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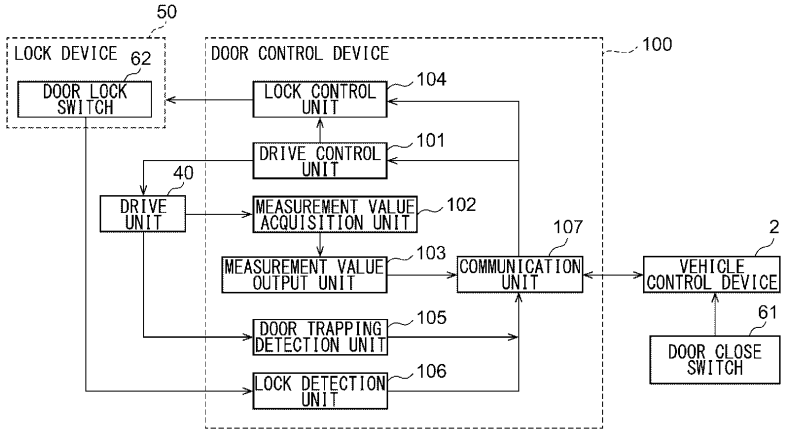
(54) SLIDING DOOR POSITION ADJUSTMENT ASSISTING DEVICE AND SLIDING DOOR POSITION ADJUSTMENT ASSISTING SYSTEM

(57) A sliding door position adjustment assisting device (100) includes: a drive control unit (101) configured to move a sliding door (10) in an opening/closing direction by controlling a drive unit (40); a measurement value acquisition unit (102) configured to acquire a measurement value related to at least one of a moving distance of the sliding door (10) and a load applied to the sliding door (10), the measurement value being measured when the sliding door (10) is driven in a direction of pressing the sliding door (10) against an opposing object under a predetermined operating condition by the drive control unit (101) with a door end rubber (11) provided at a door end of the sliding door (10) being in contact with the opposing object; and a measurement value output unit (103) configured to output the measurement value acquired by the measurement value acquisition unit (102).

FIG.3



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a sliding door position adjustment assisting device and a sliding door position adjustment assisting system.

2. Description of the Related Art

[0002] To minimize accidents such as dragging of a stroller, techniques related to detecting door trapping have gained higher attention. JP 2019-105144 A describes a door trapping detection system that detects door trapping occurring in a closing operation of a door provided to a railway vehicle or the like. The door trapping detection system in JP 2019-105144 A detects door trapping according to elastic deformation of door end rubbers each attached to the leading end in the closing direction of each of a pair of sliding doors.

PRIOR ART REFERENCE

PATENT LITERTURE

[0003] PATENT LITERTURE 1: Japanese Unexamined Patent Application Publication No. 2019-105144

SUMMARY OF THE INVENTION

[0004] The hardness of a rubber member such as a door end rubber used in a door trapping detection system is easily affected by external factors such as temperature and humidity. When a sliding door opening and closing device continues its operation with the hardness of the rubber member greatly changed by temperature and humidity, detection of door trapping may not function appropriately. In this regard, the sliding door opening and closing device is subjected to a work of adjusting the attached position of the sliding door so that the detection of door trapping functions is appropriately obtained.

[0005] Conventionally, the position adjustment work requires an operator to actually go in front of all the sliding door opening and closing devices to check whether door trapping can be appropriately detected. This means that all the sliding doors of a train need to be checked, which requires a lot of time.

[0006] In view of the above problem, an object of the present disclosure is to provide a sliding door position adjustment assisting device and a sliding door position adjustment assisting system that enable determining whether a position adjustment work is needed for a sliding door without requiring an operator to go in front of a sliding door opening and closing device.

[0007] To solve the problem described above, a sliding door position adjustment assisting device according to some aspect of the present disclosure includes: a drive control unit configured to move a sliding door in an opening/closing direction by controlling a drive unit; a measurement value acquisition unit configured to acquire a measurement value related to at least one of a moving distance of the sliding door or a load applied to the sliding door, the measurement value being measured when the sliding door is driven in a direction of pressing the sliding door against an opposing object under a predetermined operating condition by the drive control unit with a door end rubber provided at a door end of the sliding door being in contact with the opposing object; and a measurement value output unit configured to output the measurement value acquired by the measurement value acquisition unit.

[0008] A sliding door position adjustment assisting system according to another aspect of the present disclosure includes: a plurality of information output devices provided at a platform or a vehicle, and used for a plurality of sliding doors that open and close a plurality of boarding doorways to a vehicle, the information output devices being configured to execute, in response to a command signal, an operation of moving the sliding door in an opening/closing direction by controlling a drive unit, an operation of acquiring a measurement value related to at least one of a moving distance of the sliding door or a load applied to the sliding door, the measurement value being measured when the sliding door is driven in a direction of pressing the sliding door against an opposing object under a predetermined operating condition with a door end rubber provided at a door end of the sliding door being in contact with the opposing object, and an operation of outputting the measurement value that has been acquired; and a command device configured to output the command signal for causing at least one of the plurality of information output devices to execute the operation of moving, the operation of acquiring, and the operation of outputting.

[0009] Note that, any combination of the above aspects and any aspect in which the component or expression of the aspect of the present invention, such as method, device, program, temporary or non-temporary storage medium in which a program is stored, and system, is replaced with any one of those of a different aspect of the present invention are also effective as aspects of the present invention.

[0010] According to the present invention, whether position adjustment work is needed for a sliding door can be determined without requiring an operator to go in front of a sliding door opening and closing device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is a front view schematically illustrating a configuration of a sliding door opening and closing device;

Fig. 2 is a cross-sectional view taken along line A-A in Fig. 1;
Fig 3 is a block diagram of a door control device according to a first embodiment;
Fig. 4 is a view for explaining a position adjustment work for a sliding door;
Fig. 5 is a flowchart illustrating an operation of the door control device according to the first embodiment;
Fig 6 is a block diagram of a door control device according to a second embodiment;
Fig. 7 is a flowchart illustrating an operation of the door control device according to the second embodiment;
Fig 8 is a block diagram of a door control device according to a third embodiment;
Fig. 9 is a flowchart illustrating an operation of the door control device according to the third embodiment;
Fig. 10 is a block diagram of a door control device according to a fourth embodiment; and
Fig. 11 is a block diagram of a door control device according to a fifth embodiment.

DETAILED DESCRIPTION OF THE INVENTION

[0012] In the following embodiments and exemplary modifications, the same or equivalent components or members are denoted by the same reference numerals, and redundant description will be omitted as appropriate. The dimensions of the members in each drawing are appropriately enlarged or reduced in order to facilitate understanding. In each drawing, some of members that are not important for describing the embodiment are omitted.

First Embodiment

[0013] Figs. 1 and 2 are referred. A railway vehicle is provided with a sliding door opening and closing device 1 for opening and closing a boarding doorway of the railway vehicle. The sliding door opening and closing device 1 includes a pair of left and right sliding doors 10 (10A and 10B), a rail moving body 20, a sliding door rail 30, a drive unit 40, a lock device 50, a door close switch 61, a door lock switch 62, and a door control device 100. The door control device 100 can communicate with, for example, a vehicle control device 2 provided in a driver's room of the railway vehicle. The door control device 100 of the present embodiment is an example of a sliding door position adjustment assisting device and an information output device.

[0014] The vehicle control device 2 is a higher-level device of the door control device 100, and is configured to be able to transmit an open/close command signal for controlling opening and closing of the sliding door 10 to the door control device 100. The vehicle control device 2 of the present embodiment is configured to be able to transmit a test command signal, described later, to the door control device 100. The vehicle control device 2 of the present embodiment is an example of a command device. The vehicle control device 2 and the door control device 100 of the present embodiment exemplify a sliding door position adjustment assisting system.

[0015] A pair of sliding doors 10A and 10B move in opposite directions to open and close a boarding doorway. The sliding doors 10A and 10B of the present embodiment constitute a double sliding door. The sliding doors 10A and 10B are suspended from the rail moving body 20. Each of the sliding doors 10A and 10B is provided with a door end rubber 11 (11A and 11B). When the sliding door 10 is at a fully closed position, the door end rubber 11 abuts tightly with the opposing door end rubber 11 to close a gap between the door ends of the sliding doors 10A and 10B. The sliding door 10 at a fully open position is accommodated in a door pocket 12. An anti-vibration rubber 13 is provided in a gap between the sliding door 10 and the door pocket 12. The anti-vibration rubber 13 supports the sliding door 10 so as to suppress vibration of the sliding door 10.

[0016] The rail moving body 20 includes a door hanger 21, and door rollers 22 made of resin. The door rollers 22 are provided inside the door hanger 21. The door hanger 21 is attached to the sliding door 10 so as to suspend the sliding door 10 therefrom. The door hanger 21 is attached to a sliding door drive mechanism 42, described later, of the drive unit 40, and is configured to be movable, by the drive of the drive unit 40, in the opening/closing direction along the sliding door rail 30.

[0017] The sliding door rail 30 is provided to the vehicle body, above the sliding door 10. The door hanger 21 is attached to the sliding door rail 30 via the door rollers 22.

[0018] The drive unit 40 includes an electric motor 41 disposed at an upper rim of a doorway of the railway vehicle, and the sliding door drive mechanism 42 including a rack, a pinion, and the like. The motor 41 is connected to the sliding door 10 via the sliding door drive mechanism 42 and the rail moving body 20. When an output shaft of the motor 41 rotates in one direction, the sliding door 10 moves in the opening direction, and when the output shaft of the motor 41 rotates in the other direction, the sliding door 10 moves in the closing direction.

[0019] The lock device 50 has a function of locking a pair of sliding doors 10 in the fully closed state not to open. The lock device 50 is provided to each pair of sliding doors 10. The lock device 50 includes a lock pin (not illustrated) that can project toward and retract away from the sliding door 10. By the lock pin of the lock device 50 moved to the locking position and inserted in a hole (not illustrated) of the sliding door 10 in the fully closed state, the sliding door 10 is locked in an unmovable state. Note that, the present invention is not limited to this configuration. The lock device 50 may lock the sliding door 10 by various known methods not to open.

[0020] The door close switch 61 detects full closing of the sliding door 10. The door close switch 61 includes a full-close detection limit switch (not illustrated) that is

pressed by the sliding door 10 that has moved to the fully closed position. By pressing the full-close detection limit switch, full closing of the sliding door 10 is detected.

[0021] The door close switch 61 of the present embodiment detects that the sliding door 10 has moved from the fully closed position by a predetermined distance in the direction of pressing the sliding door 10 against the door end rubber 11 of the opposing sliding door 10 (hereinafter, this position after the movement is referred to as "test position".). The door close switch 61 further includes a test limit switch that is pressed by the sliding door 10 that has moved to the test position. By pressing the test limit switch, that the sliding door 10 has moved to the test position is detected.

[0022] The door lock switch 62 is a switch that detects locking of the sliding door 10 by the lock device 50. The door lock switch 62 includes a lock detection limit switch that is pressed by the lock pin of the lock device 50 when the lock pin has moved to the locking position. When the lock detection limit switch is pressed, locking of the sliding door 10 is detected. The door lock switch 62 is provided inside the lock device 50, for example.

[0023] The door control device 100 will be described with reference to Fig. 3. Each functional block illustrated in the drawing is realized, in terms of hardware, by a computer having a calculation function, a control function, a storage function, an input function, and an output function, an electronic element, a mechanical component, and the like, and in terms of software, by a computer program or the like. The illustrated functional blocks are realized by cooperation of those listed above. It is to be understood by those skilled in the art that these functional blocks can be realized in various forms by combining hardware and software.

[0024] The door control device 100 includes a drive control unit 101, a measurement value acquisition unit 102, a measurement value output unit 103, a lock control unit 104, a door trapping detection unit 105, a lock detection unit 106, and a communication unit 107. The door control device 100 of the present embodiment is provided in the vicinity of the sliding door 10 for all the boarding doorways of a train (see Fig. 1).

[0025] The drive control unit 101 moves the sliding door 10 in the opening/closing direction by controlling the drive unit 40. The drive control unit 101 of the present embodiment is configured to drive the sliding door 10 further in the closing direction from the fully closed position of the sliding door 10 in response to a test command signal, described later, supplied via the communication unit 107. The drive control unit 101 of the present embodiment controls the driving of the sliding door 10 in the opening/closing direction by controlling the drive current flowing through the motor 41 included in the drive unit 40.

[0026] The measurement value acquisition unit 102 acquires a predetermined measurement value, described later. The measurement value acquisition unit 102 of the present embodiment acquires a drive current as a measurement value related to a load.

[0027] The measurement value output unit 103 outputs the measurement value acquired by the measurement value acquisition unit 102. The measurement value output unit 103 of the present embodiment outputs the measurement value to an external device such as the vehicle control device 2 via the communication unit 107, and displays the output result on a display screen.

[0028] The lock control unit 104 controls the lock device 50 to lock the sliding door 10 when the sliding door 10 is fully closed. For example, the lock control unit 104 locks the sliding door 10 on receiving, from the vehicle control device 2 via the communication unit 107, a lock command signal for locking the sliding door 10. The lock command signal is output by the vehicle control device 2, for example, when the vehicle control device 2 receives a detection signal indicating the sliding door 10 has been fully closed from all the door close switches 61 provided at the boarding doorways. The lock control unit 104 controls the lock device 50 to unlock the sliding door 10. Note that, the drive control unit 101 may send a command for driving the lock device 50 to the lock control unit 104 to control the lock device 50.

[0029] The door trapping detection unit 105 detects door trapping when a foreign object (including a person, a part of a person, and an object.) is sandwiched by the door end of the sliding door 10 and the sliding door 10 cannot be locked (a door trapping state). For example, the door trapping detection unit 105 detects the door trapping state when the rotation of the motor 41 stops during the closing drive of the sliding door 10 when the sliding door 10 is not yet locked by the lock device 50. The thickness of an object by which door trapping is detected (hereinafter, referred to as a door trapping detection thickness) can be adjusted by adjusting the attachment position of the sliding door 10. On detecting door trapping, the door trapping detection unit 105 transmits a door trapping detection signal to the vehicle control device 2 via the communication unit 107 to report the door trapping.

[0030] The lock detection unit 106 detects locking of the sliding door 10 by the lock device 50. For example, the lock detection unit 106 detects locking of the sliding door 10 in response to the door lock switch 62 detecting the locking of the sliding door 10. The thickness of an object by which locking is detected (hereinafter, referred to as a lock detection thickness) can be adjusted by adjusting the attachment position of the sliding door 10. On detecting locking, the lock detection unit 106 transmits a lock detection signal to the vehicle control device 2 via the communication unit 107 to report the locking.

[0031] The communication unit 107 communicates with an external device. The communication unit 107 of the present embodiment is configured to be able to communicate with the vehicle control device 2.

[0032] Hereinafter, the position adjustment work of the sliding door 10 will be described. The softness (or hardness) of the door end rubber 11, the anti-vibration rubber 13, the resin door roller 22, and the like changes depending on external factors such as ambient temperature and

humidity. For example, when the door end rubber 11 softens due to the rise in the outside air temperature, the door end rubbers 11A and 11B, when sandwiching a foreign object during the closing operation, are easily deformed, which allows the sliding doors 10A and 10B to approach each other easily. Softening of the anti-vibration rubber 13, the door roller 22, and the like reduces the resistance against the opening or closing sliding door 10, which allows the sliding doors 10A and 10B to approach each other easily. In this case, even when it is originally set to detect door trapping when a foreign object having a thickness of D1 mm is trapped, for example, an event of actually trapping a foreign matter having a thickness of D1 mm may not be detected, and locking may be performed. As described above, difficulty in detecting door trapping adversely affects the safety of passengers. Furthermore, for example, when the door end rubber 11 hardens due to the decrease in the outside air temperature, the door end rubbers 11A and 11B, when sandwiching a foreign object during the closing operation, do not easily deform, which makes it difficult for the sliding doors 10A and 10B to approach each other. Hardening of the anti-vibration rubber 13, the door roller 22, and the like increases the resistance against opening and closing of the sliding door 10, which makes it difficult for the sliding doors 10 to approach each other. In this case, even when it is originally set that locking is performed with a foreign object having a thickness of D2 mm trapped, for example, such a case may happen that locking is not performed although a foreign matter having a thickness of D2 mm is actually trapped, and door trapping is detected. Although a train can usually depart with just a thin object trapped in the sliding doors 10, departure is suspended by repeated detection of door trapping, and this adversely affects on-time performance. As described above, locking and detecting of door trapping may not function appropriately depending on ambient temperature, humidity, or the like. To address this problem, a work of adjusting the attachment position of the sliding door 10 (position adjustment work) is performed at a safety inspection or in each season, for example.

[0033] In the position adjustment work, the sliding door opening and closing device 1 is attached to the railway vehicle first. Then, a lock adjustment work of adjusting the lock detection thickness and a door trapping adjustment work of adjusting the door trapping detection thickness are performed.

[0034] The lock adjustment work will be described. As illustrated in Fig. 4, in the lock adjustment work, the sliding doors 10 are driven to be closed with a door trapping adjustment jig 5 disposed on the opening/closing path of the sliding doors 10, and whether locking is detected when the door end rubbers 11A and 11B sandwich the door trapping adjustment jig 5 having a predetermined thickness is determined. In the lock adjustment work, the door trapping adjustment jig 5 having a thickness for position adjustment for locking is used. If locking is detected, it is regarded that locking is done appropriately, and the lock adjustment work is done. Meanwhile, if locking is not detected (or if door trapping is detected), the attachment position of the sliding doors 10 is adjusted in the locked state, for example. By this work, the relative position between a lock pin (not illustrated) of the lock device 50 and a hole (not illustrated) of the sliding door 10 in a state of sandwiching the door trapping adjustment jig 5 by the door end rubbers 11 is adjusted. By this adjustment, the lock pin can be inserted in the hole of the sliding door 10 to lock the sliding door 10 with the door trapping adjustment jig 5 sandwiched by the door end rubbers 11. Then, whether locking is detected is determined again using the door trapping adjustment jig 5. The position adjustment work of the sliding doors 10 is repeated until locking is detected.

[0035] The door trapping adjustment work will be described. In the door trapping adjustment work, a work basically similar to the lock adjustment work is performed except that a door trapping adjustment jig 5 having a thickness different from that for the lock adjustment work is used. In the door trapping adjustment work, the door trapping adjustment jig 5 having a thickness for door trapping adjustment is used. If door trapping is detected when the door end rubbers 11A and 11B sandwich the door trapping adjustment jig 5 (or if locking is not detected), it is regarded that detection of door trapping functions appropriately, and the door trapping adjustment work is done. Meanwhile, if door trapping is not detected (or if locking is detected), the position adjustment work for the sliding doors 10 is repeated until door trapping is detected.

[0036] As described above, the position adjustment work is performed so as both locking and door trapping are appropriately detected.

[0037] However, in a conventional position adjustment work, an operator needs to go in front of all the sliding door opening and closing devices 1 to sandwich the door trapping adjustment jig 5 by the door end rubbers 11 to determine whether position adjustment of the sliding doors 10 is necessary. This means that all the sliding doors 10 of a train need to be checked, which requires a lot of time.

[0038] The present inventors have found that by using the following method, whether position adjustment of the sliding door 10 is necessary can be determined without an operator going in front of the sliding door opening and closing device 1. This method will be described in detail below.

[0039] An operation of the door control device 100 of the present embodiment will be described with reference to Fig. 5. Fig. 5 is a flowchart illustrating an operation S10 for assisting determination on whether position adjustment of the sliding door 10 is necessary.

[0040] In S11, the drive control unit 101 receives a test command signal from the vehicle control device 2 via the communication unit 107. This test command signal is transmitted from the vehicle control device 2 to the door control device 100 provided at at least one boarding door-

way of a train in response to an input given by a user to the vehicle control device 2, for example, at the time of safety inspection of the sliding door opening and closing device 1 by a railway company.

[0041] In S12, in response to the test command signal, the drive control unit 101 moves the sliding doors 10A and 10B to the fully closed position so as to bring the door end rubber 11 into contact with the opposing door end rubber 11. The drive control unit 101 further moves the sliding door 10 from the fully closed position by a predetermined distance in the direction of pressing the sliding door against the opposing door end rubber 11, thereby moving the sliding door 10 to a test position. In the present embodiment, when the test limit switch of the door close switch 61 is pressed to detect that the sliding door 10 is located at the test position, the drive control unit 101 stops the sliding door 10 not to move in the pressing direction. Moving the sliding door 10 to the test position to largely deform the door end rubbers 11A and 11B in this manner simulates a state of the door end rubbers 11A and 11B sandwiching the door trapping adjustment jig 5.

[0042] In S13, the measurement value acquisition unit 102 acquires a measurement value related to the load in the opening direction applied to the sliding door 10 when the sliding door 10 is moved to the test position in S12. As described above, the hardness of the door end rubber 11, the anti-vibration rubber 13, the resin door roller 22, and the like changes depending on external factors such as ambient temperature and humidity. The load in the opening direction applied to the sliding door 10 at the test position varies depending on the hardness of the door end rubber 11, the anti-vibration rubber 13, the door roller 22, and the like. This is because the hardness of the door end rubber 11 affects the magnitude of the repulsive force produced by the pressed and deformed door end rubber 11, and the hardness of the anti-vibration rubber 13, the door roller 22, and the like affects the magnitude of the resistance against the opening or closing sliding door 10. Thus, by estimating the load in the opening direction, how easily can the sliding door 10 move in the closing direction under the assumption that the door end rubbers 11A and 11B are sandwiching the door trapping adjustment jig 5 can be grasped. As a result, how easily door trapping and locking are detected can be grasped.

[0043] In the present embodiment, a drive current of the motor 41 included in the drive unit 40 is acquired as the measurement value related to the load. When the load applied to the sliding door 10 increases, the load of the motor 41 used in the drive unit 40 increases, and eventually, the duty ratio of the drive voltage of the motor 41 increases, resulting in the increase in the drive current of the motor 41. Accordingly, the load applied to the sliding door 10 can be estimated based on the drive current of the motor 41. The measurement value acquisition unit 102 supplies the acquired measurement value related to the load to the measurement value output unit 103.

[0044] In S14, the measurement value output unit 103 outputs the supplied measurement value to the vehicle control device 2. As a result, the measurement value is displayed on a display unit (not illustrated) of the vehicle control device 2.

[0045] Then, the operation S10 ends.

[0046] As described above, the sliding door opening and closing device 1 of the present embodiment outputs the measurement value related to the load applied to the sliding door 10 when the sliding door 10 is driven in the direction of pressing the sliding door 10 against an opposing object under a predetermined operating condition with the door end rubber 11 in contact with the opposing object (the opposing door end rubber 11 in the present embodiment). The predetermined operating condition of the present embodiment is moving the sliding door 10 by a predetermined distance. According to the present embodiment, since an operator can grasp how easily the sliding door 10 can move in the closing direction under the assumption that the door end rubbers 11A and 11B are sandwiching the door trapping adjustment jig 5, the measurement value can be used as a guide for determining whether position adjustment of the sliding door 10 is necessary. Thus, whether position adjustment of the sliding door 10 is necessary can be determined without requiring the operator to go in front of the sliding door opening and closing device 1 to perform the work of sandwiching the door trapping adjustment jig 5 between the door end rubbers 11A and 11B. Accordingly, it is not necessary to check all the sliding doors 10 of a train, so that the man-hour for the position adjustment work can be reduced.

[0047] In the present embodiment, for a case where the sliding door 10 is one of double sliding doors (for example, the sliding door 10A), the opposing object is the door end rubber (for example, the door end rubber 11B) of the other door (for example, the sliding door 10B). According to the present configuration, whether position adjustment of the sliding door 10 is necessary can be determined with an existing configuration without providing an additional configuration for largely deforming the door end rubber 11. The opposing object may be a door receiving part.

[0048] In the present embodiment, the drive control unit 101 controls the drive current flowing through the motor 41 included in the drive unit 40, and the measurement value acquisition unit 102 acquires the drive current as the measurement value related to the load. According to the present configuration, whether position adjustment of the sliding door 10 is necessary can be determined with an existing configuration without providing an additional sensor for measuring the measurement value related to the load.

[0049] The sliding door position adjustment assisting system of the present embodiment includes a plurality of door control devices 100, and the vehicle control device 2 that outputs a test command signal to at least one of a plurality of door control devices 100. According to the present configuration, test command signals can be out-

put to the door control devices 100 at a time, so that whether the position adjustment is necessary for each of a plurality of the sliding doors 10 can be determined at a time. Thus, the work load for determining whether the position adjustment of the sliding doors 10 is necessary can be reduced.

[0050] Exemplary modifications of the present embodiment will be described below.

[0051] In the present embodiment, the sliding door 10 provided in the railway vehicle is taken as an example, but the sliding door 10 may be provided on a platform.

[0052] In the present embodiment, the double sliding door 10 is taken as an example, but the present invention is not limited to this configuration. The door may be a single sliding door. For a single sliding door, the opposing object may be, for example, a door receiving part.

[0053] In the present embodiment, the measurement value related to the load applied to the sliding door 10 is acquired when the sliding door 10 is moved by the predetermined distance with the door end rubber 11 in contact with the opposing object. However, the present invention is not limited to this configuration. For example, a measurement value related to the moving distance of the sliding door 10 that is driven in the direction of pressing the sliding door 10 against the opposing object so as to apply a predetermined load to the sliding door 10 with the door end rubber 11 in contact with the opposing object may be acquired. In this case, for example, the measurement value related to the moving distance of the sliding door 10 may be acquired using a stroke sensor that detects the stroke of the sliding door 10. For example, a plurality of limit switches that is pressed by the sliding door 10 moving to the closing direction side from the fully closed position may be provided at a plurality of positions in the closing direction side, and measurement values each related to the moving distance of the sliding door 10 may be acquired for the limit switch that is pressed. Both the measurement value related to the load and the measurement value related to the moving distance may be acquired.

[0054] In the present embodiment, the drive current of the motor 41 is measured as the measurement value related to the load applied to the sliding door 10. However, the present invention is not limited to this configuration. For example, a load sensor such as a load cell may be provided at a place where the load sensor can be sandwiched by the sliding door 10 and an object opposing the sliding door 10 (for example, the door end rubber 11), and the measurement value of the load sensor may be used as the measurement value related to the load applied to the sliding door 10. For example, the torque of the motor 41 measured using a torque sensor may be the measurement value related to the load applied to the sliding door 10.

[0055] In the present embodiment, the electric motor 41 is used in the drive unit 40, but an air cylinder that drives the sliding door 10 in the opening/closing direction using compressed air may be used. In this case, for example, a measurement value related to the load is acquired using a load sensor such as a load cell or a torque sensor.

[0056] In the present embodiment, the measurement value is output to the vehicle control device 2. However, the present invention is not limited to this configuration. For example, the measurement value may be output to an external terminal device or the like carried by an operator. The same applies to a comparison result and a necessity determination result for position adjustment, which will be described later in the following embodiments.

[0057] In the present embodiment, the door close switch 61 is provided with the test limit switch to detect whether the sliding door 10 has come to the test position. However, the present invention is not limited to this configuration. For example, a door close switch for detecting the fully closed state and a door close switch for a test to detect the sliding door 10 having come to the test position may be provided in parallel. For example, a stroke sensor for detecting the stroke of the sliding door 10 may be used to determine whether the sliding door 10 has come to the test position. For example, whether the sliding door 10 has come to the test position may be determined based on an output signal of an encoder of the motor 41.

Second Embodiment

[0058] A second embodiment of the present embodiment will be described below. In the drawing and description of the second embodiment, the same or equivalent components and members as those of the first embodiment are denoted by the same reference numerals. The description same as that on the first embodiment will be omitted as appropriate, and the configuration different from that of the first embodiment will be mainly described.

[0059] Fig. 6 is referred. A door control device 100 of the present embodiment further includes a storage unit 108, a reference value setting unit 109, and a comparison result output unit 110. The reference value setting unit 109 of the present embodiment is an example of an update unit. A vehicle control device 2 of the present embodiment is configured to be able to transmit a first test command signal and a second test command signal, described later, to the door control device 100.

[0060] An operation of the door control device 100 of the present embodiment will be described with reference to Fig. 7. Fig. 7 is a flowchart illustrating an operation S20 for assisting determination on whether position adjustment of a sliding door 10 is necessary.

[0061] In S21, a drive control unit 101 receives a test command signal from the vehicle control device 2 via a communication unit 107. The test command signal received in S21 is the first test command signal or the second test command signal. After the position adjustment work of the sliding door 10 is completed, the first test command signal is transmitted from the vehicle control

device 2 in response to an input given by a user to the vehicle control device 2. The position adjustment work is performed, for example, when a sliding door opening and closing device 1 is outfitted to a railway vehicle or when an operator determines that the position adjustment work is necessary at safety inspection or the like. The second test command signal is transmitted from the vehicle control device 2 in response to an input given by a user to the vehicle control device 2 when, for example, determination on whether the position adjustment work is necessary is to be made. Since S22 and S23 are respectively similar to S12 and S13 described above, description on S22 and S23 will be omitted.

[0062] In step S24, a measurement value output unit 103 determines whether the test command signal received in step S21 is a first test command signal or a second test command signal. If the received test command signal is a first test command signal, the measurement value output unit 103 outputs the supplied measurement value to the reference value setting unit 109, and the operation S20 proceeds to S25. If the received test command signal is a second test command signal, the measurement value output unit 103 outputs the supplied measurement value to the comparison result output unit 110, and the operation S20 proceeds to S26.

[0063] In S25, the reference value setting unit 109 sets or updates the reference value by storing the supplied measurement value in the storage unit 108 as a reference value. Specifically, the reference value setting unit 109 sets the measurement value as the reference value when the reference value has not yet been set, for example, when position adjustment is performed when the sliding door opening and closing device 1 is outfitted to a railway vehicle. For example, when the reference value has already been set, the reference value setting unit 109 updates the reference value using the measurement value. Here, the first test command signal is transmitted after completion of the position adjustment work for the sliding door 10, and in response to the first test command signal, the measurement value after the completion is set as the reference value or the reference value is updated to be the measurement value. Thus, the set or updated reference value indicates a value for a state in which locking and door trapping detection appropriately function. After S25, the operation S20 ends.

[0064] In S26, the comparison result output unit 110 outputs a comparison result between the supplied measurement value and the reference value predetermined in S25 to the vehicle control device 2 via the communication unit 107. The predetermined reference value is read from the storage unit 108. The comparison result of the present embodiment indicates, for example, a difference of the reference value from the measurement value. When the comparison result is output to the vehicle control device 2, the difference is reported as the comparison result. Specifically, the difference is displayed on a display unit of the vehicle control device 2. After S26, the operation S20 ends.

[0065] As described above, in the present embodiment, the comparison result output unit 110 outputs the comparison result between the output measurement value and the predetermined reference value. According to this configuration, the degree of deviation of the measurement value from the reference value can be grasped by referring to the comparison result of the measurement value with respect to the predetermined reference value, so that determination on whether the position adjustment is necessary can be made more easily.

[0066] In the present embodiment, the drive control unit 101 controls the drive unit 40 to press the door end rubber 11 against the opposing door end rubber 11 again in S22 after the position adjustment of the sliding door 10 is completed. In S23, a measurement value acquisition unit 102 acquires the measurement value at the time of the door end rubber 11 being pressed again. In S25, the reference value setting unit 109 updates the reference value to be the measurement value at the time of the door end rubber 11 being pressed again. The present configuration enables further accurate determination of whether the position adjustment of the sliding door 10 is necessary as compared with a case, for example, where the reference value determined using the measurement value at the time of outfitting the sliding door opening and closing device 1 is kept.

[0067] In the present embodiment, the comparison result output unit 110 informs of a difference of the reference value from the measurement value. According to the present configuration, for example, when the difference takes a positive value (when the measurement value is larger than the reference value), it can be understood that the sliding door 10 that has trapped a foreign object can move more easily in the closing direction than the sliding door 10 in a reference state. Thus, it can be understood that the position adjustment work of the sliding door 10 is to be made so as to attach the sliding door 10 further to the opening direction side. Similarly, when the difference takes a negative value (when the measurement value is smaller than the reference value), it can be understood that the sliding door 10 that has trapped a foreign object can move less easily in the closing direction than the sliding door 10 in the reference state. Thus, it can be understood that the position adjustment work of the sliding door 10 is to be made so as to attach the sliding door 10 further to the closing direction side. Furthermore, to what degree the attachment position of the sliding door 10 is to be adjusted in order to make locking and door trapping detection function appropriately can be grasped based on the magnitude of the difference. Accordingly, the workload for the position adjustment work of the sliding door 10 can be reduced.

[0068] Exemplary modifications of the present embodiment will be described below.

[0069] The comparison result output unit 110 may use, as the reference value, a different measurement value measured at the same air temperature as when the measurement value is measured. In this case, a meas-

urement value may be acquired in advance for each temperature, and each of the measurement values may be stored in association with the respective temperature in the storage unit 108. According to this configuration, reference to the comparison result between the measurement value and the reference value at the same temperature can be used as a guide for determining whether any abnormality has occurred in the sliding door opening and closing device 1 (for example, lack of grease or breakage of a door roller 22, breakage of a pinion gear of a sliding door drive mechanism 42, or abnormality of a motor 41).

[0070] The comparison result output unit 110 may report the comparison result between the temperature at which the measurement value is acquired and the temperature at which the measurement value used for setting or updating the reference value in S25 is acquired. According to this configuration, to which side, the opening direction or the closing direction, the attachment position of the sliding door 10 is to be adjusted depending on the temperature level can be grasped in the position adjustment work based on the comparison result of the temperature. As a result, the workload for the position adjustment work can be reduced. The comparison result output unit 110 may output the comparison result indicating that the measurement value is larger or smaller than the reference value.

[0071] In the present embodiment, the reference value is updated in S25. However, a predetermined reference value such as a reference value defined using, for example, the measurement value at the time of outfitting the sliding door opening and closing device 1 may be kept, without updating the reference value.

[0072] In the present embodiment, the comparison result indicates the difference of the reference value from the measurement value. However, the present invention is not limited to this configuration. For example, data in which the measurement value and the reference value are arranged in parallel may be indicated.

Third Embodiment

[0073] A third embodiment of the present embodiment will be described below. In the drawing and description of the third embodiment, the same or equivalent components and members as those of the second embodiment are denoted by the same reference numerals. The description same as that on the second embodiment will be omitted as appropriate, and the configuration different from that of the second embodiment will be mainly described.

[0074] Fig. 8 is referred. A door control device 100 of the present embodiment further includes a determination result reporting unit 111.

[0075] An operation of the door control device 100 of the present embodiment will be described with reference to Fig. 9. Fig. 9 is a flowchart illustrating an operation S30 for assisting determination on whether position adjustment of a sliding door 10 is necessary. Since S31 to S35 are respectively similar to S21 to S25 described above, description on S31 to S35 will be omitted.

[0076] In S36, a comparison result output unit 110 outputs a comparison result between a supplied measurement value and the reference value predetermined in S35 is output to the determination result reporting unit 111. The comparison result of the present embodiment is data indicating whether the measurement value is within a predetermined range from the reference value. The predetermined range is set based on, for example, the thickness of a door trapping adjustment jig 5 for a lock adjustment work and the thickness of a door trapping adjustment jig 5 for a door trapping adjustment work. The predetermined range is not limited to such setting, and is appropriately set based on an operating method or the like of a sliding door opening and closing device 1.

[0077] In S37, the determination result reporting unit 111 determines whether the position adjustment of the sliding door 10 is necessary based on the comparison result. The determination result reporting unit 111 of the present embodiment determines whether the measurement value is within the predetermined range from the reference value. That the measurement value is not within the predetermined range from the reference value is, for example, the measurement value exceeding an upper limit threshold that is above the reference value by the predetermined range or falling below a lower limit threshold that is below the reference value by the predetermined range. That the measurement value is within the predetermined range from the reference value is, for example, the measurement value being equal to or smaller than the upper limit threshold and equal to or larger than the lower limit threshold. If the measurement value is not within the predetermined range from the reference value, the determination result reporting unit 111 determines that the position adjustment of the sliding door 10 is necessary, and the operation S30 proceeds to S38. If the measurement value is within the predetermined range from the reference value, the determination result reporting unit 111 determines that the position adjustment of the sliding door 10 is not necessary, and the operation S30 proceeds to S39.

[0078] In S38, the determination result reporting unit 111 reports that the position adjustment of the sliding door 10 is necessary. Specifically, the determination result reporting unit 111 outputs a necessity determination result indicating that the position adjustment of the sliding door 10 is necessary to a vehicle control device 2 via a communication unit 107. As a result, the necessity determination result is displayed on a display unit of the vehicle control device 2. After S38, the operation S30 ends.

[0079] In S39, the determination result reporting unit 111 reports that the position adjustment of the sliding door 10 is not necessary. Specifically, the determination result reporting unit 111 outputs the necessity determination result indicating that the position adjustment of the

sliding door 10 is not necessary to the vehicle control device 2 via the communication unit 107. As a result, the necessity determination result is displayed on a display unit of the vehicle control device 2. After S39, the operation S30 ends.

[0080] As described above, in the present embodiment, the determination result reporting unit 111 reports the necessity determination result for the position adjustment of the sliding door 10 based on the comparison result. According to this configuration, the reporting on the necessity determination result for the position adjustment of the sliding door 10 makes the determination on whether the position adjustment of the sliding door 10 is necessary further easy.

[0081] Exemplary modifications of the present embodiment will be described below. In the present embodiment, whether the position adjustment of the sliding door 10 is necessary is determined by whether the measurement value is within the predetermined range from the reference value. However, the present invention is not limited this configuration. For example, whether the position adjustment of the sliding door 10 is necessary may be determined by whether the difference of the reference value from the measurement value is larger than a predetermined threshold.

Fourth Embodiment

[0082] A fourth embodiment of the present embodiment will be described below. In the drawing and description of the fourth embodiment, the same or equivalent components and members as those of the third embodiment are denoted by the same reference numerals. The description same as that on the third embodiment will be omitted as appropriate, and the configuration different from that of the third embodiment will be mainly described.

[0083] Fig. 10 is referred. A door control device 100A of the present embodiment further includes a request unit 112, an adjacent sliding door information acquisition unit 113, and an adjacent sliding door information reporting unit 114. A sliding door 10 that is controlled to be opened and closed by the door control device 100A is an example of a first sliding door that opens and closes one of a plurality of boarding doorways to a railway vehicle. A sliding door 10 that opens and closes a boarding doorway adjacent to the boarding doorway provided with the first sliding door 10 is an example of a second sliding door. An adjacent door control device 100B in Fig. 10 controls opening and closing of the second sliding door 10. The adjacent door control device 100B has a similar configuration as the door control device 100A. In the present embodiment, it is assumed that second test command signals are transmitted to the door control device 100A and the adjacent door control device 100B at a time.

[0084] The request unit 112 receives the second test command signal via a communication unit 107, and in response to the second test command signal transmits a request signal for requesting the adjacent door control device 100B of a necessity determination result for position adjustment. As a result, after the adjacent door control device 100B acquires the necessity determination result, the adjacent door control device 100B transmits the necessity determination result. The adjacent sliding door information acquisition unit 113 acquires the necessity determination result for the second sliding door 10 from the adjacent door control device 100B via the communication unit 107. The adjacent sliding door information acquisition unit 113 supplies the acquired necessity determination result to the adjacent sliding door information reporting unit 114.

[0085] The adjacent sliding door information reporting unit 114 determines whether the necessity determination result for the position adjustment of the first sliding door 10 matches the necessity determination result for the position adjustment of the second sliding door 10. If these necessity determination results do not match, the adjacent sliding door information reporting unit 114 reports to a vehicle control device 2 via the communication unit 107 that the necessity determination result for the position adjustment of the second sliding door 10.

[0086] The present embodiment can prompt checking of whether any abnormality has occurred in a sliding door opening and closing device 1 using the necessity determination result for the position adjustment of the second sliding door 10 adjacent to the first sliding door 10 as reference information.

[0087] Exemplary modifications of the present embodiment will be described below.

[0088] In the present embodiment, the adjacent sliding door information acquisition unit 113 acquires the necessity determination result for the position adjustment. However, the adjacent sliding door information acquisition unit 113 may acquire the measurement value for the second sliding door 10. In this case, the adjacent sliding door information reporting unit 114 may determine whether the degree of deviation between the measurement value for the first sliding door 10 and the measurement value for the second sliding door 10 exceeds a predetermined range. For example, when the difference or ratio between the measurement values is larger than a predetermined threshold, the adjacent sliding door information reporting unit 114 determines that the degree of deviation exceeds the predetermined range. If the adjacent sliding door information reporting unit 114 determines that the degree of deviation exceeds the predetermined range, the adjacent sliding door information reporting unit 114 may just report the measurement value for the second sliding door 10.

[0089] In the present embodiment, an example in which the second test command signals are transmitted to the door control device 100A and the adjacent door control device 100B at a time is described. However, the present invention is not limited to this configuration. For example, it may be configured that the second test command signal is not transmitted to the adjacent door control

device 100B, but is transmitted to the door control device 100A. In this case, the adjacent door control device 100B may transmit the measurement value or the necessity determination result obtained most recently in response to the request signal.

Fifth Embodiment

[0090] A fifth embodiment of the present embodiment will be described below. In the drawing and description of the fifth embodiment, the same or equivalent components and members as those of the first embodiment are denoted by the same reference numerals. The description same as that on the first embodiment will be omitted as appropriate, and the configuration different from that of the first embodiment will be mainly described.

[0091] Fig. 11 is referred. A door control device 100 of the present embodiment further includes a storage unit 108 and a prediction unit 115. In the present embodiment, every time a measurement value is supplied from a measurement value acquisition unit 102, a measurement value output unit 103 supplies the measurement value to the storage unit 108 to store the measurement value. As a result, the measurement value for each measurement is accumulated in the storage unit 108. The measurement value output unit 103 supplies the measurement value to the prediction unit 115.

[0092] When the measurement value is supplied, the prediction unit 115 reads, for example, the measurement value at the previous measurement from the storage unit 108, and predicts the timing at which the position adjustment of the sliding door 10 is necessary based on comparison between the measurement value at the previous measurement and the measurement value at the current measurement. For example, the prediction unit 115 obtains the temporal change amount of the measurement value based on the elapsed time from the previous measurement to the current measurement and the difference between the measurement value at the previous measurement and the measurement value at the current measurement. The prediction unit 115 predicts the timing by obtaining the time until the measurement value at the current measurement reaches a predetermined threshold based on the obtained temporal change amount.

[0093] As described above, in the present embodiment, the prediction unit 115 predicts the timing at which the position adjustment of the sliding door 10 is necessary based on the comparison between the measurement value acquired at a first time point and the measurement value acquired at a second time point earlier than the first time point. According to the present embodiment, the timing when the position adjustment of the sliding door 10 is necessary can be grasped.

[0094] Exemplary modifications of the present embodiment will be described below.

[0095] In the present embodiment, the prediction is made based on the comparison between the measurement value at the previous measurement and the measurement value at the current measurement. However, the present invention is not limited to this configuration. The measurement values may be those measured earlier than the measurement value at the current measurement. The above prediction may be made based on comparison among three or more measurement values.

[0096] Any combination of the above-described embodiments and modifications is also useful as an embodiment of the present invention. Any new embodiment resulting from a combination has the effect of each of the combined embodiments and modifications.

[0097] The present invention relates to a sliding door position adjustment assisting device and a sliding door position adjustment assisting system.

Claims

1. A sliding door position adjustment assisting device (100) comprising:

   a drive control unit (101) configured to move a sliding door (10) in an opening/closing direction by controlling a drive unit (40);
   a measurement value acquisition unit (102) configured to acquire a measurement value related to at least one of a moving distance of the sliding door (10) or a load applied to the sliding door (10), the measurement value being measured when the sliding door (10) is driven in a direction of pressing the sliding door (10) against an opposing object under a predetermined operating condition by the drive control unit (101) with a door end rubber (11) provided at a door end of the sliding door (10) being in contact with the opposing object; and
   a measurement value output unit (103) configured to output the measurement value acquired by the measurement value acquisition unit (102).

2. The sliding door position adjustment assisting device (100) according to claim 1, further comprising a comparison result output unit (110) configured to output a comparison result between the output measurement value and a predetermined reference value.

3. The sliding door position adjustment assisting device (100) according to claim 2, further comprising a determination result reporting unit (111) configured to report a necessity determination result for position adjustment of the sliding door (10) based on the output comparison result.

4. The sliding door position adjustment assisting device (100) according to claim 3, wherein

   the sliding door (10) is a first sliding door (10)

provided at a platform or a railway vehicle, and opens and closes one of a plurality of boarding doorways to a railway vehicle,
the sliding door position adjustment assisting device (100) comprising:

an adjacent sliding door information acquisition unit (113) configured to acquire the measurement value for a second sliding door (10) that opens and closes a boarding doorway adjacent to the boarding doorway provided with the first sliding door (10) or a necessity determination result for the position adjustment of the second sliding door (10); and
an adjacent sliding door information reporting unit (114) configured to report the measurement value for the second sliding door (10) or the necessity determination result for the position adjustment of the second sliding door (10) when a degree of deviation between the measurement value for the first sliding door (10) and the measurement value for the second sliding door (10) exceeds a predetermined range or when a necessity determination result for the position adjustment of the first sliding door (10) and the necessity determination result for the position adjustment of the second sliding door (10) do not match.

5. The sliding door position adjustment assisting device (100) according to any one of claims 2 to 4, wherein the comparison result output unit (110) uses, as the reference value, a different one of measurement values measured at a same air temperature as the measurement value is measured.

6. The sliding door position adjustment assisting device (100) according to any one of claims 2 to 5, wherein

the drive control unit (101) controls the drive unit (40) to perform pressing of the door end rubber (11) again against the opposing object after the position adjustment of the sliding door (10) is completed, and
the measurement value acquisition unit (102) acquires a measurement value measured during the pressing of the door end rubber (11) again,
the sliding door position adjustment assisting device (100) comprising an update unit (109) configured to update the reference value to be the measurement value measured during the pressing of the door end rubber (11) again.

7. The sliding door position adjustment assisting device (100) according to claim 6, wherein the comparison result output unit (110) reports a comparison result between an air temperature at which the measurement value is acquired and an air temperature at which the measurement value related to the updated reference value is acquired.

8. The sliding door position adjustment assisting device (100) according to any one of claims 2 to 7, wherein the comparison result output unit (110) reports a difference of the reference value from the measurement value.

9. The sliding door position adjustment assisting device (100) according to any one of claims 1 to 8, wherein

the predetermined operating condition includes applying a predetermined load to the sliding door (10) or moving the sliding door (10) by a predetermined distance, and
the measurement value acquisition unit (102) acquires the moving distance when the predetermined operating condition is the applying a predetermined load to the sliding door (10), and acquires the load when the predetermined operating condition is the moving the sliding door (10) by a predetermined distance.

10. The sliding door position adjustment assisting device (100) according to any one of claims 1 to 9, wherein the opposing object is a door receiving part or, when the sliding door (10) is one sliding door of a double sliding door, a door end rubber (11) of another sliding door (10).

11. The sliding door position adjustment assisting device (100) according to any one of claims 1 to 10, wherein

the drive control unit (101) controls a drive current that flows through a motor (41) included in the drive unit (40), and
the measurement value acquisition unit (102) acquires the drive current as a measurement value related to the load.

12. The sliding door position adjustment assisting device (100) according to any one of claims 1 to 11, further comprising:
a prediction unit (115) configured to predict a timing at which the position adjustment of the sliding door (10) is necessary based on comparison between the measurement value acquired at a first time point and the measurement value acquired at a second time point earlier than the first time point.

13. A sliding door position adjustment assisting system comprising:

a plurality of information output devices (100)

provided at a platform or a railway vehicle, and used for a plurality of sliding doors (10) that open and close a plurality of boarding doorways to a railway vehicle, the information output devices (100) being configured to execute, in response to a test command signal,

an operation of moving the sliding door (10) in an opening/closing direction by controlling a drive unit (40),

an operation of acquiring a measurement value related to at least one of a moving distance of the sliding door (10) or a load applied to the sliding door (10), the measurement value being measured when the sliding door (10) is driven in a direction of pressing the sliding door (10) against an opposing object under a predetermined operating condition with a door end rubber (11) provided at a door end of the sliding door (10) being in contact with the opposing object, and

an operation of outputting the acquired measurement value; and

a command device (2) configured to output the test command signal for causing at least one of the plurality of information output devices (100) to execute the operation of moving, the operation of acquiring, and the operation of outputting.

FIG.1

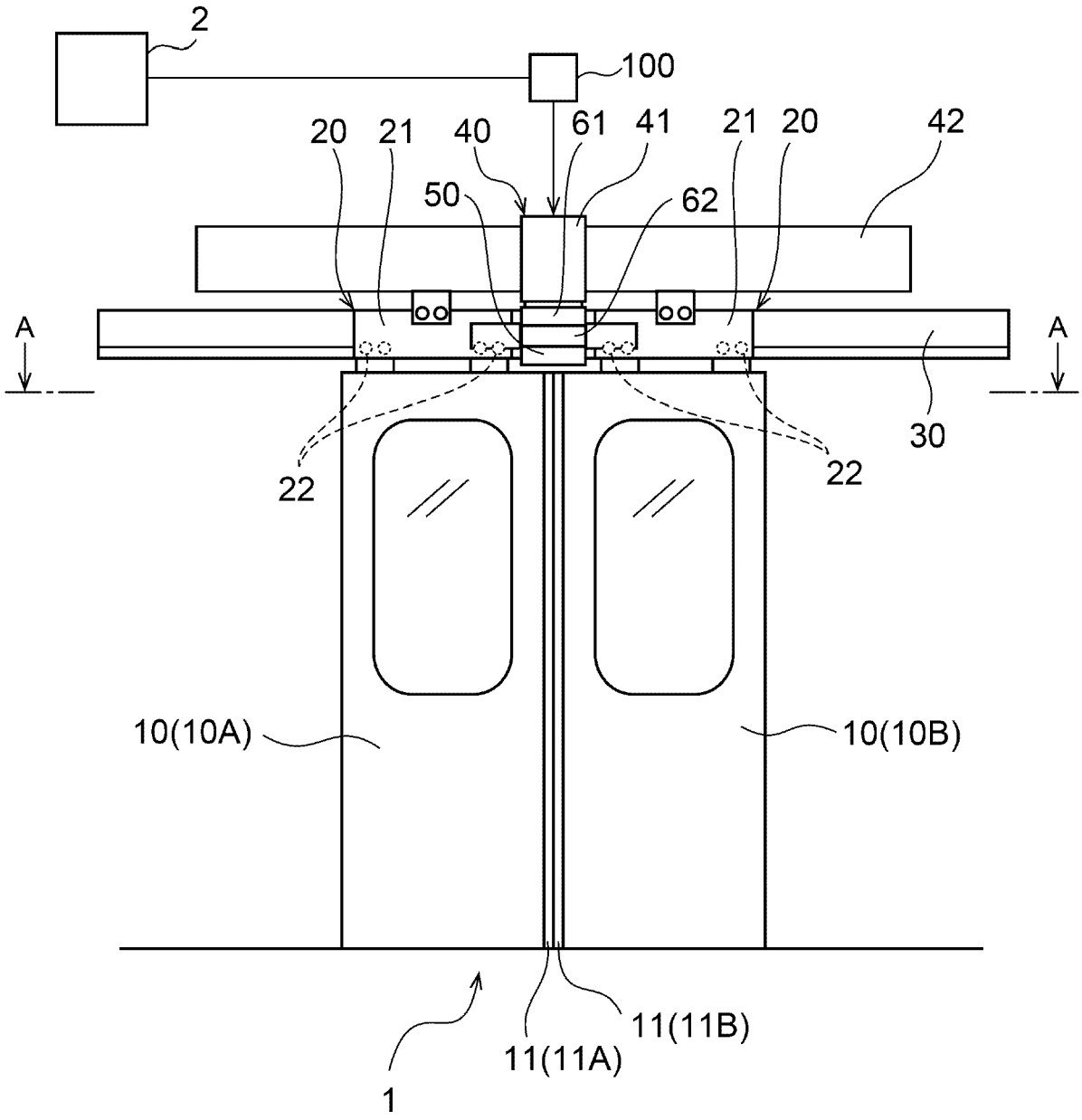
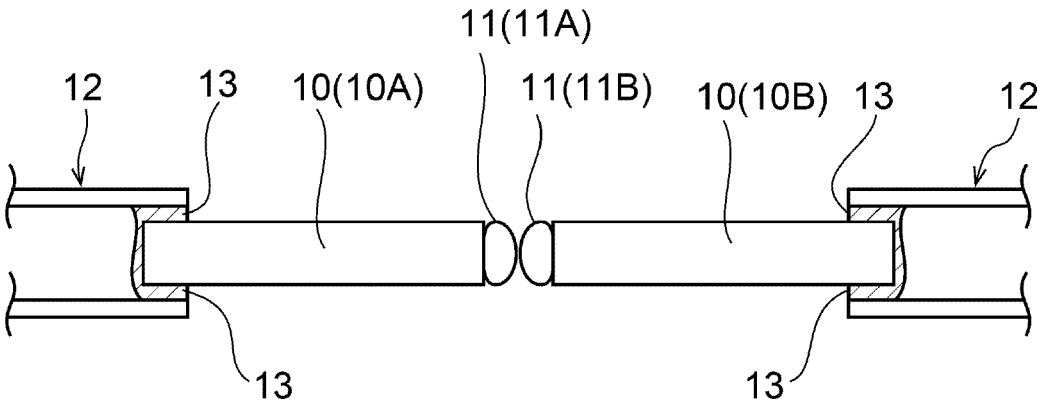

2
100
20
21
40
61
41
21
20
42
50
62
A
A
22
22
30
10(10A)
10(10B)
1
11(11A)
11(11B)

FIG.2



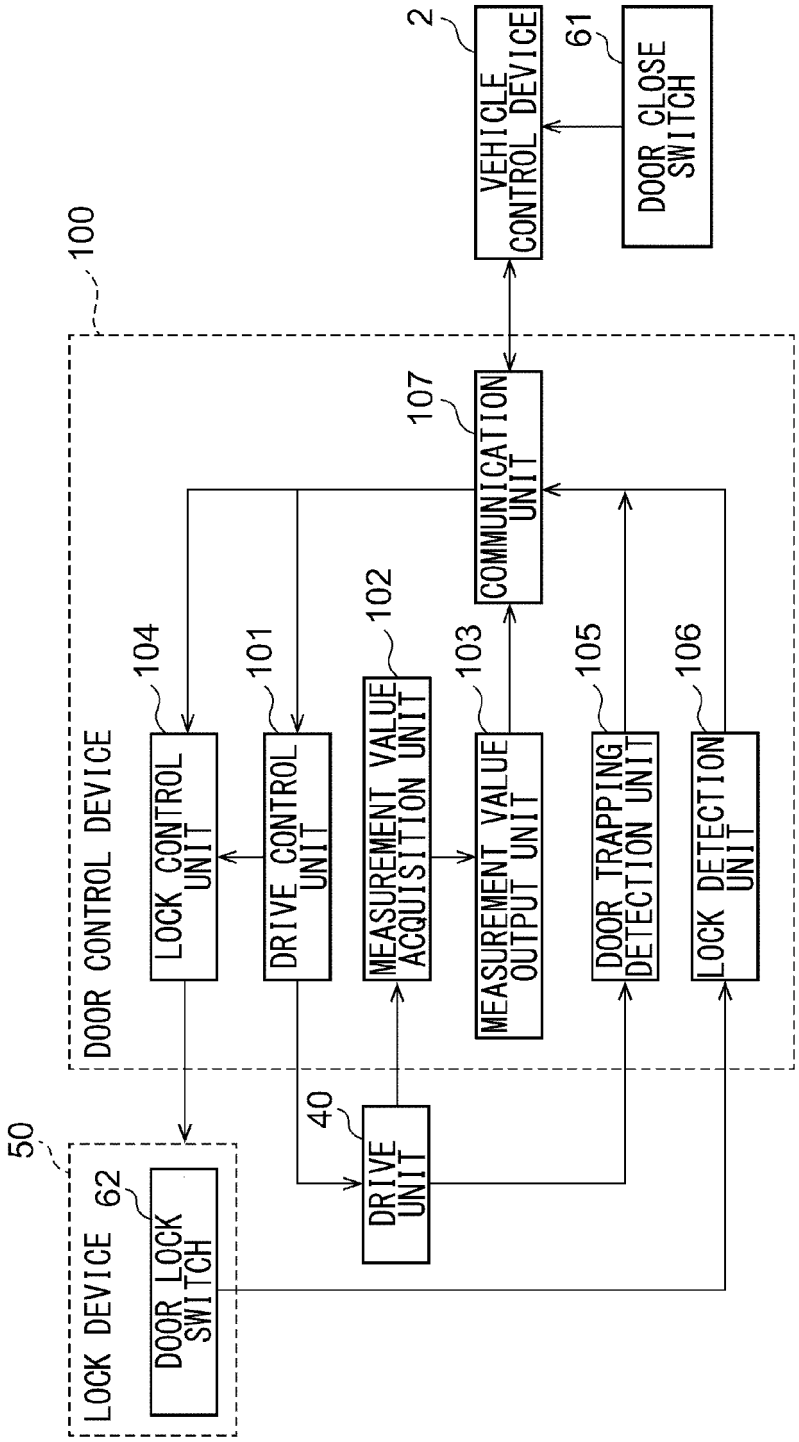

2
VEHICLE CONTROL DEVICE
61
DOOR CLOSE SWITCH
100
DOOR CONTROL DEVICE
107
COMMUNICATION UNIT
104
LOCK CONTROL UNIT
101
DRIVE CONTROL UNIT
102
MEASUREMENT VALUE ACQUISITION UNIT
103
MEASUREMENT VALUE OUTPUT UNIT
105
DOOR TRAPPING DETECTION UNIT
106
LOCK DETECTION UNIT
40
DRIVE UNIT
50
LOCK DEVICE
62
DOOR LOCK SWITCH

FIG.3

FIG.4

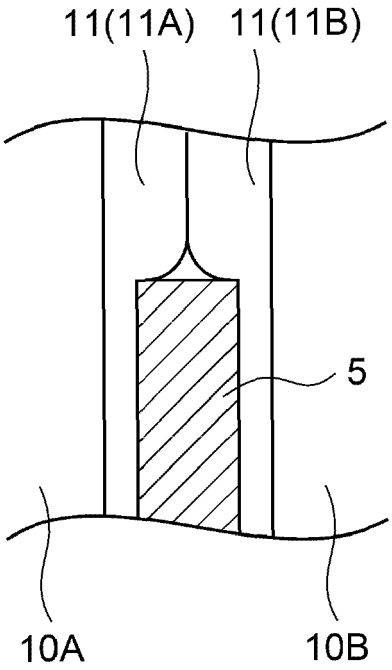
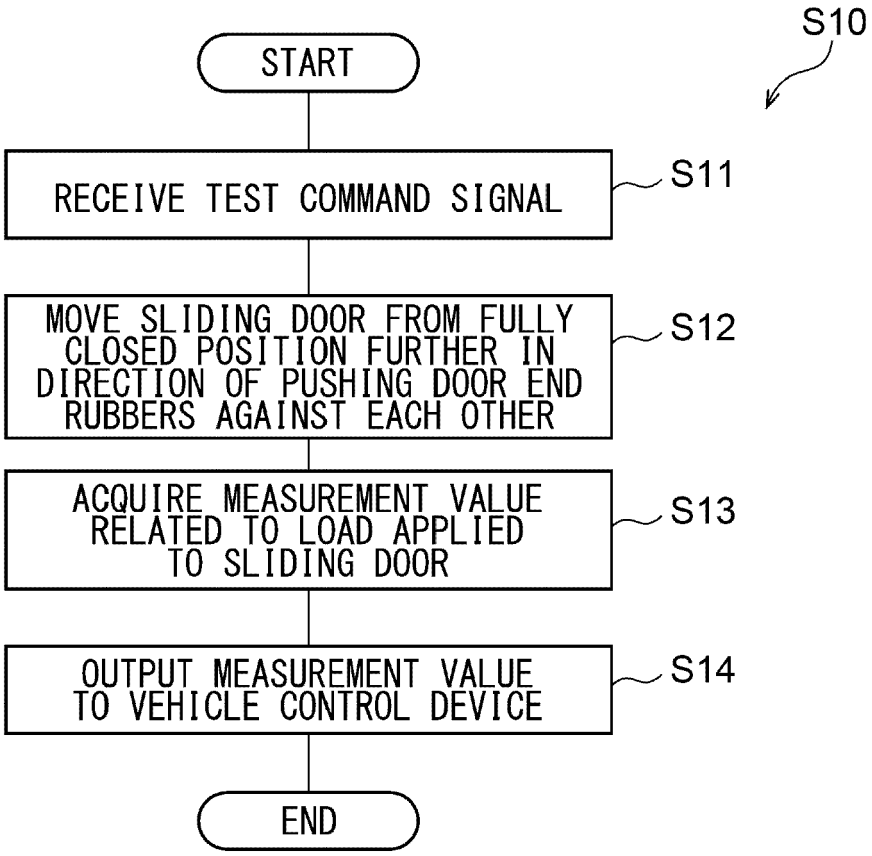


FIG.5


S10
START
RECEIVE TEST COMMAND SIGNAL
S11
MOVE SLIDING DOOR FROM FULLY CLOSED POSITION FURTHER IN DIRECTION OF PUSHING DOOR END RUBBERS AGAINST EACH OTHER
S12
ACQUIRE MEASUREMENT VALUE RELATED TO LOAD APPLIED TO SLIDING DOOR
S13
OUTPUT MEASUREMENT VALUE TO VEHICLE CONTROL DEVICE
S14
END

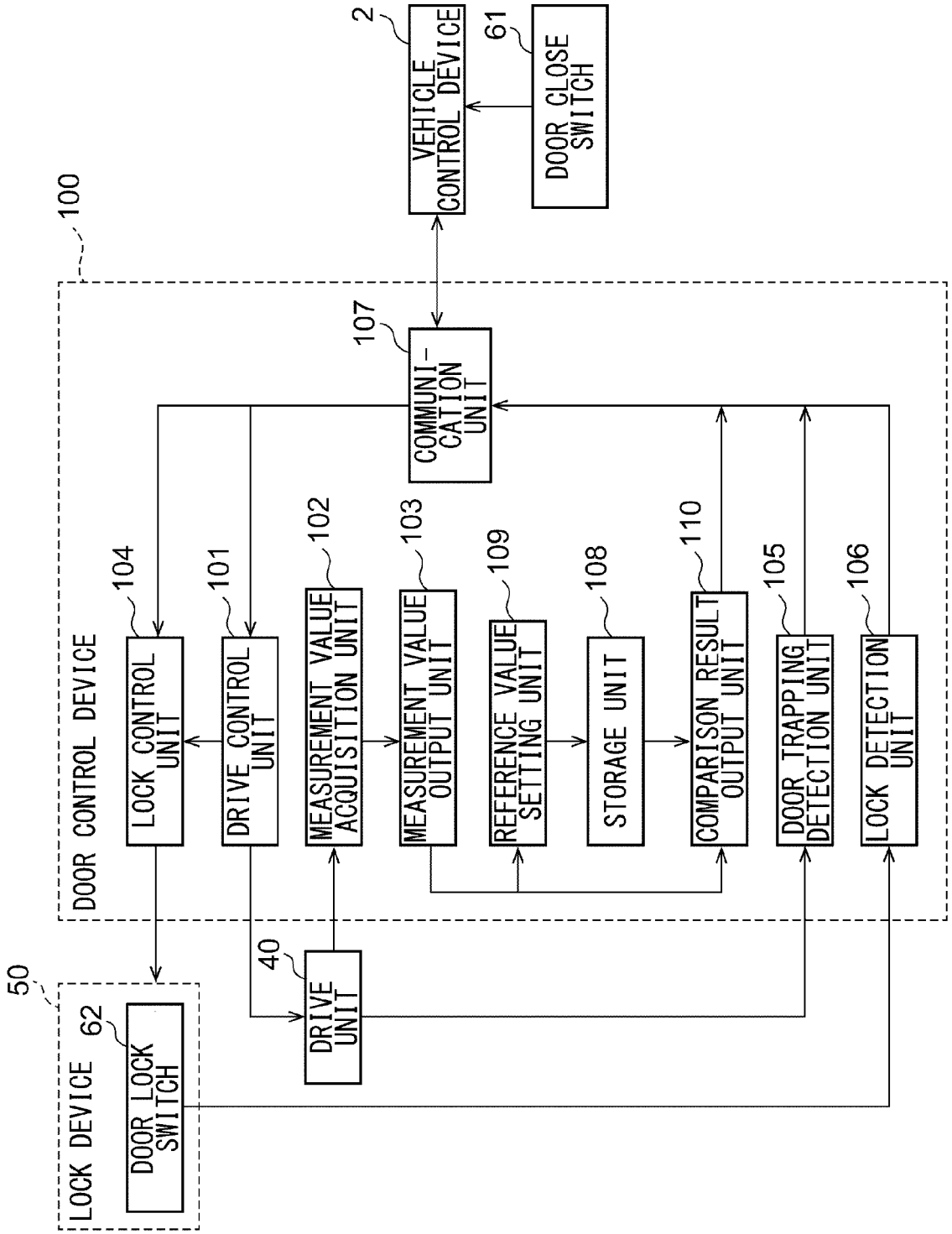

2
VEHICLE CONTROL DEVICE
61
DOOR CLOSE SWITCH
100
DOOR CONTROL DEVICE
107
COMMUNI-CATION UNIT
104
LOCK CONTROL UNIT
101
DRIVE CONTROL UNIT
102
MEASUREMENT VALUE ACQUISITION UNIT
103
MEASUREMENT VALUE OUTPUT UNIT
109
REFERENCE VALUE SETTING UNIT
108
STORAGE UNIT
110
COMPARISON RESULT OUTPUT UNIT
105
DOOR TRAPPING DETECTION UNIT
106
LOCK DETECTION UNIT
40
DRIVE UNIT
50
LOCK DEVICE
62
DOOR LOCK SWITCH

FIG.6

FIG.7

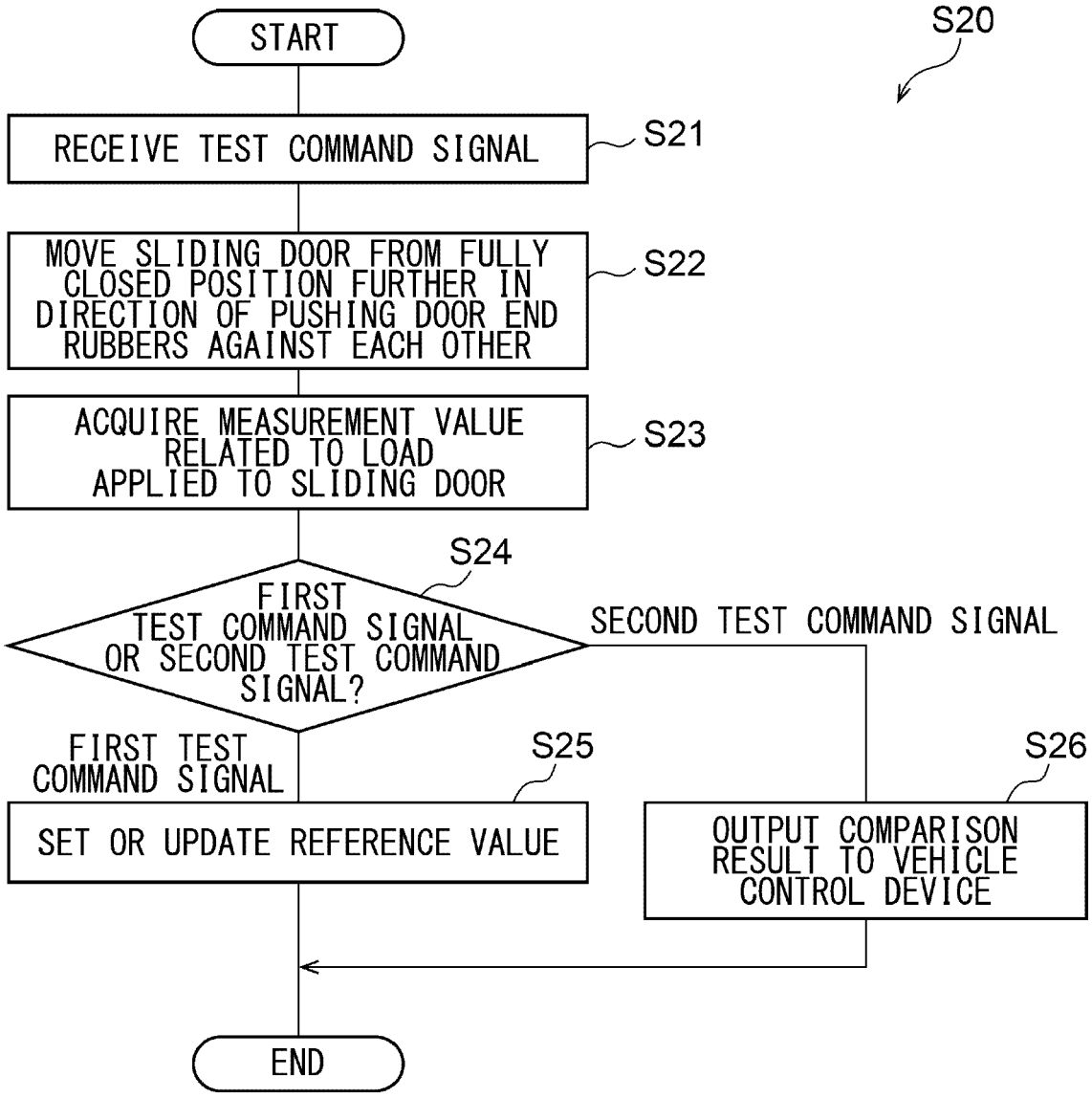

START
S20
RECEIVE TEST COMMAND SIGNAL
S21
MOVE SLIDING DOOR FROM FULLY CLOSED POSITION FURTHER IN DIRECTION OF PUSHING DOOR END RUBBERS AGAINST EACH OTHER
S22
ACQUIRE MEASUREMENT VALUE RELATED TO LOAD APPLIED TO SLIDING DOOR
S23
S24
FIRST TEST COMMAND SIGNAL OR SECOND TEST COMMAND SIGNAL?
SECOND TEST COMMAND SIGNAL
FIRST TEST COMMAND SIGNAL
S25
SET OR UPDATE REFERENCE VALUE
S26
OUTPUT COMPARISON RESULT TO VEHICLE CONTROL DEVICE
END

FIG.8

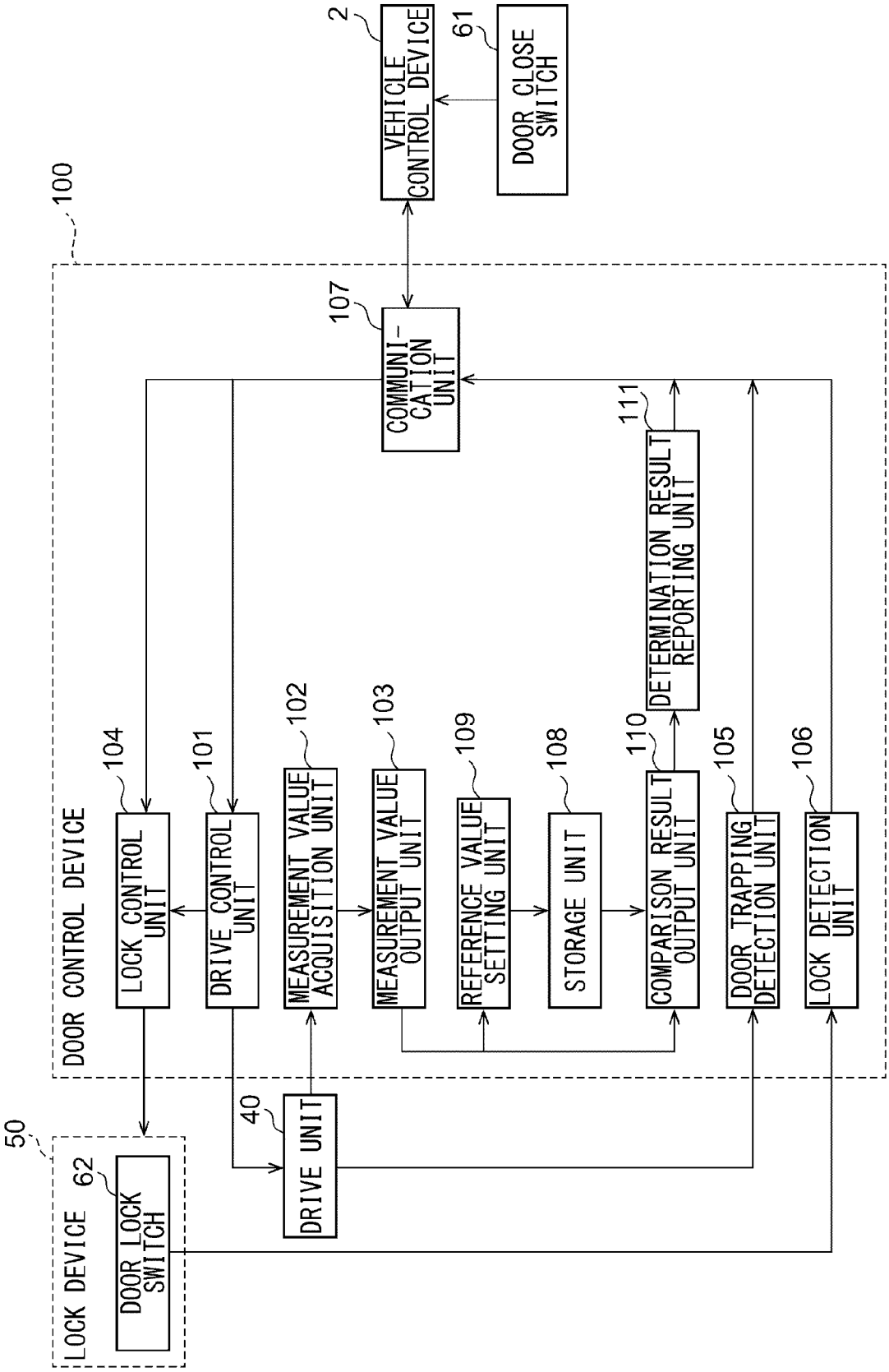

2
VEHICLE CONTROL DEVICE
61
DOOR CLOSE SWITCH
100
DOOR CONTROL DEVICE
107
COMMUNI-CATION UNIT
111
DETERMINATION RESULT REPORTING UNIT
104
LOCK CONTROL UNIT
101
DRIVE CONTROL UNIT
102
MEASUREMENT VALUE ACQUISITION UNIT
103
MEASUREMENT VALUE OUTPUT UNIT
109
REFERENCE VALUE SETTING UNIT
108
STORAGE UNIT
110
COMPARISON RESULT OUTPUT UNIT
105
DOOR TRAPPING DETECTION UNIT
106
LOCK DETECTION UNIT
40
DRIVE UNIT
50
LOCK DEVICE
62
DOOR LOCK SWITCH

FIG.9

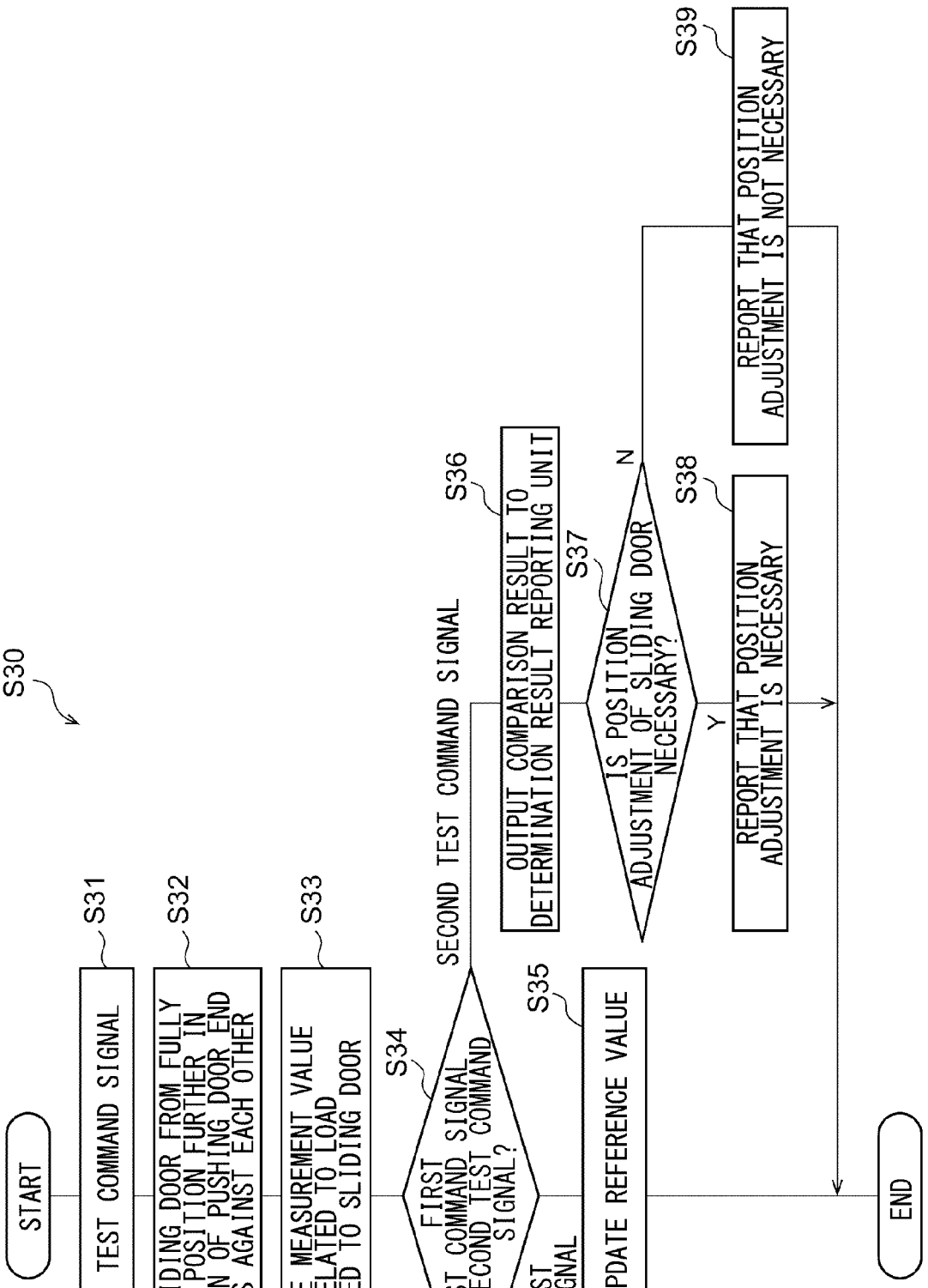

S30
START
S31
RECEIVE TEST COMMAND SIGNAL
S32
MOVE SLIDING DOOR FROM FULLY CLOSED POSITION FURTHER IN DIRECTION OF PUSHING DOOR END RUBBERS AGAINST EACH OTHER
S33
ACQUIRE MEASUREMENT VALUE RELATED TO LOAD APPLIED TO SLIDING DOOR
S34
FIRST TEST COMMAND SIGNAL OR SECOND TEST COMMAND SIGNAL?
FIRST TEST COMMAND SIGNAL
SECOND TEST COMMAND SIGNAL
S35
SET OR UPDATE REFERENCE VALUE
S36
OUTPUT COMPARISON RESULT TO DETERMINATION RESULT REPORTING UNIT
S37
IS POSITION ADJUSTMENT OF SLIDING DOOR NECESSARY?
Y
N
S38
REPORT THAT POSITION ADJUSTMENT IS NECESSARY
S39
REPORT THAT POSITION ADJUSTMENT IS NOT NECESSARY
END

FIG.10

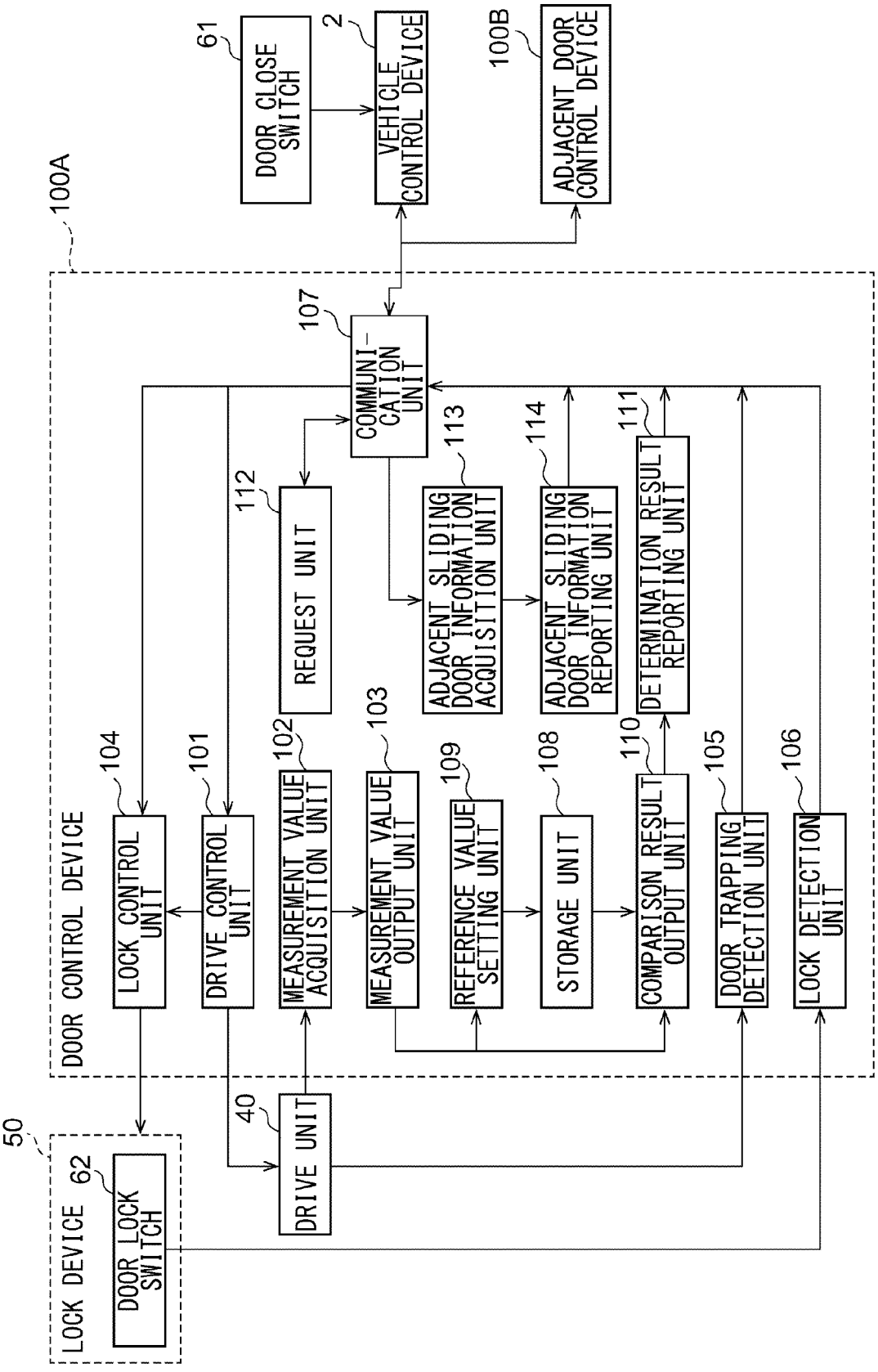
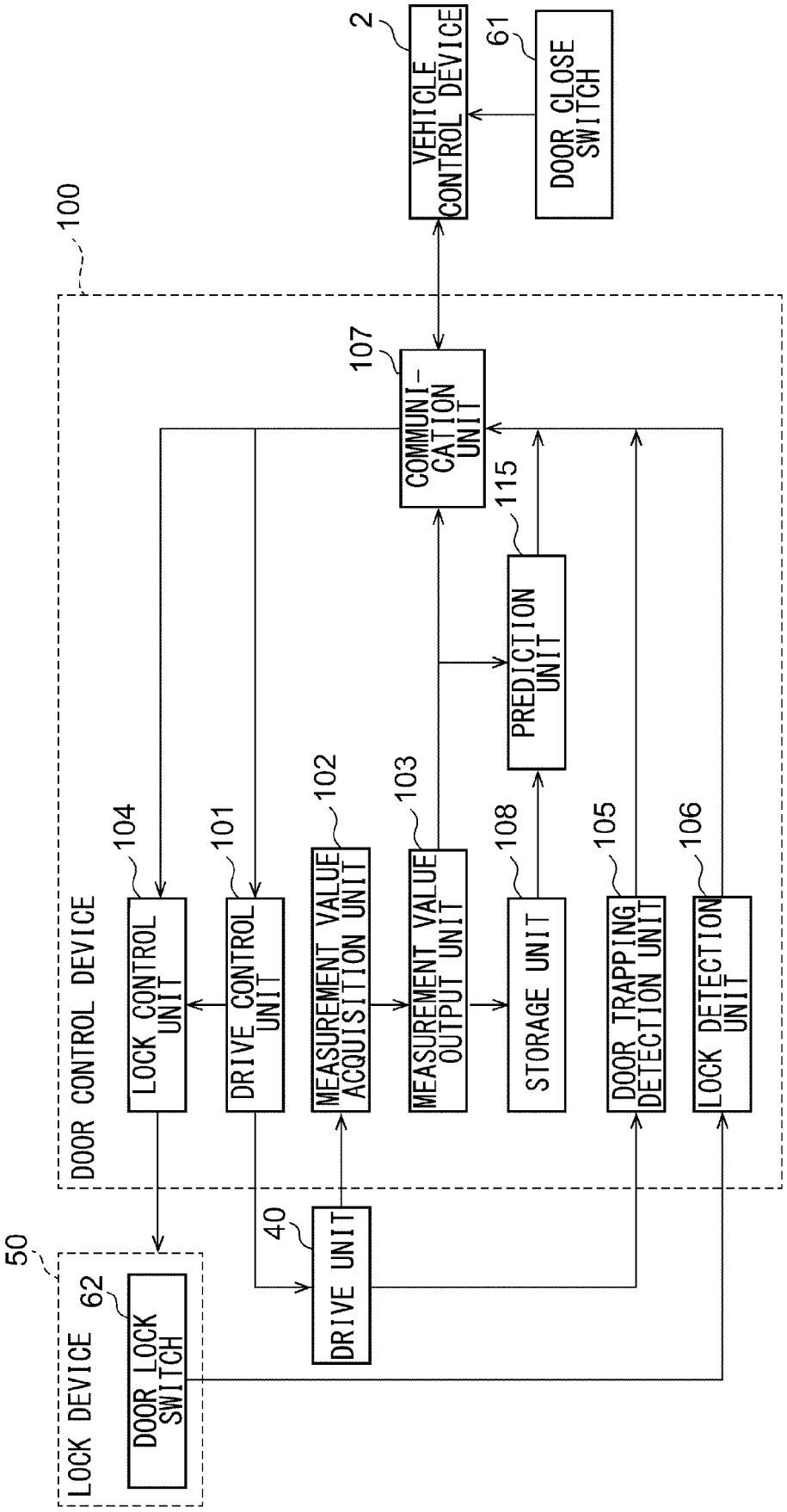

61
DOOR CLOSE SWITCH
2
VEHICLE CONTROL DEVICE
100B
ADJACENT DOOR CONTROL DEVICE
100A
DOOR CONTROL DEVICE
107
COMMUNI-CATION UNIT
112
REQUEST UNIT
113
ADJACENT SLIDING DOOR INFORMATION ACQUISITION UNIT
114
ADJACENT SLIDING DOOR INFORMATION REPORTING UNIT
111
DETERMINATION RESULT REPORTING UNIT
104
LOCK CONTROL UNIT
101
DRIVE CONTROL UNIT
102
MEASUREMENT VALUE ACQUISITION UNIT
103
MEASUREMENT VALUE OUTPUT UNIT
109
REFERENCE VALUE SETTING UNIT
108
STORAGE UNIT
110
COMPARISON RESULT OUTPUT UNIT
105
DOOR TRAPPING DETECTION UNIT
106
LOCK DETECTION UNIT
40
DRIVE UNIT
50
LOCK DEVICE
62
DOOR LOCK SWITCH

FIG.11


2
VEHICLE CONTROL DEVICE
61
DOOR CLOSE SWITCH
100
DOOR CONTROL DEVICE
107
COMMUNI-CATION UNIT
115
PREDICTION UNIT
104
LOCK CONTROL UNIT
101
DRIVE CONTROL UNIT
102
MEASUREMENT VALUE ACQUISITION UNIT
103
MEASUREMENT VALUE OUTPUT UNIT
108
STORAGE UNIT
105
DOOR TRAPPING DETECTION UNIT
106
LOCK DETECTION UNIT
40
DRIVE UNIT
50
LOCK DEVICE
62
DOOR LOCK SWITCH

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EUROPEAN SEARCH REPORT

Application Number
EP 22 15 4333

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 June 2022	Rémondot, Xavier

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