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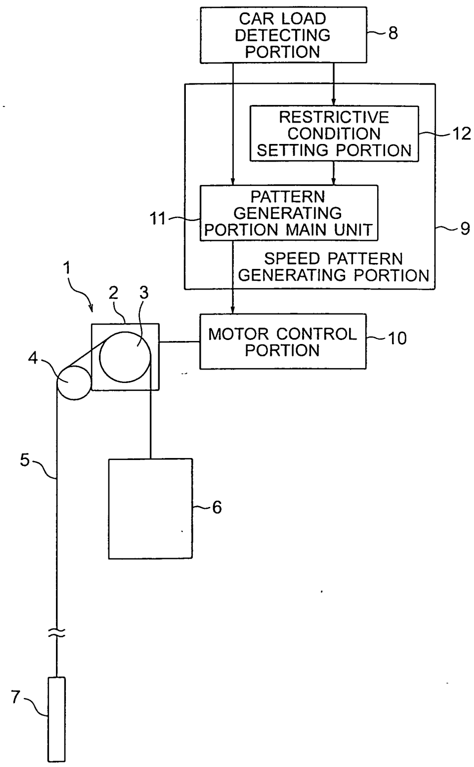
(54) ELEVATOR CONTROL DEVICE

(57) In an elevator control apparatus, the speed of a car in traveling at a constant speed and the acceleration/deceleration speeds of the car in traveling with accelerating/decelerating are changed in accordance with a loading weight of the car. The elevator control apparatus is provided with a restrictive condition setting portion. The restrictive condition setting portion imposes restrictions on at least one of the speed of the car and the acceleration/deceleration speeds of the car so as to prevent a component of an elevator from being overloaded.

FIG. 1



EP 1 731 466 A1

Description

Technical Field

[0001] The present invention relates to an elevator control apparatus that allows a speed of a car in traveling at a constant speed and acceleration/deceleration speeds of the car in traveling with accelerating/decelerating to be changed.

Background Art

[0002] In a conventional elevator control apparatus disclosed in, for example, JP 2003-238037 A, a speed of a car in traveling at a constant speed and acceleration/deceleration speeds of the car in traveling with accelerating/decelerating are changed within drive ranges of a motor and an electric component for driving the motor, in accordance with a load resulting from a loading weight of the car (hereinafter referred to as "car load"). A margin of power of the motor is thereby utilized, so the operating efficiency of the car is enhanced.

[0003] In the conventional elevator control apparatus, however, only drive limits of the motor and the electric component for driving the motor are adopted as restrictive conditions, and drive limits of the other components are not taken into account. Therefore, the restrictive conditions are not necessarily impeccable, so there have been demands for further enhancement of the operating efficiency of the car.

Disclosure of the Invention

[0004] The present invention has been made to solve the problem described above, and it is therefore an object of the invention to obtain an elevator control apparatus that allows further enhancement of the operating efficiency of a car while using all components within permissible load ranges.

[0005] According to the present invention, an elevator control apparatus for changing a speed of a car in traveling at a constant speed and acceleration/deceleration speeds of the car in traveling with accelerating/decelerating in accordance with a loading weight of the car, includes: a restrictive condition setting portion for imposing restrictions on at least one of the speed of the car and the acceleration/deceleration speeds of the car so that a component of an elevator is prevented from being overloaded.

Brief Description of the Drawings

[0006]

Fig. 1 is a schematic diagram showing an elevator apparatus according to Embodiment 1 of the present invention;
Fig. 2 is a block diagram showing a concrete structural example of a speed pattern generating portion of Fig. 1;
Fig. 3 is a graph showing a relationship between a car load and upper-limit values of acceleration as to a plurality of components;
Fig. 4 is a graph showing a relationship between the car load and upper-limit values of deceleration as to the plurality of the components;
Fig. 5 is a graph showing a relationship between the car load and a car speed in traveling at a constant speed as to the plurality of the components;
Fig. 6 is a graph showing a relationship between a car load and upper-limit values of the acceleration/deceleration speeds that does not exceed a traction capacity;
Fig. 7 is a graph showing a relationship between a car load, and a car speed and a car acceleration/deceleration speeds, which do not exceed capacity of a power-supply installation;
Fig. 8 is a graph showing a relationship between a possible output torque of a motor portion and a speed range; and
Fig. 9 is a schematic diagram showing an elevator apparatus according to Embodiment 6 of the present invention.

Best Modes for carrying out the Invention

[0007] Preferred embodiments of the present invention will be described hereinafter with reference to the drawings.

Embodiment 1

[0008] Fig. 1 is a schematic diagram showing an elevator apparatus according to Embodiment 1 of the present invention. Referring to the figure, a drive device (hoisting machine) 1 is installed in an upper portion of a hoistway. The hoisting machine 1 has a motor portion 2 and a drive sheave 3, which is rotated by the motor portion 2. The motor portion 2 is provided with a brake portion (not shown) for braking rotation of the drive sheave 3.

[0009] A rotatable deflector sheave 4 is provided in the upper portion of the hoistway. A plurality of main ropes 5 (only one of them is shown in Fig. 1) are wound around the drive sheave 3 and the deflector sheave 4. A car 6 is suspended at one end of each of the main ropes 5. A counterweight 7 is installed at another end of each of the main ropes 5.

[0010] A weight of the counterweight 7 is set such that the counterweight 7 is balanced with the car 6 when the car 6 has about half (half load) of a maximum loading weight (full load).

[0011] An elevator control apparatus for controlling operation of the motor portion 2 has a car load detecting portion 8, a speed pattern generating portion 9, and a motor control portion 10.

[0012] The car load detecting portion 8 detects a loading weight of the car 6 (car load), and transmits a detected result to the speed pattern generating portion 9. A known weighing device can be used as the car load detecting portion 8. In addition, the car load detecting portion 8 may be a device for calculating a car load through conversion of a current value or the like of the motor portion 2.

[0013] The motor control portion 10 controls the driving of the motor portion 2 according to a speed pattern generated by the speed pattern generating portion 9. The motor control portion 10 has a control portion main unit such as an inverter and means for executing a control program thereof.

[0014] The speed pattern generating portion 9 has a pattern generating portion main unit 11 for calculating a speed pattern of the car 6 (or the motor portion 2), and a restrictive condition setting portion 12 for transmitting information on restrictions on the speed and acceleration/deceleration speeds of the car 6 to the pattern generating portion main unit 11. A signal from the car load detecting portion 8 is input to the pattern generating portion main unit 11 and the restrictive condition setting portion 12, respectively.

[0015] The pattern generating portion main unit 11 generates such a speed pattern as ensures an arrival of the car 6 at a target floor in a shortest possible period of time, in accordance with a loading weight of the car 6. A method disclosed in JP 2003-238037 A can be used to calculate the speed pattern. Further, an upper-limit value of the speed of the car 6 and an upper-limit value of the acceleration/deceleration speeds of the car 6, which have been calculated by the restrictive condition setting portion 12, may be used to generate the speed pattern.

[0016] The restrictive condition setting portion 12 imposes restrictions on the speed and acceleration/deceleration speeds of the car 6 so as to prevent components of an elevator from being overloaded. The components includes, for example, the motor portion 2, the motor control portion 10, the main ropes 5, power-supply components such as a power transformer, a breaker, and the like, a regenerative component, a braking device, a safety device, and an accumulator. The restrictive condition setting portion 12 transmits information on the restrictions on the speed and acceleration/deceleration speeds of the car 6 to the pattern generating portion main unit 11 in accordance with a loading weight of the car 6.

[0017] Fig. 2 is a block diagram showing a concrete structural example of the speed pattern generating portion 9 of Fig. 1. The speedpattern generating portion 9 is provided with an input/output portion 13, a CPU (processing portion) 14, and a storage portion 15. These portions serve as both the pattern generating portion main unit 11 and the restrictive condition setting portion 12.

[0018] A detection signal from the car load detecting portion 8 is input to the CPU 14 through the input/output portion 13. A command signal to the motor control portion 10 is output from the input/output portion 13. The storage portion 15 has a ROM in which a program for generating a speed pattern and a program for setting a restrictive condition are stored, a RAM for temporarily storing data used for calculations made in the CPU 14, and the like. The CPU 14 performs calculation processings based on the programs stored in the storage portion 15.

[0019] In this embodiment, the speed of the car in traveling at a constant speed and the acceleration/deceleration speeds of the car in traveling with accelerating/decelerating can be changed according to a car load. In other words, a speed pattern can be changed according to the car load, utilizing margins of power of the motor portion 2 and the inverter of the motor control portion 10. In this embodiment, restrictions are imposed on the speed pattern in consideration of drive limits of various components susceptible to the influences of the speed and acceleration/deceleration speeds of the car 6.

[0020] The drive limits of the components each mean a maximum permissible load that does not allow a corresponding one of the components to be overloaded even when it is used continuously or for a predetermined time. The corresponding one of the components is guaranteed to operate normally without breaking down or being damaged when the load applied thereto is equal to or smaller than the maximum permissible load. In this embodiment, the restrictive condition setting portion 12 sets an upper-limit value of the speed of the car 6 in traveling at a constant speed and an upper-limit value of the acceleration/deceleration speeds of the car 6 in traveling with accelerating/decelerating according to a car load.

[0021] Next, a method according to which the restrictive condition setting portion 12 sets the upper limit values will be described. Fig. 3 is a graph showing a relationship between a car load and upper-limit values of the acceleration as to a plurality of (a plurality of kinds of) components. Fig. 4 is a graph showing a relationship between the car load and upper-limit values of the deceleration as to the plurality of the components. Fig. 5 is a graph showing a relationship between the car load and a car speed in traveling at a constant speed as to the plurality of the components.

[0022] Referring to Figs. 3 to 5, given that the car load is L1, the minimum value of the upper-limit value of the acceleration is αm. Accordingly, the upper-limit value of the acceleration within drive limits of all the components targeted for confirmation of upper limit values is αm. Thus, the smallest one of the upper limit values of all the components is selected, so an upper limit value that does not exceed the drive limits of all the components can be derived.

[0023] Similarly, the upper-limit value of the deceleration of the car 6 and the upper-limit value of the speed of the car 6 in traveling at a constant speed are βn and vj, respectively.

[0024] As described above, the restrictive condition setting portion 12 calculates permissible values (upper limit values) of the speed and acceleration/deceleration speeds of the car 6 as to the plurality of the predetermined components in accordance with the loading weight of the car 6, and transmits the lowest one of the permissible values to the pattern generating portion main unit 11 as information on the restrictions.

[0025] The information on the upper limit values as shown in Figs. 3 to 5 may be either stored in the restrictive condition setting portion 12 in advance as table values or calculated according to a calculation formula each time.

[0026] In the elevator control apparatus constructed as described above, the upper-limit value of the speed of the car 6 in traveling at a constant speed and the upper-limit value of the acceleration/deceleration speeds of the car 6 in traveling with accelerating/decelerating are set in consideration of the drive limits of the components of various kinds, and the speed pattern is generated using a maximum car speed and a maximum car acceleration/deceleration speeds within a range defined by those upper limits or such a car speed and such a car acceleration/deceleration speeds as ensure the arrival of the car 6 at a target floor in a shortest possible period of time. Therefore, the operating efficiency of the car 6 can further be enhanced while preventing the components from being overloaded.

[0027] In addition to the speed of the car in traveling at a constant speed and the acceleration/deceleration speeds of the car in traveling with accelerating/decelerating, an upper limit value for restricting a jerk (a rate of change in acceleration/deceleration speeds) may be set.

[0028] Although the restrictions are imposed on both the speed of the car in traveling at a constant speed and the acceleration/deceleration speeds of the car in traveling with accelerating/decelerating in the foregoing example, it is also appropriate to impose restrictions on only one of them.

Embodiment 2

[0029] Next, Embodiment 2 of the present invention will be described. In Embodiment 2 of the present invention, the upper-limit value of the acceleration/deceleration speeds of the car 6 is set according to a condition that is restricted by a traction capacity between the drive sheave 3 and the main ropes 5, which are the components of the elevator. The traction capacity mentioned herein represents an ability allowing the car 6 to be raised/lowered without causing the main ropes 5 to slide on the drive sheave 3 (i.e., without causing idle rotation of the drive sheave 3). The traction capacity is determined by, for example, a coefficient of friction between the drive sheave 3 and the main ropes 5, a winding angle of the main ropes 5 with respect to the drive sheave 3.

[0030] The main ropes 5 slide when a ratio between a tensile force acting on those portions of the main ropes 5 which are located between the drive sheave 3 and the car 6 and a tensile force acting on those portions of the main ropes 5 which are located between the drive sheave 3 and the counterweight 7 exceeds a value determined by the traction capacity. The aforementioned tensile forces are generated due to the weight of the car 6 side, the weight of the counterweight 7, and the torque generated by the motor portion 2.

[0031] Once the weight of the car 6 side and the weight of the counterweight 7 are determined, the acceleration/deceleration speeds of the car 6 is determined by the torque generated by the motor portion 2. On the contrary, therefore, once the weight of the car 6 side, the weight of the counterweight 7, and the acceleration/deceleration speeds of the car 6 are determined, the corresponding torque generated by the motor portion 2 is calculated.

[0032] Accordingly, once the weight of the car 6 side, the weight of the counterweight 7, and the acceleration/deceleration speeds of the car 6 are determined, the aforementioned ratio between the tensile forces can be calculated. It becomes thereby possible to calculate the upper-limit value of the acceleration/deceleration speeds of the car 6 which does not exceed the traction capacity.

[0033] Fig. 6 is a graph showing a relationship between a car load and upper-limit values of the acceleration/deceleration speeds of the car 6 which does not exceed a traction capacity. This graph represents an example of a car load and an upper-limit value of the acceleration/deceleration speeds in raising the car 6. Although a car load and an upper-limit value of the acceleration/deceleration speeds in lowering the car 6 are not shown in Fig. 6, the same line of thought as in raising the car 6 is applicable. In other words, although the following description handles a case where the car 6 is raised, the same holds true in the case where the car 6 is lowered.

[0034] In Embodiment 2, the restrictive condition setting portion 12 sets the upper-limit value of the acceleration/deceleration speeds of the car 6 based on the car load detected by the car load detecting portion 8. At this moment, when the car load is detected as, for example, L1, an upper-limit value of acceleration α1 and an upper-limit value of deceleration $\alpha 2$ are selected by reference to Fig. 6. After that, the pattern generating portion main unit 11 generates a speed pattern while preventing the upper limits from being exceeded, according to the same method as described in Embodiment 1. Then, the car 6 is caused to travel according to the generated speed pattern.

[0035] As described above, in Embodiment 2, the upper-limit value of the acceleration/deceleration speeds of the car 6 is set according to the car load within the range of the traction capacity. Therefore, it is possible to adjust the acceleration/deceleration speeds of the car 6 while preventing the main ropes 5 from sliding with respect to the drive sheave 3, and thus enhance the operating efficiency of the car 6.

[0036] The information on the upper limit values as shown in Fig. 6 may be either stored in advance in the restrictive condition setting portion 12 as table values or calculated according to a calculation formula each time.

Embodiment 3

[0037] Next, Embodiment 3 of the present invention will be described. In Embodiment 3 of the present invention, the restrictive condition setting portion 12 sets an upper-limit value of speed of the car 6 in traveling at a constant speed and an upper-limit value of acceleration/deceleration speeds of the car 6 in traveling with accelerating/decelerating under a restrictive condition that the power consumption of the traveling elevator does not exceed the capacity of a power-supply installation as a component of the elevator. As a result, such a speed pattern as ensures the arrival of the car 6 at a target floor in a short period of time is generated while preventing the power consumption of the elevator from exceeding the capacity of the power-supply installation.

[0038] The restrictive condition setting portion 12 sets such the upper-limit value of the speed of the car 6 in traveling at a constant speed and such the upper-limit value of the acceleration/deceleration speeds of the car 6 in traveling with accelerating/decelerating as satisfy the restrictive condition, according to a car load. The pattern generating portion main unit 11 generates a speed pattern based on the upper limits set by the restrictive condition setting portion 12 and the car load.

[0039] Fig. 7 is a graph showing a relationship between a car load, and a car speed and a car acceleration/deceleration speeds, which do not exceed the capacity of the power-supply installation. The relationship of Fig. 7 is calculated using the following formula.

$$\text{Capacity of Power-supply Installation} \leq \text{Power Consumption of Elevator} \times k$$

[0040] In the above formula, k represents a certain constant, for example, a coefficient for converting the power consumption of the elevator into the power supplied from the power-supply installation. The power consumption of the elevator can be calculated using, for example, a product of the torque generated by the motor portion 2 and the rotational speed thereof at that time.

[0041] Given now that the car load is L1, the restrictive condition setting portion 12 sets the upper-limit value of the speed of the car 6 in traveling at a constant speed, the upper-limit value of the acceleration of the car 6, and the upper-limit value of the deceleration of the car 6 to vm, $\alpha 2$, and $\alpha 1$, respectively. As a result, a power-supply system is prevented from being overloaded or shut off due to the operation exceeding the capacity of the power-supply installation.

[0042] The capacity of the power-supply installation can be set to, for example, the capacity of a power supply for supplying power to the inverter, the capacity of a power-supply breaker thereof. The capacity of the power-supply installation can also be set to the power consumption at the time when the car 6 travels at a certain constant speed with a rated loading weight carried thereon. Furthermore, the capacity of the power-supply installation can also be set to the maximum power consumption at the time when the car 6 travels at a certain acceleration/deceleration speeds with the rated loading weight carried thereon.

[0043] In the case where the elevator is supplied with power from an accumulator, the capacity of the power-supply installation may be set to the battery capacity of the accumulator. In Embodiment 3 of the present invention, when the source of power supply is switched over to the accumulator in case of power outage or the like, the speed of the car 6 in traveling at a constant speed and the acceleration/deceleration speeds of the car 6 in traveling with accelerating/decelerating are so set as to allow the arrival of the car 6 at a target floor in a shorter period of time while preventing the power-supply capacity of the accumulator from being exceeded.

[0044] In general, an accumulator has a smaller power-supply capacity than a generally employed power supply, and thus cannot cause a car to travel at a high speed or to accelerate/decelerate at a great acceleration/deceleration speeds. However, the car 6 is caused to travel in such a manner as to ensure the arrival thereof at a target floor in a shorter period of time within the range of the power supplying capacity of the accumulator, so a deterioration in the quality of service can be minimized.

[0045] The information on the upper limit values as shown in Fig. 7 may be either stored in advance in the restrictive condition setting portion 12 as table values or calculated according to a calculation formula each time.

Embodiment 4

[0046] Next, Embodiment 4 of the present invention will be described. In Embodiment 4 of the present invention, the upper-limit value of the speed of the car 6 in traveling at a constant speed and the upper-limit value of the acceleration/deceleration speeds of the car 6 in traveling with accelerating/decelerating are set such that the capacity to process the power regenerated to the power supply side during regenerative operation is not exceeded. The regenerative processing capacity means a power that can be regenerated by a regenerator as a component of the elevator. To be more specific, the regenerative processing capacity means a power that can be consumed by a regenerative resistor as the regenerator, or a regenerative capacity of a regenerative converter as the regenerator.

[0047] As is the case with the power consumption of the elevator, the regenerative power increases as the difference between the weight of the car 6 side and the weight of the counterweight 7 increases, or as the traveling speed or acceleration/deceleration speeds of the car 6 increases. The regenerative power can be calculated using a product of the torque generated by the motor portion 2 and the rotational speed thereof at that time, so the same method as in Embodiment 3 can be applied. Therefore, the restrictive condition setting portion 12 can set the upper-limit value of the speed of the car 6 in traveling at a constant speed and the upper-limit value of the acceleration/deceleration speeds of the car 6 in traveling with accelerating/decelerating respectively according to a car load under a condition that the regenerative processing capacity is not exceeded, using a figure (omitted) similar to Fig. 7. Then, the pattern generating portion main unit 11 generates a speed pattern based on the upper limit values set by the restrictive condition setting portion 12 and the car load.

[0048] In Embodiment 4, therefore, the regenerator can be prevented frombeing overloaded due to the operation exceeding the regenerative processing capacity. The regenerator can thereby be restrained from generating heat. Moreover, stoppage or the like of the elevator resulting from an overloaded state can be avoided, so a deterioration in the quality of service can be prevented. Furthermore, the speed pattern can be changed within the regenerative processing capacity to enhance the operating efficiency of the car 6.

Embodiment 5

[0049] Next, Embodiment 5 of the present invention will be described. In Embodiment 5, the motor control portion 10 includes a field weakening control portion (not shown). Field weakening control is a method of controlling a motor, which is applied to permanent magnet motors. In this method, a degaussing effect is achieved by causing a negative current to flow in the direction of field magnetic fluxes (i.e., in the direction of d-axis). It becomes thereby possible to suppress the terminal voltage of the motor and thus drive the motor at a higher rotational speed.

[0050] Fig. 8 is a graph showing a relationship between a possible output torque of the motor portion 2 and a speed range. Referring to the figure, while (a) indicates a possible output range at the time when field weakening control is not performed, (b) indicates a possible output range at the time when field weakening control is performed. As shown in the figure, the performance of field weakening control makes it possible to widen the drive range of the motor portion 2 to the high-speed side. In this case, there is no need to change the capacities of electric components such as the inverter.

[0051] Accordingly, adoption of field weakening control makes it possible to set the upper-limit value of the speed of the car 6 in traveling at a constant speed higher without making any modification to the electric components. This effect becomes more striking especially as the difference between the weight of the car 6 side and the weight of the counterweight 7 decreases. This is because of the following two reasons. First of all, when the difference between the weights is small, the required motor torque is small, so the power consumption and regenerative power of the elevator are also small. As a result, the elevator becomes also unsusceptible to the influences of the restriction on the capacity of the power-supply installation, the restrictive condition on the regenerative capacity, and the like. Secondly, owing to the nature of field weakening control, the rotational speed of the motor can be made higher as the generated torque decreases.

[0052] As described above, in Embodiment 5, the motor control portion 10 is provided with the field weakening control portion. Therefore, the upper-limit value of the speed of the car in traveling at a constant speed can be raised without increasing the capacities of the inverter, the power-supply installation, and the like. In consequence, the operating efficiency of the car 6 can be enhanced.

Embodiment 6

[0053] Reference will be made next to Fig. 9, which is a schematic diagram showing an elevator apparatus according to Embodiment 6 of the present invention. Referring to the figure, the speed pattern generating portion 9 is provided with a detected value correcting portion 16. Information on the loading weight of the car 6, which has been detected by the car load detecting portion 8, is input to the detected value correcting portion 16. The detected value correcting portion 16 adds a preset correction value to the loading weight and outputs a resultant value to the pattern generating portion main unit 11 and the restrictive condition setting portion 12.

[0054] In the case where the loading weight of the car 6 which has been detected by the car load detecting portion 8 includes an error, the correction value used in the detected value correcting portion 16 serves to correct the error. For example, when a correction value is added so as to increase the difference between the weight of the entire car 6 side and the weight of the counterweight (a negative correction value may therefore be added in some cases), the upper-limit value of the speed of the car 6 in traveling at a constant speed and the upper-limit value of the acceleration/deceleration speeds of the car 6 in traveling with accelerating/decelerating are so set as not to exceed the drive limits of the components for an error corresponding to the added correction value (an error as a difference between the loading weight of the car 6 and the detected value thereof).

[0055] For instance, given that a, b, b1, c, d ($d > 0$), and Δm respectively denote the weight of the car, the true value of the loading weight of the car, the detected value of the loading weight of the car 6 which has been detected by the car load detecting portion 8, the weight of the counterweight, the correction value, and the difference between the weight of the entire car 6 side and the weight of the counterweight, a relationship: $\Delta m = a + b - c$ is established. However, since the value of the loading weight of the car 6 which is used to generate a speed pattern is b1, the difference $|\Delta m|$ may become smaller than an actual value thereof by b-bl in the case of b>b1. Accordingly, the speed pattern is generated for a value that is smaller than $|\Delta m|$ by the above error.

[0056] In general, as the difference $|\Delta m|$ decreases, the allowances of the components such as the motor portion 2 and the like increase, so a speed pattern having a higher speed or a greater acceleration is generated. Therefore, as a rule, the speed pattern set for a certain difference $|\Delta m|$ (the upper-limit value of the speed of the car 6 in traveling at a constant speed and the upper-limit value of the acceleration/deceleration speeds of the car 6 in traveling with accelerating/decelerating) is not confined within the drive limits of the components for a difference in weight that is larger than $|\Delta m|$.

[0057] In Embodiment 6, the speed pattern is so generated as not to exceed the drive limits of the components even in such a case. That is, the detected value correcting portion 16 adds the correction amount $d > |b1-b|$ to the detected value b1 of the car load, and outputs the corrected detected value b1+d of the car load to the pattern generating portionmain unit 11 and the restrictive condition setting portion 12. The aforementioned difference in weight is larger when the post-correction value is used than when $|\Delta m|$ is used. Therefore, the upper-limit value of the speed of the car 6 in traveling at a constant speed and the upper-limit value of the acceleration/deceleration speeds of the car 6 in traveling with accelerating/decelerating, which are set by the restrictive condition setting portion 12, and the speed pattern calculated by the pattern generating portion main unit 11 do not exceed the drive limits of the components.

[0058] As described above, even when an error is included in an output value of the car load detecting portion 8, the detected value correcting portion 16 can correct the output value. Thus, the speed of the car 6 in traveling at a constant speed and the acceleration/deceleration speeds of the car 6 in traveling with accelerating/decelerating can be set to the respective maximum possible values while preventing the drive limits of the components of the elevator from being exceeded. In consequence, the operating efficiency of the elevator can be enhanced.

[0059] The correction amount d may be set to, for example, a value corresponding to detecting accuracy of the car load detecting portion 8.

Claims

1. An elevator control apparatus for changing a speed of a car in traveling at a constant speed and acceleration/deceleration speeds of the car in traveling with accelerating/decelerating in accordance with a loading weight of the car, comprising:

   a restrictive condition setting portion for imposing restrictions on at least one of the speed of the car and the acceleration/deceleration speeds of the car so that a component of an elevator is prevented from being overloaded.

2. An elevator control apparatus according to Claim 1, further comprising a pattern generating portion main unit for generating a speed pattern of the car in accordance with the loading weight of the car, wherein
   the restrictive condition setting portion transmits information on restrictions on the speed of the car and the acceleration/deceleration speeds of the car to the pattern generating portion main unit in accordance with the loading weight of the car.

3. An elevator control apparatus according to Claim 2, wherein the restrictive condition setting portion determines

permissible values of at least one of the speed of the car and the acceleration/deceleration speeds of the car as to a plurality of predetermined components in accordance with a loading weight of the car, and adopts a lowest one of the permissible values as the information on the restrictions.

4. An elevator control apparatus according to Claim 1, wherein:

the component is composed of a main rope for suspending the car and a drive device for raising/lowering the car via the main rope; and
the restrictive condition setting portion imposes restrictions on the acceleration/deceleration speeds of the car so that a traction capacity between the main rope and the drive device is prevented from being exceeded.

5. An elevator control apparatus according to Claim 1, wherein the component is a power-supply installation, and the restrictive condition setting portion imposes restrictions on the speed of the car in traveling at a constant speed and the acceleration/deceleration speeds of the car in traveling with accelerating/decelerating so that a power supplying capacity of the power-supply installation is prevented from being exceeded.

6. An elevator control apparatus according to Claim 5, wherein the power-supply installation is an accumulator.

7. An elevator control apparatus according to Claim 1, wherein:

the component is a regenerator for processing a power regenerated during regenerative operation; and
the restrictive condition setting portion imposes restrictions on the speed of the car in traveling at a constant speed and the acceleration/deceleration speeds of the car in traveling with accelerating/decelerating so that a regenerative processing ability of the regenerator is prevented from being exceeded.

8. An elevator control apparatus according to Claim 1, further comprising a motor control portion for controlling a motor portion of a drive device for raising/lowering the car, wherein
the motor control portion includes a field weakening control portion for performing field weakening control to cause a negative amount of electric charge to flow in a direction of field magnetic fluxes.

9. An elevator control apparatus according to Claim 1, further comprising a detected value correcting portion for correcting an error in a detected value of the loading weight of the car.

FIG. 1

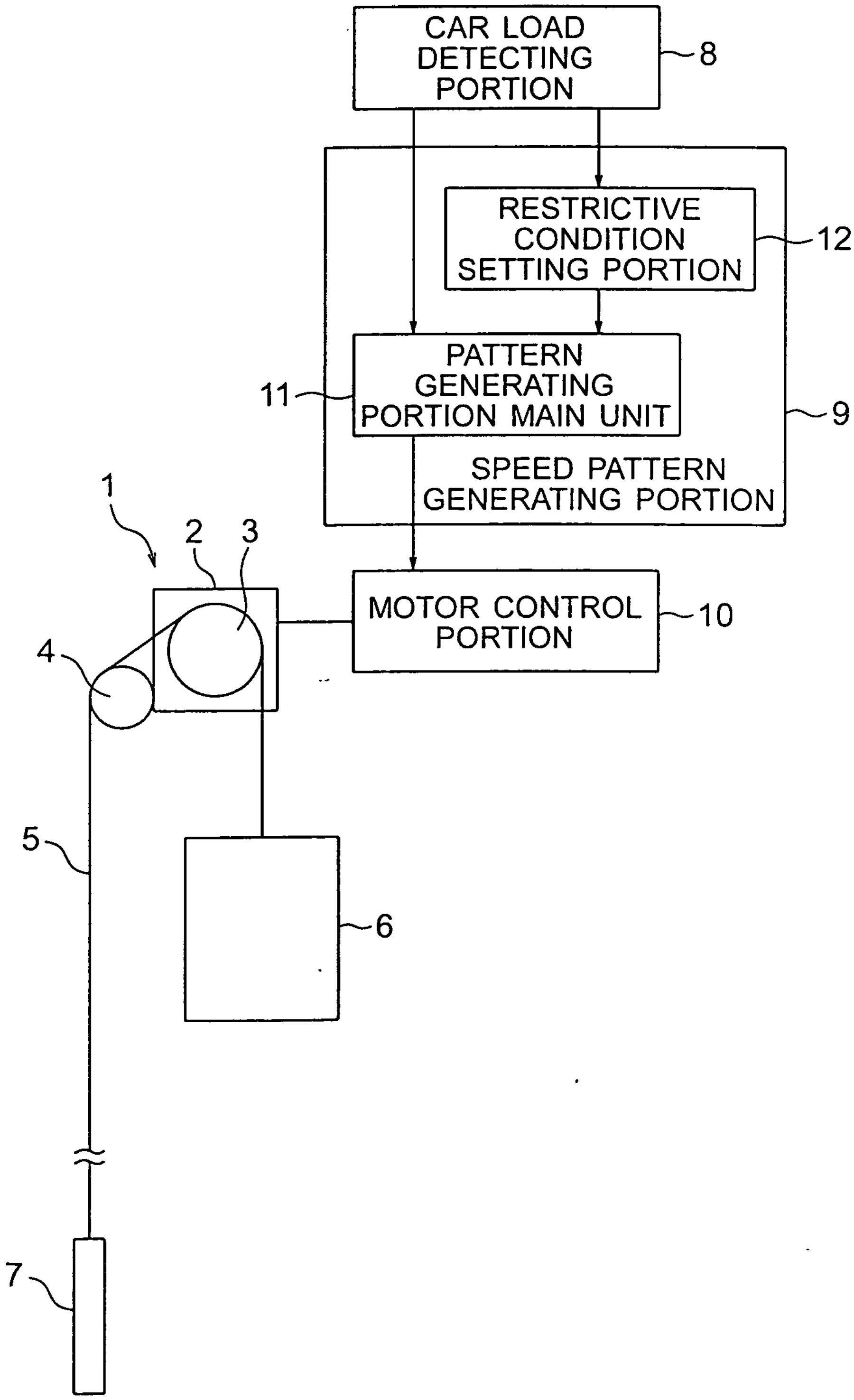

CAR LOAD DETECTING PORTION
8
RESTRICTIVE CONDITION SETTING PORTION
12
PATTERN GENERATING PORTION MAIN UNIT
11
9
SPEED PATTERN GENERATING PORTION
1
2
3
MOTOR CONTROL PORTION
10
4
5
6
7

FIG. 2

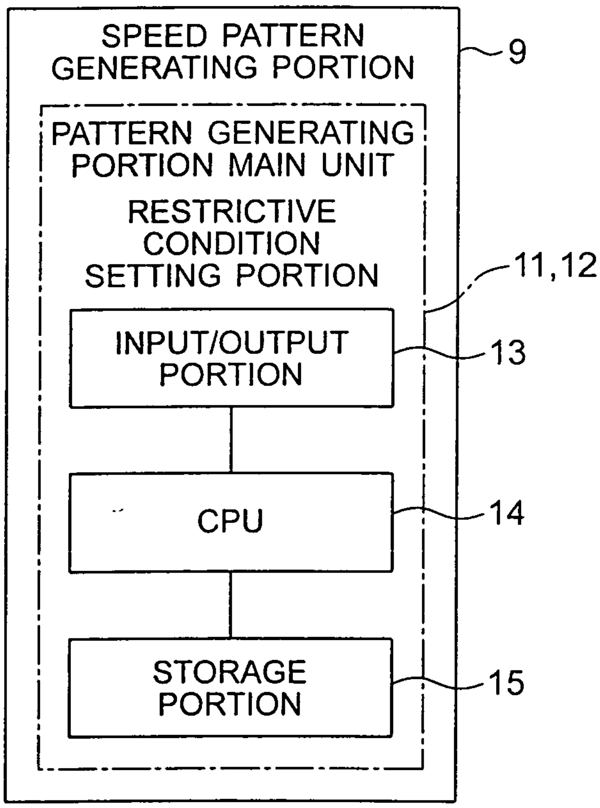

SPEED PATTERN GENERATING PORTION
9
PATTERN GENERATING PORTION MAIN UNIT
RESTRICTIVE CONDITION SETTING PORTION
11,12
INPUT/OUTPUT PORTION
13
CPU
14
STORAGE PORTION
15

FIG. 3

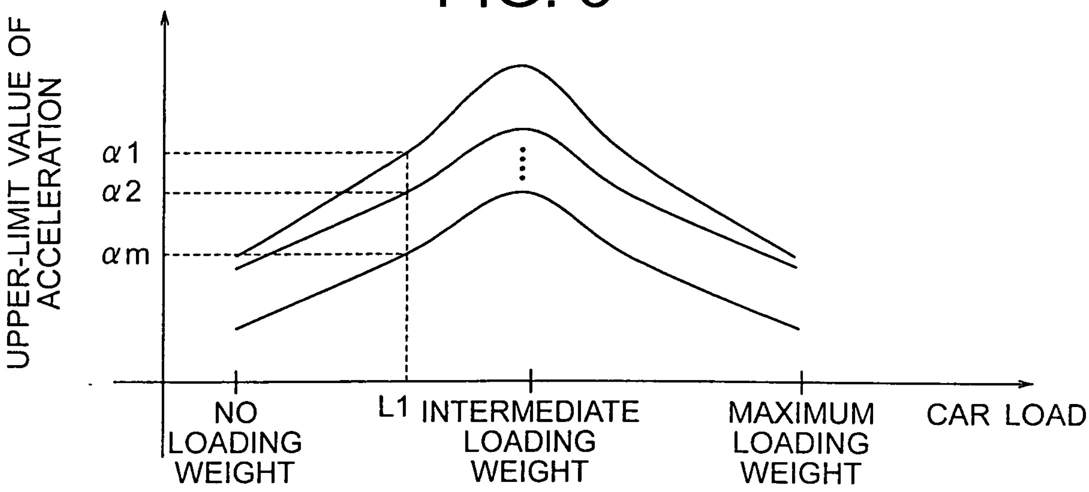


FIG. 4

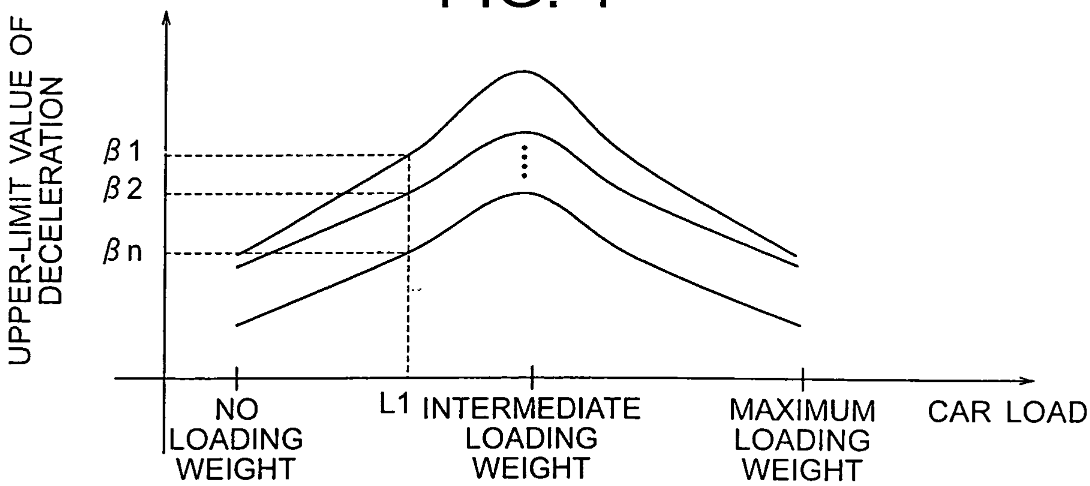


FIG. 5

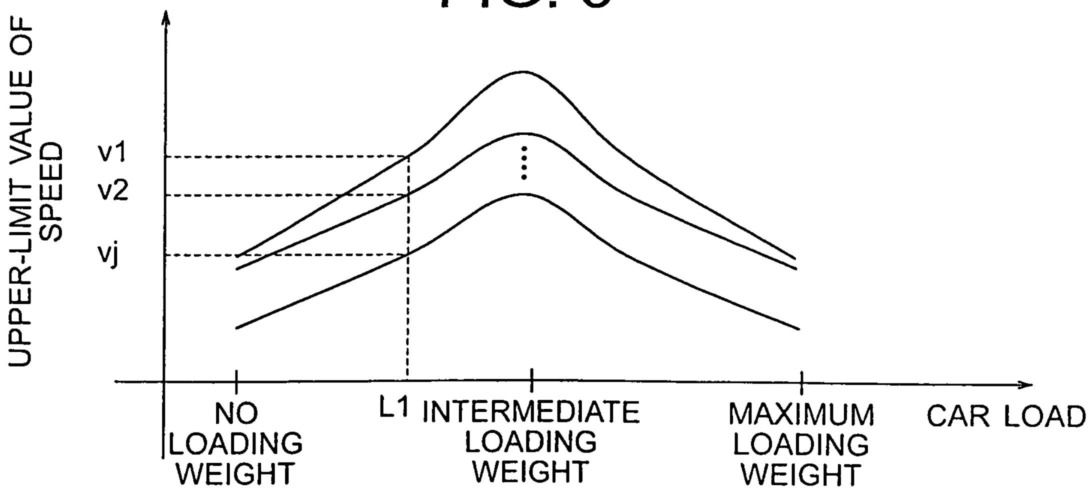


FIG. 6

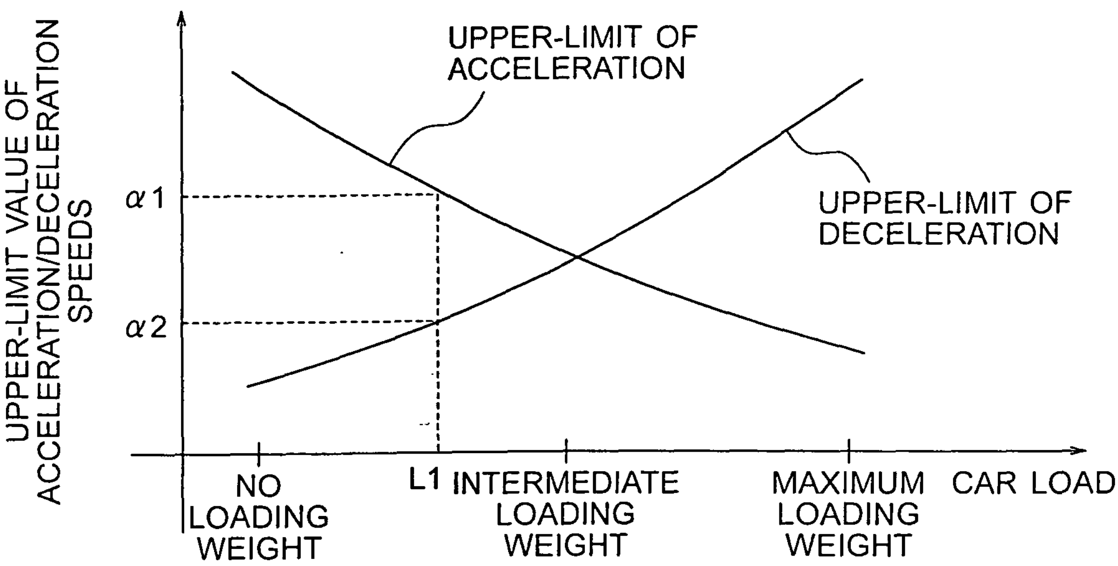

UPPER-LIMIT VALUE OF ACCELERATION/DECELERATION SPEEDS
UPPER-LIMIT OF ACCELERATION
UPPER-LIMIT OF DECELERATION
α1
α2
NO LOADING WEIGHT
L1
INTERMEDIATE LOADING WEIGHT
MAXIMUM LOADING WEIGHT
CAR LOAD

FIG. 7

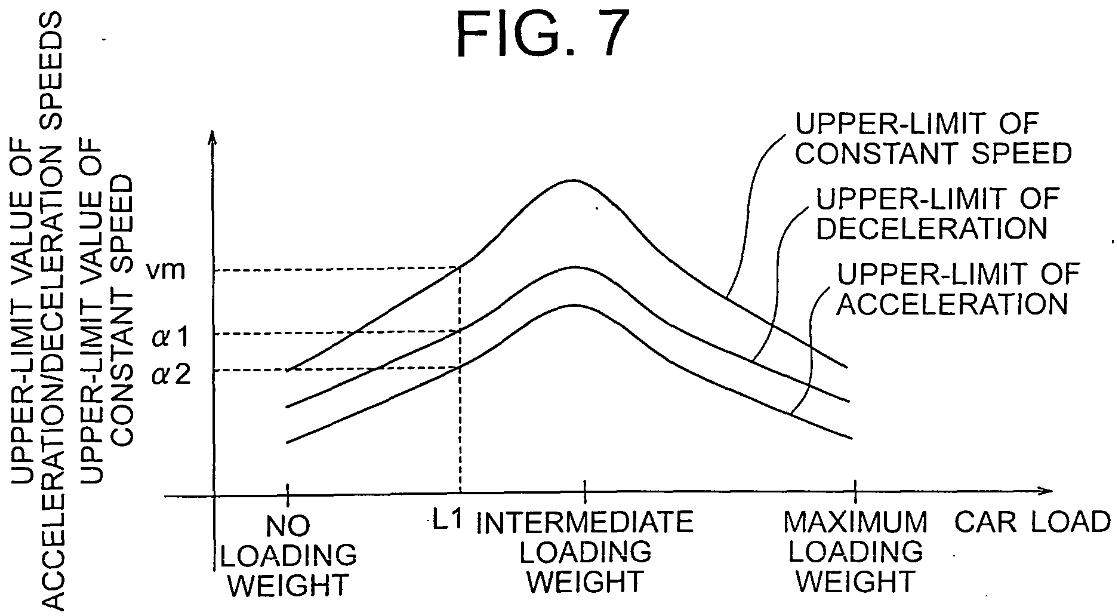

UPPER-LIMIT VALUE OF ACCELERATION/DECELERATION SPEEDS
UPPER-LIMIT VALUE OF CONSTANT SPEED
vm
α1
α2
UPPER-LIMIT OF CONSTANT SPEED
UPPER-LIMIT OF DECELERATION
UPPER-LIMIT OF ACCELERATION
NO LOADING WEIGHT
L1
INTERMEDIATE LOADING WEIGHT
MAXIMUM LOADING WEIGHT
CAR LOAD

FIG. 8

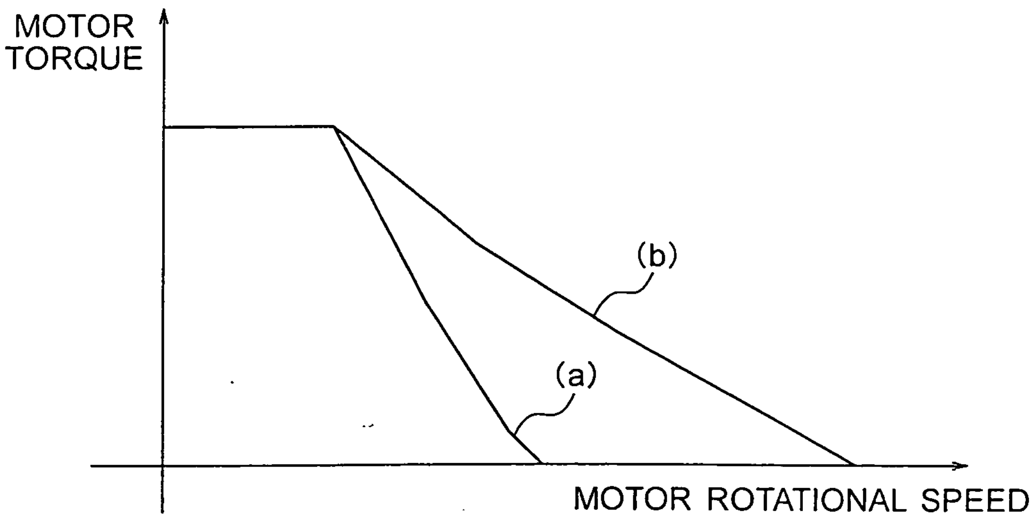
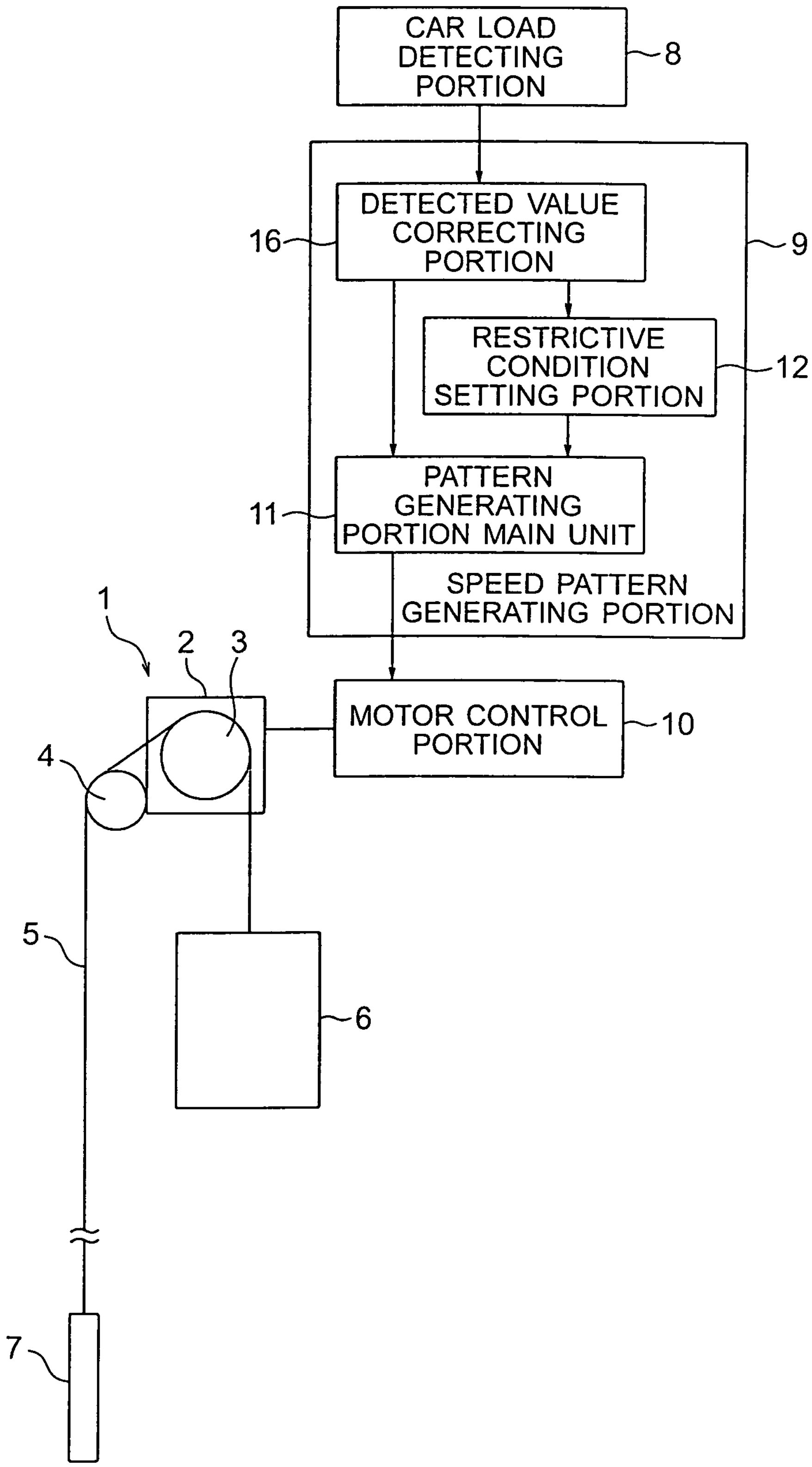


FIG. 9


CAR LOAD DETECTING PORTION
8
DETECTED VALUE CORRECTING PORTION
16
9
RESTRICTIVE CONDITION SETTING PORTION
12
PATTERN GENERATING PORTION MAIN UNIT
11
SPEED PATTERN GENERATING PORTION
1
2
3
MOTOR CONTROL PORTION
10
4
5
6
7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/004442

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B1/30

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] B66B1/00-5/28

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2004
Kokai Jitsuyo Shinan Koho	1971-2004	Toroku Jitsuyo Shinan Koho	1994-2004

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-238037 A (Mitsubishi Electric Corp.), 27 August, 2003 (27.08.03), Claims & WO 03/050028 A1	1-9
Y	JP 10-218510 A (Toshiba Corp.), 18 August, 1998 (18.08.98), Claims (Family: none)	1-9
Y	JP 59-17467 A (Hitachi, Ltd.), 18 January, 1984 (18.01.84), Claims (Family: none)	1

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 December, 2004 (24.12.04)	18 January, 2005 (18.01.05)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/004442

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2000-118903 A (Hitachi, Ltd.), 25 April, 2000 (25.04.00), Claims (Family: none)	4
Y	JP 56-155166 A (Mitsubishi Electric Corp.), 01 December, 1981 (01.12.81), Claims (Family: none)	5-6
Y	JP 7-165372 A (Hitachi, Ltd.), 27 June, 1995 (27.06.95), Claims (Family: none)	7

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2003238037 A **[0002] [0015]**