



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
25.11.2020 Bulletin 2020/48

(51) Int Cl.:
B61G 7/14 (2006.01) B61G 11/16 (2006.01)

(21) Application number: **20754132.7**

(86) International application number:
PCT/CN2020/076621

(22) Date of filing: **25.02.2020**

(87) International publication number:
WO 2020/173436 (03.09.2020 Gazette 2020/36)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

- **MIN, Hanqin**
Changchun, Jilin 130000 (CN)
- **CONG, Lixin**
Changchun, Jilin 130000 (CN)
- **ZHANG, Qiang**
Changchun, Jilin 130000 (CN)
- **SUN, Wenyue**
Changchun, Jilin 130000 (CN)

(30) Priority: **26.02.2019 CN 201910141398**
26.02.2019 CN 201920244002 U

(74) Representative: **Behr, Wolfgang**
Lorenz Seidler Gossel
Rechtsanwälte Patentanwälte
Partnerschaft mbB
Widenmayerstraße 23
80538 München (DE)

(71) Applicant: **CRRRC Changchun Railway Vehicles Co., Ltd.**
Changchun, Jilin 130000 (CN)

(72) Inventors:

- **JIANG, Shihong**
Changchun, Jilin 130000 (CN)

(54) **VEHICLE AND VEHICLE BODY COLLISION ENERGY ABSORPTION DEVICE THEREOF**

(57) A vehicle and a vehicle body collision energy absorbing device thereof are disclosed by this application. A coupler (8) of the vehicle body collision energy absorbing device includes a coupler body (81) and an expansion pipe (82) that absorbs energy and expands relative to the coupler body, and the coupler body (81) is arranged on a coupler mounting plate (1). A vehicle body structure (2) is provided with an energy absorbing cavity, and the coupler mounting plate (1) and the expansion pipe (82) are arranged in the energy absorbing cavity. The vehicle body collision energy absorbing device further includes a compression energy absorbing unit (6) arranged in the energy absorbing cavity, a locking device (3) that locks the coupler mounting plate (1) relative to the energy absorbing cavity, a retreat support (5) arranged between the coupler mounting plate (1) and the compression energy absorbing unit (6), and a shear pin (4) connecting the vehicle body structure (2) with the retreat support (5). One end of the compression energy absorbing unit (6) abuts against a rear plate of the energy absorbing cavity. The retreat support (5) is slidably arranged in the energy absorbing cavity, and is provided

with a locking component and a linkage structure. The locking component unlocks the locking device (3) after being away from the coupler mounting plate (1), and the linkage structure has a positioning structure axially positioned with the expansion pipe (82). The vehicle body collision energy absorbing device improves the energy absorption effect and ensures the safety of passengers' lives and properties.

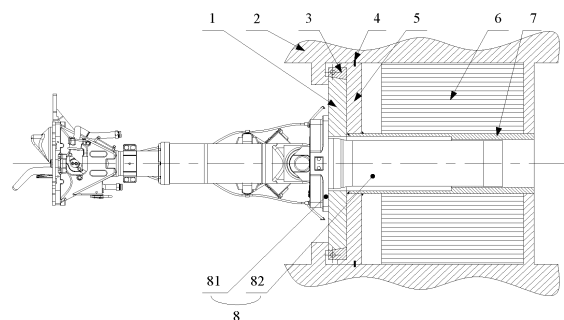


Figure 1

Description

[0001] The present application claims the priority to Chinese Patent Application No. 201910141398.3, titled "VEHICLE AND VEHICLE BODY COLLISION ENERGY ABSORBING DEVICE THEREOF", filed with the China National Intellectual Property Administration on February 26, 2019, which is incorporated herein by reference in its entirety.

[0002] The present application claims the priority to Chinese Patent Application No. 201920244002.3, titled "VEHICLE AND VEHICLE BODY COLLISION ENERGY ABSORBING DEVICE THEREOF", filed with the China National Intellectual Property Administration on February 26, 2019, which is incorporated herein by reference in its entirety.

FIELD

[0003] The present application relates to the technical field of energy absorption safety protection equipment, and in particular to a vehicle and a vehicle body collision energy absorbing device thereof.

BACKGROUND

[0004] With the rapid development of China's rail transportation construction, traveling is more convenient, and the harm caused by accidents is also increasing. While improving the reliability of active control, the passive safety of rail vehicles has gradually become the focus of attention. In order to alleviate the huge damage to the vehicle body structure when rail transportation vehicles collide with each other, how to ensure the safety of vehicle collision is worthy of designers' deep consideration. When rail vehicles collide, the leading vehicle is subjected to the greatest impact, and the impact on subsequent vehicles gradually reduces. Considering the vehicle energy absorption requirements and the actual energy absorption means, an absorbing device with large energy absorption capability is generally arranged on the leading vehicle.

[0005] When two high-speed trains collide, the coupler is impacted first. In order to absorb the energy generated by train collision as much as possible, it should be ensured that the structure of the coupler can safely and reliably absorb more energy.

[0006] Therefore, how to improve the energy absorption effect and ensure the safety of passengers' lives and properties is an urgent problem to be solved by those skilled in the art.

SUMMARY

[0007] In view of this, a vehicle body collision energy absorbing device is provided according to the present application, so as to improve the energy absorption effect and ensure the safety of passengers' lives and proper-

ties. A vehicle including the vehicle body collision energy absorbing device is further provided according to the present application.

[0008] In order to achieve the above objects, the following technical solutions are provided according to the present application.

[0009] A vehicle body collision energy absorbing device includes a coupler, a coupler mounting plate and a vehicle body structure. The coupler includes a coupler body and an expansion pipe that absorbs energy and expands relative to the coupler body. The coupler body is arranged on the coupler mounting plate.

[0010] The vehicle body structure is provided with an energy absorbing cavity, and the coupler mounting plate and the expansion pipe are arranged in the energy absorbing cavity.

[0011] The vehicle body collision energy absorbing device further includes a compression energy absorbing unit arranged in the energy absorbing cavity, a locking device that locks the coupler mounting plate relative to the energy absorbing cavity, a retreat support arranged between the coupler mounting plate and the compression energy absorbing unit, and a shear pin connecting the vehicle body structure with the retreat support.

[0012] One end of the compression energy absorbing unit abuts against a rear plate of the energy absorbing cavity. The retreat support is slidably arranged in the energy absorbing cavity, and is provided with a locking component and a linkage structure. The locking component unlocks the locking device after being away from the coupler mounting plate, and the linkage structure has a positioning structure axially positioned with the expansion pipe. When the expansion pipe drives a guide pipe and the retreat support to slide, the shear pin breaks.

[0013] Preferably, in the vehicle body collision energy absorbing device, the locking device is a trapezoidal block which is rotatable relative to the vehicle body structure, an end surface of the coupler mounting plate inclines towards the coupler along a direction of approaching the compression energy absorbing unit;

when the locking device is in a locked state, a large end of the trapezoidal block contacts the retreat support, one side surface of the trapezoidal block contacts the end surface of the coupler mounting plate, and the other side surface of the trapezoidal block contacts the locking component; and

after the retreat support is separated from the trapezoidal block, the trapezoidal block can rotate relative to the vehicle body structure and be separated from the coupler mounting plate.

[0014] Preferably, in the vehicle body collision energy absorbing device, a cross section of the trapezoidal block is a right-angled trapezoid;

the oblique sideline of the right-angled trapezoid is located on the side surface of the trapezoidal block in contact with the end surface of the coupler mounting plate; the right-angle sideline of the right-angled trapezoid is located on the side surface of the trapezoidal block in contact

with the locking component; and the locking component is a position-limiting block provided between the trapezoidal block and the vehicle body structure.

[0015] Preferably, the vehicle body collision energy absorbing device further includes a position-limiting protrusion arranged at an opening of the energy absorbing cavity and configured to restrict the coupler mounting plate from sliding out of the energy absorbing cavity.

[0016] Preferably, in the vehicle body collision energy absorbing device, two position-limiting protrusions are provided and are symmetrically arranged on two sides of the opening of the energy absorbing cavity.

[0017] Preferably, in the vehicle body collision energy absorbing device, the linkage structure is a guide pipe that is fixedly connected to the retreat support and penetrates through the compression energy absorbing unit, and the guide pipe is sleeved on the outside of the expansion pipe.

[0018] Preferably, in the vehicle body collision energy absorbing device, the rear plate of the energy absorbing cavity is provided with an avoidance hole for the guide pipe and the expansion pipe to pass through.

[0019] Preferably, in the vehicle body collision energy absorbing device, the positioning structure of the guide pipe is a stepped surface; and the outer surface of the expansion pipe has a shoulder structure capable of cooperating with the stepped surface.

[0020] Preferably, in the vehicle body collision energy absorbing device, two locking devices are provided and are symmetrically arranged at two ends of the coupler mounting plate.

[0021] A vehicle is further provided according to the present application, which includes the vehicle body collision energy absorbing device according to any one of the above aspects.

[0022] It can be seen from the above technical solutions that, in the vehicle body collision energy absorbing device provided by the present application, when two high-speed trains collide with each other, the coupler is impacted, and the expansion pipe extends outward relative to the coupler body to complete the first energy absorption; moreover, the linkage structure has a positioning structure which is axially positioned with the expansion pipe; after the expansion pipe extends outward relative to the coupler body, the expansion pipe drives the guide pipe and the retreat support to slide, and the shear pin breaks, so that the retreat support moves away from the coupler mounting plate, the locking component unlocks the locking device, and the locking device unlocks the coupler mounting plate; and the coupler mounting plate slides in the energy absorbing cavity under the action of the impact force and moves toward the compression energy absorbing unit, and the compression energy absorbing unit is compressed to complete the second energy absorption. The vehicle body collision energy absorbing device provided by the present application ef-

fectively improves the energy absorption effect and ensures the safety of passengers' lives and properties.

[0023] A vehicle is further provided according to the present application, which includes the vehicle body collision energy absorbing device according to any one of the above aspects. Since the aforementioned vehicle body collision energy absorbing device has the aforementioned technical effects, the vehicle having the aforementioned vehicle body collision energy absorbing device should also have the same technical effects, which will not be repeated here.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] For more clearly illustrating embodiments of the present application or technical solutions in the conventional technology, the drawing referred to for describing the embodiments or the conventional technology will be briefly described hereinafter. Apparently, the drawings in the following description are only some examples of the present application, and for those skilled in the art, other drawings may be obtained based on the provided drawings without any creative efforts.

Figure 1 is a schematic view of a first structure of a vehicle body collision energy absorbing device provided by an embodiment of the present application;

Figure 2 is a schematic view of a second structure of the vehicle body collision energy absorbing device provided by an embodiment of the present application;

Figure 3 is a schematic view of a third structure of the vehicle body collision energy absorbing device provided by an embodiment of the present application; and

Figure 4 is a schematic view of a fourth structure of the vehicle body collision energy absorbing device provided by an embodiment of the present application.

DETAILED DESCRIPTION OF EMBODIMENTS

[0025] A vehicle body collision energy absorbing device is disclosed according to the present application, so as to improve the energy absorption effect and ensure the safety of passengers' lives and properties. A vehicle including the vehicle body collision energy absorbing device is further provided according to the present application.

[0026] The technical solutions in the embodiments of the present application will be described clearly and completely hereinafter in conjunction with the drawings in the embodiments of the present application. The described embodiments are only a part of the embodiments of the present application, rather than all embodiments. Based

on the embodiments in the present application, all of other embodiments, made by the person skilled in the art without any creative efforts, fall into the scope of the present application.

[0027] Referring to Figure 1, a vehicle body collision energy absorbing device provided by the embodiment of the present application includes a coupler 8, a coupler mounting plate 1 and a vehicle body structure 2. The coupler 8 includes a coupler body 81 and an expansion pipe 82 that absorbs energy and expands relative to the coupler body 81. The coupler body 81 is arranged on the coupler mounting plate 1. The vehicle body structure 2 is provided with an energy absorbing cavity, and the coupler mounting plate 1 and the expansion pipe 82 are arranged in the energy absorbing cavity. The vehicle body collision energy absorbing device further includes a compression energy absorbing unit 6 arranged in the energy absorbing cavity, a locking device 3 that locks the coupler mounting plate 1 relative to the energy absorbing cavity, a retreat support 5 arranged between the coupler mounting plate 1 and the compression energy absorbing unit 6, and a shear pin 4 connecting the vehicle body structure 2 with the retreat support 5. One end of the compression energy absorbing unit 6 abuts against a rear plate of the energy absorbing cavity. The retreat support 5 is slidably arranged in the energy absorbing cavity, and is provided with a locking component and a linkage structure. The locking component unlocks the locking device 3 after being away from the coupler mounting plate 1, and the linkage structure has a positioning structure axially positioned with the expansion pipe 82. When the expansion pipe 82 drives a guide pipe 7 and the retreat support 5 to slide, the shear pin 4 breaks.

[0028] In the vehicle body collision energy absorbing device provided by the embodiment of the present application, when two high-speed trains collide with each other, the coupler 8 is impacted, and the expansion pipe 82 extends outward relative to the coupler body 81 to complete the first energy absorption; moreover, the linkage structure has a positioning structure which is axially positioned with the expansion pipe 82; after the expansion pipe 82 extends outward relative to the coupler body 81, the expansion pipe 82 drives the guide pipe 7 and the retreat support 5 to slide, and the shear pin 4 breaks, so that the retreat support 5 moves away from the coupler mounting plate 1, the locking component unlocks the locking device 3, and the locking device 3 unlocks the coupler mounting plate 1; and the coupler mounting plate 1 slides in the energy absorbing cavity under the action of the impact force and moves toward the compression energy absorbing unit 6, and the compression energy absorbing unit 6 is compressed to complete the second energy absorption. The vehicle body collision energy absorbing device provided by the embodiment of the present application effectively improves the energy absorption effect and ensures the safety of passengers' lives and properties.

[0029] As shown in Figures 2, 3 and 4, after the shear

pin 4 is broken, a first shear pin portion 41 fixed in the vehicle body structure 2 and a second shear pin portion 42 fixed in the retreat support 5 are formed.

[0030] In this embodiment, the locking device 3 is a trapezoidal block which is rotatable relative to the vehicle body structure 2. An end surface of the coupler mounting plate 1 inclines towards the coupler 8 along a direction of approaching the compression energy absorbing unit 6. When the locking device 3 is in a locked state, a large end of the trapezoidal block contacts the retreat support 5, one side surface of the trapezoidal block contacts the end surface of the coupler mounting plate 1, and the other side surface of the trapezoidal block contacts the locking component. After the retreat support 5 is separated from the trapezoidal block, the trapezoidal block can rotate relative to the vehicle body structure 2 and be separated from the coupler mounting plate 1. After the retreat support 5 is away from the coupler mounting plate 1, the other side surface of the trapezoidal block is separated from the locking component, and the trapezoidal block can rotate relative to the vehicle body structure 2, so that one side surface of the trapezoidal block is separated from the end surface of the coupler mounting plate 1, and the coupler mounting plate 1 can move toward the compression energy absorbing unit 6 under the action of impact force.

[0031] Since the end surface of the coupler mounting plate 1 inclines toward the coupler 8 along a direction of approaching the compression energy absorbing unit 6, the trapezoidal block restricts the movement of the coupler mounting plate 1 when one side surface of the trapezoidal block contacts the end surface of the coupler mounting plate 1.

[0032] Preferably, the contact between one side surface of the trapezoidal block and the end surface of the coupler mounting plate 1 and the contact between the other side surface of the trapezoidal block and the locking component are both surface contact.

[0033] In order to further improve stability, the cross section of the trapezoidal block is a right-angled trapezoid. The oblique sideline of the right-angled trapezoid is located on the side surface of the trapezoidal block in contact with the end surface of the coupler mounting plate 1. The right-angle sideline of the right-angled trapezoid is located on the side surface of the trapezoidal block in contact with the locking component. The locking component is a position-limiting block provided between the trapezoidal block and the vehicle body structure 2.

[0034] The vehicle body collision energy absorbing device provided by the embodiment of the present application further includes a position-limiting protrusion arranged at an opening of the energy absorbing cavity and configured to restrict the coupler mounting plate 1 from sliding out of the energy absorbing cavity. By providing the position-limiting protrusion, the structural stability of the coupler mounting plate 1 is effectively improved without restricting the normal sliding of the coupler mounting plate 1 in the energy absorbing cavity.

[0035] Further, two position-limiting protrusions are provided and are symmetrically arranged on two sides of the opening of the energy absorbing cavity. Through the above arrangement, the stability is effectively improved. The position-limiting protrusion may have an annular structure and be arranged along the inner wall of the opening of the energy absorbing cavity.

[0036] In this embodiment, the linkage structure is a guide pipe 7 that is fixedly connected to the retreat support 5 and penetrates through the compression energy absorbing unit 6, and the guide pipe 7 is sleeved on the outside of the expansion pipe 82. Through the above arrangement, the guide pipe 7 provides a guide operation for the expansion pipe 82, which effectively avoids the situation that the expansion pipe 82 is externally located, and further improves the stability of energy absorption.

[0037] In this embodiment, the rear plate of the energy absorbing cavity is provided with an avoidance hole for the guide pipe 7 and the expansion pipe 82 to pass through. Through the above arrangement, the guide pipe 7 and the expansion pipe 82 can directly pass through the avoidance hole during the process of the guide pipe 7 and the expansion pipe 82 driving the retreat support 5 to move toward the compression energy adsorbing unit 6, the structural stability is effectively improved, and the length requirement of the energy absorbing cavity is reduced, further improving the structural stability.

[0038] In order to ensure the axial positioning of the guide pipe 7 and the expansion pipe 82, the positioning structure of the guide pipe 7 is a stepped surface. The outer surface of the expansion pipe 82 has a shoulder structure capable of cooperating with the stepped surface. It is also applicable that one end of the guide pipe 7 is closed. The axial positioning of the guide pipe 7 and the expansion pipe 82 is completed after the end of the expansion pipe 82 contacts the closed end of the guide pipe 7.

[0039] When the locking device 3 locks the coupler mounting plate 1 and the retreat support 5 is in contact with the coupler mounting plate 1, there is a certain distance between the stepped surface of the guide pipe 7 and the shoulder of the expansion pipe 82, so that the coupler mounting plate 1 is further unlocked to complete the second energy absorption operation after the expansion pipe 82 extends out relative to the coupler body 81 to complete the first energy absorption.

[0040] The distance between the stepped surface of the guide pipe 7 and the shoulder of the expansion pipe 82 is determined according to actual requirements, and is not specifically limited here.

[0041] Further, two locking devices 3 are provided and are symmetrically arranged at two ends of the coupler mounting plate 1. Through the above arrangement, the structural stability of locking the coupler mounting plate 1 is effectively improved, and the stable sliding of the coupler mounting plate 1 in the energy absorbing cavity in the unlocked state is also ensured.

[0042] A vehicle is further provided by the embodiment

of the present application, which includes the vehicle body collision energy absorbing device according to any one of the above aspects. Since the aforementioned vehicle body collision energy absorbing device has the aforementioned technical effects, the vehicle having the aforementioned vehicle body collision energy absorbing device should also have the same technical effects, which will not be repeated here.

[0043] In the present specification, the embodiments are described in a progressive manner. Each embodiment mainly focuses on an aspect different from other embodiments, and reference can be made to these similar parts among the embodiments.

[0044] According to the above description of the disclosed embodiments, those skilled in the art can implement or practice the present application. Various modifications to the embodiments are apparent to the person skilled in the art, and the general principle herein can be implemented in other embodiments without departing from the spirit or scope of the present application. Hence, the present application is not limited to the embodiments disclosed herein, but is to conform to the widest scope in accordance with the principles and novel features disclosed herein.

Claims

1. A vehicle body collision energy absorbing device, comprising a coupler (8), a coupler mounting plate (1) and a vehicle body structure (2); the coupler (8) comprising a coupler body (81) and an expansion pipe (82) that absorbs energy and expands relative to the coupler body (81), and the coupler body (81) being arranged on the coupler mounting plate (1); wherein, the vehicle body structure (2) is provided with an energy absorbing cavity, and the coupler mounting plate (1) and the expansion pipe (82) are arranged in the energy absorbing cavity; the vehicle body collision energy absorbing device further comprises a compression energy absorbing unit (6) arranged in the energy absorbing cavity, a locking device (3) that locks the coupler mounting plate (1) relative to the energy absorbing cavity, a retreat support (5) arranged between the coupler mounting plate (1) and the compression energy absorbing unit (6), and a shear pin (4) connecting the vehicle body structure (2) with the retreat support (5); and one end of the compression energy absorbing unit (6) abuts against a rear plate of the energy absorbing cavity; the retreat support (5) is slidably arranged in the energy absorbing cavity and is provided with a locking component and a linkage structure, the locking component unlocks the locking device (3) after being away from the coupler mounting plate (1), and the linkage structure has a positioning structure axially positioned with the expansion pipe (82); and

when the expansion pipe (82) drives a guide pipe (7) and the retreat support (5) to slide, the shear pin (4) breaks.

2. The vehicle body collision energy absorbing device according to claim 1, wherein the locking device (3) is a trapezoidal block which is rotatable relative to the vehicle body structure (2), an end surface of the coupler mounting plate (1) is inclined towards the coupler (8) along a direction of approaching the compression energy absorbing unit (6);
when the locking device (3) is in a locked state, a large end of the trapezoidal block contacts the retreat support (5), one side surface of the trapezoidal block contacts the end surface of the coupler mounting plate (1), and another side surface of the trapezoidal block contacts the locking component; and after the retreat support (5) is separated from the trapezoidal block, the trapezoidal block is rotatable relative to the vehicle body structure (2) and is separated from the coupler mounting plate (1). 5
10
3. The vehicle body collision energy absorbing device according to claim 2, wherein a cross section of the trapezoidal block is a right-angled trapezoid;
an oblique sideline of the right-angled trapezoid is located on a side surface of the trapezoidal block in contact with the end surface of the coupler mounting plate (1);
a right-angle sideline of the right-angled trapezoid is located on the side surface of the trapezoidal block in contact with the locking component; and the locking component is a position-limiting block provided between the trapezoidal block and the vehicle body structure (2). 15
20
25
30
35
4. The vehicle body collision energy absorbing device according to claim 1, further comprising a position-limiting protrusion arranged at an opening of the energy absorbing cavity and configured to restrict the coupler mounting plate (1) from sliding out of the energy absorbing cavity. 40
5. The vehicle body collision energy absorbing device according to claim 4, wherein two position-limiting protrusions are provided and are symmetrically arranged on two sides of the opening of the energy absorbing cavity. 45
6. The vehicle body collision energy absorbing device according to claim 1, wherein the linkage structure is a guide pipe (7) that is fixedly connected to the retreat support (5) and penetrates through the compression energy absorbing unit (6), and the guide pipe (7) is sleeved on the outside of the expansion pipe (82). 50
55
7. The vehicle body collision energy absorbing device

according to claim 6, wherein the rear plate of the energy absorbing cavity is provided with an avoidance hole for the guide pipe (7) and the expansion pipe (82) to pass through.

8. The vehicle body collision energy absorbing device according to claim 6, wherein the positioning structure of the guide pipe (7) is a stepped surface; and an outer surface of the expansion pipe (82) has a shoulder structure capable of cooperating with the stepped surface.
9. The vehicle body collision energy absorbing device according to any one of claims 1 to 8, wherein two locking devices (3) are provided and are symmetrically arranged at two ends of the coupler mounting plate (1).
10. A vehicle comprising a vehicle body collision energy absorbing device, wherein the vehicle body collision energy absorbing device is the vehicle body collision energy absorbing device according to any one of claims 1 to 9.

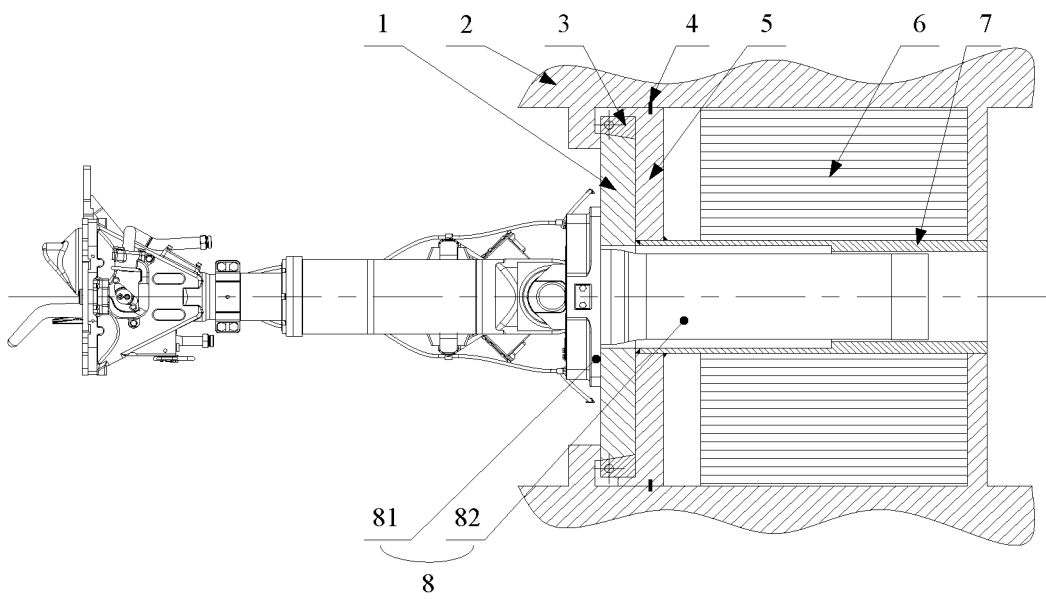


Figure 1

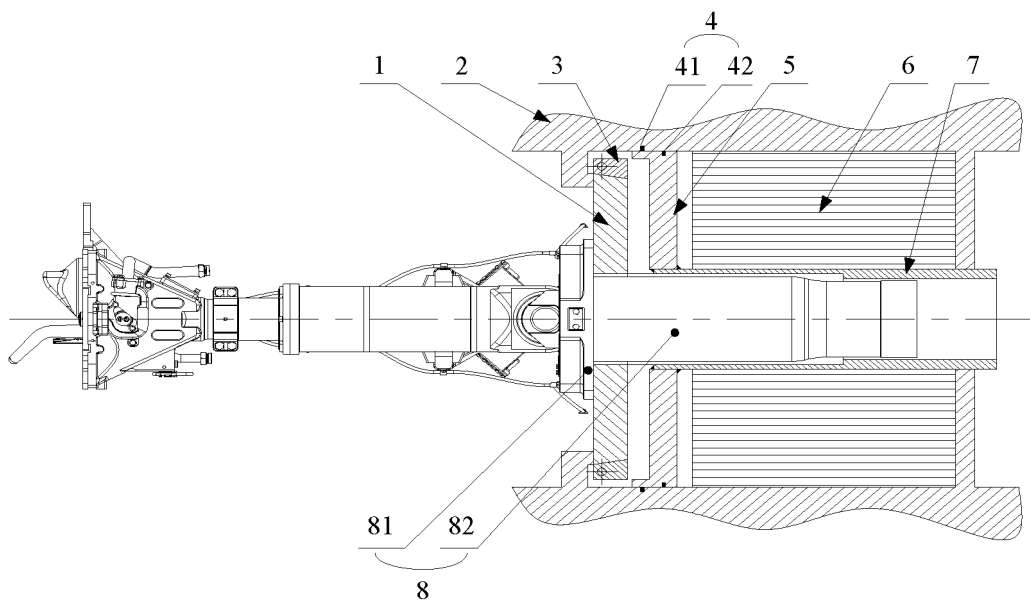


Figure 2

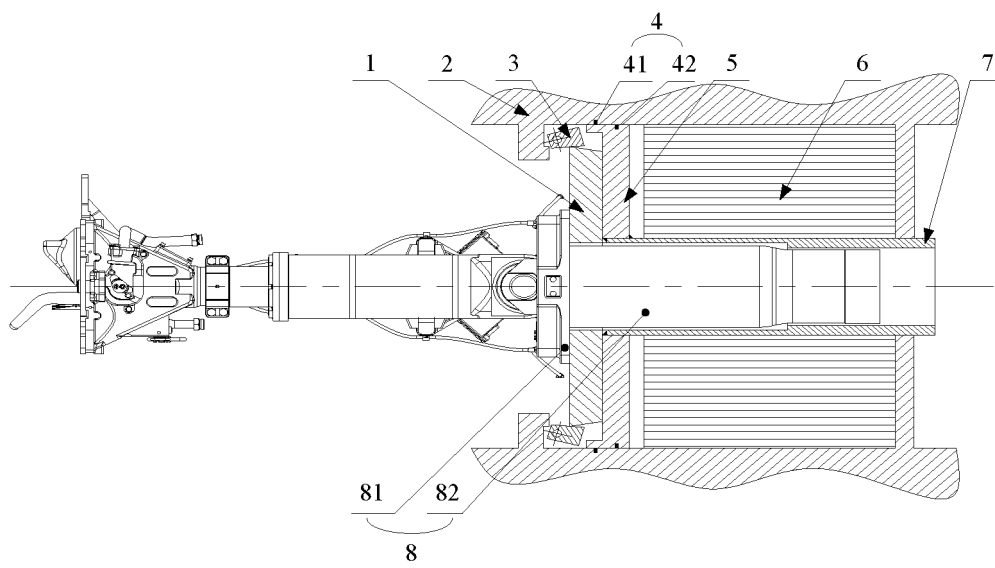


Figure 3

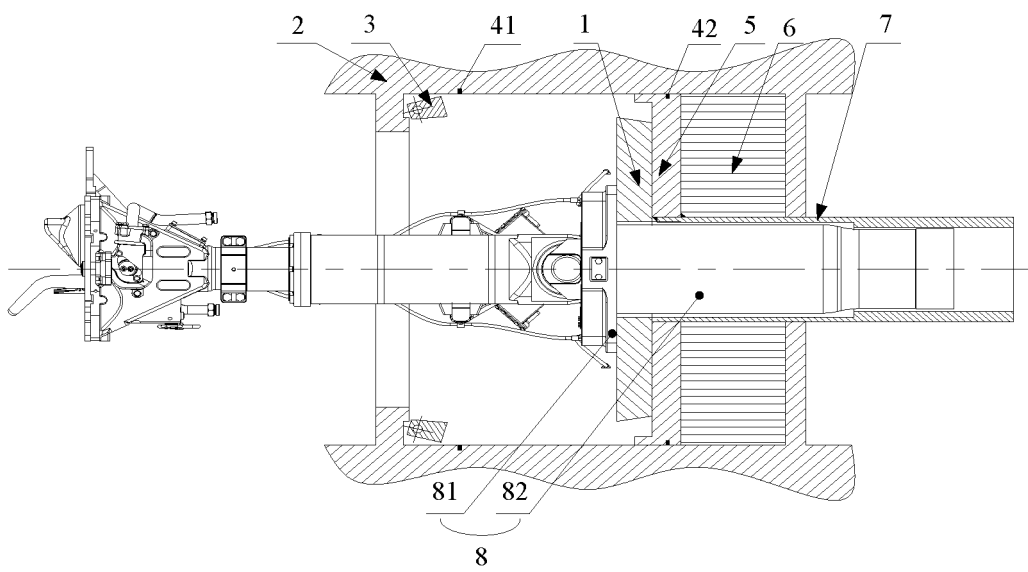


Figure 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/076621

A. CLASSIFICATION OF SUBJECT MATTER B61G 7/14(2006.01)i; B61G 11/16(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) 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) VEN, CNKI, CNABS: 火车, 碰撞, 吸能, 轨道, 压缩, 胀, 锁定, railway, collision, energy w absorb+, compress+, expansion, lock+																								
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>PX</td> <td>CN 109703591 A (CRRC CHANGCHUN RAILWAY VEHICLES CO., LTD.) 03 May 2019 (2019-05-03) see description, paragraphs [0032]-[0051], and figures 1-4</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 103625502 A (CSR QINGDAO SIFANG CO., LTD.) 12 March 2014 (2014-03-12) see description, pages 34-74, and figures 1-10</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 106364520 A (CENTRAL SOUTH UNIVERSITY) 01 February 2017 (2017-02-01) see entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 207274709 U (CRRC TANGSHAN CO., LTD.) 27 April 2018 (2018-04-27) see entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>CN 107200034 A (CRRC TANGSHAN CO., LTD.) 26 September 2017 (2017-09-26) see entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>DE 102016111556 A1 (DEUTSCHES ZENTRUM FÜR LUFT-UND RAUMFAHRT E.V.) 28 December 2017 (2017-12-28) see entire document</td> <td>1-10</td> </tr> <tr> <td>A</td> <td>DE 102016205981 A1 (VOITH PATENT GMBH) 12 October 2017 (2017-10-12) see 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.	PX	CN 109703591 A (CRRC CHANGCHUN RAILWAY VEHICLES CO., LTD.) 03 May 2019 (2019-05-03) see description, paragraphs [0032]-[0051], and figures 1-4	1-10	A	CN 103625502 A (CSR QINGDAO SIFANG CO., LTD.) 12 March 2014 (2014-03-12) see description, pages 34-74, and figures 1-10	1-10	A	CN 106364520 A (CENTRAL SOUTH UNIVERSITY) 01 February 2017 (2017-02-01) see entire document	1-10	A	CN 207274709 U (CRRC TANGSHAN CO., LTD.) 27 April 2018 (2018-04-27) see entire document	1-10	A	CN 107200034 A (CRRC TANGSHAN CO., LTD.) 26 September 2017 (2017-09-26) see entire document	1-10	A	DE 102016111556 A1 (DEUTSCHES ZENTRUM FÜR LUFT-UND RAUMFAHRT E.V.) 28 December 2017 (2017-12-28) see entire document	1-10	A	DE 102016205981 A1 (VOITH PATENT GMBH) 12 October 2017 (2017-10-12) see entire document	1-10
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																						
PX	CN 109703591 A (CRRC CHANGCHUN RAILWAY VEHICLES CO., LTD.) 03 May 2019 (2019-05-03) see description, paragraphs [0032]-[0051], and figures 1-4	1-10																						
A	CN 103625502 A (CSR QINGDAO SIFANG CO., LTD.) 12 March 2014 (2014-03-12) see description, pages 34-74, and figures 1-10	1-10																						
A	CN 106364520 A (CENTRAL SOUTH UNIVERSITY) 01 February 2017 (2017-02-01) see entire document	1-10																						
A	CN 207274709 U (CRRC TANGSHAN CO., LTD.) 27 April 2018 (2018-04-27) see entire document	1-10																						
A	CN 107200034 A (CRRC TANGSHAN CO., LTD.) 26 September 2017 (2017-09-26) see entire document	1-10																						
A	DE 102016111556 A1 (DEUTSCHES ZENTRUM FÜR LUFT-UND RAUMFAHRT E.V.) 28 December 2017 (2017-12-28) see entire document	1-10																						
A	DE 102016205981 A1 (VOITH PATENT GMBH) 12 October 2017 (2017-10-12) see entire document	1-10																						
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.																								
<table border="0"> <tr> <td>* Special categories of cited documents:</td> <td>"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</td> </tr> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"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</td> </tr> <tr> <td>"E" earlier application or patent but published on or after the international filing date</td> <td>"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</td> </tr> <tr> <td>"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)</td> <td>"&" document member of the same patent family</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td></td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>	* Special categories of cited documents:	"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	"A" document defining the general state of the art which is not considered to be of particular relevance	"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	"E" earlier application or patent but published on or after the international filing date	"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	"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)	"&" document member of the same patent family	"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													
* Special categories of cited documents:	"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																							
"A" document defining the general state of the art which is not considered to be of particular relevance	"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																							
"E" earlier application or patent but published on or after the international filing date	"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																							
"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)	"&" document member of the same patent family																							
"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																								
Date of the actual completion of the international search 11 May 2020	Date of mailing of the international search report 02 June 2020																							
Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088 China Facsimile No. (86-10)62019451	Authorized officer Telephone No.																							

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2020/076621

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	KR 20180076379 A (KRRRI) 06 July 2018 (2018-07-06) see entire document	1-10
A	CN 207875666 U (CRRC CHANGCHUN RAILWAY VEHICLES CO., LTD.) 18 September 2018 (2018-09-18) see entire document	1-10
A	WO 2013079733 A1 (PATENTES TALGO, S.L. et al.) 06 June 2013 (2013-06-06) see entire document	1-10
A	CN 105151075 A (CSR QINGDAO SIFANG CO., LTD.) 16 December 2015 (2015-12-16) see entire document	1-10
A	PL 410337 A1 (AXTONE SPÓŁKA Z OGRANICZONĄ ODPOWIEDZIALNOŚCIĄ) 06 June 2016 (2016-06-06) see entire document	1-10
A	CN 106672010 A (CRRC CHANGCHUN RAILWAY VEHICLES CO., LTD.) 17 May 2017 (2017-05-17) see entire document	1-10
A	CN 105083317 A (CSR QINGDAO SIFANG CO., LTD.) 25 November 2015 (2015-11-25) see entire document	1-10

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2020/076621

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 109703591 A	03 May 2019	None	
CN 103625502 A	12 March 2014	CN 103625502 B	25 May 2016
CN 106364520 A	01 February 2017	CN 106364520 B	13 April 2018
CN 207274709 U	27 April 2018	None	
CN 107200034 A	26 September 2017	None	
DE 102016111556 A1	28 December 2017	None	
DE 102016205981 A1	12 October 2017	WO 2017178213 A1	19 October 2017
		EP 3442847 A1	20 February 2019
		CN 109070912 A	21 December 2018
KR 20180076379 A	06 July 2018	KR 101898097 B1	13 September 2018
CN 207875666 U	18 September 2018	RU 185243 U1	28 November 2018
WO 2013079733 A1	06 June 2013	ES 2487991 B1	02 June 2015
		ES 2487991 A1	25 August 2014
CN 105151075 A	16 December 2015	CN 105151075 B	20 March 2018
PL 410337 A1	06 June 2016	CN 107107925 A	29 August 2017
		EP 3227158 B1	18 September 2019
		RU 2017123151 A3	08 February 2019
		PL 226548 B1	31 August 2017
		US 2019225244 A1	25 July 2019
		AU 2015356676 A1	22 June 2017
		RU 2017123151 A	09 January 2019
		KR 20170088404 A	01 August 2017
		CA 2969305 A1	09 June 2016
		EP 3227158 A1	11 October 2017
		US 2017361855 A1	21 December 2017
		RU 2684246 C2	04 April 2019
		WO 2016088012 A1	09 June 2016
		US 10252734 B2	09 April 2019
		AU 2015356676 B2	10 October 2019
		CN 107107925 B	13 August 2019
CN 106672010 A	17 May 2017	None	
CN 105083317 A	25 November 2015	CN 105083317 B	12 June 2018

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 201910141398 [0001]
- CN 201920244002 [0002]