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(54) PRIMARY SUSPENSION DEVICE, BOGIE AND RAILWAY VEHICLE

(57) Disclosed are a primary suspension device (3), a bogie and a rail vehicle. The bogie comprises: a frame provided with two parallel side beams (1) extending in a longitudinal direction; annular hoops (32) connected to bottom surfaces of end portions of the side beams (1), a centerline of the annular hoop (32) extending in a lateral direction; axle boxes (2), the axle box (2) being located in a space defined by the annular hoop (32), a centerline of the axle box (2) coinciding with the centerline of the annular hoop (32); and a plurality of buffer blocks (31) uniformly arranged between the annular hoops (32) and the axle boxes (2). By means of the primary suspension device (3), the bogie and the rail vehicle according to the invention, the height of the frame can be reduced on the premise that the preset strength and a buffer energy absorption effect are achieved.

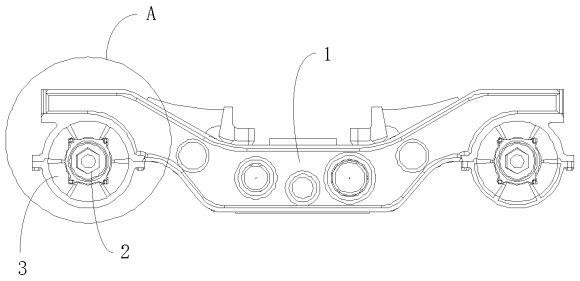

FIG. 1

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Description

TECHNICAL FIELD

[0001] This application relates to a rail vehicle buffering technology, and in particular, to a primary suspension device, a bogie and a rail vehicle.

BACKGROUND

[0002] Rail vehicles are an important transportation link connecting cities, and have gradually become the main means of transportation in cities. Rail vehicles are also the main carrier for cargo transportation. A bogie arranged at the bottom of a carriage functions to carry and steer a vehicle body, and the buffering performance of the bogie directly affects the vibration of the carriage. The bogie usually includes: a frame, wheel sets, axle boxes arranged on the wheel sets, and primary suspension devices arranged between the axle boxes and the frame. The quality of the primary suspension device directly affects the performance of the bogie.

[0003] In a traditional bogie, the primary suspension device adopts vertically arranged rubber springs, the top of the primary suspension device matches the frame, and the bottom of the primary suspension device matches the axle box to achieve positioning and buffering in the longitudinal, lateral and vertical directions. This design has high requirements on the performance of the rubber spring, and requires more frequent inspection and maintenance because serious safety accidents will occur during the operation of the vehicle once the rubber spring fails due to serious wear. In order to achieve the preset strength and a buffer energy absorption effect, the rubber spring should be designed to be relatively high, thereby increasing the height of the frame, improving the center of gravity of the entire carriage, and reducing the driving stability of the carriage.

SUMMARY

[0004] Embodiments of the present application provide a primary suspension device, a bogie and a rail vehicle, which can reduce the height of a frame on the premise that the preset strength and a buffer energy absorption effect are achieved.

[0005] An embodiment of a first aspect of this application provides a bogie, including:

a frame provided with two parallel side beams extending in a longitudinal direction;
annular hoops connected to bottom surfaces of end portions of the side beams, a centerline of the annular hoop extending in a lateral direction;
axle boxes, the axle box being located in a space defined by the annular hoop, a centerline of the axle box coinciding with the centerline of the annular hoop; and
a plurality of buffer blocks uniformly arranged between the annular hoops and the axle boxes.

[0006] An embodiment of a second aspect of the present application provides a rail vehicle, including: the bogie as described above.

[0007] An embodiment of a third aspect of this application provides a primary suspension device to be arranged between a frame and an axle box of a bogie, and the primary suspension device includes:

an annular hoop having a centerline extending in a lateral direction and connected with the frame, the annular hoop being configured to encircle an outside of the axle box; and
a plurality of buffer blocks uniformly arranged between the annular hoop and the axle box.

[0008] In the technical solution of the embodiments of this application, the annular hoop having a centerline extending in the lateral direction is configured to be connected to the bottom surface of the end portion of the side beam; the axle box is located in the space defined by the annular hoop, and the centerline of the axle box coincides with the centerline of the annular hoop; and the plurality of buffer blocks are uniformly arranged between the annular hoop and the axle box. In this way, the side beam and the axle box can be positioned and forces in multiple directions such as lateral force, longitudinal force and vertical force can be buffered. Moreover, a height difference between the side beam and the axle box is only a sum of a thickness of the annular hoop and a height of one buffer block. In this way, the height of the frame can be reduced and the center of gravity of the carriage can be further lowered, which is conducive to improving driving stability. In addition, the above-mentioned primary suspension device is relatively simple in structure, can be disassembled and assembled conveniently, and its maintenance process is relatively simple.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The drawings described herein are intended to provide a further understanding of this application and constitute a part of this application. The illustrative embodiments of this application and the description thereof are for explaining this application and do not constitute an undue limitation of this application. In the figures:

FIG. 1 is a schematic structural diagram of a bogie according to an embodiment of this application;
FIG. 2 is an enlarged view of area A in FIG. 1;
FIG. 3 is an exploded view of an assembly of a frame and a primary suspension device according to the embodiment of this application;
FIG. 4 is a schematic structural diagram of a buffer block in the bogie according to the embodiment of this application;

FIG. 5 is a schematic diagram of the buffer block in the bogie according to the embodiment of this application seen from another angle;

FIG. 6 is a schematic structural diagram of an axle box in the bogie according to the embodiment of this application;

FIG. 7 is a schematic structural diagram of the frame according to the embodiment of this application; and

FIG. 8 is a schematic structural diagram of a lower half loop in the bogie according to the embodiment of this application.

Reference numerals:

[0010]

1-side beam;

2-axle box; 21-axle box positioning protrusion; 22-axle box positioning hole;

3-primary suspension device;

31-buffer block; 311-buffer block positioning groove; 312-buffer block positioning column; 313-buffer block positioning protrusion;

32-annular hoop; 321-upper half hoop; 322-lower half hoop; 323-annular hoop positioning groove; 324-half hoop connecting part; 325-connecting hole;

4-bolt.

DETAILED DESCRIPTION

[0011] To make the technical solutions and advantages of this application clearer, the exemplary embodiments of this application will be described in further detail below with reference to the accompanying drawings. Obviously, the described embodiments are only a part, not exhaustive of all embodiments of this application. It should be noted that embodiments in this application and the features in the embodiments may be combined with each other without conflict.

First embodiment

[0012] This embodiment provides a bogie which can be applied to a rail vehicle. The rail vehicle may be a diesel locomotive or an electric locomotive, and may be an EMU, a subway train, a light-rail train, a tramcar, or the like.

[0013] In this embodiment, a direction extending along a railway line is referred to as a longitudinal direction, a direction perpendicular to the extending direction of the railway line is referred to as a lateral direction, and a direction perpendicular to a horizontal plane is referred to as a vertical direction or perpendicular direction.

[0014] FIG. 1 is a schematic structural diagram of a bogie according to an embodiment of this application; FIG. 2 is an enlarged view of area A in FIG. 1; and FIG. 3 is an exploded view of an assembly of a frame and a primary suspension device according to the embodiment of this application. As shown in FIGS. 1 to 3, the bogie according to this embodiment includes: a frame, wheel sets, a traction device, braking devices and other components, and each component is implemented according to the prior art. The frame includes two parallel side beams 1 extending in the longitudinal direction, a cross beam is connected between the two side beams 1, and components such as the traction device and the braking devices can be assembled on the beam. The wheel set includes: an axle, wheels symmetrically arranged on the axle and an axle box 2. A primary suspension device 3 is arranged between the side beam 1 and the axle box 2 to achieve positioning and buffering between the side beam 1 and the axle box 2.

[0015] A primary buffer device 3 includes: buffer blocks 31 and an annular hoop 32. The annular hoop 32 is of a circular ring structure and has a top connected to a bottom surface of an end portion of the side beam 1, and a centerline of the annular hoop 32 extends in a lateral direction. A middle part of the axle box 2 is located in a space defined by the annular hoop 32, and a centerline of the axle box 2 coincides with the centerline of the annular hoop 32. A plurality of buffer blocks 31 are provided and uniformly arranged between the annular hoop 32 and the axle box 2 to position the side beam 1 and the axle box 2, and forces from lateral, longitudinal and perpendicular directions can be buffered through the buffer blocks 31.

[0016] Compared with the prior art in which a larger space needs to be reserved between a frame and an axle box for accommodating a primary suspension device, the implementation of this embodiment in which the buffer blocks are uniformly arranged at a periphery of the axle box can reduce a space required between the axle box and the frame and thus can reduce the height of the frame.

[0017] In the technical solution of this embodiment, the annular hoop having a centerline extending in the lateral direction is configured to be connected to the bottom surface of the end portion of the side beam; the axle box is located in the space defined by the annular hoop, and the centerline of the axle box coincides with the centerline of the annular hoop; and the plurality of buffer blocks are uniformly arranged between the annular hoop and the axle box. In this way, the side beam and the axle box can be positioned and forces in multiple directions such as lateral force, longitudinal force and vertical force can be buffered, thus ensuring even stress. Moreover, a height difference between the side beam and the axle box is only a sum of a thickness of the annular hoop and a height of one buffer block. In this way, the height of the frame can be reduced and the center of gravity of the carriage can be further lowered, which is conducive to improving driving stability. In addition, the above-mentioned primary suspension device is relatively simple in structure, can be disassembled and assembled conveniently, and its maintenance process is relatively simple.

[0018] The following describes the positioning method

for the components in the primary suspension device.

[0019] A first lateral positioning structure is arranged on an inner side of the buffer block 31, and a second lateral positioning structure is arranged on an outer peripheral surface of the axle box 2. The first lateral positioning structure and the second lateral positioning structure cooperate with each other to laterally position the buffer block, thereby avoiding lateral movement of the buffer block. The first lateral positioning structure and the second lateral positioning structure may be configured as structures capable of mutually restricting lateral movement. For example, the first lateral positioning structure and the second lateral positioning structure are configured as a positioning protrusion and a positioning groove that cooperate with each other. The first lateral positioning structure may specifically be configured as a buffer block positioning groove formed in the inner side of the buffer block 31 and extending in the longitudinal direction. The second lateral positioning structure may specifically be configured as an axle box positioning protrusion protruding from the outer peripheral surface of the axle box and extending in the longitudinal direction. The axle box positioning protrusion can be accommodated in the buffer block positioning groove to limit the lateral movement of the buffer block 31.

[0020] A first longitudinal positioning structure is arranged on the inner side of the buffer block 31, and a second longitudinal positioning structure is arranged on the outer peripheral surface of the axle box 2. The first longitudinal positioning structure and the second longitudinal positioning structure cooperate with each other to longitudinally position the buffer block, thereby avoiding longitudinal movement of the buffer block. The first longitudinal positioning structure and the second longitudinal positioning structure may be configured as structures capable of mutually restricting longitudinal movement. For example, the first longitudinal positioning structure and the second longitudinal positioning structure are configured as a positioning column and a positioning hole that cooperate with each other or configured as a positioning protrusion and a positioning groove that cooperate with each other. In this embodiment, the first longitudinal positioning structure is specifically configured as a buffer block positioning column arranged on the inner side of the buffer block 31 and having a length direction extending along a radial direction of the annular hoop 32. The second longitudinal positioning structure is configured as an axle box positioning hole formed in the outer peripheral surface of the axle box 2. The buffer block positioning column can be inserted into the axle box positioning hole to limit the longitudinal movement of the buffer block 31.

[0021] A third lateral positioning structure is arranged on an outer side of the buffer block 31, a fourth lateral positioning structure is arranged on an inner side of the annular hoop 32, and the third lateral positioning structure and the fourth lateral positioning structure cooperate with each other to laterally position the buffer block 31. The third lateral positioning structure and the fourth lateral positioning structure may be configured as structures capable of mutually restricting lateral movement. For example, the third lateral positioning structure and the fourth lateral positioning structure are configured as a positioning protrusion and a positioning groove that cooperate with each other. In this embodiment, the third lateral positioning structure is configured as a buffer block positioning protrusion arranged on the outer side of the buffer block 31 and extending in the longitudinal direction. The fourth lateral positioning structure is configured as an annular hoop positioning groove formed in the inner side of the annular hoop 32. The butter block positioning protrusion can be accommodated in the annular hoop positioning groove to limit the lateral movement of the buffer block 31.

[0022] This embodiment provides a specific implementation of a primary suspension device as follows.

[0023] FIG. 4 is a schematic structural diagram of a buffer block in the bogie according to the embodiment of this application; FIG. 5 is a schematic diagram of the buffer block in the bogie according to the embodiment of this application seen from another angle; FIG. 6 is a schematic structural diagram of an axle box in the bogie according to the embodiment of this application; FIG. 7 is a schematic structural diagram of the frame according to the embodiment of this application; and FIG. 8 is a schematic structural diagram of a lower half loop in the bogie according to the embodiment of this application.

[0024] As shown in FIGS. 1 to 8, six buffer blocks 31 are provided. The buffer block 31 has a fan-shaped longitudinal section. End surfaces of the six buffer blocks 31 are connected end to end to form a closed ring. Each buffer block 31 has an inner surface facing the axle box 2 and an outer surface facing the annular hoop 32, and the inner surface and the outer surface are both arc surfaces.

[0025] The inner surface of the buffer block 31 is provided with a buffer block positioning groove 311 extending in the longitudinal direction. Correspondingly, the outer peripheral surface of the axle box 2 is provided with an annular axle box positioning protrusion 21. The axle box positioning protrusion 21 can be accommodated in the buffer block positioning groove 311. An interaction force between a side wall of the axle box positioning protrusion 21 and a side wall of the buffer block positioning groove 311 can limit the lateral movement of the buffer block 31.

[0026] The inner surface of the buffer block 31 (specifically, a bottom surface of the buffer block positioning groove 311) is provided with a buffer block positioning column 312. The buffer block positioning column 312 protrudes from the bottom surface of the buffer block positioning groove 311 and extends along the radial direction of the annular hoop 32. Correspondingly, the outer peripheral surface of the axle box 2 (specifically, a top surface of the axle box positioning protrusion 21) is provided with an axle box positioning hole 22, and the buffer block

positioning groove 311 can be inserted into the axle box positioning hole 22. The cooperation of the axle box positioning hole 22 and the buffer block positioning groove 311 limits the longitudinal movement and lateral movement of the buffer block 31. One buffer block 31 is provided with one buffer block positioning column 312, and the position and number of the axle box positioning holes 22 are set according to the number and position of the buffer block positioning columns 3 12.

[0027] The outer side of the buffer block 31 is provided with a buffer block positioning protrusion 313 extending in the longitudinal direction. Correspondingly, an annular hoop positioning groove 323 is formed in the inner side of the annular hoop 32 and the buffer block positioning protrusion 313 can be accommodated in the annular hoop positioning groove 323. An acting force between side walls of the annular hoop positioning groove 323 and the buffer block positioning protrusion 313 can limit the lateral movement of the buffer block 31.

[0028] The axle box 2, the buffer block 31 and the annular hoop 32 of the above-mentioned structures can cooperate to laterally, longitudinally and perpendicularly position the buffer blocks 31. The buffer blocks 31 also can buffer the lateral, longitudinal and perpendicular forces between the side beam 1 and the axle box 2.

[0029] The manner of cooperating and positioning among the axle box 2, the buffer block 31 and the annular hoop 32 is not limited to the above manner, and other manners may also be used, which will not limited in this embodiment. The number of buffer blocks 31 is also not limited to six, and may be four, eight or another number.

[0030] For the annular hoop 32, this embodiment also provides a specific implementation as follows.

[0031] The annular hoop 32 includes two parts: an upper half hoop 321 and a lower half hoop 322. The upper half hoop 321 is fixed on the bottom surface of the side beam 1 with its opening facing downward. The lower half hoop 322 is connected to the upper half hoop 321 with its opening facing upward, and forms a circular space together with the upper half hoop 321.

[0032] Specifically, two ends of the upper half hoop 321 respectively extend outwardly to form half hoop connecting parts 324, and connecting holes 325 are formed in the half hoop connecting parts 324. Two ends of the lower half hoop 322 respectively extend outwardly to form half hoop connecting parts 324, and connecting holes 325 are also formed in the half hoop connecting parts 324. In an assembling process, the upper half hoop 321 is first connected with the side beam 1; then, the half hoop connecting parts 324 in the lower half hoop 322 are aligned with the half hoop connecting parts 324 in the upper half hoop 321, with the connecting holes 325 coinciding; and a bolt 4 passes through the two corresponding connecting holes 325 in sequence from the bottom and is then fitted with a nut for fixing.

[0033] An inner surface of the upper half hoop 321 and an inner surface of the lower half hoop 322 are each provided with the annular hoop positioning groove 323 for accommodating the buffer block positioning protrusions 313.

[0034] The above-mentioned primary suspension device 3 can be used as an independent product applied in various bogies. The bogie to which the primary suspension device 3 is applied can be modified adaptively according to the primary suspension device 3.

[0035] This embodiment further provides a rail vehicle including the bogie according to any of the above. The annular hoop having a centerline extending in the lateral direction is configured to be connected to the bottom surface of the end portion of the side beam; the axle box is located in the space defined by the annular hoop, and the centerline of the axle box coincides with the centerline of the annular hoop; and the plurality of buffer blocks are uniformly arranged between the annular hoop and the axle box. In this way, the side beam and the axle box can be positioned and forces in multiple directions such as lateral force, longitudinal force and vertical force can be buffered. Moreover, a height difference between the side beam and the axle box is only a sum of a thickness of the annular hoop and a height of one buffer block. In this way, the height of the frame can be reduced and the center of gravity of the carriage can be further lowered, which is conducive to improving driving stability. In addition, the above-mentioned primary suspension device is relatively simple in structure, can be disassembled and assembled conveniently, and its maintenance process is relatively simple.

[0036] In the description of this application, it should be understood that the orientations or positional relationships, indicated by the terms "central", "longitudinal", "lateral", "length", "width", "thickness", "on", "under", "front", "rear", "left", "right", "vertical", "horizontal", "top", "bottom", "inside", "outside", or the like, are based on the orientations or positional relationships shown in the drawings and are only for the purpose of facilitating and simplifying the description of this application, rather than indicating or implying that the described device or element must have a particular orientation or must be constructed and operated in a particular orientation, and therefore they cannot be construed as limiting this application.

[0037] Moreover, the terms "first" and "second" are used for descriptive purposes only and are not to be construed as indicating or implying a relative importance or implicitly indicating the number of technical features indicated. Thus, features defined by the term "first" or "second" may include one or more such features, either explicitly or implicitly. In the description of this application, the meaning of "a plurality of' is at least two, such as two, three, etc., unless specifically defined otherwise.

[0038] In this application, unless otherwise stated and defined explicitly, the terms such as "install" "link", "connect", and "fix" should be understood in a broad sense; for example, a connection may be a fixed connection, a detachable connection, or an integrated connection; may be a mechanical connection, an electrical connection or intercommunication; and may be a direct connection, an

indirect connection through an intermediate medium, or a communication inside two components or interaction between two components. For those skilled in the art, the specific meanings of the above terms in the present application can be understood based on a specific situation.

[0039] Although some optional embodiments of this application have been described, those skilled in the art may make other changes and modifications to these embodiments once they have acquired the basic inventive concept. Therefore, the appended claims are intended to be interpreted as including some optional embodiments and all the changes and modifications that fall within the scope of this application.

[0040] It will be apparent to those skilled in the art that various changes and modifications can be made in this application without departing from the spirit and scope of this application. In this manner, this application is intended to incorporate such modifications and variations as the modifications and variations of this application are within the scope of the appended claims of this application and the equivalents thereof.

Claims

1. A bogie, comprising:

a frame provided with two parallel side beams extending in a longitudinal direction;
annular hoops connected to bottom surfaces of end portions of the side beams, a centerline of the annular hoop extending in a lateral direction;
axle boxes, the axle box being located in a space defined by the annular hoop, a centerline of the axle box coinciding with the centerline of the annular hoop; and
a plurality of buffer blocks uniformly arranged between the annular hoop and the axle box.

2. The bogie according to claim 1, wherein a first lateral positioning structure is arranged on an inner side of the buffer block and is configured to cooperate with a second lateral positioning structure arranged on an outer peripheral surface of the axle box to laterally position the buffer block.

3. The bogie according to claim 2, wherein the first lateral positioning structure is configured as a buffer block positioning groove formed in the inner side of the buffer block and extending in the longitudinal direction, the second lateral positioning structure is configured as an axle box positioning protrusion protruding from the outer peripheral surface of the axle box and extending in the longitudinal direction, and the axle box positioning protrusion can be accommodated in the buffer block positioning groove.

4. The bogie according to claim 1, wherein a first longitudinal positioning structure is arranged on the inner side of the buffer block and is configured to cooperate with a second longitudinal positioning structure arranged on the outer peripheral surface of the axle box to longitudinally position the buffer block.

5. The bogie according to claim 4, wherein the first longitudinal positioning structure is configured as a buffer block positioning column arranged on the inner side of the buffer block and having a length direction extending along a radial direction of the annular hoop; the second longitudinal positioning structure is configured as an axle box positioning hole formed in the outer peripheral surface of the axle box; the buffer block positioning column can be inserted into the axle box positioning hole.

6. The bogie according to claim 1, wherein a third lateral positioning structure is arranged on an outer side of the buffer block and is configured to cooperate with a fourth lateral positioning structure arranged on an inner side of the annular hoop to laterally position the buffer block.

7. The bogie according to claim 6, wherein the third lateral positioning structure is configured as a buffer block positioning protrusion arranged on the outer side of the buffer block and extending in the longitudinal direction; the fourth lateral positioning structure is configured as an annular hoop positioning groove formed in the inner side of the annular hoop; and the buffer block positioning protrusion can be accommodated in the annular hoop positioning groove.

8. The bogie according to claim 1, wherein the buffer block has a fan-shaped longitudinal section, and end surfaces of the plurality of buffer blocks are abutted and spliced to form a ring structure;
an inner surface of the buffer block is provided with the buffer block positioning groove for lateral positioning relative to the axle box; a bottom surface of the buffer block positioning groove is provided with the buffer block positioning column for longitudinal positioning relative to the axle box; the outer side of the buffer block is provided with the buffer block positioning protrusion for lateral positioning relative to the annular hoop.

9. The bogie according to claim 8, wherein the axle box is provided with the axle box positioning protrusion that can be accommodated in the buffer block positioning groove, and the axle box positioning protrusion is configured as an annular protrusion encircling the outer peripheral surface of the axle box; a top surface of the axle box positioning protrusion is provided with an axle box positioning hole for accommodating the buffer block positioning column, and a

number and position of the axle box positioning holes correspond to those of the buffer block positioning columns.

10. The bogie according to claim 8, wherein the annular hoop comprises:

an upper half hoop connected to a bottom surface of the side beam, an opening of the upper half hoop facing downward, an inner surface of the upper half hoop being provided with the annular hoop positioning groove that can accommodate the buffer block positioning protrusion; and

a lower half hoop connected to the upper half hoop, an opening of the lower half hoop facing upward, the lower half hoop together with the upper half hoop defining a circular space that can accommodate the buffer block and the axle box, an inner surface of the lower half hoop being provided with the annular hoop positioning groove that can accommodate the buffer block positioning protrusion.

11. A rail vehicle, comprising the bogie according to any of claims 1 to 10.

12. A primary suspension device to be arranged between a frame and an axle box of a bogie, the primary suspension device comprising:

an annular hoop having a centerline extending in a lateral direction and connected with the frame, the annular hoop being configured to encircle an outside of the axle box; and

a plurality of buffer blocks uniformly arranged between the annular hoop and the axle box.

13. The primary suspension device according to claim 12, wherein a first lateral positioning structure is arranged on an inner side of the buffer block and is configured to cooperate with the axle box to laterally position the buffer block.

14. The primary suspension device according to claim 13, wherein the first lateral positioning structure is configured as a buffer block positioning groove formed in the inner side of the buffer block and extending in a longitudinal direction and is configured to cooperate with an axle box positioning protrusion arranged on the outer peripheral surface of the axle box to perform lateral positioning.

15. The primary suspension device according to claim 12, wherein a first longitudinal positioning structure is arranged on the inner side of the buffer block and is configured to cooperate with the axle box to longitudinally position the buffer block.

16. The primary suspension device according to claim 15, wherein the first longitudinal positioning structure is configured as a buffer block positioning column arranged on the inner side of the buffer block and having a length direction extending along a radial direction of the annular hoop, the buffer block positioning column being configured to cooperate with an axle box positioning hole formed in the outer peripheral surface of the axle box to perform longitudinal positioning.

17. The primary suspension device according to claim 12, wherein a third lateral positioning structure is arranged on an outer side of the buffer block and is configured to cooperate with the annular hoop to laterally position the buffer block.

18. The primary suspension device according to claim 17, wherein the third lateral positioning structure is configured as a buffer block positioning protrusion arranged on the outer side of the buffer block and extending in the longitudinal direction, and the buffer block positioning protrusion can be accommodated in the annular hoop positioning groove formed in the inner side of the annular hoop to perform lateral positioning.

19. The primary suspension device according to claim 12, wherein the buffer block has a fan-shaped longitudinal section, and end surfaces of the plurality of buffer blocks are abutted and spliced to form a ring structure;

an inner surface of the buffer block is provided with the buffer block positioning groove for lateral positioning relative to the axle box; a bottom surface of the buffer block positioning groove is provided with the buffer block positioning column for longitudinal positioning relative to the axle box; the outer side of the buffer block is provided with the buffer block positioning protrusion for lateral positioning relative to the annular hoop.

20. The primary suspension device according to claim 19, wherein the annular hoop comprises:

an upper half hoop connected to the frame, an inner surface of the upper half hoop being provided with the annular hoop positioning groove that can accommodate the buffer block positioning protrusion; and

a lower half hoop connected to the upper half hoop and encircling an outside of each buffer block, an inner surface of the lower half hoop being provided with the annular hoop positioning groove that can accommodate the buffer block positioning protrusion.

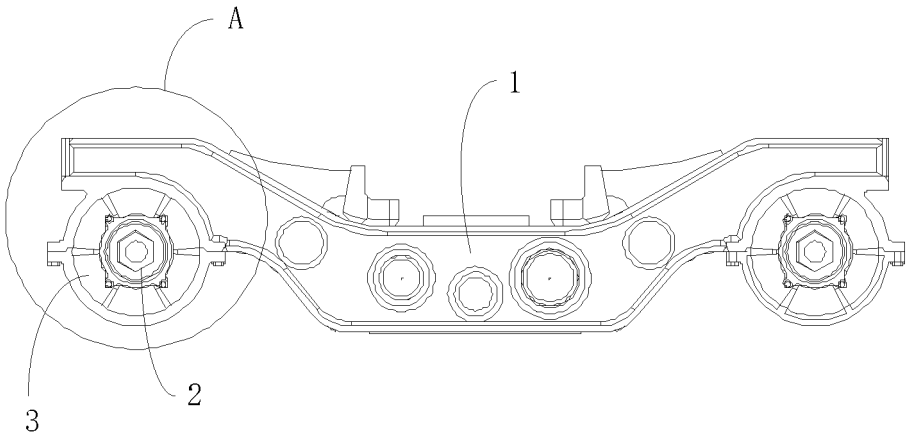

FIG. 1

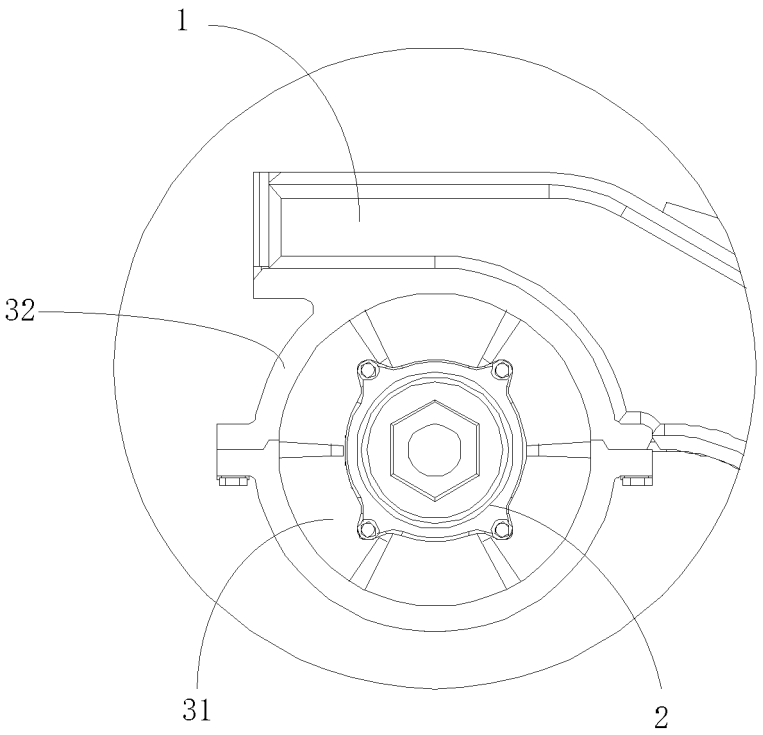

FIG. 2

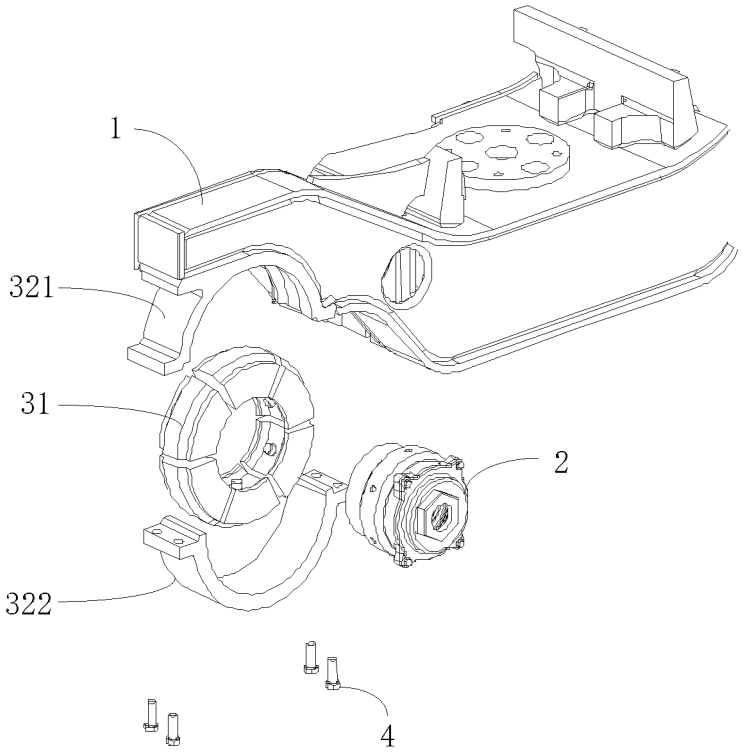

FIG. 3

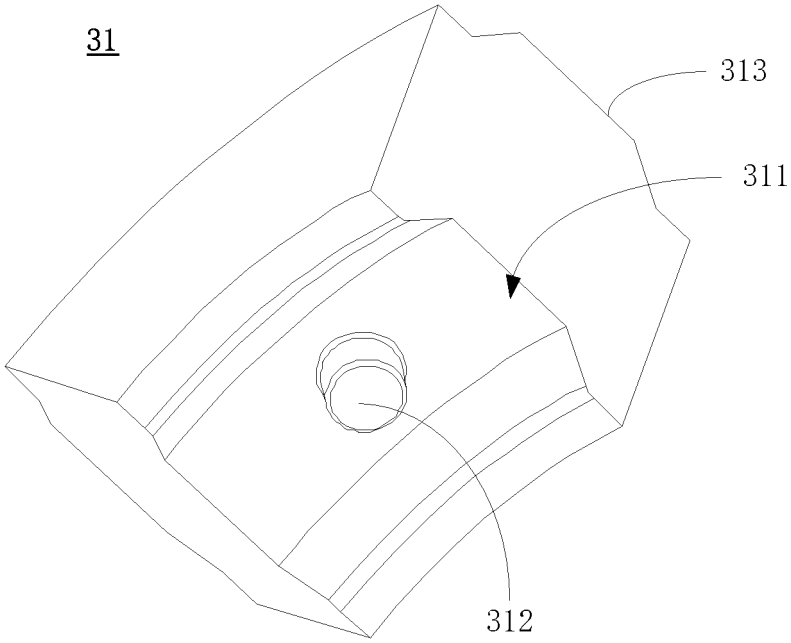

FIG. 4

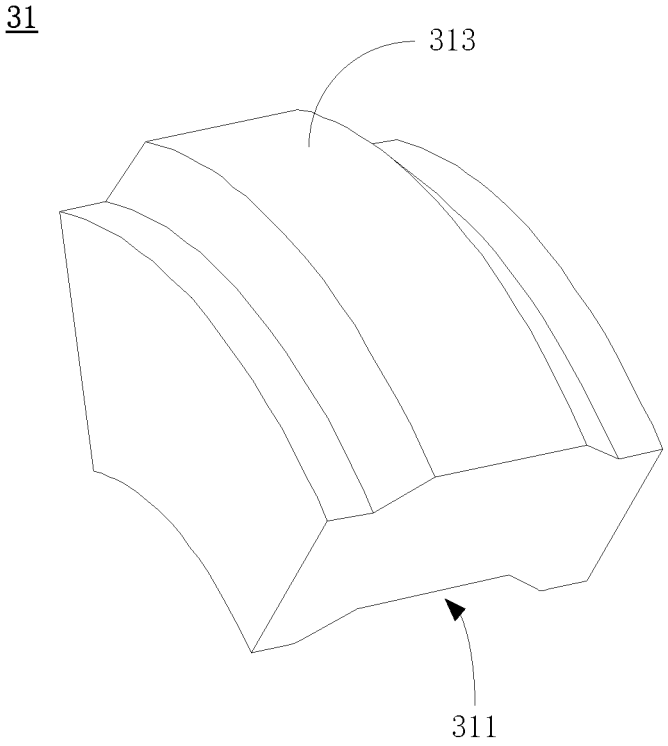

FIG. 5

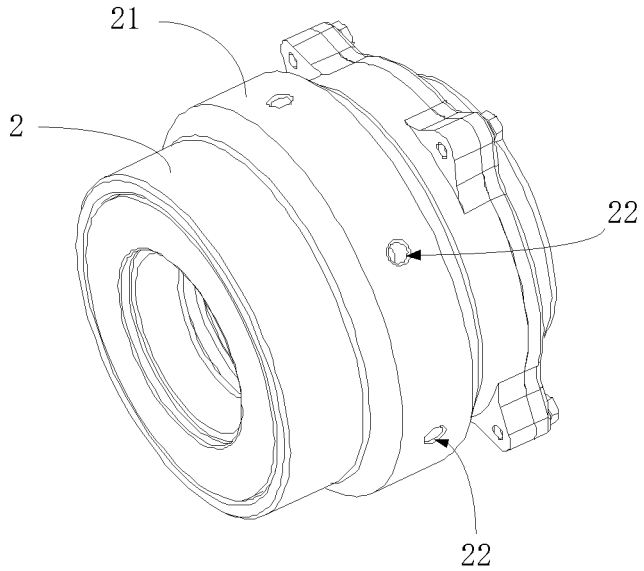

FIG. 6

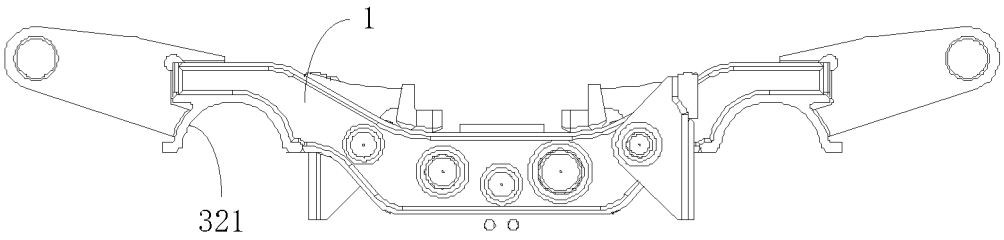

FIG. 7

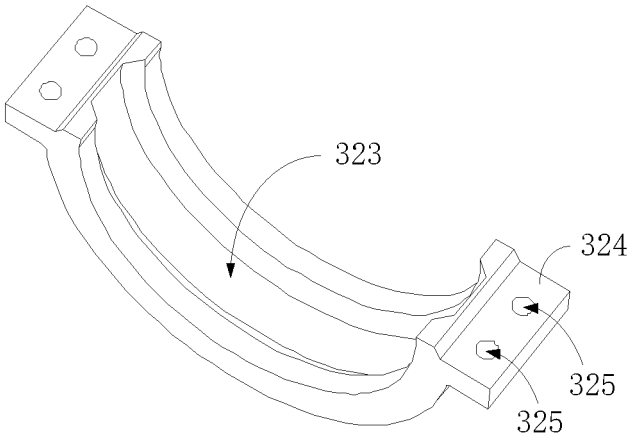

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/117332

A. CLASSIFICATION OF SUBJECT MATTER

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)

CNPAT, CNKI, EPODOC, WPI: 张隶新, 轴箱, 悬挂, 转向架, 箍, 环形, 缓冲, 减震, 减振, 弹性; axle, box, suspension, frame, shock, elastic, buffer, cushion

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4438703 A (BUDD CO.) 27 March 1984 (1984-03-27) description, column 2 line 54 to column 5 line 15, and figures 1-4	1-20
A	CN 108463389 A (BOMBARDIER TRANSP GMBH; FREUDENBERG CARL KG) 28 August 2018 (2018-08-28) entire document	1-20
A	CN 201276119 Y (QIQIHAR RAILWAY ROLLING STOCK CO., LTD.) 22 July 2009 (2009-07-22) entire document	1-20
A	CN 202016475 U (XIANGTAN ELECTRIC MFG GROUP HEAVY DUTY EQUIPMENT CO., LTD.) 26 October 2011 (2011-10-26) entire document	1-20
A	GB 813237 A (E C LENNING PROPRIETARY LTD. et al.) 13 May 1959 (1959-05-13) entire document	1-20
A	GB 822358 A (ROBERT HUDSON & SONS PROPRIETA) 21 October 1959 (1959-10-21) entire document	1-20

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 March 2020	**24 April 2020**

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Facsimile No. **(86-10)62019451**	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2019/117332

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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A	CN 207875663 U (CSR ZHUZHOU LOCOMOTIVE CO., LTD.) 18 September 2018 (2018-09-18) entire document	1-20

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2019/117332

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CN 201276119 Y	22 July 2009	None	
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GB 822358 A	21 October 1959	None	
CN 202847716 U	03 April 2013	None	
CN 207875663 U	18 September 2018	None	

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