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(71) Applicants:
• **Dalian Research and Development Center of CRRC**
Qiqihar Rolling Stock Co., Ltd.
Dalian, Liaoning 116041 (CN)
• **CRRC Qiqihar Rolling Stock Co., Ltd.**
Qiqihar, Heilongjiang 161002 (CN)

(72) Inventor: **XU, Shifeng**
Qiqihar, Heilongjiang 161002 (CN)

(74) Representative: **Epping - Hermann - Fischer**
Patentanwalts-gesellschaft mbH
Schloßschmidstraße 5
80639 München (DE)

(54) **BOGIE AND SELF-ADAPTIVE ROTARY ARM POSITIONING DEVICE THEREOF**

(57) A self-adaptive rotary arm positioning device, comprising a rotary arm body (1) and a vibration isolating cushion (2). One end of the rotary arm body (1) is rotatably connected to a frame of a bogie by means of a rotary arm joint (3), and an upper surface (4) of the other end is connected to a lower surface (5) of the vibration isolating cushion (2). The upper surface (4) and the lower surface (5) have a vertical distance therebetween, and are in rolling fit with a curved member (6) at least in front and rear directions. The vertical distance is used for providing space for the rotation of the other end of the rotary arm body (1) about the rotary arm joint; or, the upper surface (4) and the lower surface (5) are matching arc-shaped surfaces or spherical surfaces, and the arc-shaped surfaces or the spherical surfaces extend from front to back. The extending length of the upper surface (4) in the front and rear directions is greater than the extending length of the lower surface (5) in the front and rear directions. Also disclosed is a bogie. The bogie and the self-adaptive rotary arm positioning device thereof can provide space for the rotation of the other end of the rotary arm body about the rotary arm joint.

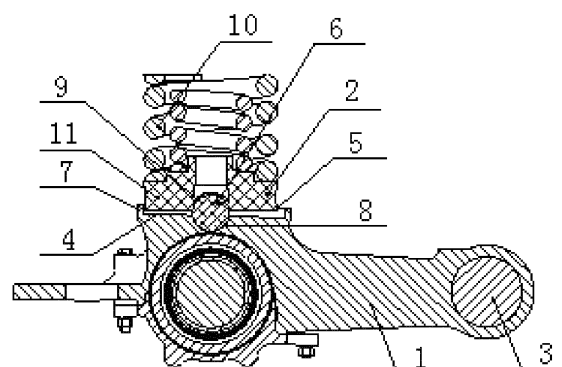


Figure 4

Description

[0001] The present application claims the benefit of priorities of the following two Chinese patent applications, the disclosures of which are incorporated herein by reference:

(1) Chinese Patent Application No. 201711340733.X, titled "BOGIE AND SELF-ADAPTIVE ROTARY ARM POSITIONING DEVICE", filed with the China National Intellectual Property Administration on December 14, 2017; and

(2) Chinese Patent Application No. 201721750973.2, titled "BOGIE AND SELF-ADAPTIVE ROTARY ARM POSITIONING DEVICE", filed with the China National Intellectual Property Administration on December 14, 2017.

FIELD

[0002] The present application relates to the technical field of railway traffic equipment, in particular to a bogie and a self-adaptive rotary arm positioning device thereof.

BACKGROUND

[0003] In the railway track traffic equipment, the smoothness, stability and safety of a vehicle at high speed depends on a bogie. At present, domestic and international railway bogies generally adopt a two-stage suspension structure, that is, a primary suspension positioning device and a secondary central suspension device. The two-stage suspension structure is a general structure for ensuring high-speed operation of vehicles.

[0004] When the vehicle is running at a high speed in a straight line, the primary suspension positioning device is required to have a strong ability to suppress snake movement of wheel pairs, so as to ensure the stability of the vehicle at high speed. In general, the railway track traffic equipment has no-load and full-load operating conditions. Especially for urban railway and freight trains, the difference between the two conditions is particularly noticeable. Therefore, in the primary suspension positioning device, it is necessary to provide an elastic positioning device to allow a rotary arm to self-adapt to different load conditions, so as to ensure the positioning accuracy and reliability of each component in the primary suspension positioning device.

[0005] Referring to Figures 1 and 2, Figure 1 is a schematic structural view of a typical rotary arm positioning device in a no-load state in the conventional technology; Figure 2 is a schematic structural view of the rotary arm positioning device shown in Figure 1 in a loaded state.

[0006] As shown in Figure 1 and Figure 2, in the conventional technology, the rotary arm positioning device of the bogie suitable for high-speed condition generally includes a rotary arm body 1', a rotary arm elastic joint 2', a vibration isolating cushion 3', a spring 4', a frame 5', and a wheel pair 6'. A transmission path of the force between the wheel tracks is a wheel → an axle → a bearing → a rotary arm body 1'. The rotary arm body 1' transmits the force to the frame 5' through two paths, that is, a first path: the rotary arm body 1' → the rotary arm elastic joint 2' → the frame 5', and a second path: the rotary arm body 1' → the vibration isolating cushion 3' → the spring 4' → the frame 5'. The frame 5' transmits the vehicle load to the rotary arm body 1' in opposite directions, and then to the wheel tracks through the rotary arm body 1'.

[0007] The rotary arm body 1' is in plane contact with the vibration isolating cushion 3', and an upper surface of the rotary arm body 1' and a lower surface of the vibration isolating cushion 3' serve as sliding surfaces M to form a sliding pair. As shown in Figure 1, in the no-load state, the sliding pair remains in a stationary state, that is, the sliding surfaces M do not slide relative to each other, and the upper surface of the rotary arm body 1' stably supports the lower surface of the vibration isolating cushion 3'. As shown in Figure 2, in the loaded state, the weight of the vehicle body acts on the frame 5', so that the frame 5' and the rotary arm elastic joint 2' move downward in the direction indicated by the right arrow in Figure 2, and then drive the rotary arm to rotate around the rotary arm elastic joint 2' clockwise in the direction indicated by the left arrow in Figure 2, so that the two sliding surfaces M slide relative to each other to adapt to the vertical movement at the rotary arm elastic joint 2'.

[0008] The above-described conventional rotary arm positioning device has the following technical problems. On the one hand, when the vertical vibration and load of the vehicle change, the rotation of the rotary arm body 1' cannot be adjusted in time, so that the adaptability of the track is poor; on the other hand, there are various uncertain factors when the rotary arm body 1' rotates, so that the vibration isolating cushion 3' and the spring 4' between the rotary arm body 1' and the frame 5' cannot be accurately positioned, and the change of a fixed wheelbase becomes uncontrollable, resulting in a wheelbase difference and reducing a critical speed. Furthermore, the vertical deflection is different in the front-rear direction of the sliding surfaces M, which causes the vibration isolating cushion 3' and the spring 4' to subject to a large bending moment and reduces the service life.

[0009] Therefore, it is urgent to design a bogie and a self-adaptive rotary arm positioning device thereof, so as to

improve the positioning ability and extend the service life of the rotary arm body while improving the self-adaptability of the rotary arm body.

SUMMARY

[0010] An object of the present application is to provide a bogie and a self-adaptive rotary arm positioning device thereof, to improve the service life of the self-adaptive rotary arm positioning device.

[0011] In order to achieve the above object, a self-adaptive rotary arm positioning device is provided according to the present application, which includes a rotary arm body and a vibration isolating cushion; one end of the rotary arm body is rotatably connected to a frame of a bogie by a rotary arm joint, and an upper surface of another end of the rotary arm body is connected to a lower surface of the vibration isolating cushion; a vertical distance is provided between the upper surface and the lower surface, both the upper surface and the lower surface are in rolling fit with a curved member at least in a front-rear direction, and the vertical distance is used for providing space for the rotation of the another end of the rotary arm body around the rotary arm joint.

[0012] As for the self-adaptive rotary arm positioning device of the present application, the upper surface of the rotary arm body is connected to the lower surface of the vibration isolating cushion through the curved member, so that a friction coefficient can be reduced, and the rotary arm body can timely respond and rotate according to the changes of vibration and load, thereby realizing the self-adaptation. More importantly, both the upper surface and the lower surface are matched with the curved member. The curved member can be reliably positioned even during the rotation of the rotary arm body, and the position of the vibration isolating cushion is determined through the curved member. When the rotary arm body rotates, the curved member can drive the vibration isolating cushion to synchronously move and accurately position the vibration isolating cushion, thereby increasing the critical speed. Moreover, when the vibration and load of the vehicle change, the rotary arm bodies of the same wheel pair can synchronously move, so that the fixed wheelbase of the bogie keeps constant. Compared with the plane sliding friction in the conventional technology, in the present application, due to the vertical distance between the upper surface and the lower surface, the rotary arm body can be self-adaptive when rotating, and the vibration isolating cushion and the spring are substantially not subjected to the bending moment of the rotary arm body, thereby prolonging the service life of components such as the vibration isolating cushion, the spring and the frame. Since the rotary arm body can self-adapt to changes in position, the adaptability to the track is improved, the force of the wheel tracks is reduced, the derailment coefficient and the rate of wheel load reduction are reduced, and the safety of the vehicle is improved.

[0013] Another self-adaptive rotary arm positioning device is provided according to the present application, which includes a rotary arm body and a vibration isolating cushion; one end of the rotary arm body is rotatably connected to a frame of a bogie through a rotary arm joint, and an upper surface of another end of the rotary arm body is connected to a lower surface of the vibration isolating cushion; the upper surface and the lower surface are arc-shaped surfaces or spherical surfaces that cooperate with each other, and the arc-shaped surfaces or the spherical surfaces extend from front to back; an extension length of the upper surface in a front-rear direction is greater than an extension length of the lower surface in the front-rear direction, to provide space for the rotation of the another end of the rotary arm body around the rotary arm joint.

[0014] Since the upper surface of the rotary arm body and the lower surface of the vibration isolating cushion are configured as arc-shaped surfaces or spherical surfaces, the vibration isolating cushion can still be accurately positioned through the arc-shaped surfaces or the spherical surfaces, thereby improving the critical speed of the vehicle. Since the rotary arm body can be self-adaptive and the adaptability to the track is good, the derailment coefficient and the rate of wheel load reduction are reduced, and the safety of the vehicle is improved. Since the change of the fixed wheelbase caused by the rotation of the rotary arm body is controllable, no wheelbase difference is generated, the critical speed is increased, the force of the wheel tracks is reduced, and the noise and the wear of wheels are reduced. The additional bending moment to which the vibration isolating cushion and the spring are subjected is small, and the service life of components such as the vibration isolating cushion, the spring, the rotary arm body, the rotary arm joint, and the frame is improved.

[0015] A bogie is further provided according to the present application, which include a frame and a self-adaptive rotary arm positioning device, wherein the frame is connected to the self-adaptive rotary arm positioning device by a rotary arm joint, and the self-adaptive rotary arm positioning device is the self-adaptive rotary arm positioning device according to any one of the above devices.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Figure 1 is a schematic structural view of a typical rotary arm positioning device in a no-load state in the conventional

technology;

Figure 2 is a schematic structural view of the rotary arm positioning device shown in Figure 1 in a loaded state;

Figure 3 is a schematic perspective structural view of a self-adaptive rotary arm positioning device in a bogie and a wheel pair according to a specific embodiment of the present application;

Figure 4 is a cross-sectional view of the self-adaptive rotary arm positioning device of Figure 3 in an arrangement; and

Figure 5 is a cross-sectional view of the self-adaptive rotary arm positioning device of Figure 3 in another arrangement.

Reference numerals in Figures 1 to 2:

rotary arm body 1',	rotary arm elastic joint 2',
vibration isolating cushion 3',	spring 4',
frame 5',	wheel pair 6';

Reference numerals in Figures 3 to 5:

rotary arm body 1,	vibration isolating cushion 2,
rotary arm joint 3,	upper surface 4,
lower surface 5,	curved member 6,
position-limiting stopper 7,	first groove 8,
second groove 9,	spring 10,
spring mounting seat 11.	

DETAILED DESCRIPTION OF EMBODIMENTS

[0017] The present application is described in detailed below in conjunction with the drawings, to allow those skilled in the art to understand technical solutions of the present application accurately.

[0018] The up and down, left and right, and front and rear are defined with reference to the track traffic equipment, with a traveling direction of the track traffic equipment as the front and a direction opposite to the front as the rear. In a plane parallel to a rail surface, a direction perpendicular to the front-rear direction is defined as the left-right direction, and viewed in the traveling direction, a direction at the left-hand side is left, and a direction at the right-hand side is right. A direction perpendicular to the rail surface is defined as the up-down direction or the vertical direction, and a direction vertically pointing to the rail surface is down, and a direction vertically away from the rail surface is up.

[0019] Terms such as "first", "second" and the like in the present application are only intended to distinguish multiple components or structures having same or similar structures, and are not used to particularly limit the order.

[0020] The inward and outward described herein are defined with reference to a central axis of the self-adaptive rotary arm positioning device, a direction toward the central axis is inward, and a direction away from the central axis is outward.

[0021] As shown in Figure 3, a bogie is provided according to the present application, which includes a frame and a self-adaptive rotary arm positioning device. The self-adaptive rotary arm positioning device includes a rotary arm body 1 and a vibration isolating cushion 2. One end of the rotary arm body 1 is rotatably connected to the frame through a rotary arm joint 3, and an upper surface 4 of another end of the rotary arm body 1 is connected to a lower surface 5 of the vibration isolating cushion 2. Moreover, the other end of the rotary arm body 1 is rotatably connected to an axle of a wheel pair through a bearing. The self-adaptive rotary arm positioning device can realize the self-adaptation of the rotary arm, improve the critical speed and safety of the vehicle, reduce the force of the wheel tracks, reduce the wear and noise of the wheels, and prolong the service life of each component.

FIRST EMBODIMENT

[0022] As shown in Figure 4, in an embodiment, the self-adaptive rotary arm positioning device provided by the present application includes a rotary arm body 1, a vibration isolating cushion 2 and a curved member 6. One end of the rotary arm body 1 is rotatably connected to the frame through a rotary arm joint 3, and an upper surface 4 of the other end of the rotary arm body 1 is connected to a lower surface 5 of the vibration isolating cushion 2. The upper surface 4 of the rotary arm body 1 and the lower surface 5 of the vibration isolating cushion 2 are both in rolling fit with the curved member

6 at least in the front-rear direction, or in other words, an upper curved surface of the curved member 6 cooperates with the lower surface 5 of the vibration isolating cushion 2, and a lower curved surface of the curved member 6 cooperates with the upper surface 4 of the rotary arm body 1. Moreover, the curved member 6 can at least roll in the front-rear direction around an axis extending in the left-right direction, so that the rotary arm body 1 can drive the curved member 6 to roll when the rotary arm body 1 rotates around the rotary arm joint 3, and then the curved member 6 drives the vibration isolating cushion 2 to rotate. Besides, there is a vertical distance between the upper surface 4 and the lower surface 5 for providing space for the rotation of the other end of the rotary arm body 1 around the rotary arm joint 3.

[0023] As the load of the vehicle changes, including no-load and weight changes of the load, the position of the frame relative to the wheel pair changes, which causes the rotary arm body 1 to rotate to adapt to positional changes between the frame and the wheel pair, so that the rotary arm body 1 and the vibration isolating cushion 2 can reach a steady state. When the rotary arm body 1 rotates about the rotary arm joint 3, the position of the upper surface 4 of the other end of the rotary arm body 1 relative to the lower surface 5 of the vibration isolating cushion 2 changes, or in other words, an inclination angle between the upper surface 4 and the lower surface 5 changes, causing the distance between the upper surface 4 and the lower surface 5 to be inconsistent in the front-rear direction. The vertical distance between the upper surface 4 and the lower surface 5 is provided to allow relative inclination of the two surfaces during rotation of the rotary arm body 1, or in other words, during the rotation of the rotary arm body 1, the vertical distance avoids collision and interference between the upper surface 4 and the lower surface 5 while the two surfaces have the maximum inclination angle, thereby preventing the vibration isolating cushion 2 from affecting the rotation of the rotary arm body 1, and providing space for the rotation of the other end of the rotary arm body 1 around the rotary arm joint 3. Therefore, the rotary arm body 1 can rotate smoothly, the position adjustment and precise positioning of the rotary arm body 1 and the vibration isolating cushion 2 are finally realized, and the self-adaptation of the rotary arm body 1 is realized.

[0024] Compared with the conventional technology in which the rotary arm body 1 is in sliding contact with the vibration isolating cushion 2 through two plane surfaces, in the present application, the upper surface 4 of the rotary arm body 1 and the lower surface 5 of the vibration isolating cushion 2 are both in rolling fit with the curved member 6. The upper surface 4 of the rotary arm body 1 can accurately position the curved member 6 through a spherical mating surface, and the curved member 6 can accurately position the vibration isolating cushion 2 through the curved surface structure thereof. Moreover, the rotary arm body 1 can also drive the vibration isolating cushion 2 to synchronously rotate through the curved member 6, which improves the positioning accuracy of the rotary arm body 1 and the vibration isolating cushion 2 to a large extent.

[0025] Since the rotary arm body 1 and the vibration isolating cushion 2 can be accurately positioned, in particular, the rotary arm body 1 is always in contact with the vibration isolating cushion 2 during the self-adaptive process in comparison with the plane sliding manner, the rotary arm bodies 1 of the same wheel pair can synchronously move when the vibration or load of the vehicle changes. Moreover, since the change of the fixed wheelbase caused by the rotation of the rotary arm body 1 is controllable, no wheelbase difference is generated, thus the force of the wheel tracks is reduced, the derailment coefficient is reduced, the noise and wear of wheels are reduced, and the critical speed and the safety of vehicle operation are increased.

[0026] Since the rotary arm body 1 is in rolling fit with the vibration isolating cushion 2 through the curved member 6, and the rotary arm body 1 is not in direct contact with the vibration isolating cushion 2, all the forces are transmitted to the vibration isolating cushion 2 through the curved member 6. The curved member 6 can be symmetric in the front-rear direction, so that the vertical deflection in the front direction is substantially the same as the vertical deflection in the rear direction, thereby reducing the additional bending moments to which the vibration isolating pad 2 and the spring 10 are subjected, and prolonging the services life of the components such as the vibration isolating cushion 2, the spring 10, and the rotary arm body 1, the rotary arm joint 3 and the frame.

[0027] Compared with the sliding fit of the upper surface and the lower surface in the conventional technology, a length of the rotary arm body 1 of the present application can be unrestricted. In the conventional technology, the sliding fit of the upper surface and the lower surface requires a longer rotary arm body 1, while the rolling fit in the present application can fully meet the requirements of self-adaptation and precise positioning, thus those skilled in the art can select a shorter rotary arm body 1 to reduce the weight of the bogie and reduce the rate of wheel load reduction, which lays a good foundation for optimizing the car body.

[0028] As shown in Figure 4, the upper surface 4 of the rotary arm body 1 may further be provided with a position-limiting stopper 7, which is capable of at least blocking the front and rear ends of the lower surface 5 of the vibration isolating cushion 2, to limit the relative movement displacement of the upper surface 4 and the lower surface 5 in the front-rear direction, and to prevent the upper surface 4 from being detached from the lower surface 5 or avoid excessive displacement between the upper surface 4 and the lower surface 5 in the front-rear direction, thereby ensuring the reliability of the connection between the vibration isolating cushion 2 and the rotary arm body 1. Moreover, the front-rear dimension of the position-limiting stopper 7 is larger than the front-rear dimension of the lower surface 5 of the vibration isolating cushion 2, so as to allow the vibration isolating cushion 2 and the rotary arm body 1 to move relative to each other in the front-rear direction, thereby avoiding affecting the rotation of the rotary arm body 1.

[0029] The position-limiting stopper 7 may be arranged in a cylindrical shape protruding from the upper surface 4, to form a mounting seat for the vibration isolating cushion 2. The mounting seat is configured to limit the relative movement displacement between the vibration isolating cushion 2 and the rotary arm body 1 in each radial direction of the cylindrical position-limiting stopper 7, especially in the front-rear direction and the left-right direction, when the upper surface 4 and the lower surface 5 roll relative to each other, so as to improve the positioning accuracy of the vibration isolating cushion 2 and the rotary arm body 1.

[0030] On this basis, the curved member 6 may be a sphere or a cylinder, and an axial direction of the cylinder may be in the left-right direction, so that the curved member 6 can roll in the front-rear direction. The curved member 6 may be arranged between the upper surface 4 and the lower surface 5. The upper surface 4 is provided with a first groove 8 that cooperates with a lower curved surface of the curved member 6, and the lower surface 5 is provided with a second groove 9 that cooperates with an upper curved surface of the curved member 6. The first groove 8 and the second groove 9 can join in the up-down direction to form a full spherical mounting groove matching the curved member 6. Both the first groove 8 and the second groove 9 may be hemisphere grooves to reliably limit the curved member 6 and to realize synchronous rotation by means of the curved member 6.

[0031] In a case that the curved member 6 is a sphere, the first groove 8 and the second groove 9 are spherical grooves, and in a case that the curved member 6 is a cylinder, the first groove 8 and the second groove 9 are arc-shaped grooves. In this embodiment, an arc corresponding to the first groove 8 may be a major arc larger than a semicircle and smaller than two-thirds of a circle. In this case, the first groove 8 is slightly larger than the second groove 9 so that the curved member 6 can be more reliably "trapped" into the first groove 8 of the rotary arm body 1, to prevent the reliability of the connection from being affected by vehicle vibration or the like. Moreover, a surface area of the second groove 9 is not too small, so that the second groove 9 and the curved member 6 have a sufficiently large contact area, and the rotary arm body 1 can drive the vibration isolating cushion 2 to correspondingly move through the curved member 6.

[0032] Here, the middle of each of the upper surface 4 and the lower surface 5 represents an intermediate region, an edge of which is spaced from the respective midpoint by a small distance, and is not strictly limited to a position in the right middle.

[0033] In detail, the second groove 9 of the vibration isolating cushion 2 may be a continuous groove in the front-rear direction, or may be a groove formed by splicing grooves in the front-rear direction. In a case that the splicing structure is employed, the second groove 9 may include two or more hemispherical grooves or semi-arc shaped grooves.

[0034] The hemispherical shape described herein is defined with reference to an entire spherical surface, and does not exactly represent half of the spherical surface. The hemispherical shape may be larger or smaller than half of the spherical surface, such as a quarter of the spherical surface. As long as it is not the entire spherical surface, it can be referred to as the hemispherical surface. Similarly, the semi-arc shape is also defined with reference to an entire circle, and does not exactly represent half of the entire circle. The semi-arc shape may be larger or smaller than half of the entire circle, such as a quarter of the entire circle, an eighth of the entire circle, or two-thirds of the entire circle. As long as it is not the entire circle, it can be referred to as the semi-arc.

[0035] It can be understood that, the curved member 6 of the present application may be a sphere or a cylinder, or may be a curved surface structure having a waist drum shape or a flying saucer shape, as long as the rotary arm body 1 can drive the curved member 6 to roll in the front-rear direction when the rotary arm body 1 rotates, and the rolling can be transmitted to the vibration isolating cushion 2 to drive the vibration isolating cushion 2 to synchronously rotate along with the rotary arm body 1.

[0036] It can be understood that, the material of the curved member 6 in the present invention may be a non-metallic wear-resistant material having a small friction coefficient such as ultrahigh molecular weight polyethylene or carbon fiber. The vibration isolating cushion 2 may be manufactured by a non-metal and rubber vulcanization process, or may be made of an elastic component such as a wear-resistant rubber or a rubber cushion.

[0037] In the present application, the number of the curved member 6 is not limited to one. Two or more curved members 6 may be provided. In a case that two or more curved members 6 are provided, the curved members 6 may be arranged at intervals in the front-rear direction or in the left-right direction according to needs. The curved members 6 may also be evenly distributed on the entire surfaces of the upper surface 4 and the lower surface 5, and the specific distribution form may be arranged according to needs.

[0038] Furthermore, an upper portion of the vibration isolating cushion 2 may be provided with a spring mounting seat 11 for mounting a vertically extending spring 10, and the vibration isolating cushion 2 is elastically connected to the frame through the spring 10, such that one end of the rotary arm body 1 is rotatably connected to the frame through the rotary arm joint 3, and the other end of the rotary arm body 1 is elastically connected to the frame through the vibration isolating cushion 2 and the spring 10. The spring mounting seat 11 may include an annular seat arranged outside and a mounting boss provided in an inner ring of the annular seat. The spring 10 may include an inner spring 10 and an outer spring 10 which are nested together. The inner spring 10 is mounted on the mounting boss, the outer spring 10 is mounted on the annular seat, and the inner spring 10 and the outer spring 10 together provide resilient support for the frame.

SECOND EMBODIMENT

[0039] In another embodiment, the self-adaptive rotary arm positioning device according to the present application includes the rotary arm body 1, and the vibration isolating cushion 2. One end of the rotary arm body 1 is rotatably connected to the frame of the bogie through the rotary arm joint 3, and the upper surface 4 of the other end of the rotary arm body 1 is connected to the lower surface 5 of the vibration isolating cushion 2. Moreover, the upper surface 4 and the lower surface 5 are arc-shaped surfaces or spherical surfaces that cooperate with each other, the arc-shaped surfaces may have an arc shape extending from front to rear, and the spherical surfaces may have a hemispherical shape extending from front to rear. The description of the structure presented by the upper surface 4 and the lower surface 5 of this embodiment is a structure which can be formed in the front-rear direction, that is, a structure which is presented on a vertical section perpendicular to the left-right direction. The arc-shaped surface refers to a structure that is arc-shaped in the front-rear direction, and the spherical surface refers to a structure that is hemispherical in the front-rear direction. An extension length of the upper surface 4 in the front-rear direction is greater than an extension length of the lower surface 5 in the front-rear direction, so as to provide space for the rotation of the other end of the rotary arm body 1 around the rotary arm joint 3.

[0040] In this embodiment, the upper surface 4 and the lower surface 5 are arc-shaped surfaces or spherical surfaces that cooperate with each other. When the rotary arm body 1 rotates around the rotary arm joint 3, the vibration isolating cushion 2 may be guided to correspondingly move through the arc-shaped structure or the spherical structure of the upper surface 4, so that the vibration isolating cushion 2 and the rotary arm body 1 synchronously move to a next steady state.

[0041] During the rotation of the rotary arm body 1 about the rotary arm joint 3, the upper surface 4 at the other end of the rotary arm body 1 moves in the form of a curved line, and the motion trajectory thereof is substantially a circular arc shape. Therefore, the curved surface or the spherical surface of the upper surface 4 can be correspondingly arranged according to the movement trajectory of the rotary arm body 1, thereby effectively guiding the vibration isolating cushion 2. Especially when the upper surface 4 of the rotary arm body 1 and the lower surface 5 of the vibration isolating cushion 2 are curved surfaces or spherical surfaces that cooperate with each other, the curved surface or the spherical surface structure can keep the upper surface 4 and the lower surface 5 in full contact at all times. Compared with the form of sliding surfaces in the conventional technology, there is no opening and closing of the sliding surfaces M in this embodiment, and the opening and closing time of the sliding surfaces M is not involved in this embodiment, such that the positioning accuracy or the safety of use is not affected by the uncertain opening and closing time of the sliding surfaces M.

[0042] Thus, by using the self-adaptive rotary arm positioning device of this embodiment, the rotary arm body 1 can be self-adaptive according to the load condition, and the rotary arm body 1 can be kept in connection with the vibration isolating cushion 2 during the self-adaptive process, so that the vibration isolating cushion 2 and the spring 10 between the frame and the rotary arm body 1 can be accurately positioned, and the critical speed can be improved.

[0043] In the conventional technology, positions of the sliding surfaces M change due to vibration during the traveling of the vehicle, position changes of the sliding surfaces M are presented both in one wheel pair and between two wheel pairs, and these changes are uncontrollable. The misalignment of the wheelbase difference of the bogie causes the wheel pair to be splayed and form an angle of attack with the track, thereby reducing the critical speed. In this embodiment, when the rotary arm body 1 rotates, the rotary arm body 1 and the vibration isolating cushion 2 move synchronously, the change of fixed wheelbase caused by the rotary arm body 1 is controllable, and no wheelbase difference is generated, such that the track adaptability is good, the force of the wheel tracks is reduced, the noise and wear of the wheels are reduced, and the critical speed and the safety of vehicle operation are increased.

[0044] As described in the first embodiment, if the plane sliding fit is used in the conventional technology, a longer rotary arm body 1 is required to meet the use requirements. While this embodiment can realize the self-adaptation of the rotary arm body 1, thus the length of the rotary arm body 1 is shortened to a large extent, which reduces the rate of wheel load reduction and the derailment coefficient, reduces the weight of the bogie while improving the safety of vehicle operation, and lays a foundation for optimizing the structure of the vehicle body.

[0045] Furthermore, the sliding surfaces M in the conventional technology are planes, and the rotation angles thereof cannot be adaptive. When the vertical deflection changes, the deflections of the sliding surfaces M of the vibration isolating cushion 2 and the spring 10 in the front-rear direction cannot keep consistent, thereby generating the bending moment. In other words, in the solution of the conventional technology, the vibration isolating cushion 2 and the spring 10 are subjected to a large bending moment, which reduces the service life. In this embodiment, since the vibration isolating cushion 2 is in contact with the rotary arm body 1 through the curved surface or the spherical surface, the vibration isolating cushion 2 can rotate synchronously with the rotary arm body 1, thereby reducing the additional bending moment to which the vibration isolating cushion 2 and the spring 10 are subjected, and prolonging the service life of the vibration isolating cushion 2, the spring 10, the rotary arm body 1, the rotary arm joint 3 and the frame.

[0046] In detail, the upper surface 4 may be a concave curved surface that is recessed downward, and the lower surface 5 may be a convex curved surface that protrudes downward; or, the upper surface 4 may be a concave spherical

surface that is recessed downward, and the lower surface 5 may be a convex spherical surface that protrudes downward. In this way, the vibration isolating cushion 2 can be effectively supported by the rotary arm body 1, and the upper surface 4 of the rotary arm body 1 can serve as the guide surface of the vibration isolating cushion 2, which guides the vibration isolating cushion 2 to move synchronously to adapt to changes in load.

[0047] Obviously, the present application is not limited to providing the concave curved surface or the concave spherical surface on the upper surface 4 and providing the convex curved surface or the convex spherical surface on the lower surface 5. A convex curved surface or a convex spherical surface may be provided on the upper surface 4 and a concave curved surface or a concave spherical surface may be provided on the lower surface 5, that is, positions of the concave and convex curved surfaces are interchanged, or positions of the concave spherical surface and the convex spherical surface are interchanged, as long as the upper surface 4 can cooperate with the lower surface 5 through the curved surfaces or the spherical surfaces.

[0048] In this embodiment, the upper surface 4 may be provided with a position-limiting stopper 7 for limiting the relative sliding between the upper surface 4 and the lower surface 5, that is, the relative movement between the rotary arm body 1 and the vibration isolating cushion 2 is controlled within a certain range, thereby avoiding the safety hazard caused by detachment of the upper surface 4 from the lower surface 5 or the excessively reduced contact area. The specific form of the position-limiting stopper 7 may be provided with reference to the first embodiment.

[0049] In addition, other parts of this embodiment such as the spring mounting seat 11 may also be provided with reference to the first embodiment, which is not described herein again.

[0050] It should be noted that, given the complicated structure of the bogie, only the self-adaptive rotary arm positioning device and the related structure thereof have been described herein, and reference can be made to the conventional technology for other components and connection relationships.

[0051] A bogie and a self-adaptive rotary arm positioning device of the bogie according to the present application are described in detail hereinbefore. The principle and the embodiments of the present application are illustrated herein by specific examples. The above description of examples is only intended to help the understanding of the idea of the present application. It should be noted that, for the person skilled in the art, various improvements and modifications may be further made to the present application without departing from the principles of the present application, and these improvements and modifications also fall within the scope of protection of claims of the present application.

Claims

1. A self-adaptive rotary arm positioning device, comprising a rotary arm body (1) and a vibration isolating cushion (2), one end of the rotary arm body (1) being rotatably connected to a frame of a bogie through a rotary arm joint (3), and an upper surface (4) of another end of the rotary arm body (1) being connected to a lower surface (5) of the vibration isolating cushion (2), wherein the self-adaptive rotary arm positioning device further comprises a curved member (6), a vertical distance is provided between the upper surface (4) and the lower surface (5), both the upper surface (4) and the lower surface (5) are in rolling fit with the curved member (6) at least in a front-rear direction, and the vertical distance is configured to provide space for rotation of the another end of the rotary arm body (1) around the rotary arm joint (3).
2. The self-adaptive rotary arm positioning device according to claim 1, wherein the upper surface (4) is further provided with a position-limiting stopper (7) which is configured to at least block front and rear ends of the lower surface (5), to limit relative movement displacement of the upper surface (4) and the lower surface (5) in the front-rear direction.
3. The self-adaptive rotary arm positioning device according to claim 2, wherein the position-limiting stopper (7) is arranged in a cylindrical shape protruding from the upper surface (4) to form a mounting seat for the vibration isolating cushion (2), the mounting seat is configured to limit relative movement displacement of the vibration isolating cushion (2) and the rotary arm body (1) in each radial direction of the position-limiting stopper (7) when the upper surface (4) and the lower surface (5) roll relative to each other.
4. The self-adaptive rotary arm positioning device according to any one of claims 1 to 3, wherein the curved member (6) is a sphere, or is a cylinder of which an axial direction is in a left-right direction, the curved member (6) is arranged in a middle of the upper surface (4) and the lower surface (5), the upper surface (4) is provided with a first groove (8) cooperating with a lower curved surface of the curved member (6), and the lower surface (5) is provided with a second groove (9) cooperating with an upper curved surface of the curved member (6).
5. The self-adaptive rotary arm positioning device according to claim 4, wherein an arc corresponding to the first groove (8) is a major arc larger than a semicircle and smaller than two-thirds of a circle.

6. A self-adaptive rotary arm positioning device, comprising a rotary arm body (1) and a vibration isolating cushion (2), one end of the rotary arm body (1) being rotatably connected to a frame of a bogie through a rotary arm joint (3), and an upper surface (4) of another end of the rotary arm body (1) being connected to a lower surface (5) of the vibration isolating cushion (2), wherein the upper surface (4) and the lower surface (5) are arc-shaped surfaces or spherical surfaces that cooperate with each other, and the arc-shaped surfaces or the spherical surfaces extend from front to rear; and an extension length of the upper surface (4) in a front-rear direction is greater than an extension length of the lower surface (5) in the front-rear direction, to provide space for rotation of the another end of the rotary arm body (1) around the rotary arm joint (3).
7. The self-adaptive rotary arm positioning device according to claim 6, wherein the upper surface (4) is a concave curved surface or a concave spherical surface that is recessed downward, and the lower surface (5) is a convex curved surface or a convex spherical surface that protrudes downward.
8. The self-adaptive rotary arm positioning device according to claim 6, wherein the upper surface (4) is further provided with a position-limiting stopper (7) which is configured to at least block front and rear ends of the lower surface (5), to limit relative movement displacement of the upper surface (4) and the lower surface (5) in the front-rear direction.
9. A bogie, comprising a frame and a self-adaptive rotary arm positioning device, and the frame being connected to the self-adaptive rotary arm positioning device through a rotary arm joint (3), wherein the self-adaptive rotary arm positioning device is the self-adaptive rotary arm positioning device according to any one of claims 1 to 8.
10. The bogie according to claim 9, wherein an upper portion of the vibration isolating cushion (2) is further provided with a spring mounting seat (11) for mounting a spring (10), and the vibration isolating cushion (2) is elastically connected to the frame through the spring (10).

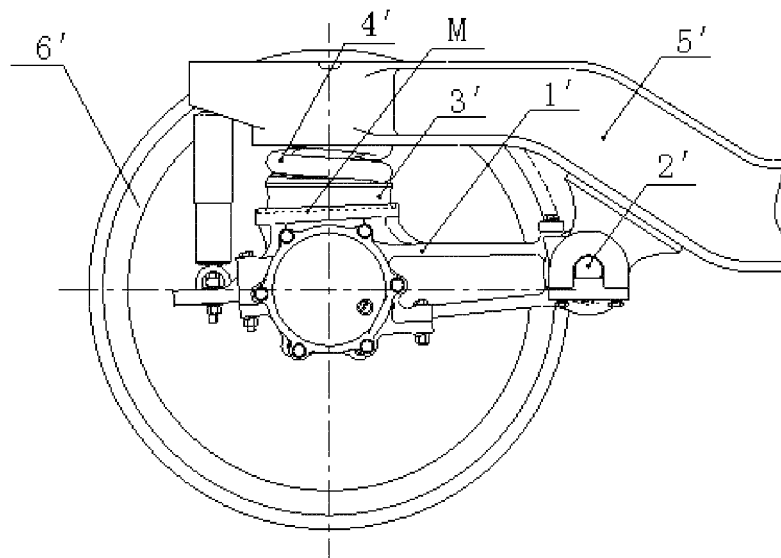


Figure 1

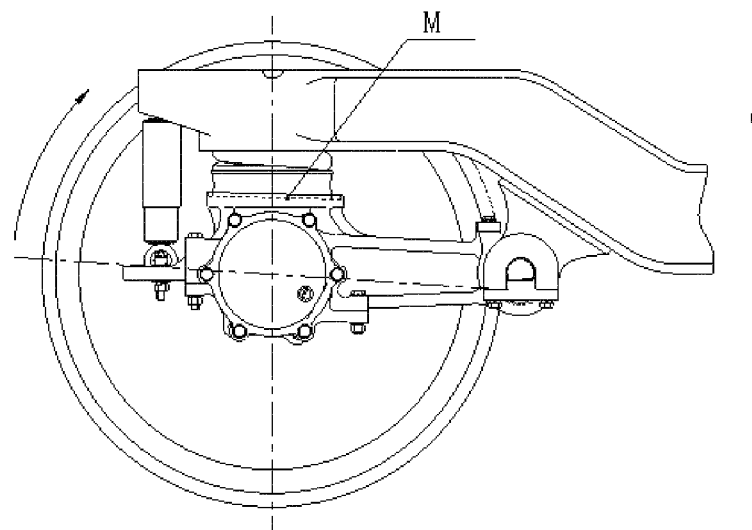


Figure 2

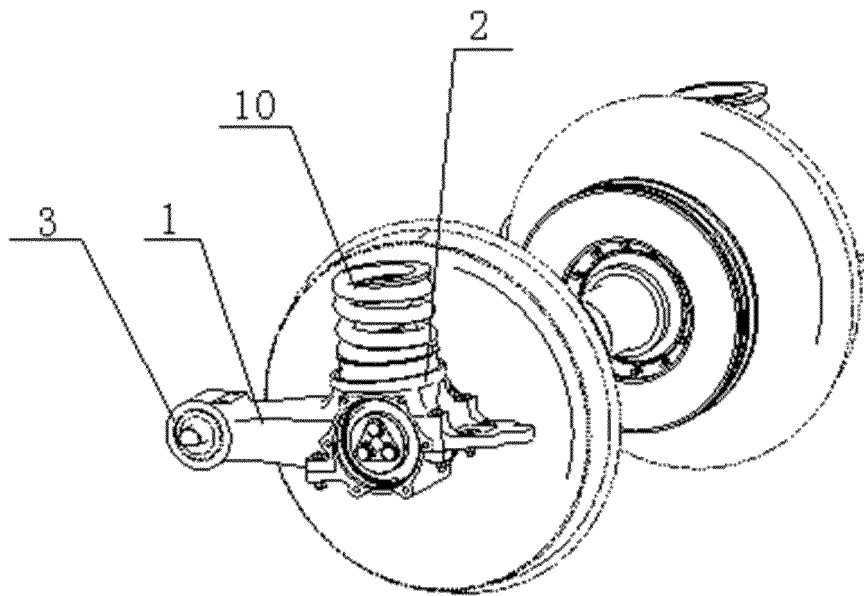


Figure 3

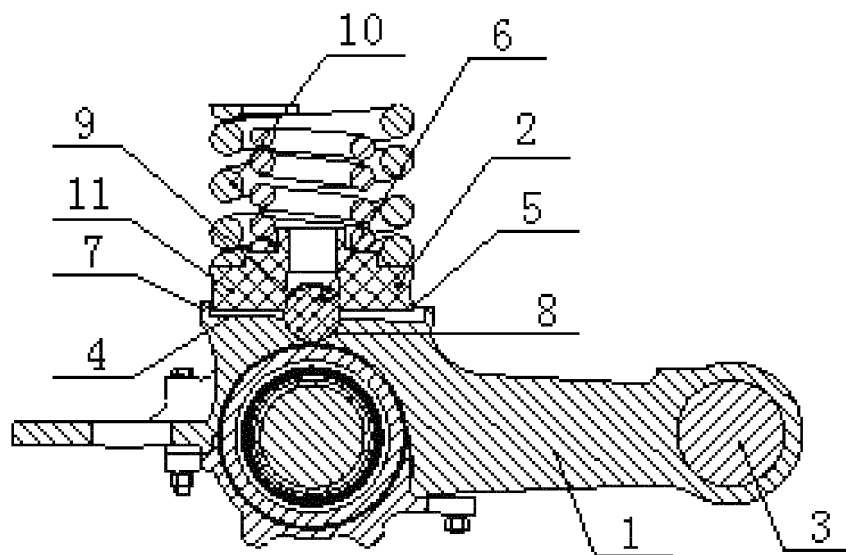


Figure 4

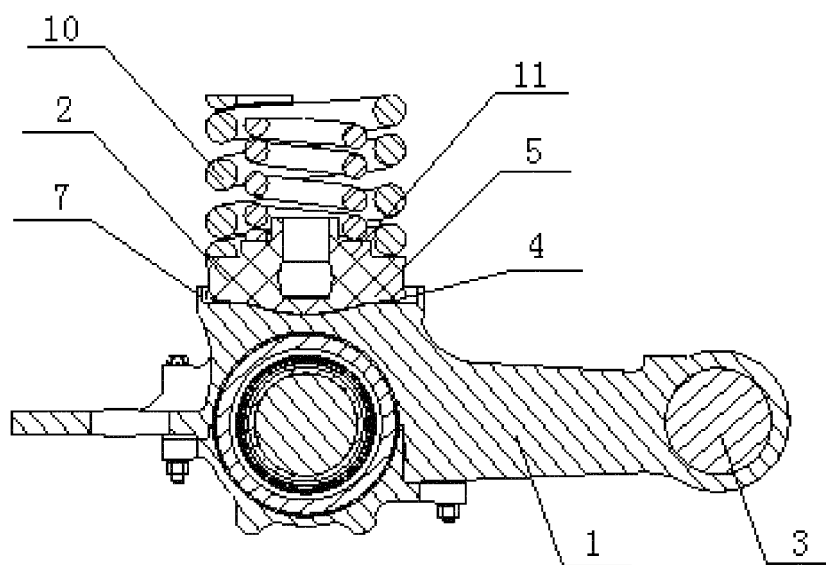


Figure 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/119681

A. CLASSIFICATION OF SUBJECT MATTER B61F 5/00(2006.01)i; B61F 5/50(2006.01)i; B61F 5/04(2006.01)i; B61F 5/38(2006.01)i; B61F 5/30(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 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) CNKI, CNABS, SIPOABS, DWPI, VEN: 转向架, 臂, 隔振垫, 弧形面, 球面, 垂向, 间距; truck, arm, vibration isolator, cambered surface, contour, spheric face, vertical, separation																								
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>CN 102616246 B (CSR ERQI CO., LTD.) 22 July 2015 (2015-07-22) description, paragraphs 0013-0017, and figures 1-2</td> <td>6-10</td> </tr> <tr> <td>A</td> <td>CN 103661463 B (QIQIHAR RAILWAY ROLLING STOCK CO., LTD.) 31 August 2016 (2016-08-31) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 201334029 Y (SOUTHWEST JIAOTONG UNIVERSITY) 28 October 2009 (2009-10-28) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 106428084 A (CRRC NANJING PUZHEN CO., LTD.) 22 February 2017 (2017-02-22) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>US 4732372 A (BUDD CO.) 22 March 1988 (1988-03-22) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 202413825 U (CSR NANJING PUZHEN CO., LTD.) 05 September 2012 (2012-09-05) entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>JP 2013075594 A (RAILWAY TECHNICAL RES. INST.) 25 April 2013 (2013-04-25) entire document</td> <td>1-10</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	CN 102616246 B (CSR ERQI CO., LTD.) 22 July 2015 (2015-07-22) description, paragraphs 0013-0017, and figures 1-2	6-10	A	CN 103661463 B (QIQIHAR RAILWAY ROLLING STOCK CO., LTD.) 31 August 2016 (2016-08-31) entire document	1-10	A	CN 201334029 Y (SOUTHWEST JIAOTONG UNIVERSITY) 28 October 2009 (2009-10-28) entire document	1-10	A	CN 106428084 A (CRRC NANJING PUZHEN CO., LTD.) 22 February 2017 (2017-02-22) entire document	1-10	A	US 4732372 A (BUDD CO.) 22 March 1988 (1988-03-22) entire document	1-10	A	CN 202413825 U (CSR NANJING PUZHEN CO., LTD.) 05 September 2012 (2012-09-05) entire document	1-10	A	JP 2013075594 A (RAILWAY TECHNICAL RES. INST.) 25 April 2013 (2013-04-25) entire document	1-10
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Date of the actual completion of the international search 01 February 2019	Date of mailing of the international search report 06 March 2019																							
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/119681

C. 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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Information on patent family members

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CN 102616246 B	22 July 2015	CN 102616246 A	01 August 2012
CN 103661463 B	31 August 2016	CN 103661463 A	26 March 2014
CN 201334029 Y	28 October 2009	None	
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US 4732372 A	22 March 1988	None	
CN 202413825 U	05 September 2012	None	
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CN 207758797 U	24 August 2018	None	
CN 107901939 A	13 April 2018	None	

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REFERENCES CITED IN THE DESCRIPTION

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