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(54) **BOGIE SUSPENSION TRACTION DEVICE FOR USE IN LOW-FLOOR ARTICULATED RAIL VEHICLE**

(57) The present disclosure relates to a suspension traction device of a low floor articulated rail vehicle, which comprises swing bolster mechanisms, traction rod mechanisms, primary springs and secondary springs. Two swing bolster mechanisms and two traction rod mechanisms are provided, two swing bolster mechanisms are provided respectively in the middle of two groups of wheel-sets. Each swing bolster mechanism is connected to the frame by a set of traction rod mechanisms and is connected to the vehicle body by means of a rotary mechanism. The disclosure has the advantages of simple and compact structure and light weight. It not only realizes the transmission of the traction and the braking force when the vehicle is running, carries the vertical, horizontal and vertical load, which greatly improves the small curving performance of the vehicle, but also reduces the height of the floor surface and the driving performance of the vehicle has also been greatly improved.

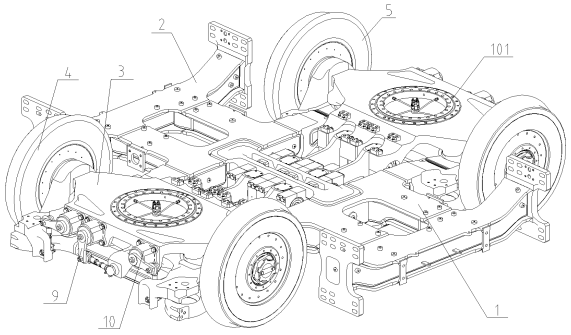

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a bogie for a rail vehicle, and particularly relates to a bogie suspension traction device for a low floor articulated rail vehicle. It belongs to a field of rail vehicle manufacturing.

BACKGROUND

[0002] Low-floor urban rail vehicles play an increasingly important role in lots of urban traffic. In low-floor urban rail vehicles, the bogie is the most important structural component, and its structure and the parameters directly determine the stability during operation and the ride comfort of the vehicle. The existing bogie of the low-floor urban rail vehicle generally has a poor small curving performance, the floor is too high for getting on and off, and the traction device is cumbersome and other problems. With the continuous improvement of urban rail vehicles, the requirements for urban rail vehicles are getting higher and higher. So it is necessary to provide a bogie suspension traction device for a low floor articulated rail vehicle which reduces the height of the floor to facilitate getting on and off and has a simple structure with good curving performance and light weight.

SUMMARY

[0003] The first technical problem that the present disclosure mainly solves is to provide a bogie suspension traction device for a low floor articulated rail vehicle, which has the advantages of simple and compact structure, a good curving performance, light weight and the possibility to reduce the height of the floor surface.

[0004] The second technical problem that the present disclosure mainly solves is to provide a bogie suspension traction device for a low floor articulated rail vehicle, which has the advantages of simple and compact structure, being beneficial to reducing the height of the floor and being possible to achieve the overall lifting function of the bogie simultaneously.

[0005] The third technical problem that the present disclosure mainly solves is to provide a bogie suspension traction device for a low floor articulated rail vehicle, which has the advantages of simple and compact structure, being beneficial to reducing the height of the floor and improving the dynamic performance during operation.

[0006] The third technical problem that the present disclosure mainly solves is to provide a bogie suspension traction device for a low floor articulated rail vehicle, which has the advantages of simple and compact structure, being easy to operate and being possible to improve the working stability of a rotary mechanism.

[0007] In order to achieve the first object mentioned above, the technical solution adopted by the present disclosure is as follows.

[0008] A suspension traction device of a low floor articulated rail vehicle comprises a swing bolster mechanism, a traction rod mechanism, primary spring mechanism and mechanism secondary spring mechanism. The secondary spring mechanism is provided between the swing bolster mechanism and the frame of the bogie. Two groups of swing bolster mechanisms and two sets of traction rod mechanisms are provided, two groups of swing bolster mechanisms are provided respectively in the middle of two groups of wheel-sets. Each group of swing bolster mechanism is connected to a frame via a set of traction rod mechanism and is connected to a vehicle body via a rotary mechanism.

[0009] Further, the two sets of the traction rod mechanisms are arranged in the middle of two side beams of the frame and are arranged separately on two sides of a central cross beam of the frame. Each set of the traction rod mechanism comprises one or more traction rods. One end of the traction rod is connected with a central cross beam and the other end is connected with the swing bolster mechanism.

[0010] Further, a mounting interface of first traction rod is provided on the swing bolster mechanism and a mounting interface of second traction rod is provided on the frame. The two ends of the traction rod mechanism are respectively fixed to the mounting interface of first traction rod and the mounting interface of second traction rod. The mounting interface of first traction rod and the mounting interface of second traction rod are separate structures.

[0011] Further, an upper section of the mounting interface of first traction rod has an arc portion curving downwards.

[0012] Further, semicircular openings are respectively provided on two separate parts of the mounting interface of first traction rod and the mounting interface of second traction rod, and are assembled together to form a first mounting opening and a second mounting opening which are circulars for mounting the traction rod. The two separate parts are fixed and connected by bolts.

[0013] Further, the traction rod comprises a rod in the middle and spherical joints at both ends and a connecting seat is mounted on each of the two spherical joint axis of each spherical joint. The connecting seats at two ends of the traction rod are respectively fixed inside the first mounting opening and the second mounting opening.

[0014] Further, the end of the rod is U-shaped and the spherical joint is inserted into the U-shaped structure and is fixedly connected to the rod by fastener.

[0015] Further, the central cross beam is integrally casted and shaped and two ends of the center beam are welded to lateral plates of the two side beams.

[0016] Further, the secondary spring mechanism is composed of an upper backing plate, a lower backing plate and a spring in the middle. A vertical backstop is provided in the spring and is fixed to the upper backing plate. A boss budging upwards is provided on the frame,

and the boss inserts into the spring after installation and faces right to the vertical backstop.

[0017] Further, the bottom of the vertical backstop and the top of the boss are spaced by a vertical stop gap or direct contact.

[0018] In order to achieve the second object mentioned above, the technical solution adopted by the present disclosure is as follows.

[0019] A suspension traction device of a low floor articulated rail vehicle comprises a swing bolster mechanism, a traction rod mechanism, a primary spring mechanism and a secondary spring mechanism. Two groups of swing bolster mechanisms are provided. And the two groups of swing bolster mechanisms are provided respectively in the middle of two groups of wheel-sets. A lifting device is provided between each group of swing bolster mechanism and an end beam of a frame.

[0020] Further, the lifting device comprises at least one lifting rod and the top end of the lifting rod is connected to the swing bolster mechanism. A lifting opening is provided for the lifting rod on the frame. A bayonet whose diameter is greater than a diameter of the lifting opening is provided at the bottom of the lifting rod. And the bayonet extends into a lower part of the lifting opening.

[0021] Further, the frame has an upward-concaving portion at the lifting opening. The lifting opening is provided on the top wall of the upward-concaving portion. The bayonet is provided inside the upward-concaving portion.

[0022] Further, two lifting rods are provided between each group of swing bolster mechanism and the frame and the two lifting rods are arranged symmetrically in the lateral direction of the vehicle body below the swing bolster mechanism.

[0023] Further, a main body of the lifting rod is a long cylinder. A top end of the lifting rod is a T-shaped head and two sides of the T-shaped head are provided with stop planes. The bottom of the lifting rod is provided with an external thread and the upper portion of the external thread is provided with a stop portion with a slightly larger diameter.

[0024] Further, a fixing port is provided in a lower surface of the swing bolster where the lifting rod is mounted. A top end of the lifting rod is mounted in the fixing port. A mounting block is provided below the T-shaped head of the lifting rod and is fixedly connected to the swing bolster by bolts, and the T-shaped head of the lifting rod is stuck and fixed to the swing bolster after the mounting block is fixed.

[0025] Further, the bayonet is mounted on an outer circumference of a stop portion and a locating block is mounted below the bayonet. An inner circle of the locating block is provided with a step-like structure and the step-like structure is abutted against the stop portion of the lifting rod after installation. A nut is tightened on the bottom of the lifting rod below the locating block for fixation.

[0026] In order to achieve the third object mentioned above, the technical solution adopted by the present disclosure is as follows.

[0027] A suspension traction device of a low floor articulated rail vehicle comprise a swing bolster mechanism, a traction rod mechanism, a primary spring mechanism and a secondary spring mechanism. Two groups of swing bolster mechanisms are provided, and the two groups of swing bolster mechanisms are provided respectively in the middle of two groups of wheel-sets. The swing bolster mechanism comprises a swing bolster, and a protruding part protrudes downwards at a central position from a lower surface of the swing bolster. The protruding part inserts into an opening provided on a frame.

[0028] Further, transverse backstops are respectively mounted on side walls of two transverse sides of an opening of the frame. The protruding part below the swing bolster extends to the space between two the transverse backstops and a transverse stop gap is left between the protruding part and the transverse backstops.

[0029] Further, the transverse backstop is composed of a wear-resisting layer, a rubber layer and a bottom layer. The wear-resisting layer is located on the top layer in contact with the protruding part of the swing bolster. The rubber layer is provided between the wear-resisting layer and the bottom layer. The bottom layer is fixed and connected to the frame.

[0030] Further, the rubber layer is a waist-drum shape with a small diameter in the middle and large diameters at two ends.

[0031] Further, a diameter of the wear-resisting layer is larger than a diameter of the end of the rubber layer to which it is bonded.

[0032] Further, one or more recessed cavities are provided on the swing bolster and the recessed cavity is provided with a drain port.

[0033] In order to achieve the fourth object mentioned above, the technical solution adopted by the present disclosure is as follows.

[0034] A suspension traction device of a low floor articulated rail vehicle comprises a swing bolster mechanism, a traction rod mechanism, a primary spring mechanism and a secondary spring mechanism. The secondary spring mechanism is mounted between the swing bolster mechanism and a frame of the bogie. Two groups of swing bolster mechanisms are provided and the two groups of swing bolster mechanisms are provided respectively in the middle of two groups of wheel-sets. Each group of the swing bolster mechanism is connected to a vehicle body via a rotary mechanism. The rotary mechanism comprises a slewing bearing, and an oiling mechanism for filling oil for the slewing bearing is provided at the center of the slewing bearing.

[0035] Further, the oiling mechanism comprises a group of grease nipples and the grease nipples are connected to the slewing bearing via oiling pipes.

[0036] Further, the grease nipples are mounted on a mounting seat of grease nipple and the mounting seat of grease nipple is fixed to the swing bolster mechanism.

[0037] Further, the mounting seat of grease nipple is

a cylindrical structure and one or more vertical accommodating cavities which extend in the vertical direction and recess inwards are provided on the circumference of the cylinder. One grease nipple is provided in each of the vertical accommodating cavities.

[0038] Further, a first lateral accommodating cavity is provided on the mounting seat of grease nipple along the transverse direction around the outer circumference of the cylindrical structure and is fixedly fastened with an oiling pipe connected to the grease nipple by a ribbon at the position of the first lateral accommodating cavity.

[0039] Further, the mounting seat of grease nipple is integrally molded with a highly wear-resistant nylon material.

[0040] Further, the mounting seat of grease nipple is mounted on the swing bolster.

[0041] In summary, the suspension traction device of the low floor articulated rail vehicle of the present disclosure, compared with the prior art, has the following advantages.

(1) In the present disclosure, two groups of swing bolster mechanisms are connected to the vehicle bodies of the adjacent two carriages by a rotary mechanism, respectively. Each group of the swing bolster mechanism is directly connected to the frame via a traction rod mechanism to achieve traction and braking. The whole structure is simple and compact. It better achieves the force transmission of traction and braking during the operation of vehicle, and better bears the vertical, horizontal and longitudinal loads, and greatly improves the vehicle's small curving performance. Besides, the whole structure is, which is beneficial to reduce the height of the floor surface and is conducive for getting on and off the vehicle. The driving performance of the vehicle is also greatly improved, and the number of bogies is reduced in the organized vehicle group, thus, saving costs of vehicle manufacturing, maintenance and repair.

(2) In the present disclosure, two groups of swing bolster mechanisms are respectively connected to the central cross beam of the frame via a set of traction rods, so that two groups of swing bolster mechanism and two sets of traction rod mechanism do not affect each other. The longitudinal movement of one swing bolster mechanism does not affect longitudinal movement of another swing bolster mechanism, and the vibration of one carriage does not pass to another carriage and two adjacent vehicle bodies are decoupled, thus, it improves the ride comfort and the reliability of operation.

(3) In the present disclosure, a lifting device is provided between the lower portion of the swing bolster and the frame, and it is possible to achieve the overall lifting of the bogie when it is needed. The whole structure is simple and compact. And the bayonet at the bottom of the lifting rod will be stuck in the lifting opening, playing the role of a vertical stop, when the overshoot of the vehicle occurs. Thus, the maximum vertical vibration distance of the vehicle body is limited, the vehicle beyond the limits is effectively avoided, and the ride comfort of the vehicle and the balance during operation is improved. And it is conducive to reducing the height of the floor.

(4) In the present disclosure, an oiling device is provided at the center of the slewing bearing. The structure is simple and is convenient for filling oil to the slewing bearing when needed to ensure the working stability of the slewing bearing.

BRIEF DESCRIPTION OF THE DARWINGS

[0042]

Fig. 1 is a schematic view of a structure of a suspension traction device of the present disclosure;
Fig. 2 is a schematic view of a structure of a frame in the present disclosure;
Fig. 3 is a top view of Fig. 1;
Fig. 4 is a sectional view taken along the A-A direction of Fig. 3;
Fig. 5 is a sectional view taken along the B-B direction of Fig. 3;
Fig. 6 is a sectional view taken along the C-C direction of Fig. 3;
Fig. 7 is a view taken along the D direction of Fig. 3;
Fig. 8 is a schematic view of a structure of a damper in the present disclosure;
Fig. 9 is a schematic view of a structure of a traction rod in the present disclosure;
Fig. 10 is a top view of Fig. 9;
Fig. 11 is a schematic view of a structure of a swing bolster in the present disclosure;
Fig. 12 is a top view of a structure of a swing bolster in the present disclosure;
Fig. 13 is a view taken along the F direction of Fig. 12;
Fig. 14 is a sectional view taken along the G-G direction of Fig. 12;
Fig. 15 is a schematic view of a structure of a swing bolster connected to a vehicle body in the present disclosure;
Fig. 16 is a schematic view of a structure of a mounting seat of grease nipple of the present disclosure;
Fig. 17 is a top view of Fig. 16;
Fig. 18 is a schematic view of a structure of a transverse backstop of the present disclosure;
Fig. 19 is a schematic view of a structure of a lifting rod of the present disclosure;
Fig. 20 is a schematic view showing an installation structure of a secondary spring of the present disclosure;
Fig. 21 is a schematic view of a structure of a secondary spring of the present disclosure;
Fig. 22 is a schematic view of a structure of a dust cover.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0043] The disclosure is described in further detail with reference to the accompanying drawings and specific embodiments.

[0044] A bogie suspension traction device of a low floor articulated rail vehicle is shown in Fig. 1, which is provided on a low floor articulated rail vehicle. The rail vehicle includes multiple carriages, a bogie 1 is installed below each junction of every two carriages and two carriages are respectively connected to the bogie 1 through a rotary mechanism 101.

[0045] The bogie 1 includes a frame 2, a suspension traction device 3, a wheel-set 4, a drive motor (not shown) and a brake and so on. Four drive motors are provided to respectively drive four wheels 5. The four drive motors and the brakes are fixedly mounted on the mounting beams 81 on both sides of the frame 2, respectively. The drive motors and the brakes are mounted on the outside of the wheel 5, beneficial to reducing the height of the floor.

[0046] As show in Fig. 2, the frame 2 comprises two side beams 80 and two end beams 82. A central cross beam 77 is provided in the middle of the two side beams 80. The two end beams 82 are arranged in parallel and symmetrically on both sides along the longitudinal direction of the central cross beam 77 (in the longitudinal direction of the vehicle body). The two side beams 80, the two end beams 82 and the central cross beam 77 form a frame structure shaped in a Chinese character as "日". The outer sides of the side beam 80 are provided with mounting beams 81 for mounting drive motors and brakes in the transverse direction (referred to as the width direction of the vehicle body). The central cross beam 77 is integrally cast and shaped, and both ends of the center beam 77 are welded to lateral plates of the two side beams 80.

[0047] As shown in Fig. from 3 to 5, the suspension traction device 3 comprises swing bolster mechanisms 6, traction rod mechanisms 7, primary spring (not shown), secondary spring mechanisms 8, transverse dampers 9 and vertical dampers 10 and the like. Two groups of swing bolster mechanisms 6 and two groups of traction rod mechanisms 7 are provided. The structures of the two groups of swing bolster mechanisms 6 are identical, and are respectively installed in the middle of the two wheels 5 in each group of wheel-set 4. The two groups of swing bolster mechanisms 6 are connected to the vehicle bodies of the adjacent two carriages by the rotary mechanism 101, respectively. The vehicle's small curving performance is greatly improved and the height of the floor surface is significantly reduced, conducive to the installation of getting on and off the vehicle. The driving performance of the vehicle is also greatly improved, helpful to reduce the wear of wheel and track. And the number of bogies 1 arranged in the vehicle group is reduced, thus costs of vehicle manufacturing, maintenance and repair are saved.

[0048] Each group of swing bolster mechanisms 6 is connected with a frame 2 through a set of traction rod mechanism 7, two sets of secondary spring mechanisms 8 are provided between the end beams 82 of the frame 2, below each set of swing bolster mechanism 6. A transverse damper 9 and two vertical dampers 10 are mounted on a side, facing the outer side of the frame 2, of each set of swing bolster mechanism 6. Two vertical dampers 10 are provided on both sides, in the transverse direction of the vehicle body, of the transverse damper 9. The bogie 1 comprises four vertical dampers 10 and two transverse dampers 9, to reduce the vibration of the vehicle body in the transverse and vertical direction and improve the ride comfort.

[0049] As shown in Fig. 3, 4 and 5, each group of swing bolster mechanism 6 is connected with the central cross beam 77 of a frame 2 through a set of traction rod mechanisms 7. Two sets of traction rod mechanisms 7 are provided between the two side beams 80 and are set separately on two sides of the central cross beam 77. Each set of traction rod mechanism 7 comprises one or more traction rods 16, that is, each group of swing bolster mechanism 6 is connected with a central cross beam 77 of a frame 2 through one or more traction rods 16. One end of the traction rod 16 is connected with the swing bolster mechanism 6, and the other end is connected with the central cross beam 77 of the frame 2. Two groups of swing bolster mechanism 6 and two sets of traction rod mechanism 7 are as a whole arranged as a flat structure, further reducing the height of the floor.

[0050] In the embodiment, preferably, each set of traction rod mechanism 7 comprises two traction rods 16, that is, each group of swing bolster mechanism 6 is connected with the central cross beam 77 of the frame 2 through two traction rods 16. The two traction rods 16 are arranged parallel to each other between the two side beams 80 of the frame 2. Two groups of swing bolster mechanism 6 are respectively connected with a central cross beam 77 of a frame 2 through two traction rods 16, thus it better realizes the transmission of the traction and braking force and bears the vertical, horizontal and longitudinal loads, while vehicle is running. Ends of each traction rod 16 are directly connected to the central cross beam 77 of the frame 2, so that two groups of swing bolster mechanism 6 and two sets of traction rod mechanism 7 do not affect each other. The longitudinal movement of one swing bolster mechanism 6 does not affect the movement in the longitudinal direction of another swing bolster mechanism 6, and the vibration of one carriage is not passed to another carriage. Thus, the two adjacent vehicle bodies are decoupled, and improves the ride comfort and the reliability during operation, parallel to each other and The two traction rods 16 which is parallel to each other serve as anti-side roll bars in the structure that each group of swing bolster mechanism 6 is connected with a central cross beam 77 of a frame 2 through two traction rods 16, so that the vehicle runs

more smoothly and the structure of the bogie is simplified.

[0051] As shown in Fig. 9 and 10, the traction rod 16 includes a rod 16a arranged in the middle and spherical joints 16b arranged at both ends. Both ends of the rod 16a are U-shaped, and the two spherical joints 16b are respectively inserted into the U-shaped structure and fixedly connected to the rod 16a by fasteners. The spherical joint 16b is composed of a spherical joint axis in the center and a spherical joint sleeve outside. The spherical joint axis and the spherical joint sleeve are hinged and fitted through a spherical surface, and the spherical joint sleeve is connected to the rod 16a. A connecting seat 16c is mounted on each of the two spherical joint axis of each spherical joint 16b and the two connecting seats 16c are symmetrically provided on both sides of the spherical joint 16b, and the connecting seat 16c is a cylindrical rubber material. A mounting hole (not shown) is provided in the center of the connecting seat, and is fitted and fixed to the spherical joint axis of spherical joint 16b.

[0052] As shown in Fig. 5, 11 and 14, each group of swing bolster mechanism 6 comprises a swing bolster 11 and the swing bolster 11 is a polygon. The swing bolster 11 is made by whole casting, not only to ensure its overall strength and stiffness, to avoid the welding stress of the welding structure and to increase the load capacity of the swing bolster 11 substantially, but also to reduce the thickness and the weight of the swing bolster 11 and the height of the floor surface, and the vehicle can be reduced in weight meanwhile. A mounting interface of first traction rod 12 which is connected to the traction rod 16 is provided on a side of the swing bolster 11 facing to the central cross beam 77. The mounting interface of first traction rod 12 and the swing bolster 11 are integrally casted.

[0053] The number of the mounting interface of first traction rods 12 depends on the number of traction rods 16. In the embodiment, two traction rods 16 are mounted on a side of each swing bolster 11.The ends of each traction rod 16 are provided with two mounting interface of first traction rods 12, for fixing the two connecting seats 16c of the ends of the traction rod 16. So that four mounting interface of first traction rods 12 are provided on one side of each swing bolster 11. The four mounting interface of first traction rods 12 are arranged side by side in a line on one side of the swing bolster 11 and two of the four mounting interface of first traction rods 12 in the middle close together or are as a whole structure. Each of the upper surfaces of the four mounting interface of first traction rods 12 has an arc portion curving downward, in order to reduce the installation height of the traction rod mechanisms 7 as a whole and then reduce the height of the floor.

[0054] Each mounting interface of first traction rod 12 has a circular first mounting opening 17 for accommodating the connecting seat 16c of the end of the traction rod 16. The spherical joint 16b of the end of the traction rod 16 is set between two mounting interface of first traction rods 12 and four bolt holes for fixing bolts 18 are provided on two sides of each mounting interface of first traction rod 12.

[0055] In order to facilitate disassembly, in the embodiment, the four mounting interface of first traction rods 12 are all set as separate structures, that is, being separated as a upper and lower part. A semicircular opening is respectively provided on the upper and lower part. The upper and the lower part, after being buckled together, form the circular first mounting opening 17. The upper and the lower part are correspondingly provided with bolt holes for fixing bolts 18, the connecting seat 16c of the end of the traction rod 16 is tightly fixed in the first mounting opening 17 after the upper and the lower part of the mounting interface of first traction rods 12 are buckled together, and finally the upper and lower parts are fixed together by four bolts 18 to achieve a fixed mounting of the traction rod 16. Wherein, the upper part of the mounting interface of first traction rod 12 is integrally formed with the swing bolster 11 and the lower part is separately mounted. Similarly, the lower part of the mounting interface of first traction rod 12 is integrally formed with the swing bolster 11 and the upper part is separately mounted. As shown in Fig. 9 and Fig. 10, in order to facilitate fixing with the mounting interface of first traction rod 12, a pin hole 78 is provided on the outer circumference of each connecting seat 16c. As shown in Fig. 5, the upper or the lower part of mounting interface of first traction rod 12 is correspondingly provided with a pin hole. A locating pin 79 is provided through the pin hole 78 of the connecting seat 16c during installation, fitted with the pin hole of the mounting interface of first traction rod 12, so that the traction rod 16 is accurately mounted and the mounting efficiency is improved.

[0056] As shown in Fig. 11, 12 and 13, in the embodiment, in order to strengthen the fixing strength of the mounting interface of first traction rod 12, so that the traction rod 16 is firmly fixed. A mounting plate 41 is provided above the mounting interface of first traction rod 12, and every two adjacent bolts 18 are provided with a mounting plate 41 correspondingly. The mounting plate 41 is a step-like structure and two bolt holes are provided in the lower step for fixing the mounting plate 41 to the mounting interface of first traction rod 12 through the bolts 43. Two bolt holes (not shown) are provided in the upper step, and the two bolt holes respectively correspond to and communicate with the bolt holes of mounting interface of first traction rod 12 below. The bolt 18 simultaneously passes through the bolt holes of the mounting interface of first traction rod 12 and the bolt holes in the upper step of the mounting plate 41, and the upper and lower parts of the mounting interface of first traction rod 12 are fixed and connected together.

[0057] As shown in Fig. 6 and Fig. 11 to 15, the rotary mechanism 101 comprises a slewing bearing 14 and a connecting seat of vehicle body 19. The center of the upper surface of the swing bolster 11 is a recessed accommodating cavity 13 in which the slewing bearing 14 is mounted. The slewing bearing 14 is fixedly connected

to the swing bolster 11 on the circumference by a plurality of bolts 15. The accommodating cavity 13 protects the slewing bearing 14 and increases the carrying capacity of the slewing bearing 14. Penetrated bolt holes 38 are provided on the circumference of the swing bolster 11, and the bolt hole 38 is a countersunk hole. A plurality of bolts 15 are correspondingly inserted through the bolt holes 38 from the bottom and are fixedly connected to the slewing bearing 14. The head of the bolt 15 is mounted inside the countersunk hole, in order to facilitate the installation and to prevent the head of the bolt 15 from protruding to the outside of the swing bolster 11.

[0058] As shown in Fig. 15, the connecting seat of vehicle body 19 is a disc-like structure, the center of the connecting seat of vehicle body 19 is a through-opening 20, and the through-opening 20 is raised upwardly to form an annular boss 24. The annular boss 24 is inserted into an underframe 23 of the vehicle body during installation, conducive to installation and positioning. The periphery of the through-opening 20 is provided with an inner and an outer loop of bolts. Twelve inner loop of bolts 21 are provided and are fixedly connected with the underframe 23 of the vehicle body. Twenty-four outer loop of bolts 22 are provided and are fixedly connected with the slewing bearing 14 and are fixedly connected with the underframe 23 of the vehicle body at the same time. It is convenient for the operator to fixedly connect the connecting seat of vehicle body 19 and the underframe 23 and to mount the whole in the slewing bearing 14, and the connecting seat of vehicle body 19 and the slewing bearing 14 are fixed by the outer loop of bolts 22 from above the underframe 23. A loop of annular mounting tables 25 projecting downwardly are provided on periphery of through-opening 20 of the lower surface of the connecting seat of vehicle body 19, and the annular mounting table 25 is pressed to the inside of slewing bearing 14 to be fixed during installation. The lower half of the outer circumferential surface of the annular mounting table 25 is a tapered surface inclined in the center direction, playing a better guide during the installation and being conducive to the installation. The connecting seat of vehicle body 19 is machined integrally, the overall structure is simple, easy to process and also conducive to the installation.

[0059] The swing bolster 11 is connected to the underframe 23 of the vehicle body via the slewing bearing 14. The slewing bearing 14 carries the vertical, longitudinal and lateral loads, and the slewing bearing 14 is able to rotate in 360 degrees, so that the ground vehicle meets requirements of going through small curve (such as 25m) and the vehicle's small curving performance is improved.

[0060] As shown in Fig. 6, 12, 14 and 15, the swing bolster 11 is provided with an oiling mechanism 26, for filling oil for the slewing bearing 14 to ensure that the slewing bearing 14 works normally. The oiling mechanism 26 comprises a group of grease nipples 27. In the embodiment, in order to ensure the effect of oiling and the lubricating oil is distributed evenly over the slewing bearing 14, four grease nipples 27 are provided. The four grease nipples 27 are respectively connected with four oiling pipes 28, the ends of the four oiling pipes 28 are respectively provided with a strait union 40, and the oiling pipe 28 is connected with the slewing bearing 14 through the strait union 40.

[0061] The four grease nipples 27 are mounted on a mounting seat of grease nipple 29, the mounting seat of grease nipple 29 is integrally molded with a highly wear-resistant nylon material and is mounted directly in the center of the accommodating cavity 13 of the swing bolster 11, i.e., the four grease nipples 27 is mounted at the center of the slewing bearing 14. Four notches are provided on the annular mounting table 25 of the connecting seat of vehicle body 19, which is used for keeping away from the four oiling pipes 28 when the annular mounting table 25 is pressed into the inside of the slewing bearing 14. The four grease nipples 27 are self-sealing grease nipples and are provided with an elastic component inside. When the oiling is required, the operator presses the self-sealing plugging 31 at the top of the grease nipple 27 downward, the plugging 31 is opened and is communicated with an oiling opening. At the end of the oiling, the plugging 31 is released and the plugging 31 bounces upward under the action of the elastic component to seal the oiling opening.

[0062] As shown in Fig. 16 and 17, the mounting seat of grease nipple 29 is a cylindrical structure as a whole and the bottom of the cylinder is placed on the swing bolster 11. Four vertical accommodating cavities 30 extend in the vertical direction are provided on the circumferential circle of the cylinder, which are approximately semicircular and are recessed. The four grease nipples 27 are respectively mounted in the four vertical accommodating cavities 30. The vertical accommodating cavity 30 not only acts as a support for the grease nipple 27 mounted therein, but also serves to protect the grease nipple 27 during the movement of the vehicle.

[0063] In addition to the vertical accommodating cavities 30 which extend vertically on the circumferential circle of the nipple mounting seats 29, first lateral accommodating cavities 32 extending laterally around the outer circumference of the cylinder are also provided. The four oiling pipes 28 are connected to the bottom of the four grease nipples 27 through pipe joints, respectively. As shown in Fig. 14, the four oiling pipes 28 are firmly fixed to the mounting seat of grease nipple 29 by the ribbon 33, and the ribbon 33 is tied to the first lateral accommodating cavity 32. The ribbon 33 not only effectively prevents breaking off between the oiling pipe 28 and the grease nipple 27 during the operation of the vehicle, but also facilitates the disassembly. Second lateral accommodating cavities 98 extending laterally around the outer circumference of the cylinder are further provided, and the second lateral accommodating cavity 98 is set below the first lateral accommodating cavity 32. The oiling pipe 28 is bent toward the outside at the bottom and the second lateral accommodating cavity 98 is provided to facil-

itate the bending of the oiling pipe 28 and also to protect the oiling pipe 28. Since the oiling pipe 28 is a copper pipe, the oiling pipe 28 can support the grease nipple 27 above by its own strength. The grease nipple 27 is fixed by tightening the oiling pipe 28 with the ribbon 33, and the mounting structure is simple and convenient.

[0064] A movable top cover 102 is mounted on the vehicle body underframe corresponding to the space above the through-opening 20 in the center of the connecting seat of vehicle body 19. When the oiling is required, the top cover 102 is opened to expose the grease nipple 27 below, and the top cover 102 is covered after the oiling is completed. Not only can the slewing bearing 14 be oiled at any time, but it is also simple and convenient for routine maintenance.

[0065] As shown in Fig. 11 and 12, two recessed cavities 34 are provided on two corners in the upper surface of the swing bolster 11. The recessed cavity 34 works as a reinforcing rib to enhance the structural strength and stiffness of the swing bolster 11. A drain port 35 is respectively provided in each of the two recessed cavities 34, and the drain port 35 penetrates through the swing bolster 11, to facilitate the discharge of the rainwater and the flushing water stored in the recessed cavity 34. As shown in Fig. 11 and 12, the outside of the four centrally converging sides of the swing bolster 11 are respectively provided with first reinforcing ribs 36 protruding outwards.

[0066] As shown in Fig. 13, on the lower surface of the swing bolster 11, two damper mounting seats 37 extending downward are arranged at the edge to the outside of the frame 2. The transverse dampers 9 and vertical dampers 10 are fixedly mounted on the damper mounting seats 37 via bolts 90. Two damper mounting seats 37 are set side by side, one is applied to fix a transverse damper 9 and a vertical damper 10, and the other one is used to fix another vertical damper 10. The first reinforcing rib 36 and the damper mounting seat 37 are integrally formed with the swing bolster 11, and are transited with the swing bolster 11 through arcs. The first reinforcing rib 36 and the damper mounting seat 37 further improves the structural strength and stiffness of the swing bolster 11.

[0067] As shown in Fig. 4, 6, 13 and 14, a protruding part 45 is projected downward at a central position of the lower surface of the swing bolster 11 and the protruding part 45 is integrally formed with the swing bolster 11 or the two parts are welded together. As shown in Fig. 2, the end beam 82 of the frame 2 is provided with an opening 46 for the protruding part 45 to insert, corresponding to the protruding part 45. The opening 46 is a rectangular structure, and the length in the transverse direction of the vehicle body is larger than the length in the longitudinal direction of the vehicle body. An opening 46 is provided on each of the two end beams 82, in regard to the two swing bolsters 11.

[0068] As shown in Fig. 6, two transverse backstops 47 are mounted on the side walls of the two transverse sides of each opening 46. The two transverse backstops 47 protrude from both sides towards the protruding part 45 below the swing bolster 11. The protruding part 45 below the swing bolster 11 extends to the space between the two transverse backstops 47. A transverse stop gap is left between the protruding part 45 and each transverse backstop 47. The transverse backstop play a better role in the horizontal stop in the operating process of the vehicle, thus to limit the lateral displacement of the vehicle beyond normal degrees of freedom, in order to avoid dangerous conditions such as the rollover when the vehicle goes through small radius of curve.

[0069] As shown in Fig. 18, in the embodiment, the transverse backstop 47 is composed of three layers, namely, a wear-resisting layer 47a, a rubber layer 47b and a bottom layer. The wear-resisting layer 47a is located on the top layer which is in contact with the protruding part 45 of the swing bolster 11. The transverse backstop 47 is in contact with the protruding part 45 of the swing bolster 11 via the wear-resisting layer 47a. The wear-resisting layer 47a is made of a nylon material with high abrasion resistance characteristics. The abrasion resistance characteristics of the nylon material improve the service life of the transverse backstop 47. The rubber layer 47b is provided between the wear-resisting layer 47a and the bottom layer, the rubber layer 47b is integrally molded by vulcanization with the bottom layer, and the wear-resisting layer 47a and the rubber layer 47b are bonded together by glue. As shown in Fig. 6, the bottom layer is secured to the side wall of the opening 46 in the end beam 82 by bolts 48. As shown in Fig. 18, the bottom layer is composed of three parts, and they are a first bottom plate 47c, a second bottom plate 47d and a third bottom plate 47e, respectively. The first bottom plate 47c is located at the bottom of the bottom layer and an opening is at the center of the first bottom plate 47c, and the cylindrical second bottom plate 47d with a thicker thickness is welded to the opening. The second bottom plate 47d extends into the inside of the rubber layer 47b and an inner tapping hole 47f is provided in the center of the second bottom plate 47d. The inner tapping hole 47f penetrates the second bottom plate 47d and the third bottom plate 47e is fixed to the top of the inner tapping hole 47f, thus the structure plays a role of a backstop while ensuring the strength of the joint. The first bottom plate 47c, the second bottom plate 47d and the third bottom plate 47e and the rubber layer 47b are integrally vulcanized and formed. The inner tapping hole 47f could be a notch structure that does not penetrate through the second bottom plate 47d and it is not necessary to separately provide the third bottom plate 47e in this situation. As shown in Fig. 6, a mounting hole 50 is formed in the side wall of the end beam 82. A bolt 48 passes through the mounting hole 50 of the end beam 82 and is fixedly connected with the inner tapping hole 47f of the bottom layer of the transverse backstop 47, then the transverse backstop 47 is fixed to the end beam 82. A fixed washer (not shown in figures) is mounted between the mounting hole 50 in the side wall of the end beam 82 and the head of the bolt 48.

[0070] The transverse backstop 47 ensures a good stiffness curve performance under the requirements of the elasticity, and ensures that the lateral displacement of the transverse backstop 47 is minimized in the worst operating conditions. The shaking caused by the traverse movement of the vehicle is greatly reduced, the running smoothness is improved and the ride comfort is increased. The structure is simple, the performance is reliable and the durability is strong.

[0071] When the transverse backstop 47 is mounted, it is necessary to adjust the transverse stop gap between the top of the transverse backstop 47 and the protruding part 45 of the swing bolster 11. One or more adjusting shims 49 are further provided between the first bottom plate 47c of the transverse backstop 47 and the side walls of the end beam 82, and the adjustment is convenient and fast.

[0072] As shown in Fig. 4, a longitudinal backstop 42 extends, from each of the two side walls in the longitudinal direction inside the opening 46, to the protruding part 45. The longitudinal backstop 42 functions as a longitudinal bearing, and the longitudinal backstop 42 engages with the protruding part 45 to drive the vehicle to operate when the traction rod 16 fails to work.

[0073] When the vehicle runs at a high speed, the vertical vibration occurs due to the line problem, and vertical impacts are caused on the vehicle body. As shown in Fig. 6 and 14, in the embodiment, a lifting device is provided between the swing bolster 11 and the end beam 82 of the frame 2 to limit the maximum vertical vibration distance of the vehicle body so as to avoid overshooting. The lifting device not only limits the maximum vertical vibration distance of the vehicle body, but also plays a role of the overall lifting of the bogie.

[0074] As shown in Fig. 6 and 14, the lifting device is two lifting rods 51 which are mounted on the lower surface of the swing bolster 11. The two lifting rods 51 are arranged symmetrically on two lateral sides of the protruding part 45, to ensure the connection strength and to maintain the balance when lifting. The structures of the two lifting rods 51 are the same, the top end of the lifting rod 51 is connected to the swing bolster 11, and the bottom end of the lifting rod 51 is connected to the end beam 82 of the frame 2.

[0075] As shown in Fig. 19, the main body of the lifting rod 51 is a long cylinder, the top end of the lifting rod 51 is a T-shaped head, and the two sides of the T-shaped head are stop planes 57. The bottom of the lifting rod 51 has an external thread and the upper portion of the external thread is a stop portion 61 with a slightly larger diameter.

[0076] As shown in Fig. 6 and 14, a fixing port 52 is designed in the lower surface of swing bolster 11 where the lifting rod 51 is to be mounted. A backing plate 53 is provided inside the fixing port 52, i.e., above the top end of the lifting rod 51. An anti-loosing backing plate 54 is mounted on the outer circumference of the fixing port 52. The inner circle of the anti-loosing backing plate 54 is two straight lines opposed to the stop plane 57 of the lifting rod 51, for restricting the rotation of the lifting rod 51. A mounting block 55 is further provided below the anti-loosing backing plate 54, and the inner circle of the mounting block 55 is a tapered surface which cooperates with the bottom surface of the T-shaped head of the lifting rod 51. The bottom of the outer circle of the mounting block 55 is designed with a step-like structure and four bolt holes are provided in the step-like structure. The mounting block 55 and the swing bolster 11 are fixed together via four bolts 56. The T-shaped head of the lifting rod 51 is fixed by the mounting block 55 after installation. Meanwhile, the mounting block 55 is also provided with a recessed annular groove which is filled with a sealing ring 58 therein, thus to further seal and fix the whole structure.

[0077] As shown in Fig. 6, a lifting opening 59 is provided for each lifting rod 51 on the end beam 82 of the frame 2 and the lifting opening 59 is symmetrically set on both sides of the opening 46. A bayonet 60 is provided at the bottom of the lifting rod 51 and the diameter of the bayonet 60 is greater than the diameter of the lifting opening 59. The bayonet 60 is away from the lifting opening 59 with a vertical distance and the distance is the maximum vertical vibration distance allowed. The inner surface of the bottom of the bayonet 60 is a tapered surface and a locating block 62 is mounted below the bayonet 60. The upper surface of the locating block 62 is a tapered surface cooperating with the tapered surface of the bayonet 60. The inner circle of the locating block 62 is designed with a step-like structure and the step-like structure is abutted against the stop portion 61 of the lifting rod 51 after installation, to play a role of locating and stopping. A nut 63 is tightened on the bottom of the lifting rod 51 below the locating block 62 for fixation. The inner circle of the bayonet 60 has a recessed annular groove which is provided with an O-shaped sealing ring 64 therein, for fixation and sealing. After installation, if the swing bolster 11 moves in the vertical direction, the bayonet 60 at the bottom of the lifting rod 51 is locked at the lifting opening 59, thereby avoiding overshooting. At the same time, when the lifting rod 51 is lifted, the bayonet 60 is caught on the frame 2, to achieve the overall lifting of the bogie and the vehicle body.

[0078] As shown in Fig. 6, the end beam 82 at the lifting opening 59 is provided with an upward-concaving portion 65 in order to protect the lifting rod 51. The mounting hole 50 for mounting the bolt 48 of the transverse backstop 47 is arranged on the side wall of the upward-concaving portion 65 and the lifting opening 59 is arranged on the top wall of the upward-concaving portion 65. The upward-concaving portion 65 not only facilitates the installation of the transverse backstop 47 and the lifting rod 51 conveniently, but also facilitates routine maintenance. Additional structures such as transverse backstop mounting seats and vertical backstop mounting seats are not needed, so that the structure of the bogie 1 is simplified to a certain extent and the weight of the bogie 1 is also re-

duced.

[0079] As shown in Fig. 6 and 20, two groups of secondary spring mechanisms 8 are provided between each swing bolster 11 and the frame 2. The two groups of secondary spring mechanisms 8 are arranged symmetrically in the lateral direction of the frame 2 outside the two lifting rods 51, and the structures of the two groups of secondary spring mechanisms 8 are the same. As shown in Fig. 21, the secondary spring mechanism 8 is composed of an upper backing plate 66, a lower backing plate 67 and a spring in the middle. The spring in the middle is a steel double-round spring and is composed of an inner spring 68 and an outer spring 69. Not only the overall structure of the secondary spring is compact and the performance is stable, but also the operation stability of vehicle is also improved. It meets the requirements of large passenger capacity, especially for low-floor urban rail vehicles with limited space between the vehicle body and bogie.

[0080] The upper backing plate 66 is composed of an upper metal plate 66a, a lower metal plate 66b and a rubber layer 66c in the middle. The rubber layer 66c is vulcanized together with the upper metal plate 66a and the lower metal plate 66b and the upper backing plate 66 is provided with a central hole 66d. As shown in Fig. 14 and 20, a first mounting groove 70 is provided on the lower surface of the swing bolster 11 corresponding to the upper backing plate 66. An annular mounting portion 71 protruding downwards is provided at the center of the first mounting groove 70, and the mounting portion 71 matches with the center hole 66d and is inserted into the center hole 66d, for positioning and fixation. The diameter of the first mounting groove 70 matches with the upper backing plate 66, so that the upper backing plate 66 is caught in the first mounting groove 70 and is fixed. Meanwhile, the center hole 66d is caught in the mounting portion 71, thereby the upper backing plate 66 and the swing bolster 11 are fixedly connected. There is no need for a conventional bolt connection between the upper backing plate 66 and the swing bolster 11, thus, to make the mounting and dismounting easier and more convenient, to reduce the use and maintenance of fasteners and to make the structure of the secondary springs 8 more compact, so that the device is more suitable for low-floor urban rail vehicles with limited space between the vehicle body and bogie.

[0081] The lower surface of the lower metal plate 66b of the upper backing plate 66 bulges downwards to form an upper spring locating protrusion 66e which is ring-shaped. The upper spring locating protrusion 66e is located between the inner spring 68 and the outer spring 69. The upper spring locating protrusion 66e is a metal plate and is welded together or integrally molded with the lower metal plate 66b.

[0082] As shown in Fig. 2, 20 and 21, a second mounting groove 72 corresponding to each secondary spring mechanism 8 is provided on the end beam 82 of the frame 2. The diameter of the second mounting groove 72 matches with the lower backing plate 67, so that the lower backing plate 67 is caught in the second mounting groove 72 and is fixed. The lower backing plate 67 is composed of a locating seat 67a and an adjusting pad, and the locating seat 67a is a metal plate. The upper surface of the locating seat 67a bugles upwards to form a lower spring locating protrusion 67b which is ring-shaped. The spring locating protrusion 67b is located between the inner spring 68 and the outer spring 69. The spring locating protrusion 67b is a metal plate and is welded together or integrally molded with the locating seat 67a. After installation, the lower backing plate 67 is secured to the bottom of the second mounting groove 72 of the frame 2 and the secondary spring mechanism 8 and the end beam 82 are fixedly connected. There is no need for a conventional bolt connection between lower backing plate 67 and the end beam 82, to make the mounting and dismounting easier and more convenient, thus, to reduce the use and maintenance of fasteners and to make the structure of the secondary spring 8 more compact. The second mounting groove 72 of the end beam 82 is an inverted conical structure. While the secondary spring 8 is fixed, it also prevents the secondary spring 8 from colliding with the inner wall of the second mounting groove 72 when the vehicle is running. In the embodiment, the second mounting groove 72 is a sinking structure, and the height of the floor surface is further reduced.

[0083] On one hand, the upper spring locating protrusion 66e and the lower spring locating protrusion 67b act as a damper, and on the other hand, this "protrusion" structure separates the inner spring 68 and the outer spring 69. When the vehicle passes a small curve, that is, when a large displacement occurs of the secondary spring mechanism 8, the possibility of collision between the inner spring 68 and the outer spring 69 is lowered, thus, it effectively prevents the instability of the secondary spring 8.

[0084] The adjustment pad of the lower backing plate 67 has two different structures. One is an inner spring adjusting pad 67c, the inner spring adjusting pad 67c is a rubber pad and is mounted against the inner ring of lower spring locating protrusion 67b which is the bottom of the inner spring 68, for adjusting the inner spring 68 at a predetermined load compression height. The other one is an outer spring adjusting pad 67d. The outer spring adjusting pad 67d is a rubber pad and is mounted against the outer ring of lower spring locating protrusion 67b which is the bottom of the outer spring 69, for adjusting the outer spring 69, to ensure the height of the inner spring 68 and the outer spring 69 compressed at the same working load, thereby to ensure the smooth operation between the vehicle body and the bogie. At the same time, the upper backing plate 66 uses the flexibility of the rubber layer 66c to greatly reduce the vibration and the impact caused by the steel spring.

[0085] A cylindrical protective cover 73 is mounted between the first mounting groove 70 and the second mounting groove 72. The secondary spring mechanism

8 is enclosed within the protective cover 73. The protective cover 73 is preferably vulcanized and made of a rubber which has an excellent oil resistance and corrosion resistance. The protective cover 73 is composed of an upper engaging portion, an intermediate cylindrical portion and a lower engaging portion, and the intermediate cylindrical portion is a wavy structure. The upper engaging portion and the lower engaging portion are respectively sealed and fixedly connected to the first mounting groove 70 and the second mounting groove 72. It not only facilitates the installation and removal of the protective cover 73, but also makes the secondary spring mechanism 8 sealed into the protective cover 73 to prevent oil, water droplets, etc. from penetrating into the frame and causing corrosion. In addition, when the vehicle is operating, the dustproof structure has the foldable characteristics with a "wave" shape itself, so as to seal with different spring deformations under different loads.

[0086] As shown in Figs. 20 and 21, in the embodiment, a vertical backstop 74 is provided at the center of the inner spring 68. The vertical backstop 74 is fixed to the upper backing plate 66 of the secondary spring mechanism. The vertical backstop 74 is composed of a rubber 74a, a bottom plate 74b and a stopper plate 74c. The rubber 74a, the bottom plate 74b and the stopper plate 74c are vulcanized together, the rubber 74a is set below the bottom plate 74b and the center of the bottom plate 74b has an internal screw hole (not shown). The stopper plate 74c is set at the bottom of the internal screw hole. The bottom plate 74b and the stopper plate 74c are metal plates. The vertical backstop 74 cooperates with a boss 76 and act as a safety support, to ensure the travel safety of the rail vehicle, even if a secondary spring is broken. The lower metal plate 66b of the upper backing plate 66 of the secondary spring mechanism 8 has a mounting hole in the center. The bottom plate 74b and the lower metal plate 66b are fixedly connected together by bolts 75. An adjusting plate 74d is also provided between the bottom plate 74b and upper backing plate 66, for adjusting the vertical stop gap between the bottom of the vertical backstop 74 and the top of the boss 76 during installation.

[0087] As shown in Fig. 20, in the second mounting groove 72 of the end beam 82, a boss 76 bulging upwards is arranged, which is integrally cast with the frame 2. An opening is provided at the center of the lower backing plate 67 of the secondary spring mechanism 8, and the boss 76 is inserted in the opening of the lower backing plate 67 after installation, which extends into the inside of the inner spring 68 and faces right to the vertical backstop 74. A vertical stop gap is provided between the bottom of the vertical backstop 74 and the top of the boss 76. The bottom of the vertical backstop 74 is not in contact with the top of the boss 76 when the vehicle is normally operating. Only when the secondary spring mechanism 8 is compressed under a larger load, the bottom of the vertical backstop 74 is in contact with the top of the boss 76 and the vertical backstop 74 is further compressed. The rigidity of the double steel circular spring is linear and the rigidity of the vertical backstop 74 which is made of the rubber material is non-linear, the vertical backstop 74 is in contact with the boss 76 of the second mounting groove 72 and is compressed when the load amount is large. Thus, the structure acts as a stopper and plays a role of changing the stiffness at the same time, which is beneficial to improve the dynamic performance of the operation of the vehicle.

[0088] As shown in Fig. from 2 to 5, the central cross beam 77 of the frame 2 is provided with an elongated annular groove 83 which extends laterally. The upper and lower surfaces of the central cross beam 77 are respectively provided one annular groove 83. The intermediate connection of the central cross beam 77 increases the structural strength and the capacity of carrying load. The two elongated annular grooves 83 are alternative to be arranged through the upper and lower surfaces. A mounting interface of second traction rod 84 is mounted on both side walls of the annular groove 83 of the central cross beam 77 and four mounting interfaces of second traction rod 84 are mounted on each side wall. The four mounting interfaces of second traction rod 84 are arranged side by side on one side wall of the annular groove 83. Two mounting interfaces of second traction rod84 in the middle are close to each other and fixed, or are set as an integral structure. The four mounting interfaces of second traction rod 84 are used for fixing four connecting seats 16c on the ends of the two traction rods 16. That the annular groove 83 is provided in the central cross beam 77 greatly facilitates the disassembly of the mounting interface of second traction rod 84.

[0089] The mounting interface of second traction rod 84 is designed as a separate structure, which is divided into a left part and a right part. Each part has a semicircular mounting opening and the two parts are engaged to form a complete second mounting opening 39, for accommodating the connecting seat 16c at the end of the traction rod 16. One part is fixedly connected to the side wall of the central cross beam 77 and the center of the part of the mounting interface of second traction rod 84 is a smooth through hole. Accordingly, a threaded hole with an internal thread is also provided on the side wall of the central cross beam 77. The part of the mounting interface of second traction rod 84 and the central cross beam 77 are fixed together by bolts 85., A groove 103 is provided on the inner wall of the part of the mounting interface of second traction rod 84 for accommodating the head of the bolt 85, in order to prevent the bolts 85 from affecting the installation of the traction rod 16 after installation. The two connecting seats 16c at the ends of the traction rod 16 are placed in a semicircular mounting opening on both sides, the other part of the mounting interface of second traction rod is engaged and the two parts are fixedly connected together by bolts 86, and then the connecting seats 16c at the ends of the traction rod 16 are fixed. The nut 104 for tightening the end of the bolt 86 extends from the center of the annular groove 83,

is inserted to the tail of the bolt 86, and is tightened. The upper and lower annular grooves 83 are respectively provided with two nuts 104 to completely fix the traction rod 16. It is easy to operate and the installation efficiency is greatly improved. The locating pin 79 is mounted in the pin hole 78 of the connecting seat 16c in the same manner as the mounting interface of first traction rod 12 is mounted. The locating pin 79 cooperates with the pin hole on the mounting interface of second traction rod 84, so that the traction rod 16 is accurately mounted and the installation efficiency is greatly improved.

[0090] In the embodiment, a connecting seat 16c of a cylinder is provided at the end of the traction rod 16, which cooperates with the first mounting opening 17 of mounting interface of first traction rod 12 and the second mounting opening 39 of the mounting interface of second traction rod 84 to fix. Longitudinal transmission force is transmitted through a complete circular fit surface. It not only improves the vertical transmission capacity, but also reduces abrasion. At the same time, both ends of the traction rod 16 are provided with spherical joints so as to have a smaller lateral rigidity. Thus, it meets the larger lateral displacement and longitudinal displacement between the vehicle body and the bogie, and it improves the longitudinal traction capability and the anti-roll capability and improves the overall performance.

[0091] As shown in Fig. 3, 7 and 8, a transverse damper 9 and two vertical dampers 10 are mounted on the damper mounting seat 37 outside each swing bolster 11, and two vertical dampers 10 and the transverse damper 9 are arranged on both sides of the vehicle body in the transverse direction. Two damper mounting seats 37 are provided, one transverse damper 9 and one vertical damper 10 are mounted on one of the damper mounting seats 37, and one vertical damper 10 is mounted on the other damper mounting seat 37. The other ends of the transverse damper 9 and the vertical dampers 10 are fixedly connected to the end beam 82 of the frame 2.

[0092] As shown in Fig. 7, the structure of the transverse damper 9 and the vertical damper 10 are the same and are composed of a damper body 87, a first connecting rod 88 and a second connecting rod 89. The housing of the damper body 87 is provided with four mounting holes which are respectively fixed to damper mounting seat 37 of the swing bolster 11 by bolts 90. One end of first connecting rod 88 is fixedly connected to the damper body 87 and the other end is connected to the second connecting rod 89. The other end of the second connecting rod 89 is connected to the frame 2. A transverse damper mounting seat 100 and a vertical damper mounting seat 99 are provided on the side wall of the end beam 82. The other end of the second connecting rod 89 is connected to the transverse damper mounting seat 100 or the vertical damper mounting seat 99 of the end beam 82. The ends of the second connecting rod 89 are connected to the first connecting rod 88, the transverse damper mounting seat 100 or the vertical damper mounting seat 99 by a joint bearing 91. The outer ring of the joint bearing 91 is connected to the second connecting rod 89, and the inner ring of the joint bearing 91 is connected to a connecting shaft 92. The connecting shaft 92 extends from one side and sticks into the transverse damper mounting seat 100 or the vertical damper mounting seat 99 of the frame 2 and is fixed by bolts which tightens from the top. The connection structure between the second connecting rod 89 and the first connecting rod 88 is the same as the structure mentioned prior.

[0093] As shown in Fig. 8, in the embodiment, the second connecting rod 89 is divided into two sections and the two sections are connected by a connecting rod 105 in the middle. The connecting rod 105 and the two sections of the second connecting rod 89 are connected by screws. This structure facilitates the fixed connection of the second connecting rod 89 with the first connecting rods 88, the transverse damper mounting seat 100 or the vertical damper mounting seat 99 at both ends.

[0094] As shown in Fig. 7 and 8, a dust cover 93 is provided respectively on each outer side of the joint bearing 91 at both ends of the second connecting rod 89. As shown in Fig. 22, the dust cover 93 is made of a rubber material and has two openings which are an opening 94 and an opening 95. The angle between the orientations of the opening 94 and the opening 95 is 90 degrees. The opening 94 is used to overlap the second connecting rod 89 and the opening 95 is used to overlap the connecting shaft 92 which is connected to the second connecting rod 89. The diameter of the opening 95 is slightly smaller than the diameter of the connecting shaft 92 and its round edge is tapered, so that it is tightly sealed after installation. The opening 94 is slightly larger in diameter, easy to install. It is tightly tied and fixed to the second connecting rod 89 by a ribbon 96 after installation. There is a wave structure in the position where the dust cover 93 is close to the opening 95, and the sufficient deformation margin is increased. And an oil filler port 97 is provided on the joint bearing 91 below the second connecting rod 89.

[0095] As shown in Fig. 7, the first connecting rod 88 of the transverse damper 9 is set vertically. The second connecting rod 89 is provided laterally, the first connecting rod 88 of the vertical damper 10 is provided laterally and the second connecting rod 89 is provided vertically. Since the joints are connected by means of joint bearings 91, the second connecting rod 89 swings in a certain degree in the lateral or vertical direction when the vehicle is subjected to lateral or vertical vibration, thereby the first connecting rod 88 is driven to swing. The damper body 87 restricts the swing angle of the first connecting rod 88 and further plays a damping effect in the lateral and vertical direction.

[0096] In the present disclosure, the transverse damper 9 and the vertical damper 10 are mounted between the side walls of the swing bolster 11 and the sides of the end beam 82 of the frame 2, the damper body 87 is connected with the frame 2 which acts as a vibration source through the first connecting rod 88 and the second

connecting rod 89. Not only the rotational motion of the damper body 87 is converted into the linear motion of the second connecting rod 89, the lateral and vertical displacement magnification is effectively achieved and the damping effect of the damper is increased. The adjustment is more flexible, the structure of the bogie is more simple and compact, and it is more conducive to reduce the height of the floor.

[0097] As described above, a similar technical scheme can be derived from the scheme contents given in the accompanying drawings. Any modifications, equivalents and modifications of the foregoing embodiments are within the scope of the technical solutions of the present disclosure without departing from the scope of the technical solutions of the present disclosure in accordance with the technical aspects of the present disclosure.

Claims

1. A suspension traction device of bogie for a low floor articulated rail vehicle, comprising a swing bolster mechanism, a traction rod mechanism, a primary spring mechanism and a secondary spring mechanism, and
the secondary spring mechanism being arranged between the swing bolster mechanism and a frame of the bogie,
wherein two groups of the swing bolster mechanisms and two sets of the traction rod mechanisms are provided,
two groups of swing bolster mechanisms are provided respectively in a middle of two groups of wheelsets, and
each group of the swing bolster mechanism is connected to the frame via one set of traction rod mechanism, and each group of the swing bolster mechanism is connected to a vehicle body by a rotary mechanism.

2. The suspension traction device of the bogie for the low floor articulated rail vehicle according to claim 1, wherein,
two sets of the traction rod mechanisms are arranged in a middle of two side beams of the frame and are arranged separately on two sides of a central cross beam of the frame,
each set of the traction rod mechanism comprises one or more traction rods, and one end of the traction rod is connected with the central cross beam and the other end of the traction rod is connected with the swing bolster mechanism.

3. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 1 or 2, wherein, a first mounting interface of traction rod is provided on the swing bolster mechanism and a second mounting interface of traction rod is provided on the frame,
two ends of the traction rod mechanism are respectively fixed to the first mounting interface of traction rod and the second mounting interface of traction rod ,
and the first mounting interface of traction rod and the second mounting interface of traction rod are separate structures.

4. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 3, wherein, an upper section of the first mounting interface of traction rod has an arc portion curving downward.

5. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 3, wherein, semicircular openings are respectively provided on two separate parts of the first mounting interface of traction rod and the second mounting interface of traction rod, and the two semicircular openings are assembled together to form a first mounting opening and a second mounting opening, which are circular, for mounting the traction rod, and
the two separate parts are fixed and connected by bolts.

6. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 5, wherein, the traction rod comprises spherical joints at both ends and a rod in between,
one connecting seat is mounted on each of the two spherical joint axes of each spherical joint, and
the connecting seats at two ends of the traction rod are respectively fixed inside the first mounting opening and the second mounting opening.

7. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 6, wherein, an end of the rod is U-shaped and the spherical joint is inserted into the U-shaped structure and is fixedly connected to the rod by fasteners.

8. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 2, wherein, the central cross beam is integrally casted and shaped, and two ends of the center cross beam are welded to lateral plates of two side beams.

9. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 1, wherein, the secondary spring mechanism is composed of an upper backing plate, a lower backing plate and a spring in between,
a vertical backstop is provided inside the spring and is fixed to the upper backing plate,
a boss budging upward is provided on the frame, and the boss inserts into the spring after installation and

faces right to the vertical backstop.

10. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 9, wherein there is a vertical stop gap or direct contact between the bottom of the vertical backstop and the top of the boss.

11. A suspension traction device of bogie for a low floor articulated rail vehicle, comprising a swing bolster mechanism, a traction rod mechanism, a primary spring mechanism and a secondary spring mechanism,
wherein two groups of swing bolster mechanisms are provided respectively between the two groups of wheel-sets and
a lifting device is provided between each group of the swing bolster mechanism and an end beam of a frame.

12. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 11, wherein, the lifting device comprises at least one lifting rod
top end of the lifting rod is connected to the swing bolster mechanism,
a lifting opening is provided for the lifting rod on the frame,
a bayonet whose diameter is greater than a diameter of the lifting opening is provided at a bottom of the lifting rod, and
the bayonet extends below the lifting opening.

13. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 12, wherein, the frame has an upward-concaving portion at the lifting opening,
the lifting opening is provided on a top wall of an upward-concaving portion, and
the bayonet is provided inside the upward-concaving portion.

14. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 12, wherein, two lifting rods are provided between each group of the swing bolster mechanism and the frame, and the two lifting rods are arranged symmetrically in a lateral direction of a vehicle body below the swing bolster mechanism.

15. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 12, wherein, a main body of the lifting rod is a long cylinder,
a top end of the lifting rod is a T-shaped head and two sides of the T-shaped head are provided with stop planes, and
a bottom of the lifting rod is provided an external thread, and a portion above the external thread is provided a stop portion with a larger diameter than that of the long cylinder.

16. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 15, wherein, a fixing port is provided in a lower surface of a swing bolster where the lifting rod is mounted,
a top end of the lifting rod is fixed in the fixing port,
a mounting block is provided below the T-shaped head of the lifting rod and is fixedly connected to the swing bolster by bolts, and
the T-shaped head of the lifting rod is stuck and fixed to the swing bolster after the mounting block is fixed.

17. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 12, wherein, the bayonet is mounted on an outer circumference of a stop portion,
a locating block is mounted below the bayonet,
an inner circle of the locating block is provided with a step-like structure and the step-like structure is abutted against the stop portion of the lifting rod after installation, and
a nut is tightened the locating block on the bottom of the lifting rod for fixation.

18. A suspension traction device of bogie for a low floor articulated rail vehicle, comprising a swing bolster mechanism, a traction rod mechanism, a primary spring mechanism and a secondary spring mechanism,
wherein, two groups of swing bolster mechanisms are provided respectively between two groups of wheel-sets,
the swing bolster mechanism comprises a swing bolster, and a protruding part protrudes downwards at a central position from a lower surface of the swing bolster, and
the protruding part inserts into an opening provided on a frame.

19. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 18, wherein, transverse backstops are respectively mounted on side walls of two transverse sides of the opening of the frame,
the protruding part below the swing bolster extends to a space between the two transverse backstops, and
a transverse stop gap is left between the protruding part and the transverse backstops.

20. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 19, wherein the transverse backstop is composed of a wear-resisting layer, a rubber layer and a bottom layer,

the wear-resisting layer is located on the top layer in contact with the protruding part of the swing bolster, the rubber layer is provided between the wear-resisting layer and the bottom layer, and
the bottom layer is fixedly connected to the frame.

21. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 20, wherein, the rubber layer is a waist-drum shape with a small diameter in the middle and large diameters at two ends.

22. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 21, wherein, a diameter of the wear-resisting layer is larger than a diameter of the end surface of the rubber layer with which the wear-resisting layer is contacted.

23. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 18, wherein, one or more recessed cavities are provided on the swing bolster and the recessed cavity is provided with a drain port.

24. A suspension traction device of bogie for a low floor articulated rail vehicle, comprising a swing bolster mechanism, a traction rod mechanism, a primary spring mechanism and a secondary spring mechanism, and the secondary spring mechanism being arranged between the swing bolster mechanism and a frame of a bogie,
wherein, two groups of swing bolster mechanisms are provided respectively between two groups of wheel-sets,
each group of the swing bolster mechanism is connected to a vehicle body via a rotary mechanism,
the rotary mechanism comprises a slewing bearing, and an oil feeding mechanism for the slewing bearing is provided at a center of the slewing bearing.

25. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 24, wherein, the oil feeding mechanism comprises a group of oil feeding nipple and the oil feeding nipple is connected to the slewing bearing via an oiling pipe.

26. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 25, wherein, the oil feeding nipple is mounted on a mounting seat of oil nipple and the mounting seat of oil nipple is fixed to the swing bolster mechanism.

27. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 26, wherein, the mounting seat of oil nipple is a structure of a cylinder,
one or more vertical accommodating cavities which extend in a vertical direction and recess inward are provided on a circumference of the cylinder, and
one oil feeding nipple is provided in each of the vertical accommodating cavities.

28. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 27, wherein, a first lateral accommodating cavity is provided on the mounting seat of oil nipple along a transverse direction around the outer circumference of the cylinder, and
the oiling pipe connected to the oil nipple is fixedly fastened by a ribbon at a position of the first lateral accommodating cavity.

29. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 26, wherein, the mounting seat of oil nipple is integrally molded with a highly wear-resistant nylon material.

30. The suspension traction device of bogie for the low floor articulated rail vehicle according to claim 29, wherein, the mounting seat of oil nipple is mounted on the swing bolster.

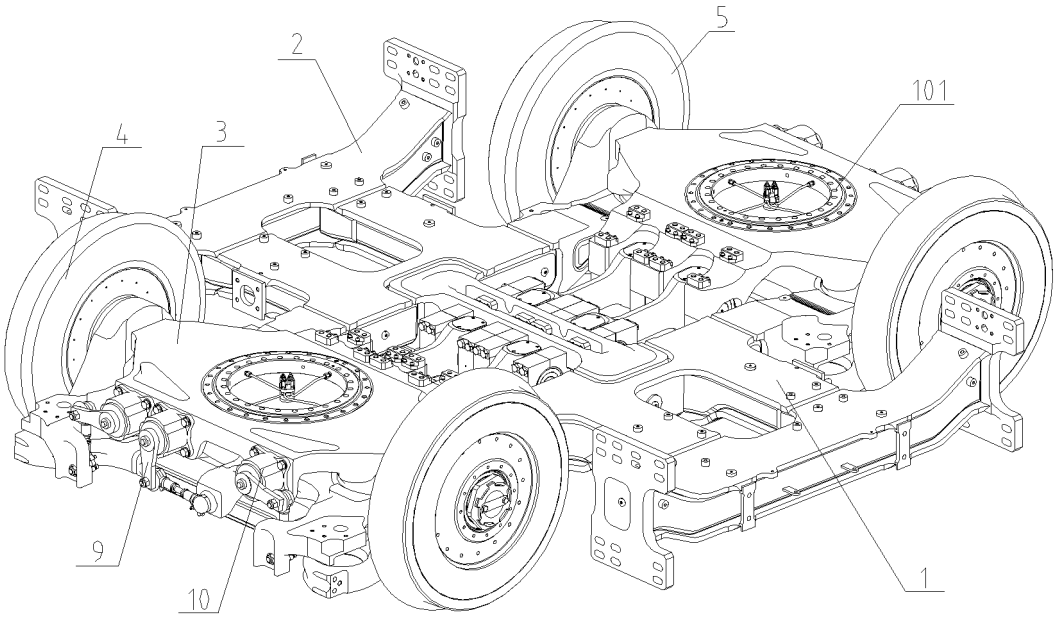

Fig. 1

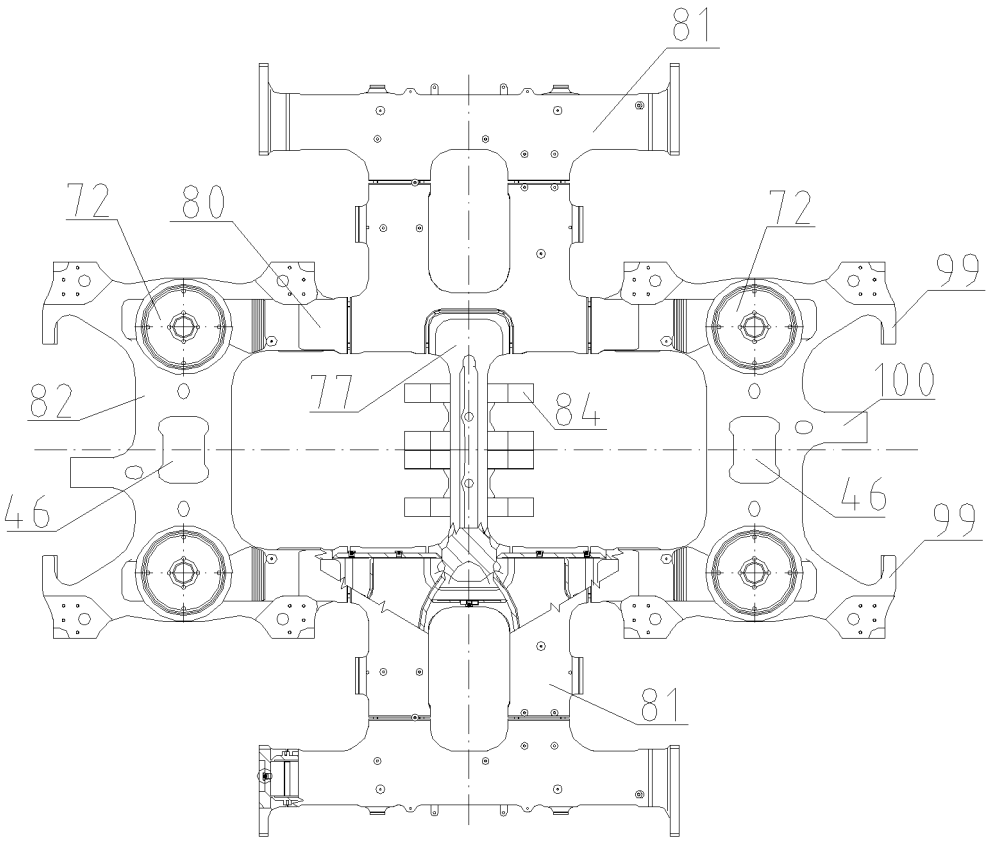

Fig. 2

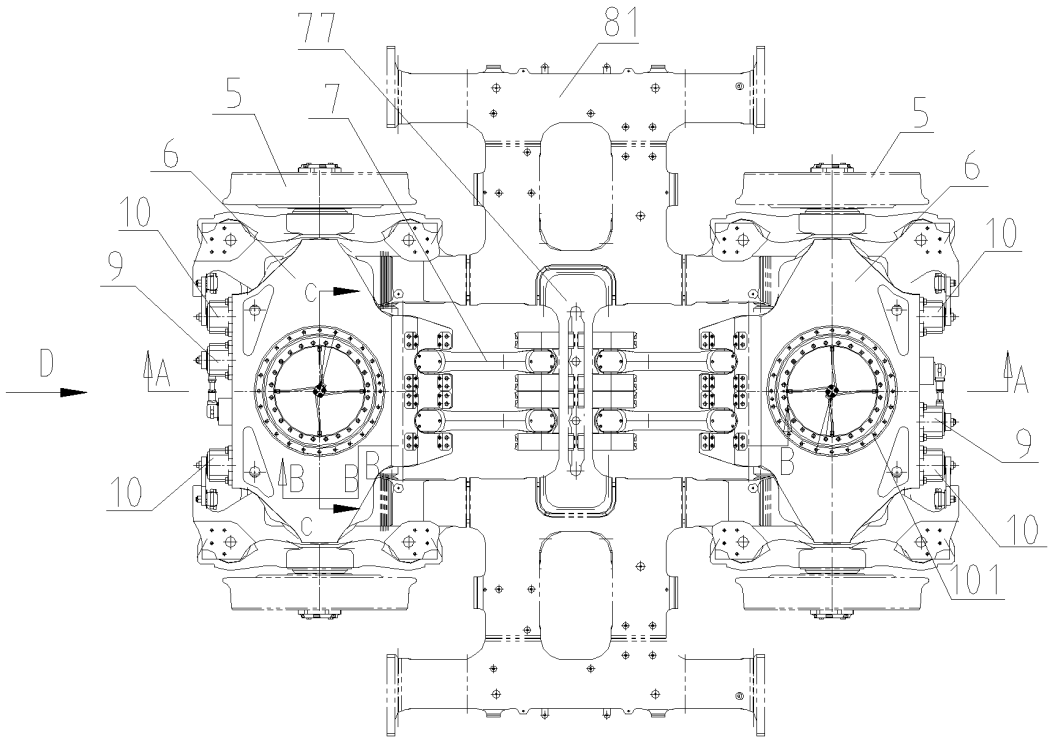
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Fig.3

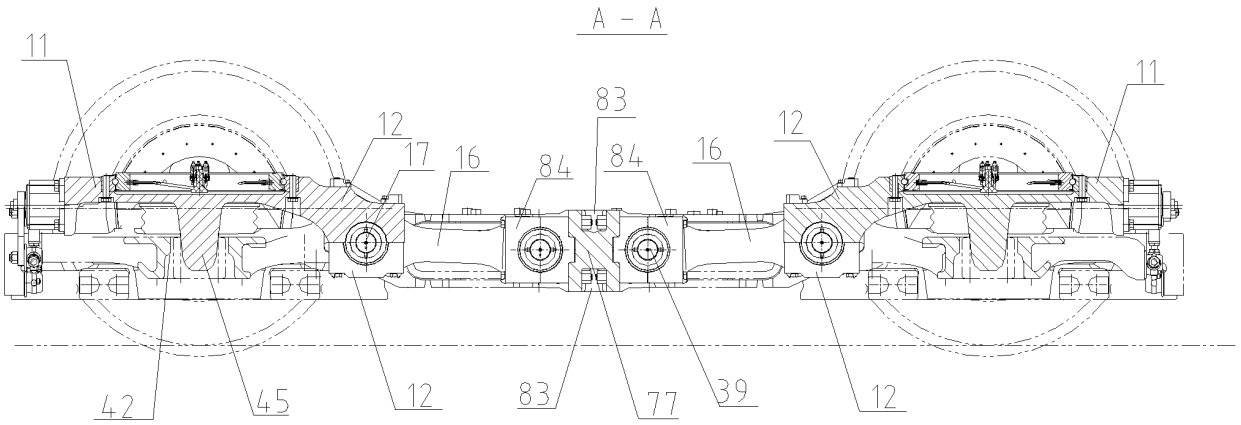
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Fig. 4

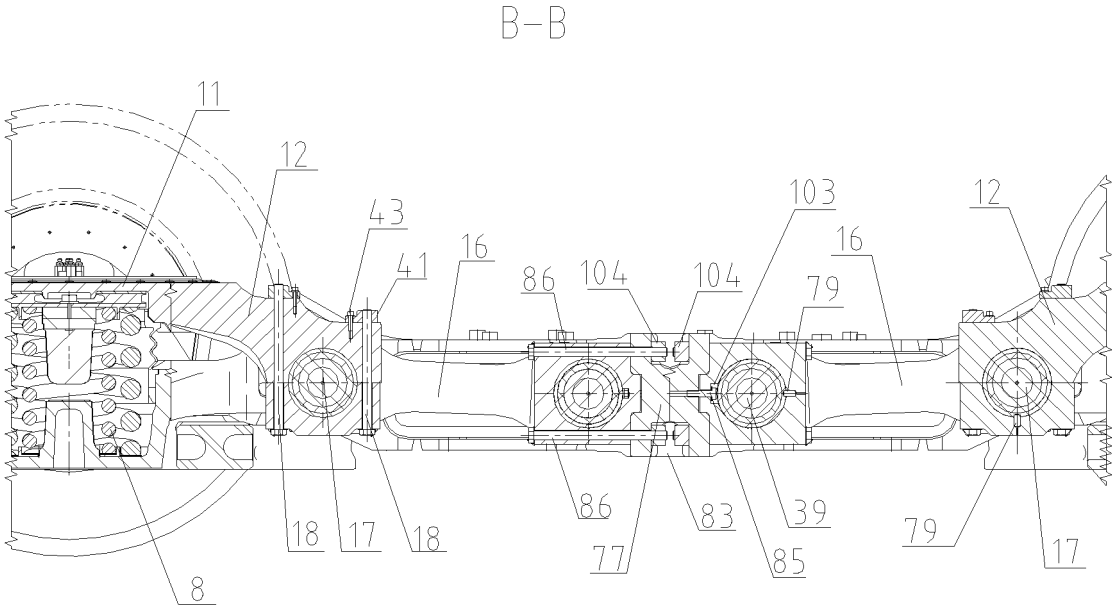
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Fig. 5

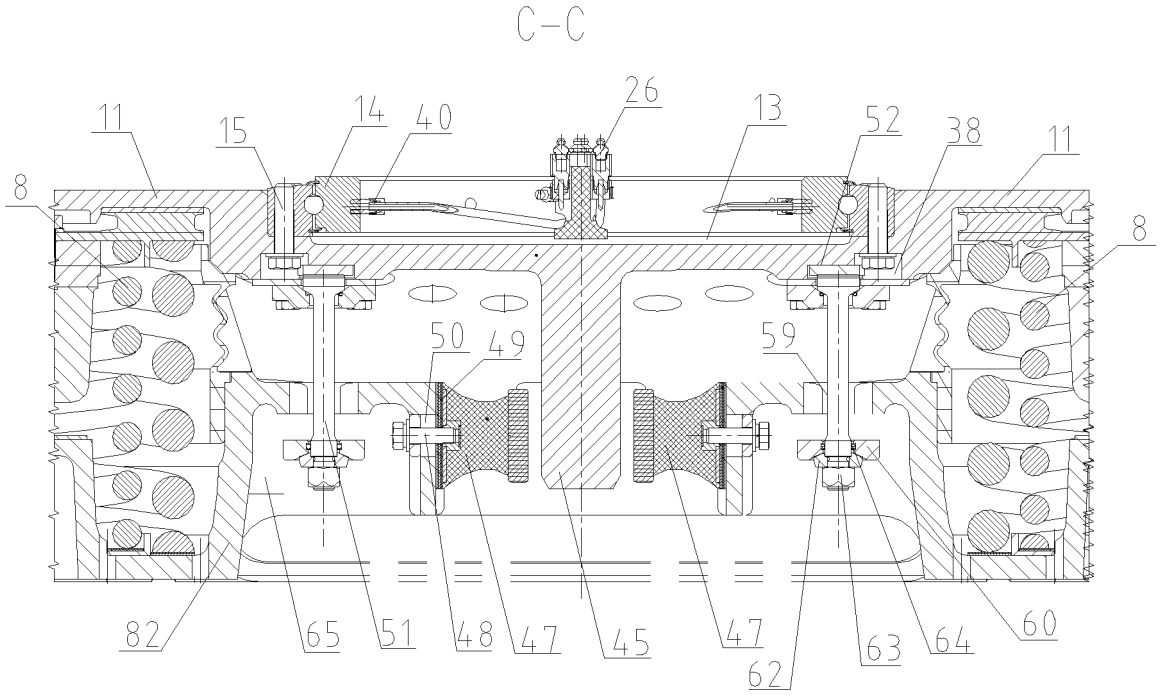
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Fig. 6

D direction

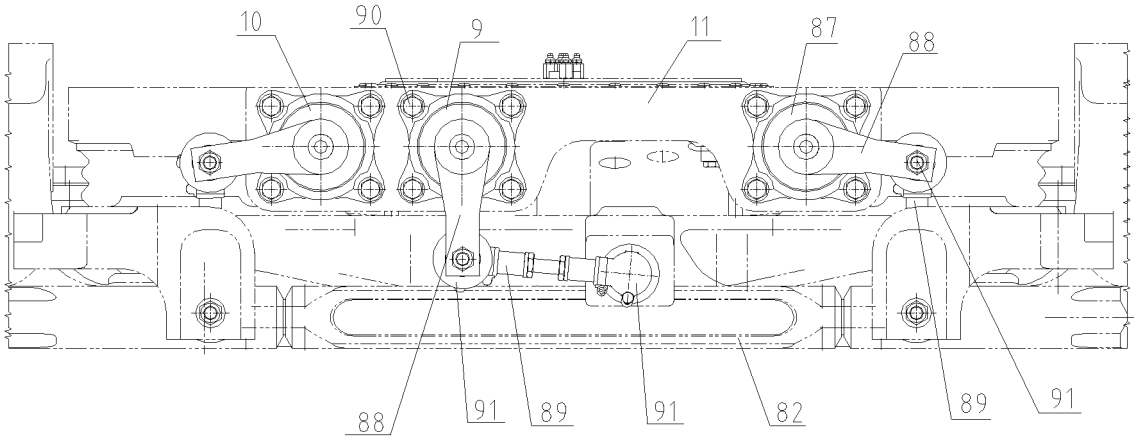


Fig. 7

E direction

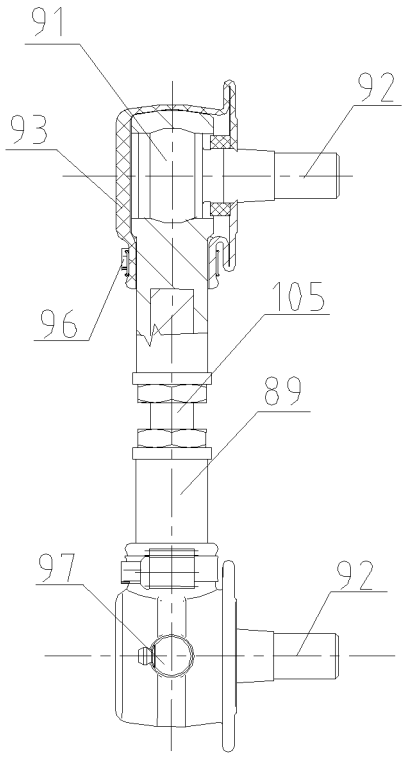


Fig. 8

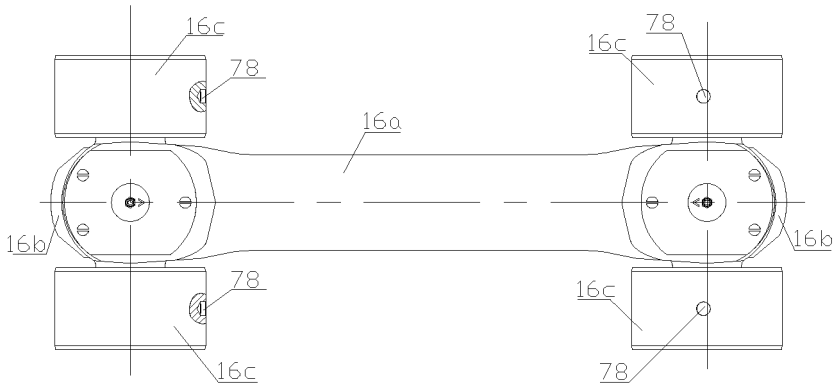


Fig. 9

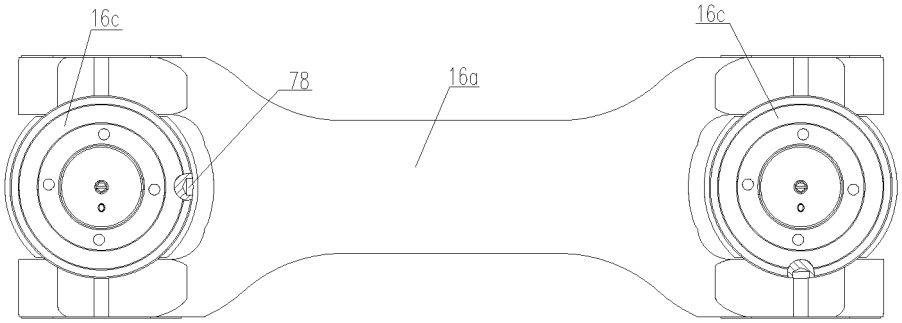


Fig. 10

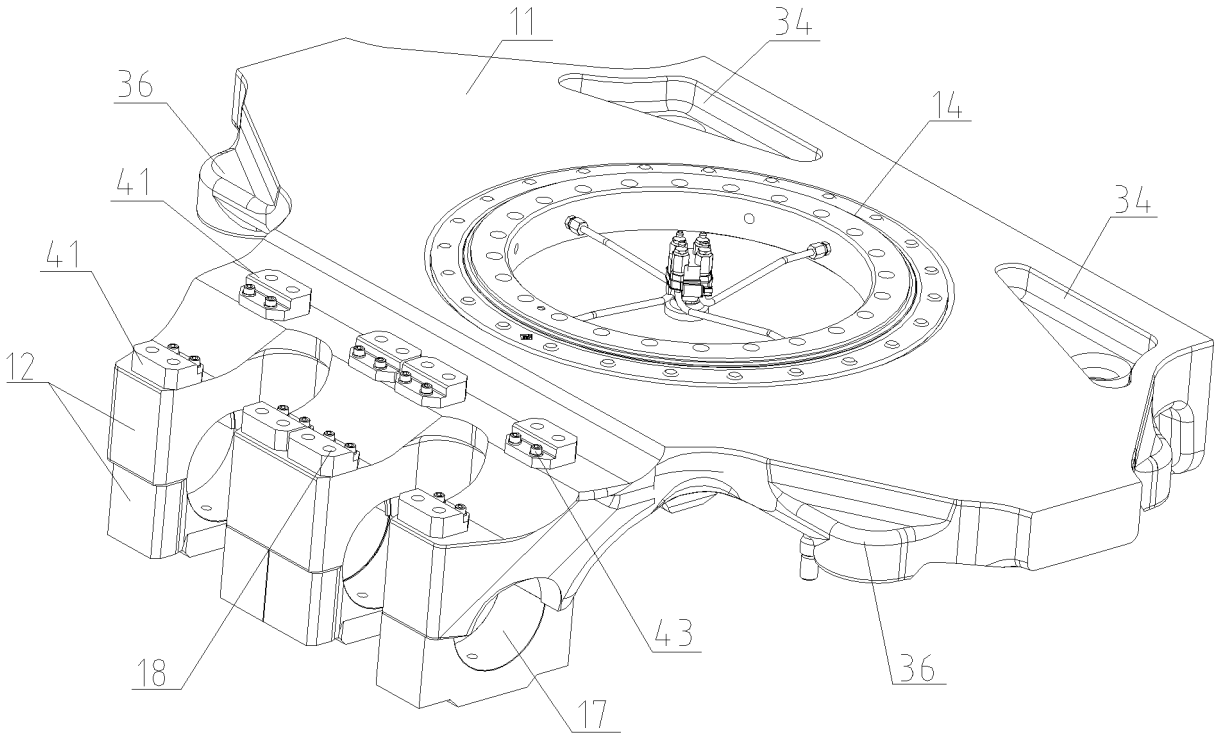


Fig. 11

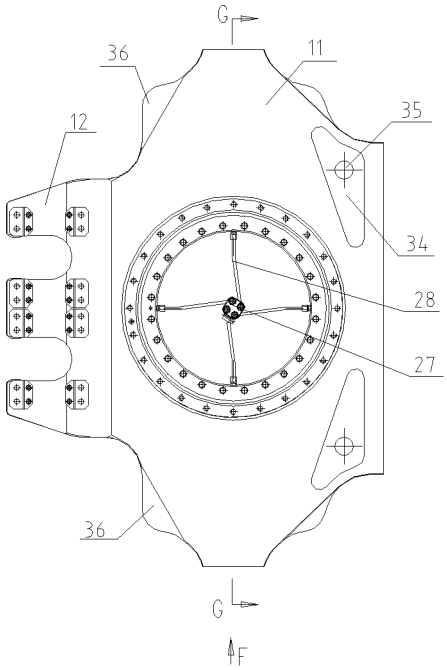
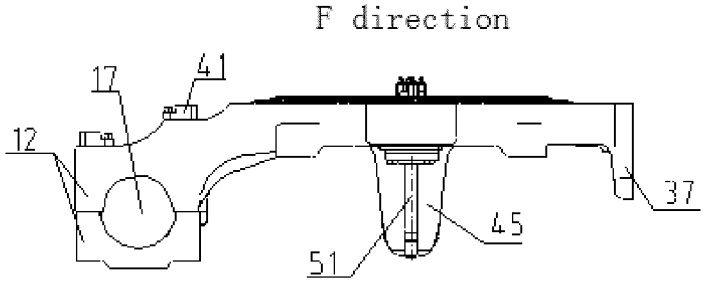


Fig. 12



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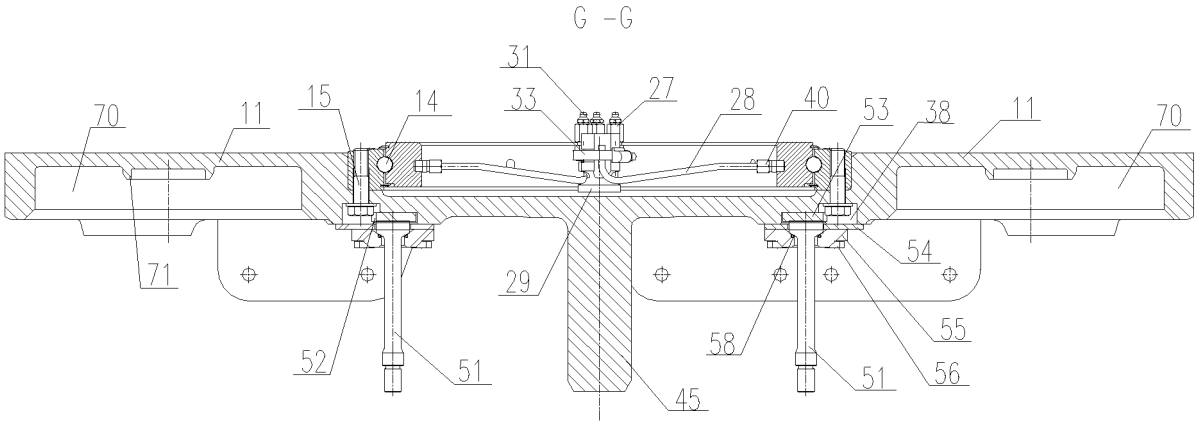

Fig. 14

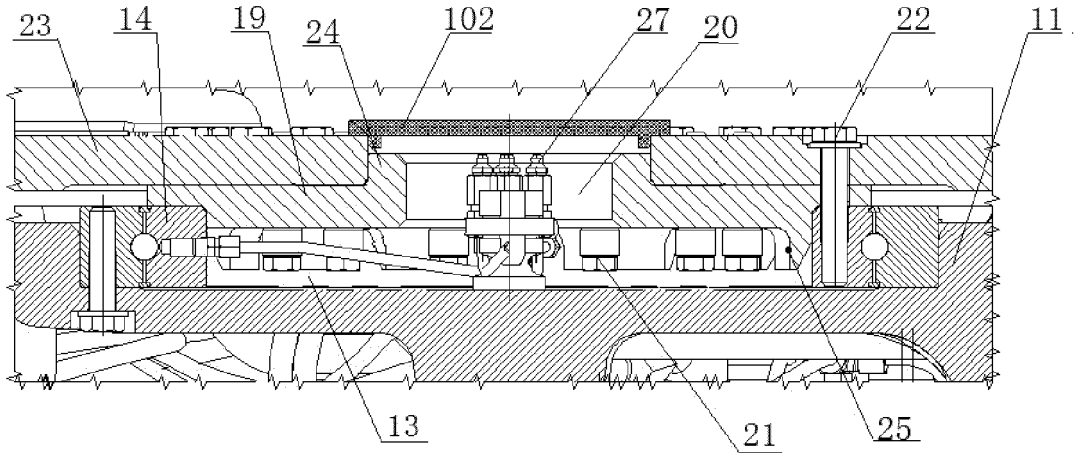

Fig. 15

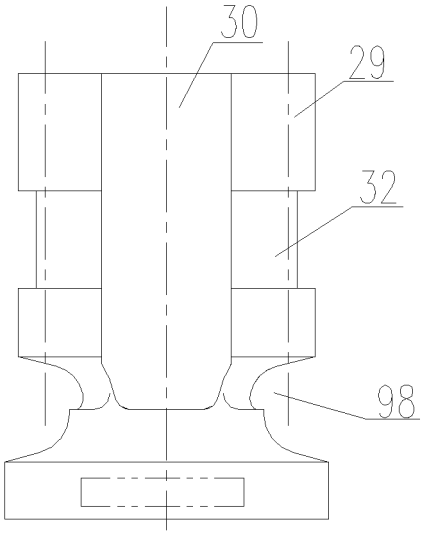

Fig.16

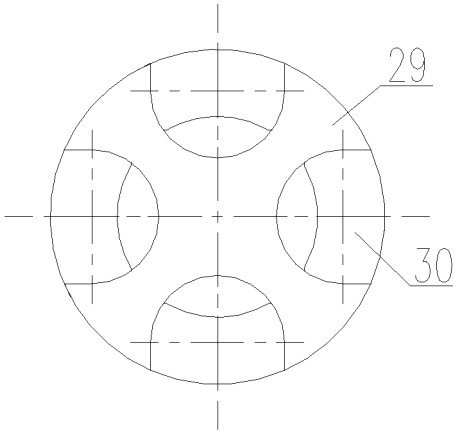

Fig. 17

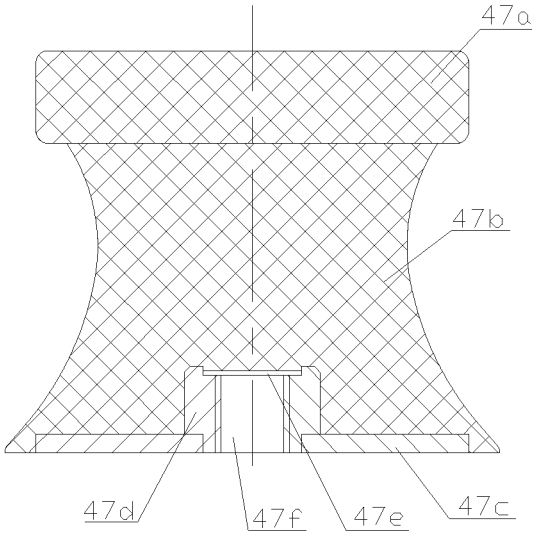

Fig. 18

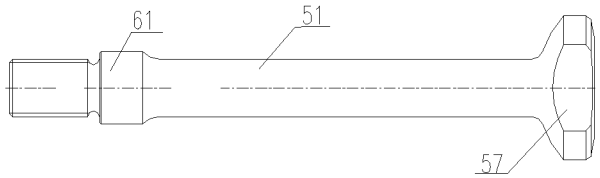

Fig. 19

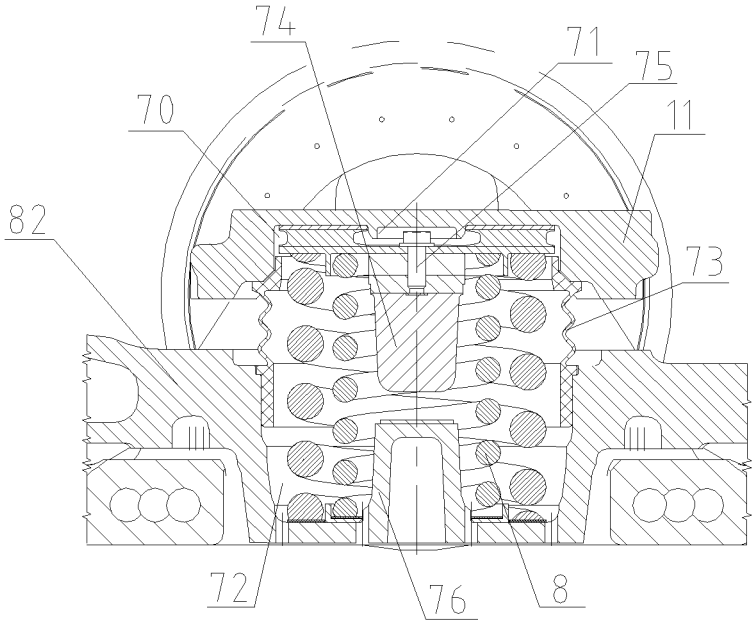

Fig. 20

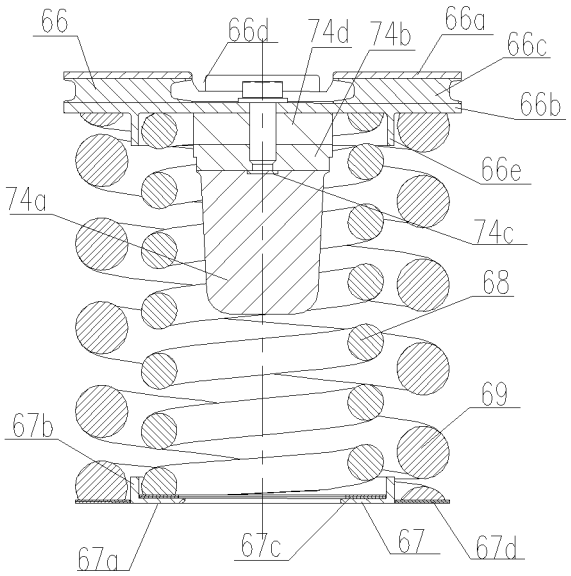
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Fig.21

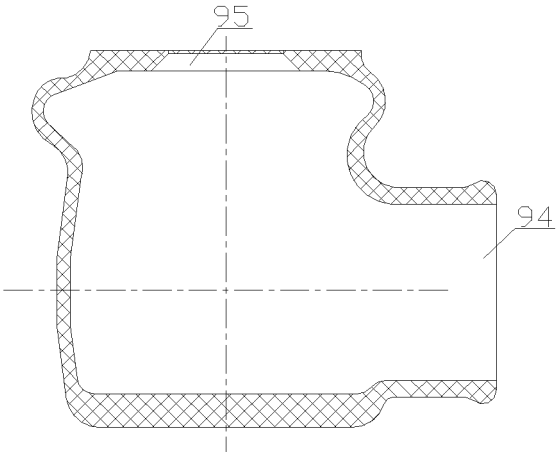
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Fig. 22

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2017/084303

A. CLASSIFICATION OF SUBJECT MATTER

B61F 5/04 (2006.01) i; B61F 5/12 (2006.01) i; B61F 5/50 (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; B61G

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
CNABS, CPRSABS, DWPI, VEN: pull rod, bogie, swing, bolster, suspension, tie, rod, revolve, rotate, spring, floor, hinge

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 105923005 A (CRRC QINGDAO SIFANG CO., LTD.), 07 September 2016 (07.09.2016), description, pages 3-12, and figures 1-22	1-30
PX	CN 105923009 A (CRRC QINGDAO SIFANG CO., LTD.), 07 September 2016 (07.09.2016), description, pages 2-11, and figures 1-22	1-30
PX	CN 206049696 U (CRRC QINGDAO SIFANG CO., LTD.), 29 March 2017 (29.03.2017), description, pages 1-4, and figures 1-4	1-10, 24-30
A	CN 102514584 A (CSR MEISHAN ROLLING STOCK CO., LTD.), 27 June 2012 (27.06.2012), description, pages 1-3, and figures 1-7	1-30
A	EP 1741610 A3 (VUKV AS et al.), 07 May 2008 (07.05.2008), the whole document	1-30
A	EP 0829413 A3 (VEVEY TECHNOLOGIES SA), 15 December 1999 (15.12.1999), the whole document	1-30
A	CN 103253282 A (CSR YANGTZE CO., LTD.), 21 August 2013 (21.08.2013), the whole document	1-30

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

* Special categories of cited documents:

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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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	Date of mailing of the international search report
08 August 2017 (08.08.2017)	**22 August 2017 (22.08.2017)**
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 **ZHANG, Wei** Telephone No.: (86-10) **62085300**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2017/084303

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 105923005 A	07 September 2016	None	
CN 105923009 A	07 September 2016	None	
CN 206049696 U	29 March 2017	None	
CN 102514584 A	27 June 2012	None	
EP 1741610 A3	07 May 2008	EP 1741610 A2	10 January 2007
		CZ 20050436 A3	11 October 2006
		CZ 297213 B6	11 October 2006
EP 0829413 A3	15 December 1999	EP 0829413 A2	18 March 1998
CN 103253282 A	21 August 2013	CN 103253282 B	02 December 2015

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