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(54) **CONTROL DEVICE OF ELEVATOR**

STEUERVORRICHTUNG FÜR AUFZUG

DISPOSITIF DE CONTRÔLE D'ASCENSEUR

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Description

Technical Field

[0001] The present invention relates to an elevator control system which adjusts acceleration and maximum speed by changing speed patterns given to motors of an elevator and the like according to loads, and the like.

Background Art

[0002] A technique related to a conventional elevator control system will be described by referring to Figure 10. Figure 10 is a diagram which shows the relationship between the output frequency (speed: hereinafter "frequency" has the same meaning as "speed") and torque of a conventional elevator control system. In Figure 10, fo represents a basic frequency (rated speed), Tmax a maximum output torque value, Tx a torque value necessary under a first load, Ty a torque value necessary under a second load (second load < first load), fx a maximum output frequency capable of being outputted under a first load, and fy a maximum output frequency capable of being outputted under a second load.

[0003] In a frequency range of not less than a basic frequency fo, a torque obtained in a frequency zone higher than a frequency fx is smaller than a torque value Tx necessary for, for example, a first load and, therefore, a maximum output frequency for the first load (necessary torque value Tx) becomes not more than the frequency fx. Also, because a torque obtained in a frequency zone higher than the a frequency fy is smaller than a torque value Ty necessary for a second load, a maximum output frequency for the second load (necessary torque value Ty) becomes not more than the frequency fy.

[0004] In view of the foregoing, in order to obtain a sufficient torque for various loads large and small, it has hitherto been a general practice to rotate a motor by setting the operating frequency of the motor to a frequency of not more than an output frequency which enables a torque for a supposed maximum load to be obtained.

[0005] In an elevator control system as described above, a maximum frequency can be set at a high value in the case of a small load, whereas in the case of a large load, a sufficient torque cannot be obtained unless a maximum output frequency is set at a low value, and hence an ascent becomes impossible in an elevator and the like, thereby posing a problem. Therefore, it was necessary to perform operation by setting a maximum output frequency at a frequency at which a sufficient torque can be obtained in the case of a maximum load.

[0006] That is, in the example shown in Figure 10, a maximum output frequency is set at fx and even in the case of a small load, the maximum output frequency remained to be fx.

[0007] For this reason, because of a low maximum output frequency in the case of a small load, acceleration requires time and operating time cannot be shortened, thereby posing the problem that efficiency is low.

[0008] To solve this problem, for example, in the Japanese Patent Laid-Open No. 3-56308, for a frequency which is not less than a rated frequency, a power value is found from voltage and current and this power value is compared with a power value at a rated frequency, whereby a speed setting is outputted in a variable speed device. In a control system disclosed in the Japanese Patent Laid-Open No. 8-107699, a variable speed device which has an inverter section which converts a DC current into an AC current of variable frequency and variable voltage is provided with a voltage detection circuit which detects a DC bus bar voltage on the entry side of the inverter section, a current detection circuit which detects the current of each phase on the output side of the inverter section, and a control circuit which automatically judges the magnitude of a load connected to the inverter section by using the detected DC bus bar voltage and the detected current of each phase and determines and outputs a maximum output frequency.

[0009] In conventional elevator control systems, maximum speeds were changed according to loads in order to shorten operating time. However, operating time is not always shortened by raising maximum speeds alone, and it might be thought that in the case of a short moving distance, operating time becomes short when an acceleration, rather than maximum speeds, is raised. Therefore, operating time becomes long depending on moving distance only by changing maximum speeds according to loads, thereby posing a problem.

[0010] Also, in the case of an elevator, the detection of loads is performed by use of a load weighing device provided in a car. However, because detection errors are included in loads detected by the load weighing device, a torque becomes insufficient if a maximum speed is raised on the basis of the loads detected by the load weighing device, thereby posing a problem.

[0011] The present invention has been made to solve these problems as described above and has as its object the provision of an elevator control system which can shorten operating time by changing maximum speeds and acceleration according to loads and moving distances. Also, the invention has as its another object the provision of an elevator control system which can detect loads with high accuracy.

Disclosure of the Invention

[0012] An elevator control system according to a first aspect of the present invention is **characterized in that** in an elevator which has a speed controller, which generates a torque command value from a speed command value and a speed signal, and causes a car and a counter weight to ascend and descend by controlling an electric motor by use of a power converter on the basis of the torque command value, after a prescribed time during which the elevator releases a brake, a torque command on startup is held, and speed patterns for determining the jerk, acceleration and deceleration, and rated speed of the car are changed according to the torque command.

Brief Description of the Drawings

[0013] For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a system configuration diagram which shows an elevator control system in the first embodiment of the present invention;
Figure 2 is a characteristic diagram which shows the relationship between the torque generated in a motor and the rotational speed of the motor in the first embodiment of the present invention;
Figure 3 is a schematic diagram for deriving a mechanical system model of an elevator in the first embodiment of the present invention;
Figure 4 is a characteristic diagram which shows the relationship between car speed patterns and motor torque patterns in the first embodiment of the present invention;
Figure 5 is a flowchart which shows the procedure for calculating car speed patterns in the first embodiment of the present invention;
Figure 6 is a diagram which shows speed and acceleration and deceleration speed tables in the first embodiment of the present invention;
Figure 7 is a diagram which shows other different speed and acceleration and deceleration speed tables;
Figure 8 is a system configuration diagram which shows an elevator control system in the second embodiment of the present invention;
Figure 9 is a characteristic diagram which shows the relationship between torques capable of being outputted by a motor and speed ranges in the fourth embodiment of the present invention; and
Figure 10 is a characteristic diagram which shows the relationship between output frequency and torque in a conventional elevator control system.

Best Mode for Carrying Out the Invention

[0014] The following describes an elevator which has a speed controller, which generates a torque command value from a speed command value and a speed signal, and causes a car and a counter weight to ascend and descend by controlling an electric motor by use of a power converter on the basis of the torque command value, and in which an elevator is provided with a load weighing device which detects an in-car load and outputs a load weighing signal, unbalanced loads on the car side and on the counter weight side being calculated on the basis of the load weighing signal, and the torque command value being corrected on the basis of the unbalanced loads, after a prescribed time during which the elevator releases a brake, a torque command on startup is held, and speed patterns which determine the jerk, acceleration and deceleration, and rated speed of the car are changed according to the torque command.

[0015] The speed patterns have predetermined standard values, and the acceleration and deceleration and rated speed are increased from the standard values at prescribed increase rates to values limited by a maximum output of the power converter and a maximum output of the electric motor.

[0016] The speed patterns which determine the jerk, acceleration and deceleration, and rated speed of the car are changed by correcting the torque command on startup of the elevator in terms of travel loss on the basis of a torque command during traveling in the last travel.

[0017] To detect a load, the number of passengers in the car is judged from an image photographed by a camera within the car of the elevator, and speed patterns which determine the jerk, acceleration and deceleration, and rated speed of the car are changed on the basis of a camera signal which outputs results of the judgment.

[0018] In addition, the following describes an elevator which has a speed controller, which generates a torque command value from a speed command value and a speed signal, and causes a car and a counter weight to ascend and descend by controlling an electric motor on the basis of the torque command value, and in which an elevator is provided with a load weighing device which detects an in-car load and outputs a load weighing signal, unbalanced loads on the car side and on the counter weight side being calculated on the basis of the load weighing signal, and the torque command value being corrected on the basis of the unbalanced loads, there is provided a speed pattern determining device which judges the number of passengers in the car from the load weighing signal, or the torque signal on startup of the elevator, or an image photographed by a camera within the car of the elevator, and in which a device selects, from tables of acceleration and speed, speed patterns which determine the jerk, acceleration and deceleration, and rated speed of the car according to a camera signal which outputs results of the judgment, or according to combinations of these data, and increase rates of the acceleration and speed are changed according to a moving distance to a target floor. The longer a moving distance to a target floor, the more dominant an increase of a maximum speed will be made.

[0019] Moreover, the following describes an elevator with a load weighing device which detects an in-car load and outputs a load weighing signal, speed patterns which determine the jerk, acceleration and deceleration and rated speed of the car being changed according to the load weighing signal, there is provided a load weighing check device which stops the changing of speed patterns, when a difference in the load weighing signal and the torque signal on startup exceeds a prescribed value, and which returns the speed patterns to predetermined standard values.

[0020] The first embodiment of the present invention will be described below on the basis of the drawings.

[0021] Figure 1 is a system configuration diagram which shows an elevator control system in the first embodiment of the present invention. In Figure 1, a main rope 3 is wound on a driving sheave 2 of a traction machine which is driven by a hoisting motor 1, and a car 4 and a counter weight 5 are each connected to both ends of the main rope 3. A speed detector 6, which is connected to the hoisting motor 1, outputs a speed signal 6a corresponding to the rotational speed of the motor 1. A load weighing device 7, which is provided in the car 4, detects an in-car load and outputs a load weighing signal 7a. A power converter 8 supplies a power source which drives the motor 1. A current detector 9 detects a current of the motor 1 and outputs a current signal 9a. A speed command generator 10 generates a speed command value 10a of the elevator. A speed controller 11, which is connected to the speed command generator 10 and the speed detector 6, outputs a first torque command value 11a using the speed command value 10a and the speed signal 6a as inputs. A load weighing compensator 12, which is connected to the load weighing device 7, outputs a torque compensation signal 12a using the load weighing signal 7a as an input. An adder 13, which is connected to the speed controller 11 and the load weighing compensator 12, outputs a second torque command value 13a. A torque controller 14 is connected to the adder 13, the speed detector 6 and the current

[0022] After the startup of the car 4, the speed controller 11 outputs a first torque command value 11a on the basis of a speed command value 10a and a speed signal 6a. Usually, PI calculation by a difference between the speed command value 10a and the signal speed signal 6a is used as speed control calculation. A first torque command value 11a is added to a torque compensation signal 12a in the adder 13 and becomes a second torque command value 13a. The torque controller 14 calculates an output 14a from the second torque command value 13a, the speed signal 6a and current signal 9a, and controls the torque of the hoisting motor 1 via the power converter 8. As a result of this, the car 4 and the counter weight 5 ascend and descend.

[0023] On startup of the car 4, the brake 15 of the driving sheave 2 of the traction machine is released on the basis of a startup command 15a from the speed command generator 10. The startup torque command detector 16 holds a torque command on startup after a prescribed time during which the elevator releases the brake 15. Furthermore, by correcting a travel loss 17a during elevator traveling calculated by the travel loss calculator 17, a balance torque during traveling at a constant speed is calculated. Although an unbalanced torque generated by a mass difference between the car 4 and the counter weight 5 in a balanced torque may be replaced with the torque compensation signal 12a outputted from the load weighing compensator 12, detection errors are included in loads detected by the load weighing device 7. Therefore, results of high accuracy are obtained by calculating a balanced torque by use of a torque command after the speed controller 11 performs control for holding still after startup.

[0024] Next, the procedure until the generation of speed patterns will be described with reference to Figures 2 to 5. Figure 2 is a characteristic diagram which shows the relationship between the torque generated in a motor and the rotational speed of the motor. Figure 3 is a schematic diagram for deriving a mechanical system model of an elevator, which shows the relationship among the hoisting motor 1, the driving sheave 2 of the traction machine, the car 4 and the counter weight 5. The lower part of Figure 4 shows a motor torque pattern, and the upper part of the figure shows a car speed pattern at this time. Figure 5 is a flowchart which shows the calculation procedure for generating car speed patterns.

[0025] In Figure 2, the hoisting motor 1 can operate in a region of shaded portion enclosed on the lines of maximum output value, which changes depending on the motor torque axis and the rotational speed of the motor, and a region containing the boundary. It is necessary only that the regions be a convex set. However, even when they are not a convex set, it is enough to perform approximation in order to ensure that the operating regions become a convex set. The regions of positive torque shows a power running state and the regions of negative torque shows a regenerative state. These regions are represented by Ω. The region A is a rated travel region in which traveling is possible at a rated speed and a standard accelerated and decelerated speeds in cases ranging from a case where there is no passenger in the car 4 to a maximum load. The region B is a region in which a rated speed, a standard acceleration, variable accelerated and decelerated speeds, and a variable speed are possible in a case where there is a passenger in the car

4 and in a small unbalanced state of the counter weight 5, i.e., when the motor torque is a light load.

[0026] In Figure 3, Tm represents a motor torque, T1 a travel loss torque, J the moment of inertia, r the radius of the traction machine, m1 the mass of the counter weight, m2 the mass of the car, α a car acceleration, and ω the rotational speed of the traction machine. Furthermore, g represents a gravity acceleration. By deriving a motion equation for the construction of Figure 3, a relational expression of a motor torque and a car acceleration, an unbalanced torque and a travel loss torque is obtained as follows:

$$Tm = \{2J/r + r(m1 + m2/2\}\alpha - \frac{r}{2}\ (m1 - m2)g + T1 \qquad \ldots(1)$$

[0027] Incidentally, in the construction of Figure 3, a relational expression of car acceleration and motor torque is given by Eq. (1). However, other constructions may be adopted so long as they ensure that the relationship between the two can be described by a linear function. Next, on the assumption that the rotational speed of the motor is equal to the rotational speed of the traction machine and if v represents the car speed, the car speed can be calculated from the rotational speed of the motor as follows:

$$v = r\ \omega \qquad \ldots(2)$$

[0028] Hence, Figure 2 can be transformed to a figure which shows the relationship between motor torque and car speed. Incidentally, it was assumed that the rotational speed of the motor is equal to the rotational speed of the traction machine. However, if a transformation ensures that the relationship between the two can be described by a linear function, it is not always necessary to use Eq. (2) above. For example, an embodiment of the present invention can be applied also to a case where a speed reducer or the like is used.

[0029] In Figure 4, the car speed pattern in the upper part of the figure is calculated with respect to the torque pattern in the lower part by Eq. (1) above and an integral value of the equation. Also, in Figure 4, t0 to t7 each represent a time, Δt1 to Δt7 an interval of time, v0 to v7 a car speed for each time, and tm0 to Tm7 a motor torque for each time. In this figure, Tm0 = Tm3 = Tm4 = Tm7 = TM0; Tm1 = Tm2 = TM1; and Tm5 = Tm6 = TM2. Also, v0 = 0, t0 = 0.

[0030] In Figure 4, traveling with a constant jerk value (with a constant value of accelerated speed, i.e., rate of change of car acceleration) is performed in the intervals of time Δt1, Δt3, Δt5, Δt7, traveling with a constant acceleration is performed in the intervals of time Δt2 and Δt6, and traveling with a constant speed is performed in the interval of time Δt4. By substituting α = 0 in Eq. (1) above, a balanced torque TM0 can be calculated as in Eq. (3) below:

$$TM0 = -r\ (m1 - m2)\ g / 2\ + T1 \cdots (3)$$

[0031] How to select a speed pattern in the speed command generator 10 in the first embodiment will be described by using Figure 5.

[0032] In Figure 5, in the processing for setting a destination floor in Step S21, for a destination floor set by a passenger in the car, in the hall or the like, the travel distance L of the car or the number of floors to be traveled is set on the basis of the floor at which the car stops next. Next, in the processing for detecting a balanced torque in Step S22, a balanced torque is calculated by adding the torque command 16a on startup detected by the startup torque command detector 16 and the travel loss 17a during elevator travel calculated by the travel loss calculator 17. Next, in the processing for setting speed and accelerated and decelerated speeds in Step S23, tables of speeds, accelerated and decelerated speeds are selected according to the travel distance L of the car or the number of floors to be traveled set in Step S21 and the balanced torque calculated in Step S22. Next, in the processing for generating speed patters in Step S24, the speed pattern shown in Figure 4 is generated on the basis of the tables of speeds, accelerated and decelerated speeds selected in Step S23.

[0033] For torque limiting conditions, it is necessary that the speed pattern and torque pattern of Figure 4 be limited within the operating range of the motor. Therefore, on the basis of Eq. (1), it is necessary to prepare beforehand tables of speeds, accelerated and decelerated speeds as shown in Figure 6 in order to ensure that the motor torque is limited within the operating range of the motor when traveling is performed in a set speed pattern and accelerated and decelerated speed patterns according to a motor torque on startup.

[0034] In this first embodiment, there are available, as travel patterns, multiple tables of speeds, accelerated and decelerated speeds corresponding to a balanced torque or an in-car loaded weight (expressed in the ratio to a rating), operating direction, etc. as shown in Figure 6. The elevator control system selects a speed, accelerated and decelerated speeds corresponding to a motor torque on startup and the operating direction from selected tables, and performs the operation of the elevator according to the selected speed, accelerated and decelerated speeds. The above-described multiple tables of speeds, accelerated and decelerated speeds can be set as follows, for example.

[0035] The table E of speeds, accelerated and decelerated speeds of Figure 6 is set in consideration of the moving distance L of the car for a tradeoff between car speeds and accelerated and decelerated speed of the car. In this case, a table to be used is selected by considering how many meters the floor to floor distance is until the target floor is reached. Incidentally, a table may be divided by the number of floors passed by the car in place of the floor to floor distance. Multiple tables are available according to the moving distance L. In the case of a short moving distance L, the operating time is shortened by increasing accelerated and decelerated speeds rather than speeds and the operation efficiency is high. Therefore, accelerated and decelerated speeds are set at high values. Inversely, when the moving distance L is large, the operating efficiency is raised by increasing speeds rather than accelerated and decelerated speeds. Therefore, speeds are set at high values. In this case, on startup, the moving distance L is first calculated on the basis of information on the floor at which the car is at a stop and the floor at which the car is to stop next, and a table is selected according to the moving distance L. For example, when the moving distance L is 12 meters, the bottommost table is selected. Next, a speed and accelerated and decelerated speeds suited to a balanced torque on the abscissa and the operation of the elevator is started.

[0036] Although the table E above is a table based on the moving distance L, a balanced torque and an operating direction, it is also possible to use a table based on the moving distance L alone and a table based on a balanced torque alone. And a table based on any combination of the above items, for example, a table based on the moving distance L and an operating direction may be used.

[0037] Also, the table F of speed and accelerated and decelerated speeds as shown in Figure 7, which is based on the ratio of car load to rated load in place of a balanced torque, may be used.

[0038] Next, the second embodiment of the present invention will be described on the basis of the drawings.

[0039] Figure 8 is a system configuration diagram which shows an elevator control system in the second embodiment of the present invention. In Figure 8, a main rope 3 is wound on a driving sheave 2 of a traction machine which is driven by a hoisting motor 1, and a car 4 and a counter weight 5 are each connected to both ends of the main rope 3. A speed detector 6, which is connected to the hoisting motor 1, outputs a speed signal 6a corresponding to the rotational speed of the motor 1. A load weighing device 7, which is provided in the car 4, detects an in-car load and outputs a load weighing signal 7a. A power converter 8 supplies a power source which drives the motor 1. A current detector 9 detects a current of the motor 1 and outputs a current signal 9a. A speed command generator 10 generates a speed command value 10a of the elevator. A speed controller 11, which is connected to the speed command generator 10 and the speed detector 6, outputs a first torque command value 11a using the speed command value 10a and the speed signal 6a as inputs. A load weighing compensator 12, which is connected to the load weighing device 7, outputs a torque compensation signal 12a using the load weighing signal 7a as an input. An adder 13, which is connected to the speed controller 11 and the load weighing compensator 12, outputs a second torque command value 13a. A torque controller 14 is connected to the adder 13, the speed detector 6 and the current detector 9, and the torque controller 14 outputs its output 14a. A brake 15, which holds still the driving sheave 2 of the traction machine, is released on the basis of a startup command 15a from the speed command generator 10. A camera 18 is provided within the car 4 of the elevator. The number of passengers in the car is judged from an image photographed by use of this camera 18 and a camera signal 18a which outputs the result of the judgment is regarded as a balanced torque. On the basis of the startup command 15a from the speed command generator 10, an in-car passenger detector 20 which replaces the startup torque command detector 16 in the first embodiment holds a torque command on startup after a prescribed time during which the elevator releases the brake 15. On the basis of the speed command value 10a, a travel loss calculator 17 calculates a travel loss 17a during elevator traveling by deducting the torque compensation signal 12a from the load weighting compensator 12 from the second torque command value 13a during traveling at a rated speed or a constant speed.

[0040] In this second embodiment, the camera signal 18a is regarded as a balanced torque and accelerated and decelerated speeds and rated speed are determined by the method of selecting a speed pattern shown in Figure 5.

[0041] As the third embodiment of the present invention, there is also available a method by which the tables of speeds and accelerated and decelerated speeds of the above described method of selecting a speed pattern are not used, and as shown in Eq. (4) and Eq. (5) below, for a standard speed V0 and a standard accelerated or decelerated speed $\alpha 0$, which are predetermined, an accelerated or decelerated speed α and a rated speed V which are appropriate to a balanced torque T (expressed in the ratio to a rating) are increased at prescribed increase rates k1, k2 to values limited by a maximum output of the power converter 8 and a maximum output of the motor 1.

$$V = k2 / T \times V0 \qquad \cdots (4)$$

$$\alpha = k1 / T \times \alpha 0 \quad \cdots (5)$$

[0042] When the load weighing checker 19 of Figure 1 judges that detection errors of the load weighing device 7 are large and outputs an abnormal signal, the speed pattern is returned to the standard speed V0 and the standard accelerated or decelerated speed $\alpha 0$, which are predetermined standard values.

[0043] As the fourth embodiment of the present invention, control means which performs field-weakening control is provided in the control of the motor which drives the traction machine. Field-weakening control is a motor control method applied to a permanent magnet motor, and is a control method which enables the motor to be driven at higher revolutions by suppressing the terminal voltage of the motor owing to the demagnetization effect, which is obtained by causing a negative current to flow in the field magnetic flux direction (d-axis direction). Figure 9 shows torques capable of being outputted by the motor and speed ranges. In Figure 9, (a) shows a region in which motor output is possible when field-weakening control is not performed, and (b) shows a region in which motor output is possible when field-weakening control is performed. The driving region of the motor can be widened to the high speed side by performing field-weakening control. At this time, it is unnecessary to change the capacity of electrical equipment, such as an inverter. Therefore, by using field-weakening control, it is possible to set an upper limit to a constant speed to the higher speed side without changing electrical equipment. The smaller the difference between the weight of the car side and the weight of the counter weight, the greater the effect of field-weakening control. The reason is as follows. When the difference between weight of the car side and the weight of the counter weight is small, a required motor torque is small and, therefore, the power consumption and regenerative power of the elevator also become small. As a result, the elevator control system becomes less affected by restrictions by the capacity of power supply equipment and limiting conditions of the regenerative capacity, and from the nature of field-weakening control, the smaller a generated torque, the higher the rotational speed at which the motor can be driven.

[0044] A motor can be driven at higher rotational speeds by adopting a method by which a tertiary harmonic wave is superposed on the inverter voltage and a two-phase modulation method as a method of raising the voltage utilization rate of an inverter in order to drive a motor at high rotational speeds.

[0045] When the rotational speed of a motor increases and the output voltage of an inverter rises, it is necessary to raise the voltage value of a DC link and the electromagnetic noise of the motor increases. However, the electromagnetic noise can be considerably suppressed by performing a dead time (Td) correction of a voltage type inverter.

[0046] As described above, after a prescribed time during which the elevator releases the brake, a torque command on startup is held and speed patterns which determine the jerk (rate of change of acceleration), accelerated and decelerated speeds and rated speed of the car are changed according to the torque command. Also, on the basis of a torque command during traveling of the last travel, speed patterns which determine the jerk, acceleration and deceleration and rated speed of the car are changed by correcting the torque command on startup of the elevator by a travel loss. Therefore, because the change of speed patterns is performed on the basis of the torque command in which a travel loss is added to the torque command after the control for holding still by the speed controller, detection errors of the load weighing device etc. are not contained and the effect of a travel loss etc. is taken into consideration. Therefore, results of high accuracy are obtained.

[0047] Furthermore, speed patterns have predetermined standard values, and for these predetermined standard values, an acceleration or deceleration and a rated speed are increased at prescribed increase rates to values limited by a maximum output of the power converter and a maximum output of the motor. Therefore, the construction can be made simple and high-accuracy speed patterns limited by a maximum output of the power converter and a maximum output of the motor can be generated.

[0048] As a method of detecting loads, the number of passengers in the car is judged from an image photographed by use of a camera provided in the elevator car, and speed patterns which determine the jerk, accelerated and decelerated speeds, rated speed of the car are changed on the basis of a camera signal which outputs the result. Therefore, even when large detection errors are generated in the load weighing device and the like, speed patterns can be accurately changed within the motor torque range.

[0049] The number of passengers in the car is judged from a load weighing signal, a torque command on startup of the elevator or an image photographed by use of a camera provided in the car, there is provided a speed pattern determining device which selects speed patterns which determine the jerk, accelerated and decelerated speeds, and rated steed of the car from a camera signal which outputs the result of the judgment or combinations of these data, and increase rates of the acceleration and speed are made variable in order to ensure that the longer the moving distance to a destination floor, the more dominant an increase in a maximum speed. Therefore, this provides the advantage that with a simple construction, the moving time of passengers is shortened, resulting in an increase in the operation efficiency of the car.

[0050] Even in the case of an elevator which is provided with a load weighing device which detects an in-car load and outputs a load weighing signal and speed patterns which determine the jerk, accelerated and decelerated speeds, and rated speed of the car are changed according to the load weighing signal, a load weighing checker is provided and in case a difference between the load weighing signal and a torque command on startup exceeds a prescribed value, the change of speed patters is stopped and set values are returned to standard values. Therefore, even when large detection errors are produced in the load weighing device and the like, the errors are detected and the change of speed patterns is stopped. Therefore, it is possible to increase reliability.

Industrial Applicability

[0051] As described above, an elevator control system of embodiments of the present invention changes maximum speed and acceleration according to load and moving distance and can shorten operating time. Furthermore, the detection of loads can be performed with high accuracy.

Claims

1. An elevator control system, **characterized in** comprising an elevator which has a speed controller (11), arranged to generate a torque command value (11a) from a speed command value (10a) and a speed signal (6a), and causes a car (4) and a counter weight (5) to ascend and descend by controlling an electric motor (1) by use of a power converter (8) on the basis of the torque command value (11a), wherein a startup torque command detector (16) is arranged to hold a torque command on start up after a prescribed time during which the elevator releases the brake (15)
and speed patterns for determining the jerk, acceleration and deceleration, and rated speed of the car are changed according to the torque command on startup.

2. An elevator control system according to Claim 1, in which the elevator is provided with a load weighing device (7) for detecting an in-car load and outputs a load weighing signal (7a), unbalanced loads on the car (4) side and on the counter weight (5) side being calculated on the basis of the load weighing signal (7a), and the torque command value (11a) being corrected on the basis of the unbalanced loads.

3. The elevator control system according to Claim 1 or 2, **characterized in that** the speed patterns have predetermined standard values, and **in that** the acceleration and deceleration and rated speed are increased from the standard values at prescribed increase rates to values limited by a maximum output of the power converter (8) and a maximum output of the electric motor (1).

4. The elevator control system according to any of Claims 1 to 3, **characterized in that** the speed patterns for determining the jerk, acceleration and deceleration, and rated speed of the car are changed by correcting the torque command on startup of the elevator in terms of travel loss on the basis of a torque command during traveling in the last travel.

Patentansprüche

1. Aufzugsteuersystem, **gekennzeichnet durch** Umfassen eines Aufzugs, der eine Geschwindigkeitssteuerung (11) aufweist, die dazu eingerichtet ist, einen Drehmomentbefehlswert (11a) aus einem Geschwindigkeitsbefehlswert (10a) und einem Geschwindigkeitssignal (6a) zu erzeugen, und eine Kabine (4) und ein Gegengewicht (5) dazu veranlasst, **durch** Steuern eines elektrischen Motors (1) mittel eines Leistungswandlers (8) auf Grundlage des Drehmomentbefehlswert (11a) auf- und abzusteigen, wobei ein Anfahrtsdrehmomentbefehlsdetektor (16) dazu eingerichtet ist, einen Drehmomentsbefehl beim Anfahren nach einer vorgeschriebenen Zeit, während der der Aufzug die Bremse (15) freigibt, zu halten und wobei Geschwindigkeitsmuster zum Bestimmen des Zugs, der Beschleunigung und der Abbremsung und der Nenngeschwindigkeit der Kabine entsprechend des Drehmomentbefehls beim Anfahren geändert werden.

2. Aufzugsteuersystem nach Anspruch 1, in dem der Aufzug mit einer Lastwiegevorrichtung (7) zum Erfassen einer Last in der Kabine ausgestattet ist und ein Lastwiegesignal (7a) ausgibt, wobei unausgeglichene Lasten auf der Kabinenseite (4) und auf der Gegengewichtsseite (5) auf Grundlage des Lastwiegesignals (7a) berechnet werden, und wobei der Drehmomentbefehlswert (11a) auf Grundlage der unausgeglichene Lasten korrigiert wird.

3. Aufzugsteuersystem nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Geschwindigkeitsmuster vorbestimmte Standardwerte haben, und **dadurch**, dass die Beschleunigung und die Abbremsung und die Nenngeschwindigkeit von den Standardwerten mit vorgeschriebenen Steigerungsraten auf Werte gesteigert werden, die durch eine maximale Ausgabe des Leistungswandlers (8) und eine maximale Ausgabe des elektrischen Motors (1) begrenzt sind.

4. Aufzugsteuersystem nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Geschwindigkeitsmuster zum Bestimmen des Zugs, der Beschleunigung und der Abbremsung und der Nenngeschwindigkeit durch Korrigieren des Drehmomentbefehls beim Anfahren des Aufzugs geändert werden im Hinblick auf einen Fahrverlust auf Grundlage eines Drehmomentsbefehls während eines Fahrens in der letzten Fahrt.

Revendications

1. Système de commande d'ascenseur, **caractérisé en ce qu'**il comprend un ascenseur qui comporte un dispositif de commande de vitesse (11), agencé pour générer une valeur de commande de couple (11a) à partir d'une valeur de commande de vitesse (10a) et d'un signal de vitesse (6a), et faire en sorte qu'une cabine (4) et un contrepoids (5) montent et descendent en commandant un moteur électrique (1) en utilisant un convertisseur de puissance (8) en fonction de la valeur de commande de couple (11a), dans lequel un détecteur de commande de couple de démarrage (16) est agencé pour maintenir une commande de couple au démarrage après une période prescrite durant laquelle l'ascenseur libère le frein (15) et-des modes de vitesse pour déterminer la saccade, l'accélération et la décélération, et la vitesse nominale de la cabine sont changés selon la commande de couple au démarrage.

2. Système de commande d'ascenseur selon la revendication 1, dans lequel l'ascenseur est pourvu d'un dispositif de pesage de charge (7) pour détecter une charge en cabine et envoyer un signal de pesage de charge (7a), des charges déséquilibrées sur le côté de cabine (4) et sur le côté de contrepoids (5) étant calculées en fonction du signal de pesage de charge (7a), et la valeur de commande de couple (11a) étant corrigée en fonction des charges déséquilibrées.

3. Système de commande d'ascenseur selon la revendication 1 ou 2, **caractérisé en ce que** les modes de vitesse possèdent des valeurs standard prédéterminées, et **en ce que** l'accélération et la décélération et la vitesse nominale sont augmentées à partir des valeurs standard à des taux d'augmentation prescrits jusqu'à des valeurs limitées par une puissance utile maximum du convertisseur de puissance (8) et une puissance utile maximum du moteur électrique (1).

4. Système de commande d'ascenseur selon une quelconque des revendications 1 à 3, **caractérisé en ce que** les modes de vitesse pour déterminer la saccade, l'accélération et la décélération, et la vitesse nominale de la cabine sont changés en corrigeant la commande de couple au démarrage de l'ascenseur en matière de perte de déplacement en fonction d'une commande de couple durant le déplacement dans le dernier déplacement.

FIG. 1

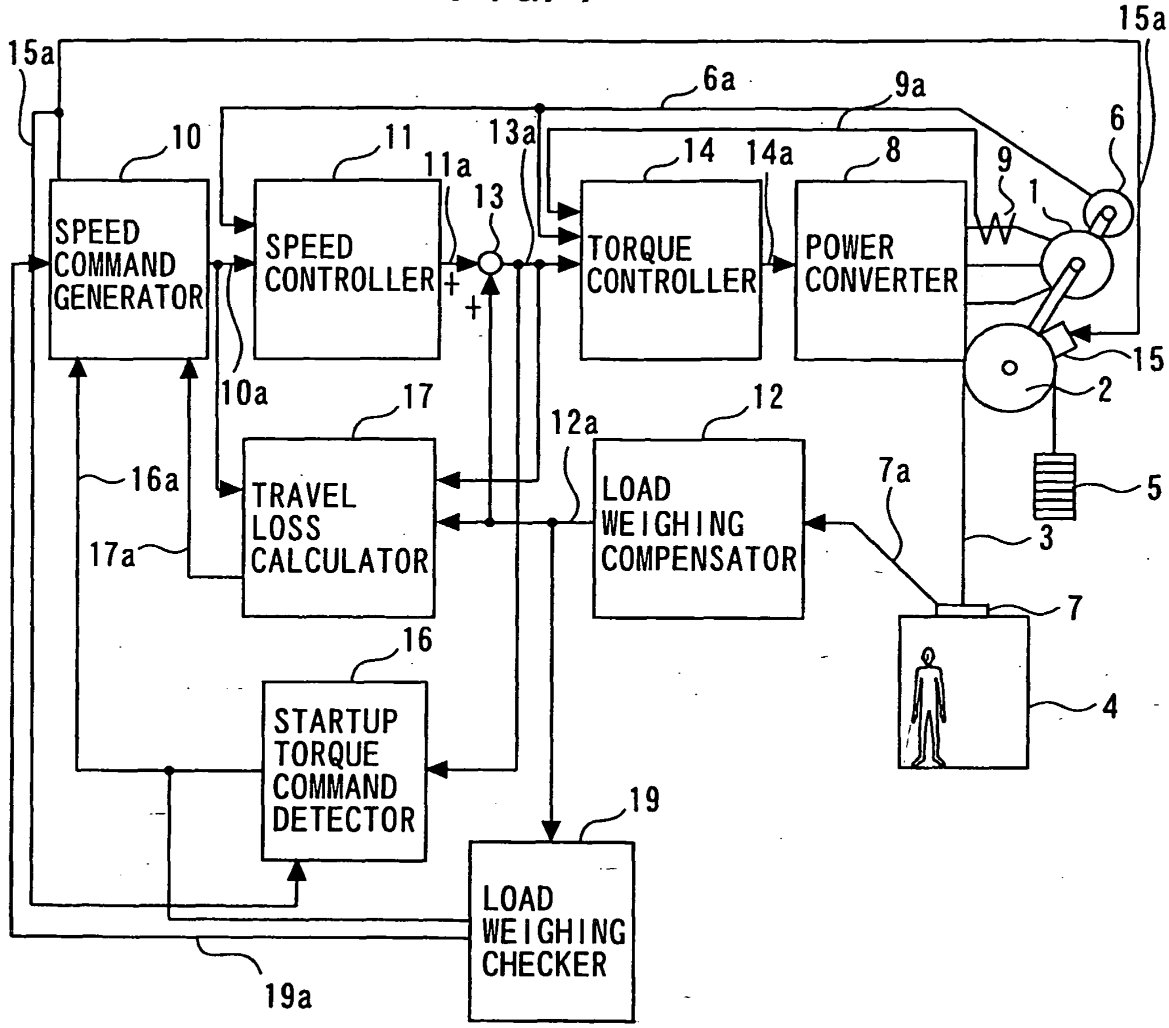

15a
15a
6a
9a
10
11
13a
14
14a
8
9
1
6
11a
13
SPEED COMMAND GENERATOR
SPEED CONTROLLER
TORQUE CONTROLLER
POWER CONVERTER
15
2
10a
17
12a
12
16a
TRAVEL LOSS CALCULATOR
LOAD WEIGHING COMPENSATOR
7a
5
3
17a
7
16
STARTUP TORQUE COMMAND DETECTOR
4
19
LOAD WEIGHING CHECKER
19a

FIG. 2

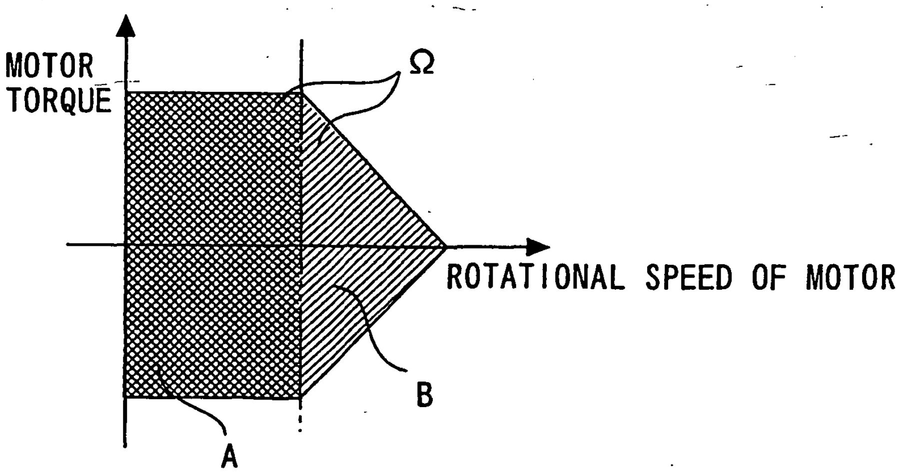

MOTOR TORQUE
Ω
ROTATIONAL SPEED OF MOTOR
B
A

FIG. 3

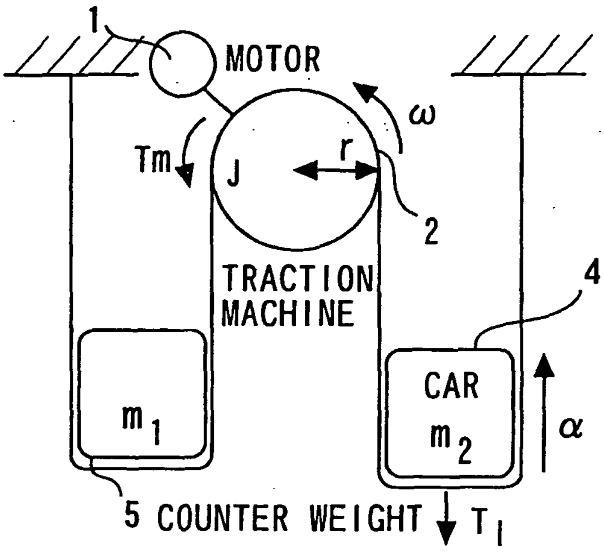

1
MOTOR
ω
Tm
J
r
2
TRACTION MACHINE
4
CAR
m2
α
m1
5 COUNTER WEIGHT
Tl

FIG. 4

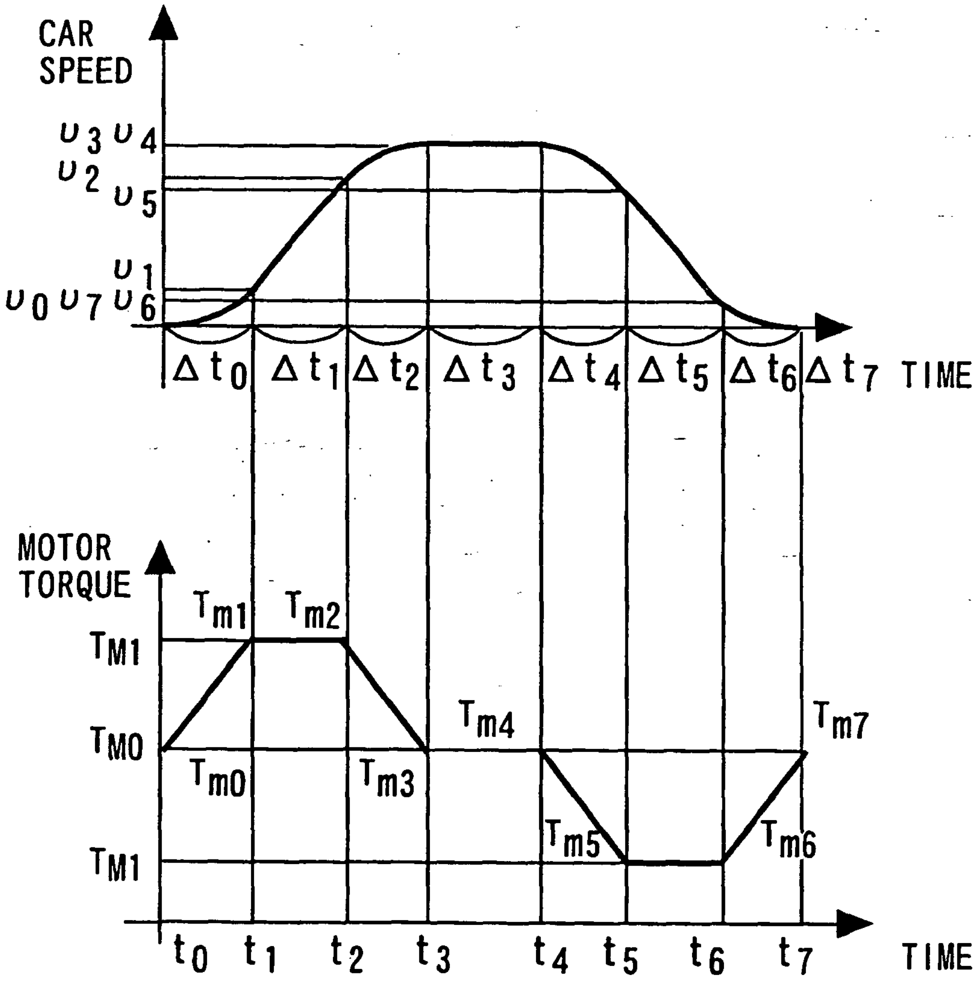

CAR SPEED
υ3 υ4
υ2
υ5
υ1
υ0 υ7 υ6
Δt0 Δt1 Δt2 Δt3 Δt4 Δt5 Δt6 Δt7 TIME
MOTOR TORQUE
Tm1 Tm2
TM1
Tm4
Tm7
TM0
Tm0
Tm3
Tm5
Tm6
TM1
t0 t1 t2 t3 t4 t5 t6 t7
TIME

FIG. 5

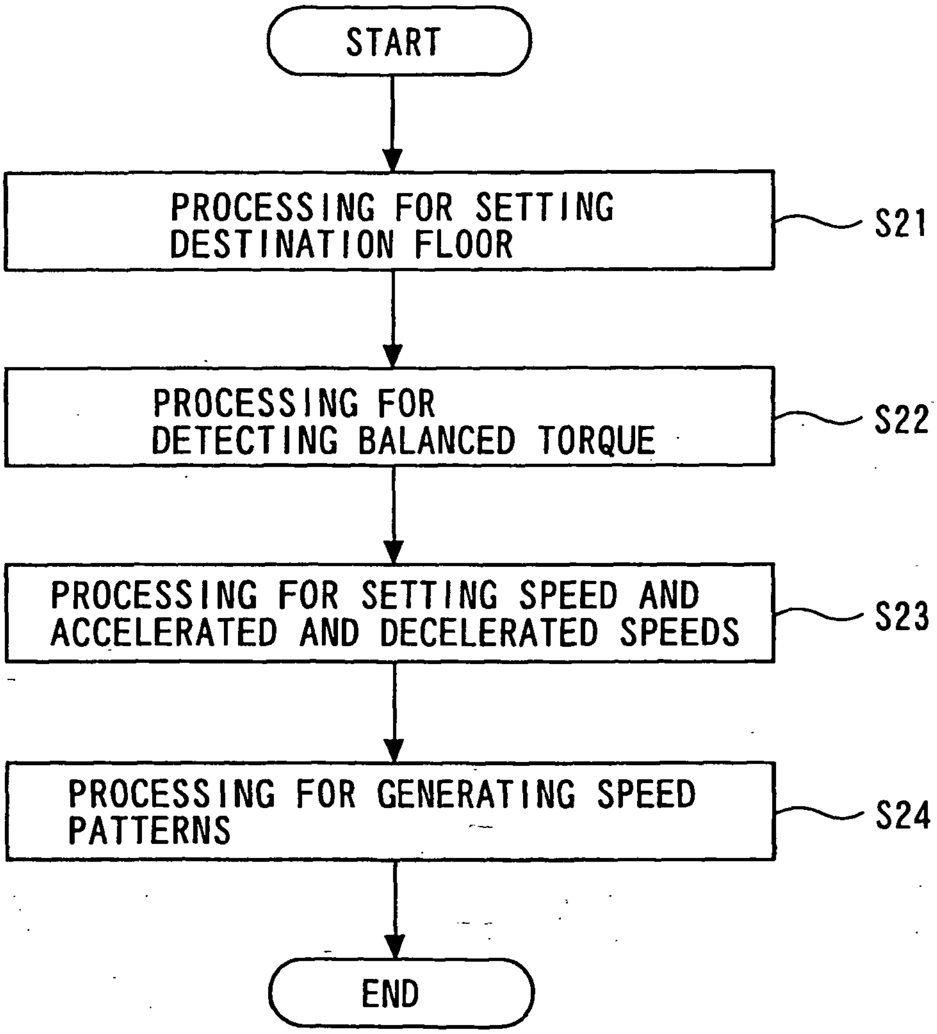

START
PROCESSING FOR SETTING DESTINATION FLOOR
S21
PROCESSING FOR DETECTING BALANCED TORQUE
S22
PROCESSING FOR SETTING SPEED AND ACCELERATED AND DECELERATED SPEEDS
S23
PROCESSING FOR GENERATING SPEED PATTERNS
S24
END

FIG. 6

TABLE E

L<5

BALANCED TORQUE [%]		0~29	30~69	70~100
SPEED[m/min]	UP	80	70	60
	DOWN	80	70	60
ACCELERATED SPEED[m/s2]	UP	1.0	0.9	0.8
	DOWN	1.0	0.9	0.8
DECELERATED SPEED[m/s2]	UP	1.0	0.9	0.8
	DOWN	1.0	0.9	0.8

5≦L<10

BALANCED TORQUE [%]		0~29	30~69	70~100
SPEED[m/min]	UP	90	80	70
	DOWN	90	80	70
ACCELERATED SPEED[m/s2]	UP	0.9	0.8	0.7
	DOWN	0.9	0.8	0.7
DECELERATED SPEED[m/s2]	UP	0.9	0.8	0.7
	DOWN	0.9	0.8	0.7

L≧10

BALANCED TORQUE [%]		0~29	30~69	70~100
SPEED[m/min]	UP	100	90	80
	DOWN	100	90	80
ACCELERATED SPEED[m/s2]	UP	0.8	0.7	0.6
	DOWN	0.8	0.7	0.6
DECELERATED SPEED[m/s2]	UP	0.8	0.7	0.6
	DOWN	0.8	0.7	0.6

FIG. 7

TABLE F

L<5

CAR LOAD [%]		0~29	30~69	70~100
SPEED[m/min]	UP	60	70	60
	DOWN	60	70	60
ACCELERATED SPEED[m/s2]	UP	0.8	0.9	0.8
	DOWN	0.8	0.9	0.8
DECELERATED SPEED[m/s2]	UP	0.8	0.9	0.8
	DOWN	0.8	0.9	0.8

5≦L<10

CAR LOAD [%]		0~29	30~69	70~100
SPEED[m/min]	UP	70	80	70
	DOWN	70	80	70
ACCELERATED SPEED[m/s2]	UP	0.7	0.8	0.7
	DOWN	0.7	0.8	0.7
DECELERATED SPEED[m/s2]	UP	0.7	0.8	0.7
	DOWN	0.7	0.8	0.7

L≧10

CAR LOAD [%]		0~29	30~69	70~100
SPEED[m/min]	UP	80	90	80
	DOWN	80	90	80
ACCELERATED SPEED[m/s2]	UP	0.6	0.7	0.6
	DOWN	0.6	0.7	0.6
DECELERATED SPEED[m/s2]	UP	0.6	0.7	0.6
	DOWN	0.6	0.7	0.6

FIG. 8

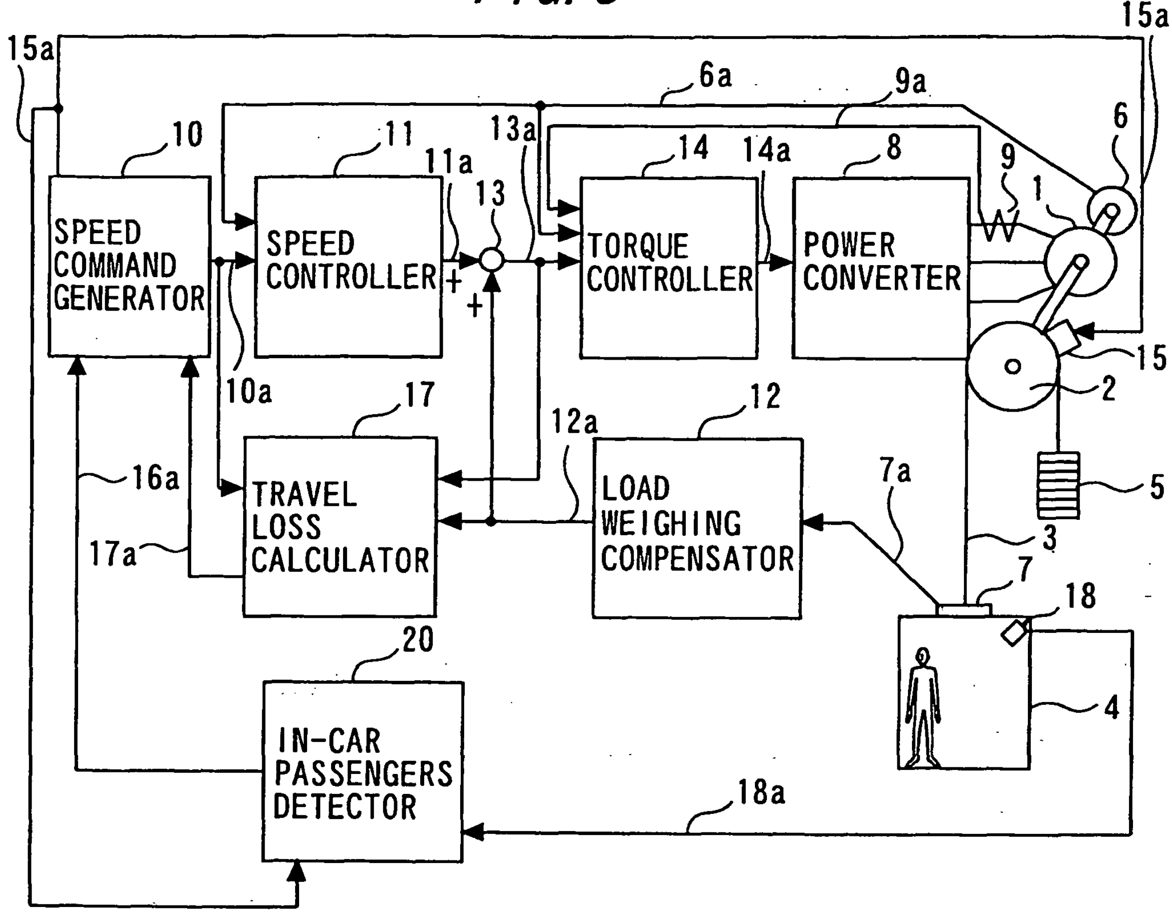

15a
15a
6a
9a
10
11
13a
14
14a
8
6
11a
13
9
1
SPEED
COMMAND
GENERATOR
SPEED
CONTROLLER
TORQUE
CONTROLLER
POWER
CONVERTER
+
+
15
10a
17
12
2
12a
16a
TRAVEL
LOSS
CALCULATOR
LOAD
WEIGHING
COMPENSATOR
7a
5
17a
3
7
18
20
4
IN-CAR
PASSENGERS
DETECTOR
18a

FIG. 9

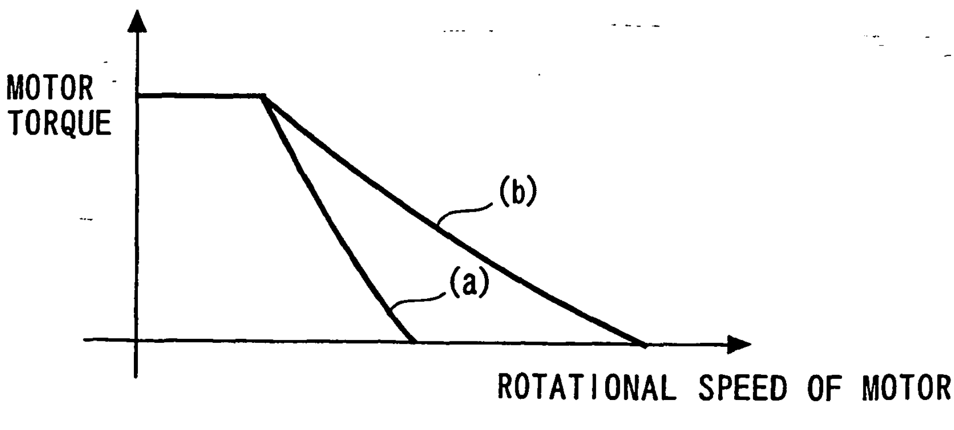
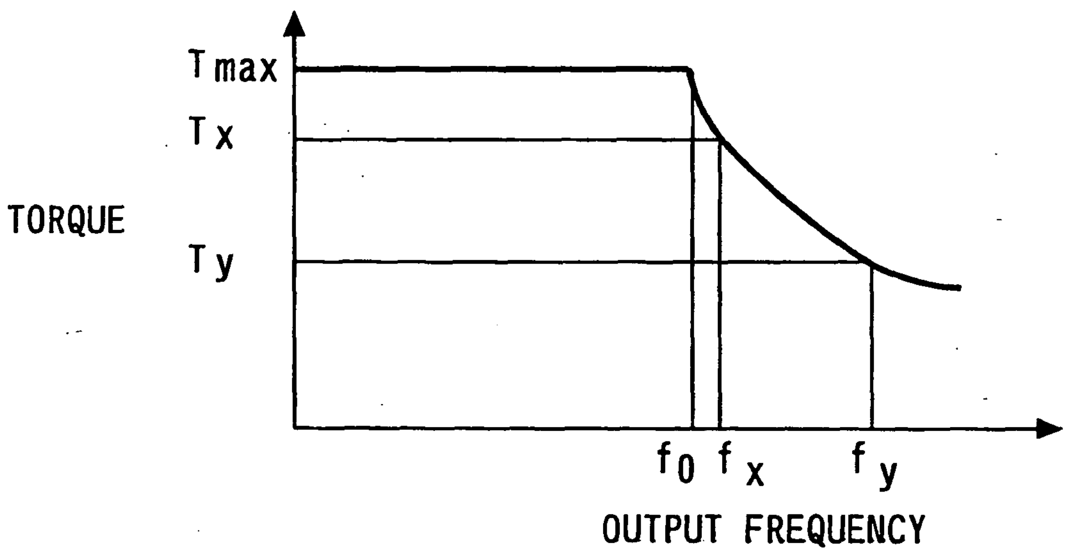

MOTOR
TORQUE
(b)
(a)
ROTATIONAL SPEED OF MOTOR

FIG. 10



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3056308 A **[0008]**
- JP 8107699 A **[0008]**