

DISTRIBUTION MACHINE AND OPERATION METHOD THEREOF

Field of the Invention

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The present invention relates to the field of concrete technology, and in particular, to a distribution machine and its operation method.

Background of the Invention

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Distribution machine is an end machine for pouring concrete in building construction, and functions to distribute the concrete to the formwork of a component to be poured. Every time when the distributing operation is completed, it is necessary to clean the distribution machine. The cleaning operation will, on the one hand, damage the electrical components of the distribution machine, and on the other hand, affect the distributing efficiency.

Summary of the Invention

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The present invention aims to provide a distribution machine and its operation method, by which the reliability and the distributing efficiency of the distribution machine can be both improved.

According to a first aspect, the present invention provides a distribution machine, comprising a hopper carrier, a rail car, and an electric control box for controlling the hopper carrier and the rail car, the hopper carrier being arranged on the rail car and movable relative to the rail car, and a hopper for receiving concrete being detachably arranged on the hopper carrier. The hopper carrier includes a hopper carrier frame,

which is provided thereon with a position-limiting assembly for fixing the hopper, a unloading vibrator for applying vibration to the hopper, a hook opening device for opening a hook arranged on the hopper, and a hopper opening device for opening a discharging port of the hopper, the hopper opening device including a hopper opening
5 motor, an encoder connected to the hopper opening motor, and a hopper opening assembly for opening the discharging port of the hopper when being driven by the hopper opening motor. The rail car includes a car body frame, on which a transmission device for driving the hopper carrier to move and a plurality of position sensors for detecting a position of the hopper carrier are arranged, and a rail walking
10 device for running on a rail and a plurality of limit sensors for detecting and controlling a position of the rail car are provided under the car body frame.

In an optional implementing mode, the hopper opening assembly is connected to the hopper carrier frame through a shaft, and can be driven into rotation by the hopper
15 opening motor. The hopper opening assembly is provided with an upward opening, which is configured as being consistent with a movement trajectory of a hopper opening link arranged on the hopper and formed by laser precision cutting in combination with the principle of a cam mechanism, for driving the hopper opening link to move so as to open the discharging port of the hopper. The encoder is
20 connected to a shaft of the hopper opening motor, for transmitting a position signal of the hopper opening motor to a frequency converter in the electrical control box.

In an optional implementing mode, the position-limiting assembly includes a plurality of trapezoidal position-limiting blocks, which together enclose a
25 position-limiting groove consisting of a large top portion and a small bottom portion. A footstand of the hopper is received in the position-limiting groove.

In an optional implementing mode, the hopper carrier further includes a plurality

of vibration absorbing mechanisms acting on the hopper, and a plurality of anti-collision rubber blocks arranged on an outer periphery of the hopper carrier frame.

5 In an optional implementing mode, the transmission device includes a chain for driving the hopper carrier, a sprocket for driving the chain, a coupling assembly for driving the sprocket, a hopper carrier moving motor for driving the coupling assembly, and an adjustable bearing for adjusting a tightness of the chain.

10 In an optional implementing mode, said plurality of position sensors include a left limit sensor and a left position sensor assembly arranged at one end along a moving direction of the hopper carrier, and a right position sensor assembly and a right limit sensor arranged at the other end thereof.

15 In an optional implementing mode, the rail walking device includes wheels arranged under the car body frame, and a car driving motor for driving the wheels.

 In an optional implementing mode, said plurality of limit sensors includes an origin and parking limit sensor unit and a limit sensor assembly. The origin and
20 parking limit sensor unit includes three slot sensors arranged side by side, which are controlled by the electric control box for detecting position signal, so as to control the rail car to return to the origin or stop. The limit sensor assembly includes two slot sensors, which are controlled by the electric control box for detecting position signal, so as to control the rail car to stop when moving to its extreme position.

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 In an optional implementing mode, the electric control box is arranged on the car body frame or the hopper carrier frame. The electric control box is provided therein with a PLC, a wireless receiver, a solenoid valve for controlling a cylinder, and a

frequency converter for controlling the hopper opening motor, the hopper carrier moving motor and the car drive motor, wherein the wireless receiver, the solenoid valve and the frequency converter are all in communication with the PLC.

5 According to a second aspect, the present invention provides a method of operating the distribution machine as mentioned above, comprising steps:

 placing the hopper filled with concrete on the hopper carrier of the distribution machine;

 unloading the concrete after controlling the rail car of the distribution machine to
10 move to a predetermined position, the unloading including: controlling the hook opening device of the hopper carrier to open the hook on the hopper; controlling the hopper opening device of the hopper carrier to open the discharging port of the hopper, and adjusting a size of the discharging port according to on-site requirement; and controlling the unloading vibrator to apply vibration on the hopper when the
15 unloading is not smooth;

 controlling, after unloading at a first position is completed, the hopper carrier to move on the rail car, and/or, the rail car to move on the rail to unload at a second position;

 controlling the hopper opening device to close the discharging port of the hopper
20 after all the concrete in the hopper is unloaded; and

 controlling the rail car to move to a designated position.

 From the above technical solutions it can be seen that the embodiments of the present invention have the following advantages.

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 The distribution machine of the present invention is detachably connected with the hopper. When not in operation, the distribution machine and the hopper are separated from each other. The hopper will be placed on the distribution machine only

when the formwork should be supplied with concrete, and thus the distribution machine and the hopper are connected with each other at this time. After concrete is distributed from the hopper completely, the hopper can be removed for cleaning. Accordingly, cleaning the hopper will not affect the distribution machine, so that the devices and electrical components of the distribution machine will be protected, but the distributing efficiency will not be influenced. Moreover, it is convenient to replace the hopper, so that the distribution machine can continuously work by replacing the hopper, thus greatly improving the distributing efficiency. If the hopper is damaged, the hopper can also be removed without affecting the normal operation of the distribution machine.

In addition, the distribution machine includes a rail car and a hopper carrier. The rail car can move on the rail along the rail direction, while the hopper carrier can move on the rail car along the other direction. Therefore, during the unloading procedure of the distribution machine, the hopper can be moved in multiple directions, such as moving forward and backward, or moving leftward and rightward. In this matter, the hopper can completely cover any position in an area, so that the distribution is more uniform with satisfactory effect.

Finally, the distribution machine is easy to operation, and convenient to maintenance and repair.

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:

Figure 1 schematically shows the structure of a hopper carrier of a distribution machine provided by an embodiment of the present invention; and

Figure 2 schematically shows the structure of a rail car of the distribution machine provided 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 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 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.

The terms "first", "second", "third" or the like in the description and claims of the present invention and the above-mentioned drawings are used to distinguish different objects, rather than to define a specific sequence. In addition, the terms "including", "having" and any variations thereof are intended to cover non-exclusive inclusion. For example, a process, method, system, product, or device that includes a series of steps or units are not limited to the steps or units as listed, but can optionally include other steps or units not being listed here, or optionally also includes other steps or units that are inherent in the process, method, product or device.

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

Referring to Figures 1 and 2, an embodiment of the present invention provides a distribution machine for pouring concrete into the formwork of a component to be poured. The distribution machine includes a hopper carrier 10, a rail car 20, and an electric control box for controlling the hopper carrier 10 and the rail car 20. The hopper carrier 10 is arranged on and thus movable relative to the rail car 20, which runs on a rail. A hopper for receiving concrete is detachably arranged on the hopper carrier 10.

As shown in Figure 1, the hopper carrier 10 includes a hopper carrier frame 100, which is provided with a position-limiting assembly 103 for fixing the hopper, a unloading vibrator 104 for applying vibration to the hopper, a hook opening device 101 for opening a hook arranged on the hopper, and a hopper opening device for opening a discharging port of the hopper. The hopper opening device includes a hopper opening motor 102, an encoder 107 connected to the hopper opening motor 102, and a hopper opening assembly 108 that can be driven by the hopper opening motor 102 to open the discharging port of the hopper. Moreover, the hopper carrier 10 further includes a plurality of vibration absorbing mechanisms 105 acting on the hopper, and a plurality of anti-collision rubber blocks 106 arranged on an outer periphery of the hopper carrier frame 100.

Optionally, the hopper opening assembly 108 is connected to the hopper carrier frame 100 through a rotatable shaft, and can be driven into rotation by the hopper opening motor 102. The hopper opening assembly 108 is provided with an upward opening, which is configured as being consistent with the movement trajectory of a hopper opening link arranged on the hopper. The opening is formed by laser precision cutting in combination with the principle of a cam mechanism, and is used to drive the hopper opening link to move so as to open the discharging port of the hopper. The

encoder 107 is connected to a shaft of the hopper opening motor 102, for feeding a position signal of the hopper opening motor 102 to a frequency converter in the electrical control box.

5 Optionally, the position-limiting assembly 103 includes a plurality of trapezoidal position-limiting blocks, which together enclose a position-limiting groove consisting of a large top portion and a small bottom portion. A footstand of the hopper is received in the position-limiting groove.

10 As shown in Figure 2, the rail car 20 includes a car body frame 200, on which a transmission device for driving the hopper carrier 10 to move and a plurality of position sensors for detecting the position of the hopper carrier 10 are arranged. A rail walking device running on the rail and a plurality of limit sensors for detecting and controlling the position of the rail car 20 are provided under the car body frame 200.

15 Optionally, the transmission device includes a chain 201 for driving the hopper carrier 10, a sprocket 206 for driving the chain 201, a coupling assembly 207 for driving the sprocket 206, a hopper carrier moving motor 208 for driving the coupling assembly 207, and an adjustable bearing 212 for adjusting the tightness of the chain
20 201.

 Optionally, said plurality of position sensors include a left limit sensor 202 and a left position sensor assembly 203 that are both arranged at one end along the moving direction of the hopper carrier 10, and a right position sensor assembly 204 and a right
25 limit sensor 205 that are both arranged at the other end thereof.

 Optionally, the rail walking device includes wheels arranged under the car body frame 200, and a car driving motor 211 for driving the wheels.

Optionally, said plurality of limit sensors includes an origin and parking limit sensor unit 209 and a limit sensor assembly 210. The origin and parking limit sensor unit 209 includes three slot sensors arranged side by side, which are controlled by the electric control box for detecting position signal, so as to control the rail car 20 to return to the origin or stop. The limit sensor assembly 210 includes two slot sensors, which are controlled by the electric control box for detecting position signal, so as to control the rail car to stop when moving to its extreme position.

Optionally, the electric control box can be arranged on the car body frame 200 or the hopper carrier frame 100. The electric control box is provided therein with a programmable logic controller (PLC), a wireless receiver, a solenoid valve for controlling a cylinder, and a frequency converter for controlling the hopper opening motor 102, the hopper carrier moving motor 208, and the car drive motor 211. The wireless receiver, the solenoid valve and the frequency converter are all in communication with the PLC, and controlled thereby. The unloading vibrator 104, the hook opening device 101, the hopper opening motor 102, the hopper carrier moving motor 208 and the car drive motor 211 are all driven and controlled by the electric control box, while the position sensors and the limit sensors are all signally connected with the electric control box, so that a user can operate the electric control box through a remote control.

Hereinafter, each device/component of the distribution machine according to the present invention will be described in further detail.

1. Hopper carrier 10

(1) Hook opening device 101

The hook opening device 101 is used to open the hook on the hopper before unloading the concrete, so that the hopper is ready for being opened to supply concrete. The hook opening device 101 includes a cylinder, two guide rods, two
5 springs, two copper sleeves, a push tongue, and the like. Said two guide rods respectively pass through the two copper sleeves. The front ends of the two guide rods are both connected with the push tongue, while the rear ends thereof are both connected with a shaft of the cylinder. Said two springs are arranged around the two guide rods, respectively, and located between the push tongue and the copper sleeves,
10 respectively.

When receiving a hopper opening signal, the PLC of the electric control box will issue a command to activate the solenoid valve that controls the cylinder. Therefore, the cylinder will drive the guide rods to push the hook open by means of the push
15 tongue arranged at the front ends of the guide rods. In order to avoid the impact which would be generated between the hook and the hook opening device and thus damage the service life of the hook, the two guide rods arranged between the push tongue and the copper sleeves are respectively provided with springs for absorbing the impact.

20 (2) Hopper opening motor 102

The hopper opening motor 102 is used to control the movement of the hopper opening assembly 108, for opening the discharging port of the hopper. The motor is controlled by a corresponding frequency converter of the electric control box, which
25 will turn on or off the motor according to a signal received.

(3) Position-limiting assembly 103

The position-limiting assembly 103 is used to limit the position of the hopper, so that the hopper is not allowed to move when being placed on the distribution machine. Thus the hopper can be not only smoothly placed on the distribution machine and taken away therefrom, but also be protected for safety. Optionally, the position-limiting assembly includes four groups, each consisting of four ladder-shaped metal blocks. Each metal block has an inclined surface which faces inwardly, so that a position-limiting groove consisting of a large top portion and a small bottom portion is formed by the inclined surfaces of four metal blocks. In this manner, the footstand of the hopper can be smoothly received in the position-limiting assembly and restricted therein. If without such position-limiting assembly, the hopper may move to leave its original position when the unloading of concrete is finished. In this case, when a hoister is used to take away the hopper, the position for taking away the hopper by the hoister will change, so that taking away the hopper by the hoister, and also by a transport vehicle, will be affected.

(4) Unloading vibrator 104

The unloading vibrator 104 is used for vibrating the hopper, so that the concrete can be smoothly discharged, and no residual material will be remained in the hopper.

The remote control can be provided with a button to activate the vibrator.

(5) Vibration absorbing mechanism 105

The vibration absorbing mechanism 105 is used to dampen the impact force generated when the hoister puts down the hopper and the unloading vibrator vibrates. Optionally, the vibration absorbing mechanism 105 consists of four identical assemblies, each including a spring, two position-limiting round blocks, a shaft and the like. The shaft is fixed on the hopper carrier frame, and the two position-limiting

round blocks and the spring are slidably arranged around the shaft. The spring is located between the two position-limiting round blocks. The end of the shaft is locked in such a manner that the position-limiting round blocks are restricted on the shaft.

5 (6) Anti-collision rubber block 106

Optionally, there are four anti-collision rubber blocks, which are separately arranged on the outer periphery of the hopper carrier frame. When the rail car moves to the left or right, the anti-collision rubber blocks can act as buffers if the hopper carrier frame moves out of the safe range and a collision occurs after the limit sensors are damaged.

(7) Encoder 107

15 The encoder 107 is used to send out signals for accurately opening and closing the discharging port of the hopper. When the discharging port is opened or closed, the hopper opening motor will rotate to drive the shaft provided with the encoder into rotation. At this time, the encoder will send out a signal to the frequency converter in the electrical control box, and the frequency converter can activate the hopper opening motor to control the size of the discharging port accurately according to the signal from the encoder. In this manner, it is convenient for controlling the amount of concrete supplied.

(8) Hopper opening assembly 108

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The hopper opening assembly 108 is used to open and close the discharging port of the hopper. The hopper opening assembly has an upward opening, the overall shape and position of which are determined by the movement trajectory of the hopper

opening link carried by the hopper itself in combination with the principle of the cam mechanism and obtained by laser precision cutting. The hopper opening assembly can be in engagement with the hopper opening link and drive the same to move, so as to open the discharging port of the hopper. In this manner, the discharging port of the hopper can be smoothly opened or closed without additional impact generated when the hopper is opened. Further, the uppermost part of the hopper opening assembly is provided with a protruding structure, by which the hook of the hopper can be in engagement with a corresponding drum of the hopper opening link during the procedure of closing the discharging port of the hopper after the concrete has been discharged. This is because that when the discharging port of the hopper is closed, the drum of the hopper opening link will be controlled by the hopper opening motor to move toward the hopper so as to be out of the free falling trajectory scope of the hook. After the hook falls stably, the hopper opening motor rotates forward for an appropriate stroke, so that the drum of the hopper opening link is released. Then, the cylinder of the hook opening assembly is retracted, so that the hook is released to be engagement with the drum accurately, thus successfully closing the discharging port of the hopper.

2. Rail car 20

(1) Chain 201

The chain 201 can be driven into rotation by the hopper carrier moving motor, thus driving the hopper carrier to move on the rail car of the distribution machine. In the context, it is assumed that the rail car moves forward and backward, while the hopper carrier moves perpendicular or substantially perpendicular to the moving direction of the rail car (that is, the hopper carrier moves leftward and rightward). Since the hopper is placed on the hopper carrier, the hopper can move leftward and

rightward accordingly.

(2) Left limit sensor 202

5 The left limit sensor 202 is configured to send out a signal to the PLC when the hopper carrier moves to the left. Then, the PLC sends out a command to the frequency converter corresponding to the hopper carrier moving motor, and the frequency converter stops the hopper carrier moving motor to prevent over-position collision.

10 (3) Left position sensor assembly 203

 The left position sensor assembly 203 is used to accurately stop the hopper when the hopper is put down or taken away, so that the hoister can accurately find the position for putting down or taking away the hopper. Optionally, this assembly 203
15 includes two left position sensors, which cooperate with right position sensors together.

(4) Right position sensor assembly 204

20 The right position sensor assembly 204 is used to accurately stop the hopper when the hopper is put down or taken away, so that the hoister can accurately find the position for putting down or taking away the hopper. Optionally, this assembly 204 includes two right position sensors, which cooperate with the left position sensors together.

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(5) Right limit sensor 205

 The right limit sensor 205 is configured to send out a signal to the PLC when the

hopper carrier moves to the right. Then, the PLC sends out a command to the frequency converter corresponding to the hopper carrier moving motor, and the frequency converter stops the hopper carrier moving motor to prevent over-position collision.

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(6) Sprocket 206

Optionally, there are a total of four sprockets. The hopper carrier moving motor, after activated, drives the sprocket through the coupling and the connecting shaft to move the chain.

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(7) Coupling assembly 207

The coupling assembly 207 is connected between the hopper carrier moving motor and the sprocket for transmitting movement and power, so that the motor can drive the sprocket into rotation.

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(8) Hopper carrier moving motor 208

The hopper carrier moving motor 208 is used to drive the chain to move the hopper to the left and right. The hopper carrier for receiving the hopper on the distribution machine can be connected to the chain at predetermined positions through connecting sheets. When the hopper is to move leftward or rightward, the operator can press a corresponding rocker on the remote control. At this time, a signal will be transmitted to the PLC of the electric control box of the distribution machine, and the PLC will send out a command to activate the frequency converter to rotate the motor and output power. Then, the motor drives the coupling to rotate, so that the shaft connected to the coupling and the sprocket arranged on the shaft both rotate

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concurrently. The sprocket in turn drives the chain to move on a chain limit rail. At this time, the hopper carrier carrying the hopper starts to move leftward and rightward, so that the hopper can move to the left and right on the hopper carrier to discharge concrete.

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(9) Origin and parking limit sensor 209

The origin and parking limit sensor 209 may include three slot sensors. The slot sensor in the middle is a shared one, and can cooperate with the other two slot sensors respectively to realize return of the entire rail car to the origin and the parking of the car. When the rail car is to return to the origin, the on-site operator can control the car driving motor through a corresponding handle of the remote control, so as to move the rail car to the origin. When two corresponding sensors are detected at the same time, the distribution machine will automatically return to the origin. When another two corresponding sensors are detected if the rail car moves to the limit position in a direction opposite to the origin, the distribution machine will stop. At this time, no matter how to control the handle associated with this direction, the distribution machine is always in a stationary state, and only the reverse operation could activate the car driving motor, thereby providing a protection for safety.

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(10) Limit sensor assembly 210

The limit sensor assembly 210 may include two slot sensors. Both sensors are configured in such a manner that when the car driving motor drives the rail car to its extreme position and thus a corresponding slot sensor is detected, the PLC will receive a signal to stop the output of the frequency converter. Accordingly, the car driving motor will stop, thereby providing a protection for safety.

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(11) Car driving motor 211

The car driving motor 211 may include two motors of the same model, which are respectively arranged on two sides of the rail car, and used to drive the entire
5 distribution machine to move forward and backward on the rail. The car driving motor is controlled by the corresponding frequency converter in the electric control box.

(12) Adjustable bearing assembly 212

10 The adjustable bearing assembly 212 is used to adjust the tightness of the chain, so that the chain can be operated in an optimized state. The bearing assembly may include two bearings, each arranged at the end of each chain assembly. Optionally, the adjusting bearing assembly includes a bearing, a screw rod, a sliding rail, a bracket and the like. The screw rod can drive the sprocket to move forward and backward
15 along the rail direction through the bearing and the shaft, thus achieving the purpose of adjusting the tightness of the chain.

The distribution machine according to an embodiment of the present invention has been described in detail in the foregoing.

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The embodiment of the present invention also provides an operation method of the distribution machine as described above. The method is used to release concrete in the formwork to be poured, and includes the following steps.

25 In step S0, the hopper filled with concrete is placed on the hopper carrier of the distribution machine, and restricted in position by the position-limiting assembly. Then, the distribution machine can be operated by the operator through a wireless remote control.

In Step S1, the formwork of the member to be poured, such as the formwork of a floor slab, is placed on a lower vibrating table of the distribution machine, and the operator can control the rail car of the distribution machine to move on the rail to a certain position for releasing concrete. The procedure of releasing concrete includes steps S2 to S6.

In step S2, the hopper opening button on the wireless remote control is pressed. At this time, a signal will be transmitted to a wireless receiver of the electric control box, and a command signal will be sent out through the PLC.

In step S3, the solenoid valve, which is configured to control the hook opening device to open the hook on the hopper, is activated by the command signal to enable the hook on the hopper disengaged.

In step S4, the PLC, after receiving the signal indicating that the hook has been disengaged, sends out an instruction to activate the corresponding frequency converter so that the hopper opening motor is energized.

In step S5, the hopper opening motor, after energized, drives the coupling and the transmission shaft to move the hopper opening device. The hopper opening device pushes away the drum of the hopper link to open the discharging port of the hopper according to the movement trajectory of the hopper link of the hopper. At the same time, the encoder sends out a signal to the corresponding frequency converter in the electric control box to determine the position of the discharging port, so that the opening size of the discharging port of the hopper can be adjusted at any time according to actual needs.

In step S6, the concrete is unloaded after the discharging port of the hopper is opened. If the unloading is not smooth at this time or the concrete is difficult to unload due to different types, the vibration button on the wireless remote control can be pressed to activate the unloading vibrator, so as to apply vibration to the hopper to
5 ensure smooth unloading.

In step S7, a corresponding handle of the wireless remote control that can be moved leftward and rightward can be toggled to control the hopper carrier moving motor, if the formwork of the floor slab is relatively large and a certain amount of
10 concrete is released at a certain position, in order to move the rail car to another position on the rail. Then, the above steps S2 to S6 are repeated for further unloading of concrete.

In step S8, the car driving motor is controlled to move forward and backward
15 after the left and right unloading is completed. Further unloading of the concrete can be achieved by repeating the above steps S2 to S6 at another desired position.

In step S9, the hopper opening device is controlled to close the opened discharging port of the hopper after the concrete in the hopper is completely unloaded.
20 At this time, the operator can operate a corresponding button of the remote control to rotate the hopper opening motor toward the hopper, and the hopper opening motor will activate the hopper opening device again through the coupling and the shaft to push away the drum of the link out of the free-falling track range of the hook. After the hook falls stably, the hopper opening motor rotates forward for a proper stroke to
25 release the drum of the link. Then, the cylinder of the hook opening device is retracted, and the hook is released, so that the drum can be accurately hooked to close the discharging port of the hopper.

In step S10, the operator can, after the discharging port of the hopper is closed, control the movement of the rail car to stop the distribution machine at a designated position as required. The entire procedure for distributing concrete is completed.

5 In summary, the embodiments of the present invention disclose a distribution machine and its operation method. From the above technical solutions, it can be seen that the embodiments of the present invention have the following advantages.

The distribution machine is detachably connected with the hopper. When not in
10 operation, the distribution machine and the hopper are separated from each other. The hopper will be placed on the distribution machine only when the formwork should be supplied with concrete, and thus the distribution machine and the hopper are connected with each other at this time. After concrete is supplied from the hopper completely, the hopper can be removed for cleaning. For example, the hopper can be
15 carried by a transport vehicle to a lotus plate for cleaning. Accordingly, cleaning the hopper will not affect the distribution machine, so that the devices and electrical components of the distribution machine will be protected but the distributing efficiency will not be influenced. Moreover, it is convenient to replace the hopper, so that the distribution machine can continuously work by replacing the hopper, thus
20 greatly improving the distributing efficiency. If the hopper is damaged, the hopper can also be removed without affecting the normal operation of the distribution machine.

In addition, the distribution machine includes a rail car and a hopper carrier. The rail car can move on the rail along the rail direction, while the hopper carrier can
25 move on the rail car along the other direction. Therefore, during the unloading procedure of the distribution machine, the hopper can be moved in multiple directions, such as moving forward and backward, or moving leftward and rightward. In this matter, the hopper can completely cover any position in an area, so that the

distribution of concrete is more uniform with satisfactory effect.

Finally, the distribution machine is easy to operation, and convenient to maintenance and repair.

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It is worth noting that compared with manual distribution of concrete, the distribution machine of the present invention has the following advantages.

When concrete is distributed by manual operation, at least two workers should
10 cooperate at the same time to unload concrete to the formwork. The operation method is as follows. One of the workers must be a certified operator, who lifts the hopper filled with concrete through the chain to a position above the formwork. Then, another worker opens the hook for locking the discharging port of the hopper, and then opens the hopper opening link to start unloading. The unloading procedure sometimes
15 becomes more difficult, because the concrete may have different moisture content and different formulas. In this case, workers may hit the housing of the hopper with hammers or other objects for facilitating the unloading procedure. This will not only damage the hopper, but also more concrete will be remained in the hopper.

20 When the distribution machine of the present invention is used, one worker is sufficient for operating the distribution machine by pressing corresponding buttons on the remote control, so as to complete forward, backward, leftward and rightward movements of the machine and unloading of concrete. At the same time, with activating the unloading vibrator of the distribution machine, there will be almost no
25 concrete remained in the hopper. Accordingly, materials can be saved, labor costs can be reduced, and efficiency can be improved.

Compared with the concrete distributing apparatus available on the market, the

distribution machine of the present invention has the following advantages.

(1) Comparison with a common concrete distributing apparatus on the market

5 The concrete distributing apparatus on the market has multiple discharging openings. When it is necessary to supply concrete to the formwork, a cylinder opens a corresponding baffle to unload the concrete. There is a corresponding screw in each discharging opening for rotating and mixing. However, the openings must be cleaned in time after the unloading is completed; otherwise, the openings cannot be used in a
10 short time due to solidification therein. Cleaning the openings should be carried out together with the whole apparatus, which will easily cause other mechanical devices and other components (such as motors) to be damaged or corroded due to moisture. In addition, since the concrete is composed of crushed marble, sand, cement and the like, the internal screw will be worn out quickly after frequent rotation and thus needs to be
15 replaced, which increases the cost.

(2) Comparison with the existing concrete distributing apparatus

(a) The distribution machine is detachably connected with the hopper. When not
20 in operation, the distribution machine and the hopper are separated from each other. The hopper will be placed on the distribution machine only when the formwork should be supplied with concrete, and thus the distribution machine and the hopper are connected with each other at this time.

25 (b) After concrete is supplied from the hopper completely, the hopper can be removed for cleaning. For example, the hopper can be carried by a transport vehicle to a lotus plate for cleaning. Accordingly, cleaning the hopper will not affect the distribution machine, so that the devices and electrical components of the distribution

machine will be protected, but the distributing efficiency will not be influenced.

(c) By replacing the hopper, the distribution machine can operate continuously, thus greatly improving the distributing efficiency.

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(d) If the hopper is damaged, the hopper can also be replaced without affecting the normal operation of the distribution machine.

(e) The distribution machine is easy to operate, and convenient to maintain and
10 repair.

(f) Only three low-power motors and two low-power vibrators are used in this distribution machine. Accordingly, the power consumption is small, thus achieving energy saving and consumption reduction, and contributing to the national
15 environmental protection.

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 distribution machine, comprising a hopper carrier (10), a rail car (20), and an electric control box for controlling the hopper carrier (10) and the rail car (20), the
5 hopper carrier (10) being arranged on the rail car (20) and movable relative to the rail car (20), and a hopper for receiving concrete being detachably arranged on the hopper carrier (10),

wherein the hopper carrier (10) includes a hopper carrier frame (100), which is provided thereon with a position-limiting assembly (103) for fixing the hopper, a
10 unloading vibrator (104) for applying vibration to the hopper, a hook opening device (101) for opening a hook arranged on the hopper, and a hopper opening device for opening a discharging port of the hopper, the hopper opening device including a hopper opening motor (102), an encoder (107) connected to the hopper opening motor (102), and a hopper opening assembly (108) for opening the discharging port of the
15 hopper when being driven by the hopper opening motor (102); and

the rail car (20) includes a car body frame (200), on which a transmission device for driving the hopper carrier (10) to move and a plurality of position sensors for detecting a position of the hopper carrier (10) are arranged, and a rail walking device for running on a rail and a plurality of limit sensors for detecting and controlling a
20 position of the rail car (20) are provided under the car body frame (200).

2. The distribution machine according to claim 1, characterized in that the hopper opening assembly (108) is configured to be rotated by the hopper opening motor (102);

25 the hopper opening assembly (108) is provided with an upward opening, which is configured as being consistent with a movement trajectory of a hopper opening link arranged on the hopper, for driving the hopper opening link to move so as to open the discharging port of the hopper; and

the encoder (107) is connected to a shaft of the hopper opening motor (102), for transmitting a position signal of the hopper opening motor (102) to a frequency converter in the electrical control box.

5 3. The distribution machine according to claim 1, characterized in that the position-limiting assembly (103) includes a plurality of trapezoidal position-limiting blocks, which together enclose a position-limiting groove consisting of a large top portion and a small bottom portion, wherein a footstand of the hopper is received in the position-limiting groove.

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4. The distribution machine according to claim 1, characterized in that the hopper carrier (10) further includes a plurality of vibration absorbing mechanisms (105) acting on the hopper, and a plurality of anti-collision rubber blocks (106) arranged on an outer periphery of the hopper carrier frame (100).

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5. The distribution machine according to claim 1, characterized in that the transmission device includes a chain (201) for driving the hopper carrier (10), a sprocket (206) for driving the chain (201), a coupling assembly (207) for driving the sprocket (206), a hopper carrier moving motor (208) for driving the coupling
20 assembly (207), and an adjustable bearing (212) for adjusting a tightness of the chain (201).

6. The distribution machine according to claim 1, characterized in that said plurality of position sensors include a left limit sensor (202) and a left position sensor
25 assembly (203) arranged at one end along a moving direction of the hopper carrier (10), and a right position sensor assembly (204) and a right limit sensor (205) arranged at the other end thereof.

7. The distribution machine according to claim 5, characterized in that the rail walking device includes wheels arranged under the car body frame (200), and a car driving motor (211) for driving the wheels.

5 8. The distribution machine according to claim 1, characterized in that said plurality of limit sensors includes an origin and parking limit sensor unit (209) and a limit sensor assembly (210),

 wherein the origin and parking limit sensor unit (209) includes three slot sensors arranged side by side, which are controlled by the electric control box for detecting
10 position signal, so as to control the rail car (20) to return to the origin or stop, and

 the limit sensor assembly (210) includes two slot sensors, which are controlled by the electric control box for detecting position signal, so as to control the rail car to stop when moving to its extreme position.

15 9. The distribution machine according to claim 7, characterized in that the electric control box is arranged on the car body frame (200) or the hopper carrier frame (100);

 the electric control box is provided therein with a PLC, a wireless receiver, a solenoid valve for controlling a cylinder, and a frequency converter for controlling the
20 hopper opening motor (102), the hopper carrier moving motor (208) and the car drive motor (211), wherein the wireless receiver, the solenoid valve and the frequency converter are all in communication with the PLC.

 10. A method of operating the distribution machine according to claim 1,
25 comprising steps:

 placing the hopper filled with concrete on the hopper carrier of the distribution machine;

 unloading the concrete after controlling the rail car of the distribution machine to

move to a predetermined position, the unloading including: controlling the hook opening device of the hopper carrier to open the hook on the hopper; controlling the hopper opening device of the hopper carrier to open the discharging port of the hopper, and adjusting a size of the discharging port according to on-site requirement; and
5 controlling the unloading vibrator to apply vibration on the hopper when the unloading is not smooth;

controlling, after unloading at a first position is completed, the hopper carrier to move on the rail car, and/or, the rail car to move on the rail to unload at a second position;

10 controlling the hopper opening device to close the discharging port of the hopper after all the concrete in the hopper is unloaded; and
controlling the rail car to move to a designated position.