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(54) **MIXING DRUM ROTATION SPEED CONTROL METHOD AND APPARATUS, AND MIXER TRUCK**

(57) Disclosed are a mixing drum speed control method, a device and a mixing truck, the method includes: obtaining a top-mounted power take-off (PTO) switch status and a key switch status of a mixing truck; in response to the top-mounted PTO switch being turned off and the key switch being turned on, controlling a mixing drum driving motor to decelerate, and obtaining a current speed of the mixing drum driving motor; and in response to the current speed of the mixing drum driving

motor being less than a first speed setting value, performing zero-speed control on the mixing drum driving motor continuously. The method, device and mixing truck provided by the present application will not cause the unloading phenomenon due to instantaneous reversal of inertia, which avoids the generation of reversal impact force to the greatest extent, alleviates the driving discomfort, and improves the driver's driving experience.

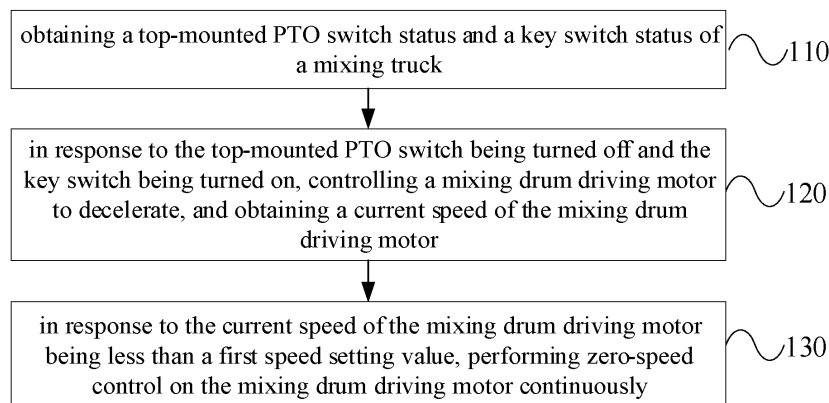


FIG. 1

Description

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] The present application claims priority to Chinese Patent Application NO. 2021109687917, entitled "MIXING DRUM SPEED CONTROL METHOD, DEVICE AND MIXING TRUCK", filed on August 23, 2021, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

[0002] The present application relates to the technical field of mechanical engineering, and in particular to a mixing drum speed control method, a device, and a mixing truck.

BACKGROUND

[0003] At present, the speed change of the mixing drum on the electric mixing truck is realized by controlling the speed of the top-mounted motor through the vehicle control unit (VCU). When the mixing drum is running, if the driver directly turns off the power switch of the top-mounted power take-off (PTO) or disconnects the key switch, the VCU will control the top-mounted motor to decelerate. When the speed of the top-mounted motor drops to a set value, the VCU will control the top-mounted motor at zero torque.

[0004] In the existing technology, when the loading capacity of the mixing drum is large, if the driver directly turns off the power switch of the top-mounted motor or disconnects the key switch, then when the speed of the mixing drum drops to zero, there will be an instant reversal of operation due to the inertial force. For one thing, it will cause the mixing drum to reverse from the feeding state to the discharging state, causing the concrete to flow out. For another, it will cause an uncomfortable driving experience to the driver due to the instantaneous reversal impact of the mixing drum.

SUMMARY

[0005] The embodiments of the present application provide a mixing drum speed control method, a device and a mixing truck, which is used to solve the problem in the related art that the mixing drum speed control is prone to reverse, causing concrete to flow out, and at the same time making the driver's driving experience poor.

[0006] The present application provides a mixing drum speed control method, including:

obtaining a top-mounted power take-off (PTO) switch status and a key switch status of a mixing truck;

in response to the top-mounted PTO switch being turned off and the key switch being turned on, controlling a mixing drum driving motor to decelerate, and obtaining a current speed of the mixing drum driving motor; and

in response to the current speed of the mixing drum driving motor being less than a first speed setting value, performing zero-speed control on the mixing drum driving motor continuously.

[0007] According to the mixing drum speed control method provided by the present application, after the obtaining the current speed of the mixing drum driving motor, the method further includes:

in response to that a duration of the current speed of the mixing drum driving motor being less than the first speed setting value is greater than a first set time, performing zero-torque control on the mixing drum driving motor.

[0008] According to the mixing drum speed control method provided by the present application, the top-mounted PTO switch is configured to indicate that a top-mounted system of the mixing truck is controllable;

in response to the top-mounted PTO switch being turned on, controlling, by the mixing drum driving motor, the mixing drum to start rotating; and in response to the top-mounted PTO switch being turned off, controlling, by the mixing drum driving motor, the mixing drum to stop rotating.

[0009] According to the mixing drum speed control method provided by the present application, after the obtaining the top-mounted PTO switch status and the key switch status of the mixing truck, the method includes:

in response to the key switch being turned off, controlling the mixing drum driving motor to decelerate, and obtaining the current speed of the mixing drum driving motor;

in response to the current speed of the mixing drum driving motor being less than a second speed setting value, performing zero-torque control on the mixing drum driving motor, and performing reversal detection on the mixing drum driving motor;

in response to detecting that the mixing drum driving motor is reversed within a second set time and a reversing speed is greater than a third speed setting value, controlling the mixing drum driving motor to decelerate until the mixing drum driving motor meets a preset condition, and in response to the mixing drum driving motor meeting the preset condition, performing a power-off operation on a controller;

the preset condition is that a duration of the speed of the mixing drum driving motor after reversal being less than the second speed setting value is greater than the second set time, or a time of controlling the

mixing drum driving motor after reversal to decelerate is greater than a third set time.

[0010] According to the mixing drum speed control method provided by the present application, after the performing reversal detection on the mixing drum driving motor, the method includes:

in response to not detecting that the mixing drum driving motor is reversed within the second set time, performing power-off operation on the controller.

[0011] According to the mixing drum speed control method provided by the present application, the controlling the mixing drum driving motor to decelerate includes: controlling the mixing drum driving motor to decelerate with a speed control method or a torque control method.

[0012] The present application provides a mixing drum speed control device, including: an obtaining unit, a deceleration unit, and a first control unit.

[0013] The obtaining unit is configured to obtain a top-mounted power take-off (PTO) switch status and a key switch status of a mixing truck.

[0014] The deceleration unit is configured to control a mixing drum driving motor to decelerate, and obtain a current speed of the mixing drum driving motor in response to the top-mounted PTO switch being turned off and the key switch being turned on.

[0015] The first control unit is configured to control the mixing drum driving motor at zero speed continuously in response to the current speed of the mixing drum driving motor being less than a first speed setting value.

[0016] The present application provides a mixing truck, including a memory, a controller, and a computer program stored on the memory and executable on the controller. When the program is executed by the controller, the steps of the mixing drum speed control method are implemented.

[0017] The present application provides an electronic device, including a memory, a processor, and a computer program stored on the memory and executable on the processor. When the program is executed by the processor, the steps of the mixing drum speed control method are implemented.

[0018] The present application provides a non-transitory computer-readable storage medium on which a computer program is stored. When the computer program is executed by a processor, the steps of the mixing drum speed control method are implemented.

[0019] According to the mixing drum speed control method, the device and the mixing truck provided by the present application, in response to the top-mounted PTO switch being turned off and the key switch being turned on, controlling a mixing drum driving motor to decelerate, and obtaining a current speed of the mixing drum driving motor; and in response to the current speed of the mixing drum driving motor being less than a first speed setting value, performing zero-speed control on the mixing drum driving motor continuously. When the top-mounted PTO switch is turned off, the mixing drum driving motor will

continue to be controlled at zero speed. The unloading phenomenon will not occur due to the instantaneous reversal of inertia, which avoids the generation of reversal impact force to the greatest extent, alleviates the driving discomfort, and improves the driver's driving experience.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] In order to more clearly illustrate the technical solutions in the embodiments of the present application or in the related art, drawings used in the embodiments or in the related art will be briefly described below. Obviously, the drawings in the following description are only some embodiments of the present application. It will be apparent to those skilled in the art that other drawings can be obtained according to the structures shown in the drawings without creative work.

FIG. 1 is a schematic flowchart of a mixing drum speed control method provided by the present application.

FIG. 2 is a schematic diagram of a speed control system installed on a mixing truck provided by the present application.

FIG. 3 is a schematic structural diagram of a mixing drum speed control device provided by the present application.

FIG. 4 is a schematic structural diagram of an electronic device provided by the present application.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0021] In order to make the purpose, technical solutions and advantages of the present application clearer, the technical solutions in the present application will be clearly and completely described below in conjunction with the accompanying drawings of the present application. Obviously, the described embodiments are part of the embodiments of the present application, not all of the embodiments. Based on the embodiments of the present application, all other embodiments obtained by those of ordinary skill in the art without creative efforts fall within the scope of the present application.

[0022] A mixing truck is a special truck configured to transport concrete for construction. The trucks are equipped with a cylindrical mixing drum to carry the mixed concrete. During transportation, the mixing drum will always be kept rotating to ensure that the concrete carried will not solidify.

[0023] FIG. 1 is a schematic flowchart of a mixing drum speed control method provided by the present application. As shown in FIG. 1, the method includes the following steps.

[0024] Step 110, obtaining a top-mounted power take-off (PTO) switch status and a key switch status of a mixing

truck.

[0025] In an embodiment, the mixing drum is connected to the mixing drum driving motor through a gearbox. The mixing drum is driven by the mixing drum driving motor. The speed of the mixing drum can be obtained through the transmission ratio of the gearbox and the speed of the mixing drum driving motor. Controlling the speed of the mixing drum means controlling the speed of the mixing drum driving motor. The mixing drum driving motor is also called a top-mounted motor. For example, for an electric mixing truck, when the mixing drum is running, if the driver turns off the top-mounted PTO switch or disconnects the key switch, the VCU generally controls the top-mounted motor to decelerate the mixing drum until the mixing drum stops rotating.

[0026] The PTO switch includes a gearbox, a clutch, and a controller, and is connected to the low gear of the transmission or the output shaft of the auxiliary box to output power to the external working device. In the embodiment of the present application, the top-mounted PTO switch is configured to indicate that the top-mounted system of the mixing truck is controllable. When the top-mounted PTO switch is turned on, the mixing drum driving motor controls the mixing drum to start rotating. When the top-mounted PTO switch is turned off, the mixing drum driving motor controls the mixing drum to stop rotating. The key switch is the main power switch of the vehicle cab. When the key switch is turned on, the power of each system on the mixing truck is turned on. When the key switch is turned off, the power of each system on the mixing truck is turned off.

[0027] Step 120, in response to the top-mounted PTO switch being turned off and the key switch being turned on, controlling a mixing drum driving motor to decelerate, and obtaining a current speed of the mixing drum driving motor.

[0028] In an embodiment, when the top-mounted PTO switch of the mixing truck is turned off and the key switch is turned on, it is necessary to control the driving motor of the mixing truck to decelerate so that the mixing drum can gradually stop rotating. During the deceleration control process, it is necessary to obtain the current speed of the mixing drum driving motor. The current speed refers to the speed of the mixing drum driving motor at the current moment.

[0029] Step 130, in response to the current speed of the mixing drum driving motor being less than a first speed setting value, performing zero-speed control on the mixing drum driving motor continuously.

[0030] In an embodiment, since the mixing drum may be loaded with substances such as concrete, if the loading amount of concrete is small, the mixing drum will gradually stop rotating after the speed drops to the set value; if the loading amount of concrete is large, the speed of the mixing drum will drop to zero. At this time, there is a lot of concrete in the mixing drum, due to the effect of inertia, the mixing drum will instantly reverse, causing the mixing drum to switch from the feeding state to the

discharging state, causing the concrete to flow out, which also produces a reversal impact force, causing the mixing truck to vibrate and bringing the driver an uncomfortable driving experience.

[0031] Therefore, the current speed of the mixing drum driving motor can be obtained in real time while the speed of the mixing drum driving motor gradually decreases. If the current speed is less than the first speed setting value, it indicates that the speed of the mixing drum driving motor is already very low, that is, the speed of the mixing drum is also already very low, which further indicates that the rotational energy of the mixing drum has been weakened, and the speed lock operation can be performed to avoid the reversal. The first speed setting value can be set according to actual needs. For example, the first speed setting value can be set to 50 revolutions per minute (rpm).

[0032] Zero-speed control refers to controlling the torque and speed of the motor to keep its speed at zero. At this time, the mixing drum driving motor can be continuously controlled at zero speed through speed control or torque control, so that the mixing drum driving motor always maintains a zero speed state, which is equivalent to using the motor to force the mixing drum to be stable and not rotate.

[0033] According to the mixing drum speed control method provided by the embodiment of the present application, in response to the top-mounted PTO switch being turned off and the key switch being turned on, controlling a mixing drum driving motor to decelerate, and obtaining a current speed of the mixing drum driving motor; and in response to the current speed of the mixing drum driving motor being less than a first speed setting value, performing zero-speed control on the mixing drum driving motor continuously. When the top-mounted PTO switch is turned off, the mixing drum driving motor will continue to be controlled at zero speed. The unloading phenomenon will not occur due to the instantaneous reversal of inertia, which avoids the generation of reversal impact force to the greatest extent, alleviates the driving discomfort, and improves the driver's driving experience.

[0034] Based on the above embodiment, after step 120, the method further includes:

in response to that a duration of the current speed of the mixing drum driving motor being less than the first speed setting value is greater than a first set time, performing zero-torque control on the mixing drum driving motor.

[0035] In an embodiment, zero-torque control refers to controlling the output torque of the motor to be zero, relying on friction and other forces to consume rotational energy, so that the speed of the motor naturally slows down.

[0036] The first set time can be set as needed, for example, 20 seconds. If the duration of the current speed of the mixing drum driving motor being less than the first speed setting value is greater than the first set time, it indicates that the rotational energy of the mixing drum is small enough and the possibility of reversal is very small.

At this time, zero-torque control can be performed to gradually decrease the speed of the mixing drum driving motor until it decreases to zero. Through zero-torque control, it is helpful to save the energy consumption of the mixing truck.

[0037] Based on any one of the above embodiments, the top-mounted PTO switch is configured to indicate that the top-mounted system of the mixing truck is controllable;

in response to the top-mounted PTO switch being turned on, controlling, by the mixing drum driving motor, the mixing drum to start rotating; and in response to the top-mounted PTO switch being turned off, controlling, by the mixing drum driving motor, the mixing drum to stop rotating.

[0038] In an embodiment, when the top-mounted PTO switch is turned on, the mixing drum driving motor controls the mixing drum to start rotating. After starting to accelerate to the set speed, for example, the speed of the mixing drum is 1 rpm, and the speed of the mixing drum driving motor is 500 rpm, the mixing drum enters a working state. When the top-mounted PTO switch is turned off, the mixing drum driving motor controls the mixing drum to stop rotating. After starting to decelerate to zero speed, the mixing drum exits the working state.

[0039] Based on any one of the above embodiments, after step 110, the method includes:

in response to the key switch being turned off, controlling the mixing drum driving motor to decelerate, and obtaining the current speed of the mixing drum driving motor;

in response to the current speed of the mixing drum driving motor being less than a second speed setting value, performing zero-torque control on the mixing drum driving motor, and performing reversal detection on the mixing drum driving motor;

in response to detecting that the mixing drum driving motor is reversed within a second set time and a reversing speed is greater than a third speed setting value, continuing to control the mixing drum driving motor to decelerate until the mixing drum driving motor meets a preset condition, and in response to the mixing drum driving motor meeting the preset condition, performing power-off operation on a controller;

the preset condition is that a duration of the speed of the mixing drum driving motor after reversal being less than the second speed setting value is greater than the second set time, or a time of controlling the mixing drum driving motor after reversal to decelerate is greater than a third set time.

[0040] In an embodiment, if it is detected that the key switch is turned off, it indicates that the power supply of

the entire mixing truck is about to be turned off, and the controller VCU will also perform a power-off operation. At this time, it will no longer be possible to force the mixing drum to remain stable through the motor.

[0041] After detecting that the key switch is turned off, the controller immediately controls the mixing drum driving motor to decelerate the mixing drum.

[0042] If the current speed of the mixing drum driving motor is less than the second speed setting value, it indicates that the speed of the mixing drum driving motor is already very low, that is, the speed of the mixing drum is also already very low, which further indicates that the rotational energy of the mixing drum has weakened, and the mixing drum driving motor adopts zero-torque control, and reversal detection is performed on the mixing drum driving motor. The second speed setting value can be set according to actual needs. For example, the second speed setting value can be set to 50 rpm.

[0043] If it is detected that the mixing drum driving motor reverses within the second set time and the reversing speed is greater than the third speed setting value, it indicates that the rotational energy of the mixing drum can still cause the mixing drum to reverse, then continue to control the mixing drum driving motor to decelerate until the mixing drum driving motor meets the preset conditions, and then the power-off operation is performed on a controller. The third speed setting value can be set according to actual needs. For example, the third speed setting value can be set to 150 rpm.

[0044] The preset conditions are configured to determine whether the controller is powered off. If the preset conditions are met, it means that the rotation energy of the mixing drum is not enough to cause reversal, and the power-off operation can be performed normally. The preset condition is that the duration of the speed of the mixing drum driving motor after reversal being less than the second speed setting value is greater than the second set time, or the time of controlling the mixing drum driving motor after reversal to decelerate is greater than a third set time.

[0045] The second set time can be set as needed, for example, 2 seconds. The third set time can be set as needed, for example, 5 seconds.

[0046] Based on any one of the above embodiments, after the performing reversal detection on the mixing drum driving motor, the method includes:

in response to not detecting that the mixing drum driving motor is reversed within the second set time, performing power-off operation on the controller.

[0047] In an embodiment, if the reversal of the mixing drum driving motor is not detected within the second set time, it indicates that the rotational energy of the mixing drum will not cause reversal, and the controller can be powered off normally.

[0048] Based on any one of the above embodiments, the controlling the mixing drum driving motor to decelerate includes:

controlling the mixing drum driving motor to decelerate

with a speed control method or a torque control method.

[0049] In an embodiment, the target physical quantity of the speed control method is the speed of the mixing drum driving motor. The speed control method uses the speed of the mixing drum driving motor as the actual value for closed-loop control, and has the characteristics of high control accuracy.

[0050] The target physical quantity of the torque control method is to control the output torque of the mixing drum driving motor. Since only the speed control method is used, when the concrete load is large, the rotational inertia may be large, causing the speed control to fail, or forcibly controlling the speed may cause equipment damage. At this time, the torque control method can be switched to control the change in torque to change the speed, which can effectively avoid damage to the equipment and improve the service life of the device.

[0051] Based on any one of the above embodiments, FIG. 2 is a schematic diagram of a speed control system installed on a mixing truck provided by the present application. As shown in FIG. 2, the system includes a VCU, a top-mounted motor controller, a power supply device, a top-mounted motor controller, and a mixing drum.

[0052] The VCU is configured to obtain accelerator and brake pedal signals in the cab, signals from the cab control panel, control signals from the electronic control handle outside the cab, gearbox gear signals, handbrake signals and vehicle speed signals, etc. According to the control logic of the top-mounted motor, the control instructions such as motor speed, motor torque and rotation direction for controlling the top-mounted motor are determined and sent to the top-mounted motor controller.

[0053] The top-mounted motor controller is configured to obtain the power source of the top-mounted motor from the power supply device, and control the top-mounted motor according to the control instructions sent by the vehicle controller.

[0054] The top-mounted motor is directly connected to the mixing drum through a method of transmission-direct driving or hydraulic connection, and the mixing drum is driven to accelerate or decelerate.

[0055] The speed control method is as follows.

[0056] Step 1, after the top-mounted mixing drum is started, the VCU adjusts the speed of the motor through either motor speed control or motor torque control, thereby realizing the normal acceleration and deceleration operation of the mixing drum.

[0057] Step 2, when the mixing drum is running, if the driver only turns off the top-mounted PTO switch (the key is not turned off at this time), the VCU will control the top-mounted motor to perform deceleration operation (motor speed control or torque control can be used). After the top-mounted motor speed is less than a certain set value N1 (a set value, such as N1 =50rpm), the VCU can have the following two different control methods.

a) When the top-mounted motor speed drops below the set value and the duration exceeds T1 (T1 is the

set value, such as T1=20 seconds), the VCU will send a zero-torque control instruction to the top-mounted motor, that is, the motor is in a follow-rotation state.

b) The VCU will always control the top-mounted motor to be in a zero-speed state, which can be achieved through motor speed control or torque control.

[0058] If the driver suddenly turns off the key switch while performing step 2, the operation process will enter step 3.

[0059] Step 3, when the mixing drum is running, if the driver directly turns off the key, the VCU will control the top-mounted motor to decelerate (motor speed control or torque control can be used); when the top-mounted motor speed is less than a certain set value N2 (a set value, such as N2=50rpm), the VCU will first perform zero-torque control on the motor, and then perform the following operations:

a) Determining whether the motor speed reverses within a certain period of time T2 (T2 is the set value, such as T2=2 seconds) and the motor reverse speed exceeds N3 (the set value, such as N3=150rpm).

b) If the motor speed does not reverse within a certain period of time T2, and the motor reverse speed does not exceed N3, the VCU can perform power-off operation normally.

c) If the motor speed reverses within a certain period of time T2, and the motor reverse speed exceeds N3, the VCU will continue to perform deceleration control on the top-mounted motor (through motor speed control or torque control). When the motor speed continues to be less than the set value (such as 50rpm) for the time T2 or the total speed exceeds N3, the VCU will continue to perform deceleration control on the top-mounted motor (through motor speed control or torque control). When the time T3 is set (T3 is the set value, such as T3=5 seconds), the VCU can perform a normal power-off operation.

[0060] The top-mounted speed control system provided by the embodiment of the present application, when the top-mounted mixing drum is running, if the driver directly turns off the top-mounted PTO switch or disconnects the key switch, the control system can ensure that the mixing drum will not have a large reverse rotation leading to unloading operation, which also minimizes the reversal impact force and alleviates driving discomfort.

[0061] Based on any one of the above embodiments, FIG. 3 is a schematic structural diagram of a mixing drum speed control device provided by the present application. As shown in FIG. 3, the device includes an obtaining unit 310, a deceleration unit 320, and a first control unit 330.

[0062] The obtaining unit 310 is configured to obtain a top-mounted power take-off switch status and a key

switch status of a mixing truck.

[0063] The deceleration unit 320 is configured to control a mixing drum driving motor to decelerate, and obtain a current speed of the mixing drum driving motor in response to the top-mounted PTO switch being turned off and the key switch being turned on.

[0064] The first control unit 330 is configured to control the mixing drum driving motor at zero speed continuously in response to the current speed of the mixing drum driving motor being less than a first speed setting value.

[0065] In the mixing drum speed control device provided in the embodiment of the present application, in response to the top-mounted PTO switch being turned off and the key switch being turned on, controlling a mixing drum driving motor to decelerate, and obtaining a current speed of the mixing drum driving motor; and in response to the current speed of the mixing drum driving motor being less than a first speed setting value, performing zero-speed control on the mixing drum driving motor continuously. When the top-mounted PTO switch is turned off, the mixing drum driving motor will continue to be controlled at zero speed. The unloading phenomenon will not occur due to the instantaneous reversal of inertia, which avoids the generation of reversal impact force to the greatest extent, alleviates the driving discomfort, and improves the driver's driving experience.

[0066] Based on any one of the above embodiments, the device further includes:

a second control unit, configured to perform zero-torque control on the mixing drum driving motor in response to that a duration of the current speed of the mixing drum driving motor being less than the first speed setting value is greater than a first set time.

[0067] Based on any one of the above embodiments, the top-mounted PTO switch is configured to indicate that the top-mounted system of the mixing truck is controllable;

in response to the top-mounted PTO switch being turned on, controlling, by the mixing drum driving motor, the mixing drum to start rotating; and in response to the top-mounted PTO switch being turned off, controlling, by the mixing drum driving motor, the mixing drum to stop rotating.

[0068] Based on any one of the above embodiments, the device further includes:

a reversal control unit, configured to control the mixing drum driving motor to decelerate, and obtain the current speed of the mixing drum driving motor in response to the key switch being turned off;

in response to the current speed of the mixing drum driving motor being less than a second speed setting value, performing zero-torque control on the mixing drum driving motor, and performing reversal detection on the mixing drum driving motor;

in response to detecting that the mixing drum driving

motor is reversed within a second set time and a reversing speed is greater than a third speed setting value, controlling the mixing drum driving motor to decelerate until the mixing drum driving motor meets a preset condition, and in response to the mixing drum driving motor meeting the preset condition, performing power-off operation on a controller;

the preset condition is that a duration of the speed of the mixing drum driving motor after reversal being less than the second speed setting value is greater than the second set time, or a time of controlling the mixing drum driving motor after reversal to decelerate is greater than a third set time.

[0069] Based on any one of the above embodiments, the reversal control unit is further configured to:

perform power-off operation on the controller in response to not detecting that the mixing drum driving motor is reversed within the second set time.

[0070] Based on any one of the above embodiments, the deceleration unit is configured to:

control the mixing drum driving motor to decelerate with a speed control method or a torque control method.

[0071] Based on any one of the above embodiments, embodiments of the present application provide a mixing truck, including a memory, a controller, and a computer program stored on the memory and executable on the controller. When the program is executed by the controller, steps of the above mixing drum speed control method are implemented.

[0072] In an embodiment, the mixing truck in the embodiment of the present application may be a fuel-driven mixing truck or a power battery-driven electric mixing truck.

[0073] Based on any one of the above embodiments, FIG. 4 is a schematic structural diagram of an electronic device provided by the present application. As shown in FIG. 4, the electronic device may include: a processor 410, a communication interface 420, a memory 430, and a communication bus 440. The processor 410, the communication interface 420, and the memory 430 are communicated with each other through the communication bus 440. The processor 410 can call logical instructions in the memory 430 to perform the following methods:

obtaining a top-mounted PTO switch status and a key switch status of a mixing truck; in response to the top-mounted PTO switch being turned off and the key switch being turned on, controlling a mixing drum driving motor to decelerate, and obtaining a current speed of the mixing drum driving motor; and in response to the current speed of the mixing drum driving motor being less than a first speed setting value, performing zero-speed control on the mixing drum driving motor continuously.

[0074] In addition, the above-mentioned logical in-

structions in the memory 430 can be implemented in the form of software functional units and can be stored in a computer-readable storage medium when sold or used as an independent product. Based on this understanding, the technical solution of the present application, in essence, or the part that contributes to the existing technology or the part of the technical solution, can be embodied in the form of a software product. The computer software product is stored in a storage medium, including several instructions configured to cause a computer device (which can be a personal computer, a server, or a network device, etc.) to execute all or part of the steps of the methods described in various embodiments of the present application. The aforementioned storage medium include: U disk, mobile hard disk, read-only memory (ROM), random access memory (RAM), magnetic disk or optical disk and other media that can store program code.

[0075] The processor in the electronic device provided by the embodiment of the present application can call logical instructions in the memory to implement the above method. The specific implementation is consistent with the implementation of the aforementioned method and can achieve the same beneficial effects, which will not be described again here.

[0076] Embodiments of the present application further provide a non-transitory computer-readable storage medium on which a computer program is stored. The computer program is implemented when executed by a processor to perform the methods provided in the above embodiments, for example, including:

obtaining a top-mounted PTO switch status and a key switch status of a mixing truck; in response to the top-mounted PTO switch being turned off and the key switch being turned on, controlling a mixing drum driving motor to decelerate, and obtaining a current speed of the mixing drum driving motor; and in response to the current speed of the mixing drum driving motor being less than a first speed setting value, performing zero-speed control on the mixing drum driving motor continuously.

[0077] When the computer program stored on the non-transitory computer-readable storage medium provided by the embodiment of the present application is executed, the above method is implemented. The specific implementation is consistent with the implementation of the foregoing method and can achieve the same beneficial effects, which will not be described again here.

[0078] The device embodiments described above are only illustrative. The units described as separate components may or may not be physically separated. The components shown as units may or may not be physical units, that is, they may be located in one location, or they can be distributed across the plurality of network units. Some or all of the modules can be selected according to actual needs to achieve the purpose of the solution of this em-

bodiment. Those of ordinary skill in the art can understand and implement the method without any creative effort.

[0079] Through the above description of the embodiments, those skilled in the art can clearly understand that each embodiment can be implemented by software plus a necessary general hardware platform, and of course, it can also be implemented by hardware. Based on this understanding, the above technical solution, in essence, or the part that contributes to the existing technology, can be embodied in the form of a software product. The computer software product can be stored in a computer-readable storage medium, such as ROM/RAM, magnetic disc, optical disc, etc., including a plurality of instructions to cause a computer device (which can be a personal computer, a server, or a network device, etc.) to execute the methods described in various embodiments or certain parts of the embodiments.

[0080] Finally, it should be noted that the above embodiments are only used to illustrate the technical solution of the present application, but not to limit the present application. Although the present application has been described in detail with reference to the foregoing embodiments, those of ordinary skill in the art should understand that modifications may still be made to the technical solutions described in the foregoing embodiments, or equivalent substitutions may be made to some of the technical features. However, these modifications or substitutions do not cause the essence of the corresponding technical solutions to deviate from the spirit and scope of the technical solutions of the embodiments of the present application.

Claims

1. A mixing drum speed control method, **characterized by** comprising:

obtaining a top-mounted power take-off (PTO) switch status and a key switch status of a mixing truck;
in response to the top-mounted PTO switch being turned off and the key switch being turned on, controlling a mixing drum driving motor to decelerate, and obtaining a current speed of the mixing drum driving motor; and
in response to the current speed of the mixing drum driving motor being less than a first speed setting value, performing zero-speed control on the mixing drum driving motor continuously.

2. The mixing drum speed control method according to claim 1, wherein after the obtaining the current speed of the mixing drum driving motor, the method further comprises:

in response to that a duration of the current speed of the mixing drum driving motor being less than the

first speed setting value is greater than a first set time, performing zero-torque control on the mixing drum driving motor.

3. The mixing drum speed control method according to claim 1, wherein the top-mounted PTO switch is configured to indicate that a top-mounted system of the mixing truck is controllable;

in response to the top-mounted PTO switch being turned on, controlling, by the mixing drum driving motor, the mixing drum to start rotating; and
in response to the top-mounted PTO switch being turned off, controlling, by the mixing drum driving motor, the mixing drum to stop rotating.
4. The mixing drum speed control method according to claim 1, wherein after the obtaining the top-mounted PTO switch status and the key switch status of the mixing truck, the method comprises:

in response to the key switch being turned off, controlling the mixing drum driving motor to decelerate, and obtaining the current speed of the mixing drum driving motor;
in response to the current speed of the mixing drum driving motor being less than a second speed setting value, performing zero-torque control on the mixing drum driving motor, and performing reversal detection on the mixing drum driving motor;
in response to detecting that the mixing drum driving motor is reversed within a second set time and a reversing speed is greater than a third speed setting value, controlling the mixing drum driving motor to decelerate until the mixing drum driving motor meets a preset condition, and in response to the mixing drum driving motor meeting the preset condition, performing a power-off operation on a controller;
wherein, the preset condition is that a duration of a speed of the mixing drum driving motor after reversal being less than the second speed setting value is greater than the second set time, or a time of controlling the mixing drum driving motor after reversal to decelerate is greater than a third set time.
5. The mixing drum speed control method according to claim 4, wherein after the performing the reversal detection on the mixing drum driving motor, the method comprises:
in response to not detecting that the mixing drum driving motor is reversed within the second set time, performing the power-off operation on the controller.
6. The mixing drum speed control method according to

any one of claims 1 to 5, wherein the controlling the mixing drum driving motor to decelerate comprises: controlling the mixing drum driving motor to decelerate with a speed control method or a torque control method.

7. A mixing drum speed control device, **characterized by** comprising:

an obtaining unit, configured to obtain a top-mounted power take-off (PTO) switch status and a key switch status of a mixing truck;
a deceleration unit, configured to control a mixing drum driving motor to decelerate, and obtain a current speed of the mixing drum driving motor in response to the top-mounted PTO switch being turned off and the key switch being turned on; and
a first control unit, configured to control the mixing drum driving motor at zero speed continuously in response to the current speed of the mixing drum driving motor being less than a first speed setting value.
8. A mixing truck, **characterized by** comprising:

a memory,
a controller, and
a computer program stored on the memory and executable on the controller,
wherein when the program is executed by the controller, steps of the mixing drum speed control method according to any one of claims 1 to 6 are realized.
9. An electronic device, **characterized by** comprising:

a memory,
a processor, and
a computer program stored on the memory and executable on the processor,
wherein when the program is executed by the processor, steps of the mixing drum speed control method according to any one of claims 1 to 6 are realized.
10. A non-transitory computer-readable storage medium, **characterized in that**, a computer program is stored on the non-transitory computer-readable storage medium, wherein when the computer program is executed by a processor, steps of the mixing drum speed control method according to any one of claims 1 to 6 are realized.

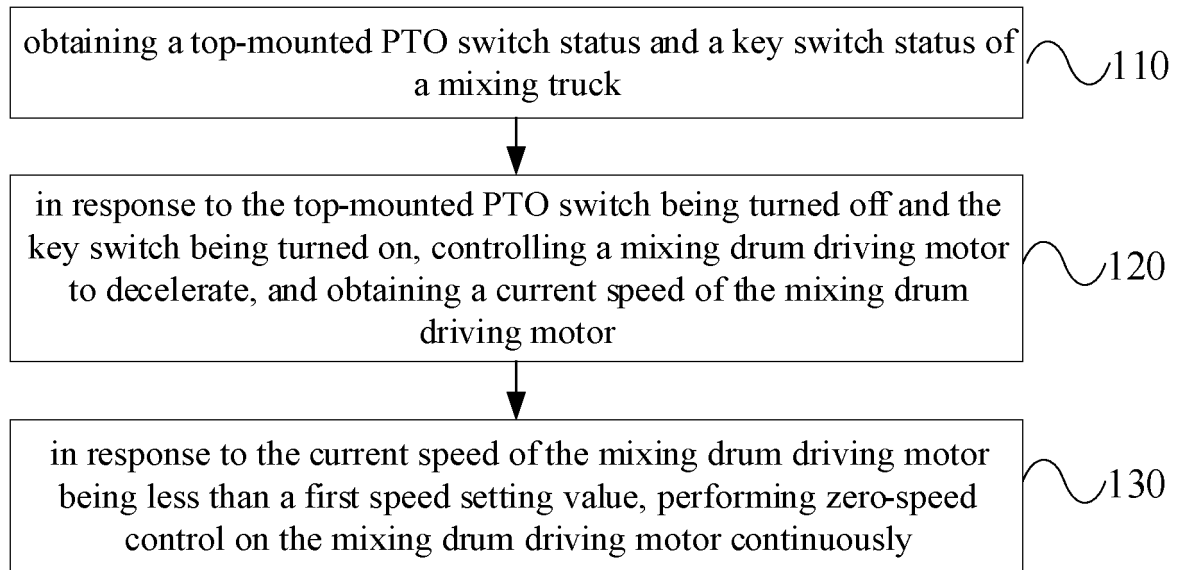


FIG. 1

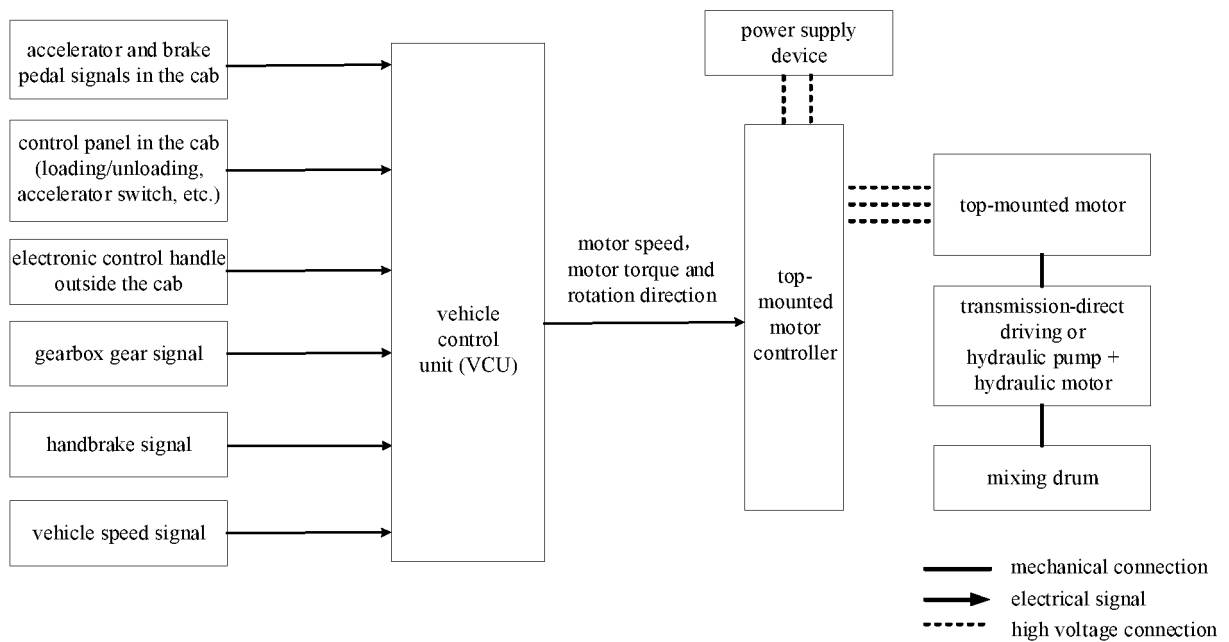


FIG. 2

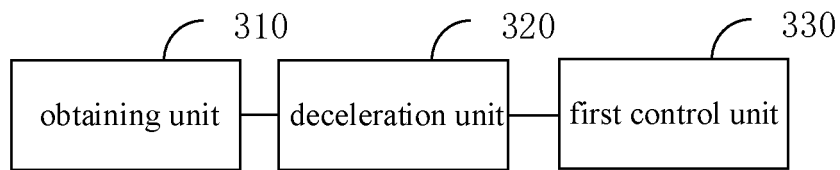


FIG. 3

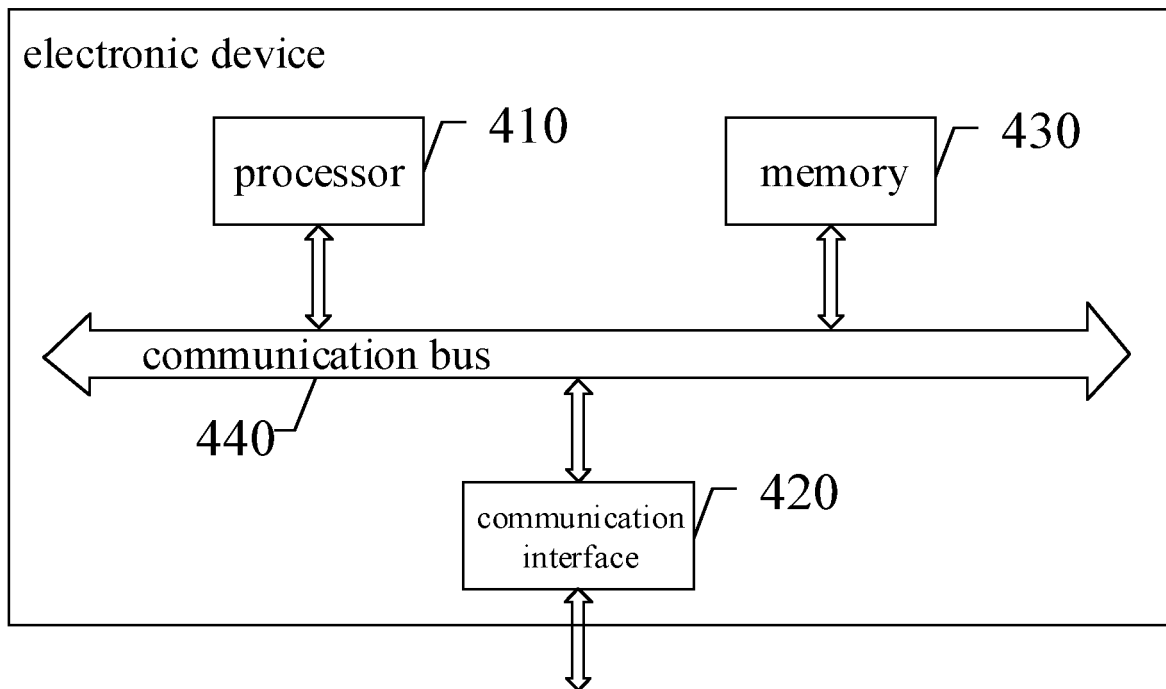


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2022/105877

A. CLASSIFICATION OF SUBJECT MATTER B28C 5/42(2006.01)i According to International Patent Classification (IPC) or to both national classification and IPC																					
B. FIELDS SEARCHED																					
Minimum documentation searched (classification system followed by classification symbols) B28C																					
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																					
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) CNABS, CNTXT, VEN, CNKI: 搅拌机, 搅拌机, 转速, 减速, 控制, 转矩, 扭矩, 反转, 回转, 冲击力, 惯性, 驱动, 电机, 电源; mix, rotate, speed, deceleration, control, torque, reverse, revolve, impact, inertia, drive, motor, power																					
C. DOCUMENTS CONSIDERED TO BE RELEVANT																					
<table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>PX</td> <td>CN 113787618 A (SANY AUTOMOBILE MANUFACTURING CO., LTD.) 14 December 2021 (2021-12-14) claims 1-10</td> <td>1-10</td> </tr> <tr> <td>Y</td> <td>CN 112549312 A (JIANGSU AOXIN NEW ENERGY AUTOMOBILE CO., LTD.) 26 March 2021 (2021-03-26) description, paragraphs 2-49, and figure 1</td> <td>1-3, 6-10</td> </tr> <tr> <td>Y</td> <td>CN 112848919 A (CHERY NEW ENERGY AUTOMOBILES CO., LTD.) 28 May 2021 (2021-05-28) description, paragraphs 2-65, and figures 1-4</td> <td>1-3, 6-10</td> </tr> <tr> <td>A</td> <td>CN 110864107 A (ANHUI JIANGHUAI AUTOMOBILE GROUP CO., LTD.) 06 March 2020 (2020-03-06) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 113183742 A (JILIN UNIVERSITY) 30 July 2021 (2021-07-30) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 112060342 A (ZOOMLION HEAVY INDUSTRY SCIENCE&TECHNOLOGY CO., LTD.) 11 December 2020 (2020-12-11) entire document</td> <td>1-10</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	PX	CN 113787618 A (SANY AUTOMOBILE MANUFACTURING CO., LTD.) 14 December 2021 (2021-12-14) claims 1-10	1-10	Y	CN 112549312 A (JIANGSU AOXIN NEW ENERGY AUTOMOBILE CO., LTD.) 26 March 2021 (2021-03-26) description, paragraphs 2-49, and figure 1	1-3, 6-10	Y	CN 112848919 A (CHERY NEW ENERGY AUTOMOBILES CO., LTD.) 28 May 2021 (2021-05-28) description, paragraphs 2-65, and figures 1-4	1-3, 6-10	A	CN 110864107 A (ANHUI JIANGHUAI AUTOMOBILE GROUP CO., LTD.) 06 March 2020 (2020-03-06) entire document	1-10	A	CN 113183742 A (JILIN UNIVERSITY) 30 July 2021 (2021-07-30) entire document	1-10	A	CN 112060342 A (ZOOMLION HEAVY INDUSTRY SCIENCE&TECHNOLOGY CO., LTD.) 11 December 2020 (2020-12-11) entire document	1-10
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Date of the actual completion of the international search 28 September 2022	Date of mailing of the international search report 13 October 2022																				
Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China Facsimile No. (86-10)62019451	Authorized officer Telephone No.																				

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/105877

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2022/105877

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 113787618 A	14 December 2021	None	
CN 112549312 A	26 March 2021	None	
CN 112848919 A	28 May 2021	None	
CN 110864107 A	06 March 2020	None	
CN 113183742 A	30 July 2021	None	
CN 112060342 A	11 December 2020	None	
JP 2015193289 A	05 November 2015	None	
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		US 2020317083 A1	08 October 2020

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