

CARRIER VEHICLE AND OPERATION METHOD THEREOF

Field of the Invention

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The invention relates to the technical field of construction equipment, and in particular to a carrier vehicle and an operation method thereof.

Background of the Invention

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Carrier vehicles are often used in building construction to transport concrete to required locations. However, conventional carrier vehicles suffer problems such as unreasonable structure, inconvenient usage, or the like.

Summary of the Invention

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The present invention aims to provide a carrier vehicle, which has an optimized structure and is more convenient to use, and an operation method thereof.

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According to a first aspect of the present invention, a carrier vehicle is provided, including a vehicle body running on a track. At least one emergency stop device, a hopper fixing device, at least one camera device, a sensor device and an electric control box are arranged on the vehicle body. The vehicle body includes a frame, on the bottom of which a set of wheels is arranged on each side thereof, and two motors opposite to each other in a diagonal manner are arranged on the frame, each motor being configured to drive one set of wheels through a gear box. Two emergency stop devices opposite to each other in a diagonal manner are arranged at a front end and a rear end of the vehicle body, respectively, each emergency stop device including an emergency stop sensor, and an emergency stop push rod assembly that can be pushed to trigger the emergency stop sensor. The hopper fixing device includes a plurality of hopper push rod assemblies, for fixing a hopper carried by the carrier vehicle, each hopper push rod assembly being provided with a push rod retracting in-position sensor and a push rod extending in-position sensor. Two camera devices are arranged

at the front end and the rear end of the vehicle body, respectively, each camera device including a camera, and a camera moving push rod for pushing the camera to rotate so as to change an angle of view thereof. The sensor device includes at least one selected from a group consisting of: an over-height sensor assembly, for detecting whether the
5 hopper is lifted to a height exceeding a limit; a carrier vehicle in-position sensor assembly, for detecting whether the carrier vehicle has reached its designated position; two hopper in-position sensors, for detecting whether the position of the carrier vehicle is accurate before the hopper is picked; a turning sensor, for detecting whether the track has a turning part; a wheel wear sensor, for monitoring whether wheel wear
10 exceeds a set value; an ultrasonic sensor, for detecting whether there is an obstacle in front of the vehicle body; and an encoding sensor, for detecting a position signal of the carrier vehicle in real time. The electrical control box is provided therein with a PLC, and the emergency stop sensor, the push rod retracting in-position sensor, the push rod extending in-position sensor, and various sensors included in the sensor
15 device are all in signal communication with the PLC. The motors, the hopper push rod assemblies, the cameras and the camera moving push rods are respectively controlled by the PLC.

In a possible implementing mode, the vehicle body is further provided with a
20 plurality of anti-collision rubber columns and a limiting wheel assembly. The anti-collision rubber columns are respectively arranged at the front and rear ends of the vehicle body, and the limiting wheel assembly includes a plurality of limiting wheels in contact with the track, for reducing pressure of the wheels.

In a possible implementing mode, the PLC is configured to: control said two
25 motors to stop, when receiving an emergency stop signal from the emergency stop sensor; control said two motors to run at differential speeds, when receiving a turning signal from the turning sensor; control said two motors to stop, when receiving an obstacle signal from the ultrasonic sensor; calculate a position of the carrier vehicle in
30 real time, when receiving an real-time detection signal from the encoding sensor; control said two motors to stop, when receiving an in-position signal from the carrier vehicle in-position sensor assembly; and send an instruction to drive the hopper push rod assembly to fix the hopper, when the hopper is loaded on the carrier vehicle.

In a possible implementing mode, the emergency stop push rod assembly comprises two copper sleeves fixed on the vehicle body, a sliding shaft arranged inside said two copper sleeves, and a spring mounted around the sliding shaft for providing a restoring force to the sliding shaft, wherein an end of the sliding shaft abuts against the emergency stop sensor.

In a possible implementing mode, the hopper push rod assembly includes an electric push rod and a load bearing shaft driven by the electric push rod, wherein the electric push rod is configured to push, when the hopper is loaded on the carrier vehicle, the load bearing shaft to pass through a lug hole of the hopper under a command from the PLC, so as to fix the hopper on the carrier vehicle.

In a possible implementing mode, the limiting wheel assembly consists of two sets of limiting wheels, each set including an adjustable limiting wheel in contact with an inner side of the track and a fixed limiting wheel in contact with an outer side of the track. Further, when the carrier vehicle makes a turn, a center point of the turning part of the track is configured to be on an extending line of a line connecting a center point of the adjustable limiting wheel and that of the fixed limiting wheel in each set of limiting wheels.

According to a second aspect of the present invention, an operation method of the carrier vehicle as mentioned above is provided, comprising steps of: driving the carrier vehicle to a designated position according to an instruction from a control center; activating said two camera devices after the carrier vehicle is driven, and acquiring real-time images at positions before and after the carrier vehicle and transmitting the images to the control center; detecting, after the carrier vehicle is driven, whether there are obstacles in front of the carrier vehicle through the ultrasonic sensor, detecting whether the wear of the wheels exceeds the set value through the wheel wear sensor, detecting a position signal of the carrier vehicle in real time through the encoding sensor, detecting whether the carrier vehicle enters the turning part of the track through the turning sensor, and detecting whether the carrier vehicle has reached the designated position through the carrier vehicle in-position

sensor assembly; controlling, after the carrier vehicle enters the turning part of the track, said two motors to run at differential speed, and controlling, after the carrier vehicle leaves the turning part of the track, said two motors to run at identical speed; stopping the carrier vehicle after the carrier vehicle has reached the designated position, and adjusting the carrier vehicle to a hopper-picking position exactly through the hopper in-position sensor; controlling, after the hopper is loaded on the carrier vehicle, the hopper fixing device to fix the hopper; and driving the carrier vehicle with the hopper to a distribution position.

It can be seen from the foregoing technical solutions that the carrier vehicle according to the present invention has the following advantages.

1. The carrier vehicle and the hopper are separate from each other. The hopper is loaded on the carrier vehicle and then fixed by a hopper fixing device only when it needs to be carried. If the hopper suffers a problem and thus cannot be used, it will not affect the normal operation of the carrier vehicle.

2. The structure of the carrier vehicle is optimized, and easy to maintain and repair, and to replace worn-out parts.

3. The carrier vehicle drives two sets of wheels through two motors respectively, which can realize differential driving, thus facilitating turning of the carrier vehicle.

4. An emergency stop device is arranged on the carrier vehicle for protection.

5. The carrier vehicle is provided with a camera device, which can monitor surrounding images before and after the carrier vehicle in real time.

6. A variety of sensors are arranged on the carrier vehicle, thus can provide the operating status of the carrier vehicle in time, thereby ensuring the carrier vehicle safe and reliable, and improving the operation efficiency thereof.

Brief Description of the Drawings

In the following, the drawings that are necessary for illustrating the embodiments and the prior arts will be briefly introduced, in order to explain the technical solutions of embodiments of the present invention more clearly. In the drawings:

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Figure 1 is a top view illustrating the structure of a carrier vehicle provided by an embodiment of the present invention; and

Figure 2 is a bottom view illustrating the structure of the carrier vehicle provided
10 by the embodiment of the present invention.

Detailed Description of the Embodiments

In order to enable those skilled in the art to better understand the technical
15 solutions of the present invention, the technical solutions of the embodiments of the present invention will be described clearly and completely with reference to the accompanying drawings in the embodiments of the present invention. Obviously, the embodiments as described are only part of, rather than all, the embodiments of the present invention. All other embodiments obtained by those ordinarily skilled in the
20 art based on the embodiments of the present invention provided here but without creative labor shall fall within the scope of protection of the present invention.

In the following, the present invention will be further illustrated with reference to specific embodiments.

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With reference to Figures 1 and 2, an embodiment of the present invention provides a carrier vehicle. The carrier vehicle includes a vehicle body running on a track. An emergency stop device, a hopper fixing device, a camera device, a sensor device and an electric control box are arranged on the vehicle body.

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The vehicle body includes a frame, on the bottom of which a set of wheels is arranged on each side thereof. In addition, two motors 2 opposite to each other in a diagonal manner are installed on the frame, and each of the motors 2 is configured to

drive a set of wheels through a gear box 1.

In this embodiment, two emergency stop devices opposite to each other in a diagonal manner are arranged at a front end and a rear end of the vehicle body, respectively. Each emergency stop device includes an emergency stop sensor 3, and an emergency stop push rod assembly 4, which can be pushed to trigger the emergency stop sensor 3.

The hopper fixing device includes a plurality of hopper push rod assemblies 6, for fixing a hopper carried by the carrier vehicle. Each hopper push rod assembly 6 is provided with a push rod retracting in-position sensor 9, and a push rod extending in-position sensor 10.

In this embodiment, two camera devices are arranged at the front end and the rear end of the vehicle body, respectively. Each camera device includes a camera 8, and a camera moving push rod 7 for pushing the camera 8 to rotate so as to change an angle of view of the camera 8.

The sensor device includes some or all of the following sensors: an over-height sensor assembly 5, for detecting whether the hopper is lifted to a height exceeding a limit; a carrier vehicle in-position sensor assembly 11, for detecting whether the carrier vehicle has reached its designated position; two hopper in-position sensors 12, for detecting whether the position of the carrier vehicle is accurate before the hopper is picked; a turning sensor 15, for detecting whether the track has a turning part; a wheel wear sensor 16, for monitoring whether the wheel wear exceeds a set value; an ultrasonic sensor 17, for detecting whether there is an obstacle in front of the vehicle body; and an encoding sensor 18, for detecting a position signal of the carrier vehicle in real time.

The electrical control box is provided therein with a PLC. The emergency stop sensor 3, the push rod retracting in-position sensor 9, the push rod extending in-position sensor 10, and various sensors included in the sensor device are all in signal communication with the PLC. In addition, the motors 2, the hopper push rod

assemblies 6, the cameras 8 and the camera moving push rods 7 are respectively controlled by the PLC.

Further, the vehicle body is also provided with a plurality of anti-collision rubber columns 13 and a limiting wheel assembly 14. The anti-collision rubber columns 13 are respectively arranged at the front and rear ends of the vehicle body. The limiting wheel assembly 14 includes a plurality of limiting wheels in contact with the track, for reducing the pressure of the wheels.

Hereinafter, each component of the carrier vehicle will be described in further detail.

0. Electric control box

The electric control box is provided therein with PLC (Programmable Logic Controller), as the core control device of the carrier vehicle. It can also be provided with a power supply for supplying power to the electric control box, a frequency converter for changing the running speed of the motor under the control of the PLC, a wireless communication device for communicating with an external control center, or the like, which are all connected to the PLC.

The PLC is configured to: control said two motors to stop, when receiving an emergency stop signal from the emergency stop sensor; control said two motors to run at differential speeds, when receiving a turning signal from the turning sensor; control said two motors to stop, when receiving an obstacle signal from the ultrasonic sensor; calculate a position of the carrier vehicle in real time, when receiving an real-time detection signal from the encoding sensor; control two motors to stop, when receiving an in-position signal from the carrier vehicle in-position sensor assembly; and send an instruction to drive the hopper push rod assembly to fix the hopper, when the hopper is loaded on the carrier vehicle.

1. Gear box

The gear box is connected between each motor and a corresponding set of wheels. Through engagement and transmission between gears, the power of the motor can be output to corresponding wheels, thus realizing movement of the whole carrier vehicle.

5 2. Motor

The motor is used to drive the entire carrier vehicle to move. There are two motors in total, which are arranged opposite to each other in a diagonal manner on the frame, for driving two sets of wheels mounted at the inner and outer sides of the frame
10 respectively. In this manner, differential driving of the carrier vehicle can be achieved in the turning part of the track, so that dispersive stress on the track caused by running on the turning part of the track can be eliminated. Accordingly, the whole carrier vehicle can smoothly run on the turning part of the track.

15 3. Emergency stop sensor

When an emergency occurs during the operation of the carrier vehicle, the emergency stop sensor will, if being triggered by the emergency stop push rod assembly, send an emergency stop signal to the PLC of the electrical control box,
20 which will then issue a command to stop the motors.

4. Emergency stop push rod assembly

The emergency stop push rod assembly comprises a sliding shaft, a spring, two
25 copper sleeves, and the like. The two copper sleeves are fixed on the vehicle body, and the sliding shaft is mounted inside said two copper sleeves. The spring is mounted around the sliding shaft, for providing a restoring force to the sliding shaft, the end of which abuts against the emergency stop sensor.

30 In case of extreme situations, such as loss of control or improper manual operation of the carrier vehicle, etc., the carrier vehicle will move forward as in its current state, and thus cannot be stopped. When the carrier vehicle runs into an obstacle in front thereof or another carrier vehicle, the anti-collision rubber columns

on the carrier vehicle can provide buffering effect. At the same time, the sliding shaft will also move backward due to the collision. When the emergency stop sensor is triggered by the sliding shaft, it will send a signal to the PLC, which immediately sends an instruction to stop the motors of the carrier vehicle, so that the whole carrier vehicle will stop. In this manner, safety and protection effects can be achieved.

In the embodiment as shown, two emergency stop push rod assemblies are arranged in a diagonal manner on the vehicle body. The purpose of which is based on an extreme situation occurred in the turning part of the track, where the carrier vehicle is collided with another carrier vehicle also in this area. If said two emergency stop push rod assemblies are arranged opposite to each other in a direct manner rather than in a diagonal manner, two sliding shafts will contact with each other with a very small area, or even will not contact, thus providing no protection. However, by means of diagonal arrangement of the assemblies, the carrier vehicle can be provided with a structural member, such as a baffle, with a larger cross-sectional area, in a position corresponding to each assembly of the other carrier vehicle. In this manner, on the one hand, the sliding shaft can be in contact with the baffle smoothly for providing satisfactory protection, and on the other hand, other members would not be affected.

5. Over-height sensor assembly

The over-height sensor assembly may consist of two photoelectric sensors, wherein one is transmitter and the other is receiver. The assembly functions to prevent the hopper from being lifted excessively high. If the hopper, after being picked, is lifted by a lifting mechanism to an excessive height, it will block signal transmission between said two sensors. Accordingly, the PLC in the electric control box will prevent the hopper from being lifted any more according to a preset program, thus providing protection.

6. Hopper push rod assembly

In this embodiment as shown, four hopper push rod assemblies are provided, each consisting of an electric push rod and a load bearing shaft. When a

corresponding lug hole of the hopper reaches its designated position, one of in-position sensors 9, 10 will send a signal to the electric control box of the carrier vehicle, so that the PLC in the electric control box will issue a command to activate the electric push rod. Then, the electric push rod pushes the load bearing shaft to pass through the lug hole of the hopper, so that the hopper can be fixed on the carrier vehicle. After that, the hopper can be brought to a designated position as required.

7. Camera moving push rod

The camera moving push rod can be controlled to rotate forward or backward by the PLC in the electric control box through a relay, so that the camera can have a horizontal viewing angle or a vertically pointed viewing angle.

8. Camera

In this embodiment as shown, two cameras are provided, wherein one is located in front of the other. When the carrier vehicle is running on the track, the PLC in the electric control box will command, according to a preset program, the camera moving push rod to push the cameras up. At this time, the cameras can take actual pictures ahead of the carrier vehicle during the driving, and the operator at the control center can observe the actual situation ahead of the carrier vehicle on a main display, and then make judgments based on the actual pictures. When the carrier vehicle reaches the designated position and thus stops, the camera moving push rod will retract and then drive the cameras down to take videos. At this time, the operator can observe the actual situation of the hopper after the carrier vehicle stops and the on-site situation in the viewing range of the cameras on the main display of the control center, and then perform subsequent operations according to the actual scene.

9. Push rod retracting in-position sensor

The push rod retracting in-position sensor is used in combination with the hopper push rod assembly 6, for checking whether the electric push rod has successfully retracted the load bearing shaft. When the electric push rod pulls back the load

bearing shaft such that the signal of the sensor is blocked, the PLC in the electric control box will issue a command according to the signal, so as to stop the electric push rod and provide a signal to a lifting platform.

5 10. Push rod extending in-position sensor

When the electric push rod pushes the load bearing shaft to extend and thus is sensed by the push rod extending in-position sensor, the sensor will send a signal to the PLC in the electric control box, which will, in turn, issue a command to stop the electric push rod.

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11. Carrier vehicle in-position sensor assembly

This carrier vehicle in-position sensor assembly operates as follows. A sensor board is arranged at a designated position of the track. When the carrier vehicle reaches a corresponding position according to an instruction, a corresponding sensor will sense the sensor board, and thus send a signal to the PLC in the electric control box of the carrier vehicle, which will, in turn, issue an instruction to stop the carrier vehicle at its destination accurately.

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12. Hopper in-position sensor

When the carrier vehicle arrives at its designated position and is ready to pick the hopper, two hopper in-position sensors should be sensed at the same time before the hopper can be picked. If only one of the sensors is sensed, the carrier vehicle has to continue moving to a position where said two sensors can be sensed. This ensures that the carrier vehicle is accurately located at the position where the hopper should be picked, and improves the accuracy of the cooperation between the hopper and the carrier vehicle.

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13. Anti-collision rubber column

The anti-collision rubber column is a column made of rubber. In the event that

the carrier vehicle is out of control, the anti-collision rubber column can withstand the impact and pressure thus generated. After the impact, it can quickly restore to its original state without damages. In this manner, the carrier vehicle is prevented from being damaged in collision. The emergency stop push rods of two carrier vehicles will
5 be pushed backward in collision, thus corresponding emergency stop sensors will be activated. Then, the PLC in the electric control box will receive the signal, and at the same time issue a command to stop the corresponding inverter of the motor, so as to stop the moving carrier vehicle, and send an alarm signal to the control center at the same time.

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14. Limiting wheel assembly

The limiting wheel assembly consists of two sets of adjustable limiting wheels and two sets of fixed limiting wheels, wherein each set of adjustable limiting wheels
15 and a corresponding set of fixed limiting wheels together form a pair. The adjustable limiting wheel includes a hydraulic cylinder, a support, a roller or the like, while the fixed limiting wheel includes a roller and a roller mounting bracket or the like. The adjustable limiting wheel is arranged at a position in contact with an inner side of the track, while the fixed limiting wheel is arranged at a position in contact with an outer
20 side of the track. These two pairs of limiting wheels are mounted based on accurate calculation. When the carrier vehicle makes a turn, the center point of the turning part of the track, which refers to the center of the arc of the turning part, will be on an extending line of a line connecting a center point of each set of adjustable limiting wheels and that of a corresponding set of fixed limiting wheels. In this manner, the
25 pressure applied on the wheels after the carrier vehicle enters the track can be reduced, and the carrier vehicle can enter the turning part of the track smoothly.

15. Turning sensor

30 A sensing plate is arranged at a position out of the turning part of the track. The turning sensor will detect the sensing plate when the carrier vehicle is about to enter the turning part. At this time, the turning sensor will send a signal to the PLC of the electric control box, which will, in turn, send a command to the inverter of the motor,

thus achieving differential running of the two motors in the turning part of the track. In this manner, the force applied on the track by the limiting wheels when the carrier vehicle enters the turning part of the track can be reduced, so that the carrier vehicle can enter the turning part of the track smoothly.

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16. Wheel wear sensor

The wheel wear sensor is mainly used to monitor the usage of wheels. If the wheel wear exceeds a set value in use, the relative standard position of the carrier vehicle will be lowered, so that that the lifting position of the lifting device (and the lotus plate also) for picking and placing the hopper becomes higher relative to the carrier vehicle, resulting in inaccurate handling of the hopper. When the wear of the wheels exceeds the set value (or the set position), the wheel wear sensor will send a signal as an alarm, reminding of replacement of the wheels.

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17. Ultrasonic sensor

The ultrasonic sensor can emit pulse waves, and determine a certain sensing distance according to safety calculation. In the event of extreme conditions, such as loss of control or misoperation of the carrier vehicle or the like, the ultrasonic sensor on the carrier vehicle will detect obstacles in front, such as objects or other carrier vehicles, thus sending a signal to the PLC, which will, in turn, issue a command to stop the carrier vehicle for safety protection. At the same time, it will send an alarm signal to the control center.

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18. Encoding sensor assembly

The encoding sensor assembly consists of two sensors, an upper one and a lower one. A plurality of sensing plates evenly arranged along a circle is arranged on the inner side of the track. Each sensing plate is provided with square through-holes and blind parts, which have the same size and are arranged alternatively. The upper and lower sensors of the encoding sensor assembly can be used to detect whether there exists a square through-hole (state ON) or a blind part (state OFF). When the carrier

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vehicle is running, the PLC will count according to the ON/OFF state of the encoding sensor assembly, in order to determine the location of each carrier vehicle. In this manner, collisions between carrier vehicles can be prevented for safety.

5 Hereinafter, the procedure of the operation method of the carrier vehicle according to the present invention will be described.

10 In step S1, when there is concrete or an empty hopper that should be taken away from a production line, on-site operator will send a signal to the control center according to actual needs.

15 In step S2, the operator at the control center will, according to the signal, issue an instruction to the carrier vehicle, which will then move to the designated position according to the instruction from the control center. When the carrier vehicle starts to move, two cameras on the carrier vehicle will be pushed up by corresponding electric push rods respectively, so as to acquire and monitor real-time images at positions before and after the carrier vehicle. The operator at the control center will monitor the actual transportation procedure of the carrier vehicle on the main display.

20 In step S3, after the carrier vehicle is started to move, it will reach a higher speed in a short time, until it approaches or reaches the designated position.

25 In step S4, when the carrier vehicle is running, the ultrasonic sensor will continuously emit pulse waves to determine whether there are obstacles in front of the carrier vehicle, such as objects or other carrier vehicles. At the same time, the wheel wear sensor will continue to maintain a standby state, in order to detect whether the wear of the wheels exceeds the set value, thus sending an alarm signal when the wheel wear exceeds a safety range. In addition, as long as the carrier vehicle starts to run, the encoding sensor assembly will continue to count, for determining the location of the carrier vehicle. The location information of all the carrier vehicles at the same time point will be sent to the control center, which will adjust the distance between individual carrier vehicles for avoiding collisions.

In step S5, the carrier vehicle detects whether it enters a turning part of the track through the turning sensor. When the carrier vehicle enters the turning part of the track, the turning sensor will detect a corresponding turn sensing board, and thus starts to work. At this time, the sensor sends a signal to the PLC in the electric control box of the carrier vehicle, which will, in turn, send instructions to two inverters for achieving differential operation of two motors, so that the carrier vehicle can smoothly enter the turning part of the track. With the same principle, when the carrier vehicle exits the turning part of the track, the sensor will detect the turn sensing board no longer, so that signal transmission is interrupted. Accordingly, the PLC in the electric control box of the carrier vehicle will, according to the program setting, issue instructions for converting parameters of said two inverters into the same data, in order to realize that the two motors are running in a linear part of the track at the same speed.

In step S6, the carrier vehicle detects whether it has reached the designated location through the carrier vehicle in-position sensor assembly. When the carrier vehicle reaches the designated position, the carrier vehicle will become slow to stop at the accurate parking position. At the same time, the hopper in-position sensors will detect that the hopper is in a corresponding position and thus send a signal. If one of the hopper in-position sensors fails to detect, the carrier vehicle will automatically keep moving to find the accurate parking position, until two hopper in-position sensors both output signals and the carrier vehicle in-position sensor assembly also sends a signal. At this time, the carrier vehicle stops exactly at the designated location.

In step S7, when the carrier vehicle stops at the accurate parking position, the hopper will be lifted by a lifting device, until four perforated lugs of the hopper enter into the hopper push rod assembly. At this time, the corresponding sensor is sensed, and the lifting device stops.

S8. When the lifting device stops, the PLC in the electric control box of the carrier vehicle receives the signal, and then sends an instruction to move the electric push rod of the hopper push rod assembly, and push out the load bearing shaft through the lug holes of the hopper. When the load bearing shaft extends to be detected by the

push rod in-position sensor, the sensor sends a signal to the PLC in the electric control box of the carrier vehicle. At this time, the load bearing shaft is in place, and then the PLC sends a command to stop the electric push rod. When all the push rod in-position sensors in four positions output signals, it means that the hopper has been fixed in the carrier vehicle.

In step S9, the lifting device for lifting the hopper descends to a safe position and sends a signal. The carrier vehicle can carry the hopper to a required position, such as the distribution position, according to this signal.

In the foregoing, the structure and operation procedure of the carrier vehicle according to the present invention have been described in detail.

It can be seen from the foregoing that the main advantages of the carrier vehicle according to the present invention are as follows.

1. The carrier vehicle and the hopper exist separately from each other. The hopper is loaded on the carrier vehicle and fixed by a hopper fixing device only when it needs to be carried. In other words, they will not affect each other except when needed. If the hopper suffers a problem and thus cannot be used, it will not affect the normal operation of the carrier vehicle.

2. The structure of the carrier vehicle is optimized, and easy to maintain and repair, and to replace worn-out parts.

3. The carrier vehicle drives two sets of wheels through two motors respectively, which can realize differential driving, thus facilitating turning of the carrier vehicle.

4. An emergency stop device and anti-collision rubber columns are arranged on the carrier vehicle for protection.

5. The carrier vehicle is provided with a camera device, which can monitor the environment images before and after the carrier vehicle in real time.

6. A variety of sensors are arranged on the carrier vehicle, thus can provide the operating status of the carrier vehicle in time, thereby ensuring the carrier vehicle safe and reliable, and improving the operation efficiency thereof.

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7. Limiting wheel assemblies are arranged in corresponding positions of the carrier vehicle, which can ensure smooth entry in the track turn.

8. If the carrier vehicle fails as a whole, the carrier vehicle can be taken away as a whole by merely removing the track and track support for the carrier vehicle, which can be completed conveniently and rapidly, and would not affect the operation of other carrier vehicles.

9. The carrier vehicle can run smoothly at an ideal speed with high efficiency within a safe range.

In the above-mentioned embodiments, the description of each embodiment has its own emphasis. For parts that are not described in detail in an embodiment, reference may be made to related descriptions of other embodiments.

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The foregoing are only preferred embodiments of the present invention, and are not intended to limit the present invention. Any modification, equivalent replacement or improvement made within the spirit and principle of the present invention should be included in the protection scope of the present invention.

CLAIMS

1. A carrier vehicle, including a vehicle body running on a track, characterized in that:

5 at least one emergency stop device, a hopper fixing device, at least one camera device, a sensor device and an electric control box are arranged on the vehicle body;

 the vehicle body includes a frame, on the bottom of which a set of wheels is arranged on each side thereof, and two motors opposite to each other in a diagonal manner are arranged on the frame, each motor being configured to drive one set of
10 wheels through a gear box;

 two emergency stop devices opposite to each other in a diagonal manner are arranged at a front end and a rear end of the vehicle body, respectively, each emergency stop device including an emergency stop sensor, and an emergency stop push rod assembly that can be pushed to trigger the emergency stop sensor;

15 the hopper fixing device includes a plurality of hopper push rod assemblies, for fixing a hopper carried by the carrier vehicle, each hopper push rod assembly being provided with a push rod retracting in-position sensor and a push rod extending in-position sensor;

 two camera devices are arranged at the front end and the rear end of the vehicle
20 body, respectively, each camera device including a camera, and a camera moving push rod for pushing the camera to rotate so as to change an angle of view thereof;

 the sensor device includes at least one selected from a group consisting of:

 an over-height sensor assembly, for detecting whether the hopper is lifted to a height exceeding a limit;

25 a carrier vehicle in-position sensor assembly, for detecting whether the carrier vehicle has reached its designated position;

 two hopper in-position sensors, for detecting whether the position of the carrier vehicle is accurate before the hopper is picked;

 a turning sensor, for detecting whether the track has a turning part; a wheel
30 wear sensor, for monitoring whether wheel wear exceeds a set value;

 an ultrasonic sensor, for detecting whether there is an obstacle in front of the vehicle body; and

 an encoding sensor, for detecting a position signal of the carrier vehicle in

real time,

wherein the electrical control box is provided therein with a PLC, and the emergency stop sensor, the push rod retracting in-position sensor, the push rod extending in-position sensor, and various sensors included in the sensor device are all

5 in signal communication with the PLC, and

wherein the motors, the hopper push rod assemblies, the cameras and the camera moving push rods are respectively controlled by the PLC.

2. The carrier vehicle according to claim 1, characterized in that the vehicle body
10 is further provided with a plurality of anti-collision rubber columns and a limiting wheel assembly,

wherein the anti-collision rubber columns are respectively arranged at the front and rear ends of the vehicle body, and the limiting wheel assembly includes a plurality of limiting wheels in contact with the track, for reducing pressure of the wheels.

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3. The carrier vehicle according to claim 1, characterized in that the PLC is configured to:

control said two motors to stop, when receiving an emergency stop signal from the emergency stop sensor;

20 control said two motors to run at differential speeds, when receiving a turning signal from the turning sensor;

control said two motors to stop, when receiving an obstacle signal from the ultrasonic sensor;

25 calculate a position of the carrier vehicle in real time, when receiving an real-time detection signal from the encoding sensor;

control said two motors to stop, when receiving an in-position signal from the carrier vehicle in-position sensor assembly; and

send an instruction to drive the hopper push rod assembly to fix the hopper, when the hopper is loaded on the carrier vehicle.

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4. The carrier vehicle according to claim 1, characterized in that the emergency stop push rod assembly comprises two copper sleeves fixed on the vehicle body, a sliding shaft arranged inside said two copper sleeves, and a spring mounted around

the sliding shaft for providing a restoring force to the sliding shaft,
wherein an end of the sliding shaft abuts against the emergency stop sensor.

5 5. The carrier vehicle according to claim 1, characterized in that the hopper push rod assembly includes an electric push rod and a load bearing shaft driven by the electric push rod,

wherein the electric push rod is configured to push, when the hopper is loaded on the carrier vehicle, the load bearing shaft to pass through a lug hole of the hopper under a command from the PLC, so as to fix the hopper on the carrier vehicle.

10 6. The carrier vehicle according to claim 2, characterized in that the limiting wheel assembly consists of two sets of limiting wheels, each set including an adjustable limiting wheel in contact with an inner side of the track and a fixed limiting wheel in contact with an outer side of the track.

15 7. The carrier vehicle according to claim 6, characterized in that a center point of the turning part of the track is configured to be on an extending line of a line connecting a center point of the adjustable limiting wheel and that of the fixed limiting wheel in each set of limiting wheels, when the carrier vehicle makes a turn.

20 8. An operation method of the carrier vehicle according to claim 1, comprising steps of:

driving the carrier vehicle to a designated position according to an instruction from a control center;

25 activating said two camera devices after the carrier vehicle is driven, and acquiring real-time images at positions before and after the carrier vehicle and transmitting the images to the control center;

30 detecting, after the carrier vehicle is driven, whether there are obstacles in front of the carrier vehicle through the ultrasonic sensor, detecting whether wear of the wheels exceeds the set value through the wheel wear sensor, detecting a position signal of the carrier vehicle in real time through the encoding sensor, detecting whether the carrier vehicle enters the turning part of the track through the turning sensor, and detecting whether the carrier vehicle has reached the designated position

through the carrier vehicle in-position sensor assembly;

controlling, after the carrier vehicle enters the turning part of the track, said two motors to run at differential speed, and controlling, after the carrier vehicle leaves the turning part of the track, said two motors to run at identical speed;

5 stopping the carrier vehicle after the carrier vehicle has reached the designated position, and adjusting the carrier vehicle to a hopper-picking position exactly through the hopper in-position sensor;

controlling, after the hopper is loaded on the carrier vehicle, the hopper fixing device to fix the hopper; and

10 driving the carrier vehicle with the hopper to a distribution position.