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(54) **RAIL TRAIN SMART ANTI-CLIMBING SYSTEM, CONTROL METHOD, AND RAIL TRAIN**

(57) The present application provides a rail train smart anti-climbing system, a control method, and a rail train. The rail train smart anti-climbing system comprises: a detection module, that is used for detecting obstacles in real time; a smart anti-climbing device, that comprises an anti-climbing device body and an energy absorption part that is connected to the anti-climbing device body and that can extend out relative to the anti-climbing device body; and a control module, that is separately signally connected to the detection module and the smart anti-climbing device and is used for, according to the detection module detecting an obstacle, controlling the smart anti-climbing device to carry out corresponding actions. The present application can actively identify obstacles in front of a train, automatically control the smart anti-climbing device to respond in real time, actively improve energy absorption performance, thereby increasing the safe collision speed of urban rail vehicles, and protecting the personal safety of drivers and passengers as well as the integrity of the train body structure.

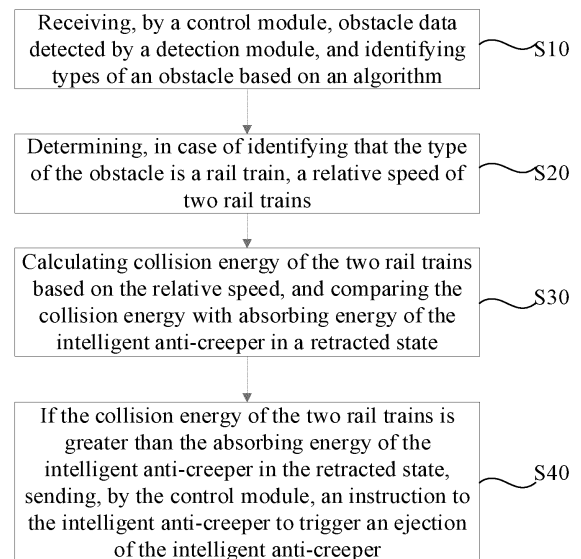


FIG. 4

Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to Chinese patent application No. 202111223607.2 filed on October 20, 2021, entitled "Rail Train Smart Anti-Climbing System, Control Method, and Rail Train", which is hereby incorporated by reference in its entirety.

FIELD

[0002] The present application relates to the field of rail train safety, and in particular to an intelligent anti-creeper system for a rail train, a control method, and a rail train.

BACKGROUND

[0003] With the continuous development of urbanization, a passenger flow intensity of urban rail transit continues to increase, a departure interval continues to be decreased, and the safety and reliability of vehicle operation are the primary concerns of manufacturers, operators and the public. While further strengthening active safety protection measures for urban rail vehicles and reducing collision accidents, studying how to improve the crash worthiness of rail trains from the perspective of passive safety protection and protect the safety of drivers and passengers as much as possible has become a hot topic in the current research and development of rail trains.

[0004] Due to the structural characteristics, coupling requirements, and curve passing capacities of urban rail vehicles, the installation and deformation space of the energy absorption device at the front end of the vehicle body is limited during operation, resulting in lower energy absorption of the entire vehicle.

SUMMARY

[0005] The present application provides an intelligent anti-creeper system for a rail train, which may actively identify an obstacle in front of a vehicle, automatically control an intelligent anti-creeper to make a real-time response, and actively improve energy-absorbing performance, thereby improving a safe collision speed of an urban rail vehicle, protecting personal safety of drivers and passengers, and integrity of a vehicle body structure.

[0006] The present application further provides a control method of an intelligent anti-creeper system for a rail train.

[0007] The present application further provides a rail train.

[0008] The present application provides an intelligent anti-creeper system for a rail train, including:

a detection module, used for detecting an obstacle

in real time;

an intelligent anti-creeper, including an anti-creeper body and an energy-absorbing portion connected to the anti-creeper body and stretchable relative to the anti-creeper body; and

a control module, connected communicatively to the detection module and the intelligent anti-creeper, respectively, and used for controlling the intelligent anti-creeper to act correspondingly based on a detection of the obstacle by the detection module.

[0009] According to an embodiment of the present application, the intelligent anti-creeper further includes a stopper;

the energy-absorbing portion has a first position and a second position relative to the anti-creeper body; in the first position, the energy-absorbing portion is at least partially located inside the anti-creeper body; and in the second position, the energy-absorbing portion stretches out of the anti-creeper body and is locked in the second position through the stopper.

[0010] According to an embodiment of the present application, a triggering mechanism is provided inside the intelligent anti-creeper, and the triggering mechanism is provided at a rear end of the anti-creeper body close to the energy-absorbing portion; and the triggering mechanism is suitable for triggering the energy-absorbing portion to be ejected out of the anti-creeper body.

[0011] According to an embodiment of the present application, the triggering mechanism is connected communicatively to the control module.

[0012] According to an embodiment of the present application, the intelligent anti-creeper system further includes an emergency braking module, the emergency braking module is connected communicatively to the control module and used for sending an emergency signal to the control module, and the control module controls the energy-absorbing portion to be ejected out of the anti-creeper body.

[0013] According to an embodiment of the present application, the emergency braking module is provided in a driver's cab of the rail train.

[0014] According to an embodiment of the present application, the emergency braking module is an emergency braking button, and the emergency braking button is provided on a console in the driver's cab.

[0015] The present application further provides a control method of an intelligent anti-creeper system for a rail train, including:

receiving, by a control module, obstacle data detected by a detection module and identifying a type of an obstacle based on an algorithm;
determining, in case of identifying that the type of the obstacle is a rail train, a relative speed of two rail trains;
calculating collision energy of the two rail trains based on the relative speed, and comparing the col-

lision energy with absorbing energy of an intelligent anti-creeper in a retracted state; and if the collision energy of the two rail trains is greater than the absorbing energy of the intelligent anti-creeper in the retracted state, sending an instruction to the intelligent anti-creeper to trigger an ejection of the intelligent anti-creeper.

[0016] According to an embodiment of the present application, calculating the collision energy of the two rail trains based on the relative speed, and comparing the collision energy with the absorbing energy of the intelligent anti-creeper in the retracted state further includes: calculating the collision energy of the two rail trains based on masses of the two rail trains and the relative speed, and comparing the collision energy with the absorbing energy of the intelligent anti-creeper in the retracted state.

[0017] The embodiment of the present application further provides a rail train, provided with the above-mentioned rail train intelligent anti-creeper system in which the intelligent anti-creeper is installed below a locomotive of the rail train.

[0018] The intelligent anti-creeper system for the rail train provided in the present application actively determines whether the intelligent anti-creeper needs to be ejected using the control module, thereby improving the energy-absorbing capacity of the anti-creeper. The system has high speed for identification and high reliability, being able to actively improve energy-absorbing performance, thereby improving a safe collision speed of an urban rail vehicle, protecting personal safety of drivers and passengers, and ensuring integrity of the vehicle body structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] To more clearly illustrate the solutions of the embodiments based on the present application or the related art, the accompanying drawings used in the description of the embodiments or the related art are briefly introduced below. It should be noted that the drawings in the following description are only some embodiments of the present application. For those of ordinary skill in the art, other drawings may be obtained based on these drawings without creative effort.

FIG. 1 is a schematic diagram of a connection relationship of an intelligent anti-creeper system for a rail train according to an embodiment of the present application;

FIG. 2 is a schematic structural diagram of the intelligent anti-creeper in a retracted state in FIG. 1;

FIG. 3 is a schematic structural diagram of the intelligent anti-creeper in a stretched state in FIG. 1;

FIG. 4 is a flowchart of a control method of an intelligent anti-creeper system for a rail train according to an embodiment of the present application; and

FIG. 5 is a flowchart of a control method of an intelligent anti-creeper system for a rail train in a specific embodiment of the present application.

Reference numerals:

[0020] 1, control module; 2, detection module; 3, intelligent anti-creeper; 31, anti-creeper body; 32, energy-absorbing portion; 33, stopper; 4, emergency braking module.

DETAILED DESCRIPTION

[0021] To make the purpose, technical solution, and advantages of the present application clearer, the following provides a clear and complete description of the technical solution in the present application in conjunction with the accompanying drawings. The described embodiments are part of the embodiments of the present application, not all of them. Based on the embodiments in the present application, all other embodiments obtained by those of ordinary skill in the art without creative effort fall within the scope of protection in the present application.

[0022] As shown in FIG.s 1 to 3, embodiments of the present application provide an intelligent anti-creeper system for a rail train. The intelligent anti-creeper system for the rail train includes a detection module 2, an intelligent anti-creeper 3, and a control module 1 connected communicatively to the detection module 2 and the intelligent anti-creeper 3, respectively.

[0023] The detection module 2 is used for detecting an obstacle in real time, and the detection module 2 may be installed on a locomotive of the rail train to detect the obstacle in front of the rail train; and the detection module 2 may be a signal acquisition sensor or a high-definition camera or other image acquisition devices.

[0024] The intelligent anti-creeper 3 includes an anti-creeper body 31, and an energy-absorbing portion 32 connected to the anti-creeper body 31 and may stretch relative to the anti-creeper body 31. The anti-creeper body 31 is also an energy absorption module, and the energy-absorbing portion 32 is installed in the anti-creeper body 31. The energy-absorbing portion 32 may stretch out of the anti-creeper body 31 along an axial direction of the anti-creeper body 31, thereby prolonging a total length of an energy absorption structure, increasing an energy-absorbing stroke, and improving passive safety performance.

[0025] It should be noted that under normal conditions, the energy-absorbing portion 32 is at least partially hidden within the anti-creeper body 31, which may neither affect an appearance of the rail train and nor change structure characteristics of the rail train locomotive.

[0026] The control module 1 is connected communicatively to the detection module 2 and the intelligent anti-creeper 3, respectively. The control module 1 may be a micro-controller used to control the intelligent anti-creeper 3 to act correspondingly based on detection of the

obstacle by the detection module 2.

[0027] "To control the intelligent anti-creeper 3 to act correspondingly" may be understood as, when the control module 1 determines that collision energy between an obstacle rail train and a host rail train exceeds absorbing energy of the anti-creeper body 31, the control module 1 triggers the energy-absorbing portion 32 to stretch out of the anti-creeper body 31, to improve energy-absorbing capacity of the intelligent anti-creeper 3, and actively improve the energy-absorbing performance, thereby enhancing a safe collision speed of the rail train, protecting the personal safety of drivers and passengers, and ensuring the integrity of a vehicle body structure. When the control module 1 determines that the collision energy between the obstacle rail train and the host rail train is within the energy absorption range of the anti-creeper body 31, it is not necessary to send an ejection signal to the intelligent anti-creeper 3. Thus, the intelligent anti-creeper 3 does not eject.

[0028] In an embodiment, the anti-creeper body 31 is an energy-absorbing tube structure, of which a first end is an installation end and a second end is an opening end. The energy-absorbing portion 32 is the energy-absorbing tube structure penetrating inside the anti-creeper body 31, and the anti-creeper body 31 and the energy-absorbing portion 32 are provided coaxially. The anti-creeper body 31 is installed on a vehicle body through the installation end, and the anti-creeper body 31 is not movable. The energy-absorbing portion 32 may stretch to a maximum length relative to the opening end of the anti-creeper body 31.

[0029] To keep the energy-absorbing portion in a fixed position after stretching, according to an embodiment of the present application, as shown in FIG. 2 and FIG. 3, the intelligent anti-creeper 3 further includes a stopper 33.

[0030] The energy-absorbing portion 32 has a first position and a second position relative to the anti-creeper body 31. In the first position, the energy-absorbing portion 32 is at least partially located inside the anti-creeper body 31, i.e., the first position is a position where the energy-absorbing portion 32 is not stretched. In the second position, the energy-absorbing portion 32 stretches out of the anti-creeper body 31 and is locked in the second position through the stopper 33, i.e., the second position is a position where the energy-absorbing portion 32 stretches. By using the stopper 33, positions of the energy-absorbing portion 32 relative to the anti-creeper body 31 may be fixed after the energy-absorbing portion 32 stretches, which increases the energy-absorbing stroke of the intelligent anti-creeper 3. The stopper 33 may be a stop block, and the stop block is installed on the anti-creeper body 31. There may be multiple stop blocks, such as two in a group, located on opposite sides of a diameter direction of the anti-creeper body 31. The stop blocks may be provided on a side wall of the anti-creeper body 31 close to the opening end, with a groove on the side wall of the opening end. An end of the energy-

absorbing portion 32 is a front end, and the other end of the energy-absorbing portion 32 is a rear end. The side wall close to the rear end of the energy-absorbing portion 32 is provided with stop grooves corresponding to stop blocks one by one. An end of the stop block is installed on the anti-creeper body 31 through an elastic member, and the other end of the stop block is tilted downward and pressed on the side wall of the energy-absorbing portion 32. When the energy-absorbing portion 32 stretches to a maximum length, the stop block is directly aligned with the stop groove, and the stop block is clamped in the stop groove to stop the energy-absorbing portion 32. That is, the energy-absorbing portion 32 is limited to keep the energy-absorbing portion 32 in the second position.

[0031] According to an embodiment of the present application, a triggering mechanism is provided inside the intelligent anti-creeper 3, and the triggering mechanism is provided at a rear end of the anti-creeper body 31 close to the energy-absorbing portion 32. The triggering mechanism is suitable for triggering the energy-absorbing portion 32 to eject out of the anti-creeper body 31. The energy-absorbing portion 32 is powered by the triggering mechanism, and the energy-absorbing portion 32 may be pushed out when necessary. The triggering mechanism may be a quick ejection device, as well as a high-pressure air cylinder, a hydraulic cylinder, or a gas cylinder.

[0032] According to an embodiment of the present application, the triggering mechanism is connected communicatively to the control module 1. Taking the triggering mechanism being the quick ejection device as an example, the quick ejection device may store an appropriate amount of energy-accumulating matter inside. The control module 1 sends an electrical signal to the quick ejection device to trigger the release of energy from the energy-accumulating matter, and the generated impact force pushes the energy-absorbing portion 32 to eject.

[0033] The quick ejection device includes a storage housing and energy-accumulating matter provided inside the storage housing. The storage housing is fixedly installed on a rear end cover inside the anti-creeper body 31, a shape of the storage housing may be a box shape, a bowl shape, etc., and the specific shape is not limited thereto. The storage housing is small in volume, occupies little space, and does not occupy installation space of the energy-absorbing portion 32. The storage housing may be bonded or connected through a fastener, etc., to the rear end cover inside the anti-creeper body 31. The specific installation mode is not limited, as long as the storage housing may be installed on the rear end cover inside the anti-creeper body 31. In the first position, the rear end of the energy-absorbing portion 32 is close to or in contact with the storage housing, so that the generated thrust may be applied to the energy-absorbing portion 32 as much as possible after the energy-accumulating matter inside the storage housing is triggered, thereby improving an energy utilization efficiency.

[0034] The specific amount of energy-accumulating matter placed inside the storage housing depends on the required thrust. The larger the required thrust, the more energy-accumulating matter is placed. The energy-accumulating matter may be an explosive that may release energy under an action of an electric spark.

[0035] The present embodiment provides thrust through the quick ejection device, which is smaller in volume and lighter in weight than structures such as screws and hydraulic devices, and may provide sufficient thrust when occupying smaller space.

[0036] According to an embodiment of the present application, the system further includes with an emergency braking module 4, and the emergency braking module 4 is connected communicatively to the control module 1. By triggering the emergency braking module 4, an emergency signal is sent to the control module 1, and the control module 1 controls the energy-absorbing portion 32 to eject out of the anti-creeper body 31. The emergency braking module 4 is used in emergency of malfunction of the detection module 2, to increase the safety of the rail train operation and reduce losses during collisions.

[0037] According to an embodiment of the present application, to facilitate in operating the emergency braking module 4, the emergency braking module 4 is located in a driver's cab of the rail train, and the driver's cab of the rail train is located at a head of the rail train. The driver's cab has a wide field of view, and the driver may clearly determine whether there is a rail train running in opposite directions in front of the rail train. Therefore, the emergency braking module 4 is provided in the driver's cab and may be operated by the driver.

[0038] According to an embodiment of the present application, the emergency braking module 4 is an emergency braking button, and the emergency braking button is provided on a console in the driver's cab for easy operation by the driver.

[0039] As shown in FIG. 4, the present embodiment provides a control method of an intelligent anti-creeper system for a rail train, the method includes the following steps:

S10, receiving, by the control module 1, obstacle data detected by the detection module 2, and identifying a type of an obstacle based on an algorithm; the specific algorithm is not limited in the present embodiment, and any algorithm that may identify the type of obstacle in prior art is acceptable;

S20, determining, in case of identifying that the type of the obstacle is a rail train, a relative speed of two rail trains;

S30, calculating collision energy of the two rail trains based on the relative speed, and comparing the collision energy with absorbing energy of the intelligent anti-creeper 3 in the retracted state; and

S40, if the collision energy of the two rail trains is greater than the absorbing energy of the intelligent

anti-creeper 3 in the retracted state, sending, by the control module 1, an instruction to the intelligent anti-creeper 3 to trigger an ejection of the intelligent anti-creeper 3. If the collision energy of the two rail trains is within an energy absorption range of the intelligent anti-creeper 3 in the retracted state, the control module 1 does not need to send the instruction to the intelligent anti-creeper 3, and the intelligent anti-creeper 3 remains in the retracted state. By automatically calculating the relative speed and the amount of energy to be dissipated through the control module 1, the method actively determines whether an ejection action is needed to improve the energy-absorbing capacity of the intelligent anti-creeper 3. The method has high speed for identification and high reliability.

[0040] According to an embodiment of the present application, S30 further includes: calculating the collision energy of the two rail trains based on masses of the two rail trains and the relative speed, and compare the collision energy with the absorbing energy of the intelligent anti-creeper 3 in the retracted state.

[0041] A specific embodiment is taken as an example to illustrate the control method of the intelligent anti-creeper system for the rail train in the present application. As shown in FIG. 5, the method includes the following steps.

(1) Monitoring an obstacle in front of a rail train in real time.

[0042] During normal operation of the rail train, a detector in front of the rail train is in a real-time monitoring status, constantly determining whether there is an obstacle in front of the host rail train.

(2) Identifying the type of the obstacle and operation status of the host rail train.

[0043] When the detector detects the obstacle in front of the host rail train, identifying the types of the obstacle in front by an algorithm; if the obstacle is a rail train operating on a same track, a relative speed of the two rail trains is further determined.

(3) Determining the collision energy and whether the intelligent anti-creeper 3 needs to be ejected.

[0044] The control module 1 calculates the collision energy of the two trains based on masses of the rail trains and the relative speed; if the retracted intelligent anti-creeper 3 cannot dissipate the collision energy, the control module 1 sends an instruction to the intelligent anti-creeper 3 to perform eject operation.

(4) The anti-creeper acts correspondingly.

[0045] After receiving an ejection instruction, a quick ejection device inside the intelligent anti-creeper 3 detonates. Under a strong impact generated by the explosion, the energy-absorbing portion 32 ejects out of the anti-creeper body 31 and moves to a corresponding position, and the stop block tilts inward under an action of a spring and limits the energy-absorbing portion 32, thereby increasing a deformation stroke of the intelligent anti-creeper 3 and increasing the absorbing energy.

[0046] The embodiment of the present application further provides a rail train, provided with the above-mentioned rail train intelligent anti-creeper system, and the intelligent anti-creeper 3 is installed below a locomotive of the rail train. The limitations of the installation and deformation space of the energy absorption device at the front end of the vehicle body are broken and the energy-absorbing performance of the vehicle is significantly improved without changing the structural characteristics, coupling requirements, and curve passing capacity requirements of the rail train.

[0047] It should be noted that the above embodiments are only used to illustrate the solution of the present application, not to limit it. Although the present application has been described in detail with reference to the aforementioned embodiments, it should be understood by those of skill in the art that changes to solutions recited in the aforementioned embodiments or equivalent replacement of some feature may be made and these modifications or replacements do not depart the solutions essentially from the scope of the present application.

Claims

1. An intelligent anti-creeper system for a rail train, comprising:

a detection module, used for detecting an obstacle in real time;
an intelligent anti-creeper, comprising an anti-creeper body and an energy-absorbing portion connected to the anti-creeper body and being stretchable relative to the anti-creeper body; and
a control module, connected communicatively to the detection module and the intelligent anti-creeper, respectively, and used for controlling the intelligent anti-creeper to act correspondingly based on a detection of the obstacle by the detection module.

2. The intelligent anti-creeper system of claim 1, wherein the intelligent anti-creeper further comprises a stopper;
the energy-absorbing portion has a first position and a second position relative to the anti-creeper body; in the first position, the energy-absorbing portion is

at least partially located inside the anti-creeper body; and in the second position, the energy-absorbing portion stretches out of the anti-creeper body and is locked in the second position through the stopper.

3. The intelligent anti-creeper system of claim 1 or 2, wherein the intelligent anti-creeper is provided with a triggering mechanism, and the triggering mechanism is provided at a rear end of the anti-creeper body close to the energy-absorbing portion; and the triggering mechanism is for triggering the energy-absorbing portion to be ejected out of the anti-creeper body.

4. The intelligent anti-creeper system of claim 3, wherein the triggering mechanism is connected communicatively to the control module.

5. The intelligent anti-creeper system of claim 1, further comprising an emergency braking module, wherein the emergency braking module is connected communicatively to the control module and used for sending an emergency signal to the control module, and the control module controls the energy-absorbing portion to be ejected out of the anti-creeper body.

6. The intelligent anti-creeper system of claim 5, wherein the emergency braking module is provided in a driver's cab of the rail train.

7. The intelligent anti-creeper system of claim 6, wherein the emergency braking module is an emergency braking button, and the emergency braking button is provided on a console in the driver's cab.

8. A control method of an intelligent anti-creeper system for a rail train, comprising:

receiving, by a control module, obstacle data detected by a detection module and identifying a type of an obstacle based on an algorithm;
determining, in case of identifying that the type of the obstacle is a rail train, a relative speed of two rail trains;
calculating collision energy of the two rail trains based on the relative speed, and comparing the collision energy with absorbing energy of the intelligent anti-creeper in a retracted state; and
if the collision energy of the two rail trains is greater than the absorbing energy of the intelligent anti-creeper in the retracted state, sending an instruction to the intelligent anti-creeper to trigger an ejection of the intelligent anti-creeper.

9. The control method of claim 8, wherein calculating the collision energy of the two rail trains based on the relative speed, and comparing the collision en-

ergy with the absorbing energy of the intelligent anti-creeper in the retracted state further comprises: calculating the collision energy of the two rail trains based on masses of the rail trains and the relative speed, and comparing the collision energy with the energy absorption of the intelligent anti-creeper in the retracted state. 5

10. A rail train, provided with an intelligent anti-creeping system for a rail train in any one of claims 1-7, and the intelligent anti-creeper is installed below a locomotive of the rail train. 10

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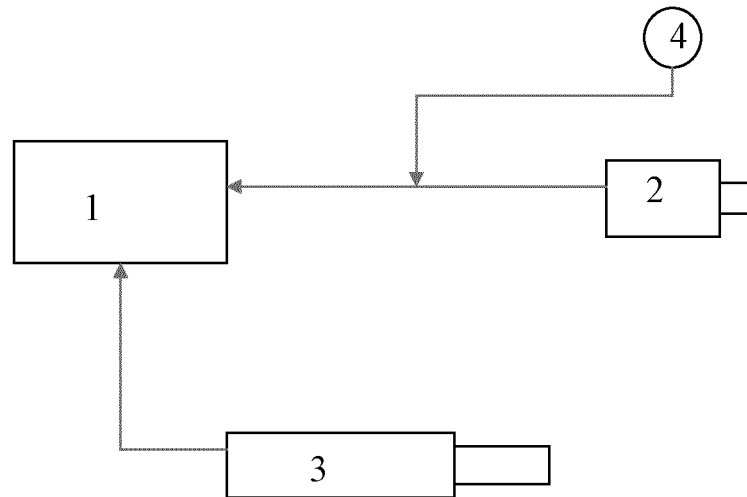


FIG. 1

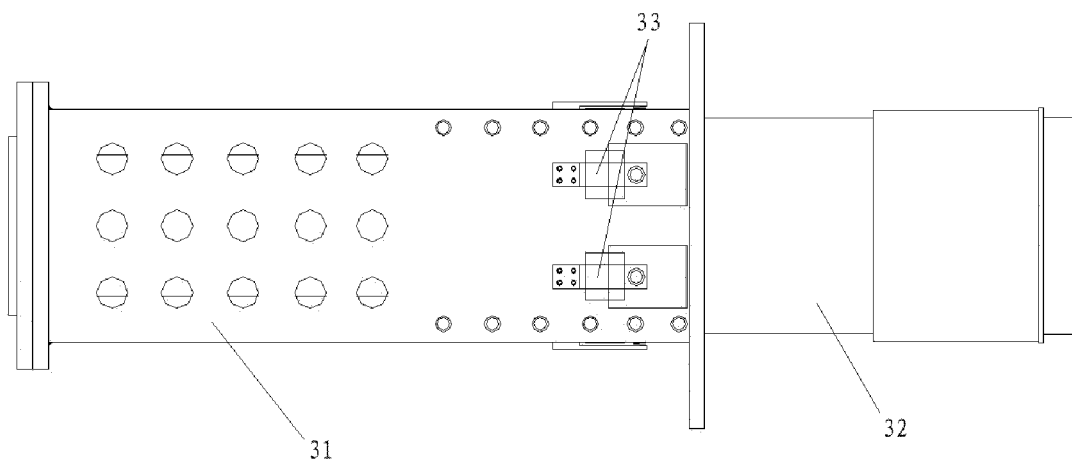


FIG. 2

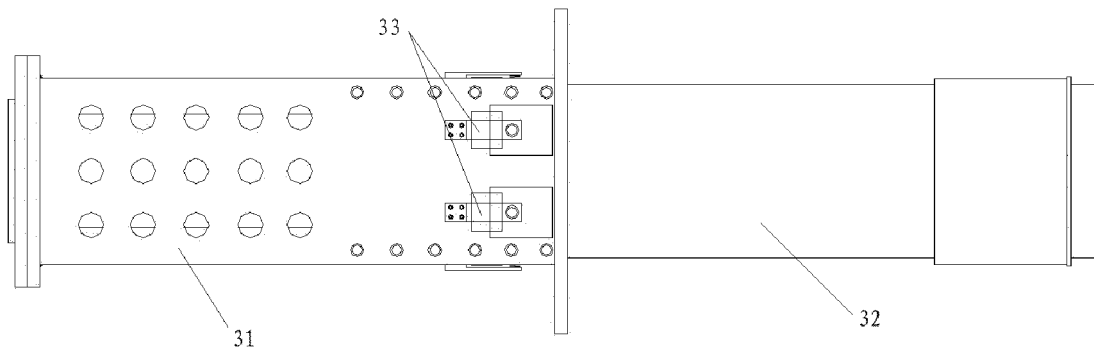


FIG. 3

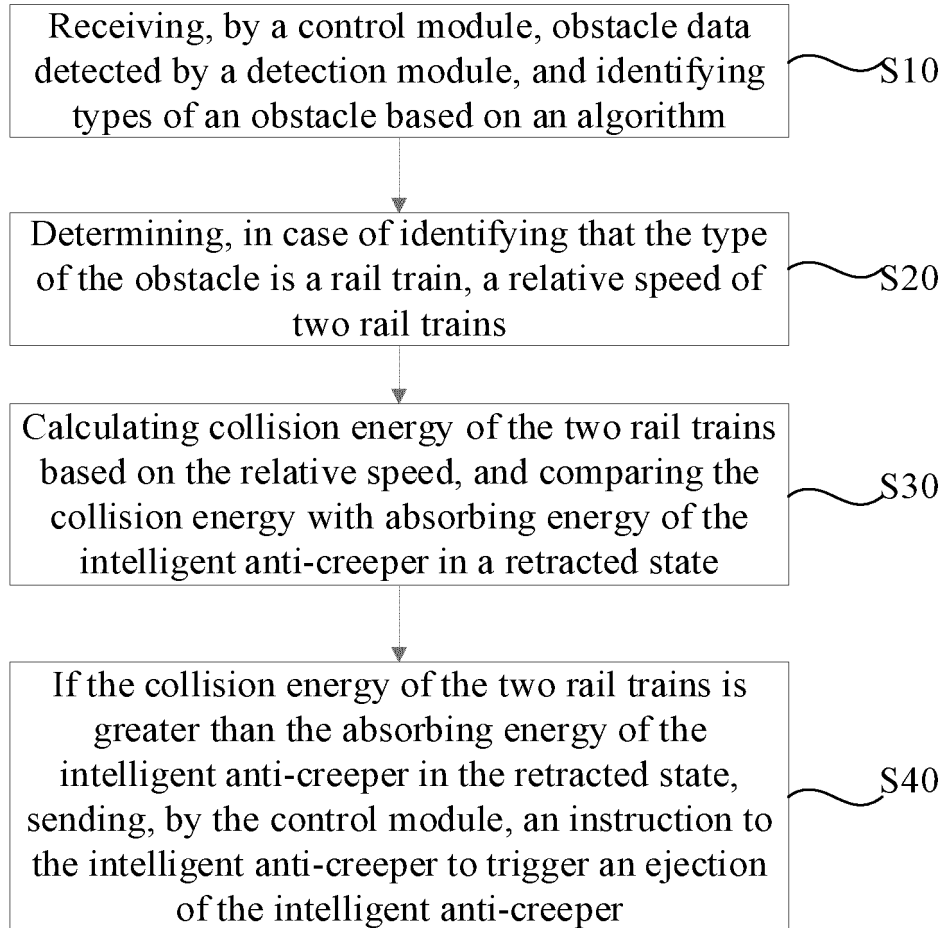


FIG. 4

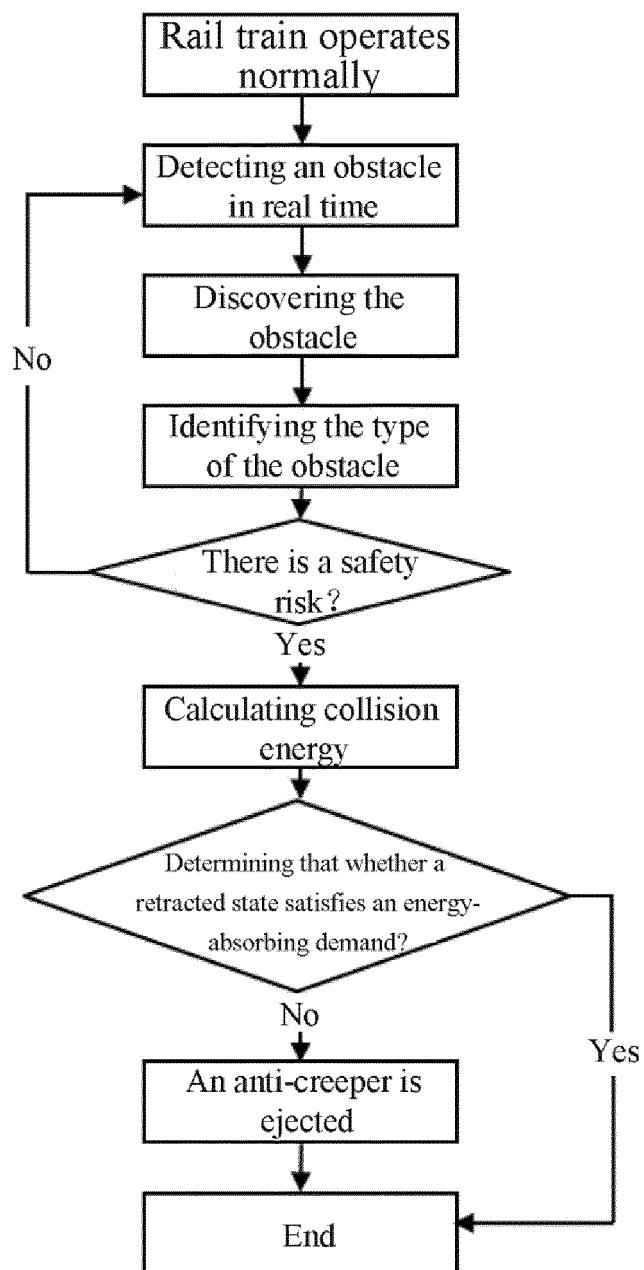


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/123123

A. CLASSIFICATION OF SUBJECT MATTER

B61F 19/04(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)

B61F; B60R

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)

CNTXT, ENTXTC, CNKI: 防爬, 吸能, 控制, 判断, 重量, 质量, 速度, 障碍, 识别, 碰撞, 传感器, 检测, 监测; VEN, ENTXT: climb, creep, control, ECU, weight, speed, velocity, recognition, sensor, real-time.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 105292164 A (CENTRAL SOUTH UNIVERSITY) 03 February 2016 (2016-02-03) description, paragraphs 31-37, and figures 1-6	1-7, 10
Y	CN 105292164 A (CENTRAL SOUTH UNIVERSITY) 03 February 2016 (2016-02-03) description, paragraphs 31-37, and figures 1-6	8-9
Y	CN 111055875 A (SHANGHAI UNIVERSITY OF ENGINEERING SCIENCE) 24 April 2020 (2020-04-24) description, paragraphs 36-42, and figures 2-3	8-9
PX	CN 113799842 A (CRRC QINGDAO SIFANG CO., LTD.) 17 December 2021 (2021-12-17) entire document	1-10
PX	CN 113799841 A (CRRC QINGDAO SIFANG CO., LTD.) 17 December 2021 (2021-12-17) entire document	1-4
A	CN 113479239 A (CRRC ZHUZHOU LOCOMOTIVE CO., LTD.) 08 October 2021 (2021-10-08) entire document	1-10
A	CN 107719285 A (JILIN UNIVERSITY) 23 February 2018 (2018-02-23) description, paragraphs 45-69, and figures 1-2	1-10

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

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier application or patent but published on or after the international filing date	"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
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Date of the actual completion of the international search

07 November 2022

Date of mailing of the international search report

28 December 2022

Name and mailing address of the ISA/CN

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International application No.

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