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(54) **HIGH SPEED RAILWAY VEHICLE BOGIE**

(57) The present invention provides a bogie for high-speed railway vehicles, comprising a wheelset, a frame, a primary suspension system and a secondary suspension system; wherein the frame comprises side beams and an intermediate crossbeam, a middle part of each of the side beams is a concave portion, and both ends of the intermediate crossbeam are separately connected with the concave portions of the side beams; the primary suspension system comprises primary axle box suspension devices, one end of each of the primary axle box suspension devices is connected with a wheel axle of the wheelset, and the other end is supported at one end of one of the side beams; and the secondary suspension system comprises at least two spring sets, which are arranged at interval on the intermediate crossbeam and located between the side beams, and upper parts of the spring sets are connected with a carbody. In the bogie for high-speed railway vehicles of the present invention, the spring sets of the secondary suspension system can provide a proper moment of rotational resistance between the frame and carbody, thus increasing the linear running stability, curve negotiation performance and crit-

ical speed of the railway vehicles.

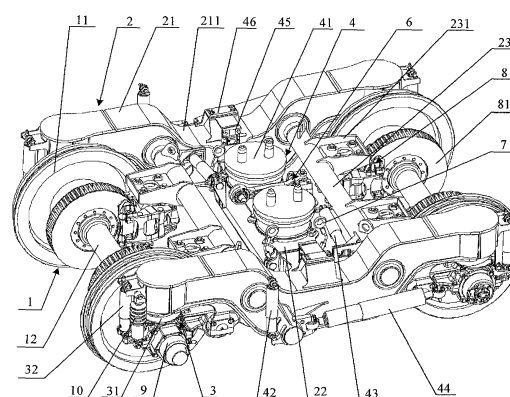


FIG. 1

Description

FIELD OF THE TECHNOLOGY

[0001] The present invention relates to bogie technology, and more particularly to a bogie for high-speed railway vehicles.

BACKGROUND

[0002] The bogie for railway vehicles is generally classified into three-piece type bogie and frame type bogie. The three-piece type bogie has shortcomings such as smaller diamond resistant rigidity, bigger unsprung mass and inability of installing disc brakes as well as the operating speed not exceeding 120km/h; while, the frame type bogie has advantages such as higher diamond resistant rigidity and smaller unsprung mass, so the dynamic performance of the frame type bogie is obviously superior to the three-piece type bogie.

[0003] The existing frame type bogie includes wheelset, frame, bolster and suspension device, wherein the frame consists of two side beams and two cross beams; the bolster is set transversely on the side beams; a center plate is set on an upper middle part of the bolster, and constant contact elastic side bearings which can carry vertical load of carbody and transfer the longitudinal force, are set on both sides of the upper part of the bolster. The suspension device which is metal liquid rubber composite spring is mounted between the frame and wheelset, and it is located by axle box.

[0004] As the center plate and the constant contact elastic side bearings are set on the bolster in the existing frame type bogie, the moment of rotational resistance between the bogie and the carbody is provided by the constant contact elastic side bearings when the car is empty, and provided by the center plate and constant contact elastic side bearings when the car is loaded. Yet, according to the loading mode of the existing center plate and constant contact elastic side bearings, it's impossible to acquire a proper moment of rotational resistance, nor guarantee the linear running stability and curve negotiation performance of railway vehicles during running at high speeds. Hence, the poorer linear running stability and curve negotiation performance has restricted the improvement of the critical speed of the railway vehicles.

SUMMARY

[0005] The present invention provides a bogie for high-speed railway vehicles, and particularly a bogie for high-speed railway wagon for solving the technical defects of the prior art, for example, the poorer linear running stability and curve negotiation performance of railway vehicles, particularly the wagons, during running at high speeds.

[0006] A bogie for high-speed railway vehicles, comprising a wheelset, a frame, a primary suspension system

and a secondary suspension system;

[0007] wherein the frame comprises side beams and an intermediate crossbeam, a middle part of each of the side beams is a concave portion, and both ends of the intermediate crossbeam are separately connected with the concave portions of the side beams;

the primary suspension system comprises primary axle box suspension devices, one end of each of the primary axle box suspension devices is connected with a wheel axle of the wheelset, and the other end is supported at one end of one of the side beams; and

the secondary suspension system comprises at least two spring sets, which are arranged at interval on the intermediate crossbeam and located between the side beams, and upper parts of the spring sets are connected with a carbody.

[0008] According to the above bogie, the secondary suspension system further comprises secondary vertical dampers, secondary transverse dampers and yaw dampers;

[0009] one end of each of the secondary vertical dampers is connected with the frame, and the other end is connected with the carbody;

one end of each of the secondary transverse dampers is connected with the frame, and the other end is connected with the carbody; and

one end of each of the yaw dampers is connected with an outer side of the side beam, and the other end is connected with the carbody.

[0010] According to the above bogie, the spring sets are rubber spring sets;

outer sides of the spring sets are provided with secondary transverse stoppers and secondary vertical stoppers ; and

the secondary vertical dampers and yaw dampers are set at outer sides of the respective secondary vertical stoppers.

[0011] According to the above bogie, the primary suspension system further comprises primary vertical dampers; one end of each of the primary vertical dampers is connected with one of the primary axle box suspension devices, and the other end is connected with one of the side beams.

[0012] According to the above bogie, the primary axle box suspension device comprises an axle box positioning rotary arm and a primary suspension spring, and a lower end of the axle box positioning rotary arm is connected with the wheel axle; and

the primary suspension spring is mounted onto an upper end of the axle box positioning rotary arm, and both ends of each of the side beams are separately provided with a spring mounting hole, into which the primary suspension spring is mounted.

[0013] According to the above bogie, the axle box positioning rotary arm is of a split structure that comprises an upper axle box, a lower axle box and a rotary arm elastic joint coupled together;

one end of the upper axle box is of a semi-bushing struc-

ture, and the other end is provided with a rotary arm elastic joint mounting hole; the lower axle box is of a semi-bushing structure; and the upper and lower axle boxes are butt-jointed to form a bushing for installation of the wheel axle;

both ends of the rotary arm elastic joint are of a semicolumn structure, which is mated with a mounting seat on the side beam in half arc pattern; and

the primary suspension spring comprises a spring mounting brace, an elastic stopping column, an inner ring spring and an outer ring spring; the elastic stopping column is mounted vertically onto the spring mounting brace, which is then mounted onto an upper end surface of the upper axle box; the inner ring spring is sleeved onto the elastic stopping column, and the outer ring spring is sleeved onto the inner ring spring.

[0014] According to the above bogie, the rotary arm elastic joint is a rotary arm rubber joint.

[0015] The above bogie further comprises an axle temperature detector for detecting the temperature of the wheel axle, wherein the axle temperature detector is set on the lower axle box.

[0016] The above bogie further comprises a traction rod device, wherein one end of the traction rod device is connected with the intermediate crossbeam, the other end is connected with the carbody, and the traction rod device is configured to provide tractive force for the intermediate crossbeam.

[0017] According to the above bogie, the traction rod device comprises a traction rod, elastic joints and a fixed seat;

both ends of the traction rod are opened with mounting holes, and the elastic joints are mounted into the mounting holes;

both ends of each of the elastic joints are of a semicolumn structure; the fixed seat is opened with semicolumn holes; the semicolumn structure at both ends of one of the elastic joints is mated with the semicolumn holes on the fixed seat, and the semicolumn structure at both ends of the other elastic joint is configured to mate with semicolumn mounting holes of the carbody.

[0018] According to the above bogie, the elastic joints is rubber joints.

[0019] According to the above bogie, the frame further comprises two auxiliary crossbeams, both ends of which are separately connected with the side beams and distributed evenly at both sides of the intermediate crossbeam;

the bogie further comprises a braking device, which comprises a brake disc, a brake cylinder, a brake pad and a clamp, the brake pad is mounted onto the clamp, the clamp is mounted onto the auxiliary crossbeam, and the brake disc is fixed on the wheel axle; frictional force generated between the brake pad and the brake disc is configured to provide braking force for the high-speed railway vehicles.

[0020] The above bogie further comprises at least one elastic safety chains; one end of each of the elastic safety

chains is connected with the intermediate crossbeam, and the other end is connected with the carbody.

[0021] According to the above bogie, the wheel axle is a hollow or solid axle;

5 optionally, both ends of the wheel axle are provided with an antiskid device.

[0022] The above bogie further comprises at least one weighing valves, wherein one end of each weighing valve is connected with the primary axle box suspension device, and the other end is connected with one of the side beams and located at outer side of the side beam; optionally, the primary vertical dampers, secondary transverse dampers and secondary vertical dampers are oil dampers.

10 **[0023]** The present invention further provides a secondary suspension system of a bogie for high-speed railway vehicles, comprising at least two spring sets; wherein a lower end of each of the spring sets is connected with the bogie, and an upper end thereof is connected with a carbody.

20 **[0024]** The present invention also provides a frame of a bogie for high-speed railway vehicles, comprising side beams and intermediate crossbeam, wherein a middle part of each of the side beams is a concave portion, and both ends of the intermediate crossbeam are separately connected with the concave portions of the side beams.

25 **[0025]** The present invention also provides a primary suspension system of a bogie for high-speed railway vehicles, comprising an axle box positioning rotary arm and a primary suspension spring, wherein a lower end of the axle box positioning rotary arm is connected with a wheel axle, the primary suspension spring is mounted onto an upper end of the axle box positioning rotary arm, and the primary suspension spring is mounted into spring mounting holes at both ends of a side beam of the bogie.

30 **[0026]** According to the above primary suspension system, the axle box positioning rotary arm is of a split structure that comprises an upper axle box, a lower axle box and a rotary arm elastic joint coupled together;

35 one end of the upper axle box is of a semi-bushing structure, and the other end is provided with a rotary arm elastic joint mounting hole; the lower axle box is of a semi-bushing structure; the upper and lower axle boxes are butt-jointed to form a bushing for installation of the wheel axle;

40 both ends of each of the rotary arm elastic joint are of a semicolumn structure, the semicolumn structure of the rotary arm elastic joint is mated with a mounting seat on the side beam of the bogie in half arc pattern;

45 the primary suspension spring comprises a spring mounting brace, an elastic stopping column, an inner ring spring and an outer ring spring; the elastic stopping column is mounted vertically onto the spring mounting brace, which is then mounted onto an upper end surface of the upper axle box; the inner ring spring is sleeved onto the elastic stopping column, and the outer ring spring is sleeved onto the inner ring spring.

[0027] The present invention also provides a traction

rod device of a bogie for high-speed railway vehicles, comprising a traction rod, elastic joints and a fixed seat; both ends of the traction rod are opened with mounting holes, and the elastic joints are mounted into the mounting holes;

both ends of each of the elastic joints are of a semicolumn structure; the fixed seat is opened with semicolumn holes; the semicolumn structure at both ends of one of the elastic joints is mated with the semicolumn holes on the fixed seat, and the semicolumn structure at both ends of the other elastic joint is configured to mate with semicolumn mounting holes of the carbody.

[0028] In the bogie for high-speed railway vehicles of the present invention, the spring sets of the secondary suspension system are set between the side beams to bear the vertical load of the carbody and also provide a proper moment of rotational resistance between the frame and the carbody, thus increasing the linear running stability, curve negotiation performance and critical speed of the railway vehicles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029]

FIG. 1 is a structural view of a bogie for high-speed railway vehicles provided in a first embodiment of the present invention;

FIG. 2 is a structural view of a frame of the bogie for high-speed railway vehicles shown in FIG. 1;

FIG. 3 is a structural view of a primary axle box suspension device provided in a second embodiment of the present invention;

FIG. 4 is a perspective view of the primary axle box suspension device shown in FIG. 3;

FIG. 5 is a perspective view of an upper axle box shown in FIG. 3;

FIG. 6 is a perspective view of a lower axle box shown in FIG. 3;

FIG. 7 is a perspective view of a rotary arm elastic joint shown in FIG. 3;

FIG. 8 is a perspective view of a traction rod provided in a third embodiment of the present invention.

DETAILED DESCRIPTION

[0030] FIG. 1 is a structural view of a bogie for high-speed railway vehicles provided in a preferred embodiment of the present invention; FIG. 2 is a structural view of a frame of the bogie for high-speed railway vehicles shown in FIG. 1.

[0031] Referring to FIGS. 1 and 2, the bogie for high-speed railway vehicles provided in the first embodiment of the present invention comprises a wheelset 1, a frame 2, a primary suspension system 3 and a secondary suspension system 4. The primary suspension system 3 is located between the frame 2 and wheelset 1 and the secondary suspension system 4 is located between the

frame 2 and the carbody.

[0032] The wheelset 1 comprises wheels 11 and wheel axle 12 connected with the wheels 11. Referring to FIG. 2, the frame 2 comprises two side beams 21 and one intermediate crossbeam 22. A middle part of each side beam 21 has a concave portion 211 and both ends of the intermediate crossbeam 22 are connected with the concave portions 211 of the side beams 21, respectively. The intermediate crossbeam 22 and the side beams 21 can be connected by means of plugging fit; specifically, an upper cover plate is mounted onto the upper end surface of the concave portion 211 of the side beam 21; a lower cover plate is mounted onto the lower end surface of the concave portion 211; the upper and lower cover plates run parallel and protrude out toward the inner side of the side beam 21. Two connecting plates perpendicular to the upper and lower cover plates are mounted onto both ends of the intermediate crossbeam 22, and the connecting plates of the intermediate crossbeam 22 are plugged between the upper and lower cover plates and welded together with the upper and lower cover plates. The frame 2 can be assembled by means of the above plugging fit to enhance its structural strength, or it can also be connected by other known means. Alternatively, the intermediate crossbeam 22 and side beams 21 are formed integrally. When the intermediate crossbeam 22 is mounted onto the concave portion 211 at middle part of each side beam 21, the height of the intermediate crossbeam 22 in relation to the track surface can be reduced, and the stability of the frame 2 can be improved.

[0033] The primary suspension system 3 comprises a primary axle box suspension device 31; one end of the primary axle box suspension device 31 is connected with the wheel axle 12 of the wheelset 1, and the other end supports on one end of the side beam 21. Specifically, the spring of the primary axle box suspension device 31 can be a metal spring or metal liquid rubber composite spring. One primary axle box suspension device 31 can be provided for each wheel.

[0034] The secondary suspension system 4 comprises at least two spring sets 41, which are arranged at intervals on the intermediate crossbeam 22 and located between the side beams 21. The transverse spacing between two spring sets 41 is 500-700mm, and the upper part of the spring set 41 is configured to connect with the carbody. Two mounting seats for the spring sets 41 can be arranged on the intermediate crossbeam 22. These two spring sets 41 can be made of rubber springs or other types of springs, e.g., metal or air springs. Two bulges are set on the upper part of each of the spring sets 41 for facilitating connection with the carbody. The spring sets 41 can bear a vertical load of the carbody and also provide a proper moment of rotational resistance between the frame 2 and the carbody.

[0035] In the bogie for high-speed railway vehicles of the present embodiment, the spring sets 41 of the secondary suspension system 4 are mounted between two

side beams 21 to bear the vertical load of the carbody and provide the proper moment of rotational resistance between the frame 2 and carbody, thus increasing the linear running stability and curve negotiation performance of railway vehicles, and thus critical speed of the railway vehicles.

[0036] Due to the smaller transverse spacing between the spring sets 41, a smaller shear deformation is generated, thus the spring sets 41 have longer service life.

[0037] On the basis of the bogie for high-speed railway vehicles provided in the first embodiment of the present invention, the technical solution of the bogie can be further improved with details below.

[0038] Furthermore, the secondary suspension system 4 also can comprise secondary vertical damper 42, secondary transverse damper 43 and yaw damper 44. One end of each of the secondary vertical dampers 42 is connected with the frame 2, and the other end is connected with the carbody. One end of each of the secondary transverse dampers 43 is connected with the frame 2, and the other end is connected with the carbody. One end of each of the yaw dampers 44 is connected with an outer side of the side beam 21, and the other end is connected with the carbody.

[0039] In detail, the secondary vertical damper 42 can be a hydraulic damper comprising an oil cylinder and a piston rod. Hydraulic damping force can be formed by stretching and compressing the piston rod, so as to realize a satisfactory vibration damping effect and flexible damping effect. A mounting seat for the secondary vertical damper 42 can be set on each side beam 21. The lower end of the secondary vertical damper 42 is connected with the mounting seat for the secondary vertical damper, and the upper end is connected with the carbody. The secondary vertical dampers 42 can be separately set at outer sides of two side beams 21 and provide a lateral rolling damping for the carbody to limit the maximum lateral rolling displacement of the carbody and improve the lateral rolling stability of vehicles. Similarly, the secondary transverse dampers 43 and yaw dampers 44 can also be hydraulic dampers. Two secondary transverse dampers 43 can be provided and separately set at inner sides of two side beams 21. One end of each of the secondary transverse dampers 43 is connected with a mounting seat at inner side of the side beam 21, and the other end is connected with the carbody. The secondary transverse dampers 43 can provide the transverse vibration damping for the railway vehicles in high-speed running, and further improve the linear running stability of the railway vehicles. The yaw dampers 44 are mounted at outer sides of the side beams 21 substantially along a longitudinal and horizontal direction, thus avoiding the occurrence of hunting instability at high-speed and improving the running stability of railway vehicles.

[0040] The bogie for high-speed railway vehicles according to the above technical solution can adopt one or more of the secondary vertical damper 42, the secondary transverse damper 43 and the yaw damper 44.

[0041] On the basis of the above embodiment, secondary transverse stoppers 45 and secondary vertical stoppers 46 can be further set at outer sides of the respective spring sets 41, specifically at the middle parts on the upper end surfaces of the concave portions 211 of the side beams 21. The secondary vertical dampers 42 and yaw dampers 44 can be set at outer sides of the respective secondary vertical stoppers 46. The secondary transverse stoppers 45 can limit the maximum transverse displacement of the carbody in relation to the bogie, and prevent the damage from excessive transverse shear deformation generated by the spring sets 41. The secondary vertical stoppers 46 can limit the maximum lateral rolling displacement of the carbody, and prevent rollover of the railway vehicles arising from excessive lateral rolling displacement during curved running. In the event of failure of the spring sets 41, the secondary vertical stoppers 46 can bear the vertical load of the carbody.

[0042] Furthermore, the primary suspension system 3 also comprises primary vertical dampers 32. One end of each of the primary vertical dampers 32 is connected with the primary axle box suspension device 31, and the other end is connected with the side beam 21. The primary vertical dampers 32 can also be a hydraulic damper, and four primary vertical dampers 32 can be mounted, wherein each of the primary vertical dampers 32 is mounted onto one primary axle box suspension device 31. A lower end of the primary vertical damper 32 is connected with a mounting seat on the primary axle box suspension device 31, and an upper end is connected with a mounting seat on the end surface of the side beam 21. The primary vertical dampers 32 can provide vertical vibration damping between the wheelset 1 and frame 2, thus improving the running stability of railway vehicles.

[0043] FIG. 3 is a structural view of a primary axle box suspension device provided in a second embodiment of the present invention; FIG. 4 is a perspective view of the primary axle box suspension device shown in FIG. 3; FIG. 5 is a perspective view of an upper axle box shown in FIG. 3; FIG. 6 is a perspective view of a lower axle box shown in FIG. 3; and FIG. 7 is a perspective view of a rotary arm elastic joint shown in FIG. 3.

[0044] Referring to FIGS. 3-7, a primary axle box suspension device 31 of the present embodiment comprises an axle box positioning rotary arm 311 and a primary suspension spring 312. A lower end of the axle box positioning rotary arm 311 is connected with the wheel axle 12. The primary suspension spring 312 is mounted onto an upper end of the axle box positioning rotary arm 311, and both ends of the side beam 21 are provided separately with a spring mounting hole, into which the primary suspension spring 312 is mounted.

[0045] In detail, the axle box positioning rotary arm 311 is of a split structure that comprises an upper axle box 3111, a lower axle box 3112 and a rotary arm elastic joint 3113 coupled together.

[0046] One end of the upper axle box 3111 is of a semi-bushing structure, and the other end is provided with a

rotary arm elastic joint mounting hole 3114. The lower axle box 3112 is of a semi-bushing structure, and the upper axle box 3111 and the lower axle box 3112 are butt-jointed to form a bushing 3115. In actual installation, a bearing can be mounted onto the wheel axle 12, and the bushing 3115 is sleeved onto the bearing, realizing the connection of the axle box positioning rotary arm 311 and the wheel axle 12. As the axle box positioning rotary arm 311 is of the split structure composed of the upper axle box 3111 and the lower axle box 3112, the wheelset 1 can be easily replaced during repair and maintenance.

[0047] Both ends of the rotary arm elastic joint 3113 are of a semicolumn structure that may adopt rubber joint for the rotary arm. The semicolumn structure of the rotary arm elastic joint 3113 is mated with a mounting seat on the side beam 21 in half arc pattern, so that the rotary arm elastic joint 3113 can withstand a higher longitudinal load, and abnormal abrasion between the rotary arm elastic joint 3113 and the mounting seat of the side beam 21 can also be avoided to increase the service life and reliability of the rotary arm elastic joint 3113.

[0048] The primary suspension spring 312 comprises a spring mounting brace 3121, an elastic stopping column 3122, an inner ring spring 3123 and an outer ring spring 3124. The elastic stopping column 3122 is mounted vertically onto the spring mounting brace 3121, which is then mounted onto the upper end surface of the upper axle box 3111. The inner ring spring 3123 is sleeved onto the elastic stopping column 3122, and the outer ring spring 3124 is sleeved onto the inner ring spring 3123.

[0049] The primary axle box suspension device 31 of the present embodiment allows to adjust the longitudinal and lateral rigidity of the rotary arm elastic joint 3113, so as to acquire the longitudinal and lateral rigidity value required for the bogie in high-speed running, and improve the dynamic performance of railway vehicles in high-speed running. In addition, since the outer ring spring 3124 and inner ring spring 3123 are set at upper part of the upper axle box 3111, the rotary arm elastic joint 3113 is free of additional moment generated by the spring force, hence, this can increase the service life and reliability of the rotary arm elastic joint 3113, and realize abrasion-free or low-abrasion design of the primary axle box suspension device.

[0050] Furthermore, the aforementioned bogie for high-speed railway vehicles also can comprise an axle temperature detector (not shown), which can be a temperature sensor and mounted onto the lower axle box 3112 of the axle box positioning rotary arm 311 for detecting the temperature of the wheel axle 12 and thus guaranteeing the running safety of railway vehicles. The axle temperature detector can also be set on the upper axle box 3111.

[0051] Optionally, the aforementioned bogie for high-speed railway vehicles is also provided with a traction rod device 6. One end of the traction rod device 6 is connected with the intermediate crossbeam 22, and the other end is connected with the carbody. The traction rod de-

vice 6 is set longitudinally to provide tractive force for the intermediate crossbeam 22. The traction rod device 6 can be designed with different kinds of structures.

[0052] FIG. 8 depicts a perspective view of a traction rod device in a third embodiment of the present invention.

[0053] Referring to FIG. 8, the traction rod device 6 comprises a traction rod 61, elastic joints 62 and a fixed seat 63.

[0054] Mounting holes are opened at both ends of the traction rod 61. The elastic joints 62 can be designed into rubber joints, and mounted into the mounting holes of the traction rod 61. The elastic joints 62 can be mated with the mounting holes by interference fit, in order to improve the fit tightness. Both ends of each of the elastic joints 62 are of a protruding semicolumn structure. Semicolumn holes are opened on the fixed seat 63, and the semicolumn structure at both ends of one of the elastic joints 62 is mated with the semicolumn holes on the fixed seat 63, and the semicolumn structure at both ends of the other elastic joint 62 is used to mate with the semicolumn mounting holes of the carbody. During installation, the fixed seat 63 is connected with the intermediate crossbeam 22 in a way that the fixed seat 63 can be welded onto the intermediate crossbeam 22. The elastic joint 62 at the other end of the traction rod 61 is connected with a semicolumn mounting seat of the carbody.

[0055] Since the elastic joint 62 is mated with the mounting holes of the fixed seat 63 in half arc pattern, this can eliminate the rotational wear of the elastic joint 62, and obtain a larger mating area, thus transferring a larger longitudinal force with reliable performance. Both ends of the elastic joint 62 are of a protruding structure, and the elastic joint 62 can be mated with the mounting holes of the fixed seat 63 in other proper patterns.

[0056] Furthermore, the aforementioned bogie for high-speed railway vehicles also comprises some elastic safety chains 7, e.g., 4 elastic safety chains 7. One end of the elastic safety chain 7 is connected with the intermediate crossbeam 22, and the other end is connected with the carbody. The elastic safety chain 7 can transfer a certain longitudinal force in the case of failure of the traction rod device 6, and also prevent excessive vertical jumping displacement generated by the carbody in relation to the frame 2, thus improving the running safety of railway vehicles.

[0057] Optionally, in the aforementioned bogie for high-speed railway vehicles, the frame 2 also comprises two auxiliary crossbeams 23, both ends of which are separately connected with the side beams 21 and distributed evenly at both sides of the intermediate crossbeam 22. The structural strength of the frame 2 can be improved with the setting of the auxiliary crossbeams 23.

[0058] The aforementioned bogie for high-speed railway vehicles also comprises a braking device 8, which comprises a brake disc 81, a brake cylinder, a brake pad and a clamp. The brake pad is mounted onto the clamp, and the clamp is mounted onto the auxiliary crossbeam 23. The brake disc 81 is fixed on the wheel axle 12. The

frictional force generated between the brake pad and the brake disc 81 is used to provide braking force for the railway vehicles. In detail, a brake hanger 231 is set on the auxiliary crossbeam 23, the brake cylinder and clamp of the braking device 8 can be suspended on the brake hanger 231 by bolts.

[0059] Furthermore, both ends of the wheel axle 12 are provided with an antiskid device 9, which is designed into either mechanical or electronic types. The antiskid device 9 can control indirectly the braking force of the braking device 8. When the braking device 8 is actuated, the antiskid device 9 can increase the sticking coefficient between the wheels 11 and the track, thus avoiding skidding of the wheels 11 in the braking process.

[0060] In addition, the aforementioned bogie for high-speed railway vehicles also comprises at least one weighing valves 10, wherein one end of each weighing valve is connected with the mounting seat on the primary axle box suspension device 31, and the other end is connected with one of the side beams 21 and located at outer side of the side beam 21. The weighing valve 10 can control the braking force of railway vehicles in idle or loaded state, thus meeting the requirements of railway vehicles for different braking forces under varied load conditions.

[0061] According to the aforementioned bogie for high-speed railway vehicles, the wheel axle 12 can be designed into a solid axle. Or, the wheel axle 12 can be a hollow axle, helping to reduce the mass of the wheel axle 12 and further the unsprung mass of the bogie. So, this allows to conduct easily ultrasonic flaw detection test for the wheel axle 12 and lower down its maintenance cost. The wheels 11 can be designed into straight web wheels or other web types, thus reducing the mass of the wheels 11 and unsprung mass of the bogie, cut down the wheel-rail force and improve the dynamic performance of railway vehicles.

[0062] It's worthy to note that, with introduction of the above-specified technical solution, the aforementioned bogie for high-speed railway vehicles can enhance the linear running stability, safety and curve negotiation performance of the high-speed railway vehicles, especially for wagons whose running speed can reach or exceed 200Km/h.

[0063] The embodiments of the present invention also provide the secondary suspension system that can be applied to the above bogie for the high-speed railway vehicles.

[0064] Referring to FIG. 1, the secondary suspension system 4 comprises at least two spring sets 41, which are arranged at interval on the intermediate crossbeam 22 and located between the side beams 21. The transverse spacing of two spring sets 41 is 500-700mm, and the upper parts of the spring sets 41 are configured to connect with the carbody. Two mounting seats for the spring sets can be arranged on the intermediate crossbeam 22. These two spring sets 41 can be made of rubber springs or other types of springs, e.g., metal or air springs.

Two bulges are set on the upper part of each of the spring sets 41 for facilitating connection with the carbody. The spring sets 41 can bear a vertical load of the carbody and also provide a proper moment of rotational resistance between the frame 2 and the carbody.

[0065] Furthermore, the secondary suspension system 4 also comprises secondary vertical dampers 42, secondary transverse dampers 43 and yaw dampers 44. One end of each of the secondary vertical dampers 42 is connected with the frame 2, and the other end is connected with the carbody. One end of each of the secondary transverse dampers 43 is connected with the frame 2, and the other end is connected with the carbody. One end of each of the yaw dampers 44 is connected with the outer side of the side beam 21, and the other end is connected with the carbody.

[0066] In detail, each of the secondary vertical damper 42 can be designed into an oil damper comprising an oil cylinder and a piston rod. Hydraulic damping force can be formed by stretching and compressing the piston rod, so as to realize a satisfactory vibration damping effect and flexible damping effect. A mounting seat for the secondary vertical damper 42 can be set on each side beam 21. A lower end of the secondary vertical damper 42 is connected with the mounting seat for the secondary vertical damper, and an upper end is connected with the carbody. The secondary vertical dampers 42 can be separately set at outer sides of two side beams 21 and provide a lateral rolling damping for the carbody to limit the maximum lateral rolling displacement of the carbody and improve the lateral rolling stability of vehicles. Similarly, the secondary transverse dampers 43 and yaw dampers 44 can also be designed into oil dampers. Two secondary transverse dampers 43 can be separately set at inner sides of two side beams 21. One end of each of the secondary transverse dampers 43 is connected with a mounting seat at inner side of the side beam 21, and the other end is connected with the carbody. The secondary transverse damper 43 can provide transverse vibration damping for the railway vehicles in high-speed running, thus further increasing the linear running stability of the railway vehicles. The yaw dampers 44 are mounted at outer sides of the side beams 21 in longitudinal and horizontal pattern, thus avoiding the occurrence of hunting instability at high-speed and improving the running stability of railway vehicles.

[0067] The embodiments of the present invention also provide a frame for a bogie for the high-speed railway vehicles, which is applied to the aforementioned bogie for the high-speed railway vehicles.

[0068] Referring to FIGS. 1 and 2, the frame 2 comprises two side beams 21 and an intermediate crossbeam 22. A middle part of each of the side beams 21 has provided with a concave portion 211, and both ends of the intermediate crossbeam 22 are connected with the concave portions 211 of the side beams 21, respectively. The intermediate crossbeam 22 and the side beams 21 can be connected by means of plugging fit; in detail, an

upper cover plate is mounted onto upper end surface of the concave portion 211 of the side beam 21, and a lower cover plate is mounted onto the lower end surface of the concave portion 211; the upper and lower cover plates run parallel and protrude out toward the inner side of the side beam 21. Two connecting plates perpendicular to the upper and lower cover plates are mounted onto both ends of the intermediate crossbeam 22, and the connecting plates of the intermediate crossbeam 22 are plugged between the upper and lower cover plates, and welded together with the upper and lower cover plates. The frame 2 can be assembled by means of the aforementioned plugging fit to enhance its structural strength, or connected by other known means. Alternatively, the intermediate crossbeam 22 and side beams 21 are formed integrally. When the intermediate crossbeam 22 is mounted onto the concave portion 211 at middle part of each side beam 21, the height of the intermediate crossbeam 22 in relation to the track surface can be reduced, and the stability of the frame 2 can be improved.

[0069] The embodiments of the present invention also provide a primary suspension system for a bogie for the high-speed railway vehicles, which is applied to the aforementioned bogie for the high-speed railway vehicles.

[0070] Referring to FIGS. 3-7, a primary axle box suspension device 31 comprises an axle box positioning rotary arm 311 and a primary suspension spring 312. A lower end of the axle box positioning rotary arm 311 is connected with the wheel axle 12, and an upper end is connected with the side beam 21. The primary suspension spring 312 is mounted onto an upper end of the axle box positioning rotary arm 311, and both ends of the side beam 21 are separately provided with a spring mounting hole, into which the primary suspension spring 312 is mounted.

[0071] In detail, the axle box positioning rotary arm 311 is of a split structure that comprises an upper axle box 3111, a lower axle box 3112 and a rotary arm elastic joint 3113 coupled together.

[0072] One end of the upper axle box 3111 is of a semi-bushing structure, and the other end is provided with a rotary arm elastic joint mounting hole 3114. The lower axle box 3112 is of a semi-bushing structure, and the upper axle box 3111 and the lower axle box 3112 are butt-jointed to form a bushing 3115 for installation of the wheel axle 12. In actual installation, a bearing can be mounted onto the wheel axle 12, and the bushing 3115 is sleeved onto the bearing, realizing the connection of the axle box positioning rotary arm 311 and the wheel axle 12. As the axle box positioning rotary arm 311 is of the split structure composed of the upper axle box 3111 and the lower axle box 3112, the wheelset 1 can be easily replaced during repair and maintenance.

[0073] Both ends of the rotary arm elastic joint 3113 are of a semicolumn structure that may adopt rubber joint for the rotary arm. The semicolumn structure of the rotary arm elastic joint 3113 is mated with a mounting seat on the side beam 21 in half arc pattern, so that the rotary

arm elastic joint 3113 can withstand higher longitudinal load, and abnormal abrasion between the rotary arm elastic joint 3113 and the mounting seat of the side beam 21 can also be avoided to increase the service life and reliability of the rotary arm elastic joint 3113.

[0074] The primary suspension spring 312 comprises a spring mounting brace 3121, an elastic stopping column 3122, an inner ring spring 3123 and an outer ring spring 3124. The elastic stopping column 3122 is mounted vertically onto the spring mounting brace 3121, which is then mounted onto the upper end surface of the upper axle box 3111. The inner ring spring 3123 is sleeved onto the elastic stopping column 3122, and the outer ring spring 3124 sleeved onto the inner ring spring 3123.

[0075] The primary axle box suspension device 31 of the present embodiment allows to adjust the longitudinal and lateral rigidity of the rotary arm elastic joint 3113, so as to acquire the longitudinal and lateral rigidity value required for the bogie in high-speed running, and improve the dynamic performance of railway vehicles in high-speed running. In addition, since the outer ring spring 3124 and inner ring spring 3123 are set at upper part of the upper axle box 3111, the rotary arm elastic joint 3113 is free of additional moment generated by the spring force, hence, this can increase the service life and reliability of the rotary arm elastic joint 3113, and realize abrasion-free or low-abrasion design of the primary axle box suspension device.

[0076] The embodiments of the present invention also provide a traction rod device for a bogie for high-speed railway vehicles, which is applied to the aforementioned bogie for high-speed railway vehicles.

[0077] Referring to FIG. 8, the traction rod device 6 comprises a traction rod 61, elastic joints 62 and a fixed seat 63.

[0078] Mounting holes are opened at both ends of the traction rod 61. The elastic joints 62 can be designed into rubber joints, and mounted into the mounting holes of the traction rod 61. The elastic joints 62 can be mated with the mounting holes by interference fit, in order to improve the fit tightness. Both ends of each of the elastic joints 62 are of a protruding semicolumn structure. Semicolumn holes are opened on the fixed seat 63, and the semicolumn structure at both ends of one of the elastic joints 62 is mated with the semicolumn holes on the fixed seat 63, and the semicolumn structure at both ends of the other elastic joint 62 is used to mate with the semicolumn mounting holes of the carbody. During installation, the fixed seat 63 is connected with the intermediate crossbeam 22 in a way that the fixed seat 63 can be welded onto the intermediate crossbeam 22. The elastic joint 62 at the other end of the traction rod 61 is connected with a semicolumn mounting seat of the carbody.

[0079] Since the elastic joint 62 is mated with the mounting holes of the fixed seat 63 in half arc pattern, this can eliminate the rotational wear of the elastic joint 62, and obtain a larger mating area, thus transferring a larger longitudinal force with reliable performance. Both

ends of the elastic joint 62 are of a protruding structure, and the mounting holes of the fixed seat 63 can be mated with the mounting holes of the intermediate crossbeam 22 in other proper patterns.

[0080] Finally, it should be noted that the above examples are merely provided for describing the technical solutions of the present invention, but not intended to limit the present invention. It should be understood by the ordinary skill in the art that although the present invention is described in detail with reference to the foregoing embodiments, modifications can be made to the technical solutions described in the foregoing embodiments, or equivalent replacements can be made to some technical features in the technical solutions, without the essence of corresponding technical solutions departing from the scope of the embodiments of the present invention.

Claims

1. A bogie for high-speed railway vehicles, comprising a wheelset, a frame, a primary suspension system and a secondary suspension system;
wherein the frame comprises side beams and an intermediate crossbeam, a middle part of each of the side beams has a concave portion, and both ends of the intermediate crossbeam are separately connected with the concave portions of the side beams; the primary suspension system comprises one or more primary axle box suspension devices, one end of each of the primary axle box suspension devices is connected with a wheel axle of the wheelset, and the other end is supported at one end of one of the side beams; and
the secondary suspension system comprises at least two spring sets, which are arranged at intervals on the intermediate crossbeam and located between the side beams, and upper parts of the spring sets are connected with a carbody.
2. The bogie of Claim 1, wherein the secondary suspension system further comprises one or more secondary vertical dampers, one or more secondary transverse dampers and one or more yaw dampers; one end of each of the secondary vertical dampers is connected with the frame, and the other end is connected with the carbody;
one end of each of the secondary transverse dampers is connected with the frame, and the other end is connected with the carbody; and
one end of each of the yaw dampers is connected with an outer side of the side beam, and the other end is connected with the carbody.
3. The bogie of Claim 2, wherein the spring sets are rubber spring sets;
outer sides of the spring sets are provided with secondary transverse stopper and secondary vertical

stopper ; and

the secondary vertical dampers and yaw dampers are set at outer sides of the respective secondary vertical stoppers.

4. The bogie of Claim 1, wherein the primary suspension system further comprises one or more primary vertical dampers; one end of each of the primary vertical dampers is connected with one of the primary axle box suspension devices, and the other end is connected with one of the side beams.
5. The bogie of Claim 1, wherein the primary axle box suspension device comprises an axle box positioning rotary arm and a primary suspension spring, and a lower end of the axle box positioning rotary arm is connected with the wheel axle; and
the primary suspension spring is mounted onto an upper end of the axle box positioning rotary arm, and both ends of each of the side beams are separately provided with a spring mounting hole, into which the primary suspension spring is mounted.
6. The bogie of Claim 5, wherein the axle box positioning rotary arm is of a split structure that comprises an upper axle box, a lower axle box and a rotary arm elastic joint coupled together;
one end of the upper axle box is of a semi-bushing structure, and the other end is provided with a rotary arm elastic joint mounting hole; the lower axle box is of a semi-bushing structure; and the upper and lower axle boxes are butt-jointed to form a bushing for installation of the wheel axle;
both ends of the rotary arm elastic joint are of a semicolumn structure, which is mated with a mounting seat on the side beam in half arc pattern; and
the primary suspension spring comprises a spring mounting brace, an elastic stopping column, an inner ring spring and an outer ring spring; the elastic stopping column is mounted vertically onto the spring mounting brace, which is then mounted onto an upper end surface of the upper axle box; the inner ring spring is sleeved onto the elastic stopping column, and the outer ring spring is sleeved onto the inner ring spring.
7. The bogie of Claim 6, wherein the rotary arm elastic joint is a rotary arm rubber joint.
8. The bogie of Claim 6 or 7, further comprising an axle temperature detector for detecting the temperature of the wheel axle, wherein the axle temperature detector is set on the lower axle box.
9. The bogie of any one of Claims 1-7, further comprising a traction rod device, wherein one end of the traction rod device is connected with the intermediate crossbeam, the other end is connected with the

carbody, and the traction rod device is configured to provide tractive force for the intermediate cross-beam.

10. The bogie of Claim 9, wherein the traction rod device comprises a traction rod, elastic joints and a fixed seat;
both ends of the traction rod are opened with mounting holes, and the elastic joints are mounted into the mounting holes;
both ends of each of the elastic joints are of a semicolumn structure; the fixed seat is opened with semicolumn holes; the semicolumn structure at both ends of one of the elastic joints is mated with the semicolumn holes on the fixed seat, and the semicolumn structure at both ends of the other elastic joint is configured to mate with semicolumn mounting holes of the carbody. 5
11. The bogie of Claim 10, wherein the elastic joints is rubber joints. 10
12. The bogie of any one of Claims 1-7, wherein the frame further comprises two auxiliary crossbeams, both ends of which are separately connected with the side beams and distributed evenly at both sides of the intermediate crossbeam;
the bogie further comprises a braking device, which comprises a brake disc, a brake cylinder, a brake pad and a clamp, the brake pad is mounted onto the clamp, the clamp is mounted onto the auxiliary cross-beam, and the brake disc is fixed on the wheel axle; frictional force generated between the brake pad and the brake disc is configured to provide braking force for the high-speed railway vehicles. 15
13. The bogie of any one of Claims 1-7, further comprising at least one elastic safety chains; one end of each of the elastic safety chains is connected with the intermediate crossbeam, and the other end is connected with the carbody. 20
14. The bogie of any one of Claims 1-7, wherein the wheel axle is a hollow or solid axle;
optionally, both ends of the wheel axle are provided with an antiskid device. 25
15. The bogie of any one of Claims 1-7, further comprising at least one weighing valves, wherein one end of each weighing valve is connected with the primary axle box suspension device, and the other end is connected with one of the side beams and located at outer side of the side beam;
optionally, the primary vertical dampers, secondary transverse dampers and secondary vertical dampers are hydraulic dampers. 30

speed railway vehicles, comprising at least two spring sets; wherein a lower end of each of the spring sets is connected with the bogie, and an upper end thereof is connected with a carbody.

17. A frame of a bogie for high-speed railway vehicles, comprising side beams and intermediate cross-beam, wherein a middle part of each of the side beams is a concave portion, and both ends of the intermediate crossbeam are separately connected with the concave portions of the side beams. 35
18. A primary suspension system of a bogie for high-speed railway vehicles, comprising an axle box positioning rotary arm and a primary suspension spring, wherein a lower end of the axle box positioning rotary arm is connected with a wheel axle, the primary suspension spring is mounted onto an upper end of the axle box positioning rotary arm, and the primary suspension spring is mounted into spring mounting holes at both ends of a side beam of the bogie. 40
19. The primary suspension system of Claim 18, wherein the axle box positioning rotary arm is of a split structure that comprises an upper axle box, a lower axle box and a rotary arm elastic joint coupled together; one end of the upper axle box is of a semi-bushing structure, and the other end is provided with a rotary arm elastic joint mounting hole; the lower axle box is of a semi-bushing structure; the upper and lower axle boxes are butt-jointed to form a bushing for installation of the wheel axle;
both ends of each of the rotary arm elastic joint are of a semicolumn structure, the semicolumn structure of the rotary arm elastic joint is mated with a mounting seat on the side beam of the bogie in half arc pattern; the primary suspension spring comprises a spring mounting brace, an elastic stopping column, an inner ring spring and an outer ring spring; the elastic stopping column is mounted vertically onto the spring mounting brace, which is then mounted onto an upper end surface of the upper axle box; the inner ring spring is sleeved onto the elastic stopping column, and the outer ring spring is sleeved onto the inner ring spring. 45
20. A traction rod device of a bogie for high-speed railway vehicles, comprising a traction rod, elastic joints and a fixed seat;
both ends of the traction rod are opened with mounting holes, and the elastic joints are mounted into the mounting holes;
both ends of each of the elastic joints are of a semicolumn structure; the fixed seat is opened with semicolumn holes; the semicolumn structure at both ends of one of the elastic joints is mated with the semicolumn holes on the fixed seat, and the semicolumn structure at both ends of the other elastic 50

joint is configured to mate with semicolumn mounting holes of the carbody.

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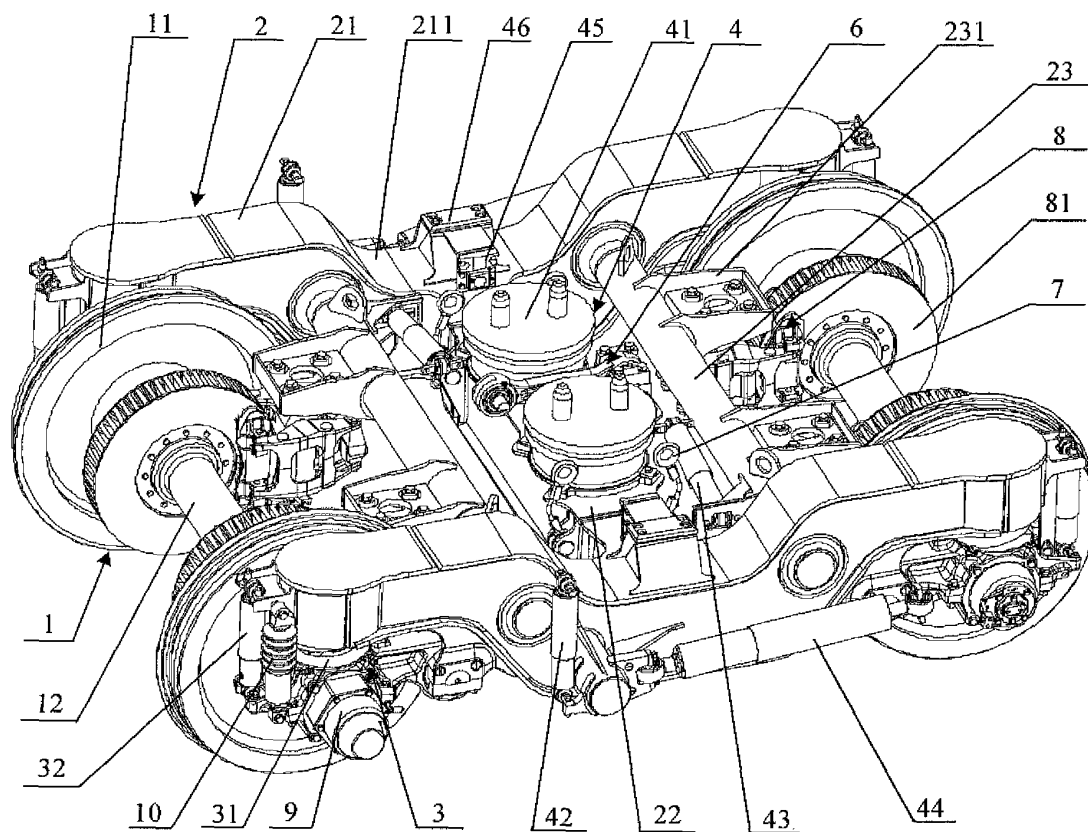


FIG. 1

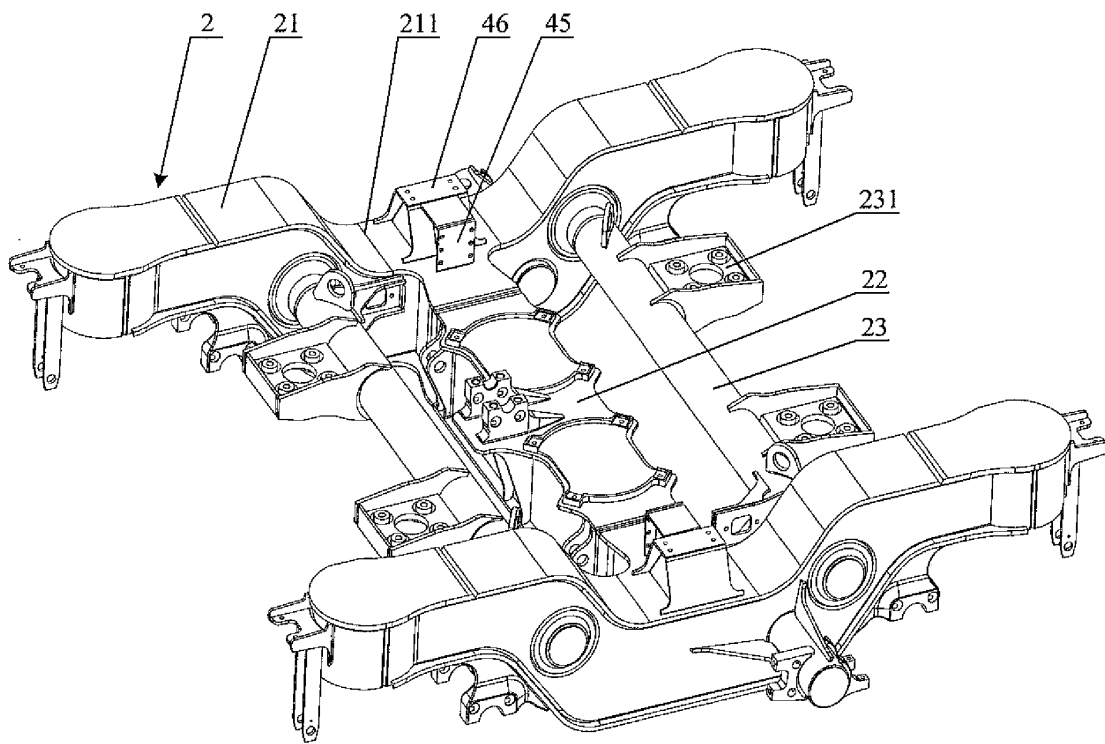


FIG. 2

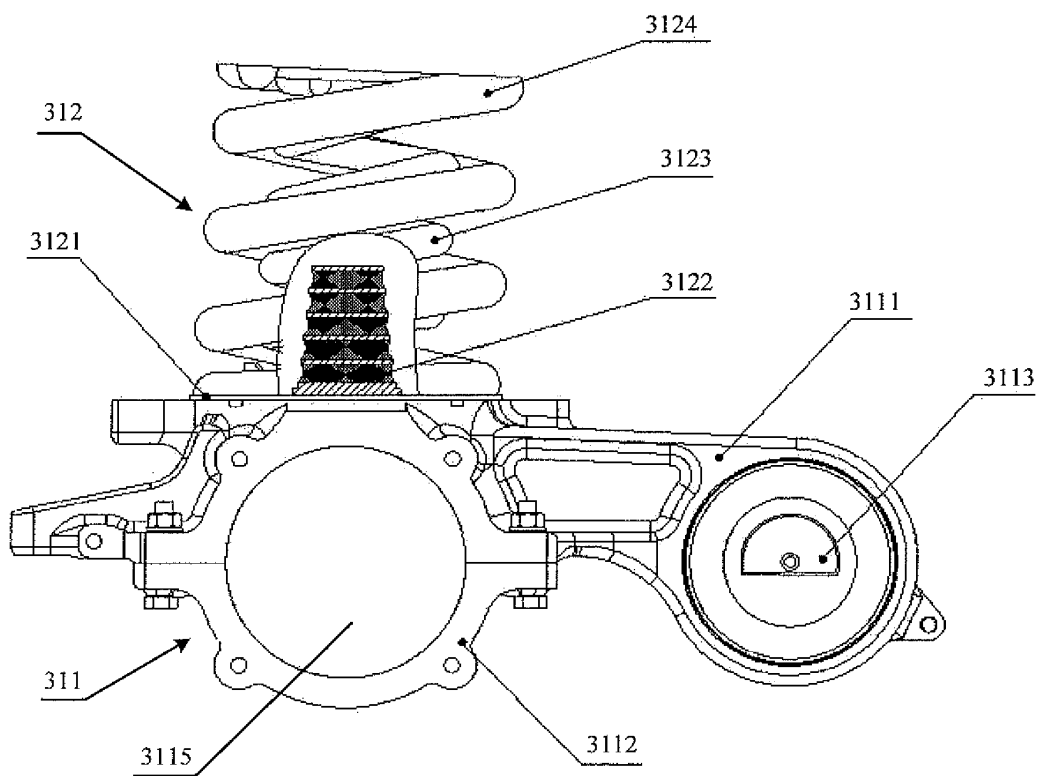


FIG. 3

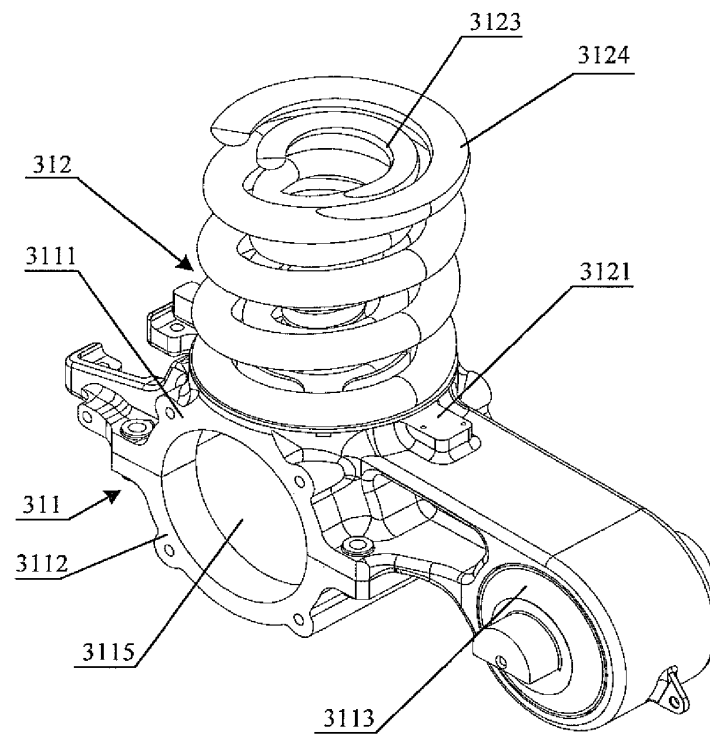


FIG. 4

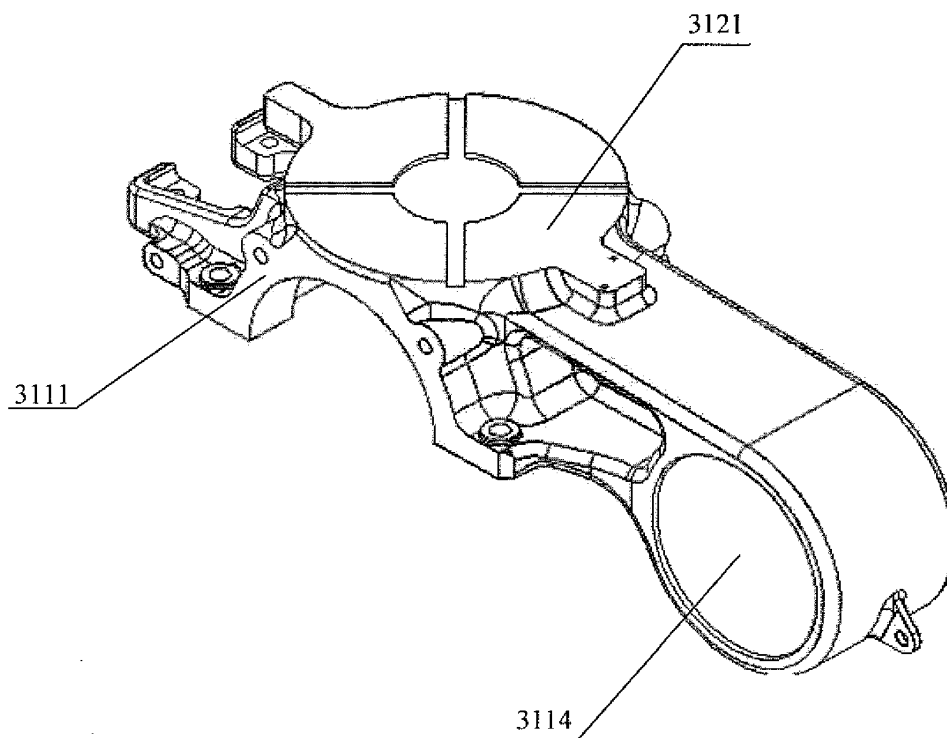


FIG. 5

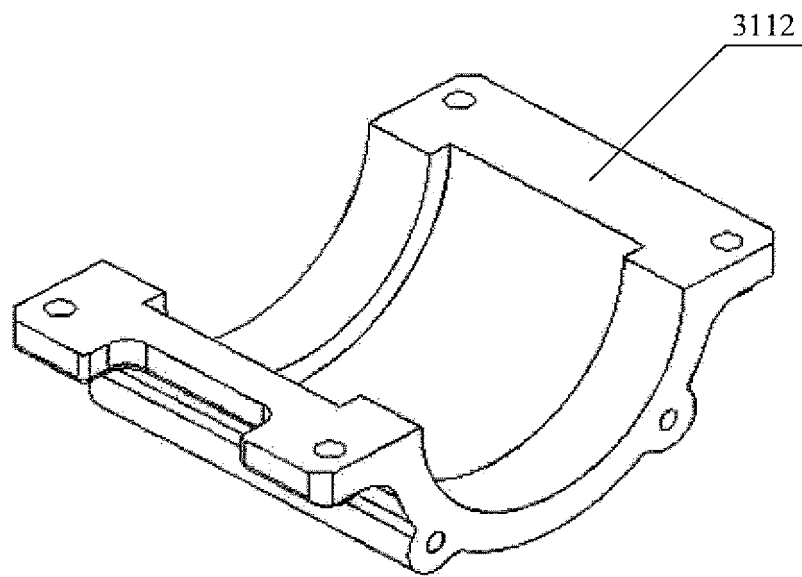


FIG. 6

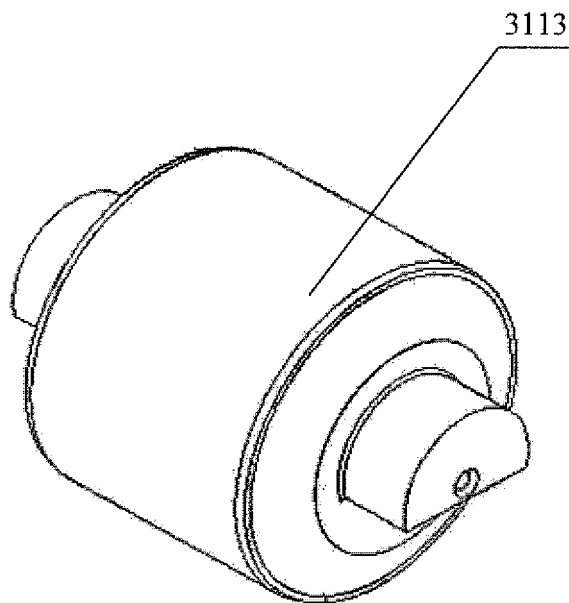


FIG. 7

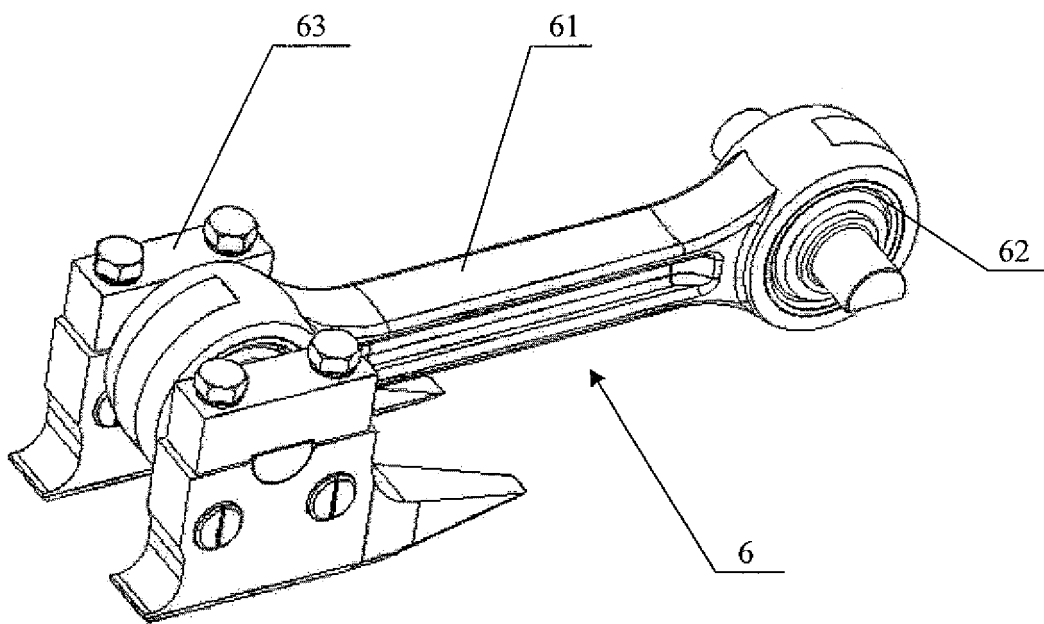


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/073579

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: B61F 5/, B61F 3/

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)

WPI; EPODOC; CNKI; CNABS: bogie, primary, secondary, suspension or suspensions, speed, absorb+, shock, vertical

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 201882093 U (SHANGHAI RAIL TRAFFIC EQUIPMENT CO LTD) 29 June 2011 (29.06.2011), description pages 3-5, figures 1-10	16-18
Y		1-5, 9, 12-15
Y	US 3941061 A (WEGMANN & CO GMBH) 2 March 1976 (02.03.1976), description columns 4-5, figures 1-3	1-5, 9, 12-15
Y	CN 101823492 A (CSR ZHUZHOU ELECTRIC LOCOMOTIVE CO LTD) 8 September 2010 (08.09.2010), description pages 2-4, figures 1-10	2-4
A	CN 101070070 A (ZHUZHOU VEHICLES FACTORY CHINE) 14 November 2007 (14.11.2007), description pages 3-5, figures 1-10	1-20
A	CN 201189868 Y (TRANSP BUREAU OF RAILWAY DEPT et al.) 4 February 2009 (04.02.2009), description pages 5-6, figures 1-3	1-20

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

* Special categories of cited documents:

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“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search
16 May 2012 (16.05.2012)Date of mailing of the international search report
14 June 2012 (14.06.2012)Name and mailing address of the ISA
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Telephone No. (86-10) 62084811

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/073579

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
 Information on patent family members

 International application No.
PCT/CN2012/073579

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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JP 11078877 A	23.03.1999	JP 3205286 B2	04.09.2001

Form PCT/ISA/210 (patent family annex) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2012/073579

A. CLASSIFICATION OF SUBJECT MATTER

B61F 5/30 (2006.01) i

B61F 3/00 (2006.01) i