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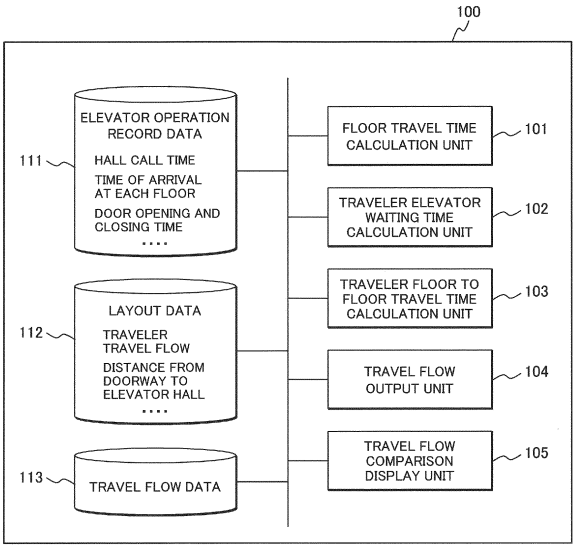
(54) TRAVELER TRAVEL CONDITION OUTPUT DEVICE AND METHOD

(57) It is difficult to evaluate how the time taken for travelers to move within a building changes depending on the elevator structure. Thus, a traveler travel condition output device (100) according to the present invention includes: a travel time calculation unit (101, 103) that obtains, for each user, a first travel time taken for the user to move from entering the building to arriving at the elevator hall, a waiting time in the elevator hall from when the user arrives at the elevator hall to when the user gets on an elevator, and a second travel time taken for the user to move from getting on the elevator to arriving at the destination floor, and collects the information of the first travel time, the waiting time, and the second travel time, to calculate the travel time statistical information of the user from entering the building to arriving at the destination floor; and a display unit (105) for displaying the travel times. The travel time calculation unit calculates travel time statistical information in a first elevator structure, as well as travel time statistical information in a second elevator structure. The display unit displays the travel time statistical information in the first elevator structure, together with the travel time statistical information in the second elevator structure.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a device and method for evaluating the traveler travel condition.

Background Art

[0002] The carrying capacity required for elevators increases with the increasing number of high-rise and large scale buildings. The carrying capacity can be maintained by increasing the number of elevators, while causing a compression of the floor area. For this reason, the elevator structure has become diverse, such as a multi-bank system designed to operate elevators by classifying destinations into a plurality of groups such as lower floors and higher floors, a sky-lobby system designed to change elevators at middle floors by using shuttle elevators, and a combination of the sky-lobby system and the multi-bank system. From the perspective of travelers using increasingly diverse elevators, it is important that each traveler can smoothly move from the building entrance until arriving at the destination.

[0003] Patent Literature 1 discloses a technique that simulates the flow of people horizontally and vertically in a consistent manner within a building, by combining a floor travel flow simulator that simulates the movement of people within the floor, an elevator movement simulator that simulates the movement of elevators, and an elevator boarding simulator that simulates the boarding of travelers onto elevators, and then displays the flow of people within the floor as well as the elevator operation condition.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Patent Application Laid-Open No. 2009-096612

Summary of Invention

Technical Problem

[0005] However, the technique described in Patent Literature 1 does not take into account the change in the elevator structure. The time when travelers move within the building may be affected by the elevator structure and possibly vary depending on the elevator structure. However, it is difficult to evaluate this point by the technique described in Patent Literature 1.

Solution to Problem

[0006] To achieve the above object, a traveler travel condition output device according to the present invention includes: a travel time calculation unit that obtains a first travel time for each user from when the user enters the building to when the user arrives at the elevator hall, a waiting time in the elevator hall from when the user arrives at the elevator hall to when the user gets on an elevator, and a second travel time taken for the user to move from getting on the elevator to arriving at the destination floor, and collects the information of the first travel time, the waiting time, and the second travel time to calculate the travel time statistical information of the user from entering the building to arriving at the destination floor; and a display unit for displaying the travel times. The travel time calculation unit calculates travel time statistical information in a first elevator structure, as well as the travel time statistical information in a second elevator structure. The display unit displays the travel time statistical information in the first elevator structure, together with the travel time statistical information in the second elevator structure.

Advantageous Effects of Invention

[0007] According to the present invention, it is possible to evaluate how the time when travelers move within the building changes depending on the elevator structure.

Brief Description of Drawings

[0008]

Figure 1 is an example diagram showing the structure of a traveler travel condition output device in Example 1.

Figure 2 is an example diagram showing the method of calculating the average travel time of inter-floor movement in Example 1.

Figure 3 is an example diagram showing the outline of the process flow of the traveler travel condition output device in Example 1.

Figure 4 is a diagram showing an example of the elevator operation record data in Example 1.

Figure 5 is a diagram showing an example of the temporary data of waiting time calculation in Example 1.

Figure 6 is a diagram showing an example of the temporary data of floor to floor travel time calculation in Example 1.

Figure 7 is a diagram showing an example of the data in a multi-bank system as traveler travel line data in Example 1.

Figure 8 is a diagram showing an example of the data in a sky-lobby system as traveler travel line data in Example 3.

Figure 9 is a diagram showing an example of the travel flow of travelers moving from the entrance to each floor in Example 1.

Figure 10 is a diagram showing an example of the travel flow of travelers moving from the building en-

trance to each floor in Example 1.
Figure 11 is a diagram showing an example of the travel flow of travelers moving from the building entrance to each floor in Example 1.
Figure 12 is a diagram showing an example of the operation record data of destination floor reservation elevator in Example 2.
Figure 13 is a diagram showing an example of the travel flow of travelers moving from each floor to the building entrance in Example 1.
Figure 14 is a diagram showing an example of the data of floor to floor travel of travelers calculated by the traveler travel condition output device in Example 1.
Figure 15 is a diagram showing an example of the data of elevator waiting time of travelers calculated by the traveler travel condition output device in Example 1.
Figure 16 is a diagram that compares the every-floor stop operation with the direct operation in the elevator moving between floors in Example 1.
Figure 17 is a diagram showing the formula for calculating the floor to floor travel time by the traveler travel condition output device in Example 1.
Figure 18 is a diagram showing an example of the comparison of a plurality of travel flows in Example 1.
Figure 19 is a diagram showing an example of the travel flow of travelers moving from the building entrance to each floor in a building using the sky-lobby system in Example 3.

Description of Embodiments

[0009] Examples of the present invention will be described in detail below with reference to drawings.

<Example 1>

[0010] An example of a traveler travel condition output device and method according to the present invention will be described below with reference to drawings.

<Device configuration>

[0011] Figure 1 is a diagram showing an example of the configuration of a traveler travel condition output device. The configuration of a traveler travel condition output device will be described with reference to Figure 1. A traveler travel condition output device 100 includes elevator operation record data 111 and layout data 112. Further, the traveler travel condition output device 100 also includes: a floor travel time calculation unit 101 that receives the layout data and calculates the travel time from each elevator hall to an arbitrary point within the floor including the doorway, based on the distance information that can be read from the building layout; a traveler elevator waiting time calculation unit 102 that receives the elevator operation record data 111 and calculates the statistic index value of the traveler elevator waiting time; a traveler floor to floor travel time calculation unit 103 that receives the elevator operation record data 111 and calculates the statistic index value of the traveler floor to floor travel time; a travel flow output unit 104 that receives the travel time from each elevator hall to an arbitrary point within the floor that is calculated by the floor travel time calculation unit 101, the statistic index value of the traveler elevator waiting time that is calculated by the traveler elevator waiting time calculation unit 102, and the statistic index value of the traveler floor to floor travel time that is calculated by the traveler floor to floor travel time calculation unit 103, a travel flow of travelers read by the layout data 112, and outputs a travel flow showing the statistic index value of the travel time at each point in the building, into travel line data 113; and a travel flow comparison display unit 105 that receives one or more travel flows from the travel line data 113, and comparatively displays and outputs the travel flows by overlaying them on each other.

[0012] The description of the configuration of the traveler travel condition output device with reference to Figure 1 ends here.

<Description of data>

[0013] Next, characteristic data in this example will be described with reference to Figures 4, 5, 6, and 7.

[0014] Figure 4 shows an example of the elevator operation record data 111. A column 401 represents the time when an elevator-related state change occurs. A column 402 represents the target car number only when a specific elevator car number is targeted. A column 403 represents the changed elevator state. A column 404 represents the vertical travel direction of a target car number only when the target car number is placed in the column 402. A column 405 represents the position (floor) of a target car number when the target car number is placed in the column 402, or otherwise representing the position (floor) at which an event of state change occurred. A column 406 represents the estimated value of the number of travelers of a target car number only when the target car number is placed in the column 402. It is assumed that the elevator operation record data are recorded in ascending order of the time in the column 401.

[0015] A record 411 shows that a call button for going upwards is pressed in the elevator hall on the first floor at time 8:49:04. A record 412 shows that the No. 1 car will move upwards at 8:49:35 while opening the door on the first floor, and at this time, the number of travelers is 0. A record 413 shows that the No. 1 car will move upwards at time 8:49:45 while closing the door on the first floor, and at this time, the number of travelers is 4.

[0016] Figure 5 shows intermediate data when the elevator waiting time and the number of waiting travelers are calculated by the traveler elevator waiting time calculation unit 102 from the elevator operation record data 111. A column 501 represents the floor on which the el-

evator waiting time is calculated, a column 502 represents the waiting time, a column 503 represents the elevator traveling direction, and a column 504 represents the number of waiting travelers. It is assumed that the waiting time is the time from when the call button of the direction to move is pressed in the elevator hall to when the elevator traveling in the same direction as the pressed button first opens the door. This waiting time is the waiting time of the traveler who first arrives at the elevator hall, which could be the maximum value of the waiting time. Here, the average of the waiting time can be halved on the assumption that travelers arrive at uniform intervals. Further, it is assumed that the number of waiting travelers is the difference between the number of travelers at the time when the elevator opens the door and the number of travelers at the time when the elevator closes the door.

[0017] Figure 5 outputs the waiting time and the number of waiting travelers as intermediate data used in calculating the traveler elevator waiting time, for each call of elevator and each arrival and departure of the elevator corresponding to the call, in the traveler elevator waiting time calculation unit 102.

[0018] The calculation method of each record in Figure 5 will be described with reference to Figure 4. In a record 511, a waiting time of 31 seconds is calculated, based on the elevator operation record data 111 in Figure 4, from the time between when the elevator call button is pressed at the time of the record 411 and when the No. 1 elevator car arrives and opens the door at the time of the record 412. Further, the number of waiting travelers is calculated to be 4 from the difference between the number of travelers at the time of door opening in the record 412 and the number of travelers at the time of door closing in the record 413.

[0019] In a record 512, a waiting time of 17 seconds is calculated, based on the elevator operation record data 111 in Figure 4, from the time between when the elevator call button is pressed at the time of a record 414 and when a No. 2 elevator car arrives and opens the door at the time of a record 417. Further, the number of waiting travelers is calculated to be 2 from the difference between the number of travelers at the time of door opening in the record 417 and the number of travelers at the time of door closing in a record 419.

[0020] Figure 15 shows an example of the data of traveler elevator waiting time that is calculated and output by the traveler elevator waiting time calculation unit 102. This data is calculated from the temporary data in Figure 5. The statistic index value of the waiting time is recorded for each elevator bank and each stop floor. Here, assuming that the statistic index value is an average, 1501 shows that the average waiting time is 43 seconds on the first floor when using a lower floor bank, and 1502 shows that the average waiting time is 40 seconds on the first floor when using a higher floor bank.

[0021] Figure 14 shows an example of the data of traveler floor to floor travel time that is calculated and output by the traveler floor to floor travel time calculation unit 103. This data is calculated from the temporary data shown in Figure 6. The statistic index value of the floor to floor travel time from a reference floor to each stop floor is recorded for each elevator bank. Here, assuming that the reference floor is the first floor and the statistic index value is the average, 1401 shows that the average travel time from the first floor to the second floor in the lower floor bank is 16 seconds. 1402 shows that the average travel time from the first floor to the third floor by using the elevator in the lower floor bank is 31 seconds. 1403 shows that the average travel time from the first floor to the seventh floor by using the elevator in the higher floor bank is 39 seconds. 1404 shows that the average travel time from the first floor to the eighth floor by using the elevator in the higher floor bank is 54 seconds. Here, the travel time from the first floor to the second floor and from the first floor to the third floor does not linearly increase because the travel time changes in the case of traveling from the first floor to the third floor, between when traveling directly to the third floor from the first floor without stopping on the second floor and when traveling to the third floor after stopping at the second floor depending on travelers on the same elevator, due to the stopping time on the second floor, the acceleration and deceleration time for stopping at the second floor, and the like. The calculation method of the travel time in the traveler floor to floor travel time calculation unit 103 will be described in detail below.

[0022] Figure 6 shows the data obtained by calculating the number of travelers getting on the floor to floor elevator and travelling between floors as well as the travel time, as intermediate data used to calculate the traveler floor to floor travel time, in the traveler floor to floor travel time calculation unit 103 from the elevator operation record data 111. A column 601 shows the departure floor of floor to floor travel, a column 602 shows the arrival floor of floor to floor travel, a column 603 shows the time taken for each traveler to travel between floors by using the elevator, and a column 604 shows the number of travelers traveled. The floor to floor travel time may also include the door opening/closing time and the standby time in the elevator, in addition to the elevator operation time.

[0023] Further, it is assumed that the number of travelers is the number of travelers when the door opens on the departure floor or the number of travelers when the door closes on the arrival floor.

[0024] The calculation method of each record in Figure 6 will be described with reference to Figure 4.

In a record 611, an operation time of 10 seconds is calculated, based on the elevator operation record data 111 in Figure 4, from the time between when the No. 1 car closes the door and starts from the first floor at the time of the record 413 and when the No. 1 car arrives at the second floor and closes the door at the time of a record 415. At this time, the number of travelers is 4.

[0025] In a record 612, an operation time of 15 seconds is calculated, based on the elevator operation record data

111 in Figure 4, from the time between when the No. 1 car closes the door and starts from the second floor at the time of a record 416 and when the No. 1 car arrives at the fourth floor and opens the door at the time of a record 418. At this time, the number of travelers is 1.

[0026] In a record 613, an operation time of 20 seconds is calculated, based on the elevator operation record data 111 in Figure 4, from the time between when the No. 2 car closes the door and starts from the first floor at the time of the record 419 and when arriving at the fourth floor and opening the door at the time of the record 412. At this time, the number of travelers is 2.

[0027] In a record 614, an operation time of 20 seconds is calculated, based on the elevator operation record data 111 in Figure 4, from the time between when the No. 1 car closes the door and starts from the fourth floor at the time of a record 420 and when arriving at the first floor and opening the door at the time of a record 423. At this time, the number of travelers is 0.

[0028] Figure 7 is a diagram showing an example of the traveler travel line data. The travel line data is the data showing the connection relationship in the travel network in the building, such as between the elevator hall and the building entrance or office entrance. Figure 7 shows the traveler travel line data in a multi-bank system building, showing that travelers can directly move from the first-floor entrance of the building to the lower floor bank and the higher floor bank. Here, only the entrance and the elevator banks are selected as targets for the travel line. However, it is also possible to select various facilities and equipment as targets, such as restaurants, observation rooms, shops, restrooms, and smoking rooms located in the building. The explicit input may be omitted, without inputting the data as shown in Figure 7, by taking into account the travel line in the processing unit or the like.

[0029] The description of the data ends here.

<Description of the processing unit>

[0030] The method of calculating the statistic index value of traveler floor to floor travel will be described with reference to Figure 2.

[0031] As described with reference to Figure 14, the floor to floor travel time by elevator greatly varies depending on stops at intermediate floors. Figure 16 shows a graph comparing the operation time between the case of direct operation from the first floor to the third floor and the case of stopping at the second floor, in which the change in the operation time due to stop at the intermediate floor is described. A vertical axis 1602 of the graph represents the position in the height direction as well as the floor number, and a horizontal axis 1601 represents the time. When starting from the first floor at time of 1603 to travel to the third floor in direct operation, the elevator arrives at the third floor at the time of 1604. On the other hand, when the elevator stops at the second floor, it takes time in the respective periods of deceleration for stopping at the second floor, stopping time at the second floor, and acceleration for going from the second floor to the third floor. It can be found that the presence or absence of the elevator stopping at intermediate floors depends on the destination of other travelers on the same elevator, and that the traveler travel time also varies depending on the number of stops at intermediate floors. The description of the change in the operation time due to elevator stop at intermediate floors ends here.

[0032] When considering the average travel time of floor to floor travel, it is necessary to take into account the number of stops at intermediate floors. Thus, the processing unit is designed to establish operation patterns showing combinations of intermediate stop floors at which the elevator stops just before stopping at the arrival floor, and express the travel time of each operation pattern as the sum of the average travel time in the case of direct operation from the intermediate stop floor to the destination floor, and the average travel time from the departure floor to the intermediate stop floor, to obtain the average travel time from the departure floor to the destination floor by the weighted average of the number of travelers from the intermediate stop floor to the destination floor.

[0033] As an example, Figure 2 shows an operation pattern from the first floor to the third floor as well as an operation pattern from the first floor to the fourth floor. The movement indicated by the solid arrow shows direct operation and the movement indicated by the dashed arrow shows that the elevator can stop at intermediate floors.

[0034] As described above, there are two patterns in the operation from the first floor to the third floor. The average travel time from the first floor to the third floor is obtained by the weighted average of the number of users with respect to the travel time of each operation pattern. A more specific calculation method of the average travel time from the first floor to the third floor is as follows. That is, the average travel time from the first floor to the third floor in a movement 214, as well as the sum of the average travel time of a movement 223 from the first floor to the second floor and the average travel time of a movement 215 from the second floor to the third floor are weight-averaged by the number of travelers arriving at the third floor in each movement.

[0035] Similarly, there are three patterns in the operation from the first floor to the fourth floor. The average travel time from the first floor to the fourth floor is calculated by the weighted average of the number of users with respect to the travel time in each operation pattern. A more specific calculation method of the average travel time from the first floor to the fourth floor is as follows. That is, the average travel time from the first floor to the fourth floor, the sum of the average travel time of a movement 221 from the first floor to the second floor and the average travel time of a movement 212 from the second floor to the fourth floor, and the sum of the average travel time of a movement 222 from the first floor to the third

floor and the average time of a movement 213 from the third floor to the fourth floor are weight-averaged by the number of travelers arriving at the fourth floor in each movement.

[0036] As a prerequisite for the calculation of the average travel time, it is assumed that the travel time in each floor is independent unless the floors between which the elevator moves overlap such as from the first floor to the third floor and from the third floor to the fifth floor. Based on this assumption, it is possible to calculate the average travel time from the departure floor to the arrival floor by adding the average travel time from the departure floor to an intermediate stop floor and the average travel time from the intermediate stop floor to the arrival floor. Further, assuming that the travel time in each floor is independent, not only average but also dispersion can be obtained by the same procedure. Note that it is possible to obtain the average travel time from the departure floor to the intermediate stop floor, which is necessary for the calculation assumption, by recursively calculating the average travel time from the departure floor to the arrival floor (the intermediate stop floor) with the intermediate stop floor as the destination floor, or by sequentially calculating the average travel time by defining the calculation order in which each floor nearest the reference floor is defined as arrival floor.

[0037] This calculation method is shown in Figure 17 as recurrence formula.

[0038] Figure 3 is a diagram showing the outline of the process and data flow with respect to an example of the traveler travel condition output device according to the present invention. The process and data flow will be described with reference to Figure 3.

[0039] The floor travel time calculation unit 101 reads a distance 302 from the doorway to the elevator hall from the layout data 111, calculates a floor travel time 303 from the average human walking speed previously set as the distance (for example, 4 km/h), and outputs the result to the travel flow output unit 104.

[0040] The traveler elevator waiting time calculation unit 102 reads the elevator operation record data 112, calculates a traveler elevator waiting time 304 through conversion to the intermediate data shown in Figure 5, and outputs the result to the travel flow output unit 104.

[0041] The traveler floor to floor travel time calculation unit 103 reads the elevator operation record data 112, calculates a traveler floor to floor travel time 305 through conversion to the intermediate data shown in Figure 6, and outputs the result to the travel flow output unit 104.

[0042] The travel flow output unit 104 receives the floor travel time 303 output from the floor travel time calculation unit 101, the traveler elevator waiting time 304 output from the traveler elevator waiting time calculation unit 102, and the traveler floor to floor travel time 305 output from the traveler floor to floor travel time calculation unit 103, and arranges the input data into a building travel time table which is intermediate data shown in Figure 14. The travel flow output unit 104 further draws a travel flow 306 from the building travel time table and outputs the result to the travel line data 113.

[0043] In other words, the travel time calculation section (the floor travel time calculation unit 101, the elevator waiting time calculation unit 102, and the floor to floor travel time calculation unit 103) of the traveler travel condition output device 100 obtains, for each user, a first travel time taken for the user to move from entering the building to arriving at the elevator hall (floor transfer time), a waiting time in the elevator hall from when the user arrives at the elevator hall to when the user gets on an elevator (traveler elevator waiting time), and a second travel time taken for the user to move from getting on the elevator to arriving at the destination floor (traveler floor to floor travel time), and collecting the information of the first travel time, the waiting time, and the second travel time to calculate the travel time statistical information of the user from entering the building to arriving at the destination floor. The display unit (travel flow comparison display unit 105) displays the total travel time. The travel time calculation unit calculates the travel time statistical information in the first elevator structure as well as the travel time statistical information in the second elevator structure. The display unit displays the travel time statistical information in the first elevator structure, together with the travel time statistical information in the second elevator structure.

[0044] Further, the travel time calculation section may calculates the maximum value, average, or dispersion of the time obtained by summing up the information of the first travel time, waiting time, and second travel time of the user, as the travel time statistical information.

[0045] Further, the first elevator structure may mean that the elevator directly goes from the reference floor to the destination floor, and the second elevator structure may mean that the elevator stops at intermediate floors, in addition to the destination floor, in the operation of going from the reference floor to the destination floor (an example will be described below with reference to Figure 10).

[0046] Further, the travel time calculation section may also calculate the average of the time taken for travelers to move from a reference floor to a destination floor, by obtaining a weighted average of the travel time from the reference floor to the destination floor, by dividing the sum of the value weighted by multiplying the elevator operation time when the elevator directly goes from the reference floor to the destination floor with the number of users, and the value weighted by multiplying the travel time when the elevator stops at intermediate floors in the operation of going from the reference floor to the destination floor with the number of users moving through each floor, by the total number of users directly going from each intermediate floor and the reference floor to the destination floor.

[0047] Further, the display unit may display the travel flows showing the traveler elevator waiting time, the elevator floor to floor travel time, and the door opening time

at each floor, by changing one or both of color and line type so that the displayed travel flows can be identified by type.

[0048] Further, the second elevator structure may be defined such that any one or more of the following elements are changed with respect to the first elevator structure: the elevator layout, the number of elevators, the layout specification, and the traveler travel demand.

[0049] Further, the display unit may set one or more reference values in advance for the required time to transfer between any two points and states, check the required time of the travel flow against the reference value, and display the travel flow by changing one or both of color and line type.

[0050] Further, in the travel time calculation section, the second travel time is calculated based on the operation record data obtained from an operation management system (not shown). The operation record data may use one or both of the record data of physical operation of the elevator and the past record data of virtual operation such as computer simulation of the elevator (which will be described in detail below in Example 2).

[0051] Further, the first elevator structure and the second elevator structure include either the building using the sky-lobby system in which travelers are expected to move by changing elevators, or the multi-bank system in which the elevator bank to be used varies depending on the destination floor (which will be described in detail below in Example 3).

[0052] The description of the process and data flow ends here.

<Output and effects>

[0053] The travel flow 306 output by the travel flow output unit 104 will be described with reference to Figures 9, 10, 11, and 13.

[0054] The graph in Figure 9 is a travel flow showing the movement from the building entrance to an office entrance which can be the movement destination in each floor. A vertical axis 951 represents the position (floor) in the height direction, and the horizontal axis represents the travel time from the building entrance in which the building entrance is defined as 0. The time of the travel flow is assumed to be the statistic index value such as the average and maximum value of the travel time of each individual traveler.

[0055] In the case of moving to lower floors, 901 represents the building entrance. After departure from the building entrance, 902 represents arrival at the elevator hall for lower floors. The time between 901 and 902 represents the travel time from the building entrance to the lower-floor elevator hall, which is drawn by using the floor travel time 303 calculated by the floor travel time calculation unit 101. Travelers wait for elevator arrival at the elevator hall, and 903 represents elevator arrival. Here, the period from 902 to 903 represents the time from when the travelers arrived at the lower-floor elevator hall to when the elevator arrived, which is drawn by using the traveler elevator waiting time 304 calculated by the traveler elevator waiting time calculation unit 102. When the elevator arrived at 903, the travelers get on the elevator and 904 represents elevator departure. The elevator starts at 904. 905 represents elevator arrival at the second floor and 906 represents elevator departure after travelers get on and off the elevator at the second floor. Similarly, with respect to the subsequent stop floors, 907 to 914 represent departure and arrival, sequentially, at each floor until the elevator arrives at the highest floor. The line showing the departure and arrival is drawn by using the traveler floor to floor travel time 305 calculated by the traveler floor to floor travel time calculation unit 103. Further, it is also shown that, after the elevator stops at each floor, each traveler getting off the elevator arrives at the destination on the floor. In the case of the second floor, the traveler gets off the elevator between 905 and 906, and 915 represents that the traveler's arrival at the destination on the second floor. The destination arrival is represented by 916. Similarly, 917 to 919 represent destination arrival on each floor. The line from the elevator stop to the destination arrival on each floor is calculated using the floor travel time 303 calculated by the floor travel time calculation unit 101.

[0056] In the case of moving to higher floors, 921 represents arrival at the elevator hall for higher floors. Here, the travel flow line is slightly displaced in the vertical axis direction so as not to overlap the lower-floor travel flow. However, the higher-floor travel flow can also be displayed overlapping the lower-floor travel flow. Travelers wait for elevator arrival at the elevator hall, and 922 represents elevator arrival. When the elevator arrived at 922, the travelers get on the elevator and 923 represents elevator departure. The elevator starts at 923. 924 represents elevator arrival at the seventh floor, and 925 represents elevator departure after travelers get on and off the elevator at the seventh floor. Similarly, with respect to the subsequent stop floors, 926 to 931 represent departure and arrival, sequentially, at each floor until the elevator arrives at the highest floor. Similar to the case of the lower floors, it is also shown that, after the elevator stops at each floor, each traveler getting off the elevator arrives at the destination on the floor, and 932 to 935 represent destination arrival on each floor. It may also be possible to represent the destination floor arrival or the destination arrival on each floor by connecting each point with a line, without discriminating between lower floors and higher floors.

[0057] Figure 10 is a diagram of a simplified representation of the travel flow shown in Figure 9, which shows only the arrival time at each floor. This can only show the time when travelers can arrive at each floor, excluding detailed information. In the comparison of travel flows or the like described below, the comparison may be easier when detailed information is removed.

[0058] Figure 11 is a diagram in which information of the magnitude of the number of moving travelers is added

to the travel flow shown in Figure 9. The line segment thickness is changed according to the number of travelers moving a specific range for each time of the travel time and the elevator waiting time. For example, the thickness of the line segment from 1122 to 1123 shows that the number of travelers who use the elevator moving from the first floor to the seventh floor is more than 2500 and less than 5000 per hour. From this figure, it is possible to check where the travel time is long and the number of users is large. In other words, the travel flow comparison display unit 105 (display unit) can display the first travel time (floor transfer time), the waiting time (traveler elevator waiting time), and the second travel time (traveler floor to floor travel time) by weighting each of them based on the number of users.

[0059] Figure 13 is a diagram showing the travel flow when travelers move from each floor to the building entrance. This travel flow is used to evaluate the flow of travelers going to the entrance of the building, for example, when having lunch and leaving their office. The vertical axis remains representing the position (floor) in the height direction. However, the horizontal axis represents the time required to move from each point to the building entrance, in which a building entrance 1300 is defined as 0. For example, 1311 represents that the travel time from the movement start point on the fifth floor to the building entrance is 128 seconds, and 1312 represents that the travel time from taking the elevator down from the third floor is 66 seconds.

[0060] Figure 18 shows an example of outputting the result of the comparison of one or more travel flows by the travel flow comparison display unit 105. The diagram of the comparison result of the travel flows is described with reference to Figure 18. The travel flow for the one-bank system that provides elevators programmed to stop at all floors is indicated by 1801. In the multi-bank system in which elevators programmed to stop at lower floors and elevators programmed to stop at higher floors are separately provided, the travel flow for lower floors is indicated by 1802 and the travel for higher floors is indicated by 1803. Here, as a result of comparison and evaluation without changing the number of elevators and the specification in each system, it can be found that the time taken to arrive at the destination is shorter in the one-bank system than in the multi-bank system with respect to all stop floors. For example, it can be found that 1812 which represents the arrival at the sixth floor in the multi-bank system is faster than 1811 which represents the arrival at the sixth floor in the one-bank system.

[0061] This example compares examples by changing the operation system. However, it is also possible to compare the travel flows by changing only the elevator specification with the same operation system, or by changing the number of elevator users or the use conditions. In this way, by comparing the travel flows in various cases, it is possible to intuitively know to what extent the travel time taken to each floor is improved in each case.

[0062] Further, it may also be possible to compare the travel flow calculated from the operation record data of an actual elevator installed in an actual building with the travel flow calculated from the operation record data of the elevator by simulating the movement of the elevator under the same and different conditions by using computer simulation or other technique. In addition, it is also possible to evaluate the accuracy in estimating the travel in the building by using computer simulation, by comparing the travel flow calculated from the operation record data of the actual elevator with the travel flow calculated under the same conditions by using computer simulation or other technique.

[0063] In other words, according to the present embodiment, it is possible to receive the elevator operation record data and output the travel flow obtained by calculating the time taken for travelers to move in the building. As a result, the time distance of the whole building can be visualized by this travel flow. Further, by comparing a plurality of travel flows obtained by calculating under different conditions, it is possible to compare the time required for individual travelers to move in the whole building. In particular, by comparing the travel flow obtained by calculation in computer simulation with the travel flow obtained by calculation in actual elevator operation, it is possible to evaluate the reproducibility by the computer simulation, regardless of the trifling difference in the elevator operation.

<Example 2>

[0064] An example of the traveler travel condition output device and method according to the present invention will be described below with reference to drawings. The basic configuration of the device, data format, data and process flow, and the like, are the same as those in Example 1, so that descriptions thereof will be omitted.

[0065] In this example, the elevator operation record data 111 to be received is different from that in Example 1. This example uses travel record data of elevator based on a destination floor reservation system, which is a system in which when a traveler presses a button of destination floor from a terminal or other device provided in or around the elevator hall, an elevator to stop at the pressed floor is indicated to the traveler, without calling elevator by pressing the up and down button upon boarding the elevator.

[0066] In the following, only the operation record data of the destination floor reservation elevator is described with reference to Figure 12. Figure 12 shows an example of the operation record data of elevator based on the destination floor reservation system. In the destination floor reservation system, each individual traveler using an elevator inputs the destination after arriving at the elevator hall before getting on the elevator, so that the arrival time at the elevator hall, the departure floor, and the destination floor are recorded in the operation record data of elevator of this system with respect to each individual elevator user. The time at which the traveler operated

the terminal is recorded in a column 1201, the destination floor input to the terminal is recorded in a column 1204, the floor on which the traveler operated the terminal (namely, the departure floor) is recorded in a column 1207, and the elevator car number that the terminal indicates to the traveler is recorded in a column 1205.

[0067] A record 1211 shows that a traveler who goes from the first floor to the second floor operates the terminal at time 8:49:04 and is instructed to get on the No. 1 car. A record 1212 shows that a traveler who goes from the first floor to the fourth floor operates the terminal at time 8:49:10 and is instructed to get on the No. 1 car.

[0068] The traveler instructed to get on the No. 1 car by the terminal gets on the No. 1 car arriving just after the instruction. From a record 1215, it can be found that the elevator on which the travelers of the records 1211 and 1212 will get arrives at time 8:49:35. The description of the operation recode data ends here.

[0069] The method of calculating the traveler elevator waiting time from the operation record data will be described. With respect to all travelers getting on elevator, the difference between the terminal operation time and the elevator arrival time is calculated as the waiting time of each traveler, and then the statistic index such as average is calculated. The calculation result is output in the format of the traveler elevator waiting time shown in Figure 15 in the same way as in Example 1. At this time, it may also be possible to calculate the traveler elevator waiting time through the data in Figure 5, similarly to Example 1. The description of the calculation method of the traveler elevator waiting time ends here.

[0070] With the traveler travel condition output device and method of this example, it is possible to output the travel flow that accurately reflects the traveler waiting time.

<Example 3 >

[0071] An example of the traveler travel condition output device and method according to the present invention will be described below with reference to drawings. The basic configuration of the device, data format, data and process flow, and the like are the same as those in Example 1, so that descriptions thereof will be omitted.

[0072] In this example, the travel flow in a building using the sky-lobby system designed to transfer a plurality of elevators will be described with reference to examples in Figures 8 and 19.

[0073] Figure 8 is a diagram showing an example of the data in the sky-lobby system as the traveler travel line data in Example 3. Figure 8 shows the traveler travel line data in a sky-lobby type building, which shows that travelers can directly move to a lower floor bank (802) from an entrance (801) on the first floor of the building, but it is necessary to transfer to a shuttle bank (804) to go to a higher bank (805).

[0074] In the building in Fig. 19, a shuttle elevator going from the first floor to the seventh floor, without stopping between floors, is provided, in which the seventh floor corresponds to a sky-lobby floor. In the sky-lobby floor on the seventh floor, an elevator bank programmed to stop at all floors from the first to seventh, as well as an elevator bank programmed to stop at all floors from the twelfth to fifteenth are provided. 1901 represents the arrival of the shuttle elevator at the first floor and 1902 represents the arrival of the shuttle elevator at the seventh sky-lobby floor. 1903 represents traveler arrival at the elevator hall of the elevator bank programmed to stop at all floors from the seventh to eleventh. 1902 and 1903 represent the movement of the traveler arriving at the seventh floor to the elevator hall, which is drawn by using the floor travel time 303 calculated by the floor travel time calculation unit 101. 1904 represents the arrival of the elevator of the elevator bank programmed to stop at all floors from the seventh to eleventh, at the seventh floor. 1903 and 1904 represent the traveler elevator waiting time from when the traveler arrives at the elevator hall to when the elevator arrives, which is drawn by using the traveler elevator waiting time 304 calculated by the traveler elevator waiting time calculation unit 102. Further, 1905 represents traveler arrival at the elevator hall of the elevator bank programmed to stop at the seventh floor and at all floors from the twelfth to the fifteenth. 1902 to 1905 represent the movement of the traveler from arrival at the seventh floor to the elevator hall, which is drawn by using the floor travel time 303 calculated by the floor travel time calculation unit 101. 1906 represents the arrival of the elevator of the elevator bank programmed to stop at the seventh floor and at all floors from the twelfth to the fifteenth, at the seventh floor. 1905 and 1906 represent the traveler elevator waiting time from when the traveler arrives at the elevator hall to when the elevator arrives, which is drawn by using the traveler elevator waiting time 304 calculated by the traveler elevator waiting time calculation unit 102.

[0075] The description of the travel flow in the building using the sky-lobby system ends here.

[0076] With the travel flow output by the traveler travel condition output device and method of this example, the traveler travel condition output device and method can also be applied to buildings designed to transfer a plurality of elevators.

Reference Signs List

[0077] 100...traveler travel condition output device, 111...elevator operation record data, 112...layout data

Claims

1. A traveler travel condition output device comprising:

a travel time calculation unit that obtains, for each user, a first travel time taken for the user to move from entering the building to arriving at

the elevator hall, a waiting time in the elevator hall from when the user arrives at the elevator hall to when the user gets on an elevator, and a second travel time taken for the user to move from getting on the elevator to arriving at the destination floor, and collects the information of the first travel time, the waiting time, and the second travel time to calculate the travel time statistical information of the user from entering the building to arriving at the destination floor; and

a display unit for displaying the travel times,

wherein the travel time calculation unit calculates travel time statistical information in a first elevator structure, as well as travel time statistical information in a second elevator structure, and

wherein the display unit displays the travel time statistical information in the first elevator structure, together with the travel time statistical information in the second elevator structure.

2. The traveler travel condition output device according to claim 1,
wherein the travel time calculation unit calculates the maximum value, average, or dispersion of the time obtained by summing up the information of the first travel time of the user, the waiting time, and the second travel time, as the travel time statistical information.

3. The traveler travel condition output device according to claim 2,
wherein the display unit displays the first travel time, the waiting time, and the second travel time by giving a weight to each of the times based on the number of users.

4. The traveler travel condition output device according to claim 3,
wherein the first elevator structure means that the elevator directly goes from a reference floor to a destination floor, and
wherein the second elevator structure means that the elevator stops at intermediate floors, in addition to the destination floor, in the operation of going from the reference floor to the destination floor.

5. The traveler travel condition output device according to claim 4,
wherein the travel time calculation unit calculates the average of the time taken for a traveler to move from a reference floor to a destination floor by obtaining the weighted average of the travel time from the reference floor to the destination floor in such a way that the sum of the value weighted by multiplying the operation time of the elevator from the reference floor straight up to the destination floor by the number of users, and the value weighted by multiplying the travel time of the elevator operating from the reference floor to the destination floor while also stopping at intermediate floors by the number of users who moved through each of the intermediate floors, is divided by the total number of users directly going from each of the intermediate floors and the reference floor to the destination floor.

6. The traveler travel condition output device according to claim 4,
wherein the display unit displays travel flows of traveler elevator waiting time, elevator travel time between each of the floors, and door opening time at each floor, by changing one or both color and line type so that the travel flows can be identified according to their types.

7. The traveler travel condition output device according to claim 3,
wherein the second elevator structure is defined such that any one or more of the elevator layout, the number of elevators, the layout specification, and the traveler travel demand are changed with respect to the first elevator structure.

8. The traveler travel condition output device according to claim 3,
wherein the display unit sets one or more reference values in advance for the required time to transfer between any two points and states, checks the required time of travel flow against the reference value, and displays the travel flow by changing one or both of color and line type.

9. The traveler travel condition output device according to claim 1,
wherein, in the travel time calculation unit, the second travel time is calculated based on operation record data, and the operation record data uses one or both of the record data of physical operation of the elevator and the record data of virtual operation such as computer simulation of the elevator.

10. The traveler travel condition output device according to claim 3,
wherein the first elevator structure and the second elevator structure include either a sky-lobby type building in which travelers are expected to transfer elevators, or a multi-bank type building in which the elevator bank to be used varies depending on the destination floor.

11. A traveler travel condition output method comprising the steps of:

with respect to each user, obtaining a first travel time taken for the user to move from entering

the building to arriving at the elevator hall, a waiting time in the elevator hall from when the user arrives at the elevator hall to when the user gets on the elevator, and a second travel time from when the user gets on the elevator to when the user arrives at a destination floor;

collecting information of the first travel time, the waiting time, and the second travel time, to calculate the travel time statistical information of the user from entering the building to arriving at the destination floor;

displaying the travel times;

calculating travel time statistical information in a first elevator structure, as well as travel time statistical information in a second elevator structure; and

displaying the travel time statistical information in the first elevator structure, together with the travel time statistical information in the second elevator structure.

FIG. 1

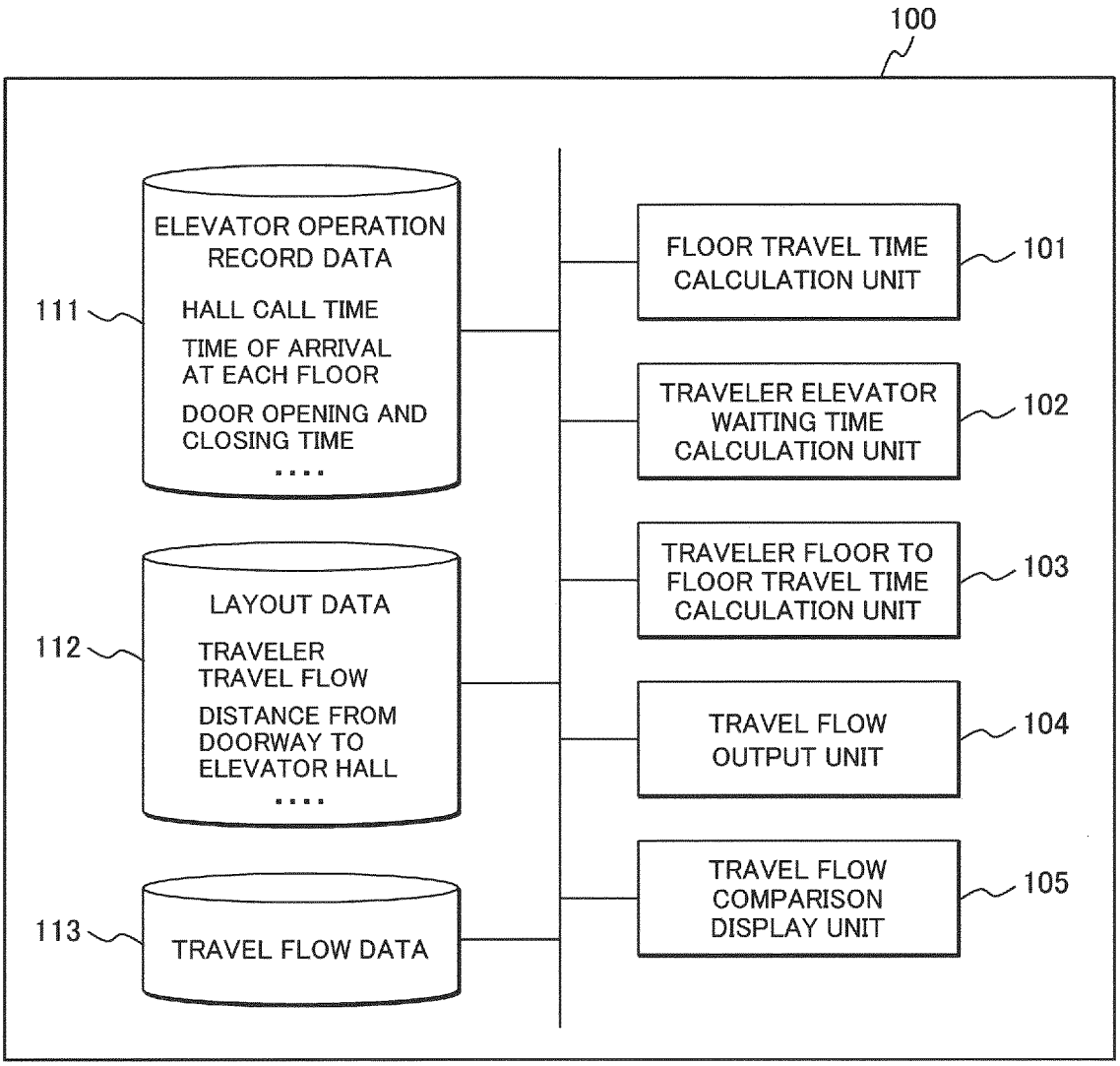
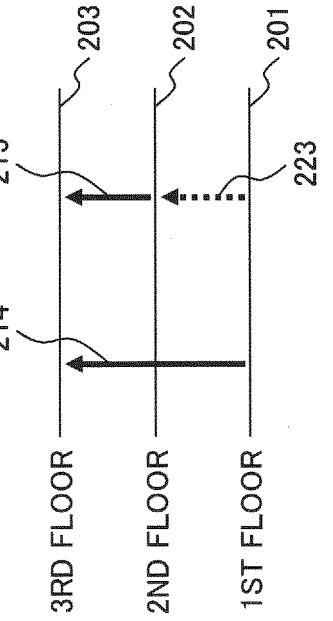

100
ELEVATOR OPERATION RECORD DATA
HALL CALL TIME
TIME OF ARRIVAL AT EACH FLOOR
DOOR OPENING AND CLOSING TIME
....
111
LAYOUT DATA
TRAVELER TRAVEL FLOW
DISTANCE FROM DOORWAY TO ELEVATOR HALL
....
112
TRAVEL FLOW DATA
113
FLOOR TRAVEL TIME CALCULATION UNIT
101
TRAVELER ELEVATOR WAITING TIME CALCULATION UNIT
102
TRAVELER FLOOR TO FLOOR TRAVEL TIME CALCULATION UNIT
103
TRAVEL FLOW OUTPUT UNIT
104
TRAVEL FLOW COMPARISON DISPLAY UNIT
105

FIG. 2

$p_{i,j}$: NUMBER OF TRAVELERS MOVING BETWEEN i AND j FLOORS (NOT INCLUDING INTERMEDIATE STOPS)

$t_{i,j}$: AVERAGE TRAVEL TIME BETWEEN i AND j FLOORS

$d_{i,j,k}$: TRAVEL TIME OF TRAVELER k BETWEEN i AND j FLOORS (NON-STOP)



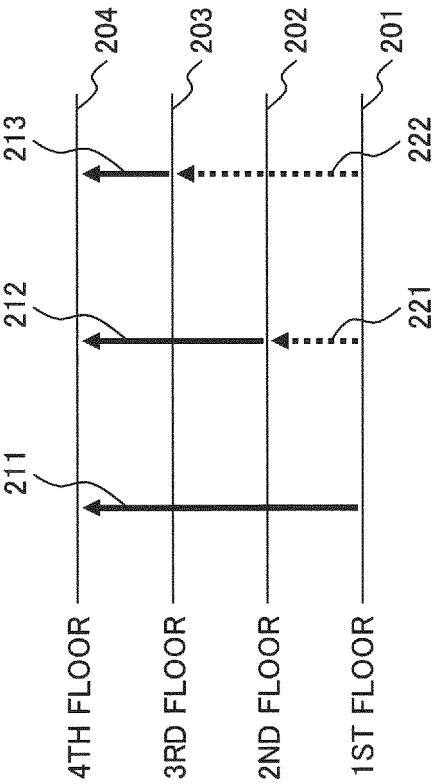


FIG. 3

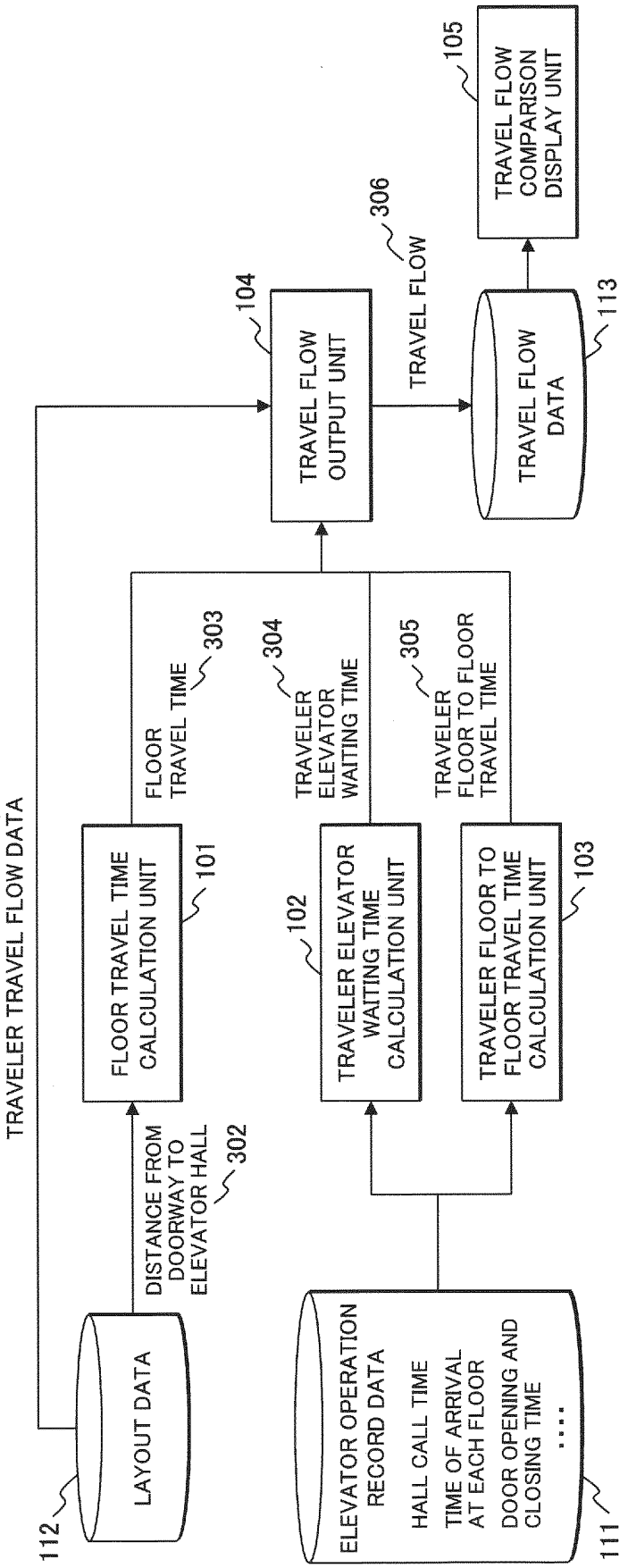
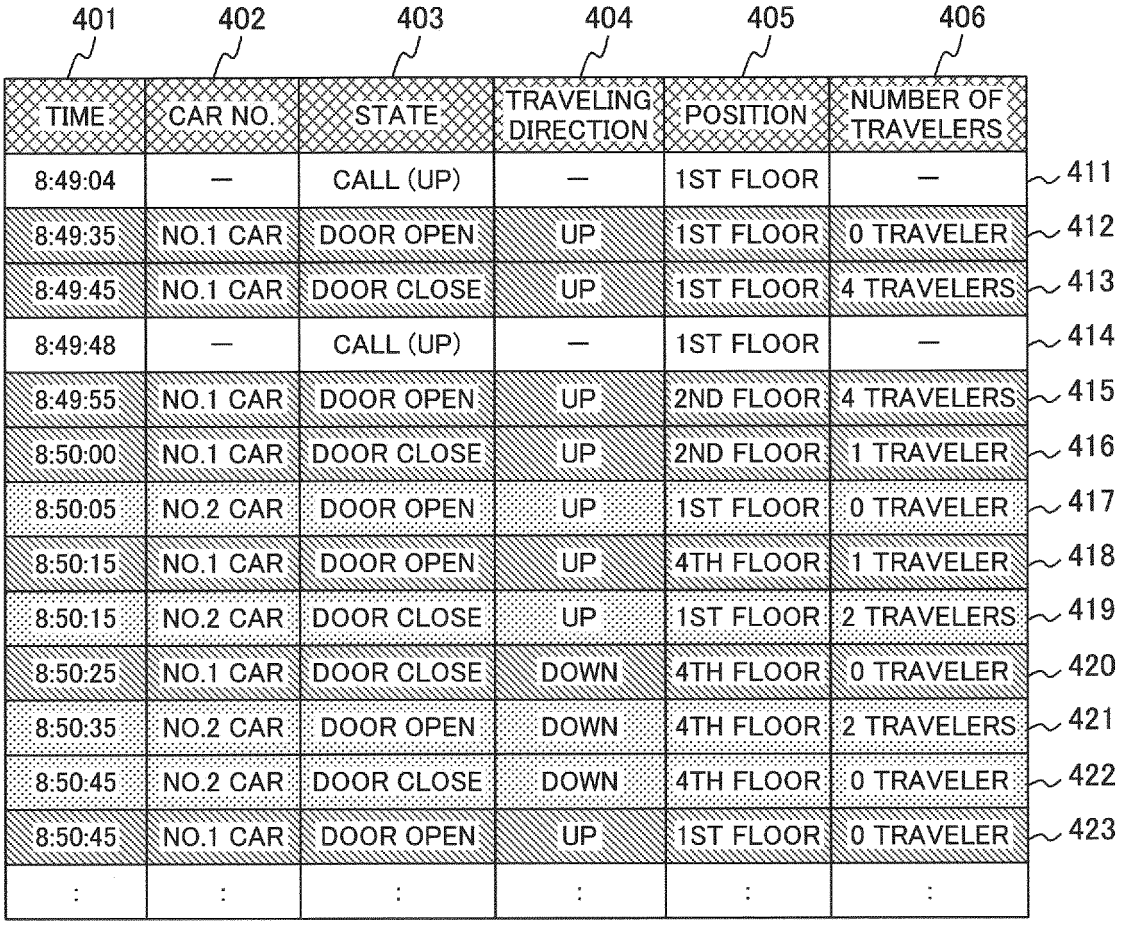
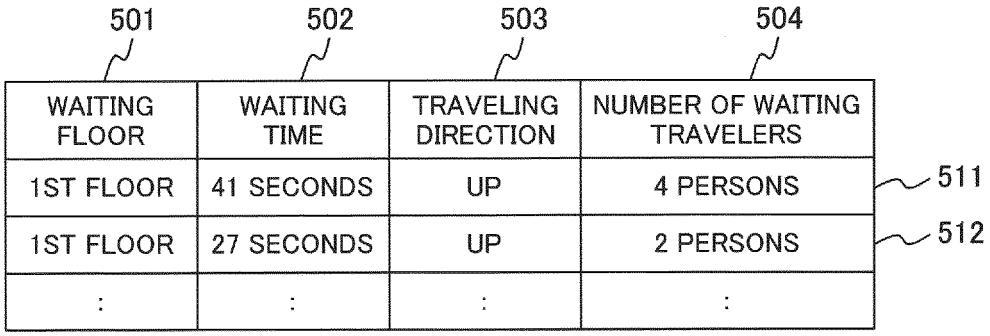

ELEVATOR OPERATION RECORD DATA
HALL CALL TIME
TIME OF ARRIVAL AT EACH FLOOR
DOOR OPENING AND CLOSING TIME
....
111
LAYOUT DATA
112
DISTANCE FROM DOORWAY TO ELEVATOR HALL
302
FLOOR TRAVEL TIME CALCULATION UNIT
101
TRAVELER ELEVATOR WAITING TIME CALCULATION UNIT
102
TRAVELER FLOOR TO FLOOR TRAVEL TIME CALCULATION UNIT
103
TRAVELER TRAVEL FLOW DATA
301
FLOOR TRAVEL TIME
303
TRAVELER ELEVATOR WAITING TIME
304
TRAVELER FLOOR TO FLOOR TRAVEL TIME
305
TRAVEL FLOW OUTPUT UNIT
104
TRAVEL FLOW
306
TRAVEL FLOW DATA
113
TRAVEL FLOW COMPARISON DISPLAY UNIT
105

FIG. 4



401 TIME	402 CAR NO.	403 STATE	404 TRAVELING DIRECTION	405 POSITION	406 NUMBER OF TRAVELERS	
8:49:04	—	CALL (UP)	—	1ST FLOOR	—	411
8:49:35	NO.1 CAR	DOOR OPEN	UP	1ST FLOOR	0 TRAVELER	412
8:49:45	NO.1 CAR	DOOR CLOSE	UP	1ST FLOOR	4 TRAVELERS	413
8:49:48	—	CALL (UP)	—	1ST FLOOR	—	414
8:49:55	NO.1 CAR	DOOR OPEN	UP	2ND FLOOR	4 TRAVELERS	415
8:50:00	NO.1 CAR	DOOR CLOSE	UP	2ND FLOOR	1 TRAVELER	416
8:50:05	NO.2 CAR	DOOR OPEN	UP	1ST FLOOR	0 TRAVELER	417
8:50:15	NO.1 CAR	DOOR OPEN	UP	4TH FLOOR	1 TRAVELER	418
8:50:15	NO.2 CAR	DOOR CLOSE	UP	1ST FLOOR	2 TRAVELERS	419
8:50:25	NO.1 CAR	DOOR CLOSE	DOWN	4TH FLOOR	0 TRAVELER	420
8:50:35	NO.2 CAR	DOOR OPEN	DOWN	4TH FLOOR	2 TRAVELERS	421
8:50:45	NO.2 CAR	DOOR CLOSE	DOWN	4TH FLOOR	0 TRAVELER	422
8:50:45	NO.1 CAR	DOOR OPEN	UP	1ST FLOOR	0 TRAVELER	423
:	:	:	:	:	:	

FIG. 5



501 WAITING FLOOR	502 WAITING TIME	503 TRAVELING DIRECTION	504 NUMBER OF WAITING TRAVELERS	
1ST FLOOR	41 SECONDS	UP	4 PERSONS	511
1ST FLOOR	27 SECONDS	UP	2 PERSONS	512
:	:	:	:	

FIG. 6

601 DEPARTURE FLOOR	602 ARRIVAL FLOOR	603 OPERATION TIME	604 NUMBER OF TRAVELERS	
1ST FLOOR	2ND FLOOR	10 SECONDS	4 TRAVELERS	611
2ND FLOOR	4TH FLOOR	15 SECONDS	1 TRAVELER	612
1ST FLOOR	4TH FLOOR	20 SECONDS	2 TRAVELERS	613
4TH FLOOR	1ST FLOOR	20 SECONDS	0 TRAVELER	614
:	:	:	:	

FIG. 7

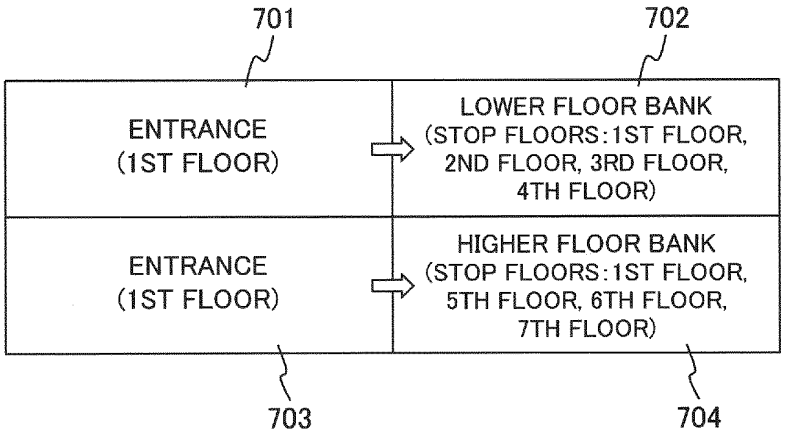


FIG. 8

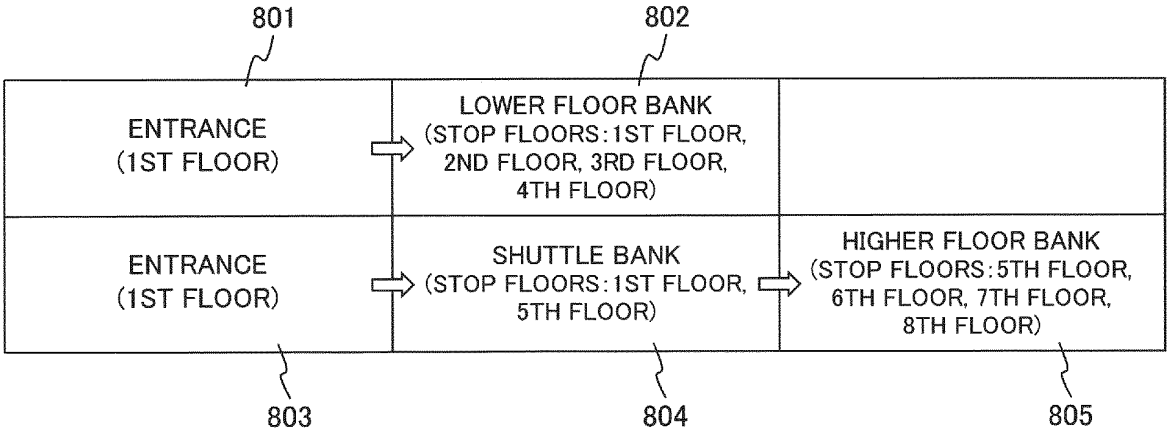


FIG. 9

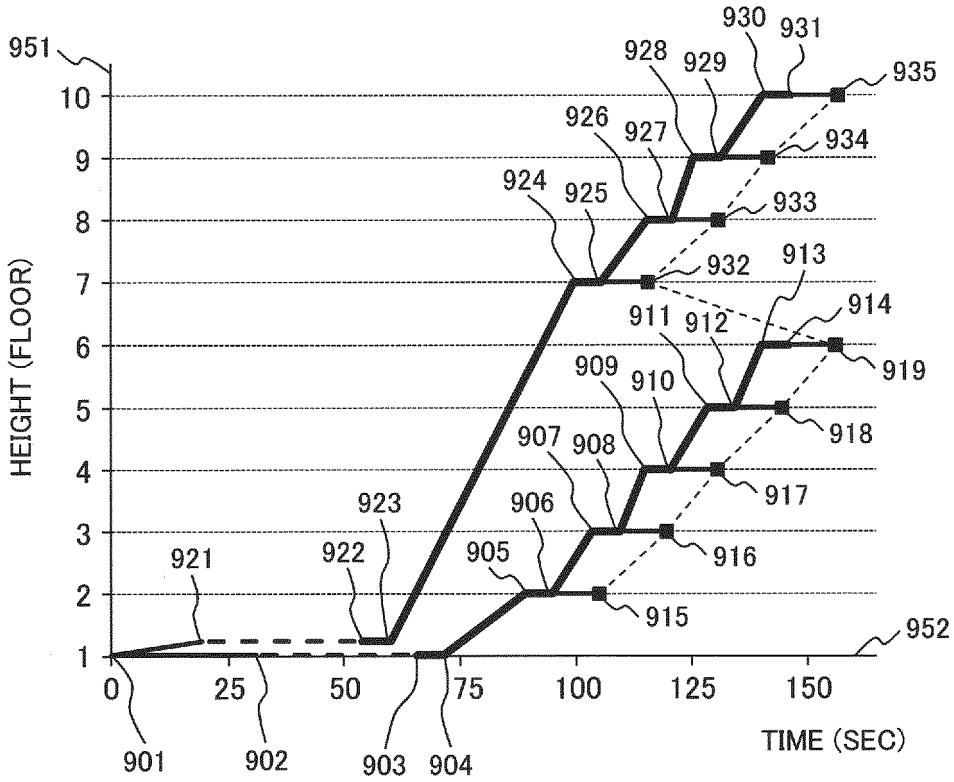

951
10
9
8
7
6
5
4
3
2
1
HEIGHT (FLOOR)
0
25
50
75
100
125
150
TIME (SEC)
901
902
903
904
921
922
923
924
925
926
927
928
929
930
931
932
933
934
935
905
906
907
908
909
910
911
912
913
914
915
916
917
918
919
952

FIG. 10

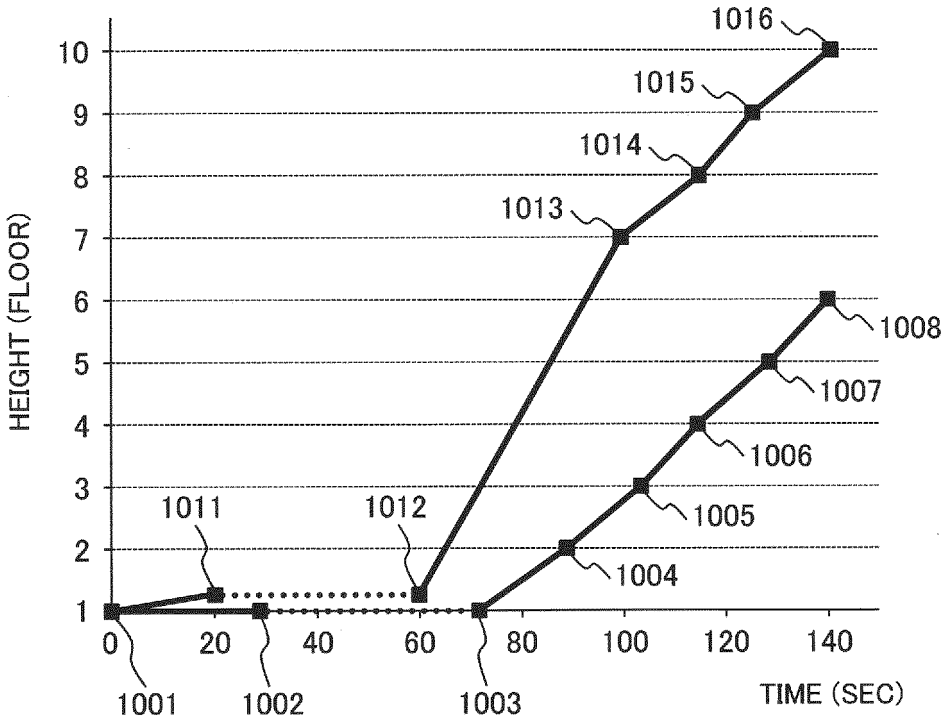

HEIGHT (FLOOR)
10
9
8
7
6
5
4
3
2
1
0
20
40
60
80
100
120
140
TIME (SEC)
1001
1002
1003
1004
1005
1006
1007
1008
1011
1012
1013
1014
1015
1016

FIG. 11

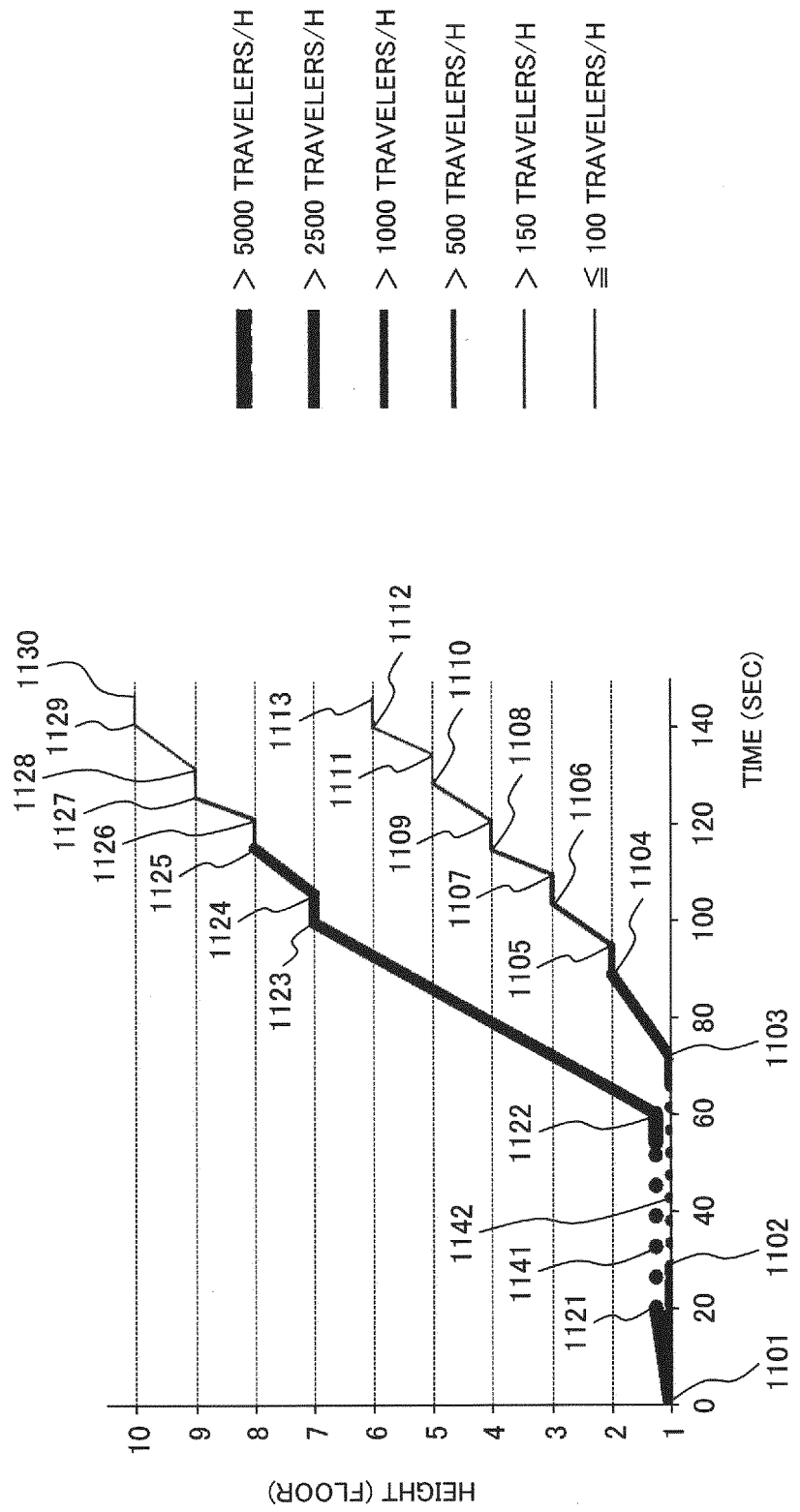

> 5000 TRAVELERS/H
> 2500 TRAVELERS/H
> 1000 TRAVELERS/H
> 500 TRAVELERS/H
> 150 TRAVELERS/H
≦ 100 TRAVELERS/H
HEIGHT (FLOOR)
TIME (SEC)
0
20
40
60
80
100
120
140
1
2
3
4
5
6
7
8
9
10
1101
1102
1103
1104
1105
1106
1107
1108
1109
1110
1111
1112
1113
1121
1122
1123
1124
1125
1126
1127
1128
1129
1130
1141
1142

FIG. 12

1201 TIME	1202 CAR NO.	1203 STATE	1204 TARGET FLOOR	1205 ALLO-CATION	1206 TRAVELING DIRECTION	1207 POSITION	1208 NUMBER OF TRAVELERS	
8:49:04	—	CALL	2ND FLOOR	NO.1 CAR	—	1ST FLOOR	—	1211
8:49:10	—	CALL	4TH FLOOR	NO.1 CAR	—	1ST FLOOR	—	1212
8:49:21	—	CALL	2ND FLOOR	NO.1 CAR	—	1ST FLOOR	—	1213
8:49:31	—	CALL	2ND FLOOR	NO.1 CAR	—	1ST FLOOR	—	1214
8:49:35	NO.1 CAR	DOOR OPEN	—	—	UP	1ST FLOOR	0 TRAVELER	1215
8:49:45	NO.1 CAR	DOOR CLOSE	—	—	UP	1ST FLOOR	4 TRAVELERS	1216
8:49:48	—	CALL	4TH FLOOR	NO.2 CAR	—	1ST FLOOR	—	1217
8:49:55	NO.1 CAR	DOOR OPEN	—	—	UP	2ND FLOOR	4 TRAVELERS	1218
8:50:00	NO.1 CAR	DOOR CLOSE	—	—	UP	2ND FLOOR	1 TRAVELER	1219
8:49:48	—	CALL	4TH FLOOR	NO.2 CAR	—	1ST FLOOR	—	1220
8:50:05	NO.2 CAR	DOOR OPEN	—	—	UP	1ST FLOOR	0 TRAVELER	1221
8:50:15	NO.1 CAR	DOOR OPEN	—	—	UP	4TH FLOOR	1 TRAVELER	1222
8:50:15	NO.2 CAR	DOOR CLOSE	—	—	UP	1ST FLOOR	2 TRAVELERS	1223
8:50:25	NO.1 CAR	DOOR CLOSE	—	—	DOWN	4TH FLOOR	0 TRAVELER	1224
8:50:35	NO.2 CAR	DOOR OPEN	—	—	DOWN	4TH FLOOR	2 TRAVELERS	1225
8:50:45	NO.2 CAR	DOOR CLOSE	—	—	DOWN	4TH FLOOR	0 TRAVELER	1226
8:50:45	NO.1 CAR	DOOR OPEN	—	—	UP	1ST FLOOR	0 TRAVELER	1227
:	:	:	:	:	:	:	:	

FIG. 13

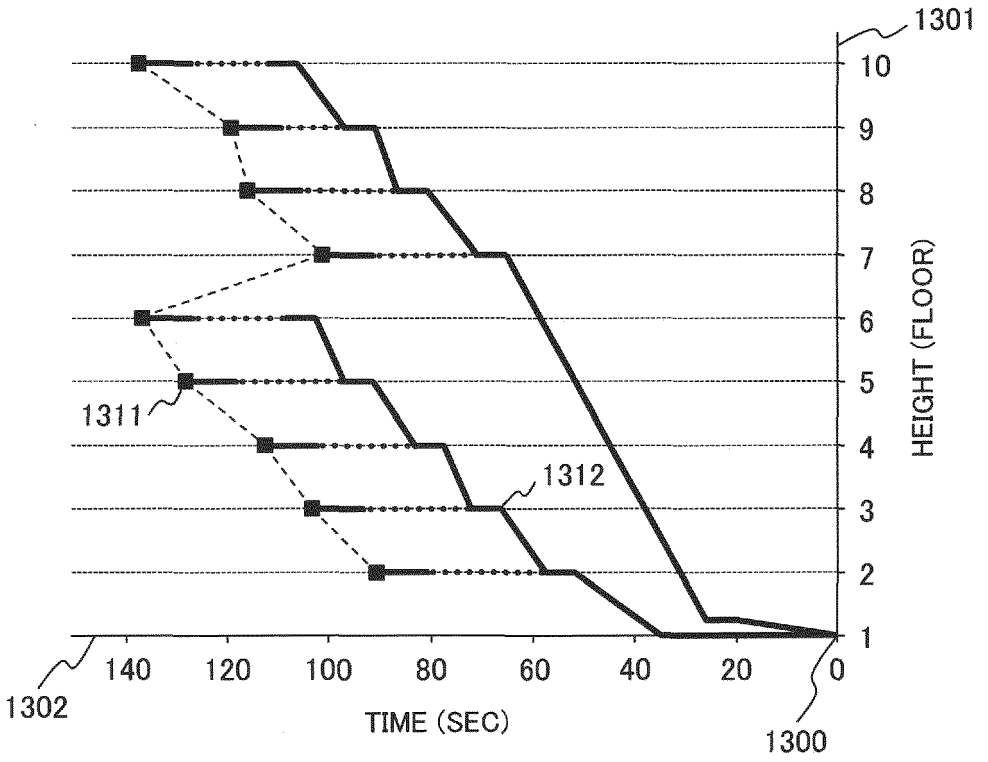


FIG. 14

	FLOOR TO FLOOR TRAVEL TIME	
	LOWER FLOOR BANK	HIGHER FLOOR BANK
1ST FLOOR ~ 2ND FLOOR	16 SECONDS	—
1ST FLOOR ~ 3RD FLOOR	31 SECONDS	—
:	:	:
1ST FLOOR ~ 7TH FLOOR	—	39 SECONDS
1ST FLOOR ~ 8TH FLOOR	—	54 SECONDS
:	:	:

1401 1402 1403 1404

FIG. 15

	ELEVATOR WAITING TIME	
	LOWER FLOOR BANK	HIGHER FLOOR BANK
1ST FLOOR	43 SECONDS	40 SECONDS
2ND FLOOR	:	:
:	:	:

1502

1501

FIG. 16

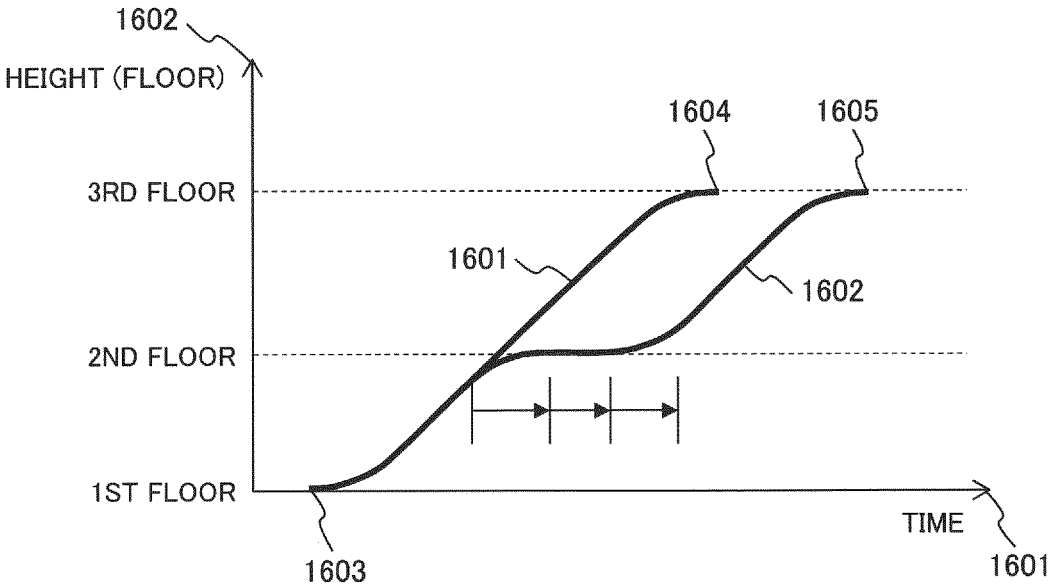


FIG. 17

$p_{i,j}$: NUMBER OF TRAVELERS MOVING BETWEEN i AND j FLOORS (NOT INCLUDING INTERMEDIATE STOPS)

$t_{i,j}$: AVERAGE TRAVEL TIME BETWEEN i AND j FLOORS

$d_{i,j,k}$: TRAVEL TIME OF TRAVELER k BETWEEN i AND j FLOORS (NON-STOP)

RECURRENCE FORMULA : WHEN $i < j$ $$t_{i,j} = \frac{\sum_{l=i}^{j-1} \sum_{k=0}^{p_{l,j}} \left(t_{i,l} + d_{l,j,k} \right)}{\sum_{l=i}^{j-1} p_{l,j}}$$

WHEN $i = j$ $$t_{i,j} = 0$$

EP 3 521 230 A1

FIG. 18

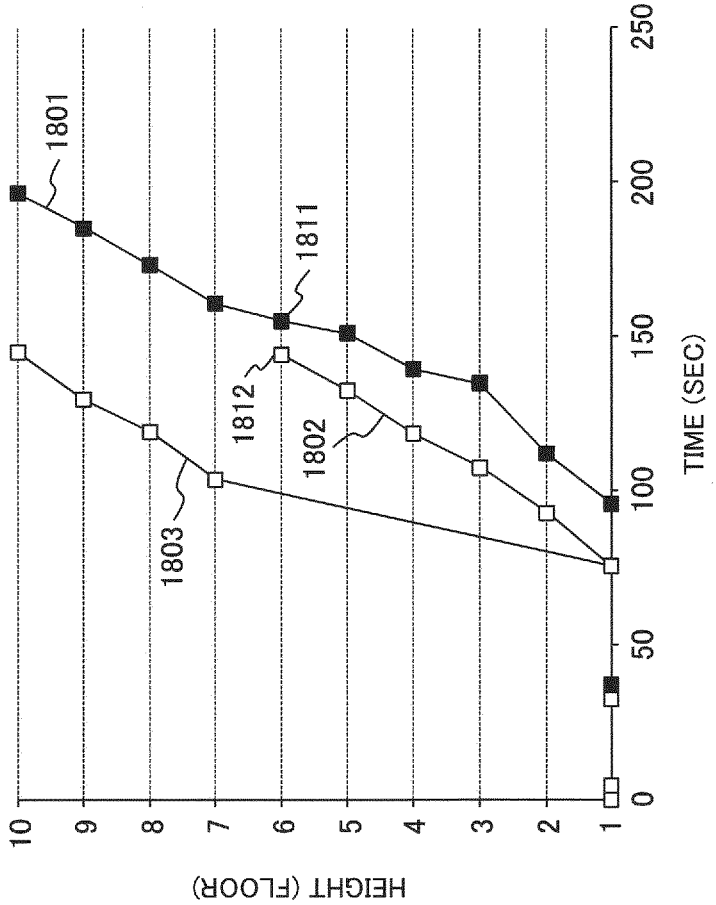
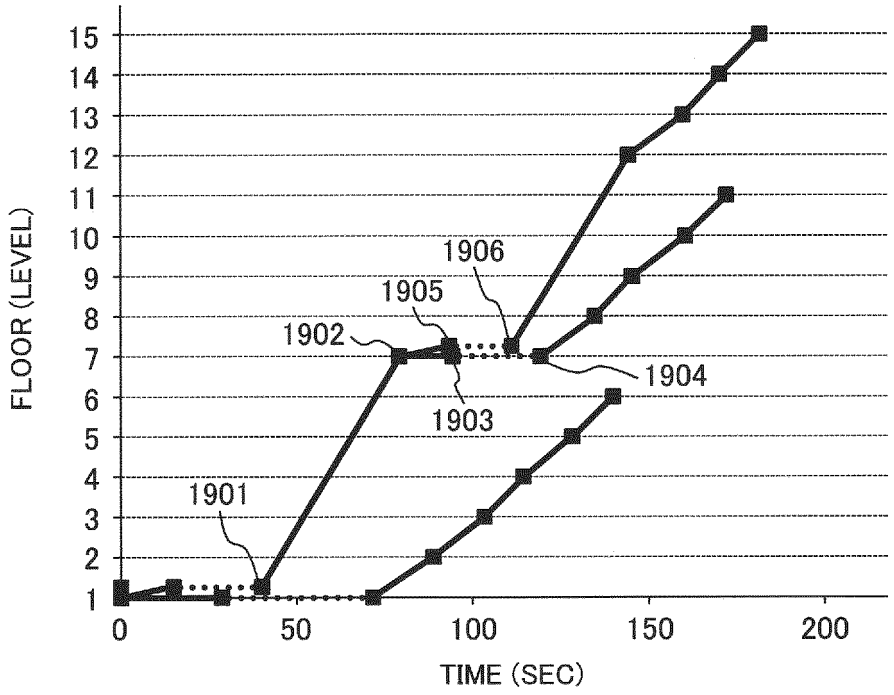

1 BANK
MULTI-BANK SYSTEM
(LOWER FLOORS/HIGHER FLOORS)
1801
1811
1812
1802
1803
HEIGHT (FLOOR)
TIME (SEC)
0
50
100
150
200
250
1
2
3
4
5
6
7
8
9
10

FIG. 19


FLOOR (LEVEL)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
50
100
150
200
TIME (SEC)
1901
1902
1903
1904
1905
1906

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/028677

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)
B66B1/100-B66B1/52, B66B3/00-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 1996-2017
Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

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.
Y A	JP 2009-96612 A (Hitachi, Ltd.), 07 May 2009 (07.05.2009), paragraphs [0024] to [0067]; fig. 1, 12 & CN 101477580 A	1-3,7-11 4-6
Y A	JP 11-217164 A (Hitachi, Ltd.), 10 August 1999 (10.08.1999), paragraphs [0015], [0019] to [0020] (Family: none)	1-3,7-11 4-6
Y A	JP 2000-44134 A (Taisei Corp.), 15 February 2000 (15.02.2000), paragraphs [0017] to [0020] (Family: none)	1-3,7-11 4-6

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 October 2017 (16.10.17)	31 October 2017 (31.10.17)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/028677

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 3-297764 A (Hitachi, Ltd.), 27 December 1991 (27.12.1991), page 15, upper left column, line 19 to upper right column, line 2; fig. 26, 27 (Family: none)	1-3,7-11 4-6
Y A	JP 3-288777 A (Hitachi, Ltd.), 18 December 1991 (18.12.1991), page 13, lower left column, line 6 to page 14, upper right, line 4; fig. 22, 24 to 25 (Family: none)	1-3,7-11 4-6
Y	JP 63-218488 A (Hitachi, Ltd.), 12 September 1988 (12.09.1988), page 6, lines 6 to 14 (Family: none)	8
Y	WO 2015/105074 A1 (Mitsubishi Electric Corp.), 16 July 2015 (16.07.2015), paragraphs [0014] to [0019]; fig. 2 to 3 & CN 106061878 A	9

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2009096612 A **[0004]**