

Title of the Invention

ELEVATOR CONTROL SYSTEM

5 Background of the Invention

The present invention relates to an elevator control system and, more particularly, to an elevator control system having a controller for automatically determining an operating mode and a notifying apparatus in each of landing floors.

10 In recent years, with the needs for increasing height and size of a building, there is a growing requirement to improve transporting capability of an elevator and to improve usability matching with use of a building. Particularly, there is a strong need to improve the transporting capacity during
15 congested hours such as office-going hours or lunch hours.

A method of increasing transporting capacity during such congested hours described above is disclosed in Japanese Patent Publication No.43-25097 (1968) where service floors of elevators are divided into plural zones and the elevators are
20 operated in a divided express operation so as to satisfy time elements and traffic demands. In Japanese Patent Application Laid-Open No.57-203668 (1982), a technology is disclosed where number of divisional cars for divisional express operation is automatically set by performing test operation. In Japanese
25 Patent Publication No.62-12148 (1987), a technology is disclosed where dividing of floors for divisional express operation is automatically set by performing test operation.

Further, in Japanese Patent Application Laid-Open No.59-177264 (1984), a technology is disclosed where by practically measuring number of users or utilization load for each of floors day-by-day, dividing floors are automatically set so that the utilization loads for all floors become a predicted ratio based on the practically measured data. Furthermore, in Japanese Patent Publication No.5-32303 (1993), a legible and understandable display panel for an elevator of an automatic operation and management elevator system is disclosed.

10 On the other hand, an LED or a liquid crystal screen is widely used as a notifying display apparatus on an elevator landing hall, and various kinds of displays such as operating state of an elevator, general information and so on can be realized.

15 In time zones when a lot of users gather such as office-going hours and lunch hours, the aforementioned dividing express operation is effective for increasing transporting capacity. However, it is necessary to notify users of servicing floors in such a manner as to be easily understood.

20 An illegible display decrease the operating efficiency of an elevator due to users' error boarding. Especially, in a case of changing service floors, the more a person is accustomed to elevator, the more frequently he makes erroneous boarding. However, frequent change in display or voice notification, or
25 excessive display or notification may spoil the building's beauty, make noise problems and make customers' complaints.

Summary of the Invention

A first object of the present invention is to provide an elevator control system having a notifying apparatus capable of changing a notifying mode to an appeal notifying mode in order to clearly notify uses of a changed point when change in the operating mode, such as change from an ordinary operation to a dividing express operation, change in service floors or the like, is made. Another object is to provide an elevator preventing customers' complaints by make duration time of an appeal notifying mode necessary and minimum and having high transporting capability by effectively performing efficient operation such as dividing express operation or the like.

In the present invention, using a plurality of elevators serving for plurality of floors, controllers for controlling the elevators, a means for capturing operating status of the elevators such as car position and/or car call of each elevator, an operating mode generating means for leaning daily traffic flow and generating a best operating mode through a simulation applied with GA (genetic algorithm) based on the learned result, a means for automatically performing the generated operating mode depending on an operating status of the elevators and a notifying apparatus installed near each entrance of the car on each floor, guidance corresponding to the automatically generated operating mode is performed. That is, the object of the present invention can be attained by

providing a notifying apparatus having a means for changing a notifying mode to an appeal notifying mode different from an ordinary notifying mode in order to accurately transmit to the users information on change in the elevator operating mode when it is changed from the previous operating status.

In other words, in a group management elevator system where an operating mode such as zone of dividing floor and number of cars for dividing express operation is automatically set, when an automatically set result becomes a different operating mode from the previous one, the users can clearly recognize the change by color in changed points, notifying mode and so on. Thereby, an elevator to be used can be easily distinguished from others, and consequently the effect of dividing express operation can be attained as expected. Further, by making duration time of an appeal notifying mode necessary and minimum, it is possible to not spoil the building's beauty and to prevent customers' complaints.

Brief Description of the Drawings

FIG.1 is a block diagram showing the construction of a system in accordance with the present invention.

FIG.2 is a flow chart explaining the overall processing of the group management control system.

FIG.3 is a flow chart explaining the overall processing of the traffic demand learning process and the operating mode setting process.

FIG.4 is a flow chart explaining the overall processing

of the operating mode planning process.

FIG.5 is a figure showing the table constructions.

FIG.6 is a bar chart showing number of persons getting-on and -off for each floors.

5 FIG.7 is a diagram showing traffic demand for each floor.

FIG.8 is a diagram showing an example of an operating mode planning.

FIG.9 is a diagram showing an example of decomposition of number of persons getting-on and -off for each floors.

10 FIG.10 is a flow chart showing the notifying method selection process.

FIG.11 is a flow chart showing the car control unit process.

15 FIG.12 is a figure showing an example of the display transmission format.

FIG.13 is a figure showing an example of the guiding method history table.

20 FIG.14 is a table showing the relationship between each of the operating modes and set value for error operation probability.

FIG.15 is a figure showing an example of an appeal display in office-going hours.

FIG.16 is a figure showing an example of notifying display for each floor in office-going hours.

25 FIG.17 is a figure showing an example of a previous announcement display after-office hours.

FIG.18 is a figure showing a display in a case of occurrence of a failure in lunch hours.

FIG.19 is a figure showing an example of control for change of operation mode and so on in lunch hours.

5 FIG.20 is a block diagram showing another embodiment of the system construction.

FIG.21 is a figure showing an example of an appeal display.

Detailed Description of the Preferred Embodiments

10 FIG.1 shows the construction of a system in accordance with the present invention. The system of this embodiment is comprises a control apparatus 1 composed of a group management control system X01 for controlling four elevators and car controllers X2-A to D for operation-controlling respective
15 elevators, notification and announcement apparatuses provided near the entrances of respective elevators, that is, notifying display apparatuses X03-A1 to An, X03-B1 to Bn, X03-C1 to Cn, X03-D1 to Dn, and voice notifying apparatuses X04-A1 to An, X04-B1 to Bn, X04-C1 to Cn, X04-D1 to Dn, and hall call
20 registers X05-1 to n provided in respective floor halls.

 The group management control system X01 will be described below. A table of car status recording part T01 receives data transmitted from the elevators and car controllers X2-A to D to the group management control system X01 through a program
25 in a group/car transmission part (I/O transmission part) P10 to record the data, and the data is updated periodically or at the time just after the data is changed. The transmitted

data is composed of information on loading weight of a car (number of persons) and number of persons getting-on and -off to detect a traffic demand, information on position and speed of the car, and input information such as a notifying status of the notification and announcement apparatus, a registered status of a car call, an opening/closing status of a door and so on.

A use information collecting and error operation detecting part P01 is composed of a program for sampling hall calls, contents of an elevator data recording part T10 and detected data on number of getting-on and -off persons on each floor for each car by on-line every collection of a certain traffic amount or every a certain period by referring to in what operating mode for each time period the elevators are operated using a table of a schedule data recording part T02, and collecting data to operate a program of leaning various kinds of traffic information and preforming a simulation and data to calculate the control parameters; and a program for counting an erroneous operation when a car call button on a floor not notified is operated, obtaining an erroneous operating probability, collecting data, and accumulating the collecting data in a table of a traffic information and use status accumulation recording part T04.

An operating mode planning program for performing simulation using GA (genetic algorithm) composing an operating mode planning part P03 obtains the best combination of

operating modes among nearly numberless combinations of operating modes through simulation based on the data of the traffic information and use status accumulation part T04, and records the result in a table of an operating mode planning recording part T08.

The operating modes composed of operating modes such as an ordinary operation (a service mode in which all cars service all floors.), an express running (a operating mode in which service is preformed by dividing service floors into upper floors and lower floors.), a skip mode (a mode in which service is performed for specified plural floors apart from one another.), a managed operation (a mode in which a specified car is operated in a pre-determined operating mode, for example, a specified car is operated in specified service floors.), as well as data for limitation in car control of the elevator such as limitation in hall call register, selection of a method of allocating hall call, limitation in car call register, control of door opening/closing time. The generated operating mode is limited by contents recorded in a table of a customer request data recording part T03 for recording customer's requests formed using required specifications of the customer. When no customer's request is recorded in the customer request data recording part T03, a common operating mode preset by a designer is generated. Several kinds of operating modes are generated at a time for one operating method, and in this embodiment two kinds of operating modes

are generated. The customer request recording part T03 can be freely re-written by the customer through an input means provided in the external though this is not shown in the figure.

5 A program of a traffic demand judgement part P04 judges whether or not an operating mode should be changed using data from the traffic information and use status accumulation part T04, and notifies the necessity of change in the operating mode to a program of an operating mode planning and command part
10 P08.

FIG.2 is a flow chart explaining the overall processing of the group management control system X01.

In FIG.2, as the power is switched on, control signals for the input unit and the like are initialized in Step S10.
15 In Step S20, signals from the car controllers X02-A to D are performed receiving processing, and in Step S30, hall call signals from the hall call buttons X05-1 to n are performed receiving processing. In Step S40, a traffic demand is learned and predicts a future traffic demand by performing
20 processing through checking with a past learned result of traffic demand (data of the traffic information and use status accumulation recording part), and plans and evaluates the most suitable operating mode for the predicted traffic demand to re-set a new operating mode. That is, in this step there are
25 a specified traffic demand detecting means, an operating mode planning means for planning an operating mode corresponding

to a specified traffic demand data value detected by the specified demand detecting means, a means for re-setting the operating mode, and a means for determining a guiding content and a mode corresponding to the changed operating mode.

5 In Step S50, an elevator allocated for hall call using the operating mode re-set in Step S40. In Step S60, output processing of allocated signal to the determined elevator and output processing of the notifying code signal to the notification and announcement apparatus. In Step S70,
10 notifying control to the hall to the allocated hall call is executed. The processing in these steps S20 to S70 are repeated to be executed until the power source is switched off.

FIG.3 is a flow chart explaining the processing of the traffic demand learning process and the operating mode setting
15 process in Step S40 in FIG.2.

In FIG.3, in Step SA10 a traffic demand between floors is obtained from a present traffic demand by the method disclosed in Japanese Patent Publication No.62-36954 (1987), and added to a work table PSTW(f,f) (f is the maximum number
20 of floors) for traffic demand classified by inter-floor for a given period. In Step SA20, based on the work table PSTW(f,f) for traffic demand classified by inter-floor for a given period, a weighted average of the traffic demand and a past traffic demand classified by inter-floor in the same
25 traffic flow is obtained, and a table PST(m, f, f) for traffic demand classified by inter-floor (m is traffic flow, and f is

the maximum number of floors) for the present traffic flow is generated. In Step SA30, a traffic demand classified by inter-floor for the next traffic flow is predicted using the data for traffic demand classified by inter-floor for the present traffic flow m generated in Step SA20 and the data learned in the past for traffic demand classified by inter-floor for the next traffic flow m_1 , and a work table $PTW(f,f)$ for traffic demand prediction classified by inter-floor is generated. Therein, the data for traffic demand classified by inter-floor for the present traffic flow m generated in Step SA20 and the data learned in the past for traffic demand classified by inter-floor for the next traffic flow m_1 are used in order to predict the traffic demand for inter-floor for the next traffic flow, but there is no need to limit to this method. It is possible to predict only based on two kinds of the traffic demand data for inter-floor for the next traffic flow m_1 learned in the past and the next-next traffic flow m_2 . Further, it is also possible to include the data of the work table $PSTW(f,f)$ for traffic demand classified by inter-floor.

In Step SA40, it is performed to plan plural operating modes corresponding to the traffic demand from the data of the work table $PTW(f,f)$ for traffic demand classified by inter-floor predicted in Step SA30.

In Step SA50, simulations are performed in the operating mode planning part P30 of FIG.1 based on the same traffic demand on the plural operating modes planned in Step SA40.

Based on the result, an overall evaluation is performed by putting weights determined by customer's needs on plural evaluation values such as an average waiting time, a ratio of long waiting, a ratio of using staircase, number of transporting persons and so on, and a set operating mode is selected. That is, in Step SA50 there is provided an operating mode selecting means. As to the operating mode such as a skip operation or a dividing express operation, one-round time of an elevator or number of transporting persons can be obtained by calculation without performing simulation.

In Step SA60, it is judged whether or not the operating mode planned and selected in Step SA40 is better than the present operating mode from the service view points such as average waiting time, ratio of long waiting and so on. In Step SA70, processing for re-setting the operating mode planned in Step SA40 is executed instead of the present operating mode.

FIG.4 is a flow chart explaining the processing of the operating mode planning process in Step SA40 of FIG.3.

In FIG.4, in Step BS10, the data of the work table PTW(f,f) for traffic demand prediction classified by inter-floor generated in Step SA30 of FIG.3 is analyzed to extract upper k inter-floors having large inter-floor traffic demands, and the extracted traffic demand data classified by inter-floor is stored in a work table STW(k) (k is number of elevators) for traffic demand between specified floors in large traffic demand order. The traffic demand data values of

the work tables STW(2) to STW(k) for traffic demand between specified floors are compared with the traffic demand data value of STW(1). If the traffic demand data value is, for example, below one-half of the data value of STW(1), the traffic demand data of STW(n) (n is 2 to n) is erased. Therein, although the upper k inter-floors having large inter-floor traffic demands are extracted, it is not limited to this. The extracted data may be fixed to upper four inter-floors. In Step BS20, the total sum of the traffic demand data values of the work tables STW(1) to STW(k) for traffic demand between specified floors is calculated, and an inter-floor traffic demand ratio PSR for between specified floors to the total sum of the traffic demand for all inter-floors is calculated using Equation (1).

15

$$PSR = \frac{\sum_{i=1}^k STW(i)}{\sum_{i=1}^f \sum_{j=1}^f PTW(i, j)}$$

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...(1)

In Step BS30, if the inter-floor traffic demand ratio PSR for between specified floors calculated in Step BS20 is above 1/k (k is number of elevators), Step BS40 is processed. In Step BS40, an operating mode of non-stop operation or skip operation between the specified floors extracted in Step BS10 is planned. Therein, the traffic demand between the specified

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floors for the non-stop operation or the skip operation is dealt in the following processing as if the traffic demand between the specified floors does not exist by clearing the data of the work table $PTW(f,f)$ for traffic demand prediction
 5 classified by inter-floor generated in Step SA30 of FIG.3 to 0 (zero). In Step BS50, number of elevators operated between the specified floors for the non-stop operation or the skip operation extracted in Step SB10 is calculated using Equation (2).

$$10 \quad k1 = PSR \times k \quad \dots(2)$$

In Step SB60, a total sum of traffic demands for ordinary floors excluding congested upper two floors (for example, a ground floor, a restaurant floor and so on) is obtained based on the work table $PTW(f,f)$ for traffic demand prediction
 15 classified by inter-floor generated in Step SA30 of FIG.3, an inter-floor traffic demand ratio PSR between the ordinary floors to the total sum of traffic demands between all floors is calculated using Equation 1.

In Step SB70, it is judged whether or not the inter-floor
 20 traffic demand ratio PSR between the ordinary floors calculated in Step SB60 is within 0.1 (10%). If the inter-floor traffic demand ratio PSR between the ordinary floors is within 0.1 (10%), Step SB80 and Step SB90 are processed. If the inter-floor traffic demand ratio PSR between the ordinary floors is
 25 above 0.1 (10%), in Step SB120 planning is executed on an operating mode for all floor service with $(k-k1)$ elevators

number of which is obtained by subtracting number k_1 of the elevators for non-stop operation calculated in Step SB50 from the total number k of elevators. In Step SB80, divided floors for divided express operation are set since the traffic demands between the ordinary floors are small in Step SB70. Therein, number of elevator for the divided express operation is the number subtracting the number k_1 of the elevators for the non-stop operation from the total number of elevators calculated in BS50. In a case where the number $(k-k_1)$ is an odd number, by using, for example, five elevators and assuming the lowermost floor as a most congested floor, two elevators are used for the lower floor side so as to serve for the traffic demand of nearly 45% to the total demand, and three elevators are used for the higher floor side so as to serve for the traffic demand of nearly 55% to the total demand, and, further, the divided floors are set so that the congested floors both in the lower floor side and in the higher floor side are served. In a case where the number $(k-k_1)$ is an even number, by using three elevators in each of the lower floor side and the higher floor side and the divided floors are set so that the traffic demand from the upper floors becomes nearly 45% to the total demand.

In Step SB90, for the divided floors set in Step SB 80, the traffic demand ratio PSR for the ordinary floors between the divided higher floors and the divided lower floors is calculated based on the work table $PTW(f,f)$ for traffic demand

prediction classified by inter-floor generated in Step sa30 of FIG.3 using Equation 1. If the inter-floor traffic demand ratio PSR for between ordinary floors is below 0.05 (5%), an operating mode of divided express operation without transfer floor is planned since the traffic demand in inter-floor between the higher floor side and the lower floor side is small. If the inter-floor traffic demand ratio PSR for between ordinary floors is above 0.05 (5%), an operating mode of divided express operation with transfer floor is planned since the traffic demand in inter-floor between the higher floor side and the lower floor side is large. Through the above process, an operating mode corresponding to the traffic demand can be planned using the predicted inter-floor traffic demand. The planned operating mode is recorded in an operating mode planning and command recording part T11.

The kinds of data recorded in the operating mode planning and command recording part T11 are operating methods such as ordinary operation, express operation, skip operation, managed operation and so on, data for limiting car control of the elevator such as limitation of hall call register, selection of method of allocating hall call, limitation of car call register, control of door opening and closing time and so on. Among these data, the kinds of data which are directly necessary for the car control are recorded in an elevator control data recording part T10.

FIG.5 is a figure showing an embodiment of the table constructions such as work table for traffic demand used in FIG.3 and FIG.4.

FIG.6 to FIG.9 are examples of operating mode plan corresponding to a traffic demand between a certain time period in lunch hours taking a building as a model. The specification of the building is number of floors is twelve, number of elevator is six, ground floor is first floor and restaurant is located on twelve floor.

FIG.6 is a bar chart showing number of persons getting-on and -off for each of floors during lunch hours. It is assumed that staggered lunch system is employed in this building during lunch hours.

FIG.7 shows a table diagram in which the number of persons getting-on and -off in FIG.6 is expressed by taking the data of the work table $PTW(f,f)$ for traffic demand prediction classified by inter-floor in Step SA30 of FIG.3 in the row direction as getting-on floors and in the column direction as getting-off floors, and a table in which the contents of the work table $STW(k)$ for traffic demand between specified floors is shown by extracting the upper k floors (in this case upper six floors) having large traffic demands in the process of Step SB10 from the data of the work table $PTW(f,f)$ for traffic demand prediction classified by inter-floor. Therein, the upper four inter-floors $STW(1)$ to $STW(4)$ are used because of condition of the magnitudes of traffic demands.

FIG.8 is a diagram showing an example of a planned operating mode which is obtained through operating mode planning processing of FIG.4 based on the data of the work table $PTW(f,f)$ for traffic demand prediction classified by inter-floor shown in FIG.7 and the work table $STW(k)$ for traffic demand between specified floors. In FIG.8, it is planned that the elevator No.5 serves only upward hall call from seventh floor and tenth floor and runs to twelfth floor of restaurant floor in non-stop operation, and the elevator No.6 serves only downward car call from twelfth floor of restaurant floor in non-stop operation. In regard to the elevators No.1 to No.4, divided express operation is planned so that the elevators No.1 and No.2 serve for first floor to fifth floor and twelfth floor and the elevators No.3 and No.4 serve for first floor and sixth floor to twelfth floor.

FIG.9 is a diagram showing decomposition of the number of persons getting-on and -off for each floors of FIG.6 based on the operating mode planned in FIG.8. In FIG.9, (a) shows an upward-dedicated non-stop operation which corresponds to the elevator No.5 in FIG.8, (b) shows a downward-dedicated non-stop operation which corresponds to the elevator No.6 in FIG.8. (c) shows a lower floor divided express operation which corresponds to the elevators No.1 and No.2, and (d) shows an upper floor divided express operation which corresponds to the elevators No.3 and No.4.

Thus the operating mode planned in FIG.8 is evaluated, and it is judged whether or not the planned operation mode is better than the present operating mode. If the planned operation mode is better than the present operating mode, the
5 planned operating mode is set.

Since there is a function to re-set the operating mode corresponding to the inter-floor traffic demand as described above, servicing floors corresponding to the traffic demand can be set. Even when number of elevators is short against a
10 traffic demand, especially, during a congested time period such as lunch hours, the transporting capability on congested floors can be improved without degrading service for ordinary floors.

As the operating mode is determined to be changed, the
15 processing proceeds to a guiding method selection part P05.

The guiding method selection part P05 operates as shown in the flow chart of FIG.10. That is, in Step S210, the guiding method selection part P05 reads data recorded in the operating mode planning and command part T11, and judges whether or not
20 the operating mode is changed. If the operating mode is not changed, the processing proceeds to Step S280. If the operating mode is changed, the processing proceeds to Step S230 to select notifying data according to the operating mode. Then, proceeding to Step S240, by comparing with data of the
25 notifying method history recording part T06, it is judged whether or not the selected notifying data differs from the

precedent one for the same operating mode. If it differs, the processing proceeds to Step S250. If it does not differ, the processing proceeds to Step S260.

The recording tables in the notifying method history recording part T06 record the notifying modes corresponding to the respective operation modes, as shown in FIG.13. The recording table is constructed to store the nearest notifying data among the respective notifying mode for each of the notification and announcement apparatuses, and data such as notification announced time period, display date. In a case of occurrence of the same operating mode as one in the past, with the recording tables the selected notifying method can be compared with the contents of announcement in the past. The notifying mode 1 and the notifying mode 2 are for notifying modes at control operation and ordinary operation, respectively, and guiding may be performed by selecting a suitable one from pre-determined notifying modes corresponding to the status of the elevator at that time. Therefore, there is no need to store the histories for such operating modes.

The various kinds of the notifying modes are recorded in the notifying mode setting recording part. The above data construction may be provided kinds of day such as sun day, ordinary day and holiday instead of display date. In Step S250, the notifying data is modified so as to perform an appeal notification and the processing proceeds to Step S280. In Step S260, it is judged whether or not the error operating ratio

becomes below a given value (3%). If the error operating ratio is not below the given value, the processing proceeds to Step S280. If it is below the given value and the appeal notification has been performed, the recording table of the notifying method instruction recording part is changed so as to release the appeal notification and the processing proceeds to Step S280. After the processing is completed, in Step S280, notifying data including data of the car status recording part T01 is generated and is stored in a recording table of a notifying method setting and recording part T07. In the notifying method setting and recording part T07, the pre-determined notifying contents corresponding to operating modes are recorded.

In this processing, the appeal notification is not released by the error operation ratio but is performed for the pre-determined time period, as explained by Step S260 but not shown in the figure. Even if the error operation ratio is high, the appeal notifying mode is switched to the ordinary notifying mode after a certain guiding time period. For example, in a case of changing service floors in a dividing express operation, a notification in an appeal mode is performed for 10 minutes every after-office hours for a week before the change, and at the time starting the change the notification in the appeal mode is also performed 5 minutes before the change of the operating mode and while the elevator is being operated by the changed operating mode. The time

period for continuing the appeal notification is set to nearly one week, and if the error operating ratio becomes below 3%, the value described above, the notification in the appeal mode is changed to the ordinary mode.

5 In a case where the operating mode is suddenly changed to the divided express operating mode, a notification in an appeal notifying mode is performed 5 minutes before the change and continued while the elevator is being operated by the dividing express operating mode. Further, a notification in
10 an appeal mode for restriction of boarding is performed 5 seconds before closing the door in order to call the users' attention even when the operating mode is not changed. When it is necessary to call the users' attention like the above case, convenience for the users can be improved by changing
15 a notifying mode such as using an appeal notifying mode.

 In a case where a voice guiding apparatus is used as a guiding announcement method, when change of the operating mode is decided, a display voice code generating part P09 generates a control code for display and voice, and records it to a table
20 of a display and voice code setting and recording part T12. Details of the appeal notifying mode is to be described later.

 A hall call registering part P02 registers a new hall call registered by the hall call registering apparatuses X05-1 to -n to a table of a hall call register recording part T05. A
25 hall call allocating part P07 allocates new hall calls registered in the hall call registering part T05 to each of

the elevators according to hall call limiting data recorded in the operating mode planning and instructing part T11 and records the result in the hall call allocating recording part.

A group/ car control part P10 performs processing to
5 periodically transmit each kind of data generated by the group management control system X01, that is, data recorded in each of the recording parts in the hall call allocating recording part T09, in the elevator control recording part T10 and in the display/voice control code recording part T12 to each of
10 the car control apparatuses X02-A to -D through a network transmission line L01.

The processing of the car control apparatuses X02-A to -D will be described below, referring to the flow chart of the car control apparatus shown in FIG.11.

15 The car control apparatus is reset-started by switching the power source on in Step S300 and performs initial processing in Step S310. Then, in Step S320 car call processing is executed, and in Step S340 and Step S350, display/voice control code data transmitted from the group
20 management control system is transmitted to each of the display guiding apparatuses X03-A1 to An, X03-B1 to Bn, X03-C1 to Cn, X03-D1 to Dn through a network transmission lines L02-A to -D. In Step S360, elevator control processing is executed and the processing is returned to Step S320. This processing
25 is repeated with a certain period.

An embodiment of a display notifying apparatus using an LED display device of 4-panel 8-half-sized character type shown by HX1 in FIG.12 will be described below. Each of the four panels a to d is constructed with 16×16 LEDs and can display various kinds of characters as well as one full sized character, two half-sized characters. It is no need to say that another kind of LED display device or a liquid crystal display device can be used. Two kinds of transmission formats FH1, HF2 to the display devices are employed. In a case of the transmission format of HF1, complex display can be performed, but periodic communication between 0.1 to 1 second is required. Therefore, in a transmission method such as RS-422A communication, transmission of 20 byte data for each of eight floors requires

20(bytes)×11(bits)×8(floors)/4800(bps) = 0.37 seconds.

Therefore, the transmission method such as RS-422A communication cannot practically be used since the load is too high.

In a case of a transmission format of HF2, once data is transmitted there is no need to change the data until contents of the data is changed since operations of the display devices are specified. Therefore, a low speed transmission method such as RS-422A can be sufficiently used.

FIG.14 is a table showing the relationship between each of the operating modes and set value for error operation probability. Decrease in the efficiency of operation can be

suppressed by setting a pre-set value for error operation probability high in a case where limitation of control mode is severe such as the divided express operation in office-going hours, and by setting a pre-set value for error operation probability low in a case where limitation of control mode is loose. The column of controlling car call in control mode in the table shows capability of car stop on a non-specified floor after a user has boarded. That is, the mark $\times$ indicates a case where car call stop on a floor other than the specified floors is not effective, and the mark $\circ$ indicates a case where car call stop on a floor other than the specified floors is effective.

FIG.15 is a figure showing an example of an appeal display in office-going hours.

The display and notifying apparatus X03-D1-1 shows an example of display for the car No.4 using an ordinary notifying mode 2 on the first floor. The reference character LP12-A indicates that hall call for upward direction is registered in the car No.4, and magnitude of area occupied by different color lamps indicates waiting time. The reference character LP11-B indicates a present position of the car No.4, the reference character LP11-C indicates the running direction of the car No.4, and the reference character LP11-D indicates the door motion of the car No.4 on the other floor. By displaying the present status of the elevator allocated for hall call in normal hours, the users are notified to the allocated elevator

and are prevented from irritation. On the other hand, in a case of divided express operation during office-going hours, it is necessary that waiting users are effectively notified by notifying the users of the present allocation status of the elevators. Therefore, it is necessary to actively notify the users of the information on service floors of the car No.4 using display of the notifying mode 3 as shown by the reference character X03-D1-2 instead of the normal display. In a case where the service floors shown by Y01 during office-going hours is changed to the service floors shown by Y02 by change in data of the operating mode planning and command recording part T11 in FIG.1 due to change in the traffic demand caused by change of tenant or some reason, display indicated by the reference character X03-D1-3 is employed in order to notify the users of the change. In order to appeal the change point, only the changed portion of the display is expressed by a hollow character different from the others, as shown by the reference character LP11-C-A. there is no need to say that display in a color attracting attention may be employed instead of the hollow character. Further, it is possible to prevent occurrence of erroneous boarding caused by change in the service floors by performing voice notification indicated by the reference character A01 in order to call the users' attention. As having been described, the appeal notifying means a notification in which a notifying mode attracting users' attention different from an ordinary

notifying mode is used. In a case of using a display device, the appeal display here is defined by display which differs from ordinary display types such as using a different color as described above or using flicker display. In a case of
5 voice notification, it is possible to attract users' attention by making a sound attracting users' attention such as alarm whistle before starting the voice notification, by changing sound volume or by repeating to announce the same contents several times.

10 FIG.16 is a figure showing an example of notification display for each floor in office-going hours which is shown as the service floors by Y01 in FIG.15. The reference character Y01A is an example of display for all elevators and all floors. The reference character X03-D0-11 indicates an
15 example of a display for the car No.4 on the B1 floor where no elevator serves during office-going hours. The display has a no entry mark, time period during no entry and reason for no entry, which advises to use the staircase. Since the notifying method history table T06 stores display time
20 periods, the appeal display can be performed when the time period is different. The reference character X03-D1-11 indicates an example of a display for the car No.4 on the first floor. This is an example of upward hall call being allocated, and an allocated direction, waiting time and destination floor
25 are displayed. The reference character X03-D2-11 indicates an example of a display for the car No.4 on the second floor.

Since the elevator No.4 does not serve the second floor, there is a display indicating no entry and the reason to conduct the users to the other elevators. This is the same for the third floor to the seventh floor. The reference character X03-D8-11 shows a display for the car No.4 on the eighth floor. Since hall call is not allocated as shown in the figure, only floors available service are displayed. The same as on the ninth floor to the twelfth floor. The reference character X03-D13-11 is an example of display for the car No.4 on the thirteenth floor. Since most of the users seldom gather on the floors other than the first floor of the lobby floor during office-going hours, a display used during ordinary time is used when hall call is allocated on the floor.

FIG.17 is a figure showing an example of a previous announcement display after-office hours. A display indicated by X03-D1-2 was displayed in the car No.4 on the first floor during office-going hours on the previous day in order to do a divided express operation with the service floors shown by Y01 in FIG.17. However, on the next day the operation necessitates to be changed to the service floors shown by Y02 in FIG.15 due to change in the traffic demand of the building. Data of the operating mode planning and command table T11 is consequently changed to result the service floors shown by Y02. In such a case, it is possible to notify which elevator should be used in office-going hours on the next day by displaying three displays of the notifying mode 6, X03-D8-1,

X03-D8-2 and X03-D8-3 being switched cyclically during after-office hours in advance. Further it is possible to notify only relating persons by displaying only the elevator allocated hall call in the downward direction during after-office hours.

5 The reference character LP18-A indicates a display for waiting time to hall call in the downward direction, the reference character LP18-D indicates door opening and closing status on the other floor and presence and absence of boarding persons. The reference character X03-D1-3 is an example of a display

10 of the car No.4 on the first floor on the day when the change is performed. In the figure, although the previous announcement is displayed by switching method, there is no problem when it is displayed by scroll display. The contents of the operating mode planning and command table T11 can be

15 changed from an input device externally provided, and the aforementioned switching of display mode is performed by inputting the change in the operating mode from the external input device. The input may be performed any time, and of course, the operating mode change can be input by specifying

20 the date in advance.

FIG.18 is a figure showing a display in a case of occurrence of a failure in one elevator during divided express operation in first-half of lunch hours. When the elevators are operated in a divided express operation with service floors

25 shown by Y03 during lunch hours, a display for the car No.2 on the first floor is as shown by X3-B1-1 and a display for

the car No.4 is as shown by X03-D1-6. At that time a failure occurs in the car No.2 and the car is brought to a state incapable of serving. In this case, service for the sixth floor to the tenth floor is largely decreased. The operation mode planning and command part P08 of FIG.1 recognizes an abnormal state of the car No.2 by the car status recognizing part T01, and in order to prevent the service for the sixth floor to tenth floor from decreasing automatically changes the operating mode planning and command table T11 of FIG.1 to allocate service floors, for example, as shown by Y04. In that time, the display for the car No.2 on the first floor is a display "FAILURE OCCURS" in notifying mode 1 for notifying the failure as shown by X03-B1-2, and the display for the car No.4 is a display of serviceable floors as shown by X03-D1-7. Since the service floors are largely changed in a short time, the displays are flickered. In addition to this, a voice notification shown by A02 is performed at the same time to call the users' attention. Setting an elevator servicing all floors as the car No.4 in Y03 during divided express operation is determined by the customer request recording part table T03. At that time, displays such as "normal", "express" are displayed in the hall call buttons as shown by X06-15, X06-25 in FIG.19, and the users can call an elevator on which they want to board.

FIG.19 shows an example of a divided express operation in first-half lunch hours without limiting car call and with

limiting display, hall call and door opening and closing time. The service floors for each of the elevators are as shown in Y05, and the displays on the fifth floor of restaurant floor are as X03-A5-10, X03-B-5-10, X03-C5-10, X03-D5-10 in
5 notifying mode 4. The reference character HLT1 is a hall lantern which indicates arriving of an elevator in the downward direction. At this time, when car call not displayed in the display device is registered, the service is performed, but the error operation detecting program P01 detects it as
10 an erroneous operation and percentage ratio of error operations to 50 times of car calls is counted. If the ratio exceeds 20% of the preset value for the error operation probability determined in FIG.14, the displays X03-A5-11, X03-B-5-11, X03-C5-11, X03-D5-11 are flickered. In addition to
15 this, a voice notification such as A03 is performed to call the users' attention. If the error operation probability becomes 15%, the flicker display and the voice notification are released to prevent a users' complaint against the intense display or the troublesome voice. If the error probability is
20 further low, for example, below 3%, car call control may be executed.

Another embodiment will be described below, referring to FIG.20.

FIG.20 shows a solely operated elevator control system
25 which has function of the group management control system X01 and the car control apparatuses X02-A to -D in FIG.1.

Different points from FIG.1 will be described.

Firstly, the hall call allocation part P07 in the group management control system of FIG.1 is changed to a hall call response order determining part P27 in this embodiment. The
5 hall call response order determining part determines service order for hall call based on the data recorded in the operating method selection recording part T10 and the hall call register recording part T05. Although it is limited to a case of solely operated elevator, it is possible to improve
10 the transportation efficiency by setting the operation method to an operation mode such as specified floor service mode or dedicated operation mode.

The traffic demand judging part P04 judges using data of the traffic information and use status accumulation recording
15 part T04 whether or not the operating mode is changed from the traffic demand and notifies the necessity of the change to the operating method planning and command part, as the same as in the group management control system.

The operating method selection and command part P08 judges
20 whether or not there is a change command for operating mode due to schedule or traffic demand using the data from the use information collecting and error operation detecting part P01 and the traffic demand judging part P04. If there is no command, the mode is maintained as before. If there is the
25 command, the operating method selection and command part reads two kinds of operating modes suitable for the time element and

the traffic demand element at that time from the operating method selection and command recording part, and records it to the operating method selection and command recording part.

The operating method selection and command recording part
5 T10 stores an ordinary operating mode, a forced express operating mode, a notifying control express operating mode, a skip operating mode (an operating mode in which service is performed for every other floors.), a skip operation multi
10 operation mode (an operating mode in which service is performed on the floors in the ordinary skip operating mode and additionally on congested floors, or excluding service floors predicted no boarding persons from the traffic demand.), as well as data for limitation in hall call, limitation change in hall call service order, limitation in
15 car call register.

The display voice code generating part P09 generates a control code for display and voice according to data of the notifying method setting recording part T07, and records it to the display and voice control code recording part.

20 The hall call registering part P02 registers a new hall call registered by the hall call registering apparatuses X05-1 to -n to the hall call register recording part T05.

The hall call response order determining part P27 determines service order according to hall call limiting data
25 of the operating method selection and command recording part T10, and commands to serve new hall calls registered in the

hall call registering part T05. The service order is recorded in the hall call response command recording part T09.

The I/O transmission part P10 has a program for periodically transmitting data generated in the car control apparatus E01, that is the hall call response command recording part T09 and the display and voice control code recording part T11 through an I/O transmission line of bus type.

In the embodiment, the notifying mode of the notification and announcement apparatus can be changed when an operating mode is decided to be changed as shown in the aforementioned embodiment of FIG.10. Therefore, when data for changing the operating mode is transmitted from the operating mode selection and command recording part T10, the notifying method selecting part P05 reads the data of the notifying method history recording part T06 and decides notifying contents and a notifying mode corresponding to the operating mode. The decided notifying contents and the decided notifying mode are recorded in the notifying method setting recording part T07. Time to announce the notification is also recorded in the notifying method setting recording part T07, and when it becomes the preset time, the corresponding notifying contents and the corresponding notifying mode of the notifying method setting recording part T07 are converted into control codes by the display and voice control code generating part P09. The converted codes are recorded in the display and voice control

code recording part T11, and then transmitted to a notification and announcement apparatus on the corresponding floor through the I/O transmission part P10. As described above, the notifying contents are can be changed according to the operating mode. However, the notifying mode may be changed to an appeal notifying mode depending on the kind of the changed operating mode, as described above. By doing so, the users easily understand the change of operating mode and the elevators can be operated smoothly.

10 In the above, although the appeal notifying mode is limited to be used for the operating modes such as the step service operation and the express operation, users' convenience can be improved by using the appeal notifying mode to the other operating modes depending on change in service state. For example, in a case where service of a specified car is stopped for a specified time period due to scheduled inspection or the like, the scheduled stoppage is announced in an appeal mode during a certain time period on the previous day or before the stoppage. By doing so, the users can understand the stoppage in advance and may avoid to use the elevator. Further, while service of the elevator is stopped due to maintenance, it can be notified that the elevator cannot be used by displaying a display in an appeal mode, for example, the "NO ENTRY" mark shown by FIG.21 (a) or (b) in
25 flicker display.

In a case where many persons gather on a specified floor and car waiting time is to be increased and it is judged that the extremely long-time waiting can be avoided by that the users on the floor just below the specified floor positively use an elevator running in the opposite direction, direction lanterns for both directions are lighted and sentence shown in FIG.21 (C) or a "U-TURN" mark, not shown in the figure, is displayed, and further an appeal mode such as flicker display mode is actively used for the display. By doing so, the long-time waiting can be avoided. Furthermore, in a case of notifying waiting time, an animation display (for example, using an animation of animals) may be used in order to not cause the users' irritation. This is one of the appeal displays in accordance with the present invention.

According to the present invention, in an elevator control system automatically setting divided floor zone of each elevator or number of elevators to an optimum operating mode to individual building during congested hours such as office-going hours, lunch hours or the like, when an automatically set result becomes an operating mode different from the previous operating mode due to change in the traffic flow, it is possible to clearly notify the users of the change by changing color or notifying mode of the changed points, and the users can board on the elevator without error, and consequently there is an effect to prevent decreasing of the transportation capability during time period of a high traffic

demand such as a divided express operation.

Further, by measuring an error operation probability and performing setting release of change in a notifying mode based on the result, the duration time of changing in the notifying mode can be made necessary and minimum. Thereby, it is possible to prevent the building's beauty from spoiling, and to prevent customers' complaints.

Furthermore, by performing divided express operation using only control of the notifying apparatus without limiting car call register, service for any floor can be performed even if car call register button for the floor not notified is registered and consequently an erroneous boarding passenger can get off on his destination floor.



What is claimed is:

1. An elevator control system comprising an elevator serving a zone of plural floors and a controller for controlling said elevator, wherein

5 a notifying announcement apparatus is provided in any one of a place near the entrance of said elevator on at least one service floor and a place in a car; and

said controller comprises:

an operating mode changing part for automatically changing
10 a service state and an operating mode based on any one of use status and reservation information;

a notifying command part for notifying operating information necessary for users;

a notifying mode changing part for changing an ordinary
15 notifying mode of an notification of said notifying and announcement apparatus to an appeal mode when said operating mode changing part changes any one of operating mode and service status to a specified status.

20 2. An elevator control system according to claim 1, wherein in a case where a display device is used for said notifying apparatus, said appeal mode is to perform any one of changing color in a specified portion of a display, flicker display, reversed display and repeating display.

25

3. An elevator control system according to claim 1, wherein in a case where a voice notifying apparatus is used for said



notifying apparatus, said appeal mode is to change at least one of sound volume, sound quality and starting time.

4. An elevator control system according to claim 1, wherein
5 said operating modes are an ordinary operating mode for servicing all the floors, a non-stop operating mode for servicing only a specified floor, an express operating mode for limiting servicing zone such as upper floors, middle floors, lower floors and the like, a skip operating mode for
10 servicing a plurality of specified floors.

5. An elevator control system according to claim 1, wherein said specified service statuses are permission service for boarding in opposite direction at occurrence of long waiting,
15 boarding prohibition during maintenance and inspection, starting state of door closing, ineffectiveness of closing button in car, both directions hall call resetting process, time requiring maintenance and inspection and the like.

20 6. An elevator control system according to claim 1, wherein a plurality of said elevators are provided; said controller being composed of car controllers for controlling operation of elevators respectively, and a group management control system for commanding servicing floors to each of the car
25 controllers; said operating mode changing part and said notifying mode changing part being provided in said group management control system.



7. An elevator control system comprising a plurality of elevators serving a zone of plural floors, controllers for controlling said elevators respectively, and a group management control system having allocating means for allocating the
5 elevator serving for hall call, wherein

a notifying announcement apparatus is provided in any one of a place near the entrance of said elevator on at least one service floor and a place in a car; and

said group management control system comprises:

10 an operating mode changing part for automatically changing any one of an operating mode and a service status based on one of learned result of use status and schedule reservation information;

a notification command part for notifying users of any
15 one of necessary operating information and service information; and

a notifying mode changing part for changing an ordinary notifying mode of an notification of said notifying and announcement apparatus to an appeal mode when said operating
20 mode changing part changes any one of operating mode and service status to a specified status.

8. An elevator control system according to claim 7, wherein in a case where a display device is used for said notifying
25 apparatus, said appeal mode is to perform any one of changing color in a specified portion of a display, flicker display, reversed display and repeating display.



9. An elevator control system according to claim 7, wherein in a case where a voice notifying apparatus is used for said notifying apparatus, said appeal mode is to change at least one of sound volume, sound quality and starting time.

5

10. An elevator control system according to claim 7, wherein said operating modes are an ordinary operating mode for servicing all the floors, a non-stop operating mode for servicing only a specified floor, an express operating mode for limiting servicing zone such as upper floors, middle floors, lower floors and the like, a skip operating mode for servicing a plurality of specified floors.