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(54) **SAFETY LOOP SYSTEM AND RAILWAY VEHICLE**

(57) The embodiment of the present disclosure provides a safety loop system and a railway vehicle, which are used to overcome the problem of low safety of the train operation caused by the identifying difficulty of a car fault through the safety loop after the safety loop of the whole train is removed. The safety loop system includes: a first bypass switch disposed in the end car and a second bypass switch disposed in at least one of the plurality of cars respectively, wherein the first bypass switch and the second bypass switch both have bypass positions, in a case where the bypass positions of the first bypass switch and the second bypass switch are both in an off-state, the first bypass switch and the second bypass switch are configured to conduct the safety loop of the whole train, and in a case where the bypass position of the second bypass switch of a target car is switched to an on-state, the second bypass switch of the target car is configured to conduct a train main line and a train status line of the safety loop system, so as to be able to conduct a partial safety loop.

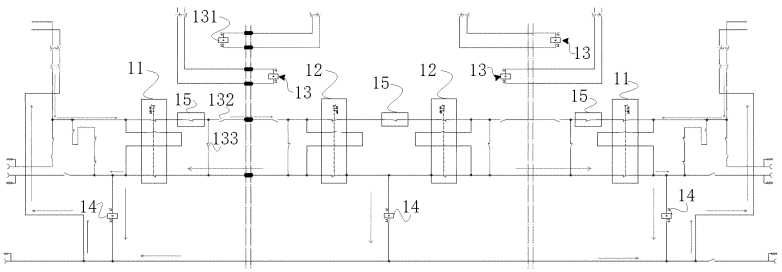

FIG. 1

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Description

FIELD OF THE INVENTION

[0001] The present disclosure relates to railway vehicle technology, and particularly to a safety loop system and a railway car.

BACKGROUND OF THE INVENTION

[0002] EMU (Electric Multiple Unit) trains are important transportation for connecting cities, and have gradually become the main vehicle of transportation in cities. EMU train mainly includes an end car and a plurality of cars. The front and rear ends of the EMU train are respectively provided with end cars, and the end cars are provided with the driver's cab. The plurality of cars are connected between the two end cars, and the cars are used to accommodate passengers or goods.

[0003] In related arts, EMU train is equipped with a safety loop, which is used to monitor faults during the operation of EMU train. During the operation of EMU train, in a case where a specific car has faults, the safety loop of the whole train will be disconnected, and the network system user of EMU train obtains the status of the safety loop of the whole train and sends it to the driver. The driver can remove the safety loop of the whole train without affecting the operation. However, after the safety loop of the whole train is removed, if another car has faults, it is difficult to identify the faults through the safety loop, which is not conducive to the operation safety of EMU train.

SUMMARY OF THE INVENTION

[0004] The embodiment of the present disclosure provides a safety loop system and a railway vehicle, which are used to overcome the problem of low safety of the train operation caused by the identifying difficulty of faults in a single car through the safety loop after the safety loop of the whole train is removed.

[0005] In an aspect, one embodiment of the present disclosure provides a safety loop system, for a railway vehicle having a plurality of cars and an end car, including:

a first bypass switch disposed in the end car; and
a second bypass switch disposed in at least one of the plurality of cars respectively;
wherein the first bypass switch and the second bypass loop switch both have bypass positions. In a case where the bypass positions of the first bypass switch and the second bypass loop switch are both in an off-state, the first bypass switch and the second bypass loop switch are used to conduct the safety loop of the whole train.

[0006] In a case where the bypass position of the second bypass loop switch of a target car is switched to an on-state, the second bypass switch of the target car is used to conduct a train main line and a train status line of the safety loop system, so as to be able to conduct the partial safety loop.

[0007] In one practicable embodiment, the security loop system further includes:
a coupling relay disposed in the end car and the car, and including a controlling portion and a first contact group. The controlling portion of the coupling relay is used to be powered on in a case where the car where the controlling portion disposed is coupled to the adjacent car. The first contact group of the coupling relay is connected in series in the safety loop, and the first contact group of the coupling relay is used to be closed in a case where the controlling portion of the coupling relay is powered on.

[0008] In one practicable embodiment, the coupling relay further includes a second contact group connected in series with the corresponding first contact group and in parallel with the corresponding second bypass switch.

[0009] The second contact group of the coupling relay is used to be closed in a case where the controlling portion of the coupling relay is powered off, and the second contact group of the coupling relay is used to conduct the train main line and the train status line of the safety loop system in a case where the second contact group is closed.

[0010] In one practicable embodiment, the safety loop system further includes: a loop status relay disposed in the end car and the car, and connected in series with the second bypass switch or the first bypass switch disposed in the same car. The loop status relay is also used to electrically connect with the network system of the railway vehicle.

[0011] In one practicable embodiment, the safety loop system further includes a triggering source contact disposed in the end car and the car, and connected in series with the second bypass switch or the first bypass switch disposed in the same car.

[0012] In a second aspect, one embodiment of the present disclosure provides a railway vehicle including a plurality of cars, an end car, and a safety loop system as described in any one of the foregoing aspects.

[0013] In one practicable embodiment, the front end and the rear end of the car are respectively provided with the second bypass switches of the safety loop system.

[0014] In one practicable embodiment, the railway vehicle includes: N cars, wherein the N cars include at least one end car and a plurality of cars. In a case where the end car at the front end is grouped and operated to an (N-m)th car, the bypass position of the second bypass switch at the rear end of the (N-m)th car is closed, the main line and the status line of the safety loop system are conducted, and the safety loop is established from the end car to the (N-m)th car, wherein N is an integer greater than 2, m is an integer greater than or equal to 1, and m is less than N.

[0015] In one practicable embodiment, the railway ve-

hicle includes: N cars, wherein the N cars have at least one end car and a plurality of cars. In a case where the end car at the front end is grouped and operated to the m-th car, and the (m-n)th car has faults, the bypass position of the second bypass switch at the front end of the (m-n)th car is closed, the main line and the status line of the safety loop system are conducted, and the safety loop is established from the end car to the (m-n-1)th car, wherein N and m are integers greater than 2, n is an integer greater than or equal to 1, m is less than N, and m is greater than n.

[0016] In one practicable embodiment, the front end and the rear end of the car are respectively provided with the coupling relays.

[0017] The first contact group and the second contact group of the coupling relay at the front end are disposed at the front side of the second bypass switch at the front end.

[0018] The first contact group and the second contact group of the coupling relay at the rear end are disposed at the rear side of the second bypass switch at the rear end.

[0019] In one practicable embodiment, the loop status relay of the safety loop system is electrically connected between the second bypass switches at the front end and the rear end.

[0020] In one practicable embodiment, the triggering source contact disposed in the car in the safety loop system is electrically connected between the second bypass switches at the front end and the rear end.

[0021] In one practicable embodiment, the railway vehicle further includes a network system, wherein the loop status relay of the safety loop system is electrically connected to the network system, and the network system determines the establishment status of the safety loop according to a feedback information of the loop status relay.

[0022] In one practicable embodiment, each of the cars is provided with second bypass switches of the safety loop system.

[0023] In one practicable embodiment, the railway vehicle includes an EMU train or a railway vehicle towed by a locomotive.

[0024] The safety loop system and the railway vehicle provided by the embodiment of the present disclosure, in a case where the safety loop of the whole train is disconnected due to one of the cars having faults, by operating the second bypass switch of the faulty car, that is, the target car, removing the target car and the cars grouped behind the target car, the cars grouped in front of the target car can establish a partial safety loop which can continue to monitor the faults of the corresponding cars during operation, thus being beneficial to improving the operation safety of the railway vehicle.

[0025] In addition, for railway vehicles with one end car, the main line and the status line of the safety loop can be conducted through the second bypass switch at the rear end of the car at the tail end, that is, the target car, so as to establish a safety loop, realize the fault detection of the coupled cars during operation, and improve the operation safety of the railway vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] The drawings illustrated herein serve to provide a further understanding of and constitute a part of this present disclosure, and the illustrative embodiments of this present disclosure and the description thereof explain this present disclosure and are not to limit. In the drawings:

Fig. 1 is a schematic structural view of a safety loop system of a railway vehicle according to an embodiment.

Fig. 2 is a schematic structural view of a safety loop system of a railway vehicle according to another embodiment.

Fig. 3 is a schematic structural view of a safety loop system of a railway vehicle according to yet another embodiment.

[0027] REFERENCES IN THE DRAWINGS:
first bypass switch 11; second bypass switch 12; coupling relay 13; controlling portion 131; first contact group 132; second contact group 133; loop status relay 14; triggering source contact 15.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0028] In order to make the technical solution and advantages of the embodiments of the present disclosure clear, the following detailed description of the embodiments of the present disclosure is further given in conjunction with the accompanying drawings, and it is apparent that the described embodiments are only a part of the embodiments of the present disclosure, and are not exhaustive of all embodiments. It should be noted that the embodiments in the present disclosure and the features in the embodiments can be combined with each other without conflict.

[0029] In related arts, EMU trains are equipped with a safety loop which is used to monitor faults during EMU train operation. Specifically, the safety loop includes a coupling relay disposed in the end car, an activation relay in the driver's cab, a safety loop relay, a triggering source, and a fault isolating switch. Both the end car and the car are provided with train coupling connectors used to connect the loops of two adjacent cars and finally form the safety loop of the whole train.

[0030] In the above EMU train, in order to form a closed safety loop, the end cars at both ends must be grouped and fixed at the same time. In the safety loop, once the fault source in some car is triggered, the whole safety loop is disconnected, and the whole safety loop must be removed on the premise of ensuring that the operation is not affected. In a case where another fault is triggered

after the safety loop has been removed, the fault of another car cannot be identified by the safety loop, not able to stop the train, which reduces the safety during operation. In addition, for railway vehicles with only one end car, such as coupled cars with a locomotive, the above safety loop cannot be established.

[0031] In order to solve at least one of the above technical problems, the safety loop system and the railway vehicle are provided by the embodiment of the present disclosure. In a case where the safety loop of the whole train is disconnected due to a single car having faults, by removing the single car having faults and the cars grouped behind, the cars grouped in front of the single car having faults can establish a partial safety loop which can continue to monitor the faults of the corresponding cars during the operation, thus being beneficial to improving the operation safety of the railway vehicle.

[0032] In addition, for railway vehicles with only one end car, such as coupled cars with a locomotive, the bypass switch of the single car at the tail end can also be placed at the bypass position, so that the safety loop of the whole train can be connected, so that the safety loop can normally realize monitoring function and provide reliable support for operation safety.

[0033] The structure, function, and implementation process of the railway vehicle provided in the embodiment will be illustrated with reference to the accompanying drawings.

[0034] The embodiment provides a railway vehicle, as shown in Figs. 1 to 3, including a plurality of cars, an end car located at one end of the railway vehicle, and a safety loop system. A plurality of cars are coupled to the end car in sequence. The safety loop system includes a first bypass switch 11 and a second bypass switch 12.

[0035] It should be noted that in the following examples, single car or single end car can also be referred to as the car for short, that is, the single car can be one car or one end car. In addition, for convenience of description, the traveling direction of railway vehicles is referred as the front end (or the head end). For example, the left side in Figs. 1 to 3 is the front end, and the left most car in Figs. 1 to 3 may be the end car.

[0036] The first bypass switch 11 is disposed in the end car. For example, the first bypass switch 11 may be disposed around the driver's desk in the end car to facilitate the driver's operation. In a case where there is one end car, the end car is provided with a first bypass switch 11. In a case where there are two end cars, the first bypass switches 11 are respectively provided in the two end cars.

[0037] The second bypass switch 12 is provided in the car. The second bypass switch 12 is disposed in at least one of the plurality of cars. For example, each car may be provided with a second bypass switch 12 which may be provided at a power distribution cabinet where each car is provided or at other positions where misoperation by passengers can be avoided. In other examples, the second bypass switch 12 may be provided in a part of the plurality of cars, such as at intervals of one car.

[0038] For the convenience of description, the first bypass switch 11 and the second bypass switch 12 are collectively referred as the bypass switch. That is the bypass switch in this embodiment may refer to the first bypass switch 11 or the second bypass switch 12.

[0039] The specific structure of the bypass switch can adopt conventional setting. For example, the bypass switch has two sets of normally closed contacts and one set of normally open contacts. In a case where the bypass switch is in an off-state, that is, in a case where the bypass switch is placed to an OFF position, two sets of normally closed contacts are respectively connected in series in the safety loop, one normally closed contact is connected in series in a positive main line of the safety loop and the other normally closed contact is connected in series in the status line of the safety loop to form a closed loop. In a case where it is necessary to bypass some cars, that is, remove from the safety loop, the bypass switch can be switched to the closed position, that is, the bypass switch is placed to an ON position, so that the normally open contacts are closed, thus the normally open contacts of the bypass switch are electrically connected to two groups of normally closed contacts, so as to conduct the positive main line of the safety loop and the status line of the safety loop.

[0040] In specific implementation, the bypass switch can be embodied as a rotary knob, and in a case where the bypass switch is rotated to the bypass position, the contacts of the bypass position are in the on-state. It is to be understood that the specific configuration of the bypass switch is not limited thereto and the present embodiment is only illustrated herein.

[0041] Both the first bypass switch 11 and the second bypass loop switch have bypass positions having the normally open contacts. In a case where the train is in trouble-free operation, the bypass position of each bypass loop switch is in the off-state, and the first bypass switch 11 and each second bypass loop switch are connected in series in the safety loop of the whole train, and the safety loop of the whole train is conducted.

[0042] In a case where one of the cars has faults, the car having faults is referred as the target car, and the bypass position of the second bypass loop switch of the target car is switched to the on-state. At this time, the second bypass switch of the target car is used to conduct the train main line with the train status line of the safety loop system, which bypasses the components after the second bypass loop switch, that is, the target car and the cars located behind are bypassed, and the cars located in front of the target car can form a partial safety loop to be conducted. The partial safety loop can continue to monitor the faults of each cars grouped in front of the target car, which is conducive to timely handling the failure status (with or without faults) of this group of cars, and is conducive to improving the operation safety of the railway vehicle.

[0043] In the cars corresponding to the partial safety

loop, if one of the cars has faults, the partial safety loop can normally monitor the fault, so as to facilitate the timely bypass of the car having faults. And the cars grouped in front of the car having faults can continue to form another partial safety loop to be conducted.

[0044] The operation of switching to the bypass position of the second loop bypass switch can be manually operated by the train attendant, or controlled by corresponding control unit, so that the bypass position of the second loop bypass switch can be automatically switched. In a case where the second bypass switch 12 can be automatically switched, the control unit can be independent of the network system of the railway vehicle and electrically connected to the network system of the railway vehicle. The network system triggers the control unit to control the status of the bypass position of the second loop bypass switch. Or, the control unit is a part of the network system, and the network system can directly trigger and control the status of the bypass position of the second loop bypass switch.

[0045] Alternatively, as shown in Fig. 1, two second bypass switches 12 may be respectively provided in each car, and the two second bypass switches 12 may be respectively located at two ends of the car.

[0046] In a case where all cars do not have faults, the whole safety loop is established. The bypass position of each bypass switch is in the off-state. The straight arrow in Fig. 1 indicates the current flow direction at this time.

[0047] In a case where a specific car has faults, it is necessary to bypass the car having faults and the cars grouped behind from the safety loop, and the bypass position of the second bypass switch 12 at the front end of the car having faults can be switched to the on-state, that is, the second bypass switch 12 at the front end of the car having faults is placed at the ON position. In this way, the car having faults and the cars grouped behind can be removed from the safety loop, while the cars grouped in front of the car having faults form the partial safety loop. The straight arrow in Fig. 3 indicates the current flow direction at this time.

[0048] In the implementation process, the network system of the railway vehicle can send the monitored abnormal state in one specific car to the end car, so that corresponding sound prompts or visual prompts can be provided in the end car, so that the person in the end car can take corresponding measures in time. For example, the trans crew in the abnormal car having faults is notified in time to close the bypass position of the second bypass switch 12 at the front end of the car, so as to remove the car having faults and the cars grouped behind. The cars in front of the car having faults form the partial safety loop.

[0049] Or, the network system sends the monitored abnormal state in one specific car to the corresponding car having faults, so that the corresponding sound prompts or visual prompts can be provided in the car, so that the trans crew in the car having faults can close the bypass position of the second bypass switch 12 at the front end of the car in time, thereby removing the car having faults and the cars behind to establish the partial safety loop in the cars grouped in front of the car having faults.

[0050] In a case where the railway vehicle is formed with coupled cars driven by a locomotive or other railway vehicles with one end car, the end car is located at the front end and is used to provide traction for a plurality of cars located behind it. The second bypass switch 12 located at the rear end of the car at the tail end is placed at the ON position, that is, the bypass position of the second bypass switch 12 at the rear end of the car at the tail end is switched to the on-state. As shown in Fig. 2, the second bypass switch 12 at the rear end of the car at the tail end can conduct the train main line and the train status line of the safety loop system, thereby establishing a safety loop and realizing the safety monitoring of each car. The straight arrow in Fig. 2 indicates the current flow direction at this time.

[0051] It should be noted that for coupled cars driven by a locomotive or other railway vehicles with one end car, the car at the tail end, that is, the last end car, can be defined as the target car, and the current car and the cars grouped in front form the partial safety loop. At this time, the cars of the whole train involved the establishment of the partial safety loop, which is only used to be different from the whole safety loop established with both two of the end cars.

[0052] In one practicable embodiment, the safety loop system further includes a coupling relay 13, which is disposed in the end car and the car, and includes a controlling portion 131 and a first contact group 132. The controlling portion 131 of the coupling relay 13 is used to be powered on in a case where the car on which the coupling relay is located is connected to the adjacent car in position.

[0053] In some examples, the coupling relay 13 at the front end of one car can be used to electrically connect with the power supply in the adjacent car on front side, so that in a case where two adjacent cars are connected in position, the corresponding coupling relay 13 can be powered on. For example, a coupling relay 13 at the front end of the car adjacent to the end car may be used to electrically connect with a power source in the end car. The coupling relay 13 in the end car can be used to electrically connect with the power supply in the adjacent car.

[0054] In some examples, in a case where two adjacent cars are not connected, the coupling relay 13 at the end of the car is disconnected from the power supply, and in a case where the adjacent cars are connected in position, the coupling relay 13 can be connected to the power supply through the adjacent cars.

[0055] In the above example, the power source for supplying power to the coupling relay 13 may be independent of devices such as the bypass switch, and the coupling relay 13 of the whole train may be connected to the same power source through an interface and a hard wire. Of course, the whole safety loop system can also have a common power supply.

[0056] The first contact group 132 of the coupling relay 13 is connected in series in the safety loop, and the first contact group 132 of the coupling relay 13 is used to be closed in a case where the controlling portion 131 of the coupling relay is powered on, to conduct the safety loop.

[0057] The first contact group 132 of the coupling relay is a normally closed contact group. In a case where the controlling portion 131 of the coupling relay is powered on, the first contact group 132 can be closed so as to conduct the safety loop. In one practicable embodiment, in a case where the adjacent cars are connected in position, the control portions 131 of the coupling relays at the corresponding ends of the two cars are powered on. In a case where two adjacent cars are not connected in position, the corresponding first contact group 132 is disconnected, so that the safety loop cannot be established.

[0058] Optionally, the coupling relay 13 further includes a second contact group 133 in series with the corresponding first contact group 132 and in parallel with the corresponding second bypass switch 12. The second contact group 133 is a normally open contact to be closed in a case where the corresponding control portion 131 is powered off.

[0059] In this way, the coupling relay at the rear end of the car at the tail end cannot be powered on, and the second contact group 133 of the coupling relay conducts the train main line with the train status line of the safety loop system, thus ensuring that the safety loop can be established.

[0060] In the specific implementation, in a case where there is only one end car, the bypass position of the second bypass switch 12 of the car at the rear end, that is, the tail end, is closed, and the second contact group 133 of the coupling relay 13 is closed, so as to ensure conducting the train main line with the train status line of the safety loop system, thus ensuring that the safety loop can be established.

[0061] Optionally, a coupling relay 13 and a second bypass switch 12 are respectively disposed at the front end and the rear end of the car. The first contact group 132 and the second contact group 133 of the coupling relay 13 located at the front end are provided at the front side of the second bypass switch 12 located at the front end. The first contact group 132 and the second contact group 133 of the coupling relay 13 located at the rear end are provided at the rear side of the second bypass switch 12 located at the rear end.

[0062] Thus, in a case where the second bypass switch 12 of the car at the tail end fails to conduct the train main line and the train status line of the safety loop system, the closed connection of the second contact group 133 of the coupling relay 13 can also ensure that the train main line and the train status line of the safety loop system are conducted, thereby ensuring that the safety loop can be established.

[0063] Optionally, the safety loop system further includes a triggering source contact disposed in the end car and the car and connected in series with the second bypass switch 12 or the first bypass switch 11 disposed in the same car. In a case where the triggering source contact 15 is disposed in the end car, the triggering source contact 15 is connected in series with the first bypass switch 11 in the end car. In a case where the triggering source contact 15 is disposed in the car, the triggering source contact 15 is electrically connected between two second bypass switches 12 at the front end and the rear end.

[0064] The triggering source contact 15 can be electrically connected to the network system. In a case where the network system monitors the abnormal state such as smoke abnormality in one specific car, the triggering source contact 15 is controlled to be disconnected, thereby disconnecting the safety loop.

[0065] In the implementation process, with the abnormal state in a certain car monitored by the network system, the triggering source contact 15 in the car is controlled to be disconnected, thus disconnecting the whole safety loop. At this time, the driver in the end car can inform the train crew in the corresponding car in time to close the bypass position of the second bypass switch 12 at the front end of the car, so as to remove the car and the cars grouped behind. Or, the network system sends prompts to the trans crew in the corresponding car, so that the trans crew in the corresponding car can close the bypass position of the second bypass switch 12 at the front end of the car in time, so as to remove the car and the cars grouped behind. The partial safety loop is established with the cars grouped in front of the car having faults.

[0066] If the trans crew does not have time to operate the second bypass switch 12, the network system can also trigger the triggering source contact 15 to disconnect, thereby disconnecting the safety loop, which is beneficial for the person in the end car to know the abnormality of the car in time. After the triggering source contact 15 in one specific car disconnect the safety loop, the trans crew in the car can remove the car having faults and the cars behind by closing the bypass position of the second bypass switch 12 at the front end of the car. The partial safety loop is established for the cars grouped in front of the car having faults.

[0067] In one practicable embodiment, the safety loop system further includes: a loop status relay 14 disposed in the end car and the car, and connected in series with the second bypass switch 12 or the first bypass switch 11 disposed in the same car. The loop status relay 14 is also used to electrically connect with the network system of the railway vehicle.

[0068] The loop status relay 14 provided in the end car is connected in series with the first bypass switch 11 in the end car. The loop status relay 14 provided in the car is connected in series with two second bypass switches 12 in the car.

[0069] Thus, for the car, in a case where the car is involved in the establishment of the safety loop, the loop status relay 14 can be powered and feedback information

about its powered status to the network system. In a case where the car does not involve in the establishment of the safety loop, that is, in a case where the bypass position of the second bypass switch 12 at the front end of the car is closed, the car does not involve in the establishment of the safety loop, the current cannot flow to the loop status relay 14 in the car, the loop status relay 14 in the car cannot be powered, and the loop status relay 14 in the cars grouped behind the car cannot be powered.

[0070] In this way, the network system can judge the establishment state of the safety loop (whole safety loop or partial safety loop) based on the information fed back by the loop status relay 14 in each car. For example, in a case where all of the loop status relays 14 in two end cars and the cars are powered on, the network system can determine accordingly that the whole safety loop of the whole train has been established. In a case where the loop relay of only one end car is powered on and the loop status relays 14 of all cars are powered on, the network system can determine that the partial safety loop has been established. In a case where the loop relay of only one end car is powered on, and the loop status relays 14 of some cars are powered on, the network system can determine that the partial safety loop has been established.

[0071] In the implementation, for the railway vehicle with only one end car, in order to display the establishment status of the safety loop, it is practicable to tell apart the partial safety loops established by all cars with the loop status relays 14 powered on or established by some cars with the loop status relays 14 powered on, for example, by displaying colors or words. For example, the partial safety loop established by all cars with the loop status relays 14 powered on may be displayed in green, and the partial safety loop established by some cars with the loop status relays 14 powered on may be displayed in yellow.

[0072] In each of the above embodiments, a conventional arrangement may be adopted for parts where the safety loop system is not explained. For example, a recoupling relay, an occupation relay, and other devices disposed in the end car can have the same or similar function and implementation process as related products.

[0073] In specific examples, the railway vehicle provided by the embodiment can be an EMU train with two end cars, or a railway vehicle with one end car, such as a railway vehicle towed by a locomotive.

[0074] The following is an example of the implementation process of this embodiment. Taking N cars in the state of full grouped as an example, the numbers of the cars are grouped in turn from 01.

[0075] In a case where only the end car No. 01 to the car No. N-m (N > m) are grouped and operated, as shown in Fig. 2, the left side of Fig. 2 is the end car, and the right side of Fig. 2 is the (N-m)th car. At this time, the bypass position of the second bypass switch can be switched to the on-state by manually operating the second bypass switch 12 at the rear end of the (N-m)th car. And the positive main line and the status line of the safety loop are conducted at the rear end of the (N-m)th car through the second bypass switch 12, so that a safety loop is formed from the (N-m)th car with the car No. 01 to N-M-1, that is, the end car No. 01 to the (N-m)th car form a safety loop to realize the effective establishment of the safety loop, wherein N is an integer greater than 2, M is an integer greater than or equal to 1, and M is less than N. The N-th car can be the other end car or car. In this way, in a case where trains need to be flexibly grouped, with the coupling relays 13 located in the front and rear ends of the central cars powered on, it is ensured that the loop of the central cars is connected, which can not only effectively establish the safety loop, but also realize the flexible amount of grouped cars.

[0076] In a case where the end car No. 01 to the m-th cars (N > m) are grouped and operated, and the triggering source contact 15 of the (n-m)th car (m > n) is disconnected triggered by faults, the safety loop of the whole train is disconnected. As shown in Fig. 3, the left side of Fig. 3 is the end car, the right side is the (n-m)th car, and the center is the (m-n-1)th car. If the driver in the end car confirms that the fault does not affect the train operation, the fault of (n-m)th car can be bypassed by the second bypass switch 12 at the front end, and at the same time, the main line and the status line of the safety loop are conducted by the second bypass switch 12 at the front end, so that the partial safety loop can be effectively established in the loop from car No. 01 to the car No.(m-n-1). N and m are integers greater than 2, n is an integer greater than or equal to 1, m is less than or equal to N, and m is greater than n. In this example, the M-th car can be the other end car or car. That is, the railway vehicle may have one end car or two end cars.

[0077] In the above example, the specific values of N, m, and n may be set according to actual needs, and the specific values of N, m, and n are not limited here in this embodiment.

[0078] In the description of the present disclosure, It should be understood that the terms "front", "back", "head", "tail" and the like denote orientations or positional relationships based on those shown in the drawings and are intended for ease of description and simplification of the description only, and are not intended to indicate or imply that the device or element must have a particular orientation, be constructed and operated in a particular orientation and therefore cannot be construed as limiting to the present disclosure.

[0079] Furthermore, the terms "first" and "second" are used for descriptive purposes only and cannot be understood as indicating or implying relative importance or implying the amount of technical features indicated. Thus, a feature defined as "first," or "second," may explicitly or implicitly include one or more of such features. In the description of this present disclosure, "a plurality of" means at least two, e.g. two, three, etc. unless expressly specified otherwise.

[0080] In this present disclosure, the terms "disposed", "connected" and the like are to be understood in a broad sense unless otherwise expressly specified and limited. Taking connected as an example, it can be directly connected or indirectly connected through an intermediate medium, and it can be the internal communication of two elements or the interaction between two elements. The specific meanings of the above terms in the present disclosure may be understood on a case-by-case basis to those of ordinary skill in the art.

[0081] Although some alternative embodiments of the present disclosure have been described additional changes and modifications may be made to these embodiments once the basic inventive concepts are known to those skilled in the art. Accordingly, the appended claims are intended to be interpreted to encompass some alternative embodiments as well as all modifications and equivalents falling within the scope of the present disclosure.

[0082] Apparently those skilled in the art may make various modifications and equivalents to the present disclosure without departing from the spirit and scope of the present disclosure. Thus the present disclosure is intended to include such modifications and variations provided that they fall within the scope of the claims and their equivalents.

Claims

1. A safety loop system, for a railway vehicle having a plurality of cars and an end car, comprising:

   a first bypass switch disposed in the end car; and a second bypass switch disposed in at least one of the plurality of cars respectively;
   wherein the first bypass switch and the second bypass loop switch both have bypass positions, in case where the bypass positions of the first bypass switch and the second bypass loop switch are both in an off-state, the first bypass switch and the second bypass loop switch are used to conduct a safety loop of a whole train; and
   in case where the bypass position of the second bypass loop switch of a target car is switched to an on-state, the second bypass switch of the target car is used to conduct a train main line and a train status line of the safety loop system, so as to be able to conduct a partial safety loop.

2. The safety loop system according to claim 1, further comprising:
   a coupling relay disposed in the end car and the car, and including a controlling portion and a first contact group, wherein the controlling portion of the coupling relay is used to be powered on in case where the car where the controlling portion disposed is connected to an adjacent car, the first contact group of the coupling relay is connected in series in the safety loop, and the first contact group of the coupling relay is used to be closed in case where the controlling portion of the coupling relay is powered on.

3. The safety loop system according to claim 2, wherein the coupling relay further includes a second contact group in series with a corresponding first contact group and in parallel with a corresponding second bypass switch;
   wherein the second contact group of the coupling relay is used to be closed in case where the controlling portion of the coupling relay is powered off, and the second contact group of the coupling relay is used to conduct the train main line and the train status line of the safety loop system in case where the second contact group is closed.

4. The safety loop system according to claim 2, further comprising:
   a loop status relay disposed in the end car and the car, and connected in series with the second bypass switch or the first bypass switch disposed in same car, wherein the loop status relay is also used to electrically connect with a network system of the railway vehicle.

5. The safety loop system according to claim 2, further comprising:
   a triggering source contact disposed in the end car and the car, and connected in series with the second bypass switch or the first bypass switch disposed in same car.

6. A railway vehicle comprising: a plurality of cars, an end car, and a safety loop system according to any one of claims 1-5.

7. The railway vehicle according to claim 6, wherein a front end and a rear end of the car are respectively provided with the second bypass switches of the safety loop system.

8. The railway vehicle according to claim 7, further comprising:
   N cars, wherein the N cars are provided with at least one end car and a plurality of cars, in case where the end car at the front end is grouped and operated to the (N-m)th car, the bypass position of the second bypass switch at the rear end of the (N-m)th car is closed, the main line and the status line of the safety loop system are conducted, and the safety loop is established from the end car to the (N-m)th cars, wherein N is an integer greater than 2, m is an integer greater than or equal to 1, and m is less than N.

9. The railway vehicle according to claim 7, further com-

prising:
N cars, wherein the N cars are provided with at least one end car and a plurality of cars, in case where the end car at the front end is grouped and operated to the m-th car and the (m-n)th car has faults, the bypass position of the second bypass switch at the front end of the (m-n)th car is closed, the main line and the status line of the safety loop system are conducted, and the safety loop is established from the end car to the (m-n-1)th car, wherein N and m are integers greater than 2, n is an integer greater than or equal to 1, m is less than N, and m is greater than n.

10. The railway vehicle according to claim 7, wherein the front end and the rear end of the car are respectively provided with coupling relays;

the first contact group and the second contact group of the coupling relay at the front end are disposed at the front side of the second bypass switch at the front end; and
the first contact group and the second contact group of the coupling relay at the rear end are disposed at the rear side of the second bypass switch at the rear end.

11. The railway vehicle according to claim 7, wherein the loop status relay of the safety loop system is electrically connected between the front and rear second bypass switches.

12. The railway vehicle according to claim 7, wherein a triggering source contact in the safety loop system is electrically connected between the front and rear second bypass switches.

13. The railway vehicle according to claim 6, further comprising a network system, wherein the loop status relay of the safety loop system is electrically connected to the network system to determine an establishment status of the safety loop based on a feedback information from each of the loop status relays.

14. The railway vehicle according to any one of claims 6-13, wherein the second bypass switch in the safety loop system is provided in each of the cars.

15. The railway vehicle according to any one of claims 6-13, comprising: an EMU train or a railway vehicle towed by a locomotive.

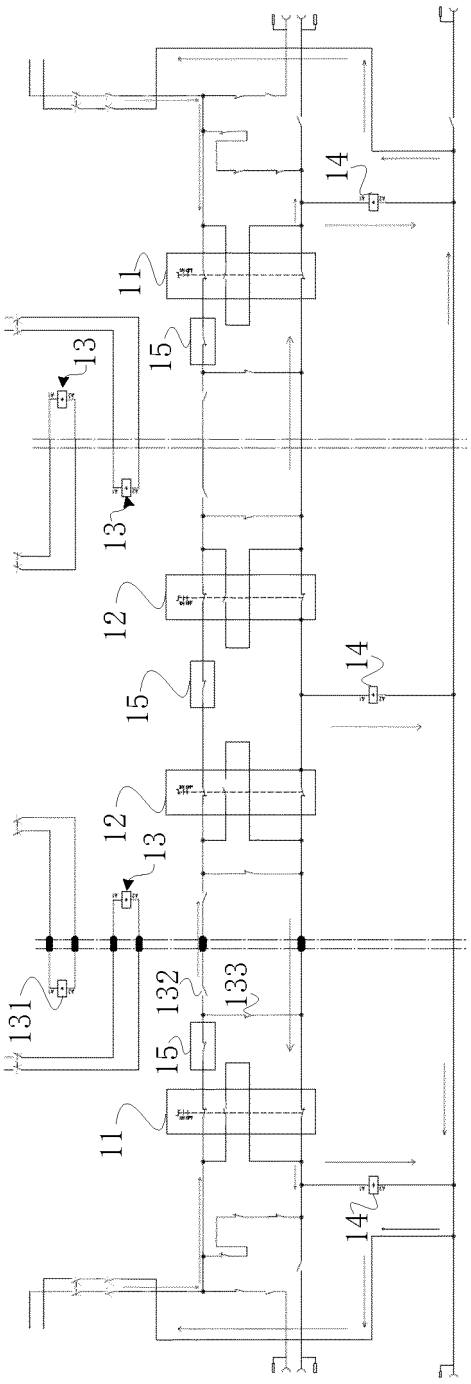

FIG. 1

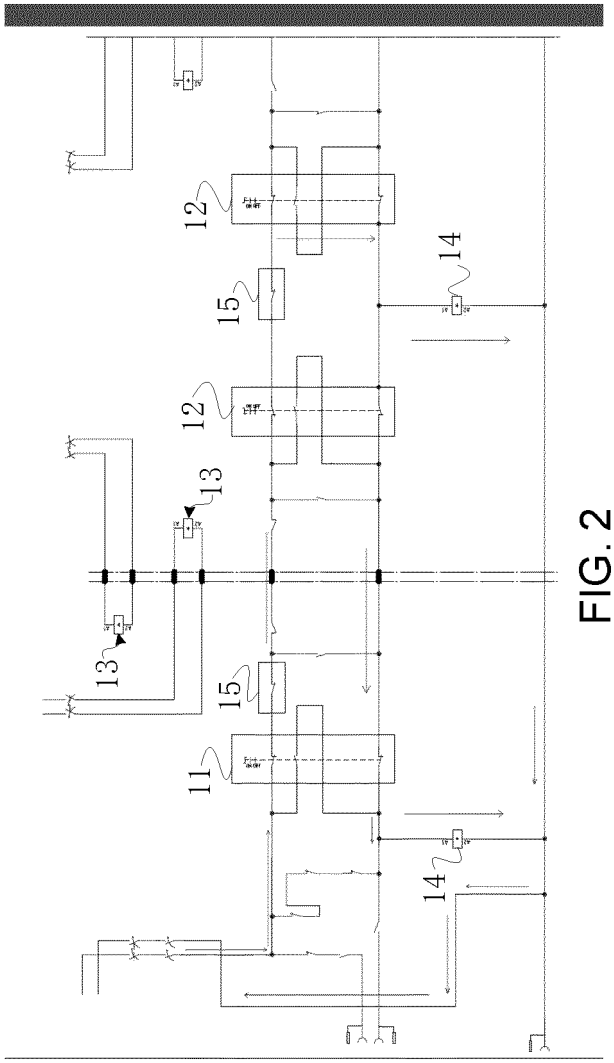

FIG. 2

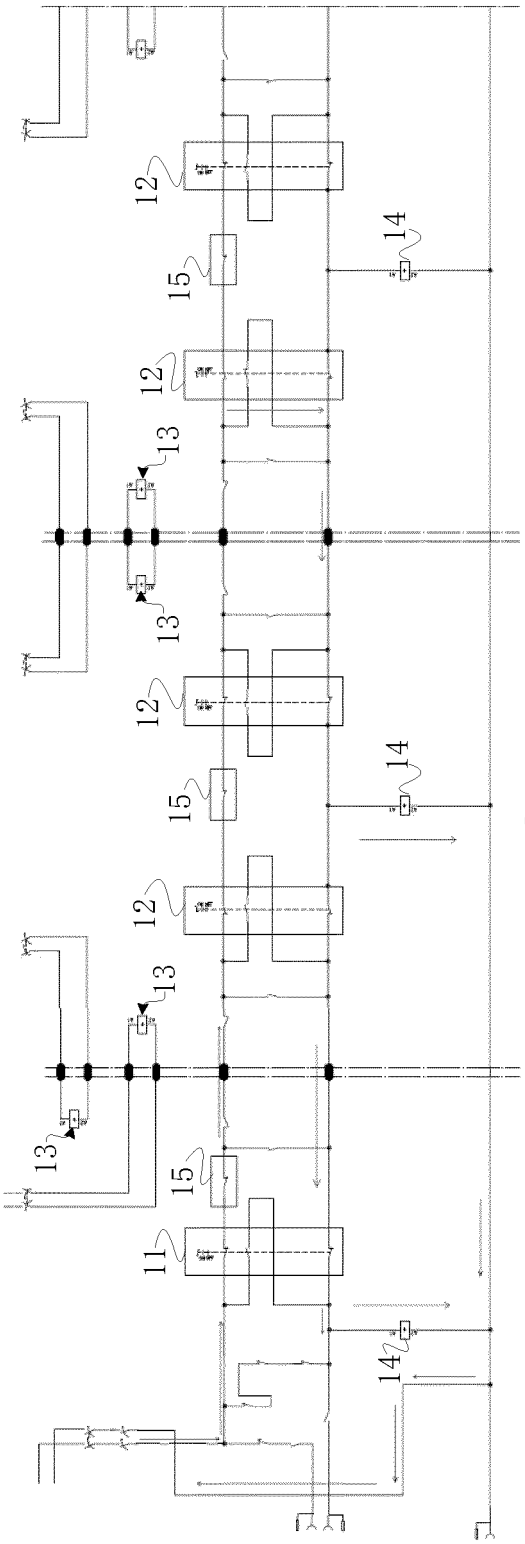

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/106680

A. CLASSIFICATION OF SUBJECT MATTER

B61L 15/00(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; B60T

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)

CNPAT/CNKI/WPI/EPODOC: 中车唐山, 胡洋, 莘海萍, 李杰, 晏志飞, 叶志刚, 继电器, 断开, 触点, 旁路, 切除, 紧急, 制动, 环路, 检测, 故障, 动车, 高铁, 火车, 轨道, contact?, emergency, isolat+, security, loop, brak+, sefety, switch+, delay?, separat+, sens+, fault, error, fail+, trouble, train, rail+, locomotive

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	罗飞平 等 (LUO, Feiping et al.). "高速动车组紧急制动技术 (High-Speed EMU Emergency Braking Technology)" *《机车电传动》 (Electric Drive for Locomotives),* No. 02, 10 March 2018 (2018-03-10), pp. 16-22	1-15
A	CN 106080567 A (CRRC TANGSHAN CO., LTD.) 09 November 2016 (2016-11-09) entire document	1-15
A	CN 109109851 A (CRRC DALIAN CO., LTD.) 01 January 2019 (2019-01-01) entire document	1-15
A	CN 104057979 A (CSR ZHUZHOU ELECTRIC LOCOMOTIVE CO., LTD.) 24 September 2014 (2014-09-24) entire document	1-15
A	CN 110816505 A (CRRC NANJING PUZHEN CO., LTD.) 21 February 2020 (2020-02-21) entire document	1-15
A	JP 08290765 A (NABCO LTD.) 05 November 1996 (1996-11-05) entire document	1-15

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 February 2021	**15 March 2021**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** **China**	Authorized officer
Facsimile No. **(86-10)62019451**	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/106680

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/106680

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		WO 2020029791 A1	13 February 2020
CN 104057979 A	24 September 2014	CN 104057979 B	09 March 2016
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		WO 2017184316 A3	23 August 2018

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