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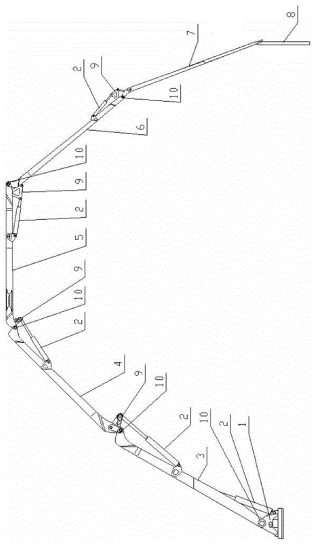
(54) CONCRETE PUMP TRUCK AND VIBRATION REDUCTION APPARATUS AND METHOD FOR CONCRETE PUMP TRUCK-MOUNTED BOOM

(57) The present invention discloses a concrete pump truck and an apparatus and a method for reducing the vibration of a boom of the concrete pump truck. The apparatus for reducing the vibration of the boom of the concrete pump truck comprises: a vibration reduction control unit (11), which is connected with an electromagnetic proportional valve (12) connected with boom cylinder (2), a boom terminal vibration monitoring unit (21), which is used for monitoring a amplitude parameter of the tail boom section (14) of the boom (13) and transmitting an amplitude parameter signal to the vibration reduction control unit (11), and a boom posture monitoring unit (20) which is used for monitoring an angle parameter of the boom (13) and transmitting an angle parameter signal to the vibration reduction control unit (11). The concrete pump truck of the present invention further comprises the apparatus for reducing the vibration of the boom of the concrete pump truck. The method for reducing the vibration of the boom of the concrete pump truck provided by the present invention comprises the following steps: monitoring the operating parameters of a concrete pump and the boom (13); generating a control signal according to the monitored operating parameters, outputting an control current of an electromagnetic proportional valve (12) according to the control signal, and controlling the piston positions of the boom cylinder (2); wherein the monitored operating parameters of the boom (13) comprise a vibration amplitude parameter of the tail boom section (14) and an angle parameter of the boom (13).

Fig. 1



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Description

Technical field of the invention

[0001] The present invention relates to the field of construction engineering machinery, in particular to a concrete pump truck and an apparatus and a method for reducing the vibration of a boom of the concrete pump truck.

Background of the invention

[0002] At present, large equipments with a plurality of rotary boom sections are widely used for the concrete construction in the construction engineering, such as a concrete pump truck arranged on a truck chassis, which is mainly used for conveying concrete from the position of the pump truck to the target position specified by the construction engineering.

[0003] The concrete pump truck mainly includes a chassis, a concrete conveying pump, a pipe and a boom. The concrete is alternately pushed to the concrete conveying pipe by a dual-feeding cylinder arranged on the chassis of the pump truck through a connection mechanism; and the pipe is fixed on one side of the boom and moves together with the rotating boom so as to convey the concrete to the predetermined target position. As shown in the side view of an unfolded boom in Fig. 1, the pump truck is generally provided with five boom sections, including a first boom section 3, a second boom section 4, a third boom section 5, a fourth boom section 6 and a fifth boom section 7, which are folded or unfolded by the shrinkage movement of boom cylinders 2. The boom sections rotate with one another by rotating shafts 10 to realize the unfolding and folding function. The adjacent next boom section is driven to rotate by a connecting rod 9 by the expansion of a piston rod of the boom cylinder 2. A rotary table 1 is mounted on an automobile chassis, and the rotary table 1 and components thereon can rotate in a horizontal range during operation; and concrete is conveyed to a hose 8 at the terminal of the boom through the pipe and further flows out from the terminal of the hose 8 to reach the position specified by an operator.

[0004] A great vibration may be generated at the hose 8 at the terminal of the boom when the concrete is conveyed discontinuously, which may make the terminal of the boom positioned inaccurately, increase the operating danger and the fatigue of the boom and the like. In order to suppress the vibration of the boom, a scheme for reducing vibration of the boom by adding anti-vibration cylinders and controlling the action of the anti-vibration cylinders by monitoring and processing the pressure information in the boom cylinders and/or anti-vibration cylinders has been put forward. By such scheme, the final vibration information of the terminal of the boom cannot be reflected accurately; moreover, it is necessary to add the additional anti-vibration cylinders.

Summary of the invention

[0005] The purpose of the present invention is to provide a concrete pump truck and an apparatus and a method for reducing the vibration of the boom of the concrete pump truck with good vibration reduction effect, simple structure and wide application.

[0006] In order to achieve the objectives, in one aspect, the present invention provides an apparatus for reducing the vibration of a boom of a concrete pump truck. The boom comprises a plurality of boom sections connected with one another and a boom cylinder between each of the boom sections; and the vibration reduction apparatus comprises: a vibration reduction control unit which is connected with an electromagnetic proportional valve connected with the boom cylinder; a boom terminal vibration monitoring unit, which is used for monitoring the vibration amplitude parameter of the tail boom section of the boom and transmitting an amplitude parameter signal to the vibration reduction control unit; and a boom posture monitoring unit, which is used for monitoring an angle parameter of the boom and transmitting an angle parameter signal to the vibration reduction control unit.

[0007] Furthermore, the apparatus for reducing the vibration of the boom of the concrete pump truck further comprises: a pump unit conveying pressure monitoring unit, which is used for monitoring a unit conveying pressure of a concrete pump and transmitting a unit conveying pressure signal to the vibration reduction control unit.

[0008] Furthermore, the apparatus for reducing the vibration of the boom of the concrete pump truck further comprises: a pump piston stroke monitoring unit, which is used for monitoring a piston stroke of the concrete pump and transmitting a piston stroke signal to the vibration reduction control unit.

[0009] Furthermore, the boom posture monitoring unit is at least arranged on the tail boom section.

[0010] In another aspect, the present invention provides a concrete pump truck, which comprises a boom and further comprises the apparatus for reducing the vibration of the boom of the concrete pump truck above.

[0011] In another aspect, the present invention provides a method for reducing the vibration of a boom of a concrete pump truck. The boom comprises a plurality of boom sections connected with one another and a boom cylinder between each of the boom sections; and the method comprises the following steps: monitoring the operating parameters of a concrete pump and the boom, generating a control signal according to the monitored operating parameters, outputting an control current of electromagnetic proportional valves according to the control signal, and controlling the piston position of the boom cylinders, wherein the monitored operating parameters of the boom comprise a vibration amplitude parameter of the tail boom section and an angle parameter of the boom.

[0012] Furthermore, the method for reducing the vibration of the boom of the concrete pump truck further com-

prises the following step:: the monitored operating parameters of the boom being real-time parameters, modifying the control signal according to the monitored operating parameters of the boom in real time.

[0013] Furthermore, the angle parameter of the boom at least comprises the angle parameter of the tail boom section.

[0014] Furthermore, the monitored parameter of the concrete pump comprises a unit conveying pressure parameter of the concrete pump or a piston stroke parameter of the concrete pump.

[0015] Furthermore, the value of the control current of the electromagnetic proportional valves is obtained by calculation according to the control signal, and the algorithm for the calculation is compared and adjusted according to the unit conveying pressure parameter.

[0016] Through the technical scheme of the present invention, the angle parameter of the boom is monitored by the boom posture monitoring unit, the vibration amplitude parameter of the tail boom section of the boom is monitored by the boom terminal vibration monitoring unit, and the signals of the parameters are transmitted to the vibration reduction control unit, which analyzes and processes the signals; and then, the electromagnetic proportional valves are controlled to output their control current by the control signal and the piston positions of the boom cylinders are regulated repeatedly to find the volume of the rod chamber or non-rod chamber of the most effective boom cylinder between two boom sections, so as to make the boom cylinder generate fluctuation and vibration opposite to that of the tail boom section of the boom by the internal force of the boom and make the vibration amplitude value of the tail boom section of the boom caused by the fluctuation and vibration approximate to that caused by the discontinuous conveying of the concrete, therefore, the aim for reducing the vibration of the boom is achieved and a good vibration reduction effect is achieved. The conventional boom structure unit is fully utilized in the technical scheme of the present invention, so that the vibration reduction apparatus is very simple in structure. In addition, the vibration reduction apparatus can be added to any concrete pump trucks, so that it is good in applicability and wide in application.

Brief description of the drawings

[0017] Drawings, which form a part of the description and are provided for further understanding of the present invention, show the preferred embodiments of the present invention, and explain the principle of the present invention together with the description. In the drawings:

Fig. 1 shows a side view of a boom of a concrete pump truck in an unfolded state in the prior art;
Fig. 2 shows a diagram of a method for reducing the vibration of a boom of a concrete pump truck according to a first embodiment of the present invention;
Fig. 3 shows a diagram of a method for reducing the vibration of a boom of a concrete pump truck according to a second embodiment of the present invention;
Fig. 4 shows a diagram of a method for reducing the vibration of a boom of a concrete pump truck according to a third embodiment of the present invention;
Fig. 5 shows a diagram of a boom terminal vibration monitoring unit of an apparatus for reducing the vibration of a boom of a concrete pump truck according to the present invention; and
Fig. 6 shows a side view of a boom of a concrete pump truck in an unfolded state according to the present invention.

Detailed description of the embodiments

[0018] The embodiments of the present invention will be described in detail below with reference to drawings, however the present invention may be implemented by various different ways defined and covered by the claims. In the drawings, identical components are indicated by identical reference number.

[0019] An apparatus for reducing the vibration of a boom of a concrete pump truck of the present invention will be described below in detail by combining with Figs. 2 to 6.

[0020] As shown in Figs. 2 to 6, according to the apparatus for reducing the vibration of the boom of the concrete pump truck of the present invention, the boom 13 comprises a plurality of boom sections connected with one another and a boom cylinder 2 between each of the boom sections; and the vibration reduction apparatus comprising: a vibration reduction control unit 11 which is connected with an electromagnetic proportional valve 12 connected with the boom cylinder 2; a boom terminal vibration monitoring unit 21, which is used for monitoring a vibration amplitude parameter of the tail boom section 14 of the boom 13 and transmitting an amplitude parameter signal to the vibration reduction control unit 11; and a boom posture monitoring unit 20, which is used for monitoring an angle parameter of the boom 13 and transmitting an angle parameter signal to the vibration reduction control unit 11.

[0021] As shown in Fig. 6, the boom 13 comprises a plurality of boom sections which are connected with one another. According to the vibration reduction apparatus of the present invention, the vibration of the terminal of the hose 8 for conveying concrete is prevented mainly by controlling the tail boom section 14 of the boom 13. In the embodiment, the angle parameter of the boom 13 is monitored by the boom posture monitoring unit 20, the vibration amplitude parameter of the tail boom section 14 of the boom 13 is monitored by the boom terminal vibration monitoring unit 21, and an angle parameter signal and an amplitude parameter signal are transmitted to the vibration reduction control unit 11, which analyzes and processes the signals; and then, the vibration reduction control unit 11 outputs an control current of the electromagnetic proportional valve to control the electromag-

netic proportional valve 12 to regulate the piston positions of the boom cylinder 2 repeatedly to find the volumes of the rod chamber and non-rod chamber of the most effective boom cylinder 2 between two boom sections, so as to make the boom cylinder 2 generate fluctuation and vibration opposite to that of the tail boom section 14 of the boom 13 by the internal force of the boom and make the vibration amplitude value of the tail boom section 14 of the boom 13 caused by the fluctuation and vibration approximate to that caused by the discontinuous conveying of the concrete, therefore, the aim of reducing the vibration of the boom 13 and a good vibration reduction effect are achieved; and furthermore, the vibration reduction apparatus is favorable for improving the positioning accuracy of the hose 8 at the terminal of the boom 13, so as to reduce the fatigue of the boom 13, prolong the service life of the boom 13 and lower the post-sale and using cost. For the vibration reduction apparatus provided by the present invention, the vibration reduction force of which is generated from the internal force of the boom cylinders, it is only necessary to add an additional boom terminal vibration monitoring unit 21, boom posture monitoring unit 20 and vibration reduction control unit 11 without changing the original structure of the conventional concrete pump truck, so that the vibration reduction apparatus is simple in structure, convenient to implement and low in cost. In addition, the vibration reduction apparatus can be added to any concrete pump trucks, so as to be good in applicability and wide in application.

[0022] In one embodiment of the present invention, as shown in Fig. 2, the amplitude signal in the gravity direction of the tail boom section 14 of the boom is monitored by the boom terminal vibration monitoring unit 21 and the angle of the tail boom section 14 of the boom is monitored by the boom posture monitoring unit 20, and the amplitude signal and the angle signal are transmitted to the vibration reduction control unit 11, which analyzes and processes the signals to obtain boom posture and vibration parameter information; then, a calculation module in the vibration reduction control unit 11 calculates and outputs the control current of the electromagnetic proportional valves to regulate the volumes of the rod chamber and non-rod chamber of the most effective boom cylinder 2 between two boom sections, such as the boom cylinder of the second boom section, by an electromagnetic proportional valve 12, so that the internal force of the boom generates a vibration which is opposite to that of the tail boom section 14 in phase. In another aspect, the vibration amplitude parameter signal and the angle parameter signal monitored by the boom terminal vibration monitoring unit 21 and the boom posture monitoring unit 20 in real time form a feedback circuit; and the vibration reduction control unit 11 modifies the control signal in real time according to a feedback signal to make the vibration amplitude value generated by the internal force of the boom more approximate to the vibration amplitude of the tail boom section 14 of the boom 13, therefore, the vibration of tail boom section 14 is controlled within a very small range.

[0023] According to another embodiment of the present invention, the apparatus for reducing the vibration of the boom of the concrete pump truck further comprises: a pump unit conveying pressure monitoring unit 15, which is used for monitoring the unit conveying pressure of the concrete pump and transmitting a unit conveying pressure signal to the vibration reduction control unit 11. The boom posture monitoring unit 20 is at least arranged on the tail boom section 14.

[0024] As shown in Fig. 5, the boom terminal vibration monitoring unit 21 comprises a vertical amplitude monitoring unit 211 and a horizontal amplitude monitoring unit 212. The vertical amplitude monitoring unit 211 and the horizontal amplitude monitoring unit 212 are used for monitoring the vertical amplitude and horizontal amplitude of the tail boom section 14 respectively. As shown in Fig. 3, in the embodiment, the boom posture monitoring unit 20 is further arranged on other boom sections besides the tail boom section 14 to monitor the angle of the tail boom section 14 and the angle of a necessary boom section to form boom posture information, and combine with the unit conveying pressure parameter reflecting the internal pressure of the concrete pump and its change monitored by the pump unit conveying pressure monitoring unit 15. Then, the vibration reduction control unit 11 reads these signals to analyze and process the signals to obtain boom posture, synthesized amplitude information and pumping frequency information, and then calculates and outputs the control current of the electromagnetic proportional valves 12 according to the analyzed vibration frequency, amplitude value and phase parameter calculation and control law to regulate the volumes of the rod chamber and non-rod chamber of the most effective boom cylinder 2 between two boom sections, so that the internal force of the boom generates vibration which is opposite to that of the terminal of the boom in phase. The pump unit conveying pressure monitoring unit 15 is arranged to measure the pumping frequency information, so that the boom cylinders 2 are controlled more accurately. In addition, the algorithm can be adjusted and compared according to the change of the unit pressure signal, so that the algorithm is more rational in cycle and controlled more timely. In the embodiment, the vibration amplitude parameter signal and the angle parameter signal monitored by the boom terminal vibration monitoring unit 21 and the boom posture monitoring unit 20 in real time form a feedback circuit; and the vibration reduction control unit 11 modifies the control parameter in real time according to a feedback signal to make the vibration amplitude value generated by the internal force of the boom more approximate to that of the tail boom section 14 of the boom 13, therefore, the vibration of tail boom section 14 is controlled within a very small range.

[0025] According to another embodiment of the present invention, as shown in Fig. 4, the apparatus for reducing the vibration of the boom of the concrete pump truck further comprises: a pump piston stroke monitoring

unit 16, which is used for monitoring the piston stroke of the concrete pump and transmitting a piston stroke signal to the vibration reduction control unit 11.

[0026] In the embodiment, the boom posture monitoring unit 20 is arranged on the tail boom section 14 to monitor the angle of the tail boom section 14 to form boom posture information by combining with the piston stroke signal reflecting the piston stroke monitored by the pump piston stroke monitoring unit 16; then, the vibration reduction control unit 11 reads these signals to analyze and process the signals to obtain boom posture and synthesize the signals into amplitude information and pumping frequency information, and then, the calculation module in the vibration reduction control unit 11 calculates and outputs the control current of the electromagnetic proportional valves 12 according to the analyzed vibration parameter to regulate the volumes of the rod chamber and non-rod chamber of the most effective boom cylinder 2 between two boom sections, so that the internal force of the boom generates vibration which is opposite to that of the terminal of the boom in phase. Other contents in the embodiment are the same as those in the former embodiment, thereby needing no further description.

[0027] The concrete pump truck of the present invention is described below by combining with drawings.

[0028] The concrete pump truck according to the present invention, as shown in Fig. 6, comprises a boom 13 and further comprises the above apparatus for reducing the vibration of the boom of the concrete pump truck.

[0029] The concrete pump truck is a construction machine applied widely, and the apparatus for reducing the vibration of the boom of the concrete pump truck is applied to the concrete pump truck so as to achieve a good vibration reduction effect. The conventional boom structure unit is fully utilized in the technical scheme of the present invention, so that the vibration reduction apparatus is very simple in structure. Therefore, the concrete pump truck provided by the present invention is applicable to pump trucks of various types so as to be widely applied.

[0030] A method for reducing the vibration of the boom of the concrete pump truck is described below by combining with drawings.

[0031] According to the method for reducing the vibration of the boom of the concrete pump truck provided by the present invention, the boom comprises a plurality of boom sections connected with one another and boom cylinders between the boom sections; and the method comprises the following steps: monitoring the operating parameters of a concrete pump and the boom; calculating and generating a control signal according to the monitored operating parameters, and calculating and outputting the control current of electromagnetic proportional valves according to the control signal and controlling the piston positions of the boom cylinders; wherein the monitored operating parameters of the boom comprise the vibration amplitude parameter of the tail boom section and the angle parameter of the boom.

[0032] As shown in Figs 2 to 4, the vibration amplitude parameter of the tail boom section adopted in the vibration reduction method can reflect the vibration parameter of the boom, such as the vibration amplitude value, mostly directly and accurately; and the angle parameter of the boom can determine the posture of the boom in real time and is used for correcting and regulating the analysis and processing of the control signal and amplitude signal. In the embodiment, the control signal is generated according to the angle parameter of the boom, the vibration amplitude parameter of the tail boom section and the parameter of the concrete pump; and the vibration reduction control unit calculates the control current of the most effective electromagnetic proportional valve between two boom sections in an online and real-time way and regulates the volumes of the rod chamber and non-rod chamber of each boom cylinder to generate fluctuation and vibration which is finally reflected to the terminal of the boom to reduce the vibration here.

[0033] The method for reducing the vibration of the boom of the concrete pump truck further comprises: the monitored operating parameters of the boom are real-time parameters and modifying the control signal according to the monitored operating parameters of the boom in real time. Preferably, the value of the control current of the electromagnetic proportional valve is obtained by calculation according to the control signal, and the algorithm for the calculation is compared and adjusted according to the unit conveying pressure parameter.

[0034] The angle parameter of the boom and the vibration amplitude signal of the tail boom section form a feedback control signal; and the vibration reduction control unit calculates the control current of the most effective electromagnetic proportional valve between two boom sections in an online and real-time way and regulates the volumes of the rod chamber and non-rod chamber of each boom cylinder repeatedly to generate fluctuation and vibration which is finally reflected to the terminal of the boom to reduce the vibration here. Due to the real-time feedback control signal, the control process is more accurate. By the conveying pressure parameter of a pressure conveying unit, the algorithm for calculation can be compared and adjusted to achieve a more accurate control effect.

[0035] In the embodiment, the angle parameter of the boom at least comprises that of the tail boom section.

[0036] For the angle of the tail boom section influences the vibration reduction process most, in order to make the control simpler, the angle parameter of the boom can be only that of the tail boom section on the premise of ensuring certain control precision. In other embodiments, to make the boom measured more accurately, fully reflect the state of the boom and make the control more accurate, the angle parameter of the boom comprises not only that of the tail boom section but also those of other boom sections.

[0037] As shown in Figs. 3 and 4, the monitored pa-

rameter of the concrete pump comprises the unit conveying pressure parameter or piston stroke parameter of the concrete pump.

[0038] The concrete pump is generally fed by a double-piston feeding cylinder circularly, therefore, when the left cylinder and the right cylinder of the double-piston feeding cylinder reverse, the concrete is conveyed discontinuously so as to cause the vibration of the boom. At the moment, the pressure in the cylinder may change suddenly, therefore, the unit conveying pressure parameter of the concrete pump can be measured to control the boom in real time. In addition, the piston stroke parameter reflects the position of the piston in the feeding cylinder and can also reflect the state of the feeding cylinder like the unit conveying pressure parameter, therefore, the boom can be controlled according to the piston stroke parameter.

[0039] Preferably, the value of the control current of each electromagnetic proportional valve is obtained by calculation according to the control signal, and the algorithm for the calculation is compared and adjusted according to the unit conveying pressure parameter.

[0040] The value of the control current of each electromagnetic proportional valve is calculated by the control signal; meanwhile, the algorithm can be adjusted and compared according to the unit conveying pressure parameter to make the algorithm more rational in cycle and controlled more timely, so that the vibration of the terminal of the boom is controlled within a very small range.

[0041] It can be seen from what described above that the embodiments of the present invention have the following technical effects:

1. The present invention has a good economic value. The present invention can effectively reduce the vibration of the boom and is favorable for improving the positioning accuracy of the hose at the terminal of the boom, so as to reduce the fatigue of the boom, prolong the service life of the boom and lower the post-sale and using costs.
2. The present invention has high universality. It is only necessary to add additional vibration monitoring unit and the vibration reduction controller without changing the original structure of the conventional concrete pump truck, and the vibration reduction force is from the internal force of the boom cylinders, so that the vibration reduction apparatus is simple in structure and convenient to implement.
3. The present invention is low in cost. The system can be added to make the boom have vibration reduction function without changing the conventional pump truck greatly.
4. The present invention has high measurement accuracy. The posture and vibration parameters of the boom can be fully reflected by the boom terminal vibration monitoring unit and the boom posture monitoring unit, and no measurement dead angle is existed, so that the present invention is favorable for improving the control accuracy.

[0042] Above contents only describe the preferred embodiments of the present invention and are not intended to limit the present invention; for one skilled in the art, the present invention may have various modifications and changes. Any modifications, equivalent replacements and improvements made within the spirit and principle of the present invention should be included within the protection scope of the present invention.

Claims

1. An apparatus for reducing the vibration of a boom of a concrete pump truck, wherein the boom (13) comprising a plurality of boom sections connected with one another and a boom cylinder (2) between each of the boom sections, **characterized in that**, the vibration reduction apparatus comprising:

   a vibration reduction control unit (11), which is connected with an electromagnetic proportional valve (12) connected with the boom cylinder (2);
   a boom terminal vibration monitoring unit (21), which is used for monitoring a vibration amplitude parameter of the tail boom section (14) of the boom (13) and transmitting an amplitude parameter signal to the vibration reduction control unit (11); and
   a boom posture monitoring unit (20), which is used for monitoring an angle parameter of the boom (13) and transmitting an angle parameter signal to the vibration reduction control unit (11).

2. The apparatus for reducing the vibration of the boom of the concrete pump truck according to claim 1, **characterized by** further comprising:

   a pump unit conveying pressure monitoring unit (15), which is used for monitoring a unit conveying pressure of a concrete pump and transmitting a unit conveying pressure signal to the vibration reduction control unit (11).

3. The apparatus for reducing the vibration of the boom of the concrete pump truck according to claim 1, **characterized by** further comprising:

   a pump piston stroke monitoring unit (16), which is used for monitoring a piston stroke of the concrete pump and transmitting a piston stroke signal to the vibration reduction control unit (11).

4. The apparatus for reducing the vibration of the boom of the concrete pump truck according to any one of claims 1 to 3, **characterized in that**, the boom posture monitoring unit (20) is at least arranged on the

tail boom section (14).

5. A concrete pump truck, comprising a boom (13), **characterized by** further comprising the apparatus for reducing the vibration of the boom of the concrete pump truck according to any one of claims 1 to 4.

6. A method for reducing the vibration of a boom of a concrete pump truck, wherein the boom comprising a plurality of boom sections connected with one another and a boom cylinder between each of the boom sections, **characterized in that**, the method comprising the following steps:

monitoring the operating parameters of a concrete pump and the boom;
generating a control signal according to the monitored operating parameters, outputting an control current of an electromagnetic proportional valve according to the control signal and controlling the piston position of the boom cylinder;
wherein the monitored operating parameters of the boom comprising:

a vibration amplitude parameter of the tail boom section, and
an angle parameter of the boom.

7. The method for reducing the vibration of the boom of the concrete pump truck according to claim 6, **characterized by** further comprising the following step: the monitored operating parameters of the boom being real-time parameters, and modifying the control signal according to the monitored operating parameters of the boom in real time.

8. The method for reducing the vibration of the boom of the concrete pump truck according to claim 6, **characterized in that**, the angle parameter of the boom at least comprising the angle parameter of the tail boom section.

9. The method for reducing the vibration of the boom of the concrete pump truck according to claim 6, **characterized in that**, the monitored parameter of the concrete pump comprising a unit conveying pressure parameter of the concrete pump or a piston stroke parameter of the concrete pump.

10. The method for reducing the vibration of the boom of the concrete pump truck according to any one of claims 6 to 9, **characterized in that**, the value of the control current of the electromagnetic proportional valve is obtained by calculation according to the control signal, and the algorithm for the calculation is compared and adjusted according to the unit conveying pressure parameter.

Fig. 1

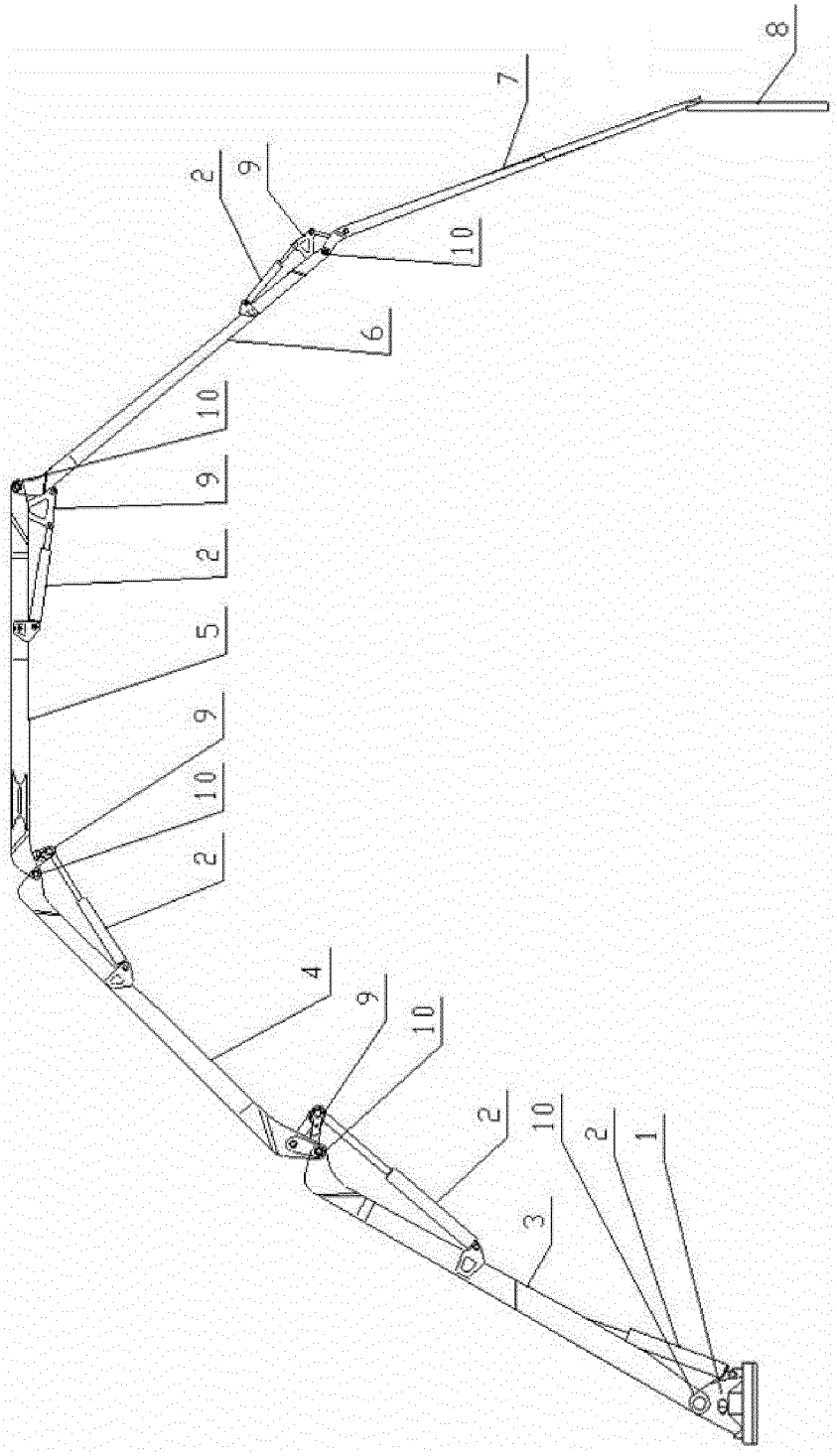


Fig. 2

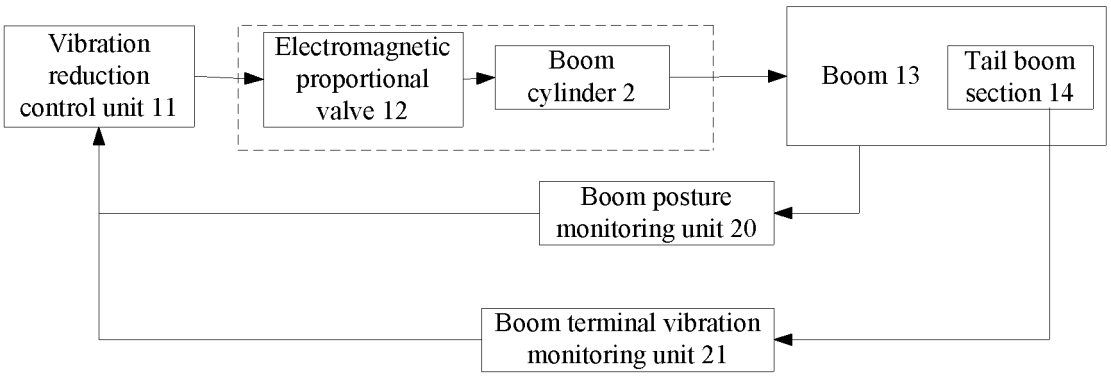

Vibration reduction control unit 11
Electromagnetic proportional valve 12
Boom cylinder 2
Boom 13
Tail boom section 14
Boom posture monitoring unit 20
Boom terminal vibration monitoring unit 21

Fig. 3

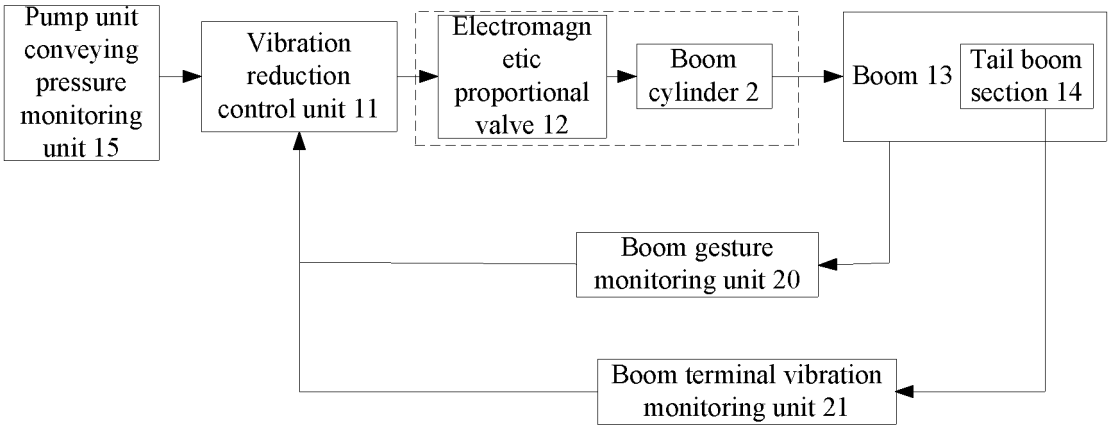

Pump unit conveying pressure monitoring unit 15
Vibration reduction control unit 11
Electromagn etic proportional valve 12
Boom cylinder 2
Boom 13
Tail boom section 14
Boom gesture monitoring unit 20
Boom terminal vibration monitoring unit 21

Fig. 4

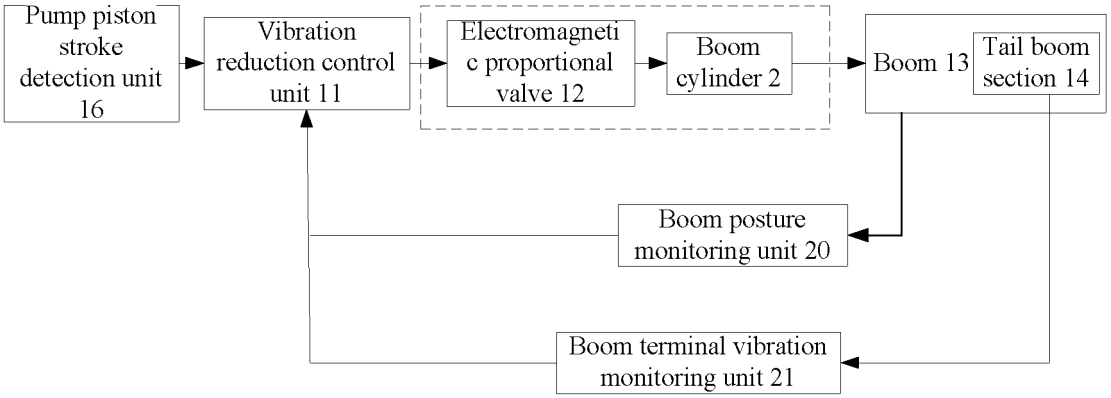

Pump piston stroke detection unit 16
Vibration reduction control unit 11
Electromagnetic proportional valve 12
Boom cylinder 2
Boom 13
Tail boom section 14
Boom posture monitoring unit 20
Boom terminal vibration monitoring unit 21

Fig. 5

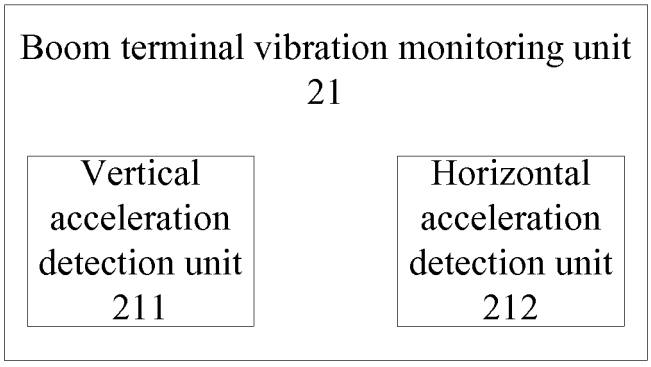
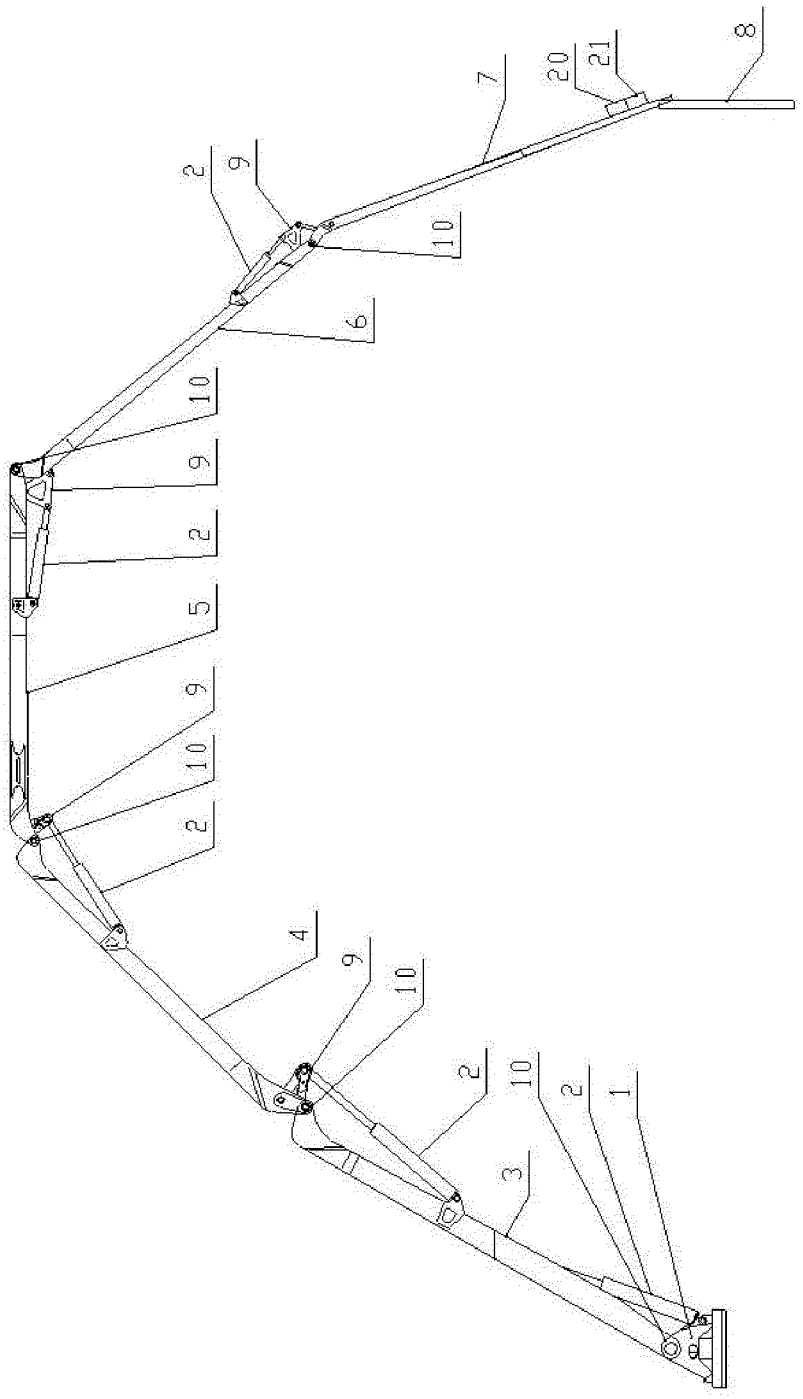

Boom terminal vibration monitoring unit 21
Vertical acceleration detection unit 211
Horizontal acceleration detection unit 212

Fig. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/078638

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet

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)

IPC: F04B 15/02, F04B 15/, F16F 15/, E04G 21/

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC: restrain, vibration, concrete, arm?, damping, shock w absorption, buffer+, control, inspect+, virbration, librat+, libration, angle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 102071809 A (CHANGSHA ZOOMLION HEAVY INDUSTRY SCIENCE & TECHNOLOGY DEVELOPMENT CO., LTD.), 25 May 2011 (25.05.2011), claims 1-10	1-10
A	CN 1932215 A (SANY HEAVY INDUSTRY CO., LTD.), 21 March 2007 (21.03.2007), claims 1-16, and figures 1-2	1-10
A	CN 201636126 U (LIAONING HAINUO CONSTRUCTION MACHINERY GROUP CO., LTD.), 17 November 2010 (17.11.2010), the whole document	1, 5-6
A	WO 02055813 A1 (SCHWING GMBH F et al.), 18 July 2002 (18.07.2002), the whole document	1-10
A	JP 5311879 A (MITSUBISHI HEAVY IND LTD.), 22 November 1993 (22.11.1993), the whole document	1-10

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

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 November 2011 (10.11.2011)	**01 December 2011 (01.12.2011)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **WANG, Jilong** Telephone No.: (86-10) **62084612**

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

F04B 15/02 (2006.01) i

F16F 15/027 (2006.01) i

E04G 21/04 (2006.01) i

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