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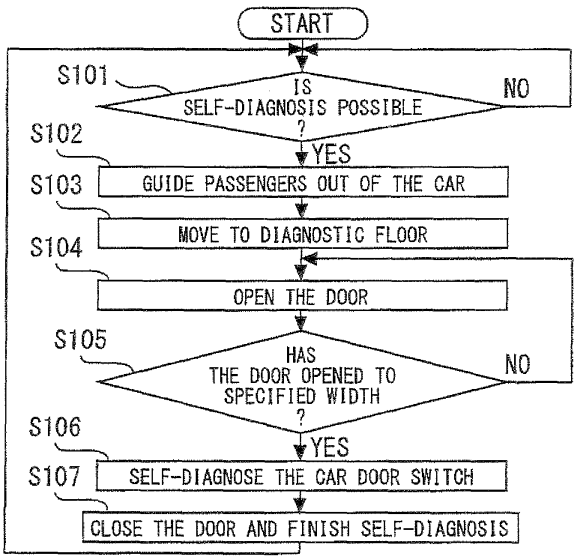
(54) ELEVATOR CONTROLLER

(57) Provided is a control device of an elevator which positively prevents users from boarding a car by mistake during the failure diagnosis of a door switch and ensures that the surrounding people do not mistake the action during the failure diagnosis for a failure of the elevator.

During a self-diagnosis of a door switch, the elevator door is caused to open beyond an action position of the door switch and the door is caused to close without causing the door to open to a width which is not less than a prescribed specified width through which an elevator user cannot pass. A determination is made as to the existence or nonexistence of a failure of the door switch on the basis of the action condition of the door switch occurring when such door opening and closing actions are carried out.

Fig. 5



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Description

Technical Field

[0001] The present invention relates to a control device which performs the failure diagnosis of a door switch of an elevator.

Background Art

[0002] In recent years, with buildings becoming higher, elevators have been playing an increasingly important role as transport means for the movement in the vertical direction. In high-rise buildings exceeding several tens of stories, it is substantially difficult to move to each floor using staircases alone. For this reason, in elevators installed particularly in high-rise buildings, it becomes important to detect failures at an early stage by performing failure diagnosis for each piece of equipment before the elevators become inoperative due to the failures.

[0003] An elevator is provided with a door switch which detects that a door (a car door and a hall door) is closed. This door switch has a very high working frequency, and if a failure occurs the operation of the elevator must be suspended. For this reason, in elevators, it is necessary to try to detect failures early by conducting the failure diagnosis in normal times.

[0004] Examples of conventional techniques related to the failure diagnosis of elevators include the following described in the patent literatures 1 and 2 below.

Patent Literature 1 proposes a technique which involves bringing an elevator from a normal operation into a diagnostic operation under prescribed conditions and conducting failure diagnoses of prescribed equipment, such as a position sensor.

Also, Patent Literature 2 proposes a technique which involves detecting failure from the opening and closing torque, opening and closing time and the like of a door in a diagnostic operation for returning an elevator to a normal operation after the occurrence of an earthquake.

Citation List

Patent Literature

[0005]

Patent Literature 1: Japanese Patent Laid-Open No. 2006-298538

Patent Literature 2: Japanese Patent Laid-Open No. 2007-230685

Summary of Invention

Technical Problem

[0006] It is impossible to make an accurate determination as to whether or not a failure of a door switch exists unless a door is opened and closed actually. For this reason, in conventional elevators including those described in Literature 1 and Literature 2, users have been prevented from boarding a car by mistake during the failure diagnosis of a door switch by switching off the car lighting and making announcements to urge passengers to get off the car.

However, it is impossible to prevent users from boarding a car by carrying out only the switching off of the car lighting and the announcement making. For this reason, the interruption of a failure diagnosis has hitherto been necessitated if users ride in a car by mistake during the failure diagnosis of a door switch.

[0007] Furthermore, in a failure diagnosis of a door switch, the opening and closing of a door is performed without the registration of an elevator call (that is, without the pressing of a hall button and the like), which creates the possibility that the people of the building, condominium and the like who see the opening and closing actions of the door consider that the elevator has started moving automatically and mistake the movement for a failure.

[0008] The present invention was made to solve such problems as described above, and an object of the invention is to provide a control device of an elevator which positively prevents users from boarding a car by mistake during the failure diagnosis of a door switch and ensures that the surrounding people do not mistake the action during the failure diagnosis for a failure of the elevator.

Solution to Problem

[0009] A control device of an elevator of the invention is a control device which comprises a car door provided in a car of the elevator, a door driving device which is provided in the car and drives the car door, a hall door provided in a hall of the elevator, a connecting device which causes the hall door to open and close in synchronization with the car door when the car has stopped at the hall, a car door switch which is provided in the car to detect that the car door is in a prescribed fully closed condition and goes into action when the car door has reached a prescribed position, run control means which causes the car to stop at the hall when prescribed requirements for conducting a failure diagnosis of the car door switch are met, door opening and closing control means which causes the car door to open beyond an action position of the car door switch after the car is stopped at the hall by the run control means and causes the car door to close without causing the car door to open to a width which is not less than a prescribed specified width through which an elevator user cannot pass, and failure determination means which makes a determination as to the existence or nonexistence of a failure of the car door switch on the basis of the action condition of the car door switch occurring when the car door is opened and closed by the door opening and closing control means.

[0010] Also, a control device of an elevator of the in-

vention is a control device which comprises a car door provided in a car of the elevator, a door driving device which is provided in the car and drives the car door, a hall door provided in a hall of the elevator, a connecting device which causes the hall door to open and close in synchronization with the car door when the car has stopped at the hall, a hall door switch which is provided in the hall to detect that the hall door is in a prescribed fully closed condition and goes into action when the hall door has reached a prescribed position, run control means which causes the car to stop at the hall when prescribed requirements for conducting a failure diagnosis of the hall door switch are met, door opening and closing control means which causes the hall door to open beyond an action position of the hall door switch after the car is stopped at the hall by the run control means and causes the hall door to close without causing the hall door to open to a width which is not less than a prescribed specified width through which an elevator user cannot pass, and failure determination means which makes a determination as to the existence or nonexistence of a failure of the hall door switch on the basis of the action condition of the hall door switch occurring when the hall door is opened and closed by the door opening and closing control means.

Advantageous Effects of Invention

[0011] According to the present invention, it is possible to positively prevent users from boarding a car by mistake during the failure diagnosis of a door switch and to ensures that the surrounding people do not mistake the action during the failure diagnosis for a failure of the elevator.

Brief Description of Drawings

[0012]

Figure 1 is a side view showing the main part of an elevator which is provided with a control device in a first embodiment according to the present invention.
Figure 2 is a front view showing the main part of an elevator which is provided with the control device in the first embodiment according to the present invention.
Figure 3 is a view taken along the arrows A-A of Figure 2 in a fully closed condition of the elevator door.
Figure 4 is a block diagram showing the control device of an elevator in the first embodiment according to the present invention.
Figure 5 is a flowchart showing the actions of the control device of an elevator in the first embodiment according to the present invention.
Figure 6 is a flowchart showing other actions of the control device of an elevator in the first embodiment according to the present invention.
Figure 7 is a diagram to explain the functions of the control device of an elevator in a second embodiment according to the present invention.
Figure 8 is a flowchart showing the actions of the control device of an elevator in a third embodiment according to the present invention.
Figure 9 is a flowchart showing the actions of the control device of an elevator in a fourth embodiment according to the present invention.
Figure 10 is a flowchart showing the actions of the control device of an elevator in a fifth embodiment according to the present invention.
Figure 11 is a flowchart showing the actions of the control device of an elevator in a sixth embodiment according to the present invention.

Description of Embodiments

[0013] The present invention will be described in more detail with reference to the accompanying drawings. Incidentally, in each of the drawings, like numerals refer to like or corresponding parts and redundant descriptions of these parts are appropriately simplified or omitted.

First embodiment

[0014] Figure 1 is a side view showing the main part of an elevator which is provided with a control device in a first embodiment according to the present invention. Figure 2 is a front view showing the main part of an elevator which is provided with the control device in the first embodiment according to the present invention. Figure 3 is a view taken along the arrows A-A of Figure 2 in a fully closed condition of the elevator door.
In Figures 1 to 3, reference numeral 1 denotes an elevator hall provided on each floor of a building, reference numeral 2 denotes a shaft of the elevator, and reference numeral 3 denotes a car of the elevator which ascends and descends in the shaft 2. That is, Figure 1 corresponds to a view obtained when the car 3 at a standstill on the hall 1 of a prescribed floor as viewed from the side, and Figure 2 corresponds to a view obtained when the car 3 is viewed from the hall 1 side.

[0015] The car 3 of the elevator is provided with a door apparatus 4 in the portion opposed to the hall 1. This door apparatus 4 is composed of, for example, a car door which opens and closes an entrance formed in the car 3 (hereinafter referred to as the "car entrance"), a door driving device which drives the car door, and a driving mechanism which converts the driving force of the door driving device into the opening and closing actions of the car door.
A concrete configuration of the door apparatus 4 is described below.

[0016] Reference numeral 5 denotes a door panel constituting the main part of the above-described car door, reference numeral 6 denotes a door hanger provided upward from an upper end portion of the door panel

5, reference numeral 7 denotes a roller freely rotatably provided on both sides of the upper part of the door hanger 6, and reference numeral 8 denotes a rail provided above the car entrance. The above-described rail 8 is provided horizontally along the opening direction of the car entrance, and is configured in such a manner that the roller 7 rolls on the upper surface thereof. That is, the door panel 5 suspended from the door hanger 6 moves horizontally in such a manner as to open and close the car entrance by the roller 7 moving on the rail 8. Also, the door panel 5 is provided with a guide shoe 9 in the lower end portion thereof, and the lower end portion of this guide shoe 9 is arranged within the groove of a sill 10, whereby the moving direction of the lower portion of the door panel 5 is guided.

[0017] Reference numeral 11 is a thin-type door motor which constitutes the main part of the door driving device, reference numeral 12 refers a motor pulley provided on the output shaft of the door motor 11, reference numeral 13 denotes a driven pulley freely rotatably provided above the car entrance, and reference numeral 14 denotes an endless drive belt wound on the motor pulley 12 and the driven pulley 13. The door motor 11 (and the motor pulley 12) are arranged above the car entrance in such a manner as to be near to one side of the car entrance. The driven pulley 13 is arranged at the same height as the motor pulley 12 and is provided on the other side of the car entrance.

[0018] When the motor pulley 12 rotates by the action of the door motor 11, the torque of the door motor 11 is transmitted to the drive belt 14 via the motor pulley 12, and the drive belt 14 moves in a direction suited to the drive direction of the door motor 11 (the rotation direction of the output shaft). The door panel 5 is connected to the drive belt 14 by an arm 15 provided on the door hanger 6 and performs opening and closing actions (horizontal movements) in synchronization with the movement of the drive belt 14.

[0019] In Figure 2, a center-opening-type door apparatus 4 provided with two car doors is shown as an example. In this case, an arm 15 provided on one door hanger 6 is connected to a portion arranged on the upper side of the drive belt 14, and an arm 15 provided on the other hanger 6 is connected to a portion arranged on the lower side of the drive belt 14.

[0020] Reference numeral 16 denotes a cam provided in a prescribed position of the upper end portion of the door hanger 6, and reference numeral 17 denotes a door switch (a car door switch) which is brought into action (ON) by pushing a detecting element into the cam 16. The door switch 17 is provided in the car 3 in order to detect that the car door is in a prescribed fully closed condition. This door switch 17 is such that the mounting position thereof, along with the mounting position of the cam 16, is set in such a manner that the door switch 17 goes into action (from ON to OFF or from OFF to ON) when the door panel 5 has reached a prescribed position which is very close to the stop position in a fully closed condition.

[0021] When the car door is in a fully closed condition, the above-described door switch 17 is in an ON condition. When a door opening action is performed from this condition, immediately after the start of the door opening action the door switch 17 reaches the action position thereof (a position spaced from the cam 16), and the condition of the door switch 17 changes from ON to OFF. When the car door is closed from the full open state, immediately before the car door is fully closed and stops, the door switch 17 reaches the action position (an engaged position with the earn 16), and the condition of the door switch 17 changes from OFF to ON.

[0022] The control of the door apparatus 4 having the above-described configuration is performed by a door controller 18 provided in a ceiling portion or the like of the car 3. This door controller 18 controls the door motor 11 on the basis of an action command from a control panel 19 which performs the operation control of the whole elevator. Upon input of a contact signal from the door switch 17, the door controller 18 transmits the information to the control panel 19. That is, in a normal operation, on the basis of the information from the door controller 18 (the action condition of the door switch 17) the control panel 19 makes a determination as to whether or not the car door is in a prescribed fully closed condition.

[0023] On the other hand, the door apparatus 20 provided in each hall 1 of the elevator is composed of, for example, a hall door which opens and closes an entrance formed in the hall 1 (hereinafter referred to the "hall entrance") and an action mechanism for causing the hall door to perform opening and closing actions.

[0024] Reference numeral 21 denotes a door panel constituting the main part of the above-described hall door, reference numeral 22 denotes a door hanger provided upward from an upper end portion of the door panel 21, reference numeral 23 denotes a roller freely rotatably provided on both sides of the upper portion of the door hanger 22, and reference numeral 24 denotes a rail provided above the hall entrance. The door panel 21 suspended from the door hanger 22 moves horizontally in such a manner as to open and close the hall entrance by the roller 23 rolling on the upper surface of the rail 24. Also, the door panel 21 is provided, in the lower end portion thereof, with a guide shoe 25, and the lower end portion of this guide shoe 25 is arranged within the groove of a sill 26, whereby the moving direction of the lower portion of the door panel 21 is guided.

[0025] Reference numeral 27 denotes a door switch (a hall door switch) provided in the hall 1 to detect that the hall door is in a prescribed fully closed condition. The door hanger 22 is provided with a cam (not shown) in a prescribed position of the upper end portion thereof, and the door switch 27 is configured to be brought into action (ON) by pushing a detecting element into this cam. That is, the door switch 27 is such that the mounting position thereof, along with the mounting position of the above-described cam, is set in such a manner that the door

switch 27 goes into action (from ON to OFF or from OFF to ON) when the door panel 21 has reached a prescribed position which is very close to the stop position in a fully closed condition.

[0026] When the hall door is in a fully closed condition, the door switch 27 is in an ON condition. When a door opening action is performed from this condition, immediately after the start of the door opening action the door switch 27 reaches the action position thereof (a position spaced from the above-described cam), and the condition of the door switch 27 changes from ON to OFF. When the hall door is closed from the fully open condition, immediately before the hall door is fully closed and stops, the door switch 27 reaches the above-described action position (the position where the door switch 27 engages with the above-described cam), and the condition of the door switch 27 changes from OFF to ON. Incidentally, a contact signal from the door switch 27 is inputted directly to the control panel 19 or into the control panel 19 via other equipment. That is, in a normal operation, on the basis of the inputted contact signal (the action condition of the door switch 27) the control panel 19 makes a determination as to whether or not the hall door is in a prescribed fully closed condition.

[0027] Reference numeral 28 denotes a connecting device which causes the hall door of the hall 1 to perform opening and closing actions in synchronization with the car door when the car 3 has stopped at the hall 1. This connecting device 28 is formed from a pair of plates 29 provided in the car door and a roller 30 provided on the hall door.

[0028] The above-described roller 30 is freely rotatably provided on the side surface of the door panel 21 opposed to the shaft 2 (hereinafter also referred to as the "back surface of the door panel 21") and is arranged in such a manner that part thereof protrudes to the inner side of the shaft 2 more than the sill 26. The roller 30 is arranged horizontally so that the rotary shaft thereof becomes orthogonal to the door panel 21, and is supported by the back surface of the door panel 21

[0029] The above-described plates 29 are vertically provided on a side surface facing the hall 1 side of the door panel 5 (hereinafter referred to as the "back surface of the door panel 5") in such a manner as to be opposed to each other with a prescribed spacing therebetween, and are arranged in such a manner that part of each of the plates protrudes to the hall 1 side more than the sill 10. Also, the plates 29 are provided on the back surface of the door panel 5 in such a manner as not to come into contact with the roller 30 of each hall 1 during the ascent and descent of the car 3 and in such a manner that when the car 3 stops at the hall 1, the forward end portion of the roller 30 becomes arranged therebetween. That is, during the ascent and descent of the car 3 and when the door is fully closed after the car 3 stops at the hall 1, a slight clearance is formed as viewed from the plane between the plates 29 and the roller 30 (and the door panel 5)(see Figure 3). During the opening and closing of the elevator door (the car door and the hall door), the plates 29 come into contact with the roller 30, whereby the driving force of the door motor 11 is transmitted to the hall door via the car door and the connecting device 28, and the hall door opens and closes in synchronization with the movement of the car door,

[0030] Next, a concrete description will be given of the function of automatically making failure diagnoses of the door switches 17 and 27 (self-diagnosis function). Figure 4 is a block diagram showing the control device of an elevator in the first embodiment according to the present invention. The self-diagnosis apparatus 31 shown in Figure 4 is provided in the control panel 19 in order to realize the above-described self-diagnosis function. This self-diagnosis apparatus 31 is provided with, for example, run control means 32 which performs the run control of the car 3, door opening and closing control means 33 which performs the opening and closing control of the elevator door by outputting an action command to the door controller 18, failure determination means 34 which makes a determination as to the existence or non-existence of a failure in the door switches 17 and 27, and notifying function control means 35 which performs the action control of prescribed notification device. Referring to Figures 5 and 6 also, concrete actions of the self-diagnosis apparatus 31 will be described below.

[0031] Figure 5 is a flowchart showing the actions of the control device of an elevator in the first embodiment according to the present invention and shows the actions of a failure diagnosis of the door switch 17 (car door switch).

As shown in Figure 5, first, the self-diagnosis apparatus 31 makes a determination as to whether or not a self-diagnosis is possible (S101). Specifically, the self-diagnosis apparatus 31 determines that a self-diagnosis is possible when prescribed start requirements for staring the failure diagnosis of the door switch 17 are met, for example, in the case where a prescribed time (period) has elapsed since the last failure diagnosis, or in the case where it is a time of night when the elevators are not used.

[0032] When it is determined in S101 that a self-diagnosis is possible, next, the self-diagnosis apparatus 31 guides elevator users (hereinafter referred to as the "passengers" also) out of the car through the use of the notifying function control means 35 (S102). Specifically, the notifying function control means 35 urges the passengers to get off the car 3 by switching off the car lighting or making audio guidance from the announcement equipment in the car 3. Incidentally, the action of S102 may be omitted if from the contents of the start requirements for starting the above-described failure diagnosis, it is apparent that there is no user in the car 3 when the start requirements are met.

[0033] After guiding the users out of the car in S102, the self-diagnosis apparatus 31 causes the run control means 32 to start a run of the car 3 and to move the car 3 to the floor (the diagnostic floor) where the failure diagnosis of the door switch 17 is to be conducted (S103).

When the car 3 has landed on the diagnostic floor, the self-diagnosis apparatus 31 outputs an action command from the door opening and closing control means 33 to the door controller 18 and carries out desired door opening and closing control.

[0034] Specifically, after the stop of the car 3 at a prescribed hall 1 through the use of the run control means 32, the door opening and closing control means 33 causes the car door to open so as to move beyond the action position of the door switch 17 in order to change the condition of the door switch 17 from ON to OFF (S104). Also, in order to prevent the users of the elevator from boarding the car 3 during the failure diagnosis of the door switch 17, the door opening and closing control means 33 limits the opening width of the elevator door to a prescribed specified width and performs control so that the elevator door opens only to such an extent that the users can neither enter nor leave the car 3.

[0035] For this reason, when the door opening action is started in S104, first, the self-diagnosis apparatus 31 makes a determination as to whether or not the elevator door has opened to the above-described specified width (S105). The self-diagnosis apparatus 31 causes the door opening action to stop at the moment the opening width of the elevator door has become the above-described specified width, and carries out a failure determination of the door switch 17 through the use of the failure determination means 34 (S106). Also, when the failure determination in S106 is finished, the self-diagnosis apparatus 31 causes the door opening and closing control means 33 to start a door closing action, and the self-diagnosis apparatus 31 finishes the self-diagnosis action by causing the elevator door to be fully closed (S 107).

[0036] According to this configuration, the elevator door is not opened to a width of not less than the above-described specified width during the self-diagnosis of the door switch 17. Incidentally, in order to realize such a self-diagnosis action, the above-described specified width is set to a width of the order of not more than 100 mm, for example.

[0037] Furthermore, on the basis of the action condition of the door switch 17 occurring when the elevator door is opened and closed by the door opening and closing control means 33, the above-described failure determination means 34 makes a determination as to the existence or nonexistence of a failure of the door switch 17. For example, the failure determination means 34 determines that a failure of the door switch 17 does not exist if the condition of the door switch 17 changes from ON to OFF while the car door opens to the above-described specified width from the fully closed condition. Also, the failure determination means 34 determines that a failure of the door switch 17 exists if the door switch 17 is in the ON condition at the moment the car door has opened to the above-described specified width.

Incidentally, the failure determination means 34 may carry out the above-described failure determination on the basis of the action condition of the door switch 17 occurring when the elevator door is closed.

[0038] On the other hand, Figure 6 is a flowchart showing other actions of the control device of an elevator in the first embodiment according to the present invention and shows the actions during a failure diagnosis of the door switch 27 (the hall door switch). The actions of S201 to S205 shown in Figure 6 are basically the same as the actions shown in S101 to S105 of Figure 5 and hence detailed descriptions thereof are omitted.

[0039] When prescribed starting requirements for starting a failure diagnosis of the door switch 27 are met, the self-diagnosis apparatus 31 causes the notifying function control means 35 to guide users out of the car and thereafter causes the car 3 to land on a diagnostic floor through the use of the run control means 32 (S201 to S203). After the stop of the car 3 at a prescribed hall 1 through the use of the run control means 32, the door opening and closing control means 33 causes the hall door to open so as to move beyond the action position of the door switch 27 in order to change the condition of the door switch 27 from ON to OFF (S204). Also, in order to prevent the users of the elevator from boarding the car 3 during the failure diagnosis of the door switch 27, the door opening and closing control means 33 limits the opening width of the elevator door to a prescribed specified width and performs control so that the elevator door opens only to such an extent that the users can neither enter nor leave the car 3.

[0040] For this reason, when the door opening action is started in S204, first, the self-diagnosis apparatus 31 makes a determination as to whether or not the elevator door has opened to the above-described specified width (S205). The self-diagnosis apparatus 31 causes the door opening action to stop at the moment the opening width of the elevator door has become the above-described specified width, and carries out a failure determination of the door switch 27 through the use of the failure determination means 34 (S206). Also, when the failure determination in S206 is finished, the self-diagnosis apparatus 31 causes the door opening and closing control means 33 to start a door closing action, and the self-diagnosis apparatus 31 finishes the self-diagnosis action by causing the elevator door to be fully closed (S207).

[0041] According to this configuration, the elevator door is not opened to a width of not less than the above-described specified width during the self-diagnosis of the door switch 27. Incidentally, in order to realize such a self-diagnosis action, the above-described specified width is set to a width of the order of not more than 100 mm, for example.

[0042] Furthermore, on the basis of the action condition of the door switch 27 occurring when the elevator door is opened and closed by the door opening and closing control means 33, the above-described failure determination means 34 makes a determination as to the existence or nonexistence of a failure of the door switch 27. For example, the failure determination means 34 determines that a failure of the door switch 27 does not exist

if the condition of the door switch 27 changes from ON to OFF while the hall door opens to the above-described specified width from the fully closed condition. Also, the failure determination means 34 determines that a failure of the door switch 27 exists if the door switch 27 is in the ON condition at the moment the hall door has opened to the above-described specified width.

Incidentally, the failure determination means 34 may carry out the above-described failure determination on the basis of the action condition of the door switch 27 occurring when the elevator door is closed.

[0043] According to the first embodiment of the present invention, it is possible to positively prevent users from boarding the car 3 by mistake during the failure diagnosis of the door switches 17 and 27. Also, because during the failure diagnosis of the door switches 17 and 27 the elevator door is opened only to the above-described specified width, it is possible to positively prevent the surrounding people from mistaking the action during the failure diagnosis for a failure of the elevator.

[0044] Although in this embodiment a failure diagnosis of each of the door switches 17 and 27 is separately described, it is needless to say that a failure diagnosis of the door switches 17 and 27 can be conducted simultaneously (by a series of self-diagnosis actions).

It is unnecessary that the self-diagnosis apparatus 31 have all of the functions thereof in the control panel 19, and part of the functions may be incorporated in other devices (for example, the door controller 18).

Second embodiment

[0045] Figure 7 is a diagram to explain the functions of the control device of an elevator in a second embodiment according to the present invention.

In a connecting device 28 shown in Figure 7, a slight clearance is formed between each plate 29 and a roller 30 when the car door and the hall door are in a fully closed condition. For this reason, when the car 3 stops at the hall 1 and a door opening action is started, for the duration during which one of the plates 29 moves in the B direction (the door opening direction) and comes into contact with the roller 30, only the car door performs a door opening action and the door opening action of the hall door is not performed.

[0046] In the case where the connecting device 28 has such a prescribed structure that causes the door opening action of the hall door from the fully closed condition to be started later than the door opening action of the car door, by appropriately setting the action position of the door switch 17 and the above-described specified width, it is possible to carry out a failure diagnosis of the door switch 17 without the opening and closing of the hall door.

[0047] That is, let C be the spacing between the plate 29 (one of the plates 29 coming into contact with the roller 30 during the door opening action) occurring when the elevator door is fully closed and the roller 30, and D be the distance from the door opening start position of the car door to the action position of the door switch 17, and in this case, the action position of the door switch 17 is set so as to satisfy the condition expression $D < C$. Also, the above-described specified width during the self-diagnosis of the door switch 17 is set so that the moving distance X of the car door in the door opening direction satisfies the condition expression $D < X < C$. Incidentally, the above-described spacing C corresponds to the distance from the door opening start position of the car door to the door opening start position of the hall door. Also, E (> C) of Figure 7 refers to the distance from the door opening start position of the car door to the action position of the door switch 27.

[0048] In an elevator having the above-described configuration, during a self-diagnosis of the door switch 17, when the car 3 stops at the hall 1 and a door opening action is started, the door switch 17 goes into action at the instant the car door has moved the distance D in the door opening direction (in the case where the door switch 17 is normal), and switching of the signal of the door switch 17 to the control panel 19 occurs. The door opening and closing control means 33 causes the door opening action to be stopped before the moving distance of the car door after the start of the door opening action reaches C, and causes a door closing action to be started.

[0049] According to this configuration, it is possible to complete the self-diagnosis of the door switch 17 without causing the hall door to perform opening and closing actions. For this reason, it is ensured that during the self-diagnosis of the door switch 17 the people in the hall 1 are not conscious of the action of the elevator and might not mistake the action of the elevator for a failure of the elevator, either.

The other respects of configuration and operation are the same as in the first embodiment

Third embodiment

[0050] Figure 8 is a flowchart showing the actions of the control device of an elevator in a third embodiment according to the present invention. In this embodiment, a description will be given of the case where the timing of failure determination of the door switch 17 by the failure determination means 34 is determined on the basis of the action condition of the door switch 27.

[0051] The actions S301 to S304 shown in Figure 8 are basically the same as the actions shown in S101 to S104 of Figure 5 and hence detailed descriptions thereof are omitted.

When a door opening action is started by the door opening and closing control means 33 after landing on a diagnostic floor (S304), the self-diagnosis apparatus 31 makes a determination as to whether or not the hall door has moved to the action position of the door switch 27 (S305). Incidentally, when the hall door has moved to the action position of the door switch 27, the condition of the door switch 27 changes from ON to OFF. For this reason, in the self-diagnosis apparatus 31, the door opening ac-

tion is caused to stop at the instant the action of the door switch 27 has been ascertained and a failure determination of the door switch 17 is carried out by the failure determination means 34 (S306). When the failure determination in S306 is finished, the self-diagnosis apparatus 31 causes the door opening and closing control means 33 to start a door closing action, and the self-diagnosis apparatus 31 finishes the self-diagnosis action by causing the elevator door to be fully closed (S307).

[0052] As described above, the timing of failure diagnosis of the door switch 17 is determined on the basis of the action of the door switch 27, whereby it is possible to clarify the above-described timing, enabling an accurate failure diagnosis of the door switch 17 to be conducted.

[0053] Incidentally, in the case where the door opening action of the hall door from the fully closed condition is started later than the door opening action of the car door, the action position of the door switch 27 is inevitably arranged to the door opening side compared to the action position of the door switch 17 if the distance from the door opening start position of the car door to the action position of the door switch 17 is on the same order as the distance from the door opening start position of the hall door to the action position of the door switch 27. For this reason, the functions in this embodiment can be especially effective means in an elevator having the above-described configuration.

The other respects of configuration and operation are the same as in the first embodiment.

Fourth embodiment

[0054] Figure 9 is a flowchart showing the actions of the control device of an elevator in a fourth embodiment according to the present invention. In this embodiment, a description will be given of the case where the timing of failure determination of the door switches 17 and 27 by the failure determination means 34 is determined on the basis of the positional information of the door. In order to obtain the positional information of the door, for example, a motor encoder (not shown) which outputs information according to the rotation of an output shaft of the door motor 11 is provided in the car 3 of the elevator. That is, the self-diagnosis apparatus 31 determines the above-described determination timing on the basis of the output information from this motor encoder.

The actions during a self-diagnosis of the door switch 17 will be described below.

[0055] The actions S401 to S404 shown in Figure 9 are basically the same as the actions shown in S101 to S104 of Figure 5 and hence detailed descriptions thereof are omitted.

When a door opening action is started by the door opening and closing control means 33 after landing on a diagnostic floor (S404), the self-diagnosis apparatus 31 computes the position of the elevator door from the output information of the above-described motor encode and makes a determination as to whether or not the elevator door has moved to a prescribed specified position (S405). The self-diagnosis apparatus 31 causes the door opening action to stop at the instant the elevator door has moved to the above-described specified position, and a failure determination of the door switch 17 is carried out by the failure determination means 34 (S406). When the failure determination in S406 is finished, the self-diagnosis apparatus 31 causes the door opening and closing control means 33 to start a door closing action, and the self-diagnosis apparatus 31 finishes the self-diagnosis action by causing the elevator door to be fully closed (S407).

[0056] As described above, the timing of failure diagnosis of the door switch 17 is determined on the basis of the positional information of the elevator door, whereby it is possible to clarify the above-described timing, enabling an accurate failure diagnosis of the door switch 17 to be conducted. Needless to say, the self-diagnosis of the door switch 27 can be carried out by actions similar to those described above.

The other respects of configuration and operation are the same as in the first embodiment.

Fifth embodiment

[0057] Figure 10 is a flowchart showing the actions of the control device of an elevator in a fifth embodiment according to the present invention. In this embodiment, a description will be given of the case where the timing of failure determination of the door switches 17 and 27 by the failure determination means 34 is determined on the basis of the time which elapses after the start of a door opening action of the car door.

The actions during a self-diagnosis of the door switch 17 will be described below.

[0058] The actions S501 to S504 shown in Figure 10 are basically the same as the actions shown in S101 to S104 of Figure 5 and hence detailed descriptions thereof are omitted.

When a door opening action is started by the door opening and closing control means 33 after landing on a diagnostic floor (S504), the self-diagnosis apparatus 31 makes a determination as to whether or not the prescribed time has elapsed since the start of door opening of the car door (S505). The self-diagnosis apparatus 31 causes the door opening action to stop at the instant the above-described prescribed time has elapsed since the start of the door opening, and carries out a failure determination of the door switch 17 by the failure determination means 34 (S506). When the failure determination in S506 is finished, the self-diagnosis apparatus 31 causes the door opening and closing control means 33 to start a door closing action, and the self-diagnosis apparatus 31 finishes the self-diagnosis action by causing the elevator door to be fully closed (S507).

[0059] As described above, the timing of failure diagnosis of the door switch 17 is determined on the basis of

the time which elapses after the start of a door opening action of the car door, whereby it is possible to clarify the above-described timing, enabling an accurate failure diagnosis of the door switch 17 to be conducted. Also, this embodiment has the advantage that the configuration can be simplified without the need of additional equipment, such as a motor encoder, in the car 3 of the elevator. Needless to say, the self-diagnosis of the door switch 27 can be carried out by actions similar to those described above.
The other respects of configuration and operation are the same as in the first embodiment.

Sixth embodiment

[0060] Figure 11 is a flowchart showing the actions of the control device of an elevator in a sixth embodiment according to the present invention.
Various kinds of notification devices (not shown), such as an indicator which indicates the position of the car 3, a hall lantern which forecasts the arrival of the car 3 and announcement equipment, are installed in the hall 1 of the elevator. When the above-described notification devices go into action during the self-diagnosis of the door switches 17 and 27, the consciousness of the users in the hall 1 turns to the elevator. For this reason, in this embodiment, during the self-diagnosis of the door switches 17 and 27 the self-diagnosis apparatus 31 performs control in such a manner as to temporarily suspend the notification function of the above-described notification devices.
The actions during a self-diagnosis of the door switch 17 will be described below.
[0061] The actions S601 and S602 shown in Figure 11 are basically the same as the actions shown in S101 and S102 of Figure 5 and hence detailed descriptions thereof are omitted.
After guiding users out of the car in S603, the self-diagnosis apparatus 31 causes the notifying function control means 35 to put out the light of the notification devices and to silence the notification devices, thereby causing the functions thereof to be suspended (S603). After the suspension of the functions of the notification devices, the self-diagnosis apparatus 31 causes the car 3 to land on a diagnostic floor, starts a door opening action, and causes the elevator door to be opened to a prescribed specified width (S604 to S606). Incidentally, the determination in S606 may be made in the same manner as S305 of Figure 8, 405 of Figure 9, or S505 of Figure 10.
[0062] The self-diagnosis apparatus 31 causes the door opening action to be stopped at the moment the elevator door has opened to the above-described specified width, and carries out a failure determination of the door switch 17 by the failure determination means 34 (S607). When the failure determination in S607 is finished, the self-diagnosis apparatus 31 causes the door opening and closing control means 33 to start a door closing action and to fully close the elevator door, and thereafter the self-diagnosis apparatus 31 finishes the self-diagnosis action (S608). After the self-diagnosis action for the door switch 17 is finished, the self-diagnosis apparatus 31 causes the notifying function control means 35 to recover the notifying function of the notification devices (S609). As a result of this, after the processing in S609, the various kinds of notification devices, such as the indicator, hall lantern and announcement equipment, function normally to suit the operation of the elevator.
[0063] According to the sixth embodiment of the present invention, there is no possibility that during a self-diagnosis of the door switch 17, various kinds of guidance might be provided by the notification devices installed in the hall 1. For this reason, the users present in the hall 1 are not conscious of the elevator actions during a self-diagnosis, and it is also possible to positively prevent the users from mistaking the elevator actions for a failure of the elevator. Incidentally, it is needless to say that a self-diagnosis of the door switch 27 can be carried out by actions similar to those described above.
The other respects of configuration and operation are the same as in the first embodiment.

Industrial Applicability

[0064] The control device of an elevator according to the present invention can be applied to an elevator in which a door switch which detects the fully closed condition of an elevator door is installed in a hall or a car.

Reference Signs List

[0065]

1	hall
2	shaft
3	car
4, 20	door apparatus
5, 21	door panel
6,22	door hanger
7, 23	roller
8,24	rail
9,25	guide shoe
10, 26	sill
11	door motor
12	motor pulley

13	driven pulley
14	drive belt
15	arm
16	cam
17, 27	door switch
18	door controller
19	control panel
28	connecting device
29	plate
30	roller
31	self-diagnosis apparatus
32	run control means
33	door opening and closing control means
34	failure determination means
35	notifying function control means

Claims

1. A control device of an elevator, comprising:

a car door provided in a car of the elevator;
a door driving device which is provided in the car and drives the car door;
a hall door provided in a hall of the elevator;
a connecting device which causes the hall door to open and close in synchronization with the car door when the car has stopped at the hall;
a car door switch which is provided in the car to detect that the car door is in a prescribed fully closed condition and goes into action when the car door has reached a prescribed position;
run control means which causes the car to stop at the hall when prescribed requirements for conducting a failure diagnosis of the car door switch are met;
door opening and closing control means which causes the car door to open beyond an action position of the car door switch after the car is stopped at the hall by the run control means and causes the car door to close without causing the car door to open to a width which is not less than a prescribed specified width through which an elevator user cannot pass; and
failure determination means which makes a determination as to the existence or nonexistence of a failure of the car door switch on the basis of the action condition of the car door switch occurring when the car door is opened and closed by the door opening and closing control means.

2. The control device of an elevator according to claim 1, wherein
the connecting device has such a prescribed structure that causes the door opening action of the hall door from the fully closed condition to be started later than the door opening action of the car door; and
the door opening and closing control means causes the car door to open and close without causing the hall door to perform opening and closing actions after the car is stopped at the hall by the run control means.

3. The control device of an elevator according to claim 1, further comprising:

a hall door switch which is provided in the hall in order to detect that the hall door is in a prescribed fully closed condition and goes into action when the hall door has reached a prescribed position,
wherein the failure determination means determines the timing of determination as to the existence or nonexistence of a failure of the car door switch on the basis of the action condition of the hall door switch.

4. A control device of an elevator, comprising:

a car door provided in a car of the elevator;
a door driving device which is provided in the car and drives the car door;
a hall door provided in a hall of the elevator;
a connecting device which causes the hall door to open and close in synchronization with the car door when the car has stopped at the hall;
a hall door switch which is provided in the hall to detect that the hall door is in a prescribed fully closed condition and goes into action when the hall door has reached a prescribed position;
run control means which causes the car to stop at the hall when prescribed requirements for conducting a failure diagnosis of the hall door switch are met;
door opening and closing control means which causes the hall door to open beyond an action position of the hall door switch after the car is stopped at the hall by the run control means and causes the hall door to close without causing the hall door to open to a width which is not less than a prescribed specified width through which an elevator user cannot pass; and
failure determination means which makes a de-

termination as to the existence or nonexistence of a failure of the hall door switch on the basis of the action condition of the hall door switch occurring when the hall door is opened and closed by the door opening and closing control means.

5. The control device of an elevator according to claim 1 or claim 4, wherein
the door driving device comprises:

a door motor for driving the car door; and
a motor encoder which outputs information suited to the rotation of an output shaft of the door motor, and

the failure determination means determines the timing of determination as to the existence or nonexistence of a failure of the car door switch or the hall door switch on the basis of output information from the motor encoder.

6. The control device of an elevator according to claim 1 or claim 4, wherein the failure determination means determines the timing of determination as to the existence or nonexistence of a failure of the car door switch or the hall door switch on the basis of the time which elapses after the start of a door opening action of the car door.

7. The control device of an elevator according to any of claims 1 to 6, further comprising:

a notification device which is provided in the hall and is formed of at least any one of an indicator, a hall lantern and announcement equipment; and
notifying function control means which puts out the light of the notification device or silences the notification device when the prescribed requirements for conducting a failure diagnosis of the car door switch or the hall door switch are met.

Fig. 1

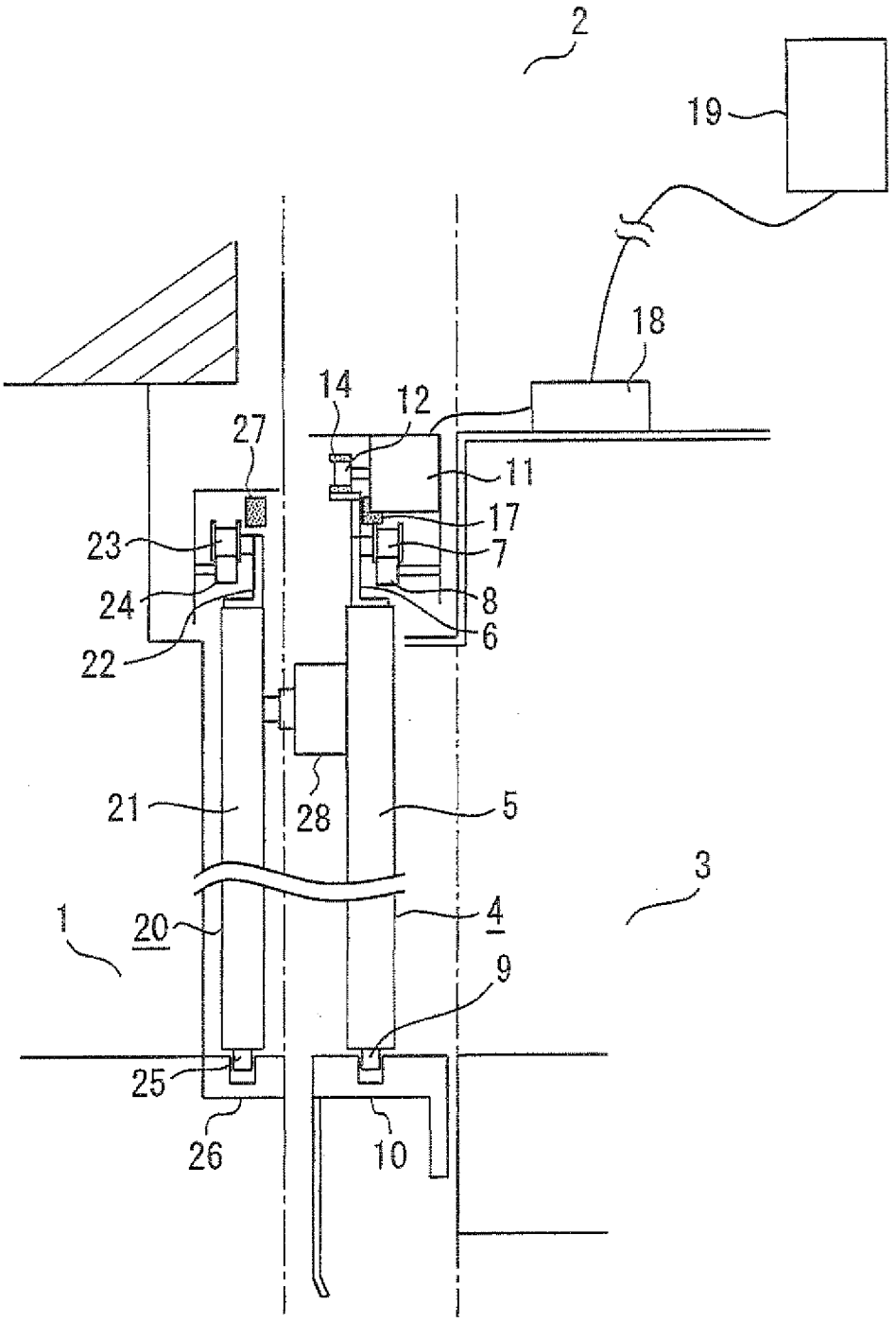
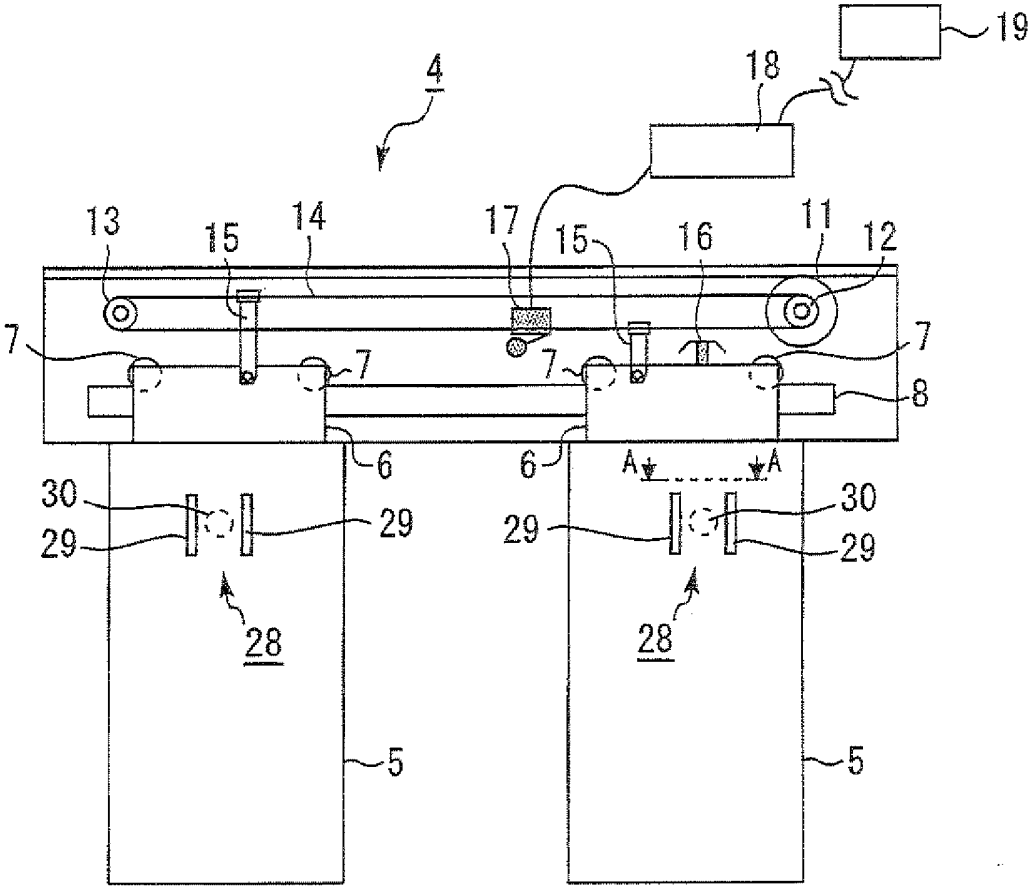


Fig. 2


19
18
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17
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12
7
7
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8
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6
A
A
30
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28
5
5

Fig. 3

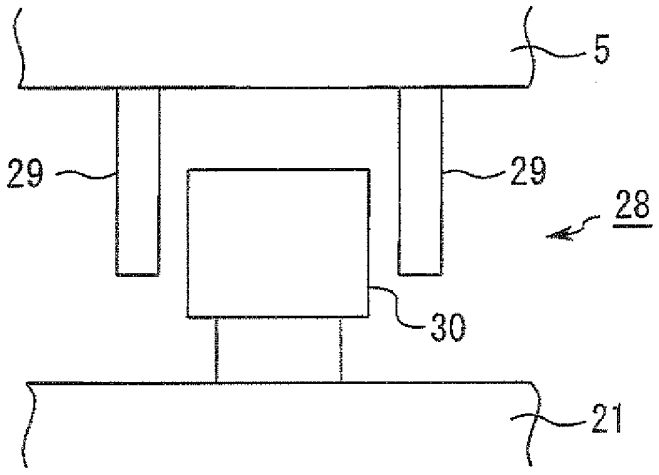

5
29
29
28
30
21

Fig. 4

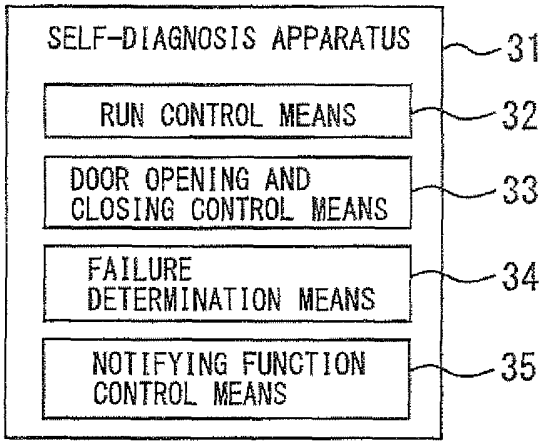

SELF-DIAGNOSIS APPARATUS
31
RUN CONTROL MEANS
32
DOOR OPENING AND CLOSING CONTROL MEANS
33
FAILURE DETERMINATION MEANS
34
NOTIFYING FUNCTION CONTROL MEANS
35

Fig. 5

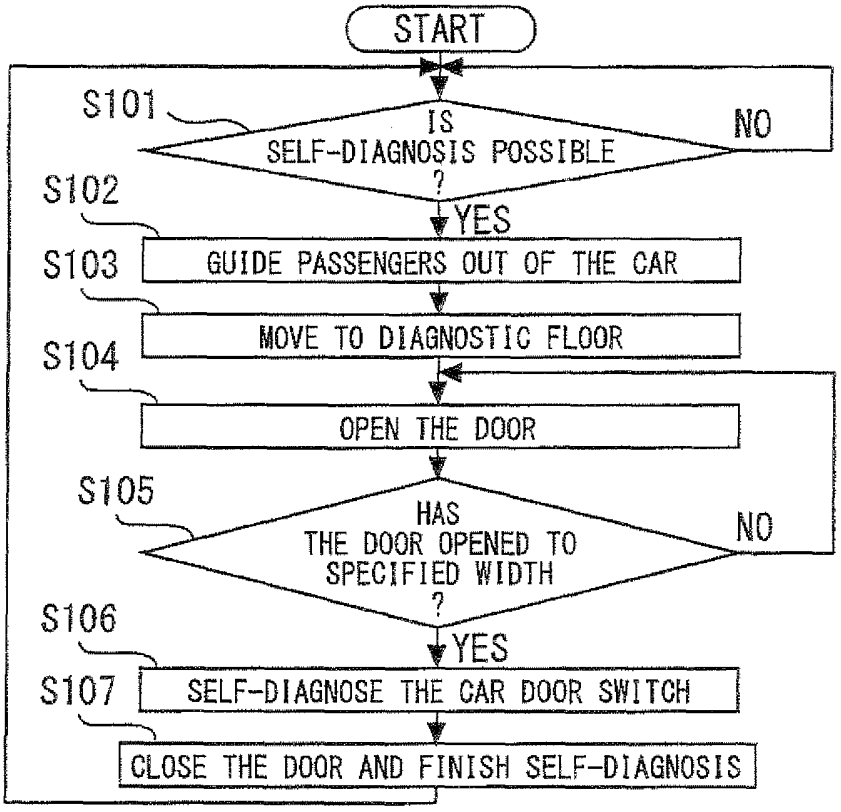

START
S101
IS SELF-DIAGNOSIS POSSIBLE ?
NO
YES
S102
S103
GUIDE PASSENGERS OUT OF THE CAR
MOVE TO DIAGNOSTIC FLOOR
S104
OPEN THE DOOR
S105
HAS THE DOOR OPENED TO SPECIFIED WIDTH ?
NO
YES
S106
S107
SELF-DIAGNOSE THE CAR DOOR SWITCH
CLOSE THE DOOR AND FINISH SELF-DIAGNOSIS

Fig. 6

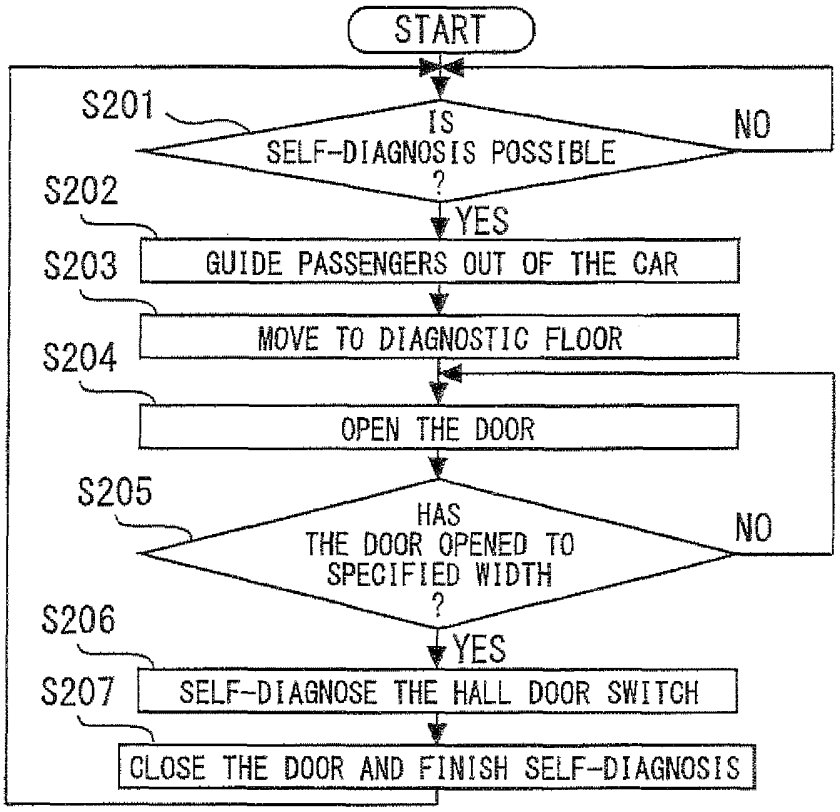

START
S201
IS SELF-DIAGNOSIS POSSIBLE ?
NO
YES
S202
S203
GUIDE PASSENGERS OUT OF THE CAR
MOVE TO DIAGNOSTIC FLOOR
S204
OPEN THE DOOR
S205
HAS THE DOOR OPENED TO SPECIFIED WIDTH ?
NO
YES
S206
S207
SELF-DIAGNOSE THE HALL DOOR SWITCH
CLOSE THE DOOR AND FINISH SELF-DIAGNOSIS

Fig. 7

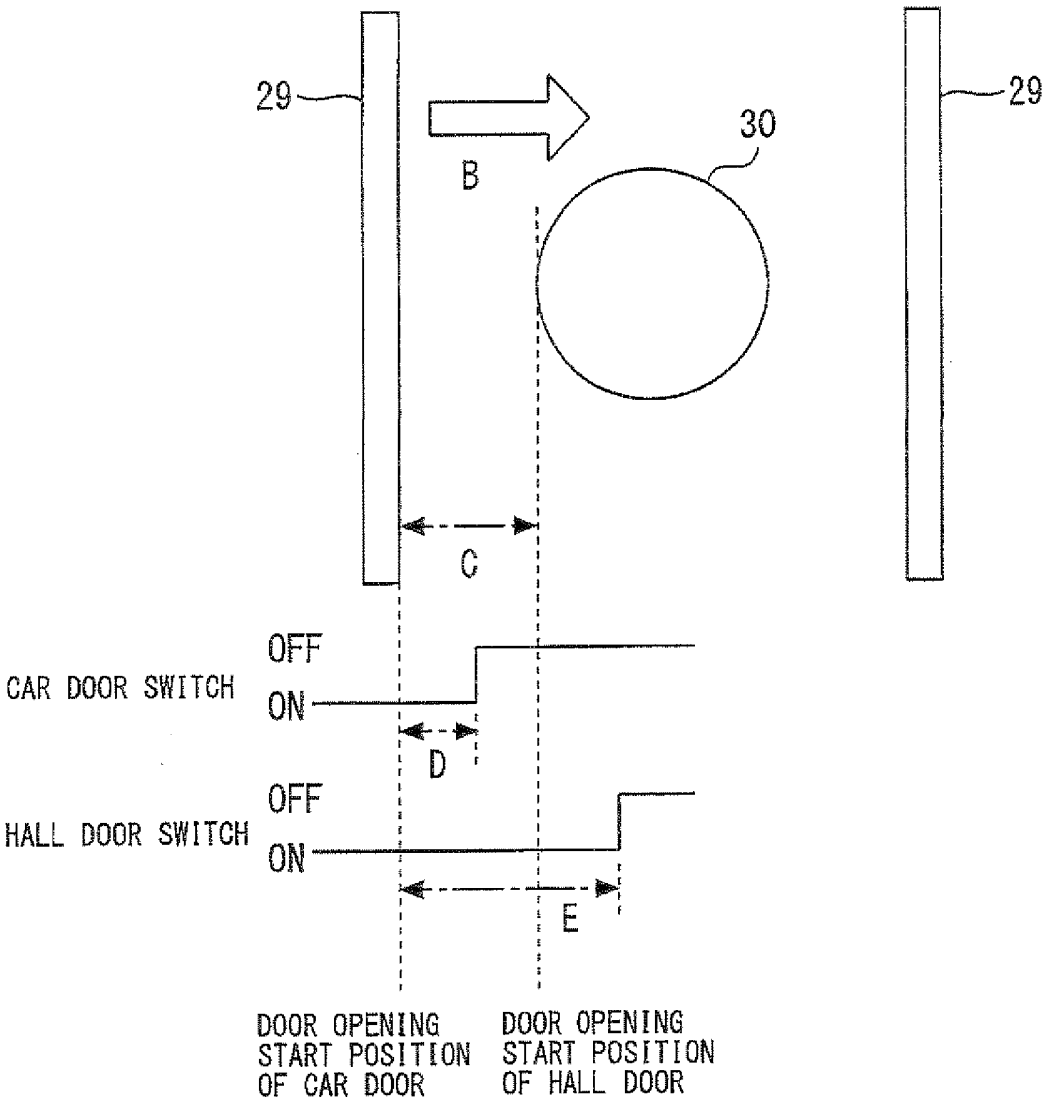

29
B
30
29
C
OFF
CAR DOOR SWITCH
ON
D
OFF
HALL DOOR SWITCH
ON
E
DOOR OPENING START POSITION OF CAR DOOR
DOOR OPENING START POSITION OF HALL DOOR

Fig. 8

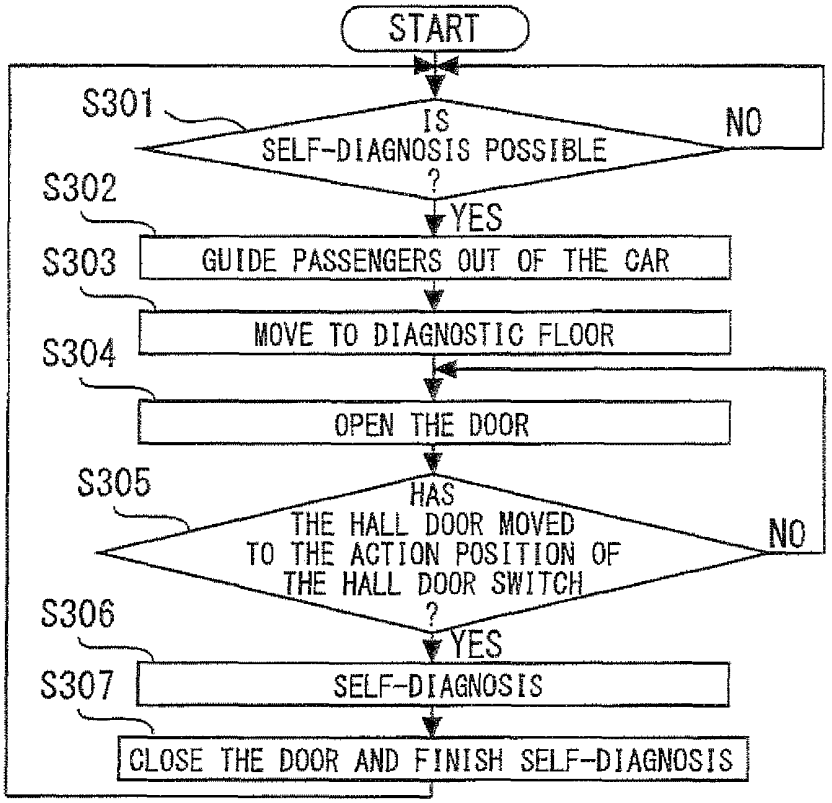

START
S301
IS SELF-DIAGNOSIS POSSIBLE ?
NO
YES
S302
S303
GUIDE PASSENGERS OUT OF THE CAR
S304
MOVE TO DIAGNOSTIC FLOOR
OPEN THE DOOR
S305
HAS THE HALL DOOR MOVED TO THE ACTION POSITION OF THE HALL DOOR SWITCH ?
NO
S306
YES
S307
SELF-DIAGNOSIS
CLOSE THE DOOR AND FINISH SELF-DIAGNOSIS

Fig. 9

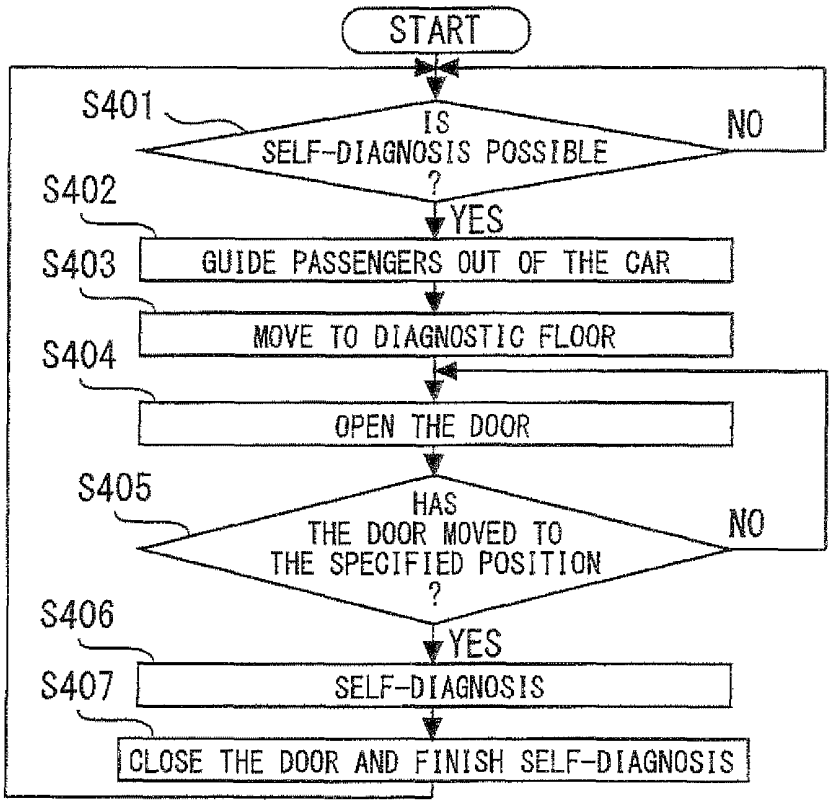

START
S401
IS SELF-DIAGNOSIS POSSIBLE ?
NO
YES
S402
S403
GUIDE PASSENGERS OUT OF THE CAR
S404
MOVE TO DIAGNOSTIC FLOOR
OPEN THE DOOR
S405
HAS THE DOOR MOVED TO THE SPECIFIED POSITION ?
NO
S406
YES
S407
SELF-DIAGNOSIS
CLOSE THE DOOR AND FINISH SELF-DIAGNOSIS

Fig. 10

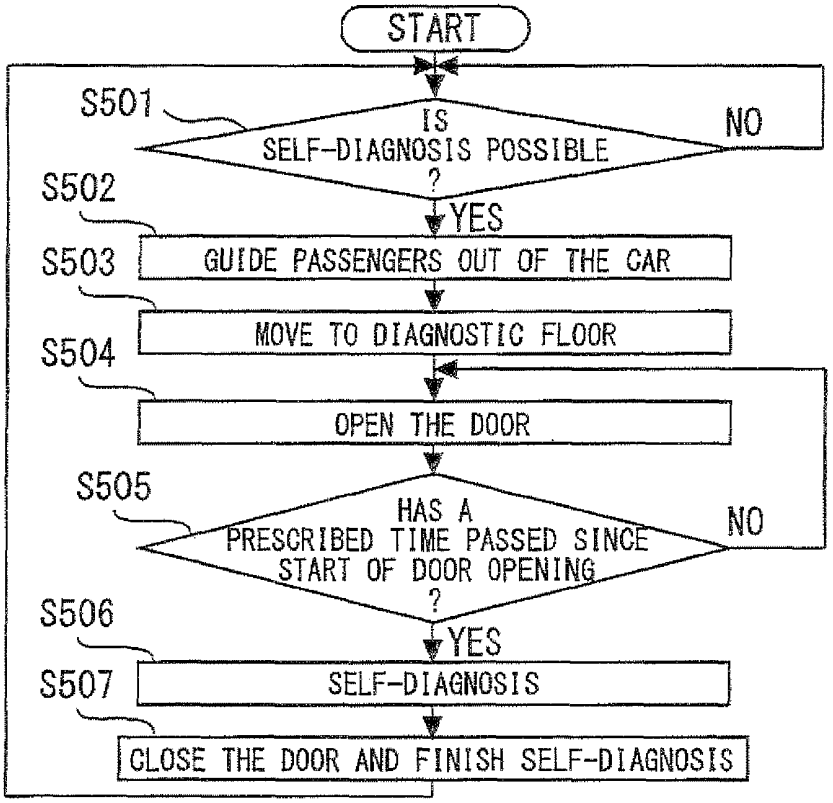
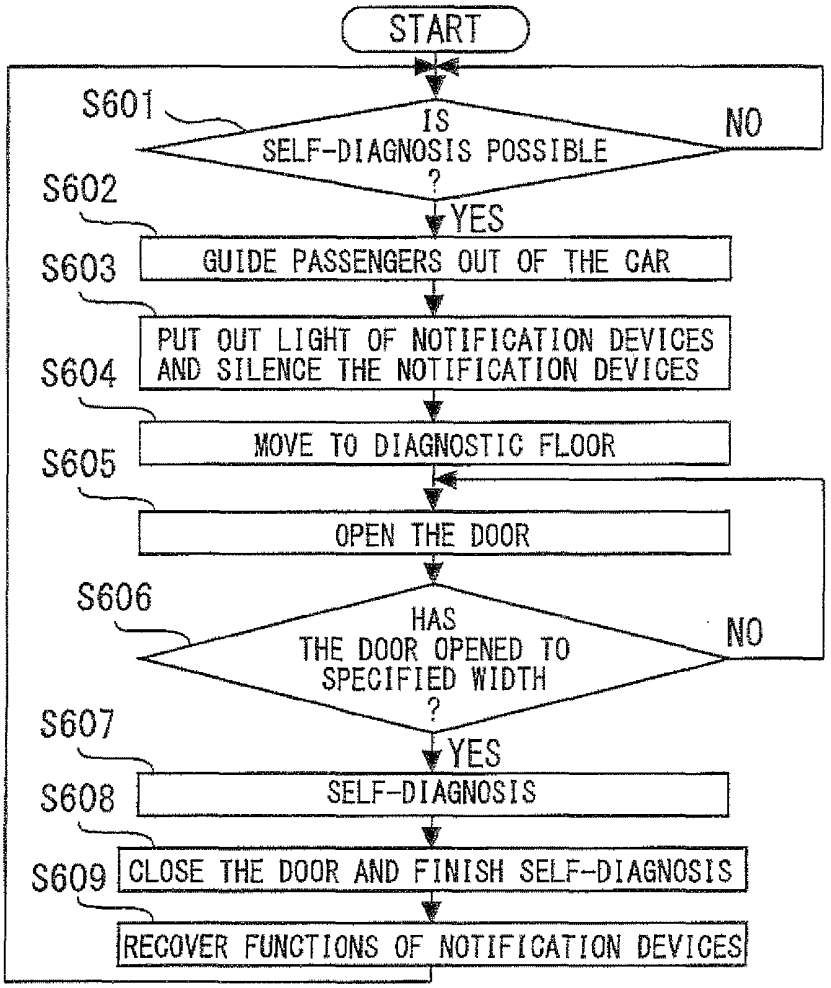

START
S501
IS SELF-DIAGNOSIS POSSIBLE ?
NO
YES
S502
S503
GUIDE PASSENGERS OUT OF THE CAR
MOVE TO DIAGNOSTIC FLOOR
S504
OPEN THE DOOR
S505
HAS A PRESCRIBED TIME PASSED SINCE START OF DOOR OPENING ?
NO
YES
S506
S507
SELF-DIAGNOSIS
CLOSE THE DOOR AND FINISH SELF-DIAGNOSIS

Fig. 11


START
S601
IS SELF-DIAGNOSIS POSSIBLE ?
NO
YES
S602
S603
GUIDE PASSENGERS OUT OF THE CAR
PUT OUT LIGHT OF NOTIFICATION DEVICES AND SILENCE THE NOTIFICATION DEVICES
S604
MOVE TO DIAGNOSTIC FLOOR
S605
OPEN THE DOOR
S606
HAS THE DOOR OPENED TO SPECIFIED WIDTH ?
NO
YES
S607
S608
SELF-DIAGNOSIS
S609
CLOSE THE DOOR AND FINISH SELF-DIAGNOSIS
RECOVER FUNCTIONS OF NOTIFICATION DEVICES

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/068058

A. CLASSIFICATION OF SUBJECT MATTER
B66B13/14(2006.01)i, *B66B5/00*(2006.01)i, *B66B13/22*(2006.01)i

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)
B66B13/14, B66B5/00, B66B13/22

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 1996-2010
Kokai Jitsuyo Shinan Koho 1971-2010 Toroku Jitsuyo Shinan Koho 1994-2010

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 2002-3116 A (Mitsubishi Electric Building Techno-Service Co., Ltd.), 09 January 2002 (09.01.2002), paragraphs [0036], [0044] (Family: none)	1-7
Y	JP 7-69570 A (Toshiba Corp.), 14 March 1995 (14.03.1995), paragraph [0024] (Family: none)	1-7
Y	JP 2003-112868 A (Hitachi, Ltd.), 18 April 2003 (18.04.2003), paragraphs [0012], [0023] (Family: none)	7

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"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
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 January, 2010 (18.01.10)	26 January, 2010 (26.01.10)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/068058

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 5-306085 A (Hitachi Building Systems & Service Engineering Ltd.), 19 November 1993 (19.11.1993), entire text; fig. 1 to 7 (Family: none)	1-7
A	JP 8-143253 A (Mitsubishi Electric Corp.), 04 June 1996 (04.06.1996), entire text; fig. 1 to 11 (Family: none)	1-7

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2006298538 A **[0005]**
- JP 2007230685 A **[0005]**