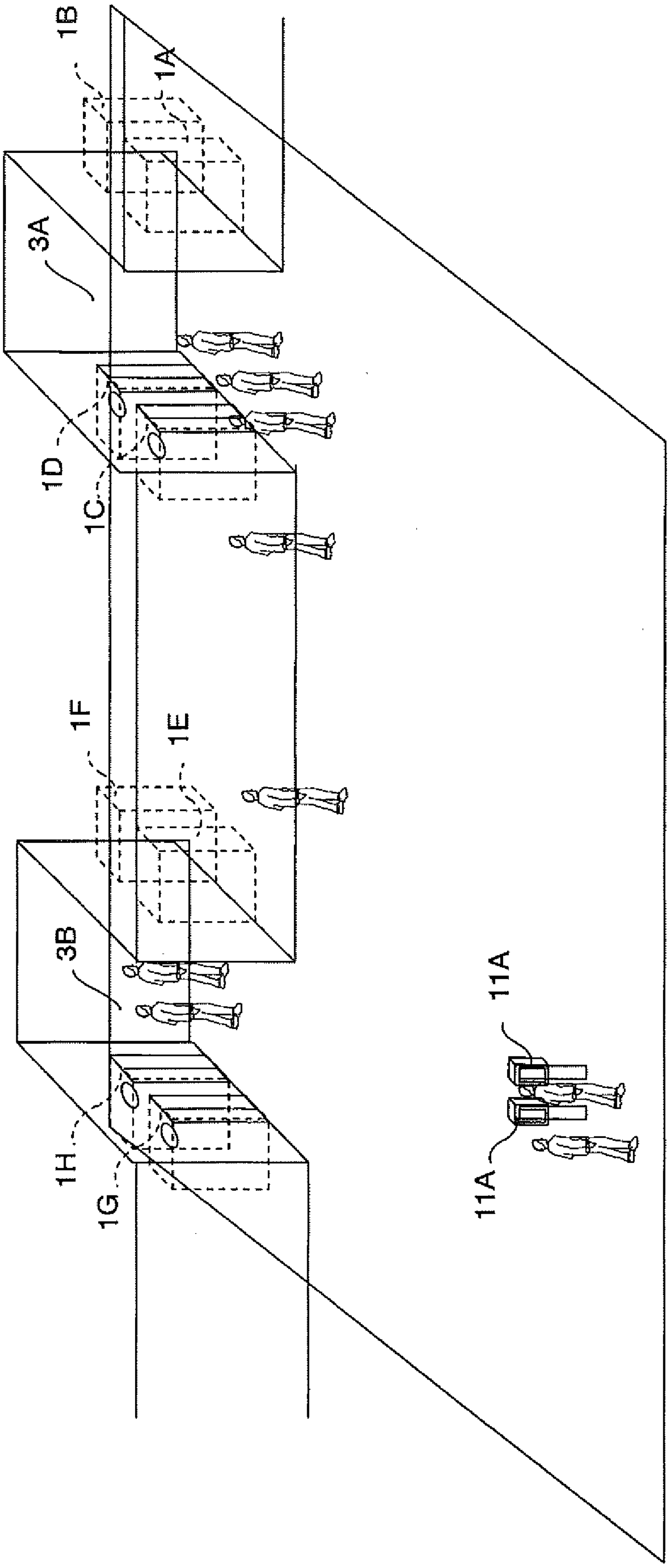


FIG.18

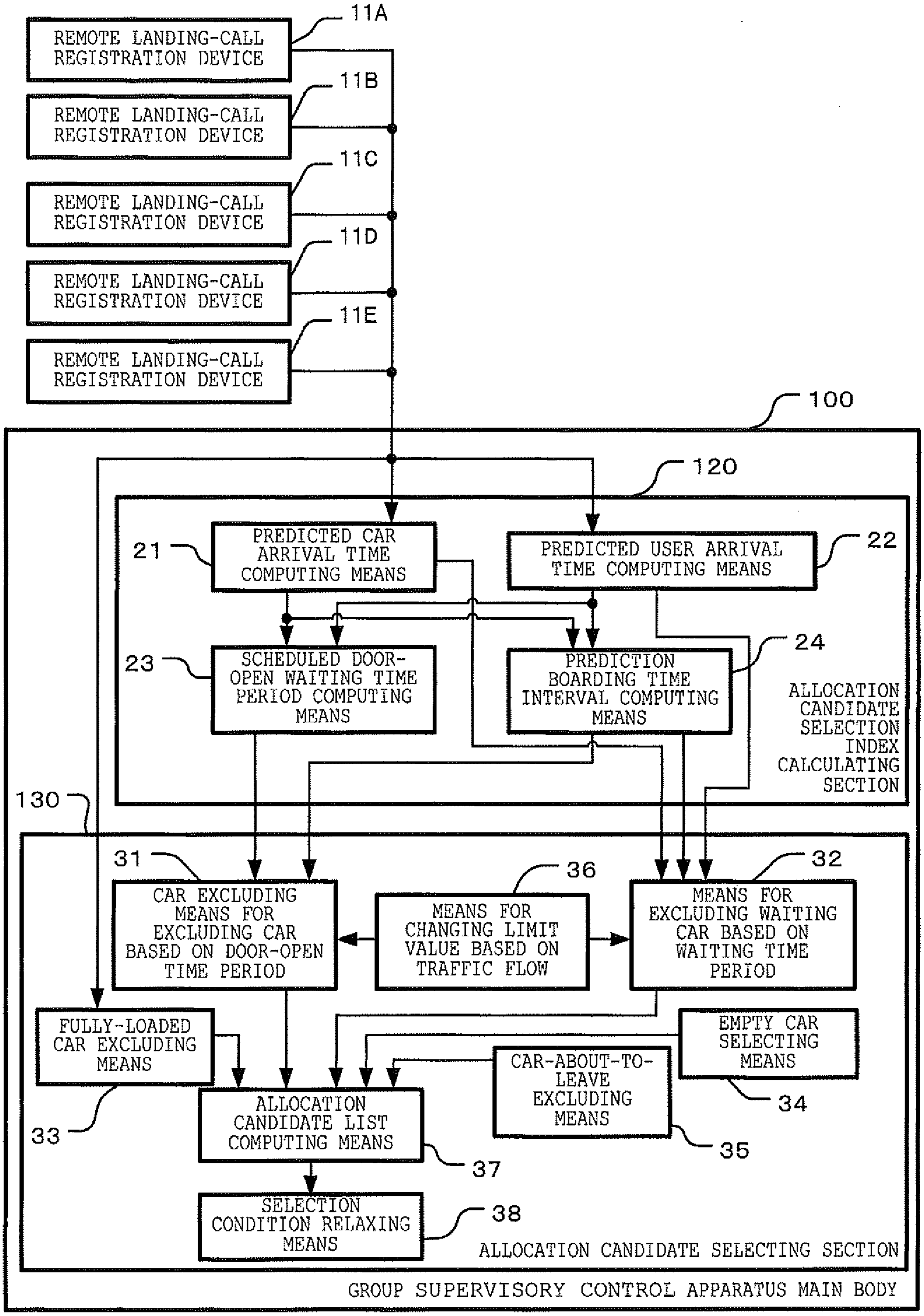

REMOTE LANDING-CALL REGISTRATION DEVICE
11A
REMOTE LANDING-CALL REGISTRATION DEVICE
11B
REMOTE LANDING-CALL REGISTRATION DEVICE
11C
REMOTE LANDING-CALL REGISTRATION DEVICE
11D
REMOTE LANDING-CALL REGISTRATION DEVICE
11E
100
120
21
PREDICTED CAR ARRIVAL TIME COMPUTING MEANS
PREDICTED USER ARRIVAL TIME COMPUTING MEANS
22
23
SCHEDULED DOOR-OPEN WAITING TIME PERIOD COMPUTING MEANS
PREDICTION BOARDING TIME INTERVAL COMPUTING MEANS
24
ALLOCATION CANDIDATE SELECTION INDEX CALCULATING SECTION
130
31
CAR EXCLUDING MEANS FOR EXCLUDING CAR BASED ON DOOR-OPEN TIME PERIOD
36
MEANS FOR CHANGING LIMIT VALUE BASED ON TRAFFIC FLOW
32
MEANS FOR EXCLUDING WAITING CAR BASED ON WAITING TIME PERIOD
FULLY-LOADED CAR EXCLUDING MEANS
33
EMPTY CAR SELECTING MEANS
34
CAR-ABOUT-TO-LEAVE EXCLUDING MEANS
35
ALLOCATION CANDIDATE LIST COMPUTING MEANS
37
SELECTION CONDITION RELAXING MEANS
38
ALLOCATION CANDIDATE SELECTING SECTION
GROUP SUPERVISORY CONTROL APPARATUS MAIN BODY

FIG.19

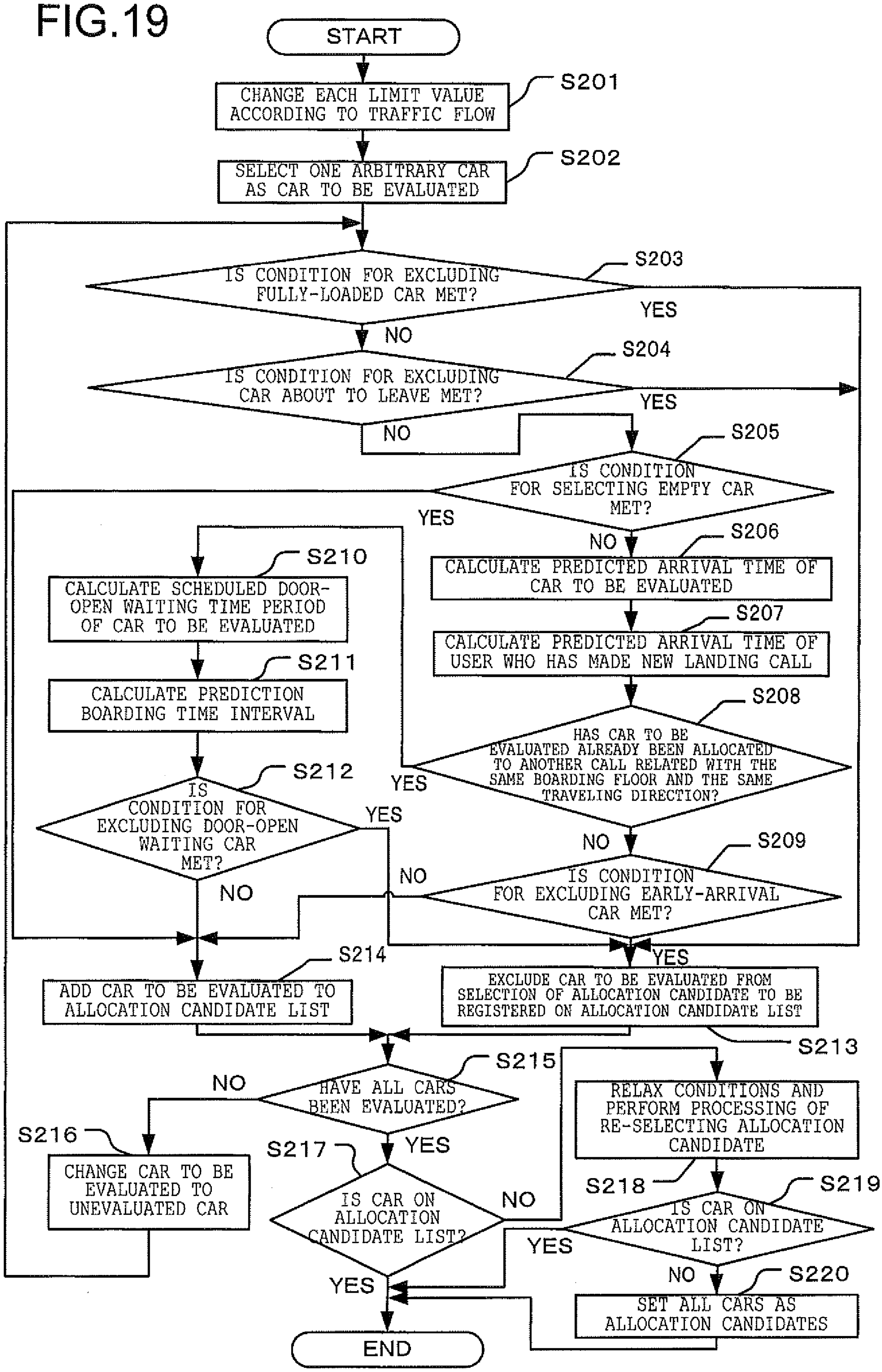

START
CHANGE EACH LIMIT VALUE ACCORDING TO TRAFFIC FLOW
S201
SELECT ONE ARBITRARY CAR AS CAR TO BE EVALUATED
S202
IS CONDITION FOR EXCLUDING FULLY-LOADED CAR MET?
S203
YES
NO
IS CONDITION FOR EXCLUDING CAR ABOUT TO LEAVE MET?
S204
YES
NO
IS CONDITION FOR SELECTING EMPTY CAR MET?
S205
YES
NO
CALCULATE PREDICTED ARRIVAL TIME OF CAR TO BE EVALUATED
S206
CALCULATE PREDICTED ARRIVAL TIME OF USER WHO HAS MADE NEW LANDING CALL
S207
HAS CAR TO BE EVALUATED ALREADY BEEN ALLOCATED TO ANOTHER CALL RELATED WITH THE SAME BOARDING FLOOR AND THE SAME TRAVELING DIRECTION?
S208
YES
NO
IS CONDITION FOR EXCLUDING EARLY-ARRIVAL CAR MET?
S209
NO
YES
CALCULATE SCHEDULED DOOR-OPEN WAITING TIME PERIOD OF CAR TO BE EVALUATED
S210
CALCULATE PREDICTION BOARDING TIME INTERVAL
S211
IS CONDITION FOR EXCLUDING DOOR-OPEN WAITING CAR MET?
S212
YES
NO
ADD CAR TO BE EVALUATED TO ALLOCATION CANDIDATE LIST
S214
EXCLUDE CAR TO BE EVALUATED FROM SELECTION OF ALLOCATION CANDIDATE TO BE REGISTERED ON ALLOCATION CANDIDATE LIST
S213
HAVE ALL CARS BEEN EVALUATED?
S215
NO
YES
CHANGE CAR TO BE EVALUATED TO UNEVALUATED CAR
S216
IS CAR ON ALLOCATION CANDIDATE LIST?
S217
NO
YES
RELAX CONDITIONS AND PERFORM PROCESSING OF RE-SELECTING ALLOCATION CANDIDATE
S218
IS CAR ON ALLOCATION CANDIDATE LIST?
S219
YES
NO
SET ALL CARS AS ALLOCATION CANDIDATES
S220
END

FIG.20

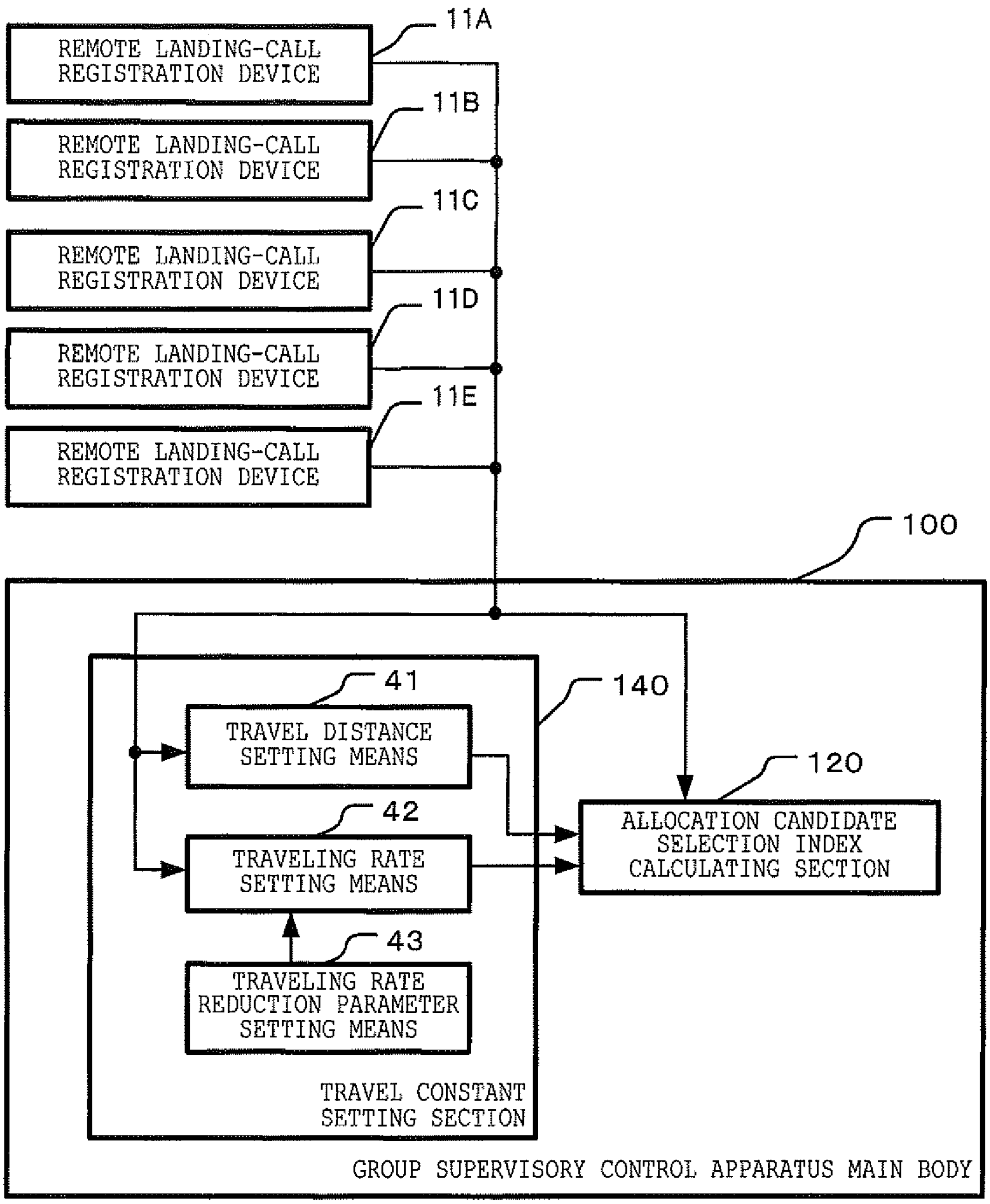

11A
REMOTE LANDING-CALL REGISTRATION DEVICE
11B
REMOTE LANDING-CALL REGISTRATION DEVICE
11C
REMOTE LANDING-CALL REGISTRATION DEVICE
11D
REMOTE LANDING-CALL REGISTRATION DEVICE
11E
REMOTE LANDING-CALL REGISTRATION DEVICE
100
41
TRAVEL DISTANCE SETTING MEANS
140
120
ALLOCATION CANDIDATE SELECTION INDEX CALCULATING SECTION
42
TRAVELING RATE SETTING MEANS
43
TRAVELING RATE REDUCTION PARAMETER SETTING MEANS
TRAVEL CONSTANT SETTING SECTION
GROUP SUPERVISORY CONTROL APPARATUS MAIN BODY

FIG.21

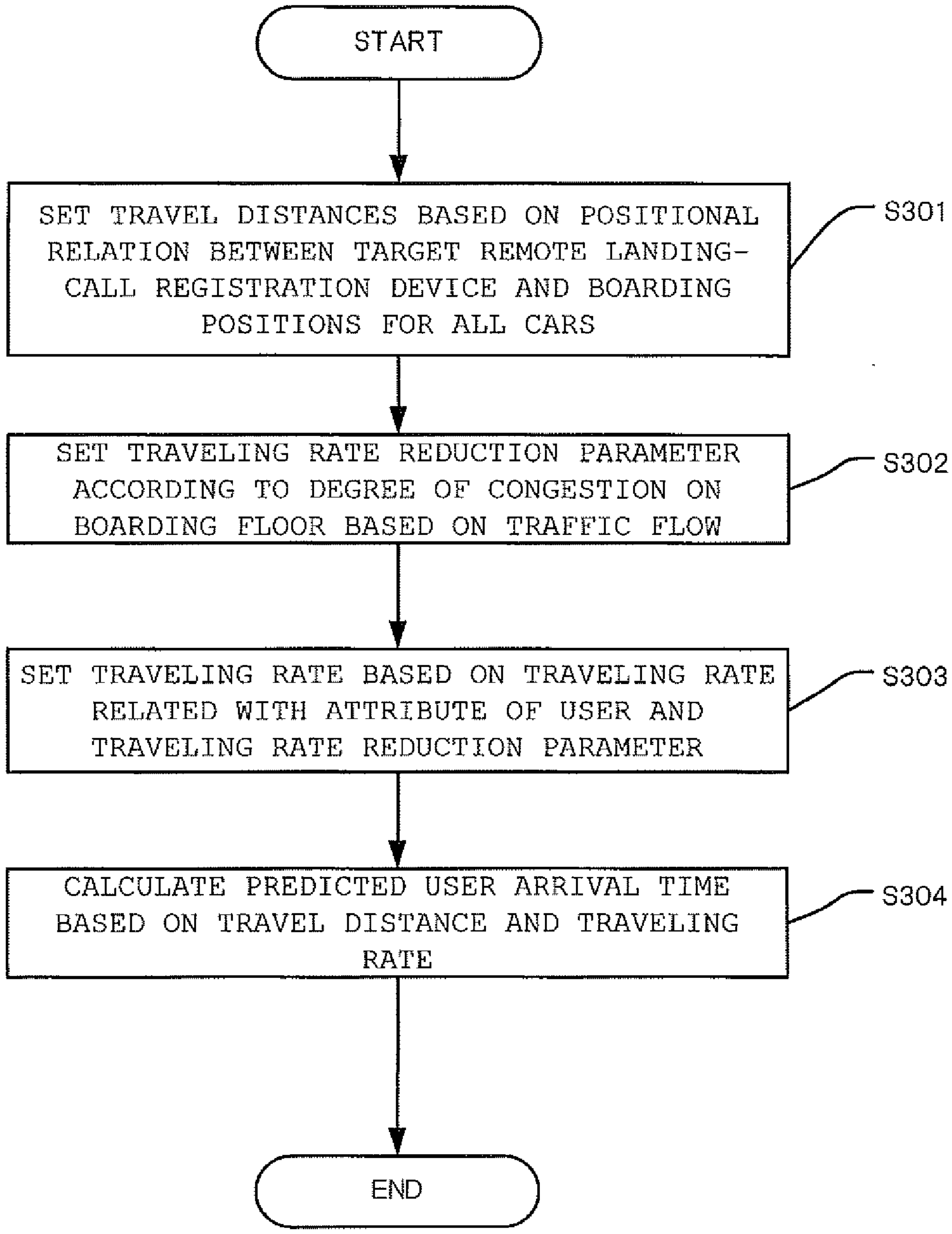

START
SET TRAVEL DISTANCES BASED ON POSITIONAL RELATION BETWEEN TARGET REMOTE LANDING-CALL REGISTRATION DEVICE AND BOARDING POSITIONS FOR ALL CARS
S301
SET TRAVELING RATE REDUCTION PARAMETER ACCORDING TO DEGREE OF CONGESTION ON BOARDING FLOOR BASED ON TRAFFIC FLOW
S302
SET TRAVELING RATE BASED ON TRAVELING RATE RELATED WITH ATTRIBUTE OF USER AND TRAVELING RATE REDUCTION PARAMETER
S303
CALCULATE PREDICTED USER ARRIVAL TIME BASED ON TRAVEL DISTANCE AND TRAVELING RATE
S304
END

FIG.22

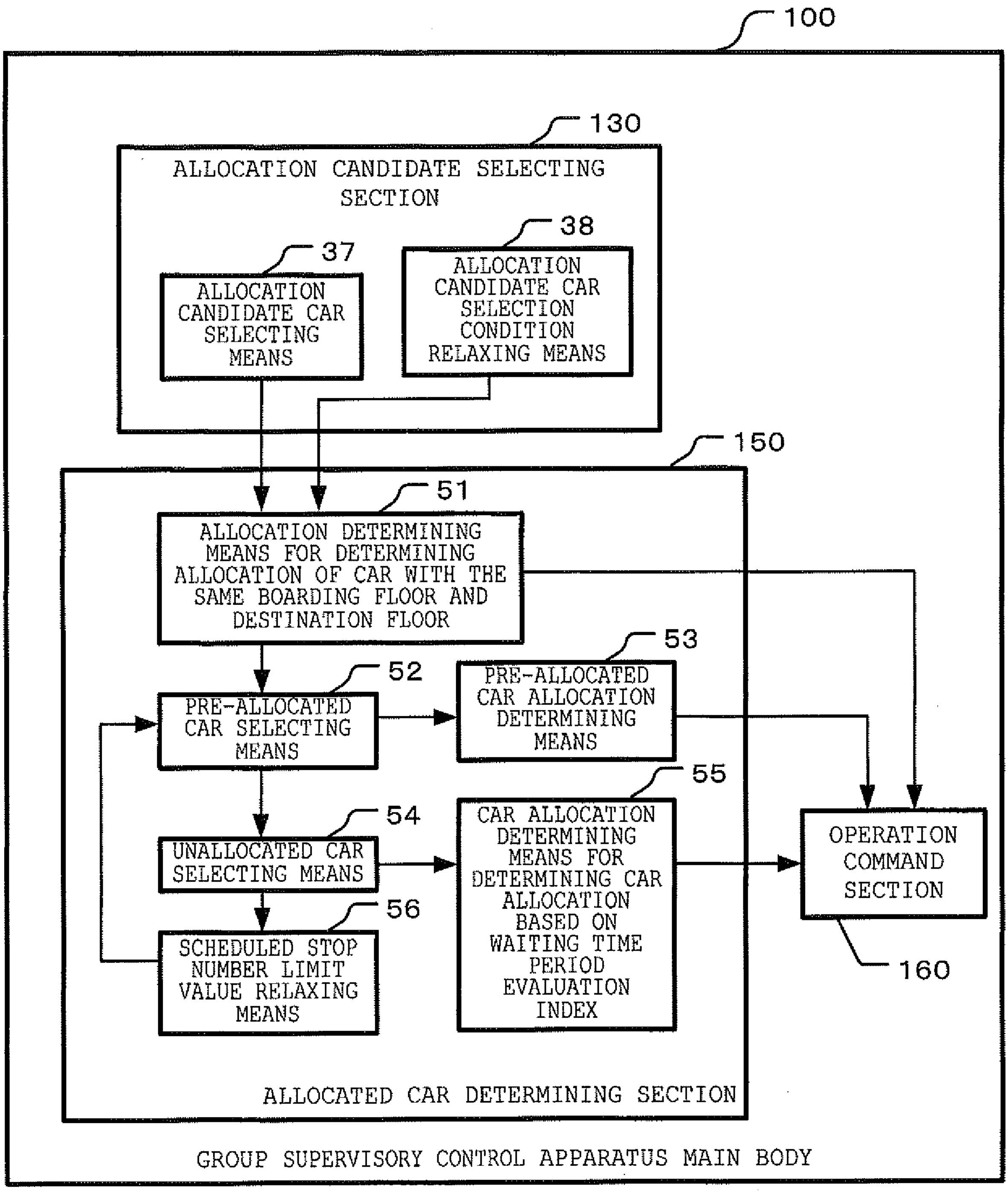
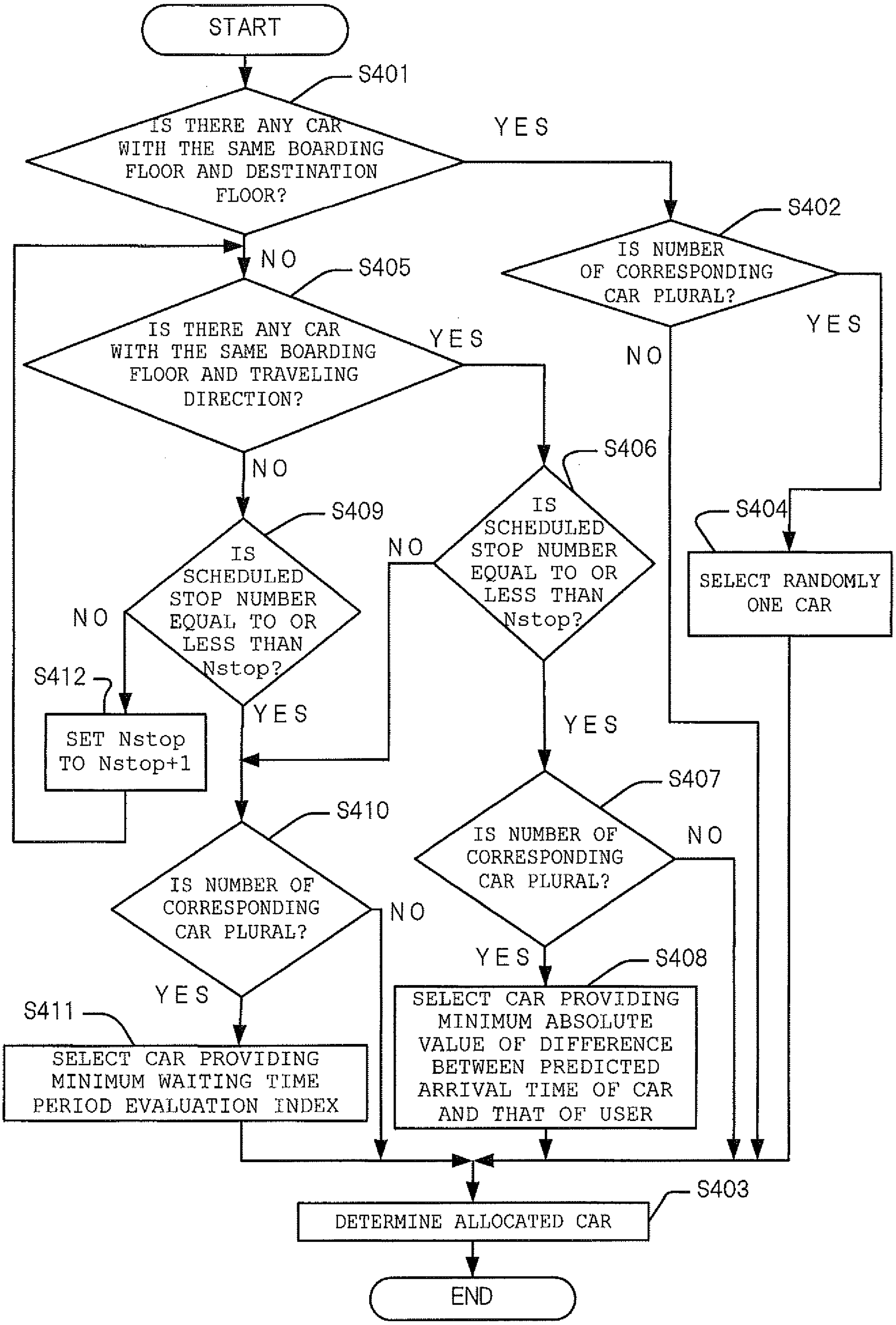

100
130
ALLOCATION CANDIDATE SELECTING SECTION
37
ALLOCATION CANDIDATE CAR SELECTING MEANS
38
ALLOCATION CANDIDATE CAR SELECTION CONDITION RELAXING MEANS
150
51
ALLOCATION DETERMINING MEANS FOR DETERMINING ALLOCATION OF CAR WITH THE SAME BOARDING FLOOR AND DESTINATION FLOOR
52
PRE-ALLOCATED CAR SELECTING MEANS
53
PRE-ALLOCATED CAR ALLOCATION DETERMINING MEANS
54
UNALLOCATED CAR SELECTING MEANS
55
CAR ALLOCATION DETERMINING MEANS FOR DETERMINING CAR ALLOCATION BASED ON WAITING TIME PERIOD EVALUATION INDEX
56
SCHEDULED STOP NUMBER LIMIT VALUE RELAXING MEANS
OPERATION COMMAND SECTION
160
ALLOCATED CAR DETERMINING SECTION
GROUP SUPERVISORY CONTROL APPARATUS MAIN BODY

FIG.23



START
S401
IS THERE ANY CAR WITH THE SAME BOARDING FLOOR AND DESTINATION FLOOR?
YES
NO
S402
IS NUMBER OF CORRESPONDING CAR PLURAL?
YES
NO
S405
IS THERE ANY CAR WITH THE SAME BOARDING FLOOR AND TRAVELING DIRECTION?
YES
NO
S406
IS SCHEDULED STOP NUMBER EQUAL TO OR LESS THAN Nstop?
NO
YES
S404
SELECT RANDOMLY ONE CAR
S409
IS SCHEDULED STOP NUMBER EQUAL TO OR LESS THAN Nstop?
NO
YES
S412
SET Nstop TO Nstop+1
S407
IS NUMBER OF CORRESPONDING CAR PLURAL?
NO
YES
S408
SELECT CAR PROVIDING MINIMUM ABSOLUTE VALUE OF DIFFERENCE BETWEEN PREDICTED ARRIVAL TIME OF CAR AND THAT OF USER
S410
IS NUMBER OF CORRESPONDING CAR PLURAL?
NO
YES
S411
SELECT CAR PROVIDING MINIMUM WAITING TIME PERIOD EVALUATION INDEX
S403
DETERMINE ALLOCATED CAR
END

FIG.24

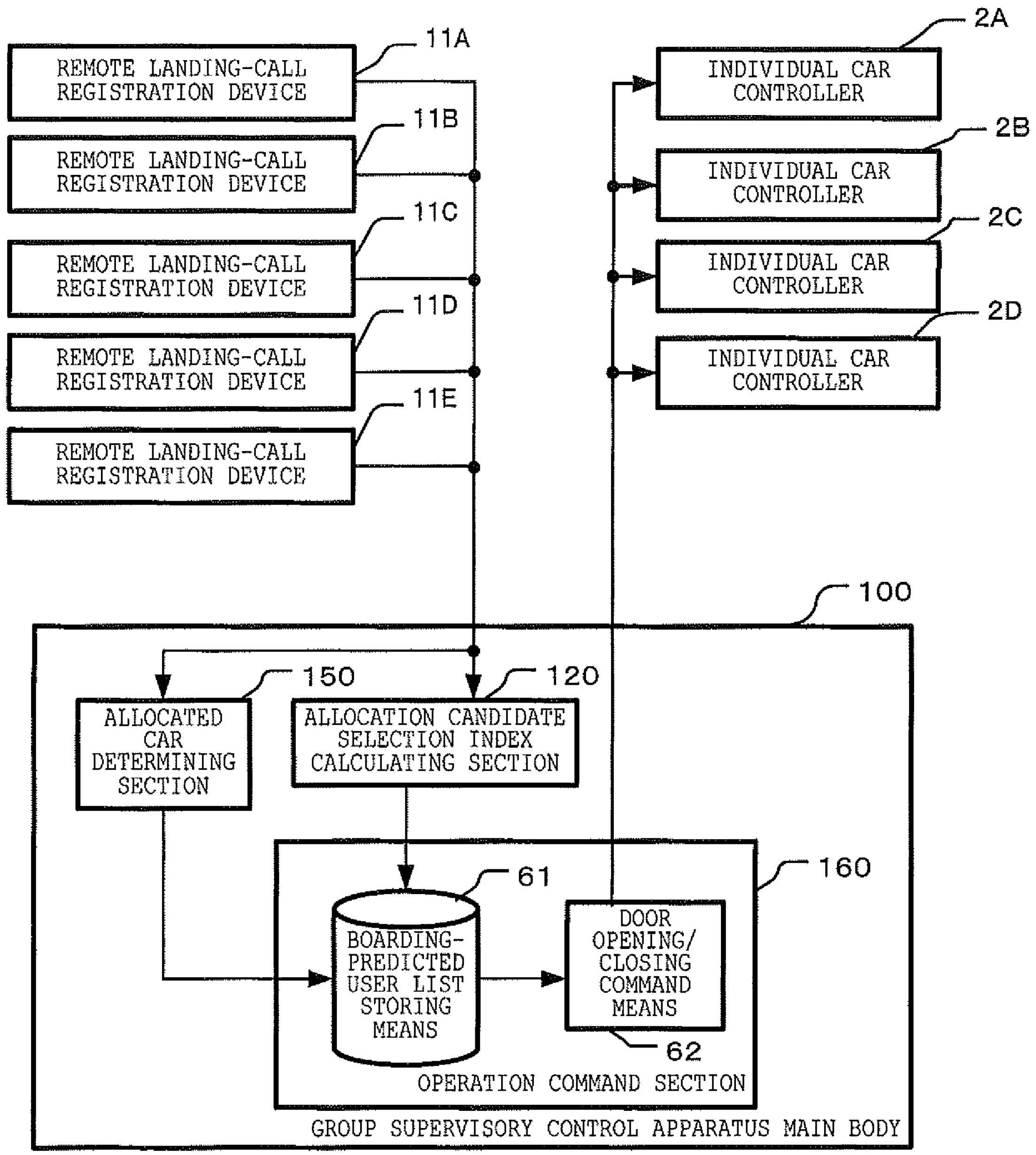
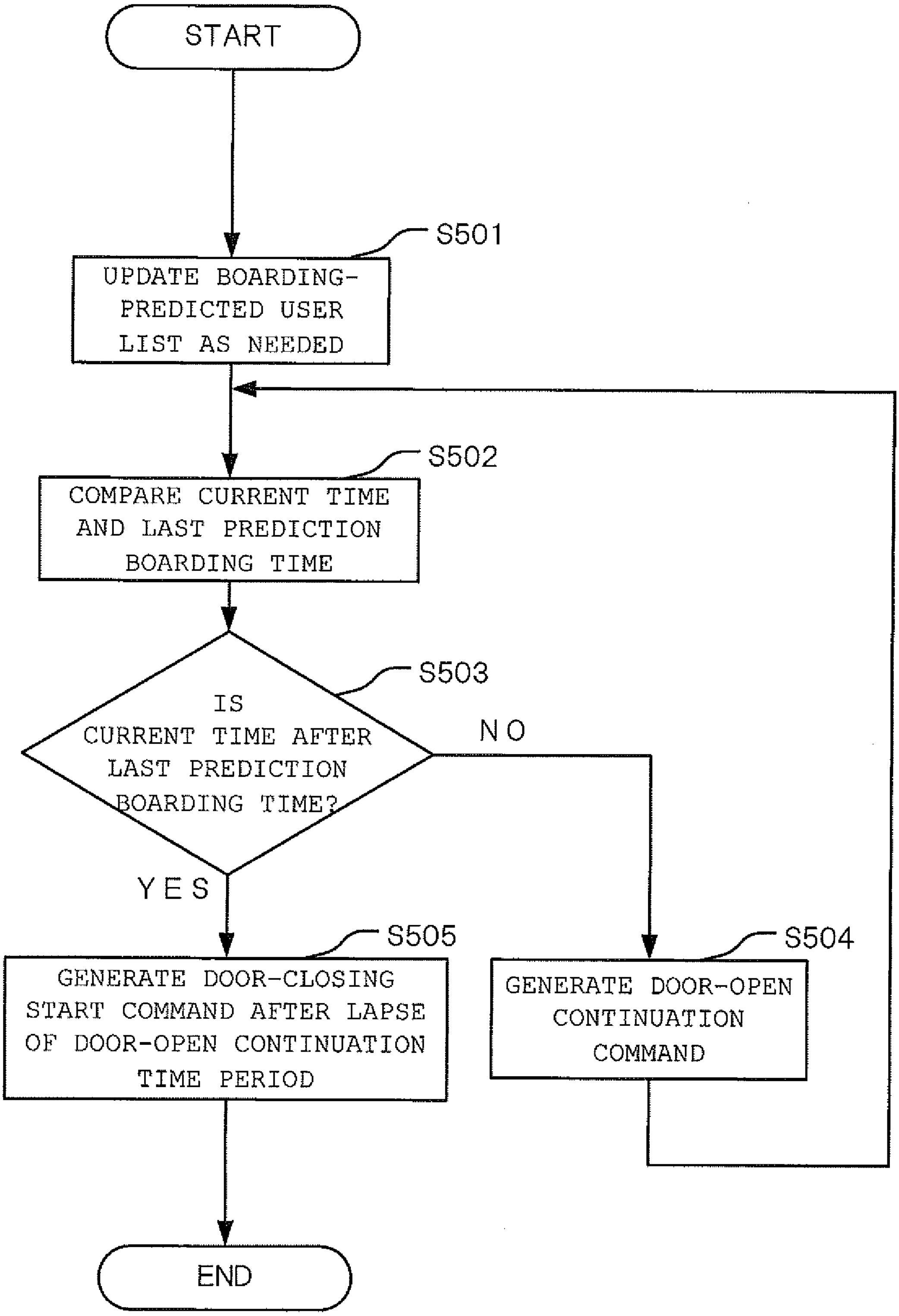

REMOTE LANDING-CALL REGISTRATION DEVICE
11A
REMOTE LANDING-CALL REGISTRATION DEVICE
11B
REMOTE LANDING-CALL REGISTRATION DEVICE
11C
REMOTE LANDING-CALL REGISTRATION DEVICE
11D
REMOTE LANDING-CALL REGISTRATION DEVICE
11E
INDIVIDUAL CAR CONTROLLER
2A
INDIVIDUAL CAR CONTROLLER
2B
INDIVIDUAL CAR CONTROLLER
2C
INDIVIDUAL CAR CONTROLLER
2D
100
ALLOCATED CAR DETERMINING SECTION
150
ALLOCATION CANDIDATE SELECTION INDEX CALCULATING SECTION
120
61
160
BOARDING-PREDICTED USER LIST STORING MEANS
DOOR OPENING/ CLOSING COMMAND MEANS
62
OPERATION COMMAND SECTION
GROUP SUPERVISORY CONTROL APPARATUS MAIN BODY

FIG.25


START
S501
UPDATE BOARDING-PREDICTED USER LIST AS NEEDED
S502
COMPARE CURRENT TIME AND LAST PREDICTION BOARDING TIME
S503
IS CURRENT TIME AFTER LAST PREDICTION BOARDING TIME?
NO
YES
S505
GENERATE DOOR-CLOSING START COMMAND AFTER LAPSE OF DOOR-OPEN CONTINUATION TIME PERIOD
S504
GENERATE DOOR-OPEN CONTINUATION COMMAND
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/056136

A. CLASSIFICATION OF SUBJECT MATTER
B66B1/18(2006.01)i, *B66B3/00*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B66B1/00-B66B3/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 07-223780 A (Hitachi, Ltd.), 22 August, 1995 (22.08.95), Par. Nos. [0007] to [0031]; Figs. 1 to 6 (Family: none)	1-2
A	JP 4-94384 A (Toshiba Corp.), 26 March, 1992 (26.03.92), Page 2, lower right column, line 17 to page 5, upper right column, line 17; Figs. 1 to 7 (Family: none)	1-2
A	JP 3040524 B2 (Inventio AG.), 15 May, 2000 (15.05.00), Par. Nos. [0007] to [0015]; Figs. 1 to 5 & US 5092431 A & EP 440967 A1	3

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
27 May, 2009 (27.05.09)	09 June, 2009 (09.06.09)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/056136

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2007/66390 A1 (Mitsubishi Electric Corp.), 14 June, 2007 (14.06.07), Par. Nos. [0009] to [0034]; Figs. 1 to 3 & US 2008/0196979 A1 & EP 1958908 A1	3
A	JP 3511167 B2 (Hitachi, Ltd.), 29 March, 2004 (29.03.04), Par. Nos. [0011] to [0022]; Figs. 1 to 5 (Family: none)	12
A	JP 2001-310877 A (Mitsubishi Electric Corp.), 06 November, 2001 (06.11.01), Par. Nos. [0024] to [0034]; Figs. 1 to 7 (Family: none)	15

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 2005112520 A **[0003]**