

DESCRIPTION**Title of Invention: ELEVATOR SYSTEM****Technical Field**

5 [0001]

The present invention relates to an elevator system equipped with an unintended car movement protection, and particularly, is suitable for a high-performance elevator system equipped with a safety controller based on a
10 microcomputer.

Background Art

[0002]

An elevator system is required to be equipped with an unintended car movement protection (UCMP), which is a
15 safety device that automatically stops a car when an actuator or a controller has broken down and a car moves up and down before doors of all the exits of a car and a hoist way are closed, and the like.

[0003]

20 The unintended car movement protection is configured to include a door zone detection sensor, a car door switch, a landing door switch, and the like, and actuates a brake at the point of time when doors of a car and a landing are opened and a car deviates from a landing by being brought
25 up and down by a predetermined distance from a door zone.

[0004]

For example, Patent Literature 1 discloses that in order to make a movement distance up to braking and stopping short by detecting an open-door starting car prior to deviating from the door zone, a car re-level operation is performed when a car position deviates from a landing zone in an open-door state and a brake is actuated when a difference between a car position when a door of a car is opened and a car position after a correction operation of a car position is performed exceeds a predetermined value and that a re-level operation is performed when a car position deviates from a bottom level and a brake is actuated by determining that a car position is suddenly changed when a car velocity V_2 after the re-level operation is larger than a car velocity V_1 at the time of the re-level operation and is sustained for a predetermined time.

Citation List

Patent Literatures

20 [0005]

Patent Literature 1: Japanese Patent Application
Laid-Open No. 2007-55691

Summary of Invention

Technical Problem

25 [0006]

In the related art, when a predetermined distance that is a reference of abnormality determination is set to be shorter within the door zone, a possibility of erroneous detection increases, and particularly, a car movement is erroneously detected due to a rope expansion according to passengers getting on or off a car. Further, in case of the erroneous detection, a car is emergency-stopped by a brake, such that a travel service of an elevator stops and travel efficiency is degraded. In particular, in an elevator having a long rope like an elevator of a long stroke, the rope is in a state like a spring, and therefore the rope can be easily expanded due to passengers getting on/off a car, such that the travel efficiency is remarkably degraded and is different for each floor.

[0007]

Further, the configurations described in Patent Literature 1 may need to perform the re-level operation of a car, increase detection time, and increase a car movement distance in the open-door state for the detecting time. Further, when the car velocity $V1$ is reduced, it is easy to erroneously detect the $V2$ as abnormality, while when the car velocity $V1$ is large, it is difficult to detect the $V2$. In addition, in an abnormal mode (mode in which acceleration is not made) in which a car travels at

V2 < V1, the detection cannot be made or the detection is delayed.

[0008]

An object of the present invention is to solve the
5 problem of the related art and certainly detect open-door
movement at a shorter movement distance (earlier point in
time) and prevent travel efficiency from being degraded
while increasing higher stability.

[0009]

10 Further, another object of the present invention is
to remove erroneous detection and increase reliability,
regardless of a long and short stroke of an elevator and a
difference between floors.

[0010]

15 In addition, another object of the present invention
is to certainly stop a car within a predetermined distance
from a landing reference position of a landing, regardless
of speed patterns such as a size of a car speed,
acceleration, deceleration, and the like.

20 [0011]

Furthermore, the present invention is to achieve at
least any one of the above objects.

Solution to Problem

[0012]

25 In order to achieve the object, the present

invention provides an elevator system equipped with an unintended car movement protection that stops a car by determining the case, in which a car door and a landing door are in an open state and a car is elevated from a landing, as open-door movement abnormality, the system including: a car door switch that detects an open state of the car door; a landing door switch that detects the open state of the landing door; a detection device that detects a speed and a movement amount of a car and a floor reference position; and a safety controller that determines an open-door movement abnormality by an abnormality determination threshold value of a set car speed with respect to a car position based on results detected by the detection device.

Advantageous Effects of Invention

[0013]

According to the present invention, it is possible to detect the open-door movement at an earlier point in time for determining the open-door movement abnormality based on only the car position, improve the safety, and remove the erroneous detection to prevent the degradation in travel efficiency, by detecting the floor reference position and the speed and movement amount of the car and setting the abnormality determination threshold value of the car speed with respect to the car position.

Brief Description of Drawings

[0014]

[FIG. 1] An overall configuration diagram illustrating an embodiment of the present invention.

5 [FIG. 2] A block diagram illustrating a safety controller according to an embodiment.

[FIG. 3] A side view illustrating a determination distance according to an embodiment.

[FIG. 4] An operation flow chart of an unintended
10 car movement protection according to an embodiment.

[FIG. 5] A graph illustrating characteristics of an abnormality determination threshold value of a set car speed with respect to a car position according to an embodiment.

15 [FIG. 6] A graph illustrating a car operation due to a rope expansion according to an embodiment.

[FIG. 7] A graph illustrating an operation (stop distance) upon the occurrence of abnormality in the embodiment and the related art.

20 [FIG. 8] A graph illustrating an operation (erroneous detection) upon the occurrence of abnormality in the embodiment and the related art.

[FIG. 9] A graph illustrating characteristics of an abnormality determination threshold value of a set car
25 speed with respect to a car position according to another

embodiment.

[FIG. 10] A graph illustrating characteristics of an abnormality determination threshold value of a set car speed with respect to a car position according to yet
5 another embodiment.

[FIG. 11] A block diagram illustrating a safety controller according to another embodiment.

[FIG. 12] A graph illustrating characteristics of an abnormality determination threshold value of a set car
10 speed with respect to a car position according to yet another embodiment.

[FIG. 13] A block diagram illustrating a safety controller according to yet another embodiment.

[FIG. 14] A graph illustrating characteristics of an
15 abnormality determination threshold value of a set car speed with respect to a car position according to yet another embodiment.

Description of Embodiments

[0015]

20 Hereinafter, embodiments will be described in detail with reference to the accompanying drawings.

In the related art, a safety styem using mechanical devices such as a contact switch or a relay circuit is configured of electronic devices using a safety controller
25 based on, for example, a microcomputer.

[0016]

The safety controller is a higher-performance electronic safety system that performs high degree processing by software that is a combination of input
5 information of a plurality of sensors or a safety switch and is a combination of a plurality of state signals.

[0017]

FIG. 1 is an overall configuration diagram illustrating an elevator system, in which an elevator car
10 2 and a balance weight 3 of an elevator are connected with each other by a main rope and the car 2 is vertically brought up and down by a shieve 5 that is rotatably driven by a motor 4. When a car stops, the shieve 5 is fixed by a brake (doubled configuration) 6. The brake 6 is also
15 used even when a car is emergency-stopped at the time of the elevator abnormality.

[0018]

The elevator of the electronic safety system is illustrated and the normal/abnormal state of the elevator
20 is determined by the mounted safety controller 1 in the high-reliable microcomputer and the like, and if it is determined that the elevator is abnormal, a main power supply that supplies power to the motor is cut off and the brake 6 is actuated, such that the car 2 is emergency-
25 stopped.

[0019]

The safety controller 1 is configured of, for example, a dual system of a microcomputer and two microcomputers mutually check a state of the other party and an operation output, thereby implementing high reliability. The safety controller 1 is configured to include an operation processing device including a microcomputer, a CPU, or a DSP and an electronic processing device in which processing logic can be mounted by programming of an FPGA (logic circuit), and the like.

[0020]

As one sensor that detects the abnormal state of the elevator, a governor device and an encoder 21 are provided to detect a speed and a movement amount (movement distance) of a car. The governor device is configured of a governor rope 22 that is supported by a rotatable governor pulley 20, fixed to a car 2, and moves together with the car. The encoder 21 (rotary encoder) is attached to the governor pulley 20 and rotates together with the car and the speed and movement amount of the car are obtained by counting a pulse generated by the rotation of the encoder 21.

[0021]

The signal of the encoder 21 is input to the safety controller 1 and the speed or movement amount of the car

is calculated by counting the pulse. The speed and movement amount of the car are detected by a detection device that reads magnetically recorded code information by attaching a magnetic tape to an hoist way (for example,
5 rail) in a vertical direction (ascending/descending direction) or performs optical (for example, bar code) detection.

[0022]

The the floor reference position of each floor and
10 the floor position information (for example, first floor, second floor) of each floor are detected by a car position sensor 30 (reflective photoelectric sensor) equipped in the car 2 and detection plates 31A, 31B, and 31C attached to thresholds of landings of each floor and when the car
15 position sensor 30 is present at a position opposite to the detection plate, reflected light of the sensor is detected from each detection plate. The length and shape of each detection plate are changed for each floor, such that it is detected whether the car 2 is present at a
20 predetermined reference position of the floor. In order to detect the reference position with high precision, an edge of the detection plate may be detected based on a change in a step shape of the sensor signal.

[0023]

25 A landing reference position (landing level) at

which the car 2 is landed is calculated from the detected reference position of the floor and the calculated movement amount. When the edge position of the detection plate is set to the reference position of floor, the
5 detection plates 31A, 31B, and 31C are attached so that the edge position and the landing reference position are at a predetermined distance. Therefore, after the edge position of the detection plate is detected by the car position sensor 30, the car (accurately, car bottom) is at
10 the landing reference position of the floor when the movement amount of the car based on the encoder 21 reaches a predetermined value.

[0024]

Further, a car door switch 43 that detects the open
15 state of the car door 42 and landing door switches 41A, 41B, and 41C that detect the open states of the landing doors 40A, 40B, and 40C of each floor are provided. In addition, as the sensor that detects a load of passengers within a car, a spring type load sensor 32 and a beam
20 sensor or a photoelectric sensor (not illustrated) that is equipped at the car door to detect passengers sandwiched in the car door are provided.

[0025]

The information on the sensor (the encoder 21 of the
25 governor, the car position sensor 30, the spring type load

sensor 32, and the beam sensor of the car door) and the switch (the car door switch 43 and the landing door switches 41A, 41B, and 41C of each floor) is converted into an electrical signal and a serial communication
5 signal and input to the safety controller 1 via a signal line.

[0026]

The safety controller 1 determines the safety state of the elevator based on the sensor information and the
10 switch information, and if it is determined that the safety state is abnormal, cuts off the main power supply and operates the brake 6, thereby emergency stopping the elevator car.

[0027]

15 FIG. 2 illustrates a block diagram of an UCMP that is the safety controller 1, in which the UCMP detects the open-door movement abnormality based on the position (the moving distance of the car from the landing reference position) and speed of the car.

20 [0028]

The car speed is calculated by counting the pulse of the encoder 21 as the number of pulses (corresponding to the car moving distance) per a predetermined time by a car speed calculation unit 101. The movement direction
25 (ascending direction or descending direction) of the car

when the car passes through the floor reference position.

[0030]

The open-door determination unit 105 detects whether any one of the car door switch 43, the car door from the
5 output signals from the landing door switches 41A, 41B, and 41C of each floor, or the landing door of each floor is opened (it may be determined that only the car door is opened).

[0031]

10 When it is detected that the car door or the landing door is in an open-door state, a car position and car speed abnormality determination unit 106 determines the occurrence of the open-door movement abnormality from the car speed, the determination distance X between the
15 landing reference position and the car position, and an overspeed threshold value (abnormality determination threshold value) of the car speed set with respect to the determination distance X.

[0032]

20 The overspeed threshold value is stored in a threshold value database 107 as a database, corresponding to the landing reference positions for each floor and the determination distance X. When it is determined to be the open-door movement abnormality by referring to the
25 threshold value database 107, the safety controller 1

outputs a signal that cuts off the main power supply of the elevator and a signal (generally, a signal that interrupts the supply power of a winch brake) that actuates the winch brake.

5 [0033]

FIG. 4 illustrates an operation flow chart of the electronic UCMP.

[0034]

It is determined whether the car door and the
10 landing doors of each floor are in an open state (F01).
If it is determined that the door is not in an open state,
it is determined that no open-door movement abnormality is
present, and thus the processing is omitted.

[0035]

15 When the door is in the open state, the car speed is
detected (F02) to calculate the determination distance X
(the moving distance of the car from the reference
position) between the current car position and the landing
reference position of the car stop floor (or nearest
20 floor) (F03).

[0036]

The comparison is performed (F05) by referring to
the abnormality determination threshold value stored in
the threshold value database 107 (F04).

25 [0037]

When the car speed is higher than the abnormality determination threshold value, that is, exceeds a speed, it is determined that the car is in the open-door movement abnormality state (F06), such that the car is emergency-
5 stopped (F07).

[0038]

FIG. 5 illustrates the abnormality determination threshold value (determination criteria), in which a horizontal axis (A01) at any Nth floor represents the car
10 speed, a vertical axis (A02) represents the car position in the ascending/descending direction, a dotted line A05 represents a landing reference position, and a curve A03 represents an abnormality determination threshold value. It is determined that an inner side (landing reference
15 position side) than the curve A03 is normal and an outer side beyond the curved line is abnormal.

[0039]

The abnormality determination threshold value is set to become smaller as the determination distance X
20 (distance to the car position) from the landing reference position is increased based on the landing reference position.

[0040]

The abnormality determination threshold value A03 is
25 set by adding a predetermined margin (margin of the speed

detection) by defining the rope expansion amount and an operation area curve A06 of the open-door movement that may also be in a normal state so as not to erroneously determine the car speed at that time based on the expansion due to passengers getting on and off a car.

[0041]

The operation area (curve A06) of the normal open-door movement due to the rope expansion, and the like will be described.

FIG. 6(A) illustrates the car operation (the operation of the position and speed) due to the expansion of the main rope when many people get in a car. An operation trace C01 represents a trace of an operation point and an arrow direction represents a temporal progress. In the start point, the car stops at the landing reference position (speed is zero). When many people get on the car, the rope is expanded such that the car descends with the increased speed and stops at any position and then, stops at a position of an end point by repeating vibrations of ascending and descending like vibrations of a spring.

[0042]

FIG. 6(B) illustrates the case in which many people get off a car and then, get on a car, in which C02 represents the operation trace. Many people get off a car

at the start point and the rope is contracted such that a car ascends once and is vibrated. The car is strongly vibrated in a descending direction because more people get on the car in the meantime.

5 [0043]

As described above, in order to erroneously detect the movement of the car due to the rope expansion, the curve A06 in the normal area may be a radial curve based on the landing reference position.

10 [0044]

FIG. 7 illustrates the operation upon the occurrence of abnormality, in which a dotted line B01 represents the determination threshold value according to the related art that determines the open-door movement abnormality only by a distance between the landing reference position and the car position.

[0045]

In the related art, the abnormality (failure) occurs when the car stops at the landing reference position, such that the car position is beyond the threshold value of the dotted line B01 and the abnormality is detected when the car descends with being accelerated according to the operation trace B04. As a result, the acceleration is continued as illustrated in the operation trace B06 and the car speed is increased as illustrated. Therefore, the

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brake is actuated at the point in time when the abnormality is detected and even in the deceleration, the time to stop and the long distance are required (the related art in the drawings).

5 [0046]

The threshold value (dotted lines B06 and B01) of the distance required to stop needs to be set so as to prevent passengers from being sandwiched in the ceiling or the bottom of the landing, and it is preferable that after
10 the car is emergency-stopped, the step between the car bottom and the landing when passengers escape from the car to the landing is small and is smaller for safety.

[0047]

In the embodiment, the abnormality is determined
15 according to a determination curve A03, and therefore even in the case of the operation trace B04, the abnormality is detected at an intersecting point of B04 and A03.

Therefore, the abnormality is detected at an earlier point of time than the related art, the movement distance to the
20 stop may be shorter, and the escape of the passenger may be safer.

[0048]

FIG. 8 illustrates that the determination threshold value B01 of FIG. 7 is set to be smaller like B01 so as to
25 make the movement distance and time short at the time of

deceleration.

[0049]

In the related art, there is a possibility of the erroneous detection that the normal open-door movement operation (area within curve A06) of the car illustrated in FIG. 5 is abnormal. That is, there is a possibility that an area D02 beyond the dotted line B01 within the curve A06 is an erroneously detected area.

[0050]

In the embodiment, since no erroneously detected area D02 is present, there is no risk of the erroneous detection. Further, for the operation trace D03 of the car, since the abnormality is detected in the area (area of D04) that is beyond the open-door normality area, the abnormality can be determined earlier. As a result, the stability for the open-door movement abnormality may be increased and the unnecessary emergency stop is avoided to improve the travel service of the elevator.

[0051]

FIG. 9 illustrates that for the description of FIG. 5, the setting value of the abnormality determination threshold value (determination criteria) is changed, the landing reference position and the threshold value database 107 corresponding to the determination distance X are changed, and the open-door movement abnormality is

defined from the relationship between the car speed and the car position for stopping the car within a predetermined distance.

[0052]

5 The requirement of the speed V for emergency-stopping the car at a predetermined position (distance) X_0 with the deceleration β and the car position X is as follows:

$$V = \sqrt{2 \cdot \beta \cdot (X_0 - X)} \quad (2)$$

10 β represents the deceleration (deceleration by a winch brake or a second brake (rope brake or rail brake)) when the car is emergency-stopped, X represents the distance between the landing reference position and the car position, V represents the abnormality determination
15 threshold value, and X_0 represents the predetermined position (distance) at which the car stops.

[0053]

FIG. 10 illustrates that the setting value of the abnormality determination threshold value (determination
20 criteria) is changed and for the landing reference position of the car stop floor, the dead zone (area sandwiched by two dotted lines A07) that does not perform determination on the close position (distance) is provided. By providing the dead zone, the time is short (the
25 amplitude width is short) such that the problem of safety

is not present due to the excessive vibration depending on passengers getting on and off a car. However, even when the car speed close to the landing reference position is significantly increased instantly, the erroneous detection
5 can be prevented, the unnecessary emergency stop can be avoided, and the travel service of the elevator can be improved.

[0054]

FIG. 11 illustrates that for the block diagram of
10 the UCMP illustrated in FIG. 2, the open-door movement abnormality is determined by the car speed and position according to the characteristics for each floor and the threshold value data 109 corresponding to the floor position of the car is defined. That is, the floor
15 position detection unit 108 detects the floor positions (first floor, second floor, third floor, and the like) of the car and determines the open-door movement abnormality by the optimized threshold value data 109 for each floor position.

20 [0055]

The input signal for the floor position detection unit 108 is the car position sensor (reference numeral 30) illustrated in FIG. 1 and when the car position sensor is the photoelectric sensor, each floor may be identified by
25 a detection plate shape and the floor information may be

identified by using an RFID tag, a barcode, and the like.
[0056]

Therefore, even though the vibration width of the rope expansion is different according to the floor position, a proper determination threshold value may be defined according to the rope expansion, a determination threshold value for earlier detection of the abnormality for a specific floor (for example, a floor in which the elder mainly reside, a floor in which children mainly reside, and the like) in a condominium building, and the like, can be defined, and the more accurate and rapid determination can be made.
[0057]

FIG. 12 illustrates the example of the determination characteristics set for each floor.

FIG. 12(A) illustrates that the floor position of the car is the uppermost floor and since the length of the main rope to which the car is hung is short, the vibration width by the rope expansion is reduced and the normal area (area surrounded by a dashed line A06) of the open-door movement by the rope expansion is reduced. Therefore, a radius (a center is a landing reference position) of the abnormality determination curve (curve A03) is also reduced. That is, the abnormality determination threshold value of the speed of the same car position is

reduced.

[0058]

FIG. 12(B) illustrates that the floor position of the car is the lowest floor and since the length of the main rope is long, the vibration width by the rope expansion is increased and the normal area (area surrounded by a dashed line A06) of the open-door movement by the rope expansion is increased. Therefore, the radius (a center is a landing reference position) of the abnormality determination curve (curve A03) is also increased. That is, the abnormality determination threshold value of the speed for the same car position is increased.

[0059]

The determination criteria of the open-door movement abnormality are changed according to the floor position, and therefore the abnormality determination is adapted to the different rope expansions at each floor position, thereby implementing the more accurate determination and protection. Further, the determination criteria may be defined based on the amount of the rope expansion even when the car height position (for example, a height of 10 m, and the like) is used instead of the floor position. That is, as the stop floor of the car is lower and the car height position is lower, the abnormality determination

threshold value may be increased.

[0060]

FIG. 13 illustrates that for the block diagram of the UCMP illustrated in FIG. 2, the determination of the open-door movement abnormality is performed according to the state of passengers getting and off a car, and it is determined whether there are passengers getting on and off the car by the passenger getting on/off state determination unit 110 to determine the abnormality from an abnormality determination threshold value data 111 based on the results.

[0061]

The passenger getting on/off states of a car is detected by the change state of the load in the car detected by a load sensor 32 in the car or the door beam signal (it can detect that passengers pass through the car door) of the car door. When passengers are getting on and off a car, the abnormal determination threshold value is defined based on the main rope expansion by the getting on/off, such that more accurate determination can be made.

[0062]

FIG. 14 illustrates an example in which the abnormality determination threshold value is defined according to whether there are passengers getting on and off a car, which represents the abnormality determination

threshold value in the case in which a curve A03A represents that passengers are getting on and off, and a curve A03B represents that passengers are not getting on and off. In the case in which passengers are getting on and off, the main rope expansion due to the passengers getting on and off a car is increased such that the normal area (area surrounded by a dashed line A06 of FIG. 5) of the open-door movement is wide, and the radius (a center is a landing reference position) of the abnormality determination curve (curve A03A) is set to be large based on the expansion. In the case in which passengers are not getting on and off, the main rope expansion is small, such that the radius (a center is a landing reference position) of the curve A03B is set to be small.

[0063]

Therefore, the open-door movement is certainly detected at a shorter movement distance regardless of passengers getting on and off a car, the stability can be improved, and the degradation in travel efficiency can be prevented. Further, instead of whether passengers getting on and off a car, the abnormality determination may be made according to the number of passengers getting on and off a car, and the abnormality determination may be performed more accurately when the expansion of the main rope is directly detected by a sensor disposed at the rope

end.

Reference Signs List

[0064]

	1	Safety controller
5	2	Car
	6	Brake
	21	Encoder (detection device)
	30	Car position sensor (position sensor)
	31A, 31B, 31C	Detection plate
10	41A, 41B, 41C	Landing door switch
	43	Car door switch
	101	Car speed calculation unit
	104	Distance calculation unit between landing reference position and car position
15	105	Open-door determination unit
	106	Abnormality determination unit of car position and car speed
	107	Threshold value database

Claims

1. An elevator system equipped with an unintended car movement protection that stops a car by determining
5 the case, in which a car door and a landing door are in an open state and the car is elevated from a landing, as open-door movement abnormality, the system comprising:

a car door switch that detects an open state of the car door; a landing door switch that detects the open
10 state of the landing door;

a detection device that detects a speed and a movement amount of a car and a floor reference position;
and

a safety controller that determines an open-door
15 movement abnormality by an abnormality determination threshold value of a car speed set with respect to a car position based on results detected by the detection device.

2. The elevator system according to claim 1, wherein
20 the detection device includes a detection sensor that detects the speed and movement amount of a car and a position sensor that detects a floor reference position of each floor.

25 3. The elevator system according to claim 1, wherein

the safety controller calculates a landing reference position at which the car is landed from the floor reference position and the movement amount and a determination distance from the landing reference position to the car position, and when a door is detected to be in an open state by the car door switch and the landing door switch, determines the open-door movement abnormality by referring to a threshold value database in which the abnormality determination threshold values are stored, corresponding to the determination distance.

4. The elevator system according to claim 1, wherein the abnormality determination threshold values are defined for each floor position.

5. The elevator system according to claim 1, wherein the safety controller calculates a landing reference position at which the car is landed from the floor reference position and the movement amount and a determination distance from the landing reference position to the car position, and the abnormality determination threshold value is set to become smaller as the determination distance is increased.

6. The elevator system according to claim 1, wherein

the abnormality determination threshold value is set so as not to be erroneous determination based on the expansion of the rope bringing up and down the car due to the passenger getting in/out of the car.

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7. The elevator system according to claim 1, wherein the abnormality determination threshold value is set based on the car position and the deceleration when the car stops at the predetermined position.

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8. The elevator system according to claim 1, wherein the safety controller calculates a landing reference position at which the car is landed from the floor reference position and the movement amount and a determination distance from the landing reference position to the car position, and a dead zone that does not perform the determination on the landing reference position is provided.

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9. The elevator system according to claim 1, wherein as a stop floor of the car is lower and a height position of the car is lower, the abnormality determination threshold value for the car position is larger.

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10. The elevator system according to claim 1,

wherein a passenger getting on/off state determination unit that detects whether or not passengers are getting on and off the car is provided, and when it is detected that passengers are getting on and off the car, the abnormality
5 determination threshold value with respect to a car position is larger than when it is detected that no passengers are getting on and off the car.

11. The elevator system according to claim 1,
10 further comprising:

an encoder that is operated together with the car to generate a pulse; a reflective photoelectric sensor provided on the car; and a detection plate that is attached to a threshold of a landing of each floor,

15 wherein the pulse is counted to calculate the speed and movement amount of the car, and when the reflective photoelectric sensor is at an opposite position to the detection plate, the floor reference position is detected.

20 12. The elevator system according to claim 1,
wherein the speed and movement amount of the car and the floor reference position are detected by reading magnetic code information recorded on a magnetic tape attached in an ascending/descending direction.

13. The elevator system according to claim 1,
wherein the speed and movement amount of the car and the
floor reference position are optically detected.