

OPERATION SPEED COMMAND CONTROLLING APPARATUS AND METHOD FOR ELEVATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an operation speed command controlling apparatus and method for an elevator, and particularly to an improved operation speed command controlling apparatus and method for an elevator which are capable of reducing a waiting time of passengers at a floor, improving an elevator car on-board feeling, and minimizing a call-based running time and a running time error by generating a proper operation speed command signal by detecting whether a passenger is riding in an elevator car or not, and whether an emergency state of an elevator is occurring.

2. Description of the Conventional Art

Generally, for a up/down movement of an elevator car in which a passenger is riding or baggage is loaded, the elevator car moving along a car moving path is connected to a balance weight by a cable. The thusly connected cable is wound and unwound in cooperation with a driving force generated by a direct current motor, an induction motor, or a linear motor. A hydraulic mechanism may be used for winding and unwinding the

cable.

Figure 1 is a schematic block diagram of a conventional operation speed command controlling apparatus.

As shown therein, an elevator car 105 is disposed for loading passengers or baggage. A balance weight 107 is connected to the elevator car 105 by a cable 108 for counterbalancing the weight of the elevator car 105 and reducing the electric consumption of the system. A driving unit 106 including a pulley (not shown) and a motor (not shown) is provided for supplying a driving force to the system, onto which pulley the cable 108 connected between the elevator car 105 and the balance weight 107 is wound. A position detector 104 is disposed for measuring the current position of the elevator car 105 in cooperation with the motor (not shown) of the driving unit 106. A car call button panel 109 and a floor call button panel 110 are respectively arranged in the elevator car 105 and at a floor for respectively generating a car call signal or a floor call signal in accordance with a call requested by a passenger. An operation sequence management unit 100 is connected for determining the priority call from multiple calls by passengers and for comprehensively checking a security system of the elevator when a car call data or a floor call data is transmitted to the system through communication lines 111 and 112. An operation speed command generator 101 is connected for controlling the position of the

elevator car in cooperation with an open control loop in an acceleration interval so that the elevator car 105 can arrive at a floor at which the priority call is generated, controlling a feedback position by a closed control loop in accordance with a car position value $P(kT)$ detected by the car position detector 104 in a deceleration interval, and generating an operation speed command voltage $V(kT)$ by using an adder 101a. An electric power amplifier 102 is connected for amplifying an electric power to a predetermined level so that the operation speed command voltage $V(kT)$ generated by the operation speed command generator 101 causes the elevator car 105 to be controlled by the motor of the driving unit 106.

The conventional operation speed command controlling method for an elevator will now be explained with reference to Figures 2 and 3.

First, when a passenger waiting at a floor or a passenger in the elevator car 105 calls the elevator car 105 or a floor by pushing the floor call button 110 or the car call button 109, a floor call data and a car call data are registered in the operation sequence management unit 100 through one of the two communication lines 111 and 112.

In step ST1 shown in Figure 2, the operation sequence management unit 100 checks which call has the priority among the currently registered calls generated by the pushing of the floor call button 110 and the car call button 109 and generates

an operation speed command signal to the operation speed command generator 101 in order for the priority call to be first performed, and thus a corresponding elevator car is moved in accordance with the thusly generated command signal.

In step ST2, the operation speed command generator 101 checks the priority call from the registered calls of the operation sequence management unit 100 and the current operation speed command state of the elevator car 105, and detects whether the current operation speed command state of the elevator car 105 is related to the acceleration state or the deceleration state.

If as a result of the detection in step ST2, when the current operation speed state of the elevator car 105 is related to the acceleration state or the uniform speed state, the operation speed command generator 101 receives a control command signal with respect to the acceleration or the uniform speed in step ST3, and obtains the operation speed command value $V(kT)$ based on an equation (1), which will be explained later, by using a conventional acceleration pattern. If as a result of the detection in step ST2, the current operation speed command state is related to a deceleration interval, the operation speed command generator 101 receives a control command with respect to the deceleration operation, and obtains an operation speed command value based on an equation (2), which will be explained later. In steps ST3 and ST4, the thusly

obtained operation speed command value is supplied to the electric power amplifier 102.

Namely, as seen in equation (1) below, the operation speed command generator 101 controls the position of the elevator car in order for the operation speed command $V(kT)$ to be generated based on a lapse of time for a predetermined interval irrespective of the position and operation speed of the current elevator car 105 in accordance with the open control loop within the acceleration interval and the uniform speed interval. In addition, a feed-back position is controlled so that the operation speed command $V(kT)$ can be generated based on the remaining distance concerning the position value $P(kT)$ of the current elevator car 105 measured by the car position detector 104 in accordance with the closed control loop to a running time error occurring position so as to reduce the running time error in the deceleration interval.

$$\hat{V}(kT) = \hat{V} \text{ acceleration } (kT) = \alpha_1 \times (kT) \quad \text{----- (1)}$$

where α_1 denotes a maximum acceleration value, and K denotes an acceleration and a uniform speed interval and has a value of $K \in \{1, 2, 3, 4\}$.

$$\hat{V}(kT) = \hat{V} \text{ deceleration } (kT) = 2\alpha_2 \times (\text{dest} - P(kT)) \quad \text{--- (2)}$$

where α_2 denotes a maximum deceleration value, k denotes a deceleration interval and has a value of $K \in \{5, 6, 7\}$, T denotes a control cycle, "dest" denotes a running time error position, and $P(kT)$ denotes the position of the current

elevator car 105.

Namely, as shown in Figure 3, the operation speed command value $V(kT)$ is determined based on a time-based operation speed pattern which increases in accordance with a lapse of time irrespective of the operation speed command value $V(kT)$ within the acceleration interval and the uniform speed interval $K4$ including an acceleration interval $K1$, a uniform acceleration interval $K2$, and an acceleration interval $K3$ in accordance with the conventional acceleration pattern. The operation speed command value $V(kT)$ is transmitted as an operation speed command value. In addition, the operation speed command value $V(kT)$ is determined based on the remaining distance from the current position of the elevator car 105 and the running time error position in order to reduce the running time error in the deceleration interval including a deceleration interval $K5$, a uniform speed interval $K6$, and a deceleration interval $K7$.

In addition, as seen from equations (1) and (2), the time (the cycle: $T1$) during the acceleration interval $K1$ is fixed to a predetermined value irrespective of the car call and the floor call, and then the operation speed command value $V(kT)$ is supplied to the electric power amplifier 102.

In other words, the electrical signal generated by the operation speed command generator 101 at every cycle ($t1$ through $T7$) is weak. Therefore, since it is unable to directly drive the motor (not shown) or the hydraulic unit (not shown)

of the driving unit 106, the operation speed command value $V(kT)$ generated by the operation speed command generator 101 is amplified to a predetermined level by using the electric power amplifier 102, and the thusly amplified value is supplied to the motor or the hydraulic unit of the driving unit 106.

In step ST5 shown in Figure 2, the motor or the hydraulic unit of the driving unit 106 is driven in accordance with an operation speed command value from the electric power amplifier 102. Thereby, the elevator car 105 is moved to a predetermined destination in cooperation with the cable 108. When the elevator car arrives at the destination, the operation of the elevator is finished.

However, as described above, in the operation speed command generation by the conventional operation speed command control apparatus and method for an elevator, as shown in Figures 1 and 2, the position control is performed in accordance with the open control loop in which the operation speed command occurs based on a lapse of time for a predetermined interval irrespective of the current position and operation speed of the elevator car within the acceleration intervals K1 through K3 and the uniform speed interval K4. In addition, the feed-back position control is performed in accordance with the closed control loop in which the operation speed command is generated in accordance with the remaining distance from the current elevator car position to the running

time error in order to reduce the running time error within the deceleration intervals K5 through K7.

Therefore, when the interval is changed from the acceleration intervals K1 through K3 or the uniform speed interval K4 to the deceleration intervals K5 through K7, the operation system of the elevator is changed. Since the speed and torque of the electric power amplifier within the acceleration intervals K1 through K3 or the uniform speed interval K4 and the deceleration intervals K5 through K7 are different from one another, a sudden vibration or the like occurs. In addition, a high operation speed difference may occur therebetween, for thus causing an uncomfortable elevator car on-board feeling. In addition, except for an ideal state where the output from the motor driving the elevator car is substantially large, and there is no error, when the elevator car 105 changes its running state interval from the acceleration interval and the uniform speed interval to the deceleration interval, since the operation system of the elevator car 105 can not satisfy the time-based speed pattern within the acceleration and uniform speed intervals, the deceleration operation must be performed or the call-based running time must be substantially delayed in order to compensate the accumulated position errors, in which operation the elevator car on-board feeling and the running time error are not considered.

Moreover, in the operation command generator, since the control cycle (the time: T_1) is fixed to a uniform value within the acceleration interval K_1 irrespective of whether a passenger is riding in the elevator car, the elevator car on-board feeling may be somehow improved. When no passenger is riding in the elevator car or when an emergency state occurs, a high speed profile may be generated, and the passenger's car service request may be quickly performed thereby; however, since the time during the acceleration interval is limitative, an inefficient operation speed command is generated thereby, for thus degrading the elevator car operation efficiency.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an operation speed command controlling apparatus for an elevator which overcomes the problems encountered in the conventional operation speed command controlling apparatus.

It is another object of the present invention to provide an improved operation command controlling apparatus and method for an elevator thereof which are capable of reducing a waiting time of a passenger at a floor, improving an elevator car on-board feeling, and minimizing a call-based running time and a running time error by generating a proper operation speed command signal by detecting whether or not a passenger is

riding in an elevator car, and whether an emergency state of an elevator is occurring.

To achieve the above objects, there is provided an operation speed command controlling apparatus for an elevator according to the present invention which includes a car call button and a floor call button for generating a car call signal or a floor call signal, an operation sequence management unit for determining an operation speed pattern to be commanded to an elevator car, determining a priority call among calls registered by the car call button and the floor call button, and generating an operation speed pattern, an operation speed command generator for determining an Jerk acceleration speed and a response time from an acceleration speed pattern set by an operating interval based on the operation speed pattern occurs in accordance with a priority call among calls registered by the operation sequence management unit and a car call from the floor or a floor call from the car, obtaining a reference speed profile by an interval, and generating an operation command proportional to a difference between a reference position profile obtained by integrating the speed profile and a position value of the current elevator car detected by a car position detector, and an electric power amplifier for amplifying the operation speed command value for operating a motor unit of a driving unit including a pulley and a motor for moving the elevator car to works in accordance with

the reference speed profile.

To achieve the above objects, there is provided an operation speed command controlling method for an elevator according to the present invention which includes the steps of driving an elevator car by determining an acceleration and a response time from an acceleration pattern set when an operation command is generated in accordance with a priority call among calls registered in an operation sequence management unit, computing a reference speed profile by an operating interval by using the determined acceleration and response time, integrating the reference speed profile and computing a reference position profile of the elevator car, and computing the operation speed command value based on the position of the current elevator car and the reference position profile for operating the elevator car.

Additional advantages, objects and features of the invention will become more apparent from the description which follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and

wherein:

Figure 1 is a schematic diagram illustrating a conventional operation speed command controlling apparatus for an elevator;

Figure 2 is a flow chart of an operation speed command controlling procedure of the conventional operation speed command controlling apparatus;

Figure 3 is a graph of a conventional acceleration pattern which is used when generating an operation speed command signal in the conventional operation speed command controlling apparatus;

Figure 4 is a schematic diagram illustrating the construction of an operation speed command controlling apparatus for an elevator according to the present invention;

Figure 5 is a flow chart of an operation speed command controlling method for an elevator according to a first embodiment of the present invention in which an elevator car on-board feeling and a running time error are considered;

Figure 6 is a flow chart of an operation speed command controlling method for an elevator according to a second embodiment of the present invention, in which method the matter of whether a passenger is riding is considered;

Figure 7 is a graph illustrating an operation speed and a position profile for which an elevator car on-board feeling and a running time error are considered; and

Figures 8A and 8B are graphs illustrating a result of a profile with respect to an elevator at a normal speed, of which:

Figure 8A is a graph illustrating an elevator position profile; and

Figure 8B is a graph illustrating an elevator acceleration profile.

DETAILED DESCRIPTION OF THE INVENTION

Figure 4 is a schematic diagram illustrating an operation speed command controlling apparatus for an elevator according to the present invention as adapted to an elevator system, which includes a car call button 109 and a floor call button 110 for generating a car call signal and a floor call signal, respectively. An operation sequence management unit 200 is arranged for generating an operation speed pattern to be commanded to an elevator car determined based on a call registered by the car call button 109 and the floor call button 110. A priority call is determined from among multiple current calls. An operation speed command generator 201 is connected for computing the operation speed command value based on a reference position profile of the elevator car 105 obtained by the integration of a reference speed profile over an operating interval and the position value of the elevator car 105

detected by the current car position detector 104. Here, an Jerk acceleration J and the response time k_1T are computed from the set acceleration pattern when generating the priority call among the currently registered calls and the operation speed pattern based on the generation of a car call from the floor or a floor call from the car, and the reference speed profile for an operating interval is obtained based on a result of such a computation. An electric power amplifier 202 is connected for amplifying the operation speed value for the operating interval generated by the operation speed command generator 201 and for operating the motor of the driving unit 106 including a pulley and motor so that the elevator car 105 is operated based on the reference speed profile.

In the operation speed command generator 201, an adder 201a is connected for adding the reference position profile $\Delta P(kT)$ inputted in accordance with the control command from the operation sequence management unit 200 and the position value $P(kT)$ of the current elevator car 105 inputted from the position detector 104. A proportional controller 201b is connected for generating an operation speed command value from which the position error obtained by the adder 201a is included.

The operation of the operation speed command controlling apparatus for an elevator according to the present invention will now be explained with reference to Figures 5 and 6.

Figure 5 is a flow chart of an operation speed command controlling method for an elevator according to a first embodiment of the present invention in which an elevator car on-board feeling and a running time error are considered.

In step ST10, when a waiting passenger at a floor or a passenger in the elevator car 105 calls the floor or the elevator car 105 by pushing the floor call button 110 or the car call button 109, the floor call data and the car call data are registered in the operation sequence management unit 200 through two communication lines 111 and 112.

In step ST11, in the operation sequence management unit 200, the priority call is determined among the currently registered calls from the car call button 109 and the floor calling button 110, and the top priority call among the thusly determined priority calls is transmitted to the operation speed command generator 201.

In step ST12, in the operation speed command generator 201, the Jerk acceleration J and the response time k_1T , for which the car on-board feeling is considered, are determined in accordance with the operation speed command inputted from the operation sequence management unit 200.

In step ST13, the elevator car 105 is operated in accordance with the Jerk acceleration J and the response time k_1T determined by the operation speed command generator 201.

In step ST14, after the elevator car 105 is operated, in

the operation speed command generator 201, the reference speed profiles $V_1(kT)$ through $V_7(kT)$ for each operating interval are computed based on the acceleration interval including the acceleration interval $K1$, the uniform acceleration interval $K2$, and the acceleration interval $K3$, and the deceleration interval including the uniform speed interval $K4$, the deceleration interval $K5$, the uniform deceleration interval $K6$, and the deceleration interval $K7$ in accordance with the following equation (3).

$$\begin{aligned} V_1(kT) &= J/2 (kT)^2 \\ V_2(kT) &= J(k_1T) (kT) + V_1(k_1T) \\ V_3(kT) &= -J/2 (kT)^2 + J(k_1T) (kT) + V_2(k_2T) \\ V_4(kT) &= J(k_1T)^2 + J(k_1T) (k_2T) \\ V_5(kT) &= -J/2 (kT)^2 + V_4(0) \\ V_6(kT) &= J(k_1T) (kT) + J/2 (k_1T)^2 + J(k_1T) (k_2T) \\ V_7(kT) &= J/2 (kT)^2 - J(k_1T) (kT) + J/2 (k_1T)^2 \text{ ----- (3)} \end{aligned}$$

where J denotes an Jerk acceleration, T denotes a control cycle time (10ms), k_1T denotes a response time, and $V_4(0)$ denotes a normal speed at a uniform interval $K4$.

In step ST15, the reference speed profiles $V_1(kT)$ through $V_7(kT)$ for the intervals $K1$ through $K7$ are obtained based on equation (3), and the thusly obtained values are integrated. Therefore, the reference position profile $P(kT)$ of the elevator car 105 is obtained by the following equation (4).

$$\hat{P}(kT) = \int V_i * dt, \text{ where } i = 1, 2, 3, \dots, 7 \text{ ----- (4)}$$

In step ST16, when the reference position profile $P(kT)$ of the elevator car 105 is obtained based on equation (4), the current position $P(kT)$ of the current elevator car 105 is detected by the car position detector 104, and the reference position profile $P(kT)$ is added by the adder 201a, for thus computing the position error. The operation speed command $V(kT)$ which is proportional to the position error is computed by the proportional controller 201b in accordance with equation (5), and the thusly computed operation speed command is transmitted to the electric power amplifier 202.

The operation speed command is computed as follows: $V(kT)$
 $= K_p * (\hat{P}(kT) - P(kT)) \text{ ----- (5)}$

where K_p denotes a proportional gain.

The operation speed command $V(kT)$ transmitted to the proportional gain unit 201b of the operation speed command generator 201 is amplified by the electric power amplifier 202, and the driving unit 106 and the hydraulic unit (not shown) including the pulley and the motor are driven thereby, and the elevator car 105 is moved to the destination.

In step ST17, the operation sequence management unit 100 detects whether the elevator car 105 driven in steps ST100 through ST 106 arrived at the floor. When the elevator car 105 did not arrive at the floor, the steps after step ST103 are repeatedly performed. When the elevator car 105 has arrived at the destination floor, the operation of the elevator is

finished.

For example, on the assumption that the speed of the elevator car is 120m/min, the Jerk acceleration J is 0.5m/sec^3 , and the response time k_1T is one second, when the operation speed command is generated in accordance with the feed-back position control method, the elevator car 105, as shown in Figure 6, provides a better on-board feeling, and the operation speed "f" and the position profile "e" are related to the reference speed "b" and the position profile "a".

Figure 7 is a graph illustrating an operation speed and a position profile for which an elevator car on-board feeling and a running time error are considered.

In Figure 6, "c" denotes the reference Jerk acceleration, and "d" denotes the operation speed command from the electric power amplifier.

Figure 6 is a flow chart of an operation speed command controlling method for an elevator according to a second embodiment of the present invention, in which method is considered whether or not a passenger is riding.

As shown in Figure 6, when an emergency occurs, it is possible to more quickly move the elevator car by extending the time T_1 for the Jerk acceleration interval K_1 in order for a passenger to escape from the elevator car. When a passenger is riding in the elevator car, it is possible to reduce the waiting time of the passenger at the floor.

The operation speed command generation method based on the car call from the floor and the floor call from the car in the elevator car automatic mode and the fire extinguishing mode will now be explained.

In step ST100 shown in Figure 7, the elevator car 105 is in the automatic mode. In step ST101, it is judged by the operation sequence management unit 200 whether a floor call from a car is generated. As a result, when a floor call is generated from the car, in step ST102, a passenger is judged to be riding in the elevator car 105, and the operation speed pattern to be transmitted to the elevator car 105 is determined.

Namely, when there is a floor call from the car, the interval T1 during the acceleration interval K1 shown in Figure 3 for which the on-board feeling was considered in step ST103 is fixed, and transmitted to the operation speed command generator 201. In the operation speed command generator 201, the car call from the floor and the floor call from the car are performed based on the operation speed command $V(kP)$ which was obtained in equations 3, 4, and 5 in cooperation with the fixed time T1 during the acceleration interval K1 in accordance with the operation speed pattern from the operation sequence management unit 200.

In steps ST102 and ST102, if there is a car call from the floor, and there is not a floor call from the car, the

operation sequence management unit 200 extends the time T1 during the acceleration interval K1 as shown in Figure 3 for which the on-board was not considered in step ST104, and the extended time is applied to the operation speed generator 201. The operation speed command generator 201 generates an operation speed command for the time T1 in the acceleration interval K1, and then the elevator car 105 is moved to the floor at which the car call was generated.

If there is not a car call from the floor in step ST101, it is detected whether there is a floor call from the car in step ST105. When there is a floor call from the car, the time T1 is fixed during the acceleration interval K1 shown in Figure 3 for which the on-board feeling was considered in step ST106 and transmitted to the operation speed command generator 201 in the same manner as in step ST103. The operation speed command generator generates an operation speed command during the fixed time T1 in the acceleration interval K1, and the elevator car 105 is moved to the destination.

In step ST101 through ST105, if there is a car call from the floor, and there is not a floor call from the car, the time T1 for the acceleration interval K1 is extended in step ST107, and the elevator car 105 is returned to the reference floor, and enters a ready state.

Differently from step ST100, when the operation mode of the elevator is in either the fire mode or the extinguishing

mode, the time T1 is extended during the acceleration interval K1 for which the on-board feeling was not considered, irrespective of the car call and floor call in step ST109, and then the operation speed profile is generated so that the passenger in the building in which the elevator is installed can more quickly escape from the building.

Namely, the upper limit of the time T1 during the acceleration interval K1 as shown in Figure 3 can be expressed by the following equation (6) based on the condition that the sum of the areas of the intervals K1, K2 and K3 as shown in Figure 3 does not exceed the normal speed MAX-V.

$$T1 \leq \sqrt{\frac{\text{normal speed MAX-V}}{\text{Jerk acceleration (J)}}} \quad \text{----- (6)}$$

Figures 8A and 8B are graphs illustrating an elevator position profile and an elevator acceleration profile according to the present invention. In this embodiment, a condition that the normal speed of the elevator is 120 m/min was adapted. When the Jerk acceleration J is fixed at 0.5 m/sec³ in the acceleration pattern shown in Figure 3, since the limitative value of the time T1 is given as two seconds as seen from equation (6), it is possible to obtain the result shown in Figure 8A. Namely, Figure 8A illustrates a result of a simulation where the time T1 during the acceleration interval K1 is set to one second and to 0.5 second which are within two

seconds. When the time T_1 is 0.5 second, it takes 18.5 seconds for the elevator car to move 20m, and when the time T_1 is one second, the elevator car takes 15 seconds to move the same distance.

As described above, when a different operation speed command is generated based on the condition of the elevator car, the service time will be minimized, and since it is possible to predict the service time, the running efficiency of the elevator car can be significantly enhanced, and a better group management system for a plurality of elevators is possible, and the on-board feeling can be enhanced, and the running time error can be minimized.

In addition, when a passenger is not riding in the elevator or an emergency occurs, it is possible to minimize the waiting time of a passenger at the floor by varying the time T_1 during the acceleration interval K_1 .

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as recited in the accompanying claims.

What is claimed is:



1. An operation speed command controlling apparatus for an elevator, comprising:

a car call button and a floor call button for generating a car call signal or a floor call signal;

an operation sequence management unit for determining an operation speed pattern to be commanded to an elevator car, determining a priority call among calls registered by the car call button and the floor call button, and generating an operation speed pattern;

an operation speed command generator for determining an Jerk acceleration speed and a response time from an acceleration speed pattern set by an operating interval based on the operation speed pattern occurs in accordance with a priority call among calls registered by the operation sequence management unit and a car call from the floor or a floor call from the car, obtaining a reference speed profile by an interval, and generating an operation command proportional to a difference between a reference position profile obtained by integrating the speed profile and a position value of the current elevator car detected by a car position detector; and

an electric power amplifier for amplifying the operation speed command value for operating a motor unit of a driving unit including a pulley and a motor for moving the elevator car



to works in accordance with the reference speed profile.

2. The apparatus of claim 1, wherein said operation speed command generator includes:

an adder for determining a reference speed profile in accordance with a speed pattern generated by the operation sequence management unit, adding a reference position profile for which the reference speed profile was integrated and a position value of the current elevator car, and obtaining a position error; and

proportional control means for generating an operation speed command proportional to the position error obtained by the adder.

3. An operation speed command controlling method for an elevator, comprising the steps of:

driving an elevator car by determining a Jerk acceleration and a response time from a Jerk acceleration pattern set when an operation command is generated in accordance with a priority call among calls registered in an operation sequence management unit;

computing a reference speed profile by an operating interval by using the determined Jerk acceleration and response time;

integrating the reference speed profile and computing a



reference position profile of the elevator car; and

computing the operation speed command value based on the position of the current elevator car and the reference position profile for operating the elevator car.

4. The method of claim 3, wherein said reference speed profile for each of seven operating intervals satisfies the following conditions:

$$V_1(kT) = J/2 (kT)^2,$$

$$V_2(kT) = J(k_1T) (kT) + V_1(k_1T),$$

$$V_3(kT) = -J/2 (kT)^2 + J(k_1T) (kT) + V_2(k_2T),$$

$$V_4(kT) = J(k_1T)^2 + J(k_1T) (k_2T),$$

$$V_5(kT) = -J/2 (kT)^2 + V_4(0),$$

$$V_6(kT) = J(k_1T) (kT) + J/2 (k_1T)^2 + J(k_1T) (k_2T), \text{ and}$$

$$V_7(kT) = J/2 (kT)^2 - J(k_1T) (kT) + J/2 (k_1T)^2,$$

where J denotes an Jerk acceleration, T denotes a control cycle time (10ms), k_1T denotes a response time, and $V_4(0)$ denotes a normal speed at a uniform speed interval (K4).

5. The method of claim 3, wherein said reference position profile of the elevator car satisfies the following condition:

$$\hat{P}(kT) = \int V_i dt, \text{ where } i = 1, 2, 3, \dots, 7$$

6. The method of claim 3, wherein said operation speed



command satisfies the following condition:

$$V(kT) = K_p * (\hat{P}(kT) - P(kT)) \text{ ----- (5)}$$
 where K_p denotes a proportional gain.

7. The method of claim 3, wherein said elevator car driving step includes:

a first sub-step in which a car call from a floor and a floor call from the car are detected;

a second sub-step in which a floor call service is performed during a time which is set based on the reference speed profile during an acceleration interval when a floor call from the car was detected; and

a third sub-step in which a car call service is performed based on the reference speed profile by varying a time of the Jerk acceleration interval in consideration of an on-board feeling when there was no floor call detected from the car in the first step.

8. The method of claim 7, wherein said time variation is performed only within the Jerk acceleration interval.

9. The method of claim 7, wherein an upper value limit of the time during the acceleration interval satisfies the following condition:



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$$T1 \leq \sqrt{\frac{\text{normal speed MAX-V}}{\text{acceleration (J)}}}$$

where (MAX-V) denotes a normal speed, and J denotes an Jerk acceleration.

10. The method of claim 8, wherein an upper value limit of the time during the acceleration interval satisfies the following condition:

$$T1 \leq \sqrt{\frac{\text{normal speed MAX-V}}{\text{acceleration (J)}}}$$

where (MAX-V) denotes a normal speed, and J denotes an Jerk acceleration.

11. The method of claim 7, further including a step in which the time of the acceleration interval is varied, irrespective of the detection of a call from a passenger in the car when an operation mode is set to a fire mode or an extinguishing mode after the elevator is operated, for this generating an emergency operation speed profile.