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(54) TRAIN POSITION DETERMINATION AUXILIARY APPARATUS AND OPERATION METHOD THEREFOR

(57) A train position determining device of the present invention calculates train position information after a train is powered on according to whether or not the train moves, a moving direction, a moving distance and train position information before the train is powered off, which are provided by an auxiliary device, so that a process of redetermining a train position after the train is powered on is omitted, the train position determining device powered on again can quickly determine the train position, determined train position information is timely reported to ground equipment by means of onboard equipment, the train may quickly receive information such as movement permission from the ground equipment, a process of redetermining a train position after the train position determining device is powered on is omitted, then the train timely enters a normal operation mode, and operation efficiency is improved; and in addition, the train position determining device detects validity of trackside information according to the received trackside information provided by the auxiliary device and executes a command included in the valid trackside information, such as a level conversion command and a wireless calling command, thereby improving operation safety.

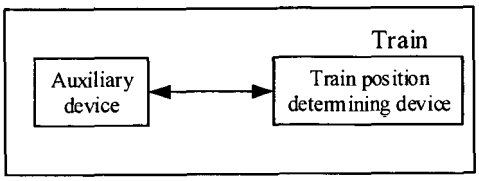

Fig. 1

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Description

FIELD OF TECHNOLOGY

[0001] The present invention belongs to the field of train control, and particularly relates to an auxiliary device for determining a train position and an operation method thereof.

BACKGROUND

[0002] After being powered off, an existing train position determining device cannot detect change of a train position if a train moves. So the device cannot determine the train position after the device is powered on again. Therefore, the train cannot enter a normal operation mode rapidly. The train can enter the normal operation mode only after running at a low speed for a certain distance and receiving trackside information, which causes low operation efficiency.

SUMMARY

[0003] In order to solve the above problem, the present invention provides an auxiliary device for determining a train position and an operation method thereof, which is capable of quickly determining the train position and enormously improving operation efficiency.

[0004] The present invention provides the auxiliary device for determining a train position, which includes a core processing unit, a speed and distance unit, a trackside information receiving unit and a recording unit,

[0005] wherein the speed and distance unit is configured to measure a speed and a distance of a train; the trackside information receiving unit is configured to receive trackside information; and the core processing unit monitors the train position in real time to determine a power-on condition of the device, calculates, based on the information from a train position determining device, output information of the speed and distance unit and output information of the trackside information receiving unit, whether or not the train moves, a moving direction, a moving distance and whether or not the trackside information is received, and stores a calculation result in the recording unit.

[0006] Furthermore, the auxiliary device for determining a train position and the train position determining device are both installed on the train.

[0007] Furthermore, the auxiliary device for determining a train position and the train position determining device may conduct information interaction in communication modes of IO, a CAN bus, an MVB, a Profibus, and a serial port.

[0008] Furthermore, the auxiliary device for determining a train position is provided with an independent power switch, and can be constantly in a power-on state.

[0009] The present invention further provides the operation method of the auxiliary device for determining a train position. The method includes the following steps:

1) monitoring, by the auxiliary device for determining a train position, a power-on state of a train position determining device in real time, and switching the auxiliary device for determining a train position into a sleep state if the train position determining device is determined to be in the power-on state;

2) switching the auxiliary device for determining a train position into an operating state if the train position determining device is determined to be in a power-off state, and monitoring a train state in real time when the train position determining device is in the power-off state; and

3) sending, by the auxiliary device for determining a train position, monitoring information when the train is in a power-off state to the train position determining device if the train position determining device is detected to be powered on again, and calculating, by the train position determining device, current train position information according to the received monitoring information sent by the auxiliary device for determining a train position.

[0010] Furthermore, in the step 2), the monitoring information of the auxiliary device for determining a train position includes whether or not the train moves, a moving direction, a moving distance and train position information before the train is powered off.

[0011] Furthermore, in the step 1), the auxiliary device for determining a train position only records information sent by the train position determining device when in the sleep state, but does not monitor an operation state of the train.

[0012] Furthermore, in the step 2), the auxiliary device for determining a train position may also receive trackside information and transmits the trackside information to the train position determining device after the train position determining device is powered on.

[0013] Furthermore, in the step 3), the train position determining device may also detect validity of trackside information transmitted by the auxiliary device for determining a train position and execute a command included in the valid trackside information.

[0014] Furthermore, the command includes a level conversion command and a wireless calling command.

[0015] According to the method and the device of the present invention, the train position determining device calculates train position information after the train is powered on according to whether or not the train moves, the moving direction, the moving distance and the train position information before the train is powered off, which are provided by the auxiliary device, determined train position information is timely reported to ground equipment by means of onboard equipment, and meanwhile, information such as movement permission is quickly received on the ground, so that a process of redetermining the train position after the train is powered on is omitted, the

train position determining device powered on again can quickly determine the train position, the determined train position information is timely reported to the ground equipment by means of the onboard equipment, the train may quickly receive the information such as the movement permission from the ground equipment, a process of redetermining the train position after the train position determining device is powered on is omitted, operating efficiency is greatly improved, then the train timely enters a normal operation mode, and operation efficiency is improved; and in addition, the train position determining device detects the validity of the trackside information according to the received trackside information provided by the auxiliary device and executes the command included in the valid trackside information, such as the level conversion command and the wireless calling command, thereby improving operation safety.

[0016] Other features and advantages of the present invention will be explained in the following specification, part of which will be obvious in the specification, or may be known through implementation of the present invention. The objective and other advantages of the present invention may be realized and obtained by means of the structure pointed out by the specification, the claims and the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] In order to more clearly illustrate technical solutions in the embodiments of the present invention or in the prior art, a brief introduction to the accompanying drawings required for the description of the embodiments or the prior art will be provided below. Obviously, the accompanying drawings in the following description are some of the embodiments of the present invention, and those of ordinary skill in the art would also be able to derive other drawings from these drawings without making creative efforts.

[0018] Fig. 1 shows a position arrangement diagram of a device according to embodiments of the present invention.

DESCRIPTION OF THE EMBODIMENTS

[0019] In order to make objectives, technical solutions and advantages of embodiments of the present invention more obvious, the technical solutions in the embodiments of the present invention will be clearly and completely described below in conjunction with accompanying drawings in the embodiments of the present invention. Obviously, the described embodiments are some, rather than all of the embodiments of the present invention. Based on the embodiments of the present invention, all other embodiments obtained by those of ordinary skill in the art without making creative efforts fall within the scope of protection of the present invention.

[0020] After being powered off, an existing train position determining device cannot detect change of a train position if a train moves. So the device cannot determine the train position after the device is powered on again. Therefore, the train cannot enter a normal operation mode rapidly. The train can enter the normal operation mode only after running at a low speed for a certain distance and receiving trackside information, which causes low operation efficiency. The present invention designs an auxiliary method and device for determining the train position. After the train position determining device is powered off, the auxiliary device uses a UPS or other power sources for power supply to continuously operate, and whether or not the train moves, a moving distance, etc. are determined by means of a sensor when the train moves. After the train position determining device is powered on, the auxiliary device sends moving information of the train to the train position determining device, so that the train position determining device can quickly determine the train position, and then the train enters the normal operation mode timely, thereby improving the operation efficiency. The sent information includes, but is not limited to, whether or not the train moves, a moving direction, the moving distance, whether or not the trackside information is received, and the trackside information.

[0021] As shown in Fig. 1, the auxiliary device for determining a train position and the train position determining device are both installed on the train, and the auxiliary device for determining a train position and the train position determining device may conduct information interaction in communication modes of IO, a CAN bus, an MVB, a Profibus, a serial port, etc. The auxiliary device for determining a train position is provided with an independent power switch, and can be constantly in a power-on state, that is, after the train position determining device is powered off, the auxiliary device for determining a train position may still be in the power-on state independently.

[0022] The auxiliary device for determining a train position includes a core processing unit, a speed and distance unit, a trackside information receiving unit and a recording unit, wherein the speed and distance unit is configured to measure a speed and a distance of the train; the trackside information receiving unit is configured to receive the trackside information; and the core processing unit calculates, based on information from the train position determining device, output information of the speed and distance unit and output information of the trackside information receiving unit, whether or not the train moves, the moving direction, the moving distance, whether or not the trackside information is received, the trackside information, etc., and stores the calculation results in the recording unit.

[0023] Specifically, the speed and distance unit, the trackside information receiving unit and the recording unit are all connected to the core processing unit, and the speed and distance unit, the trackside information receiving unit and the recording unit independently exist without any connection among them.

[0024] Specifically, the train position determining de-

vice provides initial state information for the core processing unit, which includes train position information after stop, etc.

[0025] Specifically, after entering an operating state, the auxiliary device calculates, based on the initial state information, information such as the train position and a direction in real time according to the output information of the speed and distance unit and the output information of the trackside information receiving unit; and after the train position determining device enters the operating state, the auxiliary device reports whether or not the train moves, the moving direction, the moving distance, whether or not the trackside information is received, the trackside information, etc. to the train position determining device, and the train position determining device calculates train position information after the train is powered on according to information provided by the auxiliary device, checks validity of the trackside information provided by the auxiliary device and executes a command included in the valid trackside information.

[0026] When the train position determining device is in the power-on state, the auxiliary device for determining a train position only records the information sent by the train position determining device when in a sleep state, but does not monitor an operation state of the train.

[0027] When the train position determining device is in a power-off state, the auxiliary device for determining a train position enters the operating state, and the train position determining device sends the initial state information of the train, such as the train position information after the stop, to the core processing unit; and the core processing unit calculates, based on an initial state of the train, whether or not the train moves, the moving direction, the moving distance, whether or not the trackside information is received, the trackside information, etc. in real time according to the output information of the speed and distance unit and the output information of the trackside information receiving unit, and stores the results in the recording unit.

[0028] After the train position determining device is detected to be powered on, the auxiliary device for determining a train position sends monitoring information when the train is in the power-off state to the train position determining device, which includes whether or not the train moves, the moving direction, the moving distance, whether or not the trackside information is received, etc.

[0029] The train position determining device calculates the train position information after the train is powered on according to whether or not the train moves, the moving direction, the moving distance and train position information before the train is powered off, and the information such as whether or not the train moves, the moving direction, the moving distance and train position information before the train is powered off, are provided by the auxiliary device for determining a train position, detects the validity of the trackside information provided by the auxiliary device for determining a train position and executes the command included in the valid trackside information, such as a level conversion command and a wireless calling command, thereby improving operating efficiency. Meanwhile, onboard equipment reports the determined train position information to ground equipment, so that information such as movement permission may be quickly received on the ground, thereby omitting a process of redetermining the train position after the train is powered on, and improving the operating efficiency.

[0030] According to the method and the device of the present invention, the train position determining device calculates train position information after the train is powered on according to whether or not the train moves, the moving direction, the moving distance and the train position information before the train is powered off, which are provided by the auxiliary device, determined train position information is timely reported to ground equipment by means of onboard equipment, and meanwhile, information such as movement permission is quickly received on the ground, so that a process of redetermining the train position after the train is powered on is omitted, the train position determining device powered on again can quickly determine the train position, the determined train position information is timely reported to the ground equipment by means of the onboard equipment, the train may quickly receive the information such as the movement permission from the ground equipment, a process of redetermining the train position after the train position determining device is powered on is omitted, operating efficiency is greatly improved, then the train timely enters a normal operation mode, and operation efficiency is improved; and in addition, the train position determining device detects the validity of the trackside information according to the received trackside information provided by the auxiliary device and executes the command included in the valid trackside information, such as the level conversion command and the wireless calling command, thereby improving operation safety.

[0031] Although the present invention is described in detail with reference to the above-mentioned embodiments, those of ordinary skill in the art should understand that they may still make modifications to the technical solutions described in the above-mentioned embodiments or equivalent replacements to part of technical features therein; and these modifications or replacements do not make the essence of the corresponding technical solutions depart from the spirit and scope of the technical solutions of the embodiments of the present invention.

Claims

1. An auxiliary device for determining a train position, **characterized in that** the auxiliary device comprises a core processing unit, a speed and distance unit, a trackside information receiving unit and a recording unit,
   wherein the speed and distance unit is configured to

measure a speed and a distance of a train; the trackside information receiving unit is configured to receive trackside information; and the core processing unit monitors a power-on condition of a train position determining device in real time, calculates, based on information from a train position determining device, output information of the speed and distance unit and output information of the trackside information receiving unit, whether or not the train moves, a moving direction, a moving distance and whether or not the trackside information is received, and stores a calculation result in the recording unit.

2. The auxiliary device for determining a train position according to claim 1, **characterized in that** the auxiliary device for determining a train position and the train position determining device are both installed on the train.

3. The auxiliary device for determining a train position according to claim 1, **characterized in that** the auxiliary device for determining a train position and the train position determining device can conduct information interaction in communication modes of IO, a CAN bus, an MVB, a Profibus, and a serial port.

4. The auxiliary device for determining a train position according to claim 1, **characterized in that** the auxiliary device for determining a train position is provided with an independent power switch and can be constantly in a power-on state.

5. An operation method of the auxiliary device for determining a train position according to any of claims 1-4, **characterized in that** the method comprises the following steps:

1) monitoring, by the auxiliary device for determining a train position, a power-on state of a train position determining device in real time, and switching the auxiliary device for determining a train position into a sleep state if the train position determining device is determined to be in the power-on state;
2) switching the auxiliary device for determining a train position into an operating state if the train position determining device is determined to be in a power-off state, and monitoring a train state in real time when the train position determining device is in the power-off state; and
3) sending, by the auxiliary device for determining a train position, monitoring information when the train is in the power-off state to the train position determining device if the train position determining device is detected to be powered on again, and calculating, by the train position determining device, current train position information according to the received monitoring information sent by the auxiliary device for determining a train position.

6. The operation method according to claim 5, **characterized in that** in the step 2), the monitoring information of the auxiliary device for determining a train position comprises whether or not the train moves, a moving direction, a moving distance and train position information before a train is powered off.

7. The operation method according to claim 5, **characterized in that** in the step 1), the auxiliary device for determining a train position only records information sent by the train position determining device when in the sleep state, but does not monitor an operation state of the train.

8. The operation method according to claim 5, **characterized in that** in the step 2), the auxiliary device for determining a train position can also receive trackside information and transmits the trackside information to the train position determining device after the train position determining device is powered on.

9. The operation method according to claim 5, **characterized in that** in the step 3), the train position determining device can also detect validity of the trackside information transmitted by the auxiliary device for determining a train position and executes a command included in the valid trackside information.

10. The operation method according to claim 9, **characterized in that** the command comprises a level conversion command and a wireless calling command.

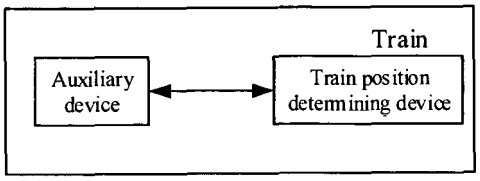
Train
Auxiliary device
Train position determining device

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/102937

A. CLASSIFICATION OF SUBJECT MATTER

B61L 25/02(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B61L

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)

CNABS; CNTXT; CNKI; SIPOABS; DWPI; USTXT; WOTXT; EPTXT: 北京全路通信, 王建敏, 张友兵, 陈志强, 孟凡勇, 于晓娜, 赵山河, 火车, 列车, 定位, 位置, 上电, 休眠, 关停, 待机, 断电, 地面, 存储, 测速, 记录, 速度, 冷运动, 冷移动, 辅助, GPS, CMD, train+, vehicle, locat+, position+, auxiliary, speed+, velocity, power, state, off, on, sleep, mode, standby, record+, memory, underground, ground, cold movement

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 112356882 A (BEIJING NATIONAL RAILWAY RESEARCH & DESIGN INSTITUTE OF SIGNAL & COMMUNICATION LTD.) 12 February 2021 (2021-02-12) claims 1-10, description paragraphs [0022]-[0033], figure 1	1-10
X	CN 109677453 A (UNITTEC CO., LTD.) 26 April 2019 (2019-04-26) description, paragraphs [0003]-[0031]	1-10
X	CN 109803870 A (SIEMENS AG) 24 May 2019 (2019-05-24) description paragraphs [0005]-[0051], figures 1, 2	1-10
A	CN 104442928 A (BEIJING TRAFFIC CONTROL TECHNOLOGY CO., LTD.) 25 March 2015 (2015-03-25) entire document	1-10
A	CN 106274986 A (BEIJING ZHONGNANSHAN TECHNOLOGY DEVELOPMENT CO., LTD.) 04 January 2017 (2017-01-04) entire document	1-10
A	DE 102011077760 A1 (DEUTA WERKE GMBH) 20 December 2012 (2012-12-20) 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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"P" document published prior to the international filing date but later than the priority date claimed
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 August 2021	**13 September 2021**

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Facsimile No. **(86-10)62019451**	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/102937

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 112356882 A	12 February 2021	None	
CN 109677453 A	26 April 2019	CN 109677453 B	09 April 2021
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		WO 2018069033 A1	19 April 2018
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CN 106274986 A	04 January 2017	None	
DE 102011077760 A1	20 December 2012	None	

Form PCT/ISA/210 (patent family annex) (January 2015)