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(54) **BOGIE**

(57) Provided is a bogie, including a framework (1), a gear box (2), a traction motor (3), a wheel pair (4), an axle (5), a six-link hollow shaft (6, 7), and a suspension cross beam (8), wherein the suspension cross beam (8) includes a beam body (81), a through groove (82) trans-

versely provided on the beam body (81), and a bearing seat (83), which is arranged so as to transversely overhang at a groove opening at one end of the through groove (82) and which is fixedly connected to the beam body (81); one end, with the through groove (82), of the

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beam body (81) is fixedly connected to the traction motor (3) in a longitudinal direction, and a closed cavity formed after connection is in sleeve connection with an outer surface of the hollow shaft (6); the other end of the traction motor (3) is suspended on a middle cross beam (11) of the framework (1); one end, without the through groove (82), of the beam body (81) is hooked with a framework end beam (12); and a driven gear (21) of the gearbox (2)

is in sleeve connection with the bearing seat (83) via a bearing (22). By means of elastic frame suspension of a driving device, the bogie solves the problem of the transverse instability of a heavy-duty freight electric locomotive during high-speed traveling. The gear box (2) uses a non-load structure so as to solve the problems of the gear box (2) having a complicated structure and being subject to a relatively heavy load of the gear box (2).

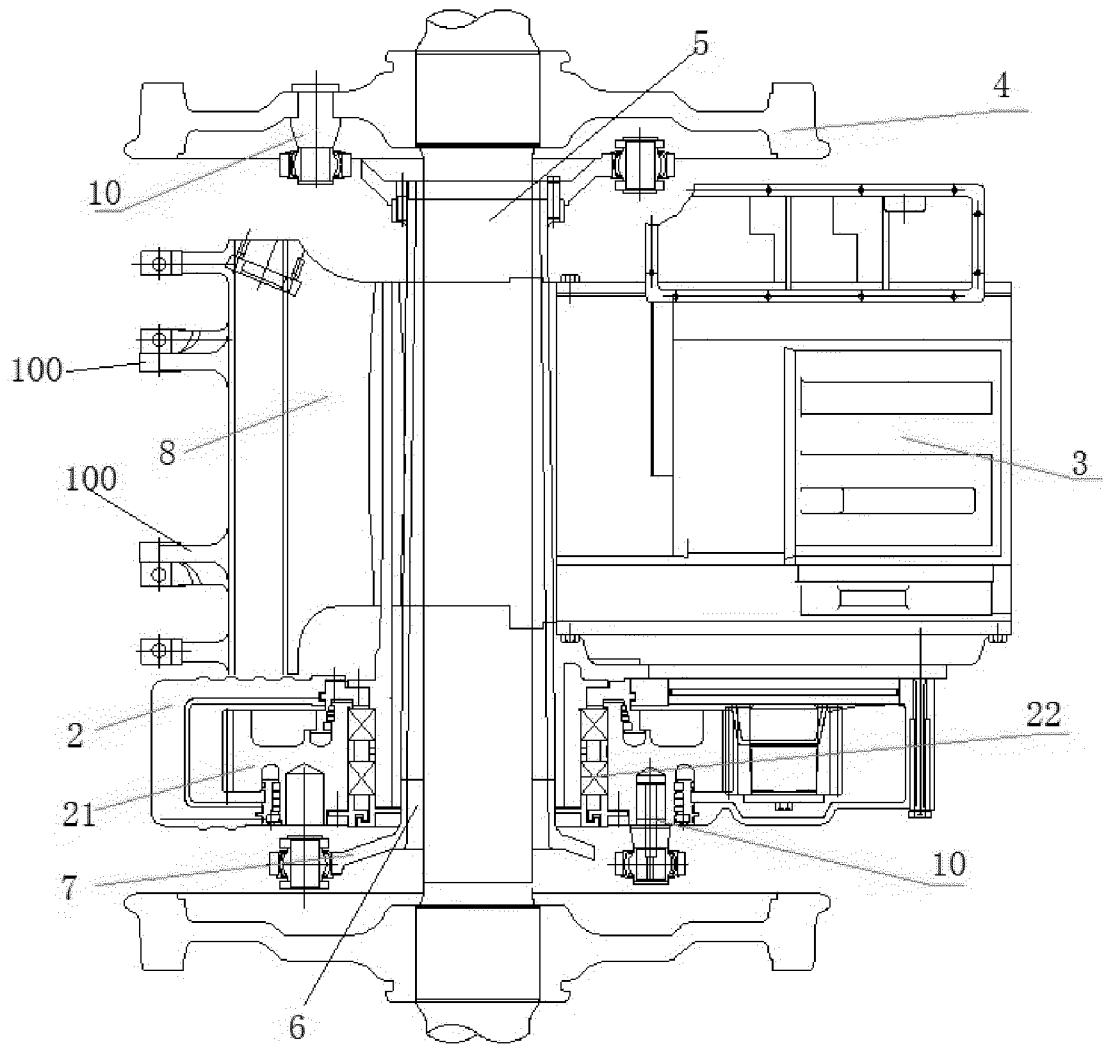


Fig. 5

Description

Field of the Invention

[0001] The present invention belongs to the field of rail traffic, and particularly relates to a bogie.

Background of the Invention

[0002] At present, the running speed of a heavy-duty freight electric locomotive is generally below 120km/h, and its driving device (including a traction motor, a gear box and the like) is generally installed in an axle suspension manner. As shown in Fig. 1, one end of the traction motor 3 is rigidly fixed with an axle suspension box 300 via a hexagon bolt, and the axle suspension bearing box 300 is suspended on an axle 5 through two sets of axle suspension bearings; and the other end of the traction motor 3 is elastically suspended on a middle cross beam of a framework through a set of suspension rods. A driven gear 21 is assembled with a gear hub 400 by bolts, the gear hub 400 is installed on the axle 5 in an interference fit manner and drives a wheel pair to rotate together while moving, so as to drive the vehicle to advance. This manner results in a large load on the axle, which is acceptable for a low-speed freight electric locomotive, but for a high-speed freight electric locomotive, when the running speed reaches 120km/h or more, its transverse force is greatly increased, and if the driving device still adopts the axle suspension arrangement manner, the transverse stability of the locomotive cannot be effectively controlled during running.

[0003] The current rapid passenger electric locomotive uses a traction motor elastic frame suspension structure, as shown in Fig. 2. A hollow shaft of a six-link hollow shaft is sleeved on the axle 5, the six-link of the six-link hollow shaft is fixedly connected with the wheel pair, and a suspension cross beam is sleeved on an outer surface of the hollow shaft. In a longitudinal direction, one end of the suspension cross beam 8 is connected with the traction motor 3, and the traction motor 3 is suspended on a middle cross beam 11 of the framework 1 through a suspension rod 9. A gear box 2 is arranged on the same side of the suspension cross beam and the traction motor, an output shaft of the traction motor 3 is connected with a driving gear in the gear box 2, and one side of the gear box body is fixedly connected with a side face of the suspension cross beam 8 by bolts. A suspension point is arranged at the other end of the suspension cross beam 8, another suspension point is arranged at one end of the gear box body away from the traction motor 3, and the two suspension points are elastically suspended on a framework end beam 12 through the suspension rod.

[0004] The gear box 2 is installed on the gear hub 400 through a bearing and forms an integral unit with the traction motor 3.

[0005] It can be seen from the above structural description that the gear box bears a part of force. For the fast

heavy-duty electric locomotive, if the gear box adopts the above load bearing structure, the heavy load will increase the complexity of the structural stress of the gear box, resulting in easier damage to the gear box.

[0006] In addition, as the running speed of the locomotive is improved, the air pressure distribution in the gear box changes more uncertainly, and since an oil lubrication manner is adopted, the oil leakage risk of the gear box is greatly increased.

[0007] With respect to the definition of direction vocabularies mentioned in this case, in the field of railway vehicles, there are usually three directions recognized by technicians: Vertical direction: a direction vertical to a rail surface.

[0008] Longitudinal direction: a direction along a rail.

[0009] Transverse direction: a direction vertical to the rail in the horizontal plane.

Summary of the Invention

[0010] In view of the above problems, the present invention aims at providing a bogie that can ensure the transverse stability, avoid stress on a gear box, prevent the damage to the gear box, is reasonable in structural stress and is suitable for fast heavy-duty freight electric locomotives with running speeds higher than 120km/h.

[0011] The technical solution for solving the problems of the present invention is as follows: a bogie, including a framework, a gear box, a traction motor, a wheel pair, an axle, a six-link hollow shaft, and a suspension cross beam, the wheel pair and the axle are arranged at the bottom of the framework, a hollow shaft of the six-link hollow shaft is sleeved on the axle, the suspension cross beam includes a beam body, a through groove transversely provided in the beam body, and a bearing seat, which is transversely arranged at a groove opening of the through groove in an overhang manner and which is fixedly connected to the beam body, the groove opening is located at one end of the through groove;

one end, with the through groove, of the beam body is fixedly connected to the traction motor in a longitudinal direction, so as to form a closed cavity after connection which is in sleeve connection with an outer surface of the hollow shaft; the other end of the traction motor is suspended on a middle cross beam of the framework; one end, without the through groove, of the beam body is hooked with a framework end beam; and a driven gear of the gear box is in sleeve connection with the bearing seat via a bearing, and a driving gear of the gear box is connected with an output shaft of the traction motor. The above measures make it possible for high-speed running of the heavy-duty freight electric locomotive, the traditional shaft suspension type structure is replaced by a six-link hollow shaft frame suspension type structure for mounting the driving device, which avoids excessive weight bearing of the axle, so that the transverse force during the high-speed running of the heavy-duty freight electric locomotive is reduced, and the transverse stabil-

ity during running is ensured. At the same time, a new suspension cross beam structure is adopted, and the suspension position is changed, so that the gear box becomes a non-load structure, and the failure probability of the gear box is greatly reduced.

[0012] Further, in a transverse direction, the six-link at one end of the six-link hollow shaft close to the gear box is connected with an end face of the driven gear through a transmission pin, and the six-link at the other end of the six-link hollow shaft is connected with the wheel pair through a transmission pin.

[0013] The traditional transmission mode is shown in Fig. 2, one end of the six-link is connected with the gear hub of the driven gear via bolts, and the other end of the six-link is connected with the wheel pair to transmit force through the gear hub. While in the present solution, the driven gear is directly connected with the six-link through the transmission pin, so that the transmission of force is more direct, the middle part is reduced, the stress is better, and the failure rate is lower.

[0014] Further, one end, without the through groove, of the beam body is provided with a symmetrical pair of transverse backstop mounting seats, a transverse backstop is installed on each transverse backstop mounting seat, and the top of the transverse backstop is fixedly connected with the framework end beam.

[0015] Due to the structural change of the suspension cross beam, from the perspective of structural layout and stress angle, the layout of structural components on the corresponding bogies shall be adjusted accordingly.

[0016] Preferably, the gear box is lubricated with grease to avoid the problem of oil leakage of the driving device, and the sealing structure of the gear box can also be simplified. Preferably, the bearing seat is integrally formed with the beam body.

[0017] The significant effects of the present invention are as follows:

1. By means of elastic frame suspension of the driving device, the problem of transverse instability of the heavy-duty freight electric locomotive during high-speed traveling is solved.
2. The gear box uses a non-load structure so as to solve the problems of the gear box having a complicated structure and being subject to a relatively heavy load.
3. The gear box is lubricated with grease to solve the problem of oil leakage of the gear box and to ensure the safe running of the locomotive.

Brief Description of the Drawings

[0018] The present invention is further described below in combination with the drawings.

Fig. 1 is a schematic diagram of shaft suspension type mounting of a driving device of a heavy-duty freight electric locomotive in the prior art.

Fig. 2 is a schematic diagram of elastic frame suspension type mounting of a driving device of a passenger locomotive in the prior art.

Fig. 3 is a bottom view of a local structure of a bogie of the present invention.

Fig. 4 is an A direction view in Fig. 3.

Fig. 5 is a local top view of the present invention after a framework is removed.

Fig. 6 is a structural diagram of a suspension cross beam.

[0019] In which: 1-framework, 2-gear box, 3-traction motor, 4-wheel pair, 5-axle, 6-hollow shaft, 7-six-link, 8-suspension cross beam, 9-suspension rod, 10-transmission pin, 11-middle cross beam, 12-framework end beam, 21-driven gear, 22-bearing, 81-beam body, 82-through groove, 83-bearing seat, 100-transverse backstop mounting seat, 200-transverse backstop, 300-axle suspension box, 400-gear hub.

Detailed Description of the Embodiments

[0020] As shown in Fig. 3 to Fig. 6, a bogie, including a framework 1, a gear box 2, a traction motor 3, a wheel pair 4, an axle 5, a six-link hollow shaft, and a suspension cross beam 8, the wheel pair 4 and the axle 5 are arranged at the bottom of the framework 1. A hollow shaft 6 of the six-link hollow shaft is sleeved on the axle 5.

[0021] The suspension cross beam 8 includes a beam body 81, a through groove 82 transversely provided in the beam body 81, and a bearing seat 83, which is transversely arranged at a groove opening of the through groove 82 in an overhang manner and which is fixedly connected to the beam body 81, the groove opening is located at one end of the through groove 82. The bearing seat 83 and the beam body 81 are integrally formed.

[0022] One end, with the through groove 82, of the beam body 81 is fixedly connected to the traction motor 3 in a longitudinal direction, so as to form a closed cavity after connection which is in sleeve connection with an outer surface of the hollow shaft 6; the other end of the traction motor 3 is suspended on a middle cross beam 11 of the framework 1 through a motor suspension seat. One end, without the through groove, of the beam body 81 is hooked with a framework end beam 12 through two suspension rods 9. Rubber joints are arranged in the suspension rods 9.

[0023] By adopting a suspension manner of the suspension rods, it can be ensured that the transverse force of the driving device is reasonably released, so as to improve the transverse stability during the running of the locomotive.

[0024] A driven gear 21 of the gear box 2 is in sleeve connection with the bearing seat 83 via a bearing 22, and a driving gear of the gear box 2 is connected with an output shaft of the traction motor 3.

[0025] In a transverse direction, the six-link 7 at one end of the six-link hollow shaft close to the gear box 2 is

connected with an end face of the driven gear 21 through a transmission pin 10, and the six-link 7 at the other end of the six-link hollow shaft is connected with the wheel pair 4 through a transmission pin 10. The output shaft of the traction motor 3 drives the driving gear to rotate, the driving gear drives the driven gear 21 to drive the six-link 7 on one side close to the gear box 2 to rotate through the transmission pin 10, thereby driving the entire six-link hollow shaft to move, and the six-link 7 fixed with the wheel pair drives the wheel pair to move.

[0026] One end, without the through groove 82, of the beam body 81 is provided with a symmetrical pair of transverse backstop mounting seats 100, a transverse backstop 200 is installed on each transverse backstop mounting seat 100, and the top of the transverse backstop 200 is fixedly connected with the framework end beam 12.

[0027] The gear box 2 is lubricated with grease.

Claims

1. A bogie, comprising a framework (1), a gear box (2), a traction motor (3), a wheel pair (4), an axle (5), a six-link hollow shaft, and a suspension cross beam (8), the wheel pair (4) and the axle (5) are arranged at the bottom of the framework (1), a hollow shaft (6) of the six-link hollow shaft is sleeved on the axle (5), wherein the suspension cross beam (8) comprises a beam body (81), a through groove (82) transversely provided in the beam body (81), and a bearing seat (83), which is transversely arranged at a groove opening of the through groove (82) in an overhang manner and which is fixedly connected to the beam body (81), the groove opening is located at one end of the through groove (82); one end, with the through groove (82), of the beam body (81) is fixedly connected to the traction motor (3) in a longitudinal direction, so as to form a closed cavity after connection which is in sleeve connection with an outer surface of the hollow shaft (6); the other end of the traction motor (3) is suspended on a middle cross beam (11) of the framework (1); one end, without the through groove (82), of the beam body (81) is hooked with a framework end beam (12); and a driven gear (21) of the gearbox (2) is in sleeve connection with the bearing seat (83) via a bearing (22), and a driving gear of the gear box (2) is connected with an output shaft of the traction motor (3).
2. The bogie according to claim 1, wherein in a transverse direction, the six-link (7) at one end of the six-link hollow shaft close to the gear box (2) is connected with an end face of the driven gear (21) through a transmission pin (10), and the six-link (7) at the other end of the six-link hollow shaft is connected with the wheel pair (4) through a transmission pin (10).

3. The bogie according to claim 1 or 2, wherein one end, without the through groove (82), of the beam body (81) is provided with a symmetrical pair of transverse backstop mounting seats (100), a transverse backstop (200) is installed on each transverse backstop mounting seat (100), and the top of the transverse backstop (200) is fixedly connected with the framework end beam (12).
4. The bogie according to claim 1, wherein the gear box (2) is lubricated with grease.
5. The bogie according to claim 1, wherein the bearing seat (83) is integrally formed with the beam body (81).

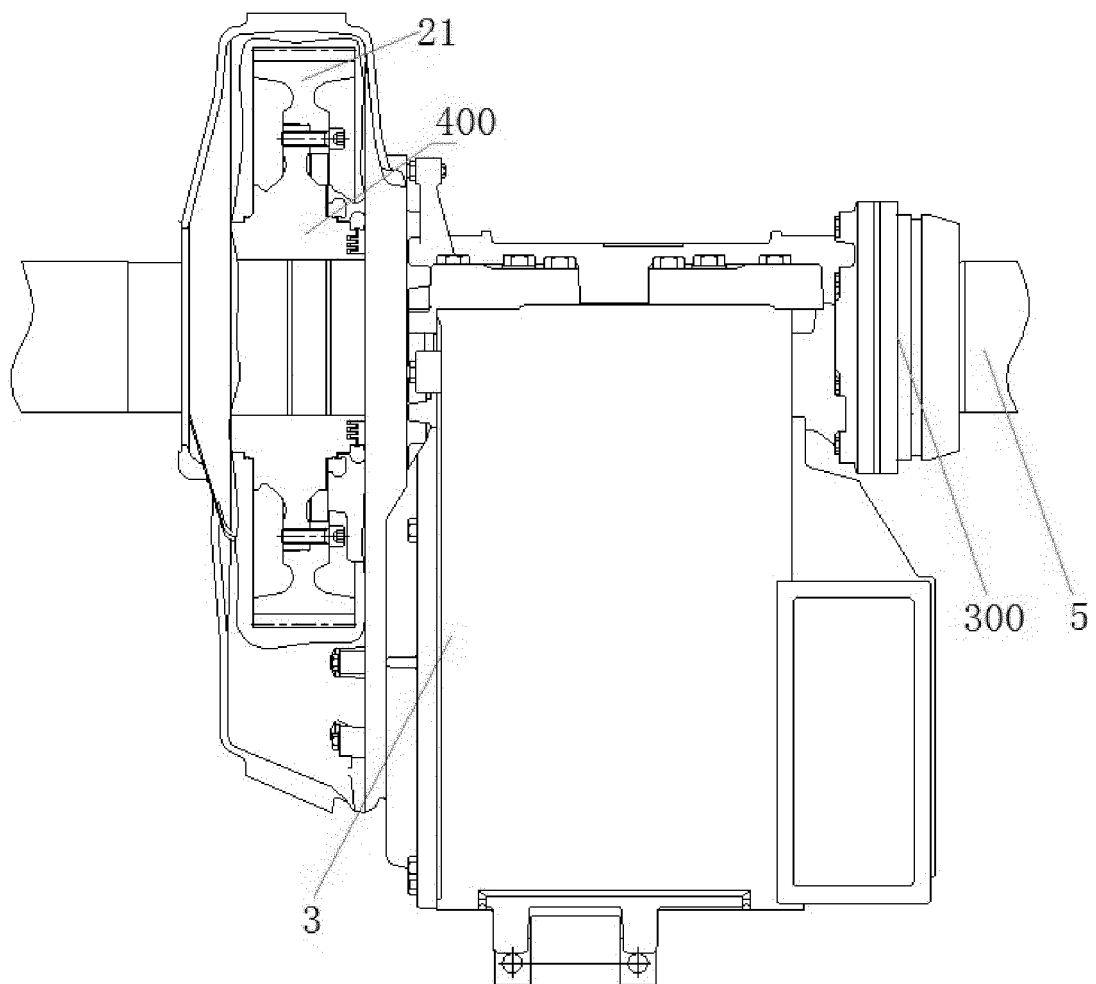


Fig. 1

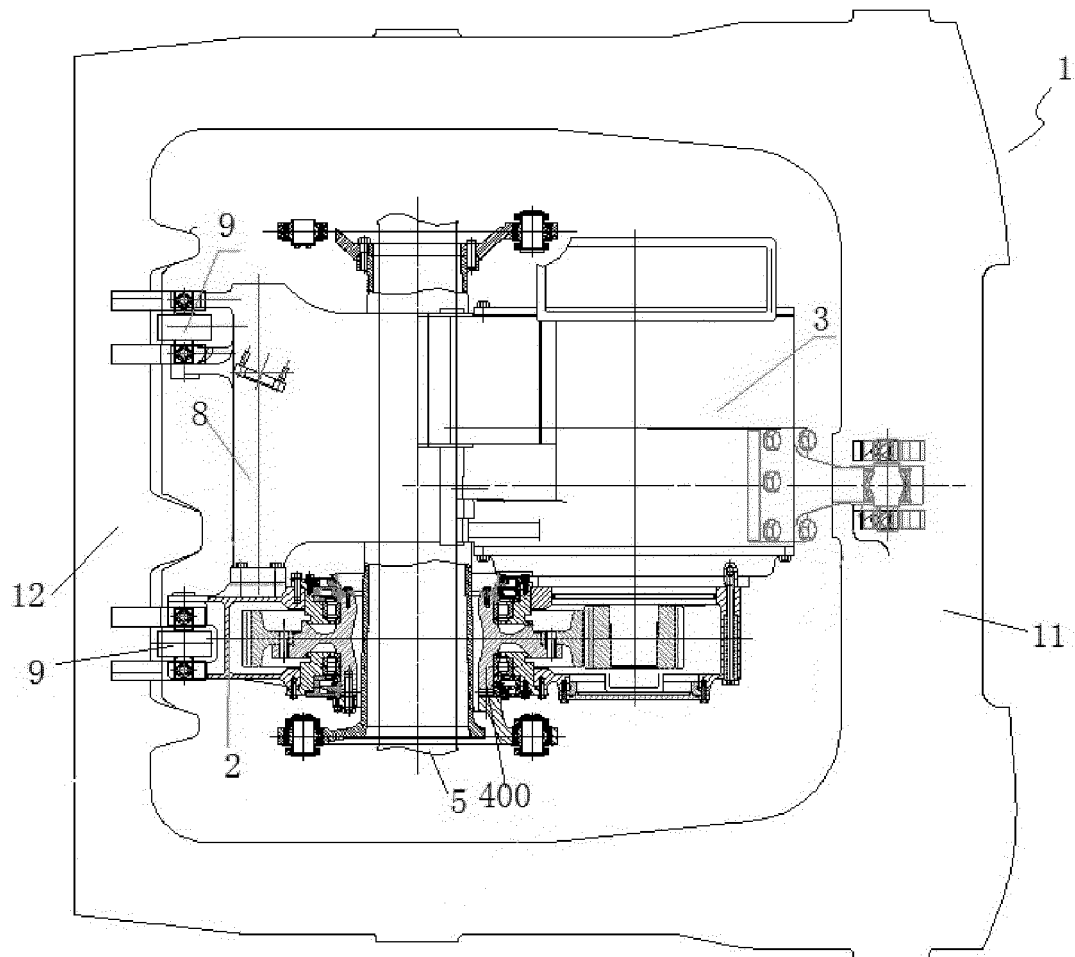


Fig. 2

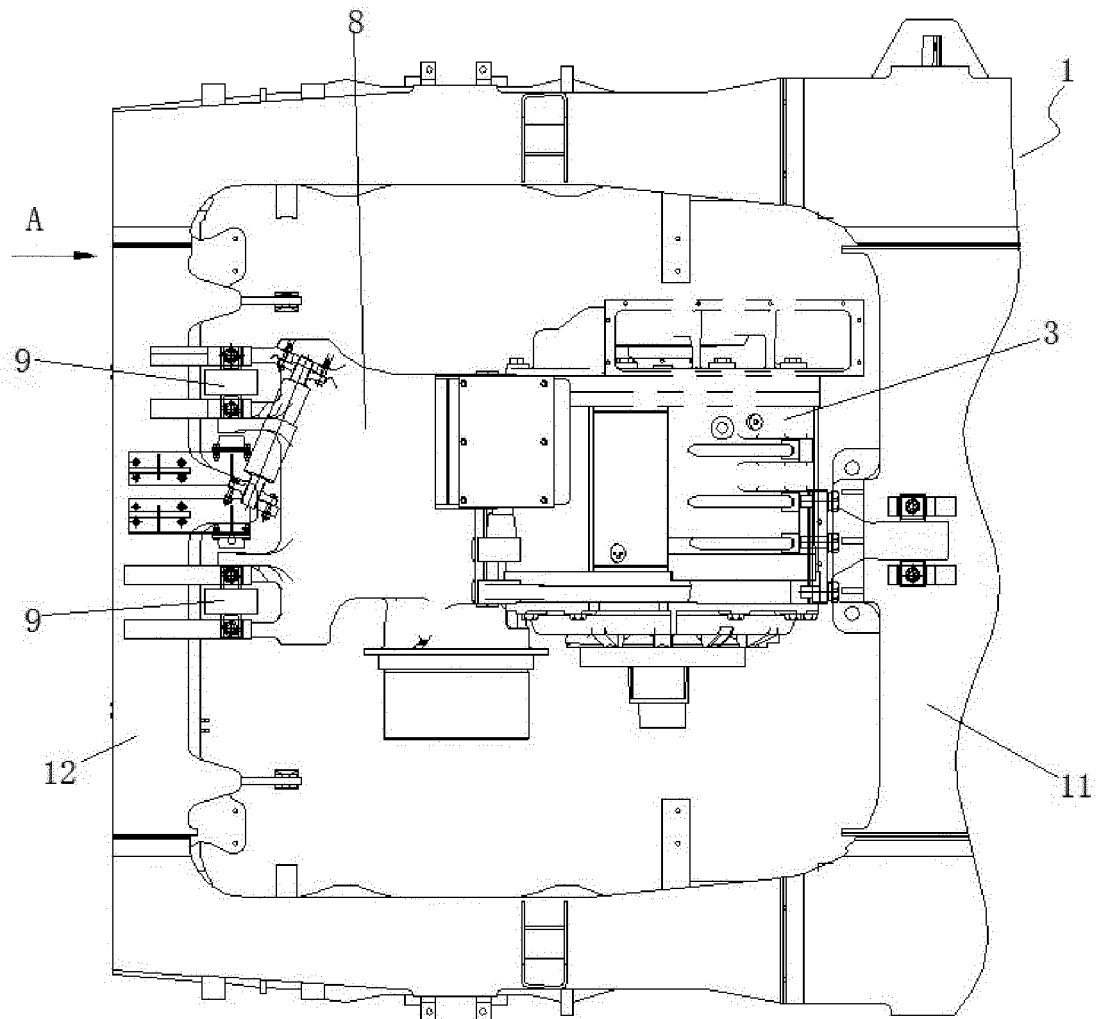


Fig. 3

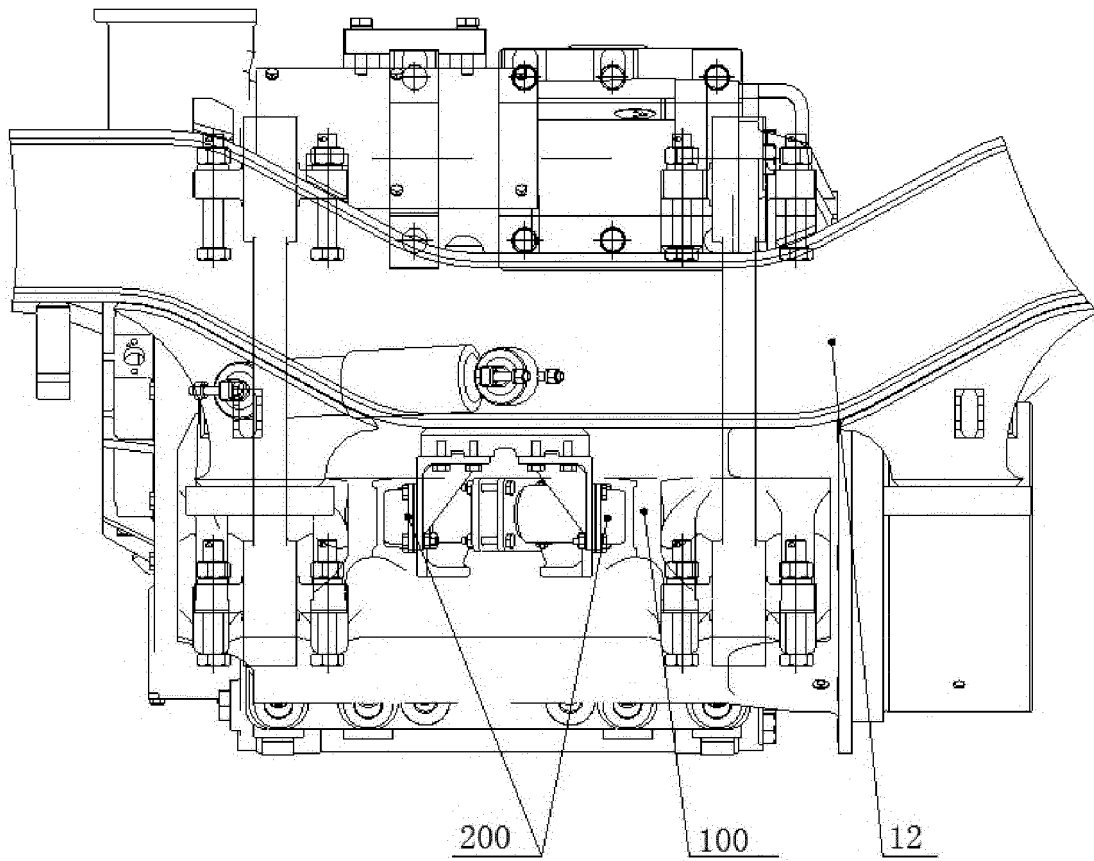


Fig. 4

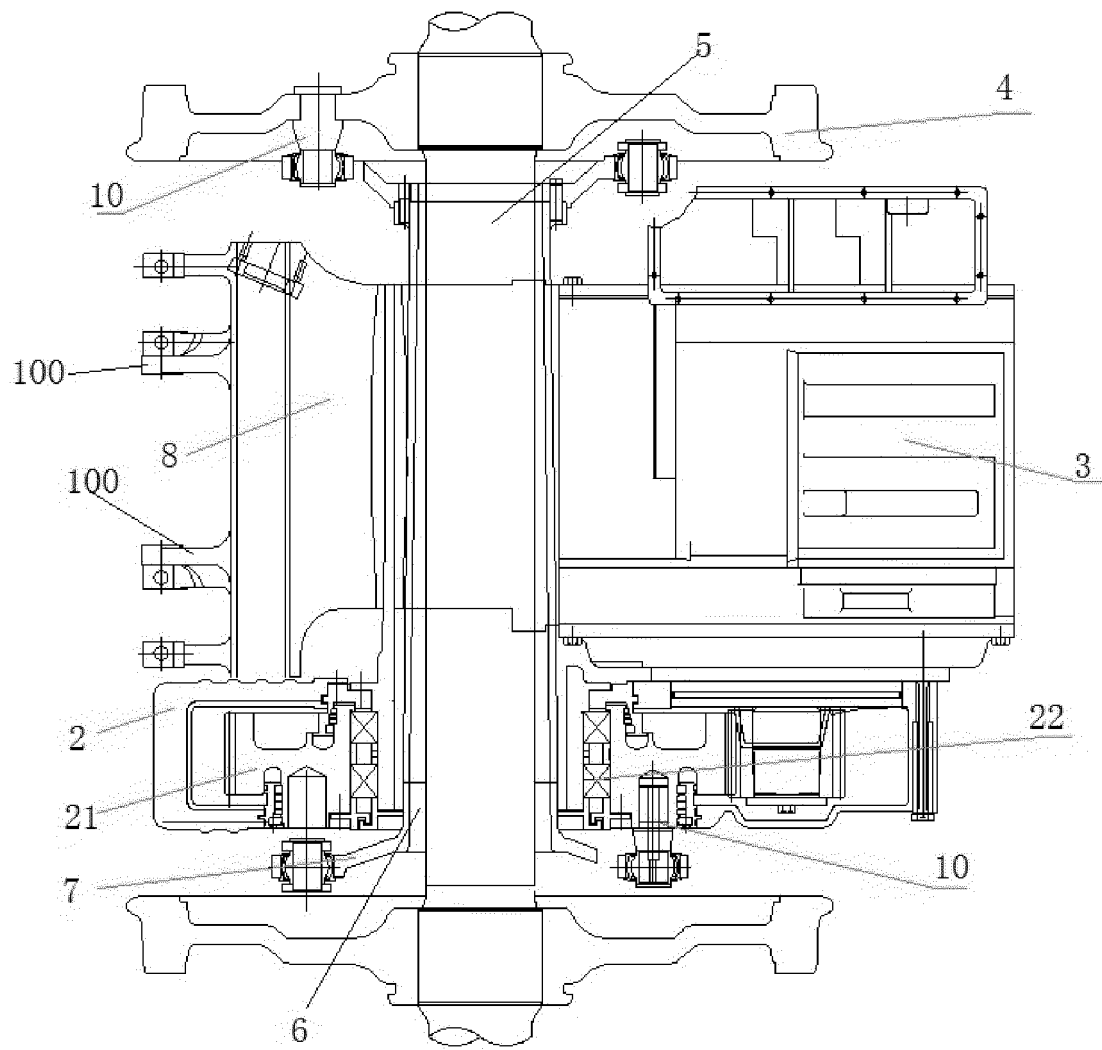


Fig. 5

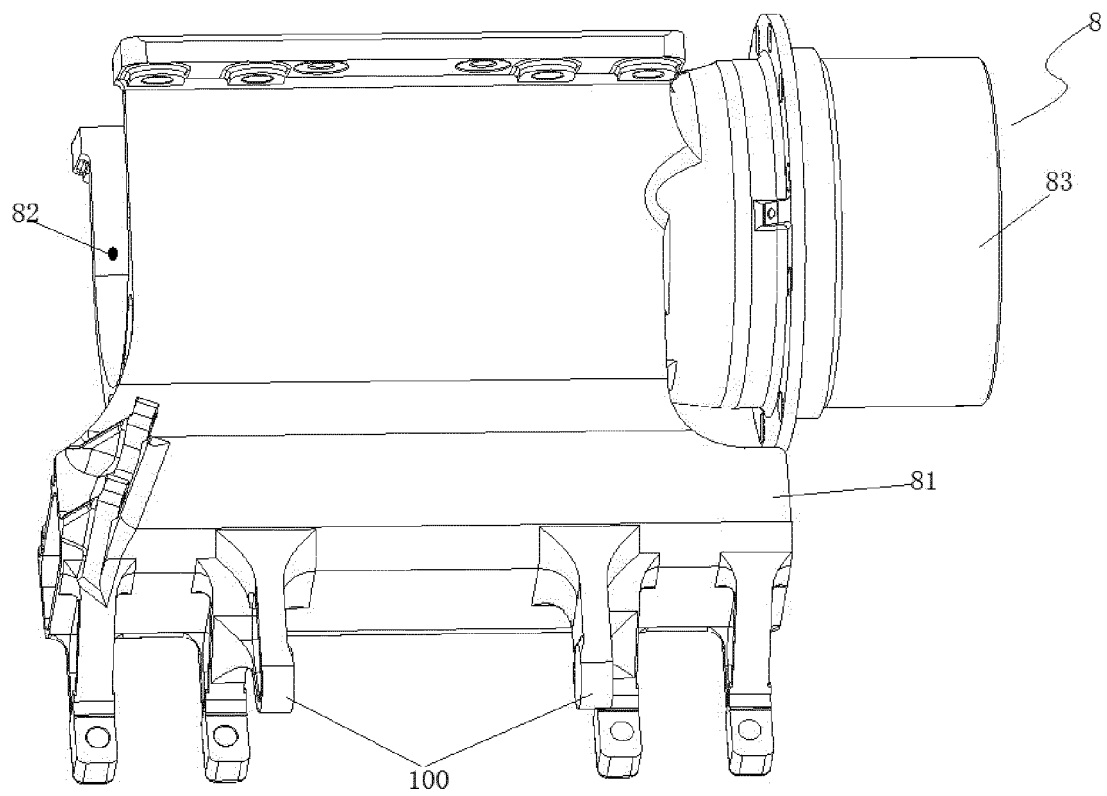


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/118289

A. CLASSIFICATION OF SUBJECT MATTER B61C 9/50(2006.01)i; B61F 5/28(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) B61F; B61C; B61G; B61H																		
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: 轨道车辆, 动车组, 动车, 转向架, 构架, 齿轮箱, 轴箱, 电机, 横梁, 端梁, 槽, 轴承, 齿轮, railway, rail vehicle, EMU, motor car, bogie, truck, chassis, bogie frame, gear box, axle box, motor, cross member, cross beam, end beam, groove, bearing, gear																		
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>A</td> <td>CN 101823492 A (CSR ZHUZHOU ELECTRIC LOCOMOTIVE CO., LTD.) 08 September 2010 (2010-09-08) description, paragraphs [0009]-[0034], and figures 1-2, 6 and 9</td> <td>1-5</td> </tr> <tr> <td>A</td> <td>CN 104228866 A (CSR ZHUZHOU ELECTRIC LOCOMOTIVE CO., LTD.) 24 December 2014 (2014-12-24) entire document</td> <td>1-5</td> </tr> <tr> <td>A</td> <td>CN 106476841 A (CRRC ZHUZHOU LOCOMOTIVE CO., LTD.) 08 March 2017 (2017-03-08) entire document</td> <td>1-5</td> </tr> <tr> <td>A</td> <td>CN 103640587 A (CSR ZHUZHOU ELECTRIC LOCOMOTIVE CO., LTD.) 19 March 2014 (2014-03-19) entire document</td> <td>1-5</td> </tr> <tr> <td>A</td> <td>CN 201882093 U (SHANGHAI RAIL TRAFFIC EQUIPMENT DEVELOPMENT CO., LTD.) 29 June 2011 (2011-06-29) entire document</td> <td>1-5</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	A	CN 101823492 A (CSR ZHUZHOU ELECTRIC LOCOMOTIVE CO., LTD.) 08 September 2010 (2010-09-08) description, paragraphs [0009]-[0034], and figures 1-2, 6 and 9	1-5	A	CN 104228866 A (CSR ZHUZHOU ELECTRIC LOCOMOTIVE CO., LTD.) 24 December 2014 (2014-12-24) entire document	1-5	A	CN 106476841 A (CRRC ZHUZHOU LOCOMOTIVE CO., LTD.) 08 March 2017 (2017-03-08) entire document	1-5	A	CN 103640587 A (CSR ZHUZHOU ELECTRIC LOCOMOTIVE CO., LTD.) 19 March 2014 (2014-03-19) entire document	1-5	A	CN 201882093 U (SHANGHAI RAIL TRAFFIC EQUIPMENT DEVELOPMENT CO., LTD.) 29 June 2011 (2011-06-29) entire document	1-5
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A	CN 106476841 A (CRRC ZHUZHOU LOCOMOTIVE CO., LTD.) 08 March 2017 (2017-03-08) entire document	1-5																
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2017/118289

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 103010226 A (CSR ZHUZHOU ELECTRIC LOCOMOTIVE CO., LTD.) 03 April 2013 (2013-04-03) entire document	1-5
A	CN 101973277 A (CSR ZHUZHOU ELECTRIC LOCOMOTIVE CO., LTD.) 16 February 2011 (2011-02-16) entire document	1-5
A	WO 2017133954 A1 (SIEMENS A. G. OSTERREICH) 10 August 2017 (2017-08-10) entire document	1-5
A	EP 1116634 A1 (ALSTOM) 18 July 2001 (2001-07-18) entire document	1-5

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2017/118289

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 101823492 A	08 September 2010	None	
CN 104228866 A	24 December 2014	None	
CN 106476841 A	08 March 2017	None	
CN 103640587 A	19 March 2014	None	
CN 201882093 U	29 June 2011	None	
CN 103010226 A	03 April 2013	None	
CN 101973277 A	16 February 2011	None	
WO 2017133954 A1	10 August 2017	AT 518243 A1	15 August 2017
EP 1116634 A1	18 July 2001	EP 1116634 B1	29 December 2004
		CA 2330460 A1	12 July 2001
		JP 2001239935 A	04 September 2001
		DE 60017067 T2	30 March 2006
		ES 2232399 T3	01 June 2005
		FR 2803572 A1	13 July 2001
		US 2001007230 A1	12 July 2001
		US 6443071 B2	03 September 2002
		FR 2803572 B1	22 February 2002
		DE 60017067 D1	03 February 2005
		CA 2330460 C	15 April 2008

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