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(54) **ELEVATOR CONTROL SYSTEM**  
**AUFZUGSSTEUERSYSTEM**  
**SYSTEME DE CONTROLE DE L'ELEVATEUR**

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## Description

### Technical Field

**[0001]** The present invention relates to an elevator control apparatus capable of varying a maximum speed and acceleration of a car in response to loads given to the car.

### Background Art

**[0002]** In a conventional elevator control apparatus disclosed in, for example, JP-A-2003-238037, a maximum speed and acceleration (including deceleration) of a car are changed in response to a load (hereinafter referred to as "car load") given by loaded weight in the car within driving ranges for a motor and an electric appliance which drives the motor. As a result, a capacity of the motor available is utilized, so an operating efficiency of the car can be improved.

**[0003]** However, in the conventional elevator control apparatus, because the maximum speed and acceleration are changed based on the signal derived from the car load detecting apparatus, in such a case that an abnormal condition occurs in the signal of the car load detecting apparatus, the car load is mistakenly recognized, and thus, the maximum speed and acceleration are increased, which exceed capacity ranges of the motor and of an inverter. As a result, there was a fear of malfunction of the appliances.

**[0004]** Also, in such a case that driving losses of the car and of the counterweight are large and a mechanical loss of a hoisting machine is large, because required motor torque is increased, the motor and the inverter are used exceeding the capacity ranges. As a result, there is a fear in that failures of the appliances may occur.

**[0005]** Further, since the motor and the inverter are continuously used under the maximum condition of the capacity ranges, heat generations of the motor and the inverter are increased. In the case where the initiation frequency of the elevator is high, there are some risks in that the motor and the inverter may be brought into malfunction conditions due to abnormal heat generations.

**[0006]** In addition to the above, there is known from JP 07-228444 an elevator monitoring device that issues a stop command to an elevator control device based on a comparison of a received speed signal with a so-called ordinary pattern.

### Disclosure of the Invention

**[0007]** The present invention has been made to solve the above-explained problems, and has an object to achieve an elevator control apparatus capable of preventing a secondary failure of an appliance when an elevator is operated under abnormal condition, and capable of improving reliability.

**[0008]** The above problems are solved by the subject-

matter of the independent claim. Further preferred embodiments of the present invention are defined in the dependent claims.

**[0009]** According to an aspect of the present invention, there is provided an elevator control apparatus for driving a car by increasing a maximum speed and acceleration of the car when a difference between weight on a side of the car and weight of a counterweight is small instead of when there is a large difference therebetween, comprising a motor control unit for controlling operation of a motor unit that raises/lowers the car in response to weight loaded in the car; and an abnormal condition detecting unit for detecting an abnormal condition of the elevator; wherein: in a case where the car travels while the maximum speed and acceleration are increased, when an abnormal condition is detected by the abnormal condition detecting unit, the operation mode of the motor control unit is switched from a normal condition mode to an abnormal condition mode, wherein the abnormal condition detecting unit calculates a difference  $\Delta \tau$  between a motor torque value  $\tau_1$  while the car travels at a constant speed and a torque value  $\tau_0$  which is calculated from an output signal of a car load detecting unit, and then judges that the abnormal condition occurs when the difference  $\Delta \tau$  is equal to or larger than a preset threshold value.

**[0010]** According to another aspect of the present invention, there is provided an elevator control apparatus for driving a car by increasing a maximum speed and acceleration of the car when a difference between weight on a side of the car and weight of a counterweight is small instead of when there is a large difference therebetween, comprising a motor control unit for controlling operation of a motor unit that raises/lowers the car in response to weight loaded in the car; and an abnormal condition detecting unit for detecting an abnormal condition of the elevator; wherein in a case where the car travels while the maximum speed and acceleration are increased, when an abnormal condition is detected by the abnormal condition detecting unit, the operation mode of the motor control unit is switched from a normal condition mode to an abnormal condition mode, wherein the abnormal condition detecting unit judges that the abnormal condition occurs when a temperature detected by a temperature detecting unit for detecting a temperature of at least one of the motor unit and an inverter which drives the motor unit is equal to or larger than preset abnormal levels A and B, in a case that the temperature detected by the temperature detecting unit exceeds the abnormal level B while the car is under drive condition, the car is suddenly stopped, and in a case that the temperature detected by the temperature detecting unit is equal to or higher than the abnormal level A and is equal to or lower than the abnormal level B when the car travels while the maximum speed and acceleration are increased, the maximum speed is decreased.

**[0011]** According to yet another aspect of the present invention, there is provided an elevator control apparatus for driving a car by increasing a maximum speed and

acceleration of the car when a difference between weight on a side of the car and weight of a counterweight is small instead of when there is a large difference therebetween, comprising a motor control unit for controlling operation of a motor unit that raises/lowers the car in response to weight loaded in the car; and an abnormal condition detecting unit for detecting an abnormal condition of the elevator; wherein in a case where the car travels while the maximum speed and acceleration are increased, when an abnormal condition is detected by the abnormal condition detecting unit, the operation mode of the motor control unit is switched from a normal condition mode to an abnormal condition mode, wherein the abnormal condition detecting unit judges that the abnormal condition occurs when a temperature detected by a temperature detecting unit for detecting a temperature of at least one of the motor unit and an inverter which drives the motor unit is equal to or larger than preset abnormal levels A and B, in a case that the temperature detected by the temperature detecting unit exceeds the abnormal level B while the car is under stop condition, an initiation of the elevator is prohibited, and in a case that the temperature detected by the temperature detecting unit is equal to or higher than the abnormal level A and is equal to or lower than the abnormal level B while the car is under stop condition, the elevator control apparatus sets that both the maximum speed and acceleration of the car are not increased for the subsequent operations of the car.

#### Brief Description of the Drawings

#### [0012]

Fig. 1 is a structural diagram for showing an elevator apparatus according to Embodiment 1 of the present invention;

Fig. 2 is a block diagram for representing a concrete structural example of the elevator control apparatus of Fig. 1;

Fig. 3 is a timing chart for indicating a control method of a car speed according to a first example of an abnormal condition mode in Embodiment 1;

Fig. 4 is a timing chart for indicating a control method of a car speed according to a second example of an abnormal condition mode in Embodiment 1;

Fig. 5 is a timing chart for indicating a control method of a car speed according to the third example of an abnormal condition mode in Embodiment 1;

Fig. 6 is a structural diagram for showing an elevator apparatus according to Embodiment 2 of the present invention;

Fig. 7 is an explanatory diagram for indicating a first example of an abnormal condition judging method by an abnormal condition judging unit of Fig. 6;

Fig. 8 is an explanatory diagram for indicating a second example of the abnormal condition judging method by an abnormal condition judging unit of Fig. 6;

Fig. 9 is a flow chart for showing operations of the elevator control apparatus of Fig. 6 while the car travels; and

Fig. 10 is a flow chart for showing operations of the elevator control apparatus of Fig. 6 while the car is stopped.

#### Best Mode for carrying out the Invention

[0013] Next, a description is made of preferred Embodiments of the present invention with reference to drawings.

#### Embodiment 1

[0014] Fig. 1 is a structural diagram for indicating an elevator apparatus according to Embodiment 1 of the present invention. In the drawing, a driving machine (hoisting machine) 1 is installed on an upper portion of a hoistway. The hoisting machine 1 contains a motor unit 2 and a drive sheave 3 which is driven by the motor unit 2. A brake device (not shown) for breaking rotations of the drive sheave 3 is provided on the motor unit 2.

[0015] A deflector sheave 4 is rotatably provided on the upper portion of the hoistway. A plurality of main ropes 5 (only one rope is shown in the drawing) are wrapped around the drive sheave 3 and the deflector sheave 4. A car 6 is suspended on one ends of the main ropes 5.

A counterweight 7 is set to the other ends of the main ropes 5.

[0016] Weight of the counterweight 7 is set to a balancing condition when loaded weight of the car 6 is approximately equal to a half value (half load) of maximum loaded weight (full load).

[0017] The motor unit 2 is energized by an inverter 8 so as to be driven. Loaded weight of the car 6 (load of car) is detected by a car load detecting unit 9. As the car load detecting unit 9, for example, a known weighting apparatus may be employed.

[0018] An elevator control apparatus which controls the inverter 8 is equipped with a motor control unit 10 and an abnormal condition detecting unit 11. A detection signal derived from the car load detecting unit 9 is supplied to the motor control unit 10. The motor control unit 10 is provided with a speed pattern producing unit 12 which calculates a speed pattern of the car 6 and a speed control unit 13 which controls driving operations of the motor unit 2 in accordance with speed patterns produced by the speed pattern producing unit 12. Also, the speed control unit 13 is provided with a means for executing a control program of the inverter 8.

[0019] The speed pattern producing unit 12 produces such a speed pattern that the car 6 may reach a target floor within the shortest time in response to loaded weight of the car 6. Concretely speaking, the speed pattern producing unit 12 contains an unbalance amount calculating unit which calculates a difference between weight loaded on the car 6 and the weight of the counterweight 7 (un-

balance amount) based on information as to a car load obtained from the car load detecting unit 9. Also, the speed pattern producing unit 12 produces a speed pattern in such a manner that when the above-described unbalance amount is small, both a maximum speed and acceleration (including deceleration) are increased within allowable drive ranges of the motor unit 2 and of the inverter 8, as compared with such a case that the unbalance amount is large. In this case, the above-described maximum speed corresponds to a maximum speed within one speed pattern, and normally, a constant speed that the car 6 travels in this constant speed.

**[0020]** As a method for calculating speed patterns, for instance, the method described in JP-A-2003-238037 may be employed.

**[0021]** The abnormal condition detecting unit 11 detects an abnormal condition of an elevator in response to a sensor signal such as a temperature sensor or a signal from the car load detecting unit 9. When an abnormal condition of the elevator is detected by the abnormal detecting unit 11, this information is transmitted to at least one of the speed pattern producing unit 12 and the speed control unit 13. In Embodiment 1, in the case where the car 6 travels by increasing both the maximum speed and acceleration, when an abnormal condition is detected by the abnormal condition detecting unit 11, the operation mode of the motor control unit 10 is switched from a normal condition mode to an abnormal condition mode.

**[0022]** As a first example of the abnormal condition mode, the motor control unit 10 suddenly stops the car 8, for example. As a second example of the abnormal condition mode, the motor control unit 10 decreases the maximum speed of the car 6. As a third example of the abnormal condition mode, the motor control unit 10 sets both the maximum speed and acceleration of the car 6 to be the same as the values set in the case of the large amount unbalance for the subsequent drive operations of the car 6.

**[0023]** Fig. 2 is a block diagram for indicating a concrete structural example of the elevator control apparatus of Fig. 1. The elevator control apparatus is provided with an input/output unit 14, a CPU (processing unit) 15, and a storage unit 16, which have the same functions as both of the motor control unit 10 and the abnormal condition detecting unit 11.

**[0024]** A sensor signal derived which senses an abnormal condition of the elevator and a detection signal derived from the car load detecting unit 9 are inputted via the input/output unit 14 to the CPU 15. An instruction signal to the inverter 8 is outputted from the input/output unit 14. The storage unit 16 contains a ROM for storing programs and the like therein and a RAM which temporarily stores data used in calculations executed in the CPU 15 therein.

**[0025]** In the ROM of the storage unit 16, a program for producing speed patterns, a program for judging whether or not an abnormal condition of the elevator is

present, a program for switching operation modes in response to conditions of the elevator, information as to operating methods for each of the operation modes, and the like are stored in advance.

5 **[0026]** The CPU 15 executes a calculating operation process for every calculation time period based on programs stored in the storage unit 16.

**[0027]** Next, a concrete explanation is made of control methods for the motor unit 2 in abnormal condition modes.

10 **[0028]** First, Fig. 3 is a timing chart for indicating a control method for a car speed based on a first example of the abnormal condition mode in Embodiment 1. In the first example, in the case where both the maximum speed and acceleration of the car 6 are increased by the speed pattern producing unit 8, when an abnormal condition is detected by the abnormal condition detecting unit 11, this information is sent to the speed control unit 13 and an instruction signal for sudden stop of the car 6 is outputted from the speed control unit 13 to the inverter 8. As a result, the supply of electric power to the motor unit 2 is stopped, and the rotation of the drive sheave 3 is braked by the braking apparatus of the motor unit 2, so that the car 6 is suddenly stopped.

25 **[0029]** Further, Fig. 4 is a timing chart for indicating a control method for a car speed based on a second example of the abnormal condition mode in Embodiment 1. In the second example, in the case where both the maximum speed and acceleration of the car 6 are increased by the speed pattern producing unit 8, when an abnormal condition is detected by the abnormal condition detecting unit 11, this information is sent to the speed control unit 13, so that the maximum speed of the car 6 is decreased. Such a decreasing operation of the maximum speed is rapidly carried out in order that either the motor unit 2 or the inverter 8 is not brought into malfunction, and furthermore, is smoothly carried out in order that vibrations are not produced in the car 6.

30 **[0030]** Still further, Fig. 5 is a timing chart for indicating a control method for a car speed based on a third example of the abnormal condition mode in Embodiment 1. In the third example, in the case where both the maximum speed and acceleration of the car 6 are increased by the speed pattern producing unit 8, when an abnormal condition is detected by the abnormal condition detecting unit 11, this information is sent to the speed control unit 13, so that, for the subsequent operations of the car 6, both the maximum speed and acceleration of the car 6 are limited to the same values set in the case of the difference between the weight on the side of the car 6 and the weight of the counterweight is large.

35 **[0031]** Thereafter, when the operating condition is recovered from the abnormal condition to the normal condition, this information is sent to the speed pattern producing unit 12, so that both the maximum speed and acceleration are again increased and the car 6 can be driven in the increased maximum speed and the increased acceleration.

**[0032]** It should be noted that even when the operating condition is recovered from the abnormal condition to the normal condition, both the maximum speed and acceleration may not be again increased until a confirmation is made by, for example, a maintenance staff member. In this alternative case, after the maintenance staff member makes such a confirmation, a reset switch may be manipulated so that both the maximum speed and acceleration may be again increased in response to the manipulation of the reset switch.

**[0033]** As previously described, in accordance with the elevator control apparatus, it is possible to avoid secondary malfunction of the appliances when the abnormal condition of the elevator occurs, so that reliability can be improved.

#### Embodiment 2

**[0034]** Next, Fig. 6 is a structural diagram for showing an elevator apparatus according to Embodiment 2 of the present invention. In the drawing, a temperature of the motor unit 2 and a temperature of the inverter 8 are detected by a temperature detecting unit 17. An abnormal condition judging unit 18 for judging an abnormal condition of the elevator is provided with the abnormal condition detecting unit 11. The abnormal condition judging unit 18 judges an abnormal condition based on a signal from the car load detecting unit 9, a signal from the speed control unit 13, and a signal from the temperature detecting unit 17, and transmits the information as to the abnormal condition to both the speed pattern producing unit 12 and the speed control unit 13. The other structure of the elevator control apparatus are similar to those of Embodiment 1.

**[0035]** Fig. 7 is an explanatory diagram for indicating a first example as to the abnormal condition judging method executed by the abnormal condition judging unit 18 of Fig. 6. The abnormal condition judging unit 18 calculates, for instance, a difference  $\Delta \tau$  between a motor torque value  $\tau_1$  while the car 6 travels at a constant speed and a torque value  $\tau_0$  which is calculated from an output signal of the car load detecting unit 9, and then judges that an abnormal condition occurs when the difference  $\Delta \tau$  is equal to or larger than a preset threshold value. The motor torque value  $\tau_1$  while the car 6 travels in the constant speed may be directly measured by way of, for instance, a torque meter or the like. Alternatively, this motor torque value  $\tau_1$  may be obtained by employing a torque instruction value corresponding to the internal signal of the speed control unit 13.

**[0036]** Also, in such a case that travel losses of the car 6 and of the counterweight 7 are abnormally large and a mechanical loss of the drive apparatus 1 is abnormally large, the value of the difference  $\Delta \tau$  is increased. Also, in this case, the abnormal condition judging unit 18 may similarly detect the above-explained large travel losses and mechanical loss as abnormal conditions.

**[0037]** The above-explained example explains the de-

tections of the abnormal conditions while the car 6 travels. An abnormal condition may be detected even while the car 6 is stopped. For instance, even in such a case that a change amount of output signals from the car load detecting unit 9 is not defined within a preset setting range but is continuously changed, this condition may be detected as an abnormal condition of the car load detecting unit 9. When such an abnormal condition is detected, for example, it is possible to set that the maximum speed and acceleration of the next drive operation are not increased.

**[0038]** Next, Fig. 8 is an explanatory diagram for indicating a second example as to the abnormal condition judging method executed by the abnormal condition judging unit 18 of Fig. 6. In the second example, the abnormal condition judging unit 18 judges abnormal degrees of the elevator in a stepwise manner based on a motor temperature detected by the temperature detecting unit 17. That is, in such a case that a motor temperature is equal to or lower than a preset abnormal level A, both the maximum speed and acceleration are increased so as to be brought into drivable operations.

**[0039]** Further, in the case where a motor temperature is equal to or higher than the abnormal level A and is equal to or lower than an abnormal level B, when the car 6 is under drive operation, for instance, the maximum speed is decreased ((a) of Fig. 8), and when the car 6 is under stop condition, both the maximum speed and acceleration are not increased in the next drive operation. Then, if a motor temperature is lower than the abnormal level A ((b) of Fig. 8), then both the maximum speed and acceleration are again increased so as to be brought into drivable operations.

**[0040]** Still further, in such a case that a motor temperature exceeds the preset abnormal level B while the car 6 is under drive condition ((c) of Fig. 8), the car 6 is suddenly stopped.

**[0041]** It should also be understood that in this example, the abnormal level is divided into the 3 stages in advance and the corresponding methods are changed accordingly. Alternatively, the abnormal level may be divided into 2 stages, 4 stages, or more stages. Further, for example, while an abnormal portion which is equal to or higher than the abnormal level A and is equal to or lower than the abnormal level B may be divided in either a stepwise manner or a continuous manner, the upper limit values of both the maximum speed and acceleration may be limited, or any one of these upper limit values may be limited.

**[0042]** In this example, the motor temperatures are detected. Similarly, an inverter temperature may be detected.

**[0043]** Further, in an elevator having a regenerative resistor which is used so as to consume regenerative electric power generated from the motor unit 2, temperatures of the regenerative resistor may be similarly considered.

**[0044]** Still further, abnormal condition detection levels

with respect to the motor temperatures, the inverter temperatures, and the regenerative resistor temperatures may be made equal to each other. However, it is preferable to separately set these abnormal condition detecting levels.

**[0045]** Also, the temperature detecting unit 17 may directly measure temperatures by employing a temperature detector (temperature sensor) such as a thermistor, or by way of calculations based on a motor current value or a motor torque instruction value which corresponds to the internal signal of the speed control unit 13. Also, as to temperatures of the regenerative resistor, the temperature detecting unit 17 may directly measure by employing a temperature detector, and alternatively measure by calculating an amount of regenerative electric power so as to predict a temperature increase.

**[0046]** In this case, Fig. 9 is a flow chart for indicating operations while the car 6 of the elevator control apparatus of Fig. 6 travels. This judging algorithm is realized by such a computer as shown in Fig. 2.

**[0047]** First, the CPU 15 judges as to whether or not a temperature detected by the temperature detecting unit 17 is equal to or lower than the abnormal level B (step S1). Then, in the case where the detected temperature exceeds the abnormal level B, the car 9 is suddenly stopped (step S2).

**[0048]** In the case where the detected temperature is equal to or lower than the abnormal level B, the CPU 15 judges as to whether or not the detected temperature is equal to or higher than the abnormal level A (step S3). Then, in such a case that the detected temperature is equal to or higher than the abnormal level A, the CPU 15 judges as to whether or not both the maximum speed and acceleration have been increased (step S4). In the case where the car 6 travels while the maximum speed and acceleration are increased, the maximum speed is decreased (step S5).

**[0049]** In the case where the detected temperature is lower than the abnormal level A or the car 6 travels while the maximum speed and acceleration are not increased, the present condition is maintained.

**[0050]** After the detected temperature has been checked, the CPU 15 checks as to whether or not a detection of a car load is abnormal.

In other words, the CPU 15 judges as to whether or not a difference  $\Delta \tau$  between motor torque  $\tau_1$  while the car 6 travels in the constant speed and a torque value  $\tau_0$  which is calculated from an output signal of the car load detecting apparatus is equal to or larger than a threshold value  $\alpha_1$  which has been previously set (step S6). When the difference  $\Delta \tau$  is equal to or larger than the threshold  $\alpha_1$ , the CPU 15 judges as an abnormal condition of the car load detecting unit 9, abnormal travel losses of both the car 6 and the counterweight 7, or an abnormal mechanical loss of the driving machine 1, and the CPU 15 turns ON a car load abnormal condition detection signal (step S7). In the case where the difference  $\Delta \tau$  is smaller than the threshold value  $\alpha_1$ , the CPU 15 turns OFF the

car load abnormal condition detection signal (step S8). This car load abnormal condition detection signal is used to judge an abnormal condition while the car 6 is stopped, which is described in the below-mentioned description.

**[0051]** Next, Fig. 10 is a flow chart for indicating operations while the car 6 of the elevator control apparatus of Fig. 6 is stopped. It is apparent that this judging algorithm is realized by such a computer as shown in Fig. 2.

**[0052]** First, the CPU 15 judges as to whether or not a temperature detected by the temperature detecting unit 17 is equal to or lower than the abnormal level B (step S11). Then, in the case where the detected temperature exceeds the abnormal level B, the initiation of the elevator is prohibited (step S12).

**[0053]** In the case where the detected temperature is equal to or lower than the abnormal level B, the CPU 15 judges as to whether or not the detected temperature is equal to or higher than the abnormal level A (step S13). Then, in such a case that the detected temperature is equal to or higher than the abnormal level A, the CPU 15 sets that both the maximum speed and acceleration of the car 6 are not increased for the subsequent operations of the car 6 (step S14).

**[0054]** In other words, the maximum speed and acceleration of the car 6 are set in a similar to those in the case where the difference between the weight on the side of the car 6 and the weight of the counterweight 7 is large.

**[0055]** In the case where the detected temperature is lower than the abnormal level A, the CPU 15 judges as to whether or not a car load abnormal condition detection signal is under ON state (step S15). In the case where the car load abnormal condition detection signal is under the ON state, the CPU 15 sets that both the maximum speed and acceleration of the car 6 are not increased for the subsequent operations of the car 6 (step S14).

**[0056]** In the case where the car load abnormal condition detection signal is under OFF state, the CPU 15 judges as to whether or not a change amount  $\Delta x$  of an output signal from the car load detecting unit 9 is larger than a preset threshold value  $\alpha_2$  (step S16). The change amount  $\Delta x$  may be calculated as a difference  $\Delta x = X_z - X_{z-1}$  between an output signal  $X_{z-1}$  during a preceding calculation operation and a present output signal  $X_z$  in a calculating time period of the CPU 15.

**[0057]** In the case where the difference  $\Delta x$  is larger than the threshold value  $\alpha_2$ , the CPU 15 judges as an abnormal condition of the car load detecting unit 9 and sets that the maximum speed and acceleration of the car 6 are not increased for the subsequent operations of the car 6 (step S14).

**[0058]** In the case where the difference  $\Delta x$  is smaller than the threshold value  $\alpha_2$ , the CPU 15 judges as a normal condition and sets that while the maximum speed and acceleration of the car 6 are increased, the car 6 can be driven (step S17).

**[0059]** In accordance with such an elevator control apparatus, even when primary failures such as the malfunction

tion of the car load detecting unit 9, the abnormal increases in the drive losses of the car 6 and the counterweight 7, the abnormal increase in the mechanical losses of the driving machine 1, and the abnormal increases in the motor temperature and the inverter temperature occur, it is possible to prevent the failures of the motor unit 2 and of the inverter 8 from occurring in the secondary manner. Thus, the elevator having higher reliability and a higher efficiency can be provided.

**[0060]** It should also be noted that the above-explained combinations between the abnormal conditions and the movement of the elevator after the abnormal conditions are detected are merely one example, and therefore, the present invention is not limited only to the above-described example.

**[0061]** Also, in the above-explained example, both the ROM and the RAM are exemplified as the storage units. Alternatively, a hard disk device and the like may be employed as the storage unit. Also, a storage medium such as a CD-ROM may be alternatively employed as the ROM.

## Claims

1. An elevator control apparatus for driving a car (6) by increasing a maximum speed and acceleration of the car (6) when a difference between weight on a side of the car (6) and weight of a counterweight (7) is small instead of when there is a large difference therebetween, comprising:

a motor control unit (10) for controlling operation of a motor unit (2) that raises/lowers the car in response to weight loaded in the car (6); and an abnormal condition detecting unit (11) for detecting an abnormal condition of the elevator; wherein:

in a case where the car (6) travels while the maximum speed and acceleration are increased, when an abnormal condition is detected by the abnormal condition detecting unit (11), the operation mode of the motor control unit (10) is switched from a normal condition mode to an abnormal condition mode

### characterized in that

the abnormal condition detecting unit (11) calculates a difference  $\Delta \tau$  between a motor torque value  $\tau_1$  while the car (6) travels at a constant speed and a torque value  $\tau_0$  which is calculated from an output signal of a car load detecting unit (9), and then judges that the abnormal condition occurs when the difference  $\Delta \tau$  is equal to or larger than a preset threshold value.

2. An elevator control apparatus for driving a car (6) by increasing a maximum speed and acceleration of the car (6) when a difference between weight on a side of the car (6) and weight of a counterweight (7) is small instead of when there is a large difference therebetween, comprising:

a motor control unit (10) for controlling operation of a motor unit (2) that raises/lowers the car in response to weight loaded in the car (6); and an abnormal condition detecting unit (11) for detecting an abnormal condition of the elevator; wherein:

in a case where the car (6) travels while the maximum speed and acceleration are increased, when an abnormal condition is detected by the abnormal condition detecting unit (11), the operation mode of the motor control unit (10) is switched from a normal condition mode to an abnormal condition mode

### characterized in that

the abnormal condition detecting unit (11) judges that the abnormal condition occurs when a temperature detected by a temperature detecting unit (17) for detecting a temperature of at least one of the motor unit (2) and an inverter (8) which drives the motor unit (2) is equal to or larger than preset abnormal levels A and B,

in a case that the temperature detected by the temperature detecting unit (17) exceeds the abnormal level B while the car (6) is under drive condition, the car (6) is suddenly stopped, and

in a case that the temperature detected by the temperature detecting unit (17) is equal to or higher than the abnormal level A and is equal to or lower than the abnormal level B when the car (6) travels while the maximum speed and acceleration are increased, the maximum speed is decreased.

3. An elevator control apparatus for driving a car (6) by increasing a maximum speed and acceleration of the car (6) when a difference between weight on a side of the car (6) and weight of a counterweight (7) is small instead of when there is a large difference therebetween, comprising:

a motor control unit (10) for controlling operation of a motor unit (2) that raises/lowers the car in response to weight loaded in the car (6); and an abnormal condition detecting unit (11) for detecting an abnormal condition of the elevator; wherein:

in a case where the car (6) travels while the maximum speed and acceleration are increased, when an abnormal condition is detected by the abnormal condition detecting unit (11), the operation mode of the motor control unit (10) is switched from a normal condition mode to an abnormal condition mode

**characterized in that**

the abnormal condition detecting unit (11) judges that the abnormal condition occurs when a temperature detected by a temperature detecting unit (17) for detecting a temperature of at least one of the motor unit (2) and an inverter (8) which drives the motor unit (2) is equal to or larger than preset abnormal levels A and B,

in a case that the temperature detected by the temperature detecting unit (17) exceeds the abnormal level B while the car (6) is under stop condition, an initiation of the elevator is prohibited, and

in a case that the temperature detected by the temperature detecting unit (17) is equal to or higher than the abnormal level A and is equal to or lower than the abnormal level B while the car (6) is under stop condition, the elevator control apparatus sets that both the maximum speed and acceleration of the car (6) are not increased for the subsequent operations of the car (6).

4. The elevator control apparatus according to claim 3 wherein, in the abnormal condition mode, the motor control unit (10) sets both the maximum speed and acceleration of the car (6) for the subsequent operations of the car (6) in a similar manner to that when the difference between the weight on the side of the car (6) and the weight of the counterweight (7) is large.
5. The elevator control apparatus according to any one of claims 1 to 4 wherein the abnormal condition detecting unit (11) includes an abnormal degree judging unit (18) for judging an abnormal degree of the elevator in a stepwise manner.

**Patentansprüche**

1. Aufzugssteuerungsgerät zum Ansteuern einer Kabine (6) durch Erhöhen einer maximalen Geschwindigkeit und Beschleunigung der Kabine (6), wenn eine Differenz zwischen einem Gewicht auf einer Seite der Kabine (6) und einem Gewicht eines Gegengewichts (7) klein ist, anstatt wenn es eine große Differenz dazwischen gibt, umfassend:

eine Motorsteuereinheit (10) zum Steuern eines Betriebs einer Motoreinheit (2), welche die Kabine anhebt/absenkt, ansprechend auf Gewicht, welches in der Kabine (6) geladen ist; und eine Abnormaler-Zustand-Erfassungseinheit (11), zum Erfassen eines abnormalen Zustands des Aufzugs; wobei:

in einem Fall, in welchem die Kabine (6) fährt, während die maximale Geschwindigkeit und Beschleunigung erhöht sind, wenn ein abnormaler Zustand von der Abnormaler-Zustand-Erfassungseinheit (11) erfasst wird, der Betriebsmodus der Motorsteuereinheit (10) von einem Normaler-Zustand-Modus zu einem Abnormaler-Zustand-Modus geschaltet wird

**dadurch gekennzeichnet, dass**

die Abnormaler-Zustand-Erfassungseinheit (11) eine Differenz  $\Delta \tau$  zwischen einem Motordrehmomentswert  $\tau 1$  während die Kabine (6) mit einer konstanten Geschwindigkeit fährt und einem Drehmomentswert  $\tau 0$ , welcher aus einem Ausgabesignal einer Kabinenladungs-Erfassungseinheit (9) berechnet wird, berechnet, und dann beurteilt, dass der abnormale Zustand auftritt, wenn die Differenz  $\Delta \tau$  gleich oder größer als ein voreingestellter Schwellenwert ist.

2. Aufzugssteuerungsgerät zum Ansteuern einer Kabine (6) durch Erhöhen einer maximalen Geschwindigkeit und Beschleunigung der Kabine (6), wenn eine Differenz zwischen einem Gewicht auf einer Seite der Kabine (6) und einem Gewicht eines Gegengewichts (7) klein ist, anstatt wenn es eine große Differenz dazwischen gibt, umfassend:

eine Motorsteuereinheit (10) zum Steuern eines Betriebs einer Motoreinheit (2), welche die Kabine anhebt/absenkt, ansprechend auf Gewicht, welches in der Kabine (6) geladen ist; und eine Abnormaler-Zustand-Erfassungseinheit (11), zum Erfassen eines abnormalen Zustands des Aufzugs; wobei:

in einem Fall, in welchem die Kabine (6) fährt, während die maximale Geschwindigkeit und Beschleunigung erhöht sind, wenn ein abnormaler Zustand von der Abnormaler-Zustand-Erfassungseinheit (11) erfasst wird, der Betriebsmodus der Motorsteuereinheit (10) von einem Normaler-Zustand-Modus zu einem Abnormaler-Zustand-Modus geschaltet wird

**dadurch gekennzeichnet, dass**

die Abnormaler-Zustand-Erfassungseinheit (11) beurteilt, dass der abnormale Zu-



stand auftritt, wenn eine Temperatur, welche durch eine Temperatur-Erfassungseinheit (17) zum Erfassen einer Temperatur von wenigstens einem aus der Motoreinheit (2) und einem Wechselrichter (8), welcher die Motoreinheit (2) ansteuert, erfasst wird, gleich oder größer als voreingestellte Abnormal-Pegel A und B ist, in einem Fall, in welchem die Temperatur, welche durch die Temperatur-Erfassungseinheit (17) erfasst wird, den Abnormal-Pegel B überschreitet, während die Kabine (6) sich in einem Fahr-Zustand befindet, die Kabine (6) unvermittelt angehalten wird, und in einem Fall, in welchem die Temperatur, welche durch die Temperatur-Erfassungseinheit (17) erfasst wird, gleich oder größer als der Abnormal-Pegel A und gleich oder niedriger als der Abnormal-Pegel B ist, wenn die Kabine (6) fährt, während die maximale Geschwindigkeit und Beschleunigung erhöht sind, die maximale Geschwindigkeit verringert wird.

3. Aufzugssteuerungsgerät zum Ansteuern einer Kabine (6) durch Erhöhen einer maximalen Geschwindigkeit und Beschleunigung der Kabine (6), wenn eine Differenz zwischen einem Gewicht auf einer Seite der Kabine (6) und einem Gewicht eines Gegengewichts (7) klein ist, anstatt wenn es eine große Differenz dazwischen gibt, umfassend:

eine Motorsteuereinheit (10) zum Steuern eines Betriebs einer Motoreinheit (2), welche die Kabine anhebt/absenkt, ansprechend auf Gewicht, welches in der Kabine (6) geladen ist; und eine Abnormaler-Zustand-Erfassungseinheit (11), zum Erfassen eines abnormalen Zustands des Aufzugs; wobei:

in einem Fall, in welchem die Kabine (6) fährt, während die maximale Geschwindigkeit und Beschleunigung erhöht sind, wenn ein abnormaler Zustand von der Abnormaler-Zustand-Erfassungseinheit (11) erfasst wird, der Betriebsmodus der Motorsteuereinheit (10) von einem Normaler-Zustand-Modus zu einem Abnormaler-Zustand-Modus geschaltet wird

**dadurch gekennzeichnet, dass**

die Abnormaler-Zustand-Erfassungseinheit (11) beurteilt, dass der abnormaler Zustand auftritt, wenn eine Temperatur, welche durch eine Temperatur-Erfassungseinheit (17) zum Erfassen einer Temperatur von wenigstens einem aus der Motoreinheit (2) und einem Wechselrichter (8), welcher

die Motoreinheit (2) ansteuert, erfasst wird, gleich oder größer als voreingestellte Abnormal-Pegel A und B ist, in einem Fall, in welchem die Temperatur, welche durch die Temperatur-Erfassungseinheit (17) erfasst wird, den Abnormal-Pegel B überschreitet, während die Kabine (6) sich in einem Anhalte-Zustand befindet, ein Initiieren des Aufzugs verhindert wird, und in einem Fall, in welchem die Temperatur, welche durch die Temperatur-Erfassungseinheit (17) erfasst wird, gleich oder größer als der Abnormal-Pegel A und gleich oder niedriger als der Abnormal-Pegel B ist, während die Kabine (6) sich in einem Anhalte-Zustand befindet, das Aufzugssteuergerät einstellt, dass die maximale Geschwindigkeit und Beschleunigung der Kabine (6) für den anschließenden Betrieb der Kabine (6) nicht erhöht sind.

4. Aufzugssteuergerät nach Anspruch 3, wobei, in dem Abnormaler-Zustand-Modus, die Motorsteuereinheit (10) sowohl die maximale Geschwindigkeit als auch Beschleunigung der Kabine (6) für den anschließenden Betrieb der Kabine (6) in einer ähnlichen Weise setzt, wie wenn die Differenz zwischen dem Gewicht auf der Seite der Kabine (6) und dem Gewicht des Gegengewichts (7) groß ist.
5. Aufzugssteuergerät nach einem der Ansprüche 1 bis 4, wobei die Abnormaler-Zustand-Erfassungseinheit (11) eine Abnormal-Grad-Beurteilungseinheit (18) umfasst, um einen Abnormal-Grad des Aufzugs schrittweise zu beurteilen.

## Revendications

1. Appareil de commande d'ascenseur pour entraîner une cabine (6) en augmentant une vitesse maximale et une accélération de la cabine (6) quand une différence entre un poids du côté de la cabine (6) et un poids d'un contrepoids (7) est petite plutôt que lorsqu'il y a une grande différence entre ceux-ci, comprenant :

une unité de commande de moteur (10) pour commander l'opération d'une unité formant moteur (2) qui élève / abaisse la cabine en réponse à un poids chargé dans la cabine (6) ; et une unité de détection d'état anormal (11) pour détecter un état anormal de l'ascenseur ; dans laquelle :

dans un cas où la cabine (6) se déplace tandis que la vitesse maximale et l'accélération sont augmentées, quand un état

anormal est détecté par l'unité de détection d'état anormal (11), le mode d'opération de l'unité de commande de moteur (10) est commuté d'un mode d'état normal à un mode d'état anormal

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**caractérisé en ce que**

l'unité de détection d'état anormal (11) calcule une différence  $\Delta \tau$  entre une valeur de couple de moteur  $\tau_1$  tandis que la cabine (6) se déplace à une vitesse constante et une valeur de couple  $\tau_0$  qui est calculée à partir d'un signal de sortie d'une unité de détection de charge de cabine (9), et détermine ensuite que l'état anormal survient quand la différence  $\Delta \tau$  est égale ou supérieure à une valeur de seuil fixée à l'avance.

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2. Appareil de commande d'ascenseur pour entraîner une cabine (6) en augmentant une vitesse maximale et une accélération de la cabine (6) quand une différence entre un poids du côté de la cabine (6) et un poids d'un contrepoids (7) est petite plutôt que lorsqu'il y a une grande différence entre ceux-ci, comprenant :

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une unité de commande de moteur (10) pour commander l'opération d'une unité formant moteur (2) qui élève / abaisse la cabine en réponse à un poids chargé dans la cabine (6) ; et une unité de détection d'état anormal (11) pour détecter un état anormal de l'ascenseur ; dans laquelle :

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dans un cas où la cabine (6) se déplace tandis que la vitesse maximale et l'accélération sont augmentées, quand un état anormal est détecté par l'unité de détection d'état anormal (11), le mode d'opération de l'unité de commande de moteur (10) est commuté d'un mode d'état normal à un mode d'état anormal

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**caractérisé en ce que**

l'unité de détection d'état anormal (11) détermine que l'état anormal survient quand une température détectée par une unité de détection de température (17) pour détecter une température d'au moins un de l'unité formant moteur (2) et d'un inverseur (8) qui entraîne l'unité formant moteur (2) est égale ou supérieure à des niveaux anormaux A et B fixés à l'avance, dans un cas où la température détectée par l'unité de détection de température (17) dépasse le niveau anormal B tandis que la cabine (6) est sous un état d'entraînement, la cabine (6) est soudainement arrêtée, et dans un cas où la température détectée par l'unité de détection de température (17) est

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égale ou supérieure au niveau anormal A et est égale ou inférieure au niveau anormal B quand la cabine (6) se déplace tandis que la vitesse maximale et l'accélération sont augmentées, la vitesse maximale est diminuée.

3. Appareil de commande d'ascenseur pour entraîner une cabine (6) en augmentant une vitesse maximale et une accélération de la cabine (6) quand une différence entre un poids du côté de la cabine (6) et un poids d'un contrepoids (7) est petite plutôt que lorsqu'il y a une grande différence entre ceux-ci, comprenant :

une unité de commande de moteur (10) pour commander l'opération d'une unité formant moteur (2) qui élève / abaisse la cabine en réponse au poids chargé dans la cabine (6) ; et une unité de détection d'état anormal (11) pour détecter un état anormal de l'ascenseur ; dans laquelle :

dans un cas où la cabine (6) se déplace tandis que la vitesse maximale et l'accélération sont augmentées, quand un état anormal est détecté par l'unité de détection d'état anormal (11), le mode d'opération de l'unité de commande de moteur (10) est commuté d'un mode d'état normal à un mode d'état anormal

**caractérisé en ce que**

l'unité de détection d'état anormal (11) détermine que l'état anormal survient quand une température détectée par une unité de détection de température (17) pour détecter une température d'au moins un de l'unité formant moteur (2) et d'un inverseur (8) qui entraîne l'unité formant moteur (2) est égale ou supérieure à des niveaux anormaux A et B fixés à l'avance,

dans un cas où la température détectée par l'unité de détection de température (17) dépasse le niveau anormal B tandis que la cabine (6) est sous un état d'arrêt, un démarrage de l'ascenseur est interdit, et

dans un cas où la température détectée par l'unité de détection de température (17) est égale ou supérieure au niveau anormal A et est égale ou inférieure au niveau anormal B tandis que la cabine (6) est sous un état d'arrêt, l'appareil de commande d'ascenseur fixe que tant la vitesse maximale que l'accélération de la cabine (6) ne sont pas augmentées pour les opérations suivantes de la cabine (6).

4. Appareil de commande d'ascenseur selon la reven-

dication 3 dans lequel, dans le mode d'état anormal, l'unité de commande de moteur (10) fixe tant la vitesse maximale que l'accélération de la cabine (6) pour les opérations suivantes de la cabine (6) d'une manière similaire à celle lorsque la différence entre le poids du côté de la cabine (6) et le poids du contrepoids (7) est grande. 5

5. Appareil de commande d'ascenseur selon l'une quelconque des revendications 1 à 4, dans lequel l'unité de détection d'état anormal (11) inclut une unité de détermination de degré anormal (18) pour déterminer un degré anormal de l'ascenseur d'une façon pas à pas. 10

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FIG. 1

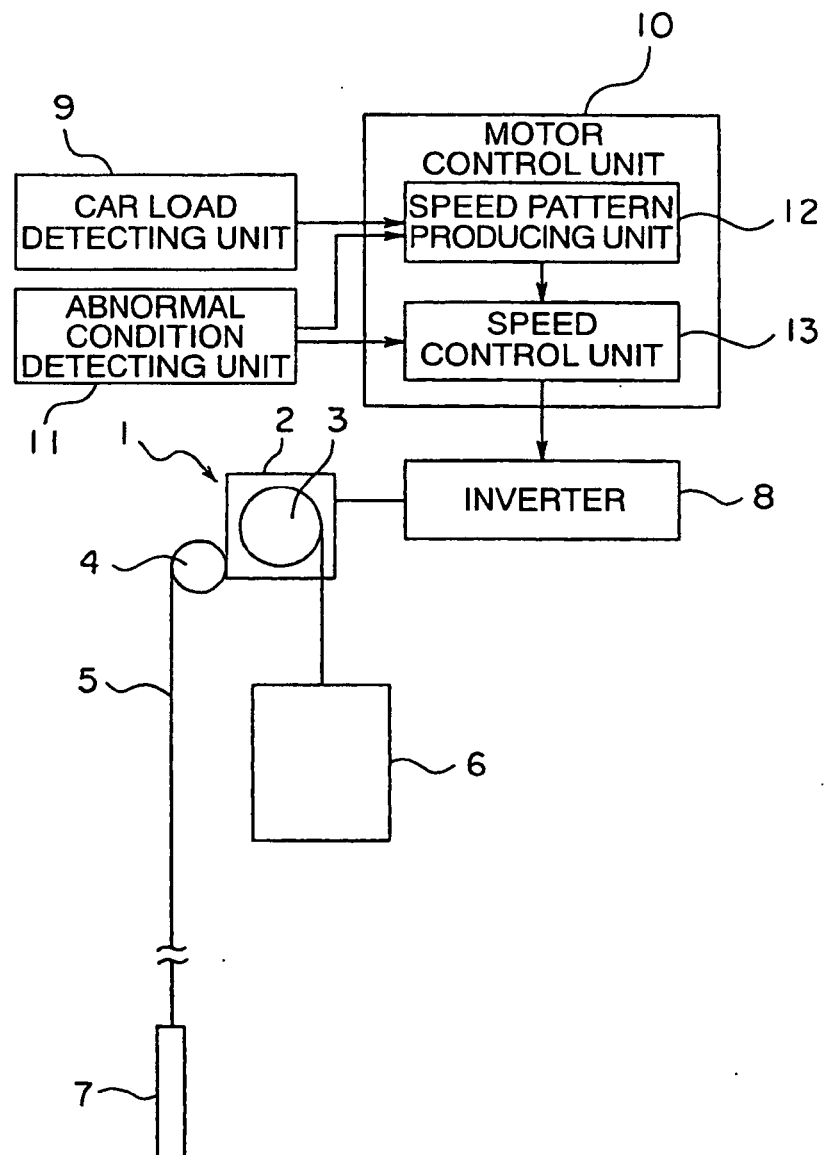


FIG. 2

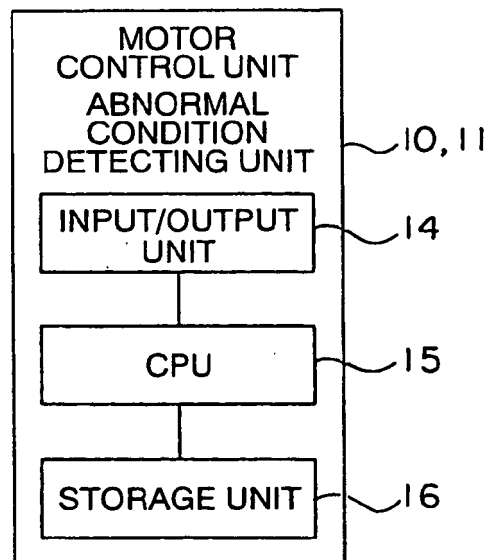


FIG. 3

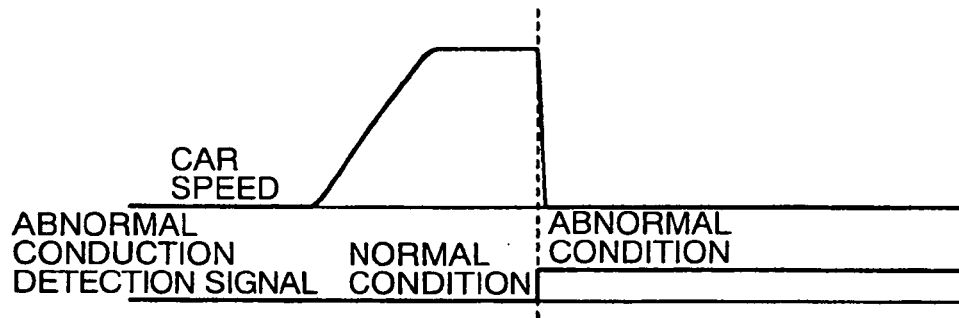


FIG. 4

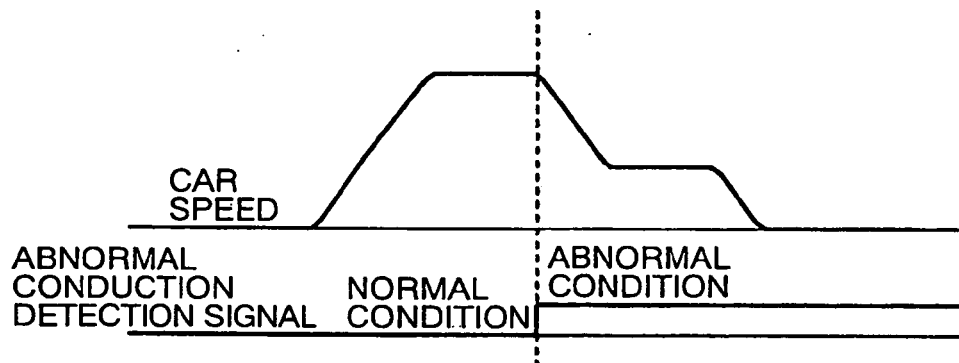


FIG. 5

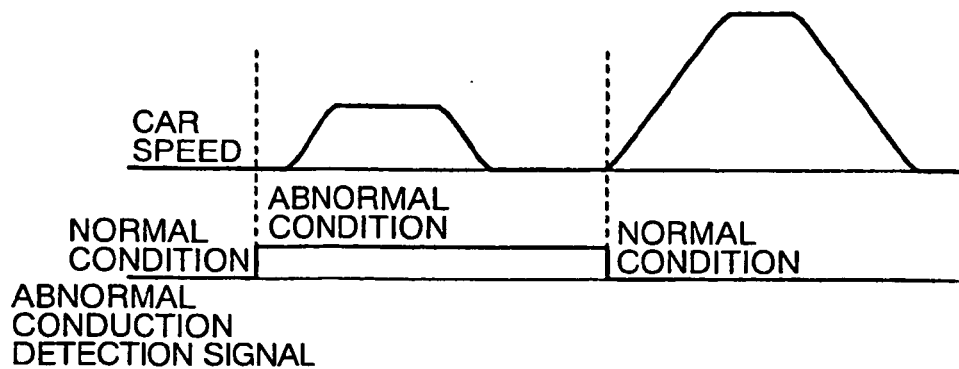


FIG. 6

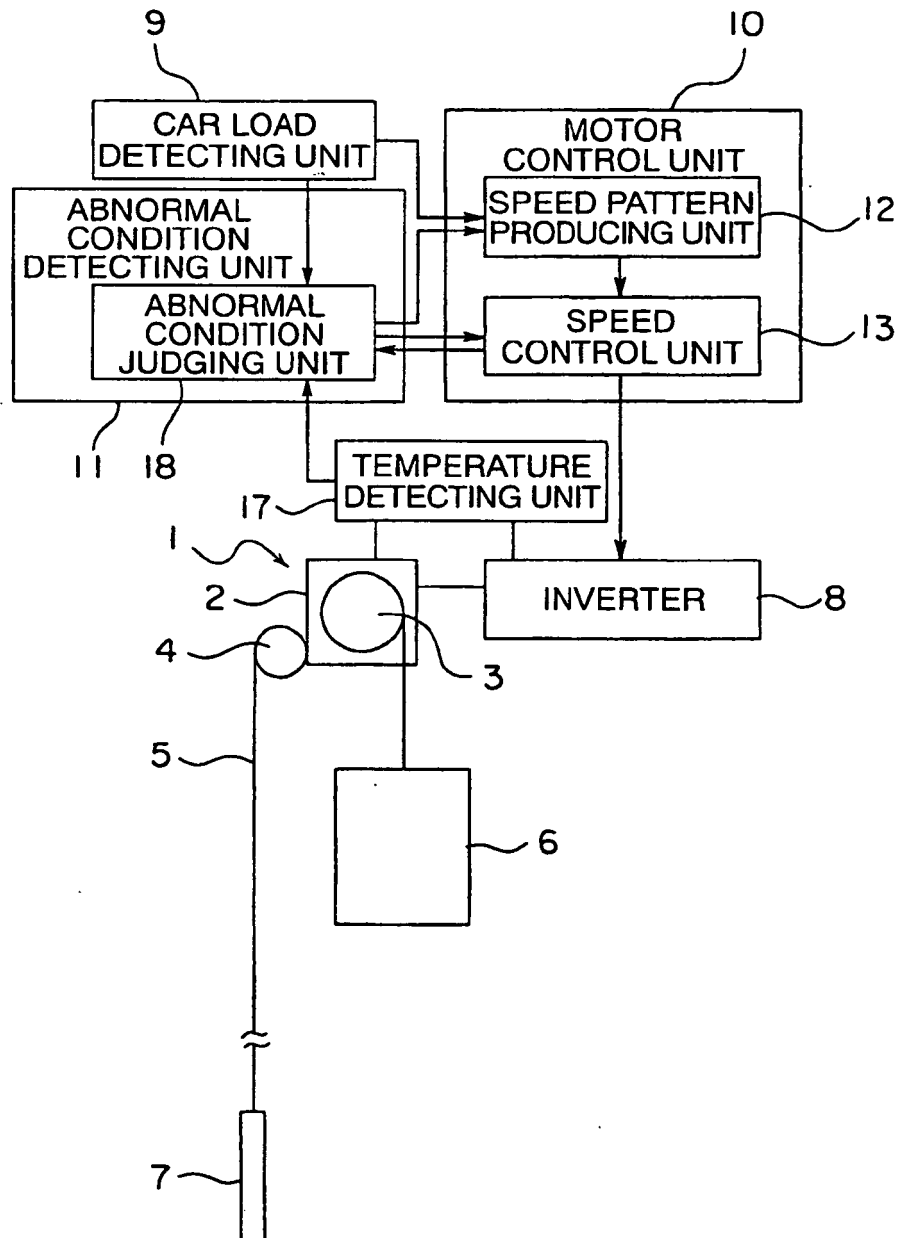


FIG. 7

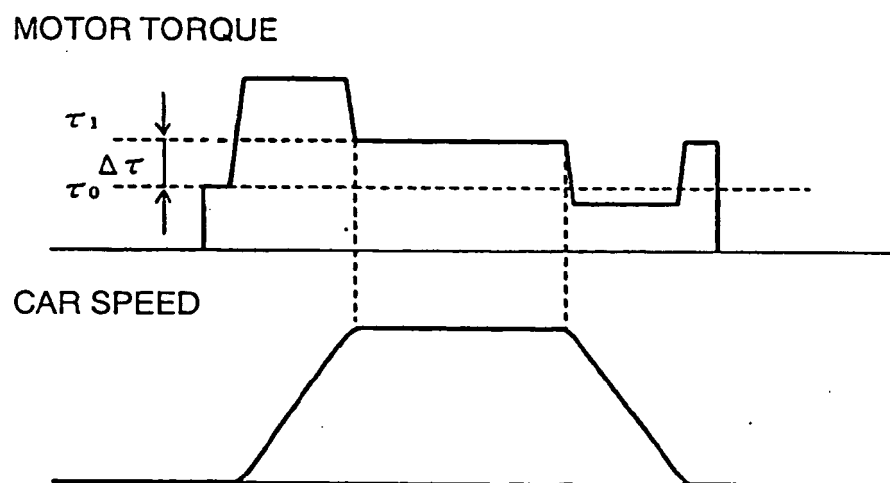




FIG. 8

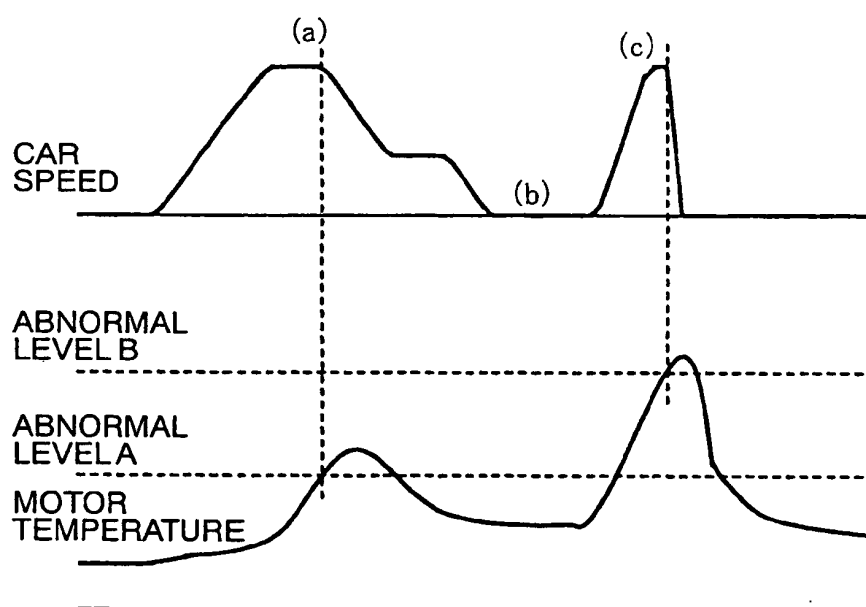


FIG. 9

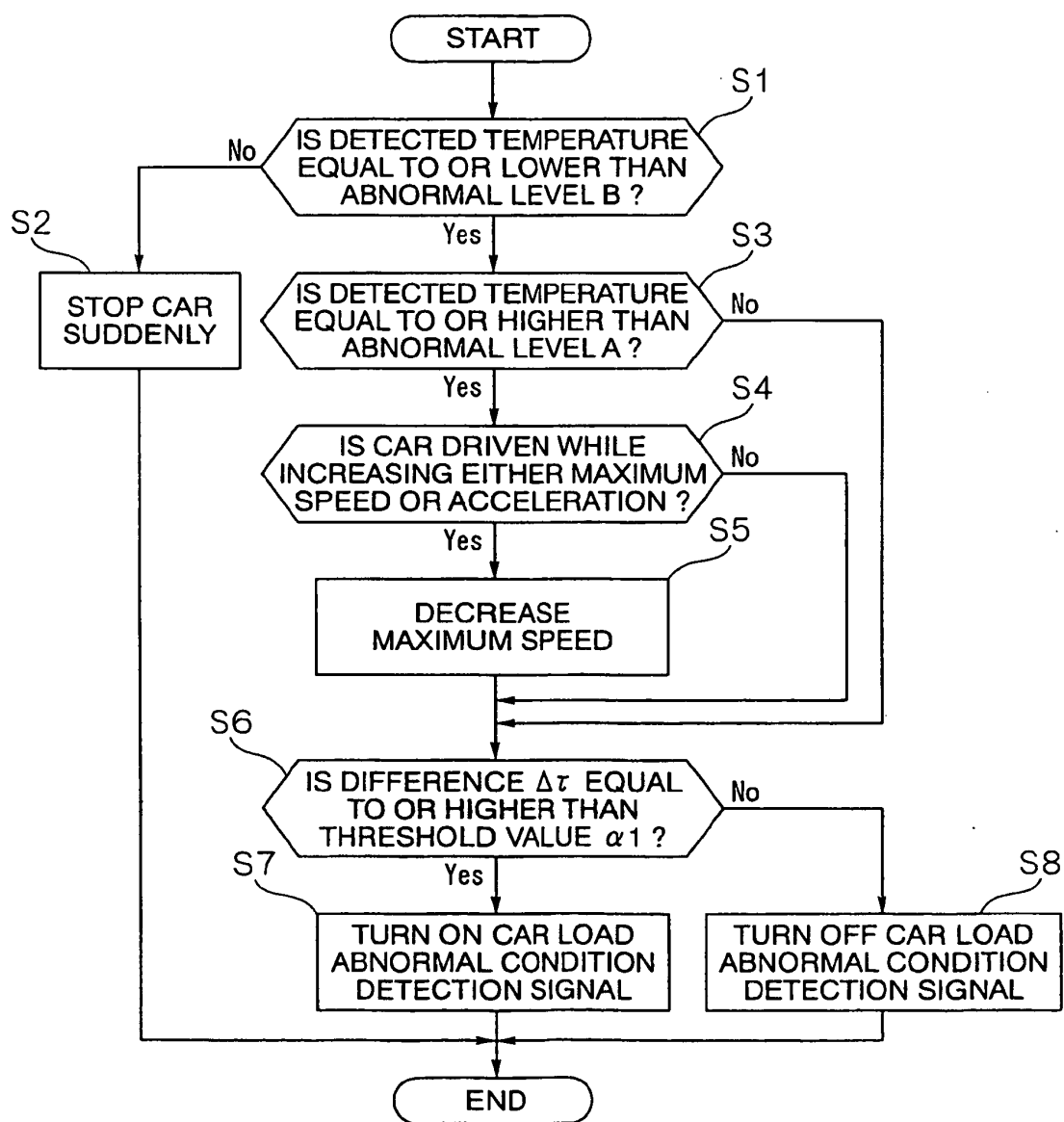
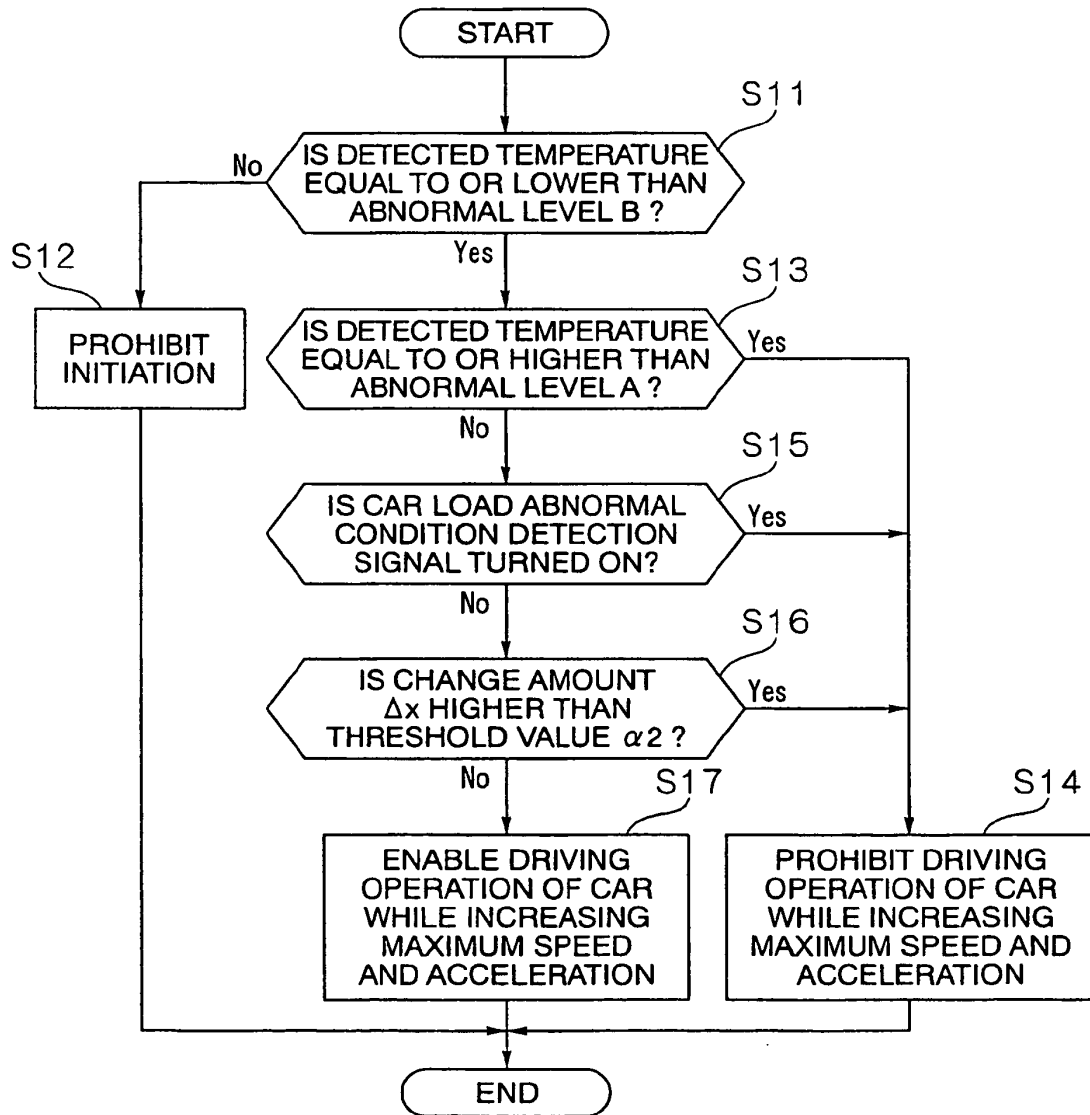


FIG. 10



**REFERENCES CITED IN THE DESCRIPTION**

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