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(71) Applicant: **MITSUBISHI DENKI KABUSHIKI KAISHA**
Chiyoda-ku, Tokyo 100-8310 (JP)

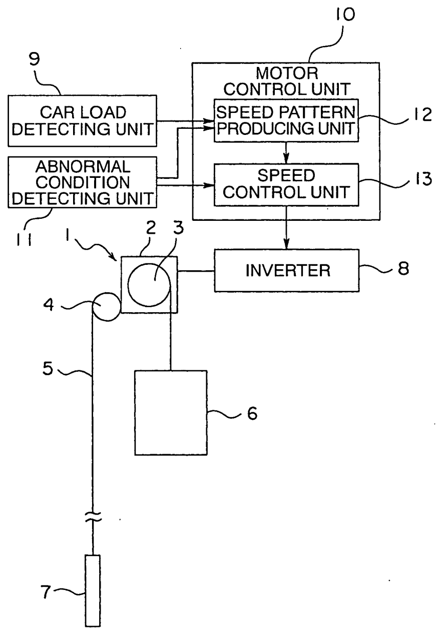
(72) Inventors:
- **KARIYA, Y.,**
Mitsubishi Denki Kabushiki Kaisha
Tokyo 100-8310 (JP)
- **SAKAI, Masaya**
Mitsubishi Denki Kabushiki Kaisha
Tokyo 100-8310 (JP)
- **UEDA, Takaharu**
Mitsubishi Denki Kabushiki Kaisha
Tokyo 100-8310 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) ELEVATOR CONTROL SYSTEM

(57) Provided is an elevator control system which changes a maximum speed and acceleration of a car according to a load weight in the car. The elevator control system includes a motor control unit for controlling operation of a motor unit in response to weight loaded in the car and an abnormal condition detecting unit for detecting an abnormal condition of an elevator. 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.

FIG. 1



EP 1 728 752 A1

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.

Disclosure of the Invention

[0006] 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.

[0007] According to the present invention, 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, includes: 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; in which: 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.

Brief Description of the Drawings

[0008]

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

[0009] Next, a description is made of preferred Embodiments of the present invention with reference to drawings.

Embodiment 1

[0010] 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.

[0011] 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 mail ropes 5.

[0012] 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).

[0013] 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.

[0014] 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.

[0015] 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 (unbalance 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.

[0016] As a method for calculating speed patterns, for instance, the method described in JP-A-2003-238037 may be employed.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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 thereinto and a RAM which temporarily stores data used in calculations executed in the CPU 15 thereinto.

[0021] 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.

[0022] The CPU 15 executes a calculating operation process for every calculation time period based on programs stored in the storage unit 16.

[0023] Next, a concrete explanation is made of control methods for the motor unit 2 in abnormal condition modes.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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

[0030] 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.

[0031] 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 speedmay 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.

[0032] 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.

[0033] The above-explained example explains the detections 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.

[0034] 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.

[0035] 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.

[0036] 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.

[0037] 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.

[0038] In this example, the motor temperatures are detected. Similarly, an inverter temperature may be detected.

[0039] 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.

[0040] 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.

[0041] 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.

[0042] 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.

[0043] 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).

[0044] 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).

[0045] 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.

[0046] 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.

[0047] 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.

[0048] 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).

[0049] 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). 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.

[0050] 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).

[0051] 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 Δx 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 Δx 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.

[0052] In the case where the difference Δx 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).

[0053] In the case where the difference Δx 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).

[0054] In accordance with such an elevator control apparatus, even when primary failures such as the malfunction 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.

[0055] 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.

[0056] 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 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.

2. The elevator control apparatus according to claim 1 wherein, in the abnormal condition mode, the motor control unit immediately stops the car.

3. The elevator control apparatus according to claim 1 wherein, in the abnormal condition mode, the motor control unit decreases the maximum speed of the car.

4. The elevator control apparatus according to claim 1 wherein, in the abnormal condition mode, the motor control unit sets both the maximum speed and acceleration of the car for the subsequent operations of the car in a similar manner to that when the difference between the weight on the side of the car and the weight of the counterweight is large.

5. The elevator control apparatus according to claim 1 wherein the abnormal condition detecting unit includes an abnormal degree judging unit for judging an abnormal degree of the elevator in a stepwise manner.

6. The elevator control apparatus according to claim 1 wherein the abnormal condition detecting unit detects an abnormal condition of the elevator based on information derived from the car load detecting unit for detecting a car load.

7. The elevator control apparatus according to claim 1 wherein the abnormal condition detecting unit detects an abnormal condition of the elevator based on

information derived from a temperature detecting unit for detecting a temperature of at least one of the motor unit and an inverter which drives the motor unit.

FIG. 1

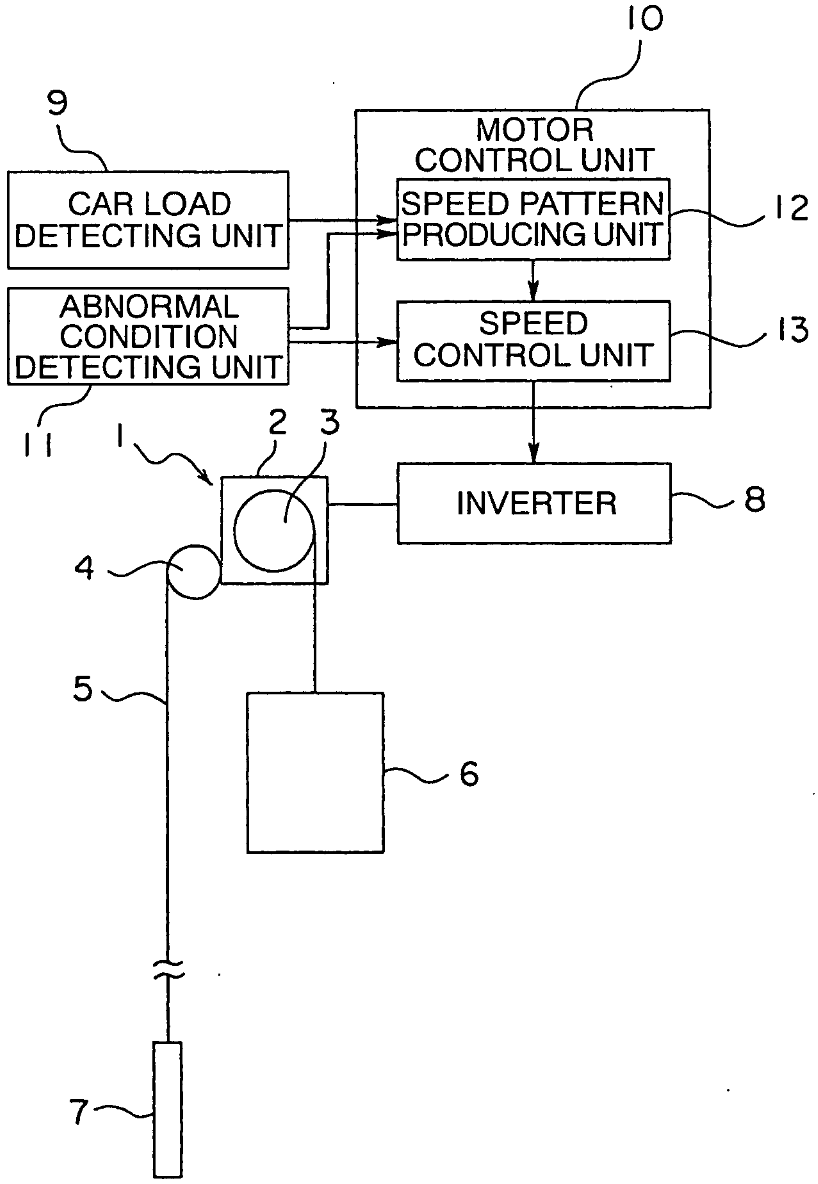

10
9
MOTOR
CONTROL UNIT
CAR LOAD
DETECTING UNIT
SPEED PATTERN
PRODUCING UNIT
12
ABNORMAL
CONDITION
DETECTING UNIT
SPEED
CONTROL UNIT
13
11
1
2
3
INVERTER
8
4
5
6
7

FIG. 2

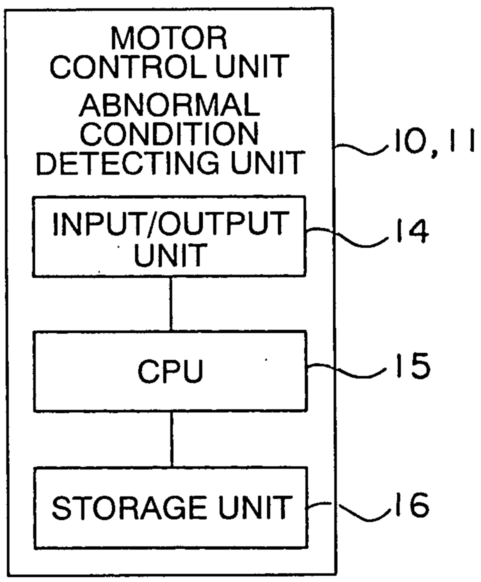

MOTOR
CONTROL UNIT
ABNORMAL
CONDITION
DETECTING UNIT
10, 11
INPUT/OUTPUT
UNIT
14
CPU
15
STORAGE UNIT
16

FIG. 3

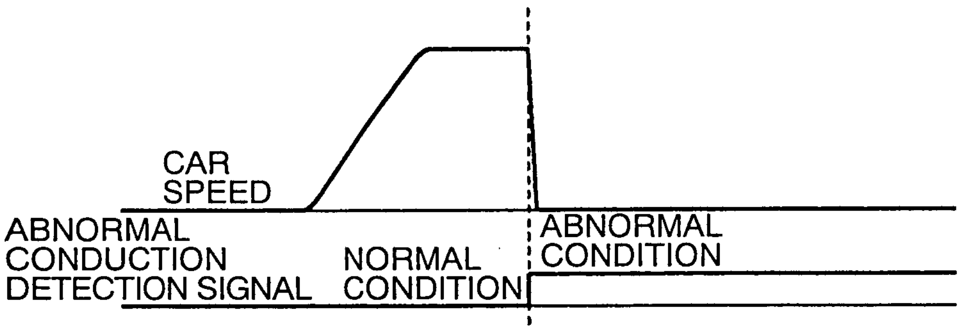


FIG. 4

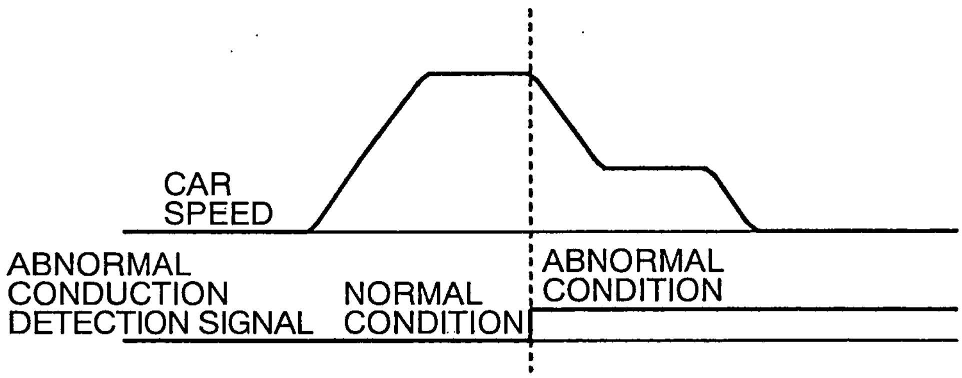


FIG. 5

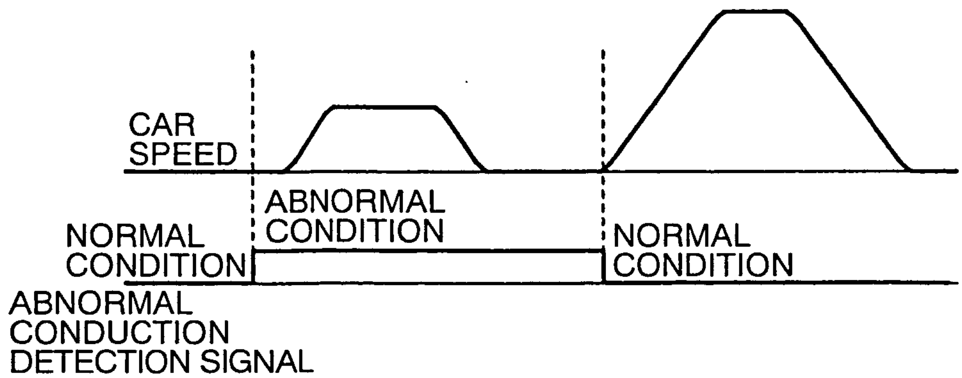


FIG. 6

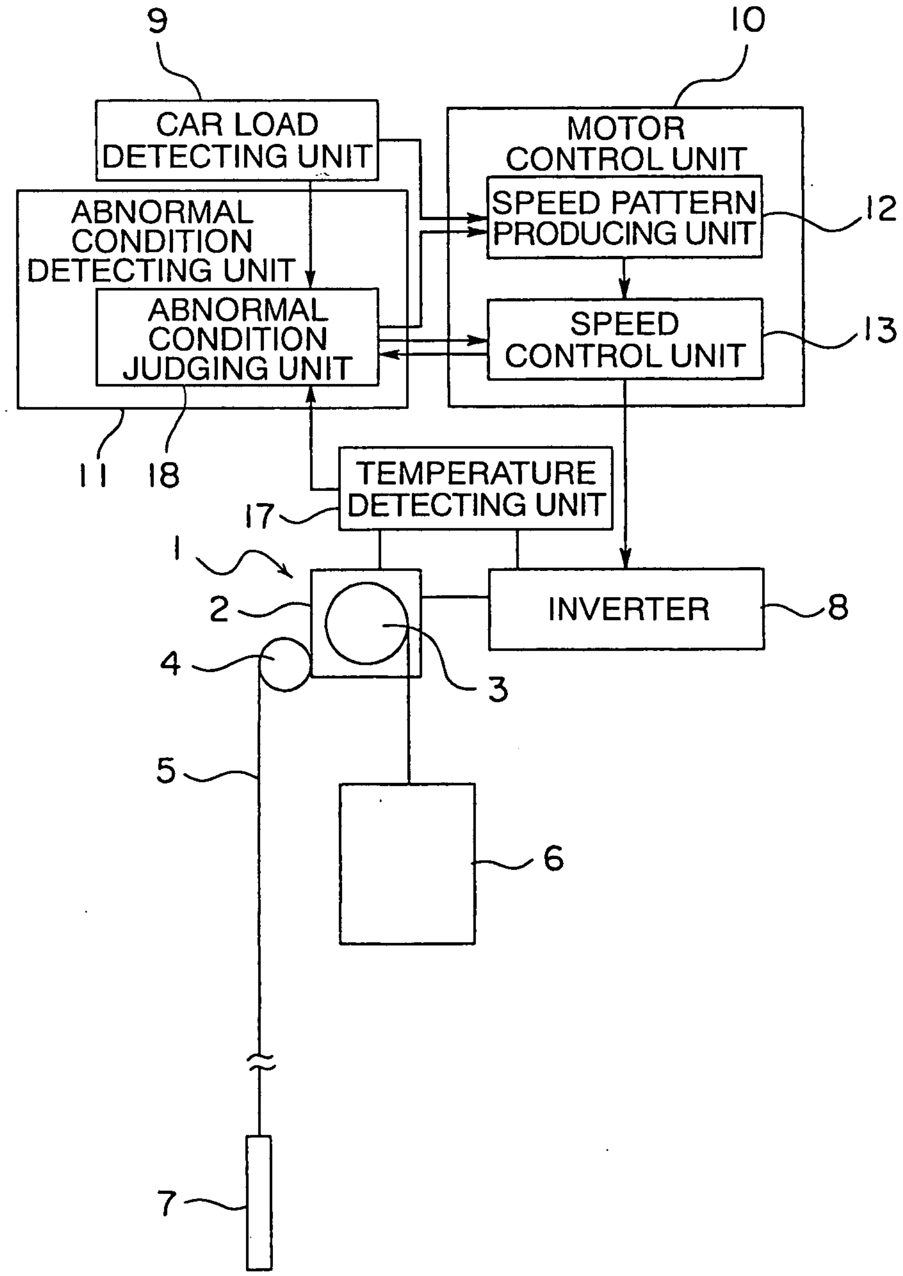

9
10
CAR LOAD DETECTING UNIT
MOTOR CONTROL UNIT
ABNORMAL CONDITION DETECTING UNIT
SPEED PATTERN PRODUCING UNIT
12
ABNORMAL CONDITION JUDGING UNIT
SPEED CONTROL UNIT
13
11
18
TEMPERATURE DETECTING UNIT
17
1
2
INVERTER
8
4
3
5
6
7

FIG. 7

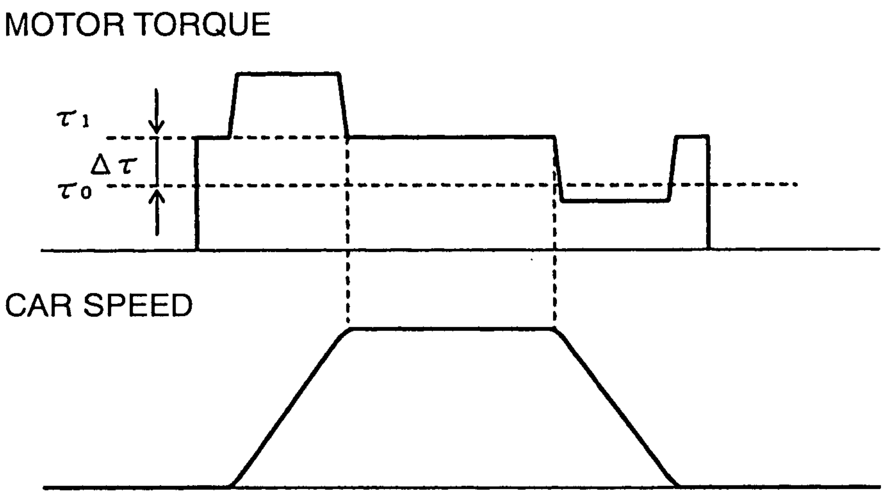


FIG. 8

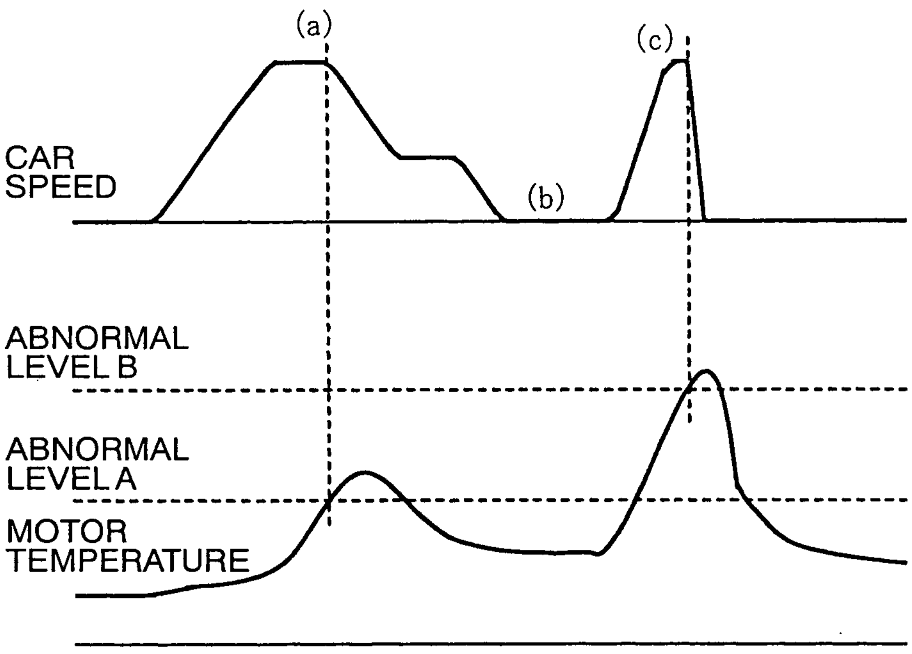

(a)
(c)
CAR
SPEED
(b)
ABNORMAL
LEVEL B
ABNORMAL
LEVEL A
MOTOR
TEMPERATURE

FIG. 9

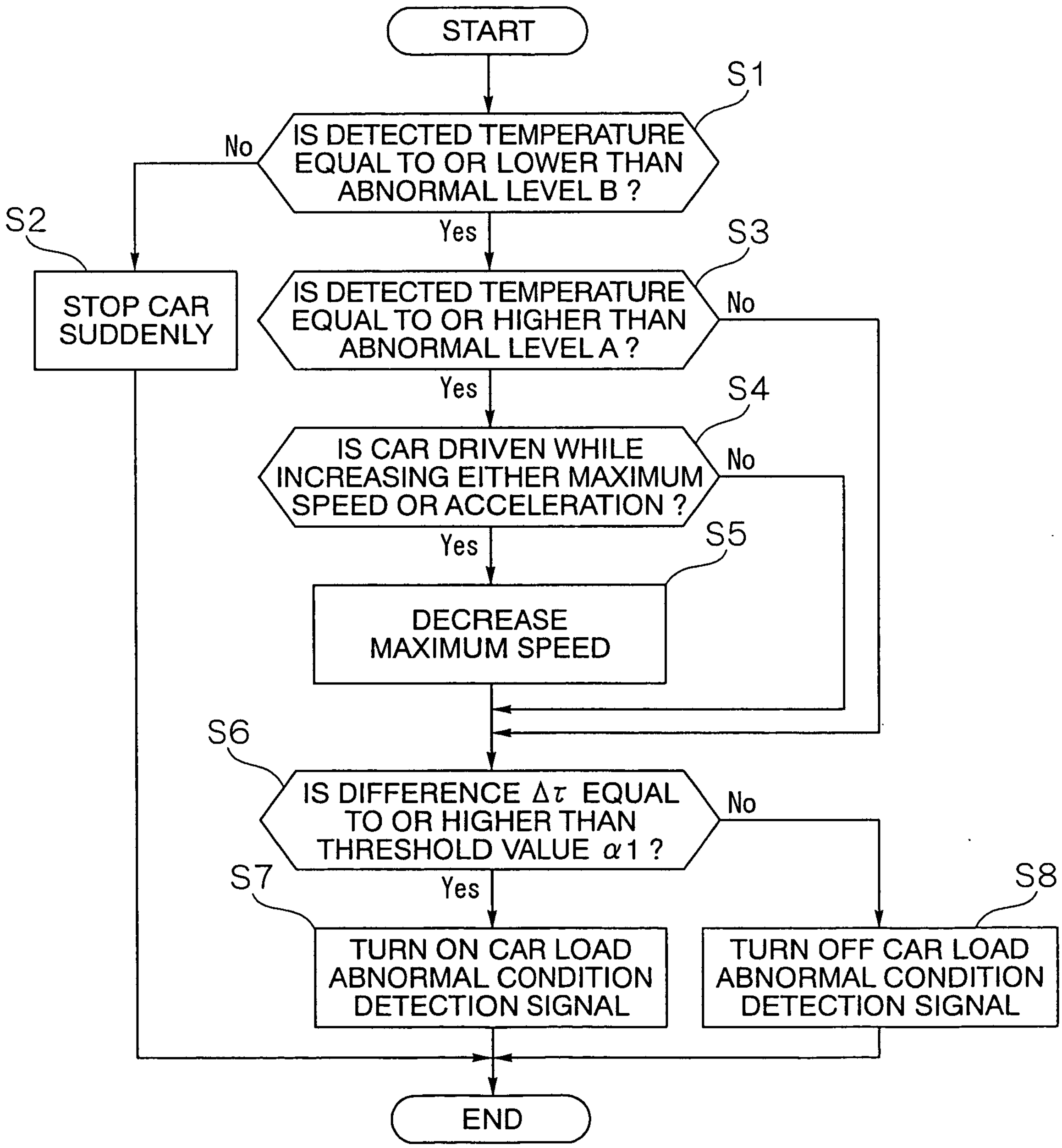
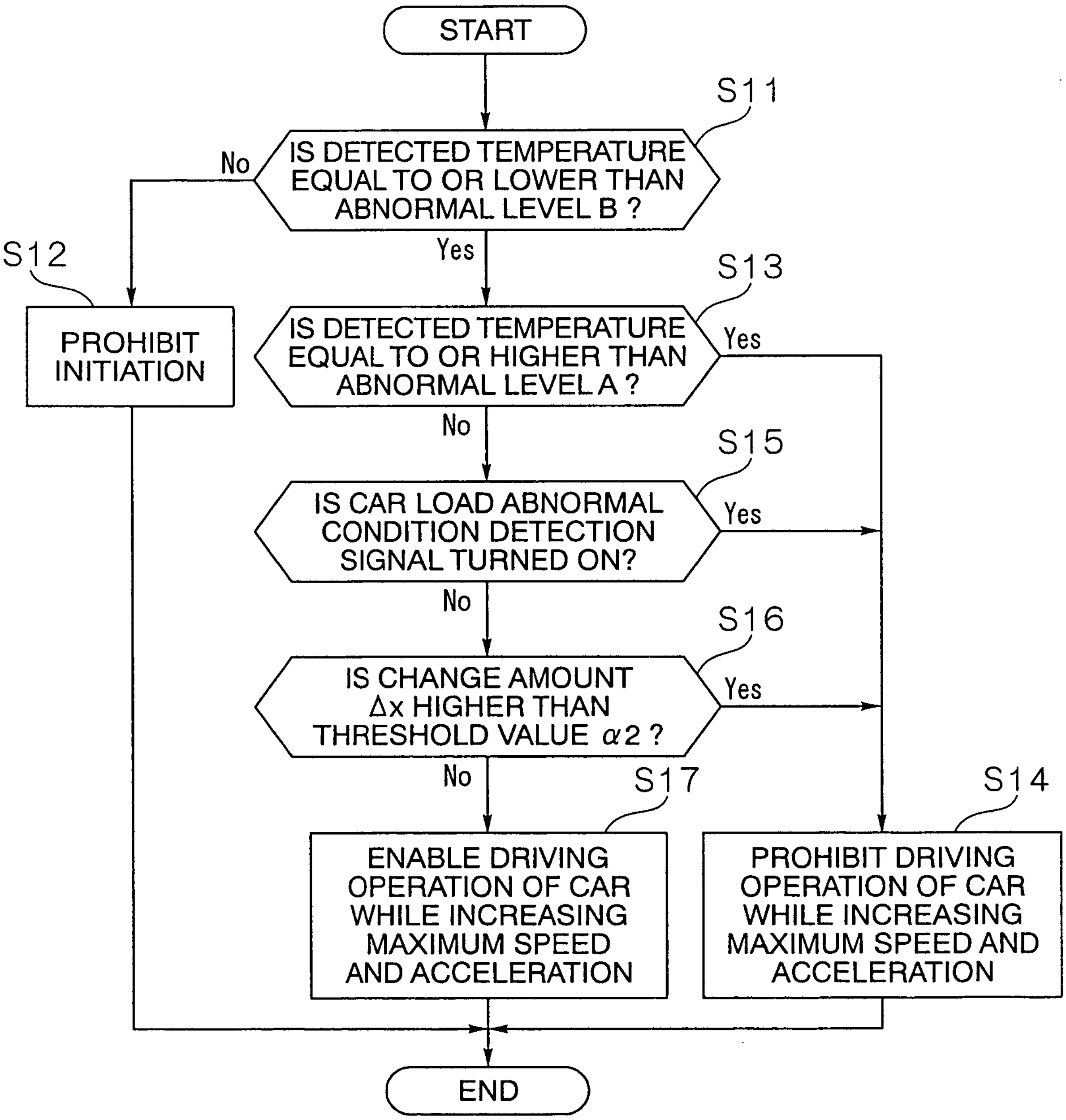

START
S1
IS DETECTED TEMPERATURE EQUAL TO OR LOWER THAN ABNORMAL LEVEL B ?
No
Yes
S2
STOP CAR SUDDENLY
S3
IS DETECTED TEMPERATURE EQUAL TO OR HIGHER THAN ABNORMAL LEVEL A ?
No
Yes
S4
IS CAR DRIVEN WHILE INCREASING EITHER MAXIMUM SPEED OR ACCELERATION ?
No
Yes
S5
DECREASE MAXIMUM SPEED
S6
IS DIFFERENCE Δτ EQUAL TO OR HIGHER THAN THRESHOLD VALUE α1 ?
No
Yes
S7
TURN ON CAR LOAD ABNORMAL CONDITION DETECTION SIGNAL
S8
TURN OFF CAR LOAD ABNORMAL CONDITION DETECTION SIGNAL
END

FIG. 10


START
S11
IS DETECTED TEMPERATURE EQUAL TO OR LOWER THAN ABNORMAL LEVEL B ?
No
Yes
S12
PROHIBIT INITIATION
S13
IS DETECTED TEMPERATURE EQUAL TO OR HIGHER THAN ABNORMAL LEVEL A ?
Yes
No
S15
IS CAR LOAD ABNORMAL CONDITION DETECTION SIGNAL TURNED ON?
Yes
No
S16
IS CHANGE AMOUNT Δx HIGHER THAN THRESHOLD VALUE α2 ?
Yes
No
S17
ENABLE DRIVING OPERATION OF CAR WHILE INCREASING MAXIMUM SPEED AND ACCELERATION
S14
PROHIBIT DRIVING OPERATION OF CAR WHILE INCREASING MAXIMUM SPEED AND ACCELERATION
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/004256

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B5/02, 1/30

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

B. FIELDS SEARCHED

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

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

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-238037 A (Mitsubishi Electric Corp.), 27 August, 2003 (27.08.03), Claims & WO 03/050028 A1	1-7
Y	JP 7-228444 A (Hitachi, Ltd.), 29 August, 1995 (29.08.95), Claims (Family: none)	1-7
Y	JP 7-330231 A (Hitachi, Ltd.), 19 December, 1995 (19.12.95), Abstract (Family: none)	6

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

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 December, 2004 (24.12.04)	18 January, 2005 (18.01.05)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/004256

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2002-3091 A (Toshiba FA System Engineering Kabushiki Kaisha), 09 January, 2002 (09.01.02), Abstract (Family: none)	7

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2003238037 A **[0002] [0016]**