

CONCRETE TRANSPORT VEHICLE

Technical Field

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The present invention relates to a transport device, and in particular, to structural improvements on a transport vehicle for transporting concrete running along a track.

Technical Background

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In the prior arts, concrete used in building structures is usually mixed in a concrete mixing plant, and then transported to a concrete feeding device which is located at the construction site or in the factory for manufacturing prefabricated concrete parts. Through the concrete feeding device, concrete is directly poured to the part of the building structure to be cast, or injected into a material carrier by which the concrete is further transported to the desirable destination. On certain suitable occasions such as production lines for prefabricated concrete parts, concrete transport vehicles running along a track are often adopted, in order to transport concrete from the concrete mixing plant to the feeding device more efficiently.

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Since most of the material-receiving hoppers adopted on the production lines have a capacity of 1 cubic meter, the traditional track-type concrete transport vehicle is also provided with a hopper with a capacity of 1 cubic meter, both for full load transport. If the demand for concrete on the production line exceeds 1 cubic meter, the concrete transport vehicle needs to transport twice or more, which will undoubtedly slow down the production process. Meanwhile, if the demand for concrete on the production line is less than 1 cubic meter, the remaining concrete in the hopper will solidify and thus become unusable, resulting in material waste and increased costs. Moreover, for production lines with different demand for concrete, this kind of

transport vehicle may not be suitable.

In addition, this kind of traditional concrete transport vehicle with a single function lacks automation and requires more manual intervention, which increases labor cost. It is also prone to errors, and thus affects the production process.

Summary of the Invention

The technical problem to be solved by the present invention is to provide a concrete transport vehicle with higher transportation efficiency that can avoid the waste of concrete.

The present invention adopts technical solutions as follows. A concrete transport vehicle is provided, which is mounted on and runs along a track. The concrete transport vehicle comprises a vehicle frame, hoppers arranged on the vehicle frame, wheels arranged on a left and a right sides of the vehicle frame, and motors for driving the wheels to rotate.

The concrete transport vehicle further comprises weighing devices arranged on the vehicle frame for weighing material loaded in the hoppers, and a PLC control system.

Two hoppers are provided, each of which is provided with a pneumatic cylinder for opening or closing a feeding port arranged at a bottom of the hopper. The motors, the weighing devices and the pneumatic cylinders are all connected to the PLC control system.

The vehicle frame is provided with two buffering columns protruding outward therefrom at a left front side and a right front side thereof, respectively, behind each of

which an emergency stop device is arranged, wherein the emergency stop device comprises a push rod, a spring abutting against the push rod, and a micro switch connected to the PLC control system. The buffering column moves backward when being collided, so that the push rod is pushed backward to trigger the micro switch.

- 5 The PLC control system stops the motor upon receipt of a corresponding signal and sends an alarm signal.

A bumper plate is provided at a rear portion of the vehicle frame, and the emergency stop device is provided in front of the bumper plate. The bumper plate
10 knocks open the push rod of the emergency stop device when being collided, so as to trigger the micro switch. The PLC control system stops the motor upon receipt of a corresponding signal and sends an alarm signal.

The concrete transport vehicle of the present invention further comprises a
15 leak-proof plate rotatably arranged below the feeding ports located at the bottom of the hoppers, and leak-proof plate cylinders connected to the PLC control system for activating the leak-proof plate to rotate.

A pneumatic hammer connected to the PLC control system is arranged on one
20 side of each hopper.

A limiting wheel assembly is arranged on a bottom portion of the vehicle frame at each of a left and a right sides thereof, and consists of two adjustable limiting wheels and two fixed limiting wheels, wherein each adjustable limiting wheel is
25 arranged in a position in contact with an inner side of the track, while each fixed limiting wheel is arranged in a position in contact with an outer side of the track.

A wheel sensor connected to the PLC control system is arranged on one side of each wheel, for monitoring wear of the wheel.

Two motors are provided on the left and the right sides for driving the wheels on the left and the right sides, respectively. A turning sensor assembly connected to the PLC control system is provided in a middle portion of the vehicle frame. A turn sensing board is provided on the track adjacent to a turning part thereof. The turning sensor assembly sends, when detecting the turn sensing board, a signal to the PLC control system, which issues instructions to inverters of the motors on the left and the right sides, so that the two motors control the wheels on the left and the right sides respectively to enter the turning part at differential speeds.

A front in-position sensor, a middle in-position sensor assembly and a rear in-position sensor all connected to the PLC control system are provided in a middle portion of the vehicle frame in sequence. A parking-position sensing board is provided in a corresponding position on the track. When detecting the parking-position sensing board, the front in-position sensor sends a signal to the PLC control system to control the motors to decelerate, the rear in-position sensor sends a signal to the PLC control system to control the motors to stop, and the middle in-position sensor assembly sends a signal to the PLC control system to control the motor to move slightly, until the transport vehicle moves to an accurate parking position.

A position sensor assembly connected to the PLC control system is provided in a middle portion of the vehicle frame. A position sensing board extending along an extension direction of the track is provided in a corresponding position on the track below the position sensor assembly. The PLC control system determines a position of the transport vehicle according to a signal indicating a position of the position sensing board from the position sensor assembly.

Compared with the prior arts, the concrete transport vehicle of the present invention are provided with two hoppers and additional weighing devices, thus the

amount of concrete loaded each time is significantly increased, so that transportation and production efficiency are both improved. Meanwhile, the loading amount of concrete can be controlled accurately as needed, which avoids the waste of concrete. Therefore, the transport vehicle can be applicable for the existing production systems
5 with various requirements, thereby achieving consistency, standardization, full series and full versatility. Since one kind of transport vehicle is applicable for almost all types of production lines, there is no need to purchase a variety of transport vehicles from the market, which saves material resources and conforms to the conception of environmentally friendly design. In addition, most of the operations of the transport
10 vehicle are automatically controlled by the PLC control system, which is more intelligent, thus can reduce manual intervention, and better ensure the normal supply of concrete.

Brief Description of the Drawings

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Fig. 1 schematically shows a top portion of a concrete transport vehicle according to the present invention, viewed from front.

Fig. 2 schematically shows a bottom portion of the concrete transport vehicle
20 according to the present invention, viewed from one side of rear.

Fig. 3 schematically shows the bottom portion of the concrete transport vehicle according to the present invention, viewed from the other side of rear.

25 Fig. 4 is a side view of the concrete transport vehicle according to the present invention.

Fig. 5 schematically shows the emergency stop device.

Detailed Description of the Embodiments

The present invention will be described in further detail with reference to the embodiments as shown in the accompanying drawings.

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The concrete transport vehicle according to the present invention is mounted on and runs along a track. Accordingly, the concrete can be transported by the track to a material-receiving position of a production line. As shown in Figs. 1, 2 and 4, the concrete transport vehicle according to the present invention comprises a vehicle
10 frame 1, hoppers 2, wheels 3, motors 4, weighing devices 5, a PLC control system and a plurality of sensors, wherein the PLC control system is connected to each of the electric devices and sensors of the transport vehicle.

Two hoppers 2, one located in front of the other, are provided at the center of the
15 vehicle frame 1, and separated from each other by a metal plate 23 arranged therebetween. The bottom of each hopper 2 is provided with an opening to form a feeding port, which can be closed with a baffle 24 rotatably connected thereto. A pneumatic cylinder 21 connected to the PLC control system is provided at one side of each of the two hoppers 2, and is connected to a corresponding baffle 24 for opening
20 or closing a corresponding feeding port. A pneumatic hammer 22 connected to the PLC control system is further arranged on one side of each of the two hoppers 2, and is configured to vibrate the outer wall of a corresponding hopper 2 for facilitating the feeding.

25 The wheels 3 are arranged on the left and the right sides of the bottom portion of the vehicle frame 1, wherein two wheels 3, one located in front of the other, are provided on each side respectively, so that a total of four wheels 3 are mounted on the track accordingly. In order to ensure the wheels 3 do not come off the track, a limiting wheel assembly is further arranged at the bottom portion of the vehicle frame 1, and

consists of two adjustable limiting wheels 91 and two fixed limiting wheels 92. Each of the adjustable limiting wheels 91 comprises a spring, a support, a roller, etc. As the transport vehicle runs, the position of the roller of each adjustable limiting wheel 91 will be adjustably changed accordingly. As shown in Fig. 2, the two adjustable limiting wheels 91, one located in front of the other, are arranged in positions in contact with the inner side of the track. Each of the fixed limiting wheels 92 comprises a roller, a roller mounting bracket, etc, wherein the roller is fixed and unmovable. As shown in Fig. 3, the two fixed limiting wheels 92, one located in front of the other, are arranged in positions in contact with the outer side of the track. The four limiting wheels are arranged based on precise calculation, so that a center line formed by connecting a center point of each adjustable limiting wheel and that of the corresponding fixed limiting wheel will, after extended to the inner side of a turning part of the track, meet a center point of the turning part of the track. In this manner, the pressure applied on the wheels after the transport vehicle enters the track can be reduced, and the transport vehicle can enter the turning part of the track smoothly.

Two motors 4 are mounted on the left and the right sides of the vehicle frame 1, respectively, each of which is configured to drive the wheels 3 on the same side, so that the vehicle frame 1 can run along the track. The motors 4 each is provided with an inverter and connected with the PLC control system, so that the rotational speed of each of the wheels 3 on the left and the right sides can be controlled through the PLC control system.

As shown in Fig. 1, four weighing devices 5 connected to the PLC control system are provided on the vehicle frame 1 at the front and the rear edges of the two hoppers 2, respectively. The weighing devices 5 are configured to weigh the concrete loaded in the hoppers 2. When the concrete loaded reaches a set weight, the weighing devices 5 send a signal to the PLC control system, which then sends an instruction to a central batching plant chute to stop feeding.

As shown in Fig. 1, two buffering columns 71 made of rubber are provided at a left front side and a right front side of the vehicle frame 1 respectively, protruding outward therefrom, so as to avoid damages caused by collision between two adjacent transport vehicles running on the track. In the event that the transport vehicle is out of control and thus collides with another transport vehicle on the track, the buffering columns 71 can withstand the impact and pressure and quickly restore to their respective original states without damages after the impact. In this manner, the transport vehicle is prevented from being damaged in collision. An emergency stop device 72 is provided at the rear of each buffering column 71. As shown in Fig. 5, the emergency stop device 72 comprises a push rod 721, a spring 723 abutting against the push rod 721 to restore the same, and a micro switch 722 connected to the PLC control system. When moving backward in collision, the buffering column 71 collides with the push rod 721, which then moves backward to trigger the micro switch 722. The PLC control system will receive a signal, and at the same time send a command to stop the corresponding inverter of the motor 4, so as to stop the moving transport vehicle and send an alarm signal at the same time.

As shown in Fig. 2 or 3, a bumper plate 73 is provided at the rear end surface of the vehicle frame 1, and the emergency stop devices 72 are provided in front of the bumper plate 73. In the event that another transport vehicle behind this transport vehicle is out of control and collides with this transport vehicle, the bumper plate 73 will be the first member to be impacted. When collided and pressed, the bumper plate 73 collides with the push rod 721 of the emergency stop device 72, which then triggers the micro switch 722. The PLC control system will receive a signal, and at the same time send a command to stop the corresponding inverter of the motor 4, so as to stop the moving transport vehicle and send an alarm signal at the same time.

Since the concrete contains moisture, it is inevitable that there will be mud water

dripping from the hoppers 2 on the transport vehicle after the feeding is completed. As shown in Figs. 3 and 4, in order to avoid the spilling of mud water, a rotatable leak-proof plate 81 is arranged below the feeding ports at the bottom portions of the hoppers 2, and leak-proof plate cylinders 82 connected to the PLC control system are arranged on one side of the hoppers 2, for pushing the leak-proof plate 81 to rotate. The leak-proof plate 81 is shaped as a groove. After the feeding is completed, the leak-proof plate 81 is pushed by the leak-proof plate cylinders 82 to a position below the feeding ports, so as to receive the mud water dripping from the feeding ports.

As shown in Fig. 2, a wheel sensor 61 connected to the PLC control system is arranged on one side of each of the wheels 3, for monitoring the wheel's wear. When the wheel's wear exceeds a set value, the wheel sensor 61 will detect the track surface and send a signal as an alarm, reminding of replacement of the wheel.

As shown in Fig. 3, a turning sensor assembly 62 comprising two sensors is provided in the middle of the vehicle frame 1, and is connected to the PLC control system. A turn sensing board is provided on the track adjacent to a turning part. When the transport vehicle is about to enter the turning part, the turning sensor assembly 62 will detect the turn sensing board. At this time, a signal is sent to the PLC control system, which issues instructions to inverters of the motors 4 on the left and the right sides, so that the motors 4 control the wheels 3 on the left and the right sides to differential speeds for entering the turning part. In this manner, the force applied on the track by the limiting wheel assembly when the transport vehicle enters the turning part can be reduced, so that the transport vehicle can enter the turning part smoothly.

A front in-position sensor 63, a middle in-position sensor assembly 64 and a rear in-position sensor 65 all connected to the PLC control system are provided in the middle of the vehicle frame 1 in sequence, wherein the middle in-position sensor assembly 64 comprises 5 sensors arranged from the front to the rear, which function

collectively. A parking-position sensing board is provided in a corresponding position on the track. When detecting the parking-position sensing board, the front in-position sensor 63 sends a signal to the PLC control system to control the motors 4 to decelerate, the rear in-position sensor 65 sends a signal to the PLC control system to control the motors 4 to stop, and the middle in-position sensor assembly 64 sends a signal to the PLC control system to control the motors 4 to move slightly, until the transport vehicle moves to its accurate parking position.

As shown in Fig. 2, a position sensor assembly 66 connected to the PLC control system is provided in the middle of the vehicle frame 1, and comprises two sensors. A position sensing board extending along the extension direction of the track is provided in a corresponding position on the track below the position sensor assembly 66. The position sensing board is provided with square through-holes and blind parts, which have the same size and are arranged alternately. When the transport vehicle is running, the PLC control system will count the ON/OFF state of the position sensor assembly 66, in order to determine the position of each transport vehicle. In this manner, collisions between transport vehicles can be prevented for safety.

The operation procedures of the concrete transport vehicle according to the present invention are as follows.

1. When it is necessary to supply concrete to the production line, on-site operator will send a signal to the control center according to needs.
2. The operator at the control center will, according to the signal, issue an instruction to the transport vehicle, which will then move to the material receiving opening of the central batching plant chute.
3. When the hoppers 2 of the transport vehicle are loaded with concrete of the set

weight, the weighing devices 5 of the transport vehicle will send a signal to the central batching plant chute, where the operator will control the central batching plant chute to terminate the feeding.

5 4. The transport vehicle loaded with concrete leaves the central batching plant chute and moves to the position on the production line where concrete is needed.

10 5. When the transport vehicle is running, the wheel sensors 61 will continue to maintain a standby state, and send an alarm signal when the wheel wear exceeds a safety range. In addition, as long as the transport vehicle starts to run, the position sensor assembly 66 will start to count continuously in order to determine the position of the transport vehicle. At the same time, the position information will be sent to the PLC control system, which will adjust the distance between adjacent transport vehicles for avoiding collisions.

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 6. When the transport vehicle enters a turning part of the track, the turning sensor assembly 62 will detect a corresponding turn sensing board, and thus starts to work. At the same time, the turning sensor assembly 62 sends a signal to the PLC control system of the transport vehicle, which will send instructions to the corresponding
20 inverters of the motors 4 on both sides respectively to adjust parameters thereof, for achieving differential operation of two motors 4, so that the transport vehicle can enter the turning part smoothly. Similarly, when the transport vehicle exits the turning part of the track, the turning sensor assembly 62 will detect the turn sensing board no longer, so that signal transmission is interrupted. Accordingly, the PLC control system
25 of the transport vehicle will, according to the program setting, issue instructions to said two inverters to adjust parameters thereof into the same data, so that the two motors 4 run in a linear part of the track at the same speed.

 7. When the transport vehicle is near the required position on the production line,

it begins to decelerate if the front in-position sensor 63 detects the parking position sensing board first and sends a signal to the PLC control system. When the transport vehicle decelerates until the rear in-position sensor 65 detects the parking position sensing board and sends a signal to the PLC control system, the transport vehicle
5 stops, and then the middle in-position sensor assembly 64 will start to work. When two of the sensors of the middle in-position sensor assembly 64 detect the parking position sensing board and send a position signal of the set production line, the PLC control system sends an instruction to start the motors 4 of the transport vehicle again, moving the motors 4 slightly, and then the transport vehicle stops at the required
10 destination accurately according to the signal feedback of the sensor.

8. After the transport vehicle stops at the required destination accurately, the front and the rear leak-proof plate cylinders 82 will move simultaneously according to the instruction from the PLC control system, so that the leak-proof plate 81 rotates
15 away from the feeding ports of the hoppers 2 on the transport vehicle.

9. After the leak-proof plate 81 rotates in position, a signal is sent to the PLC control system, which issues an instruction to open the front and the rear pneumatic cylinders 21 at the same time or separately. At this time, the pneumatic hammers 22
20 also start to vibrate the outer walls of the hoppers 2, so that the concrete starts to fall into the material receiving device of the production line.

10. After the feeding is completed, the readings of the weighing devices 5 decrease because there is no concrete in the hoppers 2 of the transport vehicle. At the
25 same time, the weighing devices 5 will send a signal to the PLC control system, which issues an instruction to stop the pneumatic hammers 22 from vibrating, and activates the pneumatic cylinders 21 to close the feeding ports. The leak-proof plate cylinders 82 are also activated, so that the leak-proof plate 81 rotates to a position below the feeding ports of the hoppers 2.

11. After the above procedures are completed, the transport vehicle finishes the transporting of concrete. When there is more demand for production, the corresponding transport vehicle will move to the central batching plant chute again to receive the material.

The foregoing description is merely illustrative of preferred embodiments of the present invention, and is not intended to limit the present invention. Any modifications, equivalent substitutions, improvements, and the like within the spirit and principles of the present invention are intended to be included within the scope of protection of the present invention.

CLAIMS

1. A concrete transport vehicle, mounted on and running along a track, comprising a vehicle frame (1), hoppers (2) arranged on the vehicle frame (1), wheels
5 (3) arranged on a left and a right sides of the vehicle frame (1), and motors (4) for driving the wheels (3) to rotate, characterized in that,

the concrete transport vehicle further comprises weighing devices (5) arranged on the vehicle frame (1) for weighing material loaded in the hoppers (2), and a PLC control system,

10 wherein two hoppers are provided, each of which is provided with a pneumatic cylinder (21) for opening or closing a feeding port arranged at a bottom of the hopper (2); and

the motors (4), the weighing devices (5) and the pneumatic cylinders (21) are all connected to the PLC control system.

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2. The concrete transport vehicle according to claim 1, characterized in that the vehicle frame (1) is provided with two buffering columns (71) protruding outward therefrom at a left front side and a right front side thereof, respectively, behind each of which an emergency stop device (72) is arranged,

20 wherein the emergency stop device (72) comprises a push rod (721), a spring (723) abutting against the push rod (721), and a micro switch (722) connected to the PLC control system; and

the buffering column (71) is configured to move backward when being collided, so that the push rod (721) is pushed backward to trigger the micro switch (722), and
25 the PLC control system is configured to stop the motor (4) upon receipt of a corresponding signal and send an alarm signal.

3. The concrete transport vehicle according to claim 2, characterized in that a bumper plate (73) is provided at a rear portion of the vehicle frame (1), and the

emergency stop device (72) is provided in front of the bumper plate (73);

the bumper plate (73) is configured to knock open the push rod (721) of the emergency stop device (72) when being collided, so as to trigger the micro switch (722), and the PLC control system is configured to stop the motor (4) upon receipt of
5 a corresponding signal and send an alarm signal.

4. The concrete transport vehicle according to claim 1, 2 or 3, characterized in that the concrete transport vehicle further comprises a leak-proof plate (81) rotatably arranged below the feeding ports located at the bottom of the hoppers (2), and
10 leak-proof plate cylinders (82) connected to the PLC control system for activating the leak-proof plate (81) to rotate.

5. The concrete transport vehicle according to claim 1, 2 or 3, characterized in that a pneumatic hammer (22) connected to the PLC control system is arranged on
15 one side of each hopper (2).

6. The concrete transport vehicle according to claim 1, 2 or 3, characterized in that a limiting wheel assembly is arranged on a bottom portion of the vehicle frame (1) at each of a left and a right sides thereof, and consists of two adjustable limiting
20 wheels (91) and two fixed limiting wheels (92), wherein each adjustable limiting wheel (91) is arranged in a position in contact with an inner side of the track, while each fixed limiting wheel (92) is arranged in a position in contact with an outer side of the track.

25 7. The concrete transport vehicle according to claim 1, 2 or 3, characterized in that a wheel sensor (101) connected to the PLC control system is arranged on one side of each wheel (3), for monitoring wear of the wheel.

8. The concrete transport vehicle according to claim 1, 2 or 3, characterized in

that two motors (4) are provided on the left and the right sides for driving the wheels (3) on the left and right sides, respectively;

a turning sensor assembly (62) connected to the PLC control system is provided in a middle portion of the vehicle frame (1);

5 a turn sensing board is provided on the track adjacent to a turning part thereof; and

the turning sensor assembly (62) is configured to send, when detecting the turn sensing board, a signal to the PLC control system, which issues instructions to inverters of the motors (4) on the left and the right sides, so that the two motors (4) control the wheels (3) on the left and the right sides respectively to enter the turning part at differential speeds.

9. The concrete transport vehicle according to claim 1, 2 or 3, characterized in that a front in-position sensor (63), a middle in-position sensor assembly (64) and a rear in-position sensor (65) all connected to the PLC control system are provided in a middle portion of the vehicle frame (1) in sequence;

a parking-position sensing board is provided in a corresponding position on the track; and

when detecting the parking-position sensing board, the front in-position sensor (63) sends a signal to the PLC control system to control the motor (4) to decelerate, the rear in-position sensor (65) sends a signal to the PLC control system to control the motor (4) to stop, and the middle in-position sensor assembly (64) sends a signal to the PLC control system to control the motor (4) to move slightly, until the transport vehicle moves to an accurate parking position.

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10. The concrete transport vehicle according to claim 1, 2 or 3, characterized in that a position sensor assembly (66) connected to the PLC control system is provided in a middle portion of the vehicle frame (1);

a position sensing board extending along an extension direction of the track is

provided in a corresponding position on the track below the position sensor assembly (66); and

the PLC control system is configured to determine a position of the transport vehicle according to a signal indicating a position of the position sensing board from
5 the position sensor assembly (66).