DESCRIPTION

ELEVATOR GROUP MANAGEMENT CONTROL APPARATUS AND ELEVATOR GROUP MANAGEMENT CONTROL METHOD

Field

Embodiments of the present invention relate to an elevator group management control apparatus and an elevator group management control method.

Background

An elevator is usually provided as an elevator group which includes a plurality of elevators, so that a plurality of cars thereof is integrally managed as a group by an elevator group management control apparatus in some cases.

Summary

~~An object of embodiments is to~~Embodiments of the present invention provide an elevator group management control apparatus that is capable of providing energy saving while maintaining the proper service performance, thereby allowing the balance between the service performance and the energy-saving performance to be optimized.

~~According to an embodiment, an elevator group management control apparatus for managing an elevator group including a plurality of cars includes an actual value aggregation unit, a target setting unit, an operating time adjustment unit, and an operating time management unit. The actual value aggregation unit is configured to aggregate an actual response time value that is an actual value of a response time corresponding to a time from when a hall call is registered to when the car responds to the hall call. The target setting unit is configured to set a target response time value that is a target value of the response time. The operating time adjustment unit is configured to adjust an energy saving level so that the actual response time value aggregated by the actual value aggregation unit converges to~~

~~the target response time value set by the target setting unit, the energy saving level representing the degree of energy saving that affects the actual response time value of the elevator group. The operating time management unit is configured to create on the basis of the energy saving level a car mask for limiting a car able to respond to a call.~~

According to a first aspect of the present invention, there is provided an elevator group management control apparatus for managing an elevator group including a plurality of cars, the apparatus comprising: an actual value aggregation unit configured to aggregate an actual response time value that is an actual value of a response time corresponding to a time from when a hall call is registered to when the car responds to the hall call; a target setting unit configured to set a target response time value that is a target value of the response time; an operating time adjustment unit configured to adjust an energy-saving level so that the actual response time value aggregated by the actual value aggregation unit converges to the target response time value set by the target setting unit, the energy-saving level representing the degree of energy saving that affects the actual response time value of the elevator group; and an operating time management unit configured to create on the basis of the energy-saving level a car mask for limiting a car able to respond to a call, wherein the energy-saving level is set according to the number of cars in operation per unit time, the number of cars in operation being a parameter that can take a decimal value, when the number of cars in operation is an integer value, the number of cars in operation representing that the integer number of the cars can be assigned, and when the number of cars in operation is a decimal value, the number of cars in operation representing a proportion of time that can be assigned in a unit time interval.

According to a second aspect of the present invention,

there is provided an elevator group management control method for managing an elevator group including a plurality of cars, the method comprising: aggregating an actual response time value that is an actual value of a response time corresponding to a time from when a hall call is registered to when the car responds to the hall call; setting a target response time value that is a target value of the response time; adjusting an energy-saving level so that the actual response time value aggregated converges to the target response time value set, the energy-saving level representing the degree of energy saving that affects the actual response time value of the elevator group; and creating, on the basis of the energy-saving level, a car mask for limiting a car able to respond to a call, wherein the energy-saving level is set according to the number of cars in operation per unit time, the number of cars in operation being a parameter that can take a decimal value, when the number of cars in operation is an integer value, the number of cars in operation representing that the integer number of the cars can be assigned, and when the number of cars in operation is a decimal value, the number of cars in operation representing a proportion of time that can be assigned in a unit time interval.

According to the elevator group management control apparatus described above, it is possible to provide energy saving while maintaining the proper service performance, thereby allowing the balance between the service performance and the energy-saving performance to be optimized.

Brief Description of Drawings

FIG. 1 is a block diagram illustrating the outline of a group management control apparatus according to an embodiment.

FIG. 2 is a diagram illustrating an example of a record of operation of a car created by the group management control apparatus according to the embodiment.

FIG. 3 is a diagram illustrating an example of a target setting input screen used by the group management control apparatus according to the embodiment.

FIG. 4 is a diagram illustrating an example of an energy-saving level setting table created by the group management control apparatus according to the embodiment.

FIG. 5 is a time chart illustrating an example of an operating time schedule set by the group management control apparatus according to the embodiment.

FIG. 6 is a time chart illustrating an example of the operating time schedule set by the group management control apparatus according to the embodiment.

FIG. 7 is a flowchart illustrating an example of control performed by the group management control apparatus according to the embodiment.

FIG. 8 is a diagram illustrating an example of a car mask created by the group management control apparatus

CLAIMS

1. An elevator group management control apparatus for managing an elevator group including a plurality of cars, the apparatus comprising:

an actual value aggregation unit configured to aggregate an actual response time value that is an actual value of a response time corresponding to a time from when a hall call is registered to when the car responds to the hall call;

a target setting unit configured to set a target response time value that is a target value of the response time;

an operating time adjustment unit configured to adjust an energy-saving level so that the actual response time value aggregated by the actual value aggregation unit converges to the target response time value set by the target setting unit, the energy-saving level representing the degree of energy saving that affects the actual response time value of the elevator group; and

an operating time management unit configured to create on the basis of the energy-saving level a car mask for limiting a car able to respond to a call.

2. The apparatus according to claim 1, wherein

the energy-saving level is set according to the number of cars in operation and a switch pitch between a state where a predetermined one of the cars responds to a call and a state where the predetermined one does not respond to the call, and

the number of cars in operation is an average number of cars in operation per unit time, takes a value corresponding to a total number of the cars of the elevator group when the energy-saving level is at a lowest level, and decreases as the energy-saving level is increased from the lowest level.

3. The apparatus according to claim 1, wherein the operating time adjustment unit is configured to set in advance a time period during which the energy-saving level is not adjusted.

4. The apparatus according to claim 1, wherein the operating time adjustment unit is configured to individually set in advance a default value of the energy-saving level.

5. The apparatus according to claim 1, wherein the operating time management unit is configured to, when creating the car mask, select from among preset candidates the car that has a restriction on responding to a call.

6. The apparatus according to claim 1, further comprising a display controller configured to cause a display unit to display information related to the target value set by the target setting unit and information related to the actual value aggregated by the actual value aggregation unit.

7. The apparatus according to claim 1, further comprising a group management controller configured to manage an operation of the plurality of cars on the basis of the car mask created by the operating time management unit.

8. The apparatus according to claim 1, wherein

the actual value aggregation unit is configured to aggregate an average actual response time value that is an average value of the actual response time value in every fixed time interval that is preset,

the target setting unit is configured to set an average target response time value that is a target value of the average actual response time value in the every fixed time interval,

the operating time adjustment unit is configured to

adjust the energy-saving level in the every fixed time interval so that the average actual response time value in the every fixed time interval aggregated by the actual value aggregation unit converges to the average target response time value set by the target setting unit, and

the operating time management unit is configured to create the car mask on the basis of the energy-saving level in the every fixed time interval.

9. The apparatus according to claim 8, wherein the operating time adjustment unit is configured to change by the day the energy-saving level in the every fixed time interval one level at a time.

10. The apparatus according to claim 8, wherein the operating time adjustment unit is configured to changes by the day the energy-saving level in the every fixed time interval according to a deviation between the average actual response time value in the every fixed time interval and the average target response time value.

11. The apparatus according to claim 8, wherein

the elevator group includes an in-hall destination registration device configured to register a destination floor in an elevator hall, and

the actual value aggregation unit is configured to aggregate as an average actual response time value in the every fixed time interval either an average actual waiting time value in the every fixed time interval or a pseudo average actual response time value corresponding to an average waiting time on a floor where the in-hall destination registration device is installed.

12. The apparatus according to claim 8, wherein the operating time adjustment unit is configured to relatively

decrease the energy-saving level in the fixed time interval when the average actual response time value in the every fixed time interval is greater than the average target response time value, and relatively increase the energy-saving level in the fixed time interval when the average actual response time value in the every fixed time interval is smaller than the average target response time value, to adjust the energy-saving level in the every fixed time interval so that the average actual response time value in the every fixed time interval converges to the average target response time value.

13. The apparatus according to claim 8, wherein

the actual value aggregation unit is configured to further aggregate an actual operating power consumption value that is an actual value of power consumed when the elevator group is operated, and

the target setting unit is configured to calculate a target operating power consumption value on the basis of the actual operating power consumption value per day with no energy saving implemented and a preset target operating power consumption reduction rate per day, and set the average target response time value that is allowable so that the actual operating power consumption value in the every fixed time interval aggregated by the actual value aggregation unit converges to the target operating power consumption value.

14. The apparatus according to claim 8, wherein

the actual value aggregation unit is configured to further aggregate the actual value of the number of users that is an actual value of the number of persons who use the elevator group,

the apparatus further comprises a sudden traffic demand detector configured to detect an occurrence of a sudden traffic demand on the basis of a change in the average actual

response time value in the every fixed time interval aggregated by the actual value aggregation unit or an actual value of the number of users, and

the operating time adjustment unit is configured to set the energy-saving level to a lowest level when the occurrence of the sudden traffic demand is detected by the sudden traffic demand detector, and bring the energy-saving level back to a level before the occurrence of the sudden traffic demand when the sudden traffic demand detector detects an end of the sudden traffic demand.

15. An elevator group management control method for managing an elevator group including a plurality of cars, the method comprising:

aggregating an actual response time value that is an actual value of a response time corresponding to a time from when a hall call is registered to when the car responds to the hall call;

setting a target response time value that is a target value of the response time;

adjusting an energy-saving level so that the actual response time value aggregated converges to the target response time value set, the energy-saving level representing the degree of energy saving that affects the actual response time value of the elevator group; and

creating, on the basis of the energy-saving level, a car mask for limiting a car able to respond to a call.

CLAIMS:

[Claim 1]

An elevator group management control apparatus for managing an elevator group including a plurality of cars, the apparatus comprising:

an actual value aggregation unit configured to aggregate an actual response time value that is an actual value of a response time corresponding to a time from when a hall call is registered to when the car responds to the hall call;

a target setting unit configured to set a target response time value that is a target value of the response time;

an operating time adjustment unit configured to adjust an energy-saving level so that the actual response time value aggregated by the actual value aggregation unit converges to the target response time value set by the target setting unit, the energy-saving level representing the degree of energy saving that affects the actual response time value of the elevator group; and

an operating time management unit configured to create on the basis of the energy-saving level a car mask for limiting a car able to respond to a call, wherein

the energy-saving level is set according to the number of cars in operation per unit time, the number of cars in operation being a parameter that can take a decimal value, when the number of cars in operation is an integer value, the number of cars in operation representing that the integer number of the cars can be assigned, and when the number of cars in operation is a decimal value, the number of cars in operation representing a proportion of time that can be assigned in a unit time interval.

[Claim 2]

The apparatus according to claim 1, wherein

the energy-saving level is set further according to a pitch that is a switch pitch between a state where the cars respond to a call and a state where the cars do not respond to the call, and

the number of cars in operation is an average number of cars in operation per unit time, takes a value corresponding to a total number of the cars of the elevator group when the energy-saving level is at a lowest level, and decreases as the energy-saving level is increased from the lowest level.

[Claim 3]

The apparatus according to claim 1, wherein the operating time adjustment unit is configured to set in advance a time period during which the energy-saving level is not adjusted.

[Claim 4]

The apparatus according to claim 1, wherein the operating time adjustment unit is configured to individually set in advance a default value of the energy-saving level.

[Claim 5]

The apparatus according to claim 1, wherein the operating time management unit is configured to, when creating the car mask, select from among preset candidates the car that has a restriction on responding to a call.

[Claim 6]

The apparatus according to claim 1, further comprising a display controller configured to cause a display unit to display information related to the target value set by the target setting unit and information related to the actual value aggregated by the actual value aggregation unit.

[Claim 7]

The apparatus according to claim 1, further comprising a group management controller configured to manage an operation of the plurality of cars on the basis of the car mask created by the operating time management unit.

[Claim 8]

The apparatus according to claim 1, wherein

the actual value aggregation unit is configured to aggregate an average actual response time value that is an average value of the actual response time value in every fixed time interval that is preset,

the target setting unit is configured to set an average target response time value that is a target value of the average actual response time value in the every fixed time interval,

the operating time adjustment unit is configured to adjust the energy-saving level in the every fixed time interval so that the average actual response time value in the every fixed time interval aggregated by the actual value aggregation unit converges to the average target response time value set by the target setting unit, and

the operating time management unit is configured to create the car mask on the basis of the energy-saving level in the every fixed time interval.

[Claim 9]

The apparatus according to claim 8, wherein the operating time adjustment unit is configured to change by the day the energy-saving level in the every fixed time interval one level at a time.

[Claim 10]

The apparatus according to claim 8, wherein the operating time adjustment unit is configured to changes by the day the energy-saving level in the every fixed time interval according to a deviation between the average actual response time value in the every fixed time interval and the average target response time value.

[Claim 11]

The apparatus according to claim 8, wherein

the elevator group includes an in-hall destination registration device configured to register a destination floor in an elevator hall, and

the actual value aggregation unit is configured to aggregate as an average actual response time value in the every fixed time interval either an average actual waiting time value in the every fixed time interval or a pseudo average actual response time value corresponding to an average waiting time on a floor where the in-hall destination registration device is installed.

[Claim 12]

The apparatus according to claim 8, wherein the operating time adjustment unit is configured to relatively decrease the energy-saving level in the fixed time interval when the average actual response time value in the every fixed time interval is greater than the average

target response time value, and relatively increase the energy-saving level in the fixed time interval when the average actual response time value in the every fixed time interval is smaller than the average target response time value, to adjust the energy-saving level in the every fixed time interval so that the average actual response time value in the every fixed time interval converges to the average target response time value.

[Claim 13]

The apparatus according to claim 8, wherein

the actual value aggregation unit is configured to further aggregate an actual operating power consumption value that is an actual value of power consumed when the elevator group is operated, and

the target setting unit is configured to calculate a target operating power consumption value on the basis of the actual operating power consumption value per day with no energy saving implemented and a preset target operating power consumption reduction rate per day, and set the average target response time value that is allowable so that the actual operating power consumption value in the every fixed time interval aggregated by the actual value aggregation unit converges to the target operating power consumption value.

[Claim 14]

The apparatus according to claim 8, wherein

the actual value aggregation unit is configured to further aggregate the actual value of the number of users that is an actual value of the number of persons who use the elevator group,

the apparatus further comprises a sudden traffic demand detector configured to detect an occurrence of a sudden traffic demand on the basis of a change in the average actual response time value in the every fixed time interval aggregated by the actual value aggregation unit or an actual value of the number of users, and

the operating time adjustment unit is configured to set the energy-saving level to a lowest level when the occurrence of the sudden traffic demand is detected by the sudden traffic demand detector, and bring the energy-saving level back to a level before the occurrence of the sudden traffic demand when the sudden traffic demand detector detects an end of the sudden traffic demand.

[Claim 15]

An elevator group management control method for managing an elevator group including a plurality of cars, the method comprising:

aggregating an actual response time value that is an actual value of a response time corresponding to a time from when a hall call is registered to when the car responds to the hall call;

setting a target response time value that is a target value of the response time;

adjusting an energy-saving level so that the actual response time value aggregated converges to the target response time value set, the energy-saving level representing the degree of energy saving that affects the actual response time value of the elevator group; and

creating, on the basis of the energy-saving level, a car mask for limiting a car able to respond to a call, wherein

the energy-saving level is set according to the number of cars in operation per unit time, the number of cars in operation being a parameter that can take a decimal value, when the number of cars in operation is an integer value, the number of cars in operation representing that the integer number of the cars can be assigned, and when the number of cars in operation is a decimal value, the number of cars in operation representing a proportion of time that can be assigned in a unit time interval.