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(54) **RAIL TRANSIT VEHICLE, AND DOOR CONTROL METHOD AND SYSTEM FOR RAIL TRANSIT VEHICLE**

(57) Disclosed is a rail transit vehicle. The rail transit vehicle comprises a plurality of carriages, wherein each of the carriages comprises a plurality of doors respectively arranged on two sides of the carriage; each of the doors is correspondingly provided with a door controller for receiving a door control signal and controlling the door to be opened or closed; the door control signal comprises a door opening instruction, a door closing instruction, a zero-speed signal, a door enabling signal and a platform enabling signal; and when the door opening instruction, the zero-speed signal, the door enabling signal and the platform enabling signal are all in effect, the door controller controls the corresponding door to be opened. Also disclosed are a door control method and system for a rail transit vehicle. By means of same, vehicle safety can be improved.

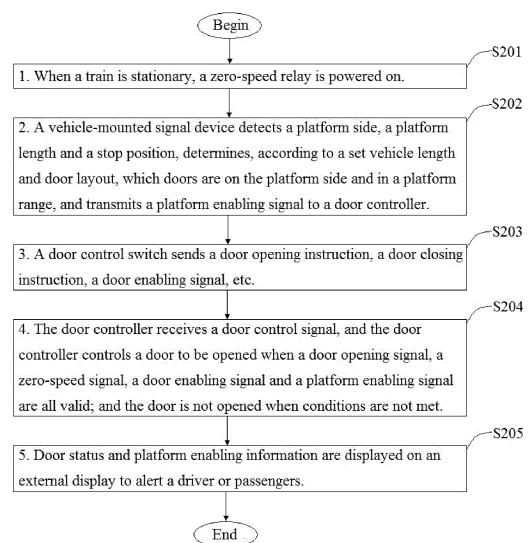


Fig. 2

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to the technical field of rail transit, in particular to a rail transit vehicle, and a door control method and system for a rail transit vehicle.

BACKGROUND OF THE INVENTION

[0002] Rail transit is an important part of a transportation system, and plays a very important role in passenger transportation and logistics transportation. With the rapid development of rail transit industry, the requirement for the traffic volume of a rail vehicle is increasingly high during peak traffic. In order to meet the requirement for the traffic volume, rail vehicle coupling is usually required.

[0003] The rail vehicle coupling refers to a coupling operation of two or more vehicle units, which can greatly increase the transport capacity of the coupled rail vehicle. However, when two or more vehicle units are coupled to operate, sometimes the length of the rail vehicle exceeds the length of a platform in some places. Then, the doors of some carriages are located outside the platform. Once the doors outside the platform are opened, passengers or staffs may get off from the doors outside the platform, resulting in casualties. Existing door control systems cannot guarantee that the doors outside the platform will not be opened.

[0004] The control failure of the doors, as an important part of the rail vehicle, directly affects the running safety, reliability and efficiency of the rail vehicle. Therefore, how to provide a solution to the above technical problems is an urgent problem to be solved by those skilled in the art.

SUMMARY OF THE INVENTION

[0005] Aiming at the shortcomings of the prior art, the technical problem to be solved by the present invention is to provide a rail transit vehicle, and a door control method and system for a rail transit vehicle, which ensures that only doors on a platform side and in a platform range can be opened, thereby avoiding casualties caused when passengers or staffs get off doors outside the platform, ensuring the safety of passengers, and improving the safety of the vehicle.

[0006] In order to solve the technical problem, the technical solution adopted by the present invention is as follows: a rail transit vehicle includes a plurality of carriages, each carriage includes a plurality of doors arranged on two sides of the carriage; each of the doors is correspondingly provided with a door controller for receiving a door control signal and controlling the door to be opened or closed;

[0007] The door control signal includes a door opening instruction, a door closing instruction, a zero-speed signal, a door enabling signal and a platform enabling signal;

and when the door opening instruction, the zero-speed signal, the door enabling signal and the platform enabling signal are all valid, the door controller controls the corresponding door to be opened.

[0008] The above solution achieves the purpose that only the doors on a platform side and in a platform range can be opened, avoids casualties caused when passengers or staffs get off the doors outside the platform, ensures the safety of the passengers and staffs, and improves the safety of the vehicle. The rail transit vehicle has the advantages of safety and reliability, and easy to be implemented and promoted.

[0009] Further, each of the doors is correspondingly provided with a door control switch, an input end of the door control switch is connected with a vehicle zero-speed relay and an output end of the door control switch is connected with the corresponding door controller.

[0010] The door control switch facilitates the opening and closing of the door, such that the door control is safe, reliable, and easy to be implemented and promoted.

[0011] Further, the door controller is connected with a vehicle-mounted signal device; and the vehicle-mounted signal device is used for detecting a platform side, a platform length and a stop position where the rail transit vehicle locates, and identifying, according to a set vehicle length and door layout, whether the door is on the platform side and in a platform range, and transmitting a platform enabling signal to the corresponding door controller.

[0012] The platform enabling signal can be transmitted to the door controller via a hard wire or a communication bus, such that the accurate platform enabling signal can be acquired.

[0013] Further, the door controller is connected with a display arranged on an exterior side of the vehicle to display a door status.

[0014] The present invention further provides a door control method for a rail transit vehicle, the method including: when a door opening instruction, a zero-speed signal, a door enabling signal and a platform enabling signal of a door are all valid, controlling the door to be opened; otherwise, controlling the door not to be opened.

[0015] In the method of the present invention, the process of acquiring the platform enabling signal of the door includes:

45 Detecting a platform side, a platform length and a stop position where the rail transit vehicle locates, determining, according to a set vehicle length and door layout, whether the door is on the platform side and in a platform range, and sending the platform enabling signal if the door is on the platform side and in the platform range.

[0016] Preferably, the specific implementation process of determining whether the door is on the platform side and in a platform range includes:

- 55 (1) Obtaining, after the vehicle stops, the stop position of the vehicle and the platform side corresponding to the stop position; and
- (2) Determining whether the door is in the platform

range under the following two situations a) and b):

a) If the stop position does not exceed a platform starting point on the platform side, determining whether $L-S_0 < S$ is true;

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If $L-S_0 < S$ is true, respectively determining whether $S_1 < L-S_0$, $S_2 < L-S_0$, ..., and $S_n < L-S_0$ are true;

If $S_1 < L-S_0$ is true, determining that a first door is in the platform range; otherwise, determining that the first door is not in the platform range;

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If $S_2 < L-S_0$ is true, determining that a second door is in the platform range; otherwise, determining that the second door is not in the platform range;

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And so on;

If $S_n < L-S_0$ is true, determining that the n-th door is in the platform range; otherwise, determining that the n-th door is not in the platform range;

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If $L-S_0 < S$ is not true, that is, $L-S_0 \geq S$, determining that all the doors on the platform side are in the platform range;

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b) If the stop position exceeds the platform starting point on the platform side, respectively determining whether $S_1 < S_0$, $S_2 < S_0$, ..., and $S_n < S_0$ are true;

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If $S_1 < S_0$ is true, determining that the first door is not in the platform range, otherwise, determining whether $S_1-S_0 < L$ is true and if so, determining that the first door is in the platform range, otherwise determining that the first door is not in the platform range;

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If $S_2 < S_0$ is true, determining that the second door is not in the platform range, otherwise, determining whether $S_2-S_0 < L$ is true, and if so, determining that the second door is in the platform range, otherwise determining that the second door not in the platform range;

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And so on;

If $S_n < S_0$ is true, determining that the n-th door is not in the platform range, otherwise, determining whether $S_n-S_0 < L$ is true and if so, determining that the n-th door is in the platform range, otherwise determining that the n-th door is not in the platform range; Herein, L is the length of a platform; S is the length of the vehicle; S_1 is the distance between the first door and the front end of the vehicle; S_2 is the distance between the second door and the front end of the vehicle; S_n is the distance between the n-th door and the front end of the vehicle; S_0 is the

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distance between the stop position and the platform starting point, that is, the distance between the front end of the vehicle and the platform starting point; the first door refers to the first door near the front end of the vehicle on the platform side, and the front end of the vehicle refers to the end near the platform starting point.

[0017] Preferably, the above-mentioned method of determining whether the door is on the platform side and in the platform range has the following advantages:

1) The method can accurately determine whether the door is on the platform side and in the platform range, is easy to implement, does not need to install a position sensor or a platform detection device on each door, and reduces the equipment cost and maintenance cost.

2) The method ensures that only the doors on the platform side and in the platform range can be opened, thereby avoiding casualties caused when passengers or staffs get off the doors outside the platform, ensuring the safety of the passengers and staffs, and improving the safety of the vehicle.

3) The method can automatically identify whether the door is on the platform side and in the platform range, which improves the degree of automation of opening and closing the door, reduces the labor intensity of a driver, and improves the reliability and safety of the vehicle.

[0018] As an inventive concept, the present invention further provides a door control system for a rail transit vehicle, including:

A plurality of door controllers, wherein each of the door controllers correspondingly controls a door, and controls the door to be opened when a door opening instruction, a zero-speed signal, a door enabling signal and a platform enabling signal of the door are all valid.

[0019] Further, the door control system of the present invention further includes a plurality of door control switches, each of driver's rooms, crew rooms and/or mechanic's rooms shall be provided with a left/right door control switch, and the door control switches are all connected with a vehicle zero-speed relay; and the door control switch is used for sending a door opening instruction, a door closing instruction, a zero-speed signal and a door enabling signal to the door controller of the corresponding side.

[0020] Further, the door control system of the present invention further includes a vehicle-mounted signal device; and the vehicle-mounted signal device is used for detecting a platform side, a platform length and a stop position where the rail transit vehicle locates, and identifying, according to a set vehicle length and door layout, whether the door is on the platform side and in a platform range, and transmitting a platform enabling signal to the

corresponding door controller.

[0021] The vehicle-mounted signal device can be replaced by other single device or a plurality of devices to obtain a platform side, a platform length and a stop position. For example, the stop position can be obtained by GPS, the platform length can be obtained from a preset platform table, the platform side can be obtained by a platform detection device, etc.

[0022] Compared with the prior art, the present invention has the following beneficial effects: the present invention can ensure that only the doors on the platform side and in the platform range can be opened, thereby avoiding casualties caused when passengers or staffs get off the doors outside the platform, ensuring the safety of the passengers and staffs, and improving the safety of the vehicle; and the present invention has the advantages of safety, reliability, and is easy to be implemented and promoted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a structural block diagram of a door control system according to an embodiment of the present invention;

FIG. 2 is a flowchart of a door control method according to an embodiment of the present invention; FIG. 3 is a schematic diagram of determining whether doors are on a platform side and in a platform range according to an embodiment of the present invention; and

FIG. 4 is a flowchart of a method of determining whether doors are on a platform side and in a platform range according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0024] A rail transit vehicle according to an embodiment of the present invention includes a plurality of carriages, each of the carriages includes a plurality of doors I (1, 2, ..., n, n is the number of doors on a single side) and a plurality of doors II (1, 2, ..., n) respectively arranged on two sides of the carriage, each of the doors is correspondingly provided with a door controller and a door control switch (the door control switch may be installed in a driver's room, a crew room and a mechanic room), and a vehicle-mounted signal device and the door control switch are both connected with the door controller. The vehicle-mounted signal device detects a platform side, a platform length and a stop position where the rail transit vehicle locates, and can identify, according to a set vehicle length and door layout, whether the door is on the platform side and in a platform range. The vehicle-mounted signal device outputs a platform enabling signal when the door is on the platform side and in the platform range, and transmits the platform enabling signal to the corre-

sponding door controller via a hard wire or a communication bus. A door control signal should at least include a door opening instruction, a door closing instruction, a zero-speed signal, a door enabling signal, a platform enabling signal, etc. The door controller controls the door to be opened when the door opening signal, the zero-speed signal, the door enabling signal and the platform enabling signal are all valid.

[0025] The door opening instruction or door opening signal is sent by the door control switch. The door control switch is triggered to send the door opening instruction or door closing instruction to the door controller. The door opening instruction or door closing instruction is electrically a high level signal or low level signal. The specific door opening instruction being a high level signal or low level signal may be set. Assuming that the door opening instruction is a high level signal, when the door controller receives a high level signal from the door control switch, the door opening instruction is considered valid, otherwise the door opening instruction is invalid.

[0026] The zero-speed signal is sent by a zero-speed relay to the door controller through the door control switch. When the vehicle is stationary, the zero-speed relay is powered on and the zero-speed signal is valid.

[0027] The door enabling signal is sent by the vehicle-mounted signal device or the door control switch. The door enabling signal indicates whether the door can be controlled to be opened or closed. When the door enabling signal is valid, it indicates that the door can be controlled to be opened, otherwise the door cannot be controlled to be opened.

[0028] The platform enabling signal is sent to the door controller by the vehicle-mounted signal device. It is confirmed whether each door on the platform side can be opened, according to the determination whether the door is on the platform side and in the platform range. When a door is on the platform side and in the platform range, the platform enabling signal of the door is valid.

[0029] If the door opening signal, the zero-speed signal, the door enabling signal and the platform enabling signal of a door are all valid, the vehicle is stationary, the door can be controlled to be opened, and the door control switch of the door sends a door opening instruction. It is determined whether the door is on the platform side and in the platform range, which ensures that only the doors on the platform side and in the platform range can be opened, thereby avoiding casualties caused when passengers or staffs get off the doors outside the platform.

[0030] As shown in FIG. 1, a door control system according to an embodiment of the present invention includes: a vehicle-mounted signal device, a door controller, a door control switch, and an external display.

[0031] The vehicle-mounted signal device 101 is used for detecting a platform side, a platform length and a stop position where the rail transit vehicle locates, and identifying, according to a set vehicle length and door layout, whether a door is on the platform side and in a platform range, and transmitting a platform enabling signal to the

corresponding door controller. The platform enabling signal is transmitted to the door controller via a hard wire or a communication bus.

[0032] Each of the doors is provided with a door controller 102 for receiving a door control signal and controlling the door to be opened or closed. The door control signal should at least include a door opening instruction, a door closing instruction, a zero-speed signal, a door enabling signal, a platform enabling signal, etc., which can be transmitted to the door controller via a hard wire or a communication bus. The way to transmit a signal by a hard wire is more reliable. The door controller controls the door to be opened when the door opening signal, the zero-speed signal, the door enabling signal and the platform enabling signal are all valid.

[0033] The door control switch 103 is used for sending a door opening instruction, a door closing instruction, a door enabling instruction, etc. In front of the door control switch, a zero-speed signal (i.e., a zero-speed relay) shall be connected in series to ensure that a door opening instruction, a door closing instruction, a door enabling instruction, etc. can only be sent when the vehicle is stationary. The door control switch is not limited to being implemented by means of a hard button or a soft button of a switch or a display screen, and may also be integrated in the vehicle-mounted signal device, and the vehicle-mounted signal device automatically sends a door opening instruction, a door closing instruction, a door enabling instruction, etc.

[0034] The external display 104 is used for displaying information such as door state and platform enabling information. The external display is not limited to an LED display or an LCD display, or the external display is integrated in a vehicle monitoring display.

[0035] As shown in FIG. 2, a door control process according to an embodiment of the present invention is as follows:

S201. When a vehicle is stationary, a zero-speed relay is powered on and a zero-speed signal is valid.

S202. A vehicle-mounted signal device detects a platform side, a platform length and a stop position where the rail transit vehicle locates, determines, according to a set vehicle length and door layout, which doors are on the platform side and in a platform range, and transmits a platform enabling signal to a door controller.

S203. A door control switch sends a door opening/closing instruction, a door enabling signal, a zero-speed signal, etc.

S204. The door controller receives a door control signal, and the door controller controls a door to be opened when a door opening signal, a zero-speed signal, a door enabling signal and a platform enabling signal are all valid; and the door is not opened when any of the door opening signal, the zero-speed signal, the door enabling signal, and the platform enabling signal is invalid.

S205. Door status and platform enabling information are displayed on an external display to alert a driver or passengers.

[0036] With reference to FIG. 3 and FIG. 4, it is assumed that the length of a platform is L , the length of a vehicle is S , the distance between a first door and the front end of the vehicle is S_1 , the distance between a second door and the front end of the vehicle is S_2 , the distance between an n -th door and the front end of the vehicle is S_n , and the distance between a stop position and a platform starting point is S_0 . S_0 refers to the distance between the front end of the vehicle and the platform starting point, the first door refers to the first door near the front end of the vehicle on the platform side, the second door refers to the second door near the front end of the vehicle on the platform side, and so on. The n -th door refers to the n -th door near the front end of the vehicle on the platform side, and the front end of the vehicle refers to the end near the platform starting point. A method of determining whether a door is on a platform side and in a platform range is as follows:

1) After a vehicle stops, a stop position of the vehicle and a platform side corresponding to the stop position are obtained;

2) Whether the door is in a platform range is determined under the following two situations a) and b);

a) If the stop position does not exceed a platform starting point, whether $L - S_0 < S$ is true is determined;

i) If $L - S_0 < S$ is true, whether $S_1 < L - S_0$, $S_2 < L - S_0$, ..., and $S_n < L - S_0$ are true is determined respectively;

If $S_1 < L - S_0$ is true, the first door is in the platform range, otherwise not in the platform range.

If $S_2 < L - S_0$ is true, the second door is in the platform range, otherwise not in the platform range.

And so on;

If $S_n < L - S_0$ is true, the n -th door is in the platform range, otherwise not in the platform range.

ii) If $L - S_0 < S$ is not true, that is, $L - S_0 \geq S$ is true, all the doors on the platform side are in the platform range;

b) If the stop position exceeds the platform starting point, whether $S_1 < S_0$, $S_2 < S_0$, ..., and $S_n < S_0$ are true is determined respectively;

If $S_1 < S_0$, the first door is not in the platform range, otherwise whether $S_1 - S_0 < L$ is true

is determined, and if so, the first door is in the platform range, otherwise not in the platform range.

If $S2 < S0$ is true, the second door is not in the platform range, otherwise whether $S2 - S0 < L$ is true is determined, and if so, the second door is in the platform range, otherwise not in the platform range.

If $S_n < S0$ is true, the n-th door is not in the platform range, otherwise whether $S_n - S0 < L$ is true is determined, and if so, the n-th door is in the platform range, otherwise not in the platform range.

Claims

1. A rail transit vehicle, comprising a plurality of carriages, each having a plurality of doors arranged on two sides of the carriage, wherein:

each of the doors is correspondingly provided with a door controller for receiving a door control signal and controlling the door to open or close; the door control signal comprises a door opening instruction, a door closing instruction, a zero-speed signal, a door enabling signal and a platform enabling signal; and the door controller is configured to control the corresponding door to open when the door opening instruction, the zero-speed signal, the door enabling signal and the platform enabling signal are all valid.

2. The rail transit vehicle according to claim 1, wherein each of the doors is correspondingly provided with a door control switch, an input end of the door control switch is connected with a vehicle zero-speed relay, and an output end of the door control switch is connected with the corresponding door controller.

3. The rail transit vehicle according to claim 1, wherein the door controller is connected with a vehicle-mounted signal device, and the vehicle-mounted signal device is configured to detect a platform side, a platform length and a stop position where the rail transit vehicle locates, and to identify, according to a set vehicle length and door layout, whether the door is on the platform side and in a platform range, and transmitting a platform enabling signal to the corresponding door controller.

4. The rail transit vehicle according to one of claims 1 to 3, wherein the door controller is connected with a display arranged on an exterior side of the rail transit vehicle.

5. A door control method for a rail transit vehicle, where-

in the method comprises:

when a door opening instruction, a zero-speed signal, a door enabling signal and a platform enabling signal of a door are all valid, controlling a vehicle door to open; otherwise, controlling the door to remain closed.

6. The door control method for a rail transit vehicle according to claim 5, wherein a process of acquiring the platform enabling signal of the door comprises:

detecting a platform side, a platform length and a stop position where the rail transit vehicle locates;

determining, according to a set vehicle length and door layout, whether the door is on a platform side and in a platform range; and sending the platform an enabling signal if the door is on the platform side and in the platform range,

preferably, the step of determining whether the door is on the platform side and in a platform range comprises:

- (1) obtaining, after the vehicle stops, a stop position of the vehicle and the platform side corresponding to the stop position; and
- (2) determining whether the door is in the platform range under the following conditions:

a) if the stop position does not exceed a platform starting point on the platform side, determining whether $L - S0 < S$ is true;

if $L - S0 < S$ is true, respectively determining whether $S1 < L - S0$, $S2 < L - S0$, ..., and $S_n < L - S0$ are true;

if $S1 < L - S0$ is true, determining that a first door is in the platform range; otherwise, determining that the first door is not in the platform range;

if $S2 < L - S0$ is true, determining that a second door is in the platform range; otherwise, determining that the second door is not in the platform range;

and so on;

if $S_n < L - S0$ is true, determining that the n-th door is in the platform range;

otherwise, determining that the n-th door is not in the platform range; if $L - S0 < S$ is not true, that is, $L - S0 \geq S$, determining that all the

doors on the platform side are in the platform range;

b) if the stop position exceeds the platform starting point on the platform side, respectively determining whether $S1 < S0$, $S2 < S0$, ..., and $S_n < S0$ are true;

if $S1 < S0$ is true, determining that the first door is not in the platform range;

otherwise, determining whether $S1 - S0 < L$ is true, and if so, determining that the first door is in the platform range, otherwise determining that the first door is not in the platform range;

if $S2 < S0$ is true, determining that the second door is not in the platform range, otherwise, determining whether $S2 - S0 < L$ is true and if so, determining that the second door is in the platform range, otherwise determining that the second door is not in the platform range; and so on;

if $S_n < S0$ is true, determining that the n-th door is not in the platform range;

otherwise, determining whether $S_n - S0 < L$ is true and if so, determining that the n-th door is in the platform range, otherwise determining that the n-th door is not in the platform range;

where L is the length of a platform, S is the length of the vehicle, S1 is a distance between the first door and a front end of the vehicle, S2 is a distance between the second door and the front end of the vehicle, S_n is a distance between the n-th door and the front end of the vehicle, S0 is a distance between the stop position and the platform starting point, the first door refers to the first door near the front end of the vehicle on the platform side, and the front end of the vehicle refers to the end near the platform starting point.

7. The door control method for a rail transit vehicle according to claim 5, further comprising: displaying a door status and the platform enabling signal.

8. A door control system for a rail transit vehicle, comprising:

a plurality of door controllers, wherein each of the door controllers is configured to correspondingly control a door, and to control the door to open when a door opening instruction, a zero-speed signal, a

door enabling signal and a platform enabling signal of the door are all valid.

9. The door control system for a rail transit vehicle according to claim 8, further comprising:

a plurality of door control switches, wherein each of the doors is correspondingly provided with one of the door control switches, and the door control switches are all connected with a vehicle zero-speed relay; and

the door control switch is used for sending, to the corresponding door controller, a door opening instruction, a door closing instruction, a zero-speed signal and a door enabling signal that are used for the door controller to control the corresponding door.

10. The door control system for a rail transit vehicle according to claim 8, further comprising a vehicle-mounted signal device, wherein the vehicle-mounted signal device is configured to detect a platform side, a platform length and a stop position where the rail transit vehicle locates, to identify, according to a set vehicle length and door layout, whether the door is on the platform side and in a platform range, and to transmit a platform enabling signal to the corresponding door controller.

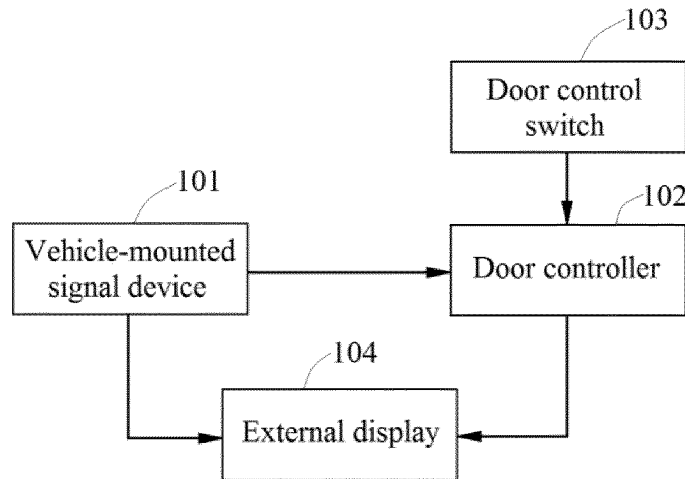


Fig. 1

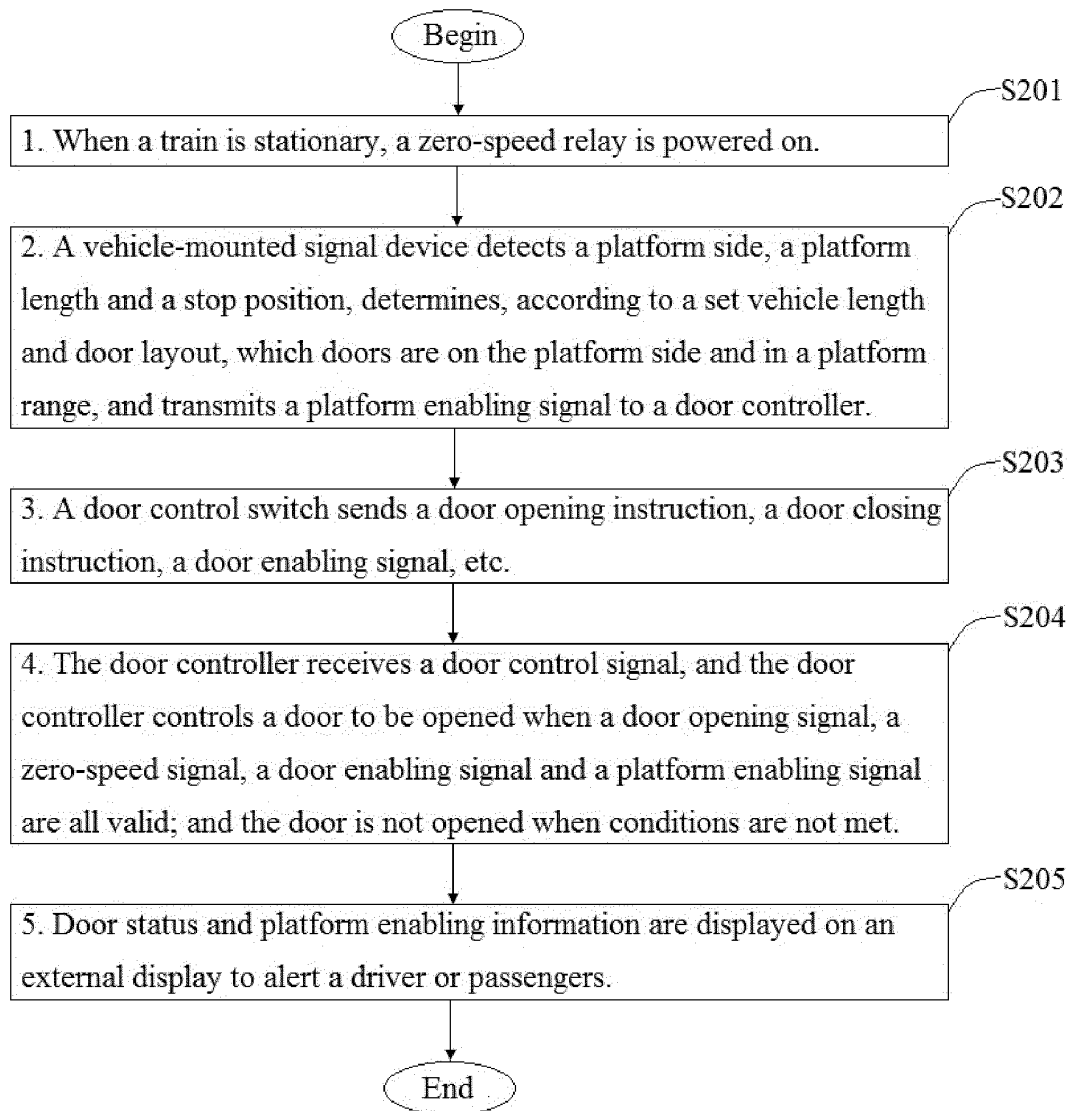


Fig. 2

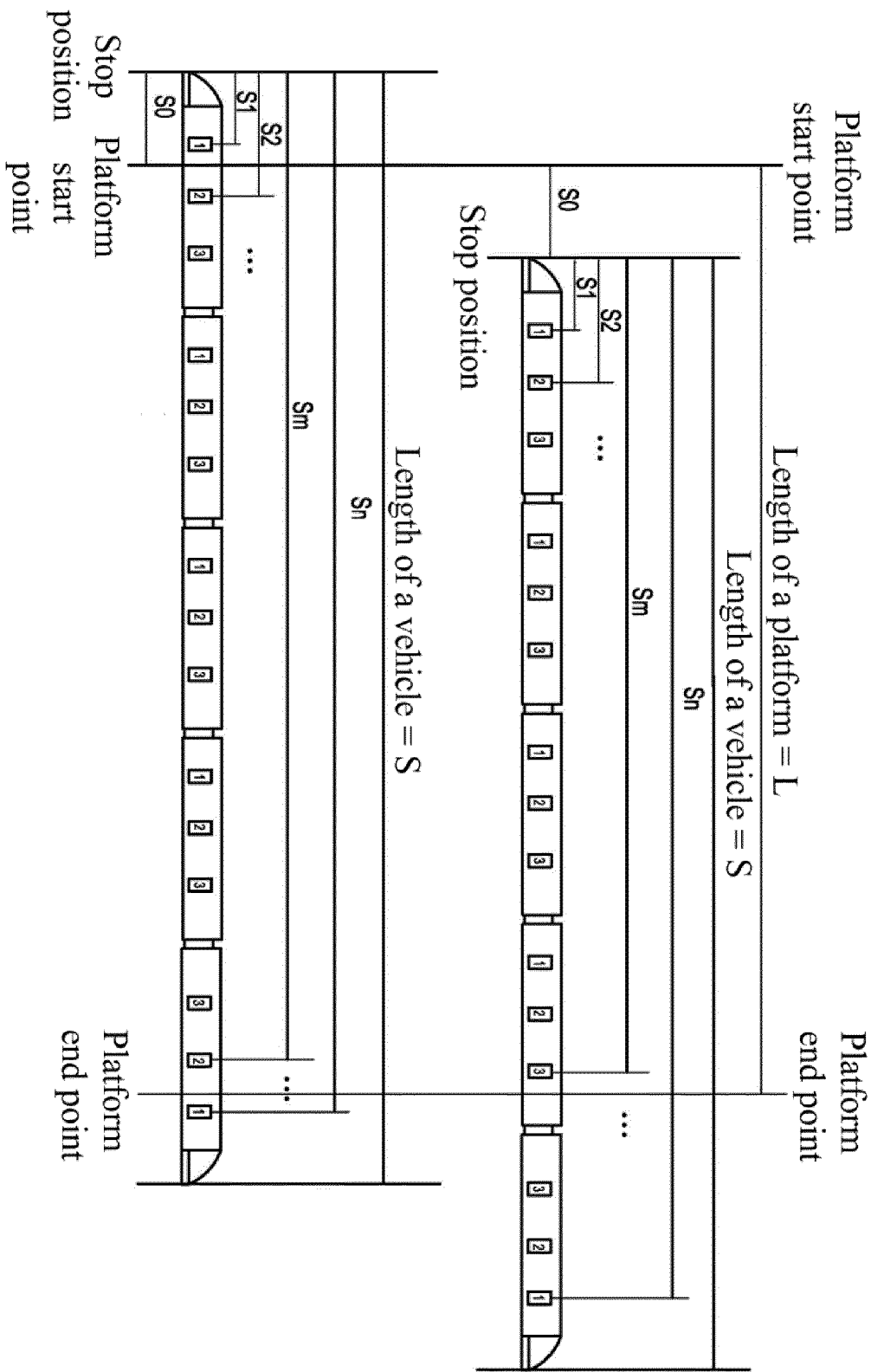


Fig. 3

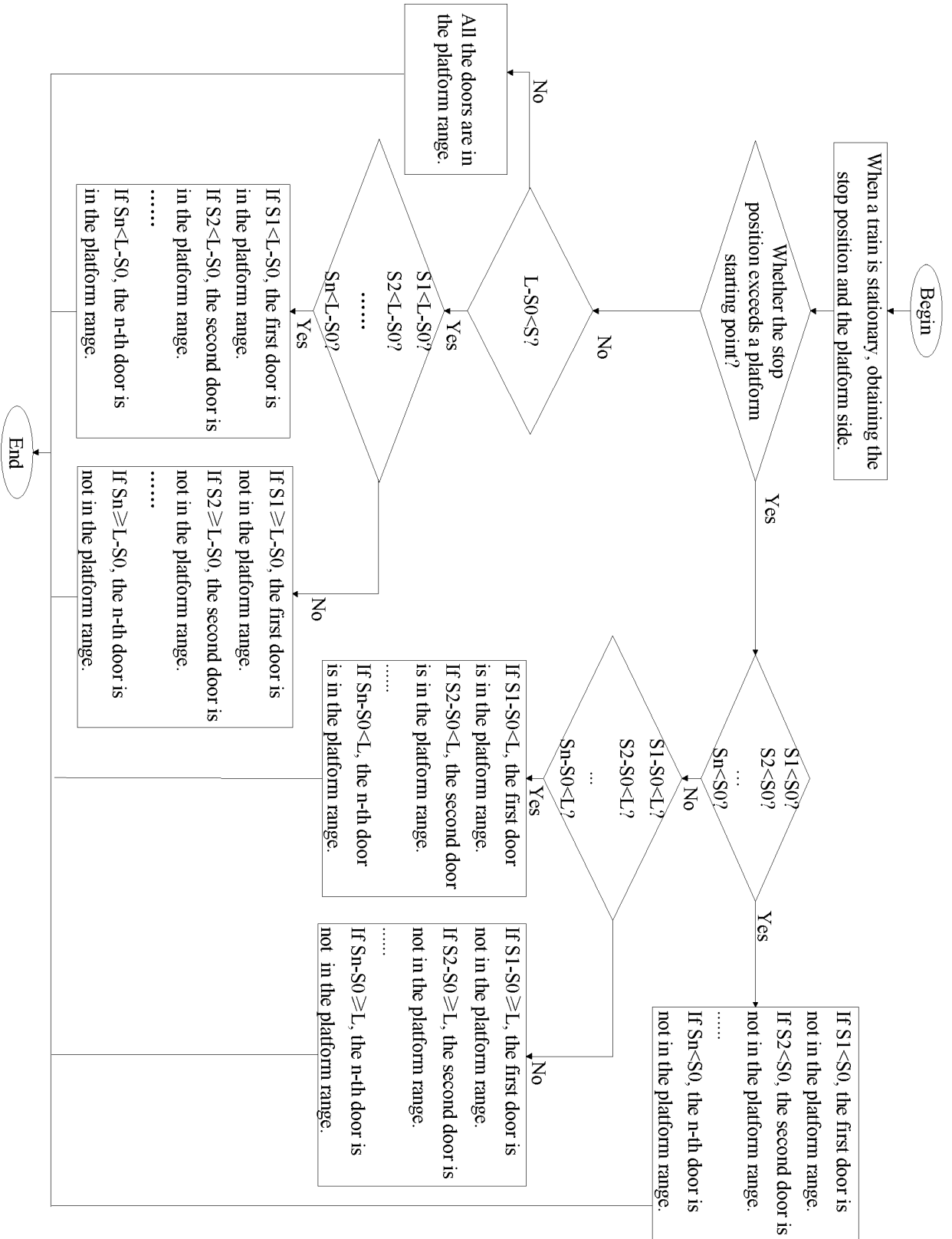


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/130772

A. CLASSIFICATION OF SUBJECT MATTER

E05F 15/73(2015.01)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)

E05F,G08G,B61B,B61K

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

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

VEN, CNKI, CNABS; vehicle, door, control, signal; 列车, 车辆, 控制信号, 车门

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	CN 111119652 A (CRRC ZHUZHOU LOCOMOTIVE CO., LTD.) 08 May 2020 (2020-05-08) description, pages 1-8, and figure 1	1-10
A	US 6208102 B1 (HONDA MOTOR CO., LTD. et al.) 27 March 2001 (2001-03-27) entire document	1-10
A	JP 2018145738 A (AUTO NETWORK GIJUTSU KENKYUSHO KK et al.) 20 September 2018 (2018-09-20) entire document	1-10
A	KR 20200020531 A (KOREA MOBILE TAXI WELFARE GROUP CORP et al.) 26 February 2020 (2020-02-26) entire document	1-10
A	CN 108877275 A (CHANGSHA RUNWEI ELECTROMECHANICAL TECHNOLOGY CO., LTD.) 23 November 2018 (2018-11-23) entire document	1-10

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

* Special categories of cited documents:

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Date of the actual completion of the international search

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Telephone No.

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INTERNATIONAL SEARCH REPORT

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT
Information on patent family members

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