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(54) LOCOMOTIVE STRUCTURE FOR ELECTRIC MULTIPLE UNIT

(57) A multiple-unit train locomotive structure is disclosed by the present application. Tail ends of a first side wall (1), a second side wall (2) and a vehicle roof (4) of the multiple-unit train locomotive structure are all connected with a ring frame (5). Groups of first main longitudinal beams (6) are respectively arranged at the intersection between the first side wall (1) and the vehicle roof (4) and at the intersection between the second side wall (2) and the vehicle roof (4), and each group of first main longitudinal beams (6) extend from a front wall (3) of the multiple-unit train locomotive structure to the ring frame (5). Multiple abreast arranged second main longitudinal beams (7) are provided below a window of the first side wall (1) and below a window of the second side wall (2), multiple second main longitudinal beams (7) are provided below the first side wall (1) and below the second side wall (2) for connecting with the vehicle bottom, and each second main longitudinal beam (7) extends from the front wall (3) to the ring frame (5). Multiple vertical beams (8) arranged in parallel are provided on the first side wall (1), the second side wall (2) and the vehicle roof (4), and the vertical beams (8) are perpendicular to the forward direction of the multiple-unit train.

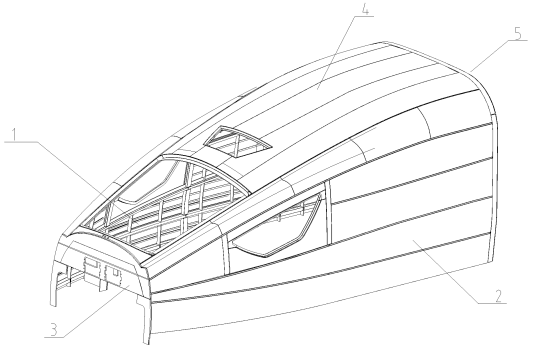

Figure 1

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Description

[0001] The present application claims the benefit of priorities to the following two Chinese patent applications, both of which are incorporated herein by reference in their entireties,

1) Chinese Patent Application No. 201910141359.3, titled "MULTIPLE-UNIT TRAIN LOCOMOTIVE STRUCTURE", filed with the China National Intellectual Property Administration on February 26, 2019, and

2) Chinese Patent Application No. 201920243963.2, titled "MULTIPLE-UNIT TRAIN LOCOMOTIVE STRUCTURE", filed with the China National Intellectual Property Administration on February 26, 2019.

FIELD

[0002] The present application relates to the technical field of rail vehicles, and in particular to a multiple-unit train locomotive structure.

BACKGROUND

[0003] Multiple-unit train refers to a train consisting of at least two motor cars and multiple trailer cars. A motor car is a powered carriage. A trailer car is a carriage which needs to be towed to move. The locomotive structure of the multiple-unit train is generally streamlined.

[0004] With the increase of the speed of multiple-unit trains in China, the safety requirements for the locomotive structure of multiple-unit train are getting higher and higher.

[0005] Therefore, how to ensure the efficiency of collision energy absorption and transmission of the locomotive structure to meet the requirements of high-speed travelling conditions for collision energy absorption and distribution is an urgent technical problem to be solved by those skilled in the art.

SUMMARY

[0006] In view of this, an object of the present application is to provide a multiple-unit train locomotive structure. In the locomotive structure, main longitudinal beams extending across the whole length of the locomotive in the front-rear direction of the locomotive are provided, which can ensure the absorption and transmission efficiency of the collision energy of the locomotive structure and meet the requirements of high-speed travelling conditions for collision energy absorption and distribution.

[0007] In order to achieve the above object, the following technical solutions are provided according to the present application.

[0008] A multiple-unit train locomotive structure includes a framework and an envelope. The framework includes a ring frame, first main longitudinal beams, second main longitudinal beams and vertical beams, wherein

tail ends of a first side wall, a second side wall and a vehicle roof of the multiple-unit train locomotive structure are all connected with the ring frame;

groups of first main longitudinal beams are respectively arranged at the intersection between the first side wall and the vehicle roof and at the intersection between the second side wall and the vehicle roof, and each group of first main longitudinal beams extend from a front wall of the multiple-unit train locomotive structure to the ring frame;

multiple abreast arranged second main longitudinal beams are provided below a window of the first side wall and below a window of the second side wall, multiple second main longitudinal beams are provided below the first side wall and below the second side wall for connecting with the vehicle bottom, and each second main longitudinal beam extends from the front wall to the ring frame; and

multiple vertical beams arranged in parallel are provided on the first side wall, the second side wall and the vehicle roof, and the vertical beams are perpendicular to the forward direction of the multiple-unit train.

[0009] Preferably, in the above multiple-unit train locomotive structure, each of the vertical beams has a plate-shaped structure.

[0010] Preferably, the above multiple-unit train locomotive structure further includes multiple vehicle roof longitudinal beams and multiple side wall longitudinal beams, wherein:

the multiple vehicle roof longitudinal beams are abreast provided on the vehicle roof; and
the multiple side wall longitudinal beams are arranged on the first side wall and the second side wall.

[0011] Preferably, in the above multiple-unit train locomotive structure, each group of the first main longitudinal beams includes two symmetrically arranged first main longitudinal beams, and each first main longitudinal beam is a profile with an L-shaped, U-shaped or rectangular cross section.

[0012] Preferably, in the above multiple-unit train locomotive structure, multiple parallel plate-shaped connecting beams are arranged between the two symmetrically arranged first main longitudinal beams.

[0013] Preferably, in the above multiple-unit train locomotive structure, the envelope includes a vehicle roof envelope and a side wall envelope, and the vehicle roof envelope and the side wall envelope are fixedly connected with the plate-shaped connecting beams by welding.

[0014] Preferably, in the above multiple-unit train locomotive structure, on the first side wall and the second side wall, apart from the vertical beams located above and below the windows, multiple vertical beams between one first main longitudinal beam and an adjacent second main longitudinal beam correspond to multiple vertical beams between two adjacent second main longitudinal beams in one-to-one correspondence in the vertical extension direction.

[0015] Preferably, in the above multiple-unit train locomotive structure, first reinforcement beams are provided on the front and rear sides of the windows, the first reinforcement beams are perpendicular to the forward direction of the multiple-unit train, and each reinforcement beam is connected with the first main longitudinal beam and extends to the vehicle bottom, and is divided into multiple reinforcement vertical beam units by the second main longitudinal beams.

[0016] Preferably, in the above multiple-unit train locomotive structure, the vehicle roof is provided with a second reinforcement beam which is perpendicular to the forward direction of the multiple-unit train, and each of two ends of the second reinforcement beam is connected with a group of the first main longitudinal beams.

[0017] Preferably, in the above multiple-unit train locomotive structure, the envelope includes a vehicle roof envelope and a side wall envelope, and the vehicle roof envelope and the side wall envelope are formed by stretching aluminum profiles with multiple T-shaped reinforcing ribs, wherein the T-shaped reinforcing ribs are positioned on the inner side of the envelope and extend along the front-rear direction of the locomotive.

[0018] It can be seen from the above technical solutions that, in the framework of the multiple-unit train locomotive structure provided by the present application, multiple first main longitudinal beams and second main longitudinal beams which run through the whole length of the locomotive are used as main force transmission beams for absorbing and transmitting collision energy in the locomotive, wherein a group of first main longitudinal beams at the intersection between the first side wall and the vehicle roof and a group of first main longitudinal beams at the intersection between the second side wall and the vehicle roof constitute main force transmission areas.

[0019] Experiments prove that the multiple-unit train locomotive structure provided by the application can effectively transfer the head load borne by the locomotive to the vehicle bottom and the rear vehicle body structure, ensure that the locomotive structure has high absorption and transmission efficiency of the collision energy, and can meet the requirements of high-speed travelling conditions for collision energy absorption and distribution.

[0020] Therefore, it can be seen that the beams in the multiple-unit train locomotive structure provided by the present application are reasonably arranged, which can safely and quickly transfer part of the collision energy to high-strength modules such as the vehicle body and the chassis. Moreover, the vertical beams are used as support to strengthen the strength of the locomotive structure, thus finally achieving the purpose of effectively transferring collision energy and greatly improving safety.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] For more clearly illustrating embodiments of the present application or technical solutions in the conventional technology, the drawings 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 overall view of a multiple-unit train locomotive structure provided by an embodiment of the present application;

Figure 2 is a schematic view of the layout structure of a side wall framework provided by an embodiment of the present application;

Figure 3 is a schematic view of the force transmission route of the side wall framework provided by an embodiment of the present application;

Figure 4 is a schematic view showing the sections of envelope profiles provided by an embodiment of the present application;

Figure 5 is a schematic structural view of the outer side of a vehicle roof provided by an embodiment of the present application;

Figure 6 is a schematic view of the layout structure of the framework on the inner side of the vehicle roof provided by an embodiment of the present application;

Figure 7 is a schematic view of the layout structure of plate-shaped connecting beams provided by an embodiment of the present application;

Figure 8 is a schematic view of the layout structure of main force transmission areas of the multiple-unit train locomotive structure provided by an embodiment of the present application; and

Figure 9 is a schematic cross-sectional view of the main force transmission area provided by an embodiment of the present application.

[0022] Reference numerals in the drawings:

1	first side wall,	2	second side wall,
3	front wall,	4	vehicle roof,
5	ring frame,	6	first main longitudinal beam,
7	second main longitudinal beam,	8	vertical beam,
9	T-shaped reinforcing rib,	10	plate-shaped connecting beam,
11	first reinforcement beam,	12	second reinforcement beam,
A main force transmission area.			

DETAILED DESCRIPTION OF EMBODIMENTS

[0023] A multiple-unit train locomotive structure is disclosed by the present application. In the locomotive structure, main longitudinal beams extending across the whole length of the locomotive in the front-rear direction of the locomotive are provided, which can ensure the absorption and transmission efficiency of the collision energy of the locomotive structure and meet the requirements of high-speed travelling conditions for collision energy absorption and distribution.

[0024] The technical solutions according to the embodiments of the present application will be described clearly and completely as follows in conjunction with the drawings in the embodiments of the present application. It is apparent that the described embodiments are only a part of the embodiments according to the present application, rather than all of the 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.

[0025] Referring to Figures 1 to 9, Figure 1 is a schematic overall view of a multiple-unit train locomotive structure provided by an embodiment of the present application; Figure 2 is a schematic view of the layout structure of a side wall framework provided by an embodiment of the present application; Figure 3 is a schematic view of the force transmission route of the side wall framework provided by an embodiment of the present application; Figure 4 is a schematic view showing the sections of envelope profiles provided by an embodiment of the present application; Figure 5 is a schematic structural view of the outer side of a vehicle roof provided by an embodiment of the present application; Figure 6 is a schematic view of the layout structure of the framework on the inner side of the vehicle roof provided by an embodiment of the present application; Figure 7 is a schematic view of the layout structure of plate-shaped connecting beams provided by an embodiment of the present application; Figure 8 is a schematic view of the layout structure of main force transmission areas of the multiple-unit train locomotive structure provided by an embodiment of the present application; and Figure 9 is a schematic cross-sectional view of the main force transmission area provided by an embodiment of the present application.

[0026] The multiple-unit train locomotive structure provided by the embodiments of the present application includes a framework and an envelope. The framework includes a ring frame 5, first main longitudinal beams 6, second main longitudinal beams 7 and vertical beams 8, wherein

tail ends of a first side wall 1, a second side wall 2 and a vehicle roof 4 of the multiple-unit train locomotive structure

are all connected with the ring frame 5;

groups of first main longitudinal beams 6 are respectively arranged at the intersection between the first side wall 1 and the vehicle roof 4 and at the intersection between the second side wall 2 and the vehicle roof 4, and each group of first main longitudinal beams 6 extend from a front wall 3 of the multiple-unit train locomotive structure to the ring frame 5 (that is, the first main longitudinal beams 6 extend across the whole length of the locomotive in the front-rear direction of the locomotive, or in other words, the first main longitudinal beams 6 run through the whole length of the locomotive), so as to absorb the collision energy load borne by the locomotive and effectively transmit the load to the rear vehicle body;

multiple abreast arranged second main longitudinal beams 7 are provided below a window of the first side wall 1 and below a window of the second side wall 2 (the "abreast" herein includes parallel or non-parallel), wherein multiple second main longitudinal beams 7 are provided below the first side wall 1 and below the second side wall 2 for connecting with the vehicle bottom so as to absorb the collision energy load borne by the locomotive and effectively transmit the load to the vehicle bottom and the rear vehicle body; each group of second main longitudinal beams 7 extend from the front wall 3 to the ring frame 5 (that is, the second main longitudinal beams 7 extend across the whole length of the locomotive in the front-rear direction of the locomotive, or in other words, the second main longitudinal beams 7 run through the whole length of the locomotive), so as to absorb the collision energy load borne by the locomotive and effectively transmit the load to the rear vehicle body; and

multiple vertical beams 8 arranged in parallel are provided on the first side wall 1, the second side wall 2 and the vehicle roof 4, and the vertical beams 8 are perpendicular to the forward direction of the multiple-unit train (that is, the vertical beams are in a vertical plane perpendicular to the forward direction of the multiple-unit train). The vertical beams 8 are configured to support the locomotive structure and further consolidate the strength of the locomotive structure.

[0027] It should be noted here that the "longitudinal" and "longitudinal direction" in this specification refer to the front-rear direction of the multiple-unit train ("front" refers to the front of the locomotive, "rear" refers to the rear of the locomotive for connecting with other carriages), "vertical" and "vertical direction" refer to being located in a vertical plane that is perpendicular to the front-rear direction of the multiple-unit train.

[0028] It can be seen from the above technical solutions that, in the framework of the multiple-unit train locomotive structure provided by the embodiments of the present application, multiple first main longitudinal beams 6 and second main longitudinal beams 7 which run through the whole length of the locomotive are used as main force transmission beams for absorbing and transmitting collision energy in the locomotive, wherein a group of first main longitudinal beams 6 at the intersection between the first side wall 1 and the vehicle roof 4 and a group of first main longitudinal beams 6 at the intersection between the second side wall 2 and the vehicle roof 4 constitute main force transmission areas A.

[0029] Experiments prove that the multiple-unit train locomotive structure provided by the embodiments of the application can effectively transfer the head load borne by the locomotive to the vehicle bottom and the rear vehicle body structure, ensure that the locomotive structure has high absorption and transmission efficiency of the collision energy, and can meet the requirements of high-speed travelling conditions for collision energy absorption and distribution.

[0030] Therefore, it can be seen that the beams in the multiple-unit train locomotive structure provided by the embodiments of the present application are reasonably arranged, which can safely and quickly transfer part of the collision energy to high-strength modules such as the vehicle body and the chassis. Moreover, the vertical beams 8 are used as support to strengthen the strength of the locomotive structure, thus finally achieving the purpose of effectively transferring collision energy and greatly improving safety.

[0031] In a specific embodiment, two first main longitudinal beams 6 are arranged at the intersection between the first side wall 1 and the vehicle roof 4, and two first main longitudinal beams 6 are arranged at the intersection between the second side wall 2 and the vehicle roof 4, which are configured to absorb and transmit collision energy. In addition, as shown in Figure 2, two second main longitudinal beams 7 are arranged between a lower part of the window of the first side wall 1 and the vehicle bottom, and two second main longitudinal beams 7 are arranged between a lower part of the window of the second side wall and the vehicle bottom, for absorbing and transmitting collision energy. In addition, the lower part of the first side wall 1 is used for welding with the vehicle bottom, and the lower part of the second side wall 2 is used for welding with the vehicle bottom, and two second main longitudinal beams 7 are respectively arranged at the two welding positions for absorbing and transmitting collision energy.

[0032] Therefore, it can be seen that the multiple-unit train locomotive structure provided by the embodiments of the present application can ensure that the upper, middle and lower parts of the first side wall 1 and the second side wall 2 are provided with main force transmission beams for absorbing and transmitting collision energy. The second main longitudinal beams 7 located at the lower parts of the side walls can not only absorb the collision energy load borne by

the locomotive and effectively transfer the load to the rear vehicle body, but also can effectively transfer the collision energy load to the vehicle bottom.

[0033] However, it is not limited to this. In other specific embodiments, the first main longitudinal beams 6 may be arranged in groups of three or four or other numbers, and are arranged at the intersection between the first side wall 1 and the vehicle roof 4, and at the intersection between the second side wall 2 and the vehicle roof 4. Two or four or other numbers of second main longitudinal beams 7 may be arranged on the first side wall 1 and/or the second side wall 2. The present application does not specifically limit the number of the first main longitudinal beams 6, the number of the second main longitudinal beams 7 and the number of the vertical beams 8.

[0034] In a specific embodiment, as shown in Figure 2, when arranging the vertical beam 8, two main longitudinal beams on two sides of the installation position are taken as the reference (herein, the first main longitudinal beam 6 and the second main longitudinal beam 7 are collectively referred to as "main longitudinal beam"). The vertical beams 8 between the two main longitudinal beams are arranged according to the collision energy distribution to ensure the structural strength of the side walls (herein, the first side wall 1 and the second side wall 2 are collectively referred to as "side wall"). The framework welding is positioned by tooling, which ensures the dimensional accuracy between the beams and the profiles.

[0035] In a specific embodiment, the first side wall 1 and the second side wall 2 are arranged symmetrically according to the longitudinal centerline of the locomotive.

[0036] In a specific embodiment, the vertical beam 8 preferably adopts a plate-shaped structure, which is beneficial to reduce processing difficulty and production cost and improve processing efficiency, compared with vertical beams of other stretching structures.

[0037] In a specific embodiment, the above multiple-unit train locomotive structure further includes multiple vehicle roof longitudinal beams and multiple side wall longitudinal beams. The multiple vehicle roof longitudinal beams are abreast provided on the vehicle roof 4, and the multiple side wall longitudinal beams are arranged on the first side wall 1 and the second side wall 2. Vehicle roof longitudinal beams and side wall longitudinal beams can also transmit force, which is beneficial to the effective transmission of head load to the rear vehicle body structure.

[0038] In a specific embodiment, the first main longitudinal beams 6, the second main longitudinal beams 7, the vehicle roof longitudinal beams, and the side wall longitudinal beams all have a profile-stretching structure with rectangular, ⊟-shaped or L-shaped cross sections. In addition, the first main longitudinal beams 6 are the main transmitting beams for transmitting the force on the upper part of the locomotive. The second main longitudinal beams 7 on the side walls close the windows are the main transmitting beams for transmitting the force on the middle part of the locomotive, and the second main longitudinal beams 7 on the side walls close the vehicle bottom are the main transmitting beams for transmitting the force on the bottom of the locomotive, while the vehicle roof longitudinal beams and side wall longitudinal beams are mainly configured to support and install the envelope and to additionally enhance the strength of the locomotive on the basis of the first main longitudinal beams 6 and the second main longitudinal beams 7. Therefore, the cross-sectional areas of the first main longitudinal beams 6 and the second main longitudinal beams 7 are both larger than those of the vehicle roof longitudinal beams and the side wall longitudinal beams.

[0039] Specifically, the first main longitudinal beams 6, the second main longitudinal beams 7, the vehicle roof longitudinal beams and the side wall longitudinal beams are collectively referred to as longitudinal beams, and the longitudinal beams are vertically connected and supported by the vertical beams 8, thus forming a locomotive frame meeting the strength requirements.

[0040] In a specific embodiment, the first main longitudinal beams 6, the second main longitudinal beams 7, the vertical beams 8, the ring frame 5, the vehicle roof longitudinal beams, the side wall longitudinal beams are fixed to the envelope by welding at respective connection positions.

[0041] In a specific embodiment, each group of the first main longitudinal beams 6 includes two symmetrically arranged first main longitudinal beams 6, and each first main longitudinal beam 6 is a profile with an L-shaped, ⊟-shaped or rectangular cross section. Therefore, the section of the main force transmission area A has a cavity structure formed by the profile end faces, ensuring the strength and feasibility of force transmission. Reference can be made to Figure 8 and Figure 9 for details.

[0042] Further, multiple parallel plate-shaped connecting beams 10 are arranged between the two symmetrically arranged first main longitudinal beams 6. Reference can be made to Figure 7 for details.

[0043] Specifically, the envelope includes a vehicle roof envelope and a side wall envelope, and the vehicle roof envelope and the side wall envelope are fixedly connected with the plate-shaped connecting beams 10 by welding.

[0044] In a specific embodiment, as shown in Figure 2, on the first side wall 1 and the second side wall 2, apart from the vertical beams 8 located above and below the windows, multiple vertical beams 8 between one first main longitudinal beam 6 and an adjacent second main longitudinal beam 7 correspond to multiple vertical beams 8 between two adjacent second main longitudinal beams 7 in one-to-one correspondence in the vertical extension direction.

[0045] In a specific embodiment, as shown in Figure 2, first reinforcement beams 11 are provided on the front and

rear sides of the windows, and the first reinforcement beams 11 are perpendicular to the forward direction of the multiple-unit train (that is, the first reinforcement beams are in a vertical plane perpendicular to the forward direction of the multiple-unit train). In addition, each first reinforcement beam 11 is connected with the first main longitudinal beam 6 and extends to the vehicle bottom, and is divided into multiple reinforcement vertical beam units by the second main longitudinal beams 7.

[0046] In a specific embodiment, as shown in Figure 6, second reinforcement beams 12 are provided on the vehicle roof 4, the second reinforcement beams 12 are perpendicular to the forward direction of the multiple-unit train (that is, the second reinforcement beams are in a vertical plane perpendicular to the forward direction of the multiple-unit train), and each of two ends of the second reinforcement beam 12 is connected with a group of the first main longitudinal beams 6.

[0047] In a specific embodiment, as shown in Figure 4, the envelope includes a vehicle roof envelope and a side wall envelope, and the vehicle roof envelope and the side wall envelope are formed by stretching aluminum profiles with multiple T-shaped reinforcing ribs 9, wherein the T-shaped reinforcing ribs 9 are positioned on the inner side of the envelope and extend along the front-rear direction of the locomotive, so as to ensure the strength of the locomotive and the distribution of the force transmission by the locomotive, which promotes the force transmission.

[0048] In a specific embodiment, the framework and the envelope are of aluminum profile structure, and the framework is fixedly connected with the envelope by welding.

[0049] In summary, the multiple-unit train locomotive structure provided by the embodiments of the present application can not only effectively transmit and absorb the collision energy of the locomotive, evenly distribute the collision energy, and improve the safety, but also has simple production process, low error, and is easy to weld, and the assembly thereof is convenient and reliable.

[0050] Finally, it should be further noted that the relationship terms herein such as "first", "second" and the like are only used to distinguish one entity or operation from another, rather than necessitate or imply that any such actual relationship or order exists between these entities or operations. Moreover, terms such as "include", "have" or any other variants thereof are meant to cover non-exclusive inclusion, so that the process, method, item or apparatus including a series of elements is not limited to those elements, and may include other elements that are not specifically listed or that are inherent in the process, method, item or apparatus. With no other limitations, an element restricted by the phrase "include a ..." does not exclude the existence of other identical elements in the process, method, item or apparatus including the element.

[0051] The above embodiments are described in a progressive manner. Each of the embodiments is mainly focused on describing its differences from other embodiments, and references may be made among these embodiments with respect to the same or similar parts.

[0052] According to the above description of the disclosed embodiments, those skilled in the art can implement or practice the present application. Various modifications to these embodiments are obvious to a person skilled in the art, the general principles defined herein may be implemented in other embodiments without departing from the spirit and 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 multiple-unit train locomotive structure, comprising a framework and an envelope, wherein the framework comprises a ring frame (5), first main longitudinal beams (6), second main longitudinal beams (7) and vertical beams (8), tail ends of a first side wall (1), a second side wall (2) and a vehicle roof (4) of the multiple-unit train locomotive structure are all connected with the ring frame (5);
   groups of first main longitudinal beams (6) are respectively arranged at intersection between the first side wall (1) and the vehicle roof (4) and at intersection between the second side wall (2) and the vehicle roof (4), and each group of first main longitudinal beams (6) extend from a front wall (3) of the multiple-unit train locomotive structure to the ring frame (5);
   a plurality of abreast arranged second main longitudinal beams (7) are provided below a window of the first side wall (1) and below a window of the second side wall (2), a plurality of second main longitudinal beams (7) are provided below the first side wall (1) and below the second side wall (2) for connecting with the vehicle bottom, and each second main longitudinal beam (7) extends from the front wall (3) to the ring frame (5); and
   a plurality of vertical beams (8) arranged in parallel are provided on the first side wall (1), the second side wall (2) and the vehicle roof (4), and the vertical beams (8) are perpendicular to a forward direction of the multiple-unit train.

2. The multiple-unit train locomotive structure according to claim 1, wherein the vertical beam (8) has a plate-shaped structure.

3. The multiple-unit train locomotive structure according to claim 1, further comprising a plurality of vehicle roof longitudinal beams and a plurality of side wall longitudinal beams, wherein
the plurality of vehicle roof longitudinal beams are abreast provided on the vehicle roof (4); and
the plurality of side wall longitudinal beams are arranged on the first side wall (1) and the second side wall (2).

4. The multiple-unit train locomotive structure according to claim 1, wherein each group of the first main longitudinal beams (6) comprises two symmetrically arranged first main longitudinal beams (6), and each first main longitudinal beam (6) is a profile with an L-shaped, ⊟-shaped or rectangular cross section.

5. The multiple-unit train locomotive structure according to claim 4, wherein a plurality of parallel plate-shaped connecting beams (10) are arranged between the two symmetrically arranged first main longitudinal beams (6).

6. The multiple-unit train locomotive structure according to claim 5, wherein the envelope comprises a vehicle roof envelope and a side wall envelope, and the vehicle roof envelope and the side wall envelope are fixedly connected with the plate-shaped connecting beams (10) by welding.

7. The multiple-unit train locomotive structure according to claim 1, wherein on the first side wall (1) and the second side wall (2), apart from the vertical beams (8) located above and below the windows, a plurality of vertical beams (8) between one first main longitudinal beam (6) and an adjacent second main longitudinal beam (7) correspond to a plurality of vertical beams (8) between two adjacent second main longitudinal beams (7) in one-to-one correspondence in a vertical extension direction.

8. The multiple-unit train locomotive structure according to claim 1, wherein first reinforcement beams (11) are provided on front and rear sides of the windows, the first reinforcement beams (11) are perpendicular to the forward direction of the multiple-unit train, and each reinforcement beam (11) is connected with the first main longitudinal beam (6) and extends to the vehicle bottom, and is divided into a plurality of reinforcement vertical beam units by the second main longitudinal beams (7).

9. The multiple-unit train locomotive structure according to claim 1, wherein the vehicle roof (4) is provided with a second reinforcement beam (12) which is perpendicular to the forward direction of the multiple-unit train, and each of two ends of the second reinforcement beam (12) is connected with a group of the first main longitudinal beams (6).

10. The multiple-unit train locomotive structure according to any one of claims 1 to 9, wherein the envelope comprises a vehicle roof envelope and a side wall envelope, and the vehicle roof envelope and the side wall envelope are formed by stretching aluminum profiles with multiple T-shaped reinforcing ribs (9), wherein the T-shaped reinforcing ribs (9) are positioned on the inner side of the envelope and extend along a front-rear direction of the locomotive.

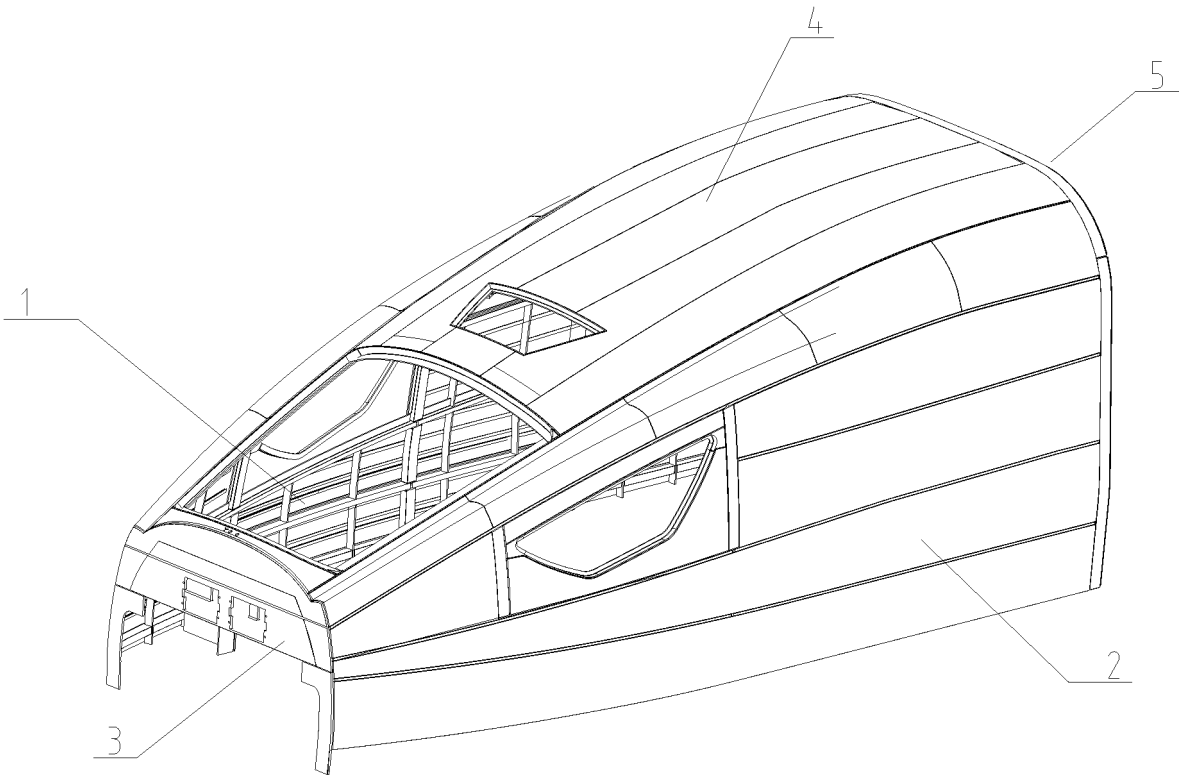

Figure 1

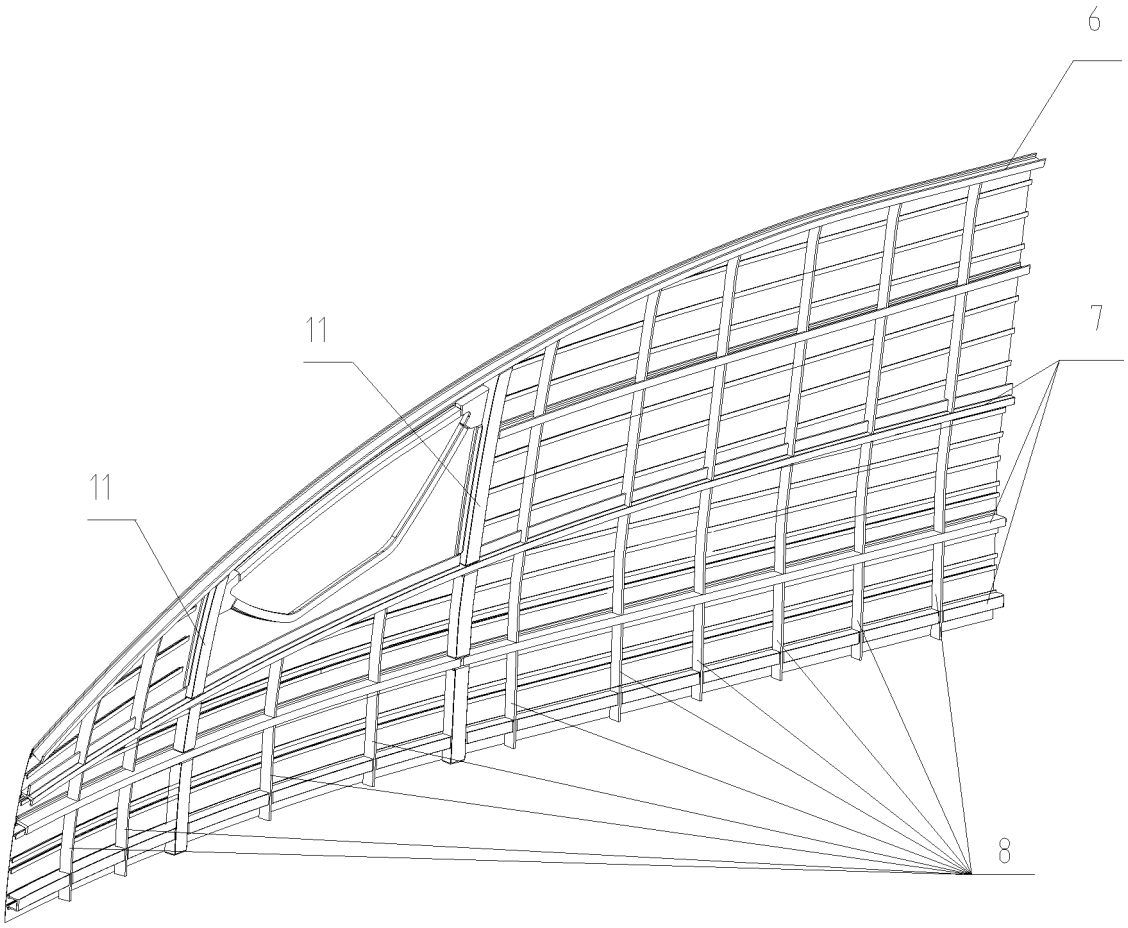

Figure 2

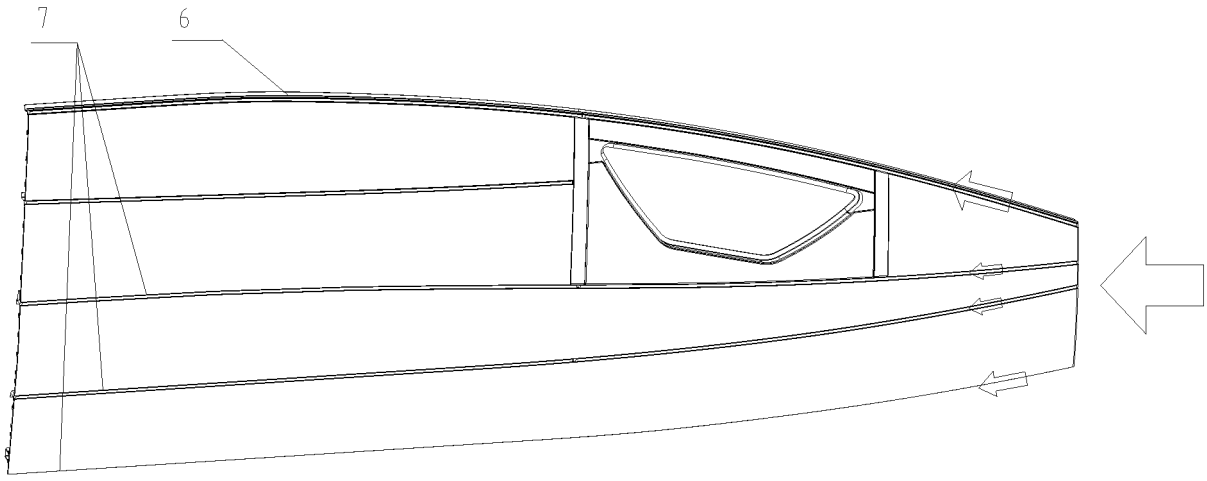

Figure 3

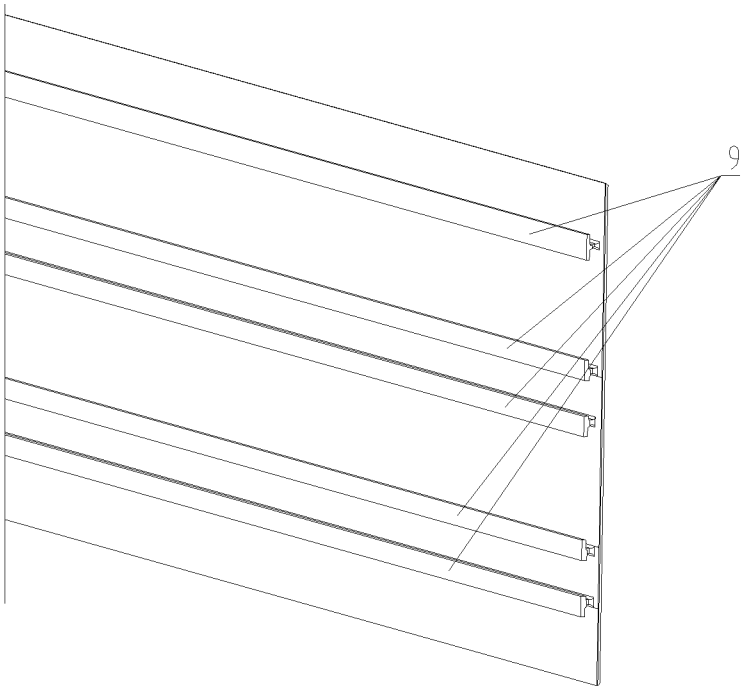

Figure 4

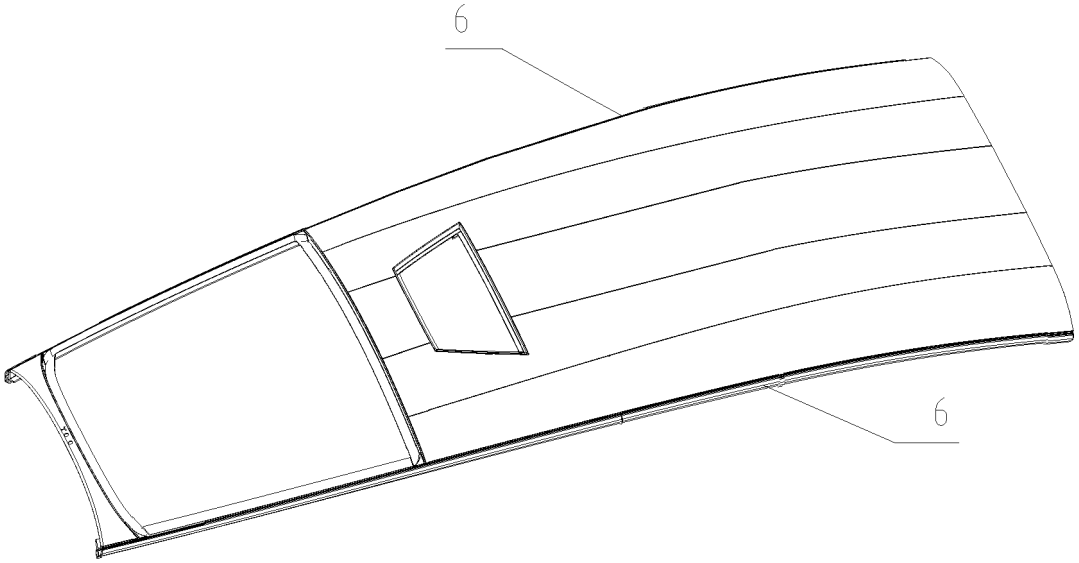

Figure 5

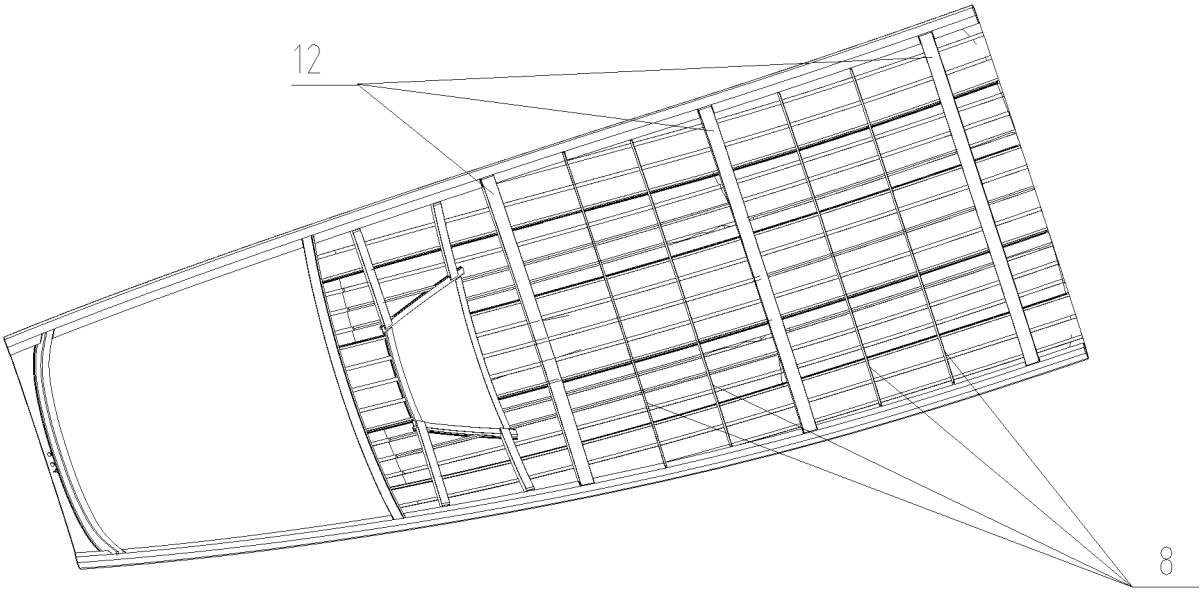

Figure 6

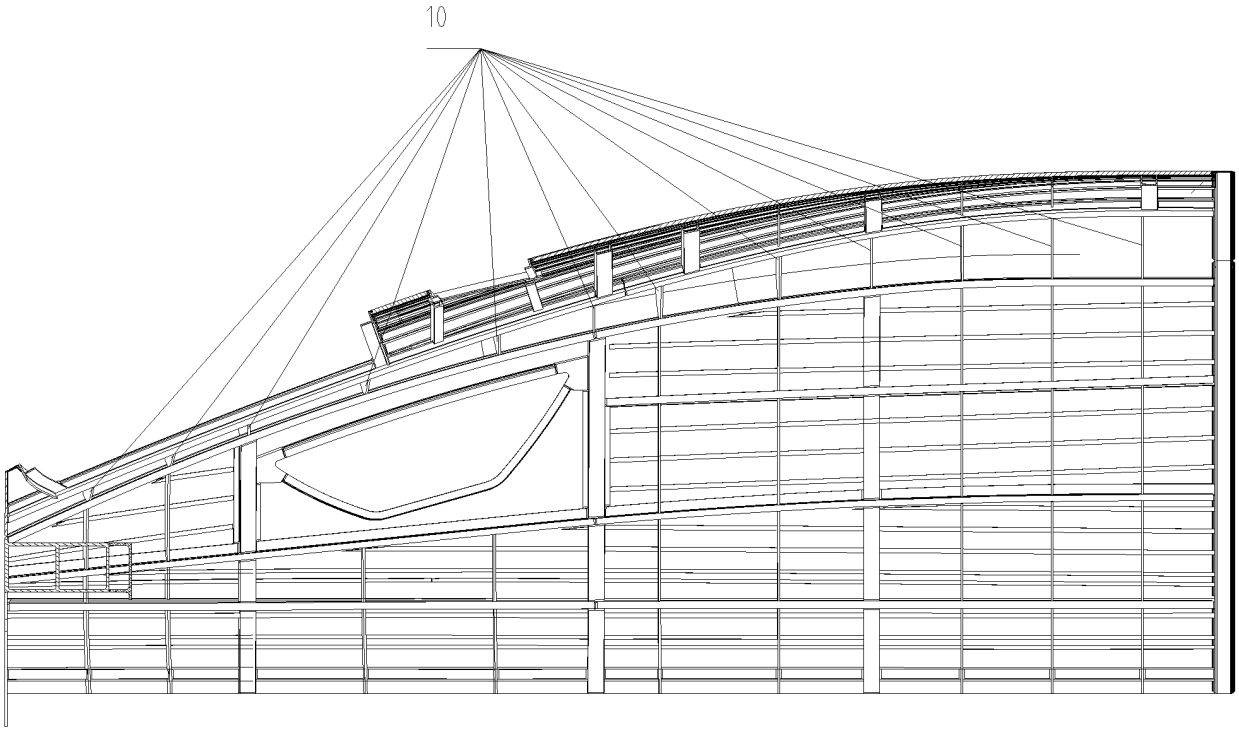

Figure 7

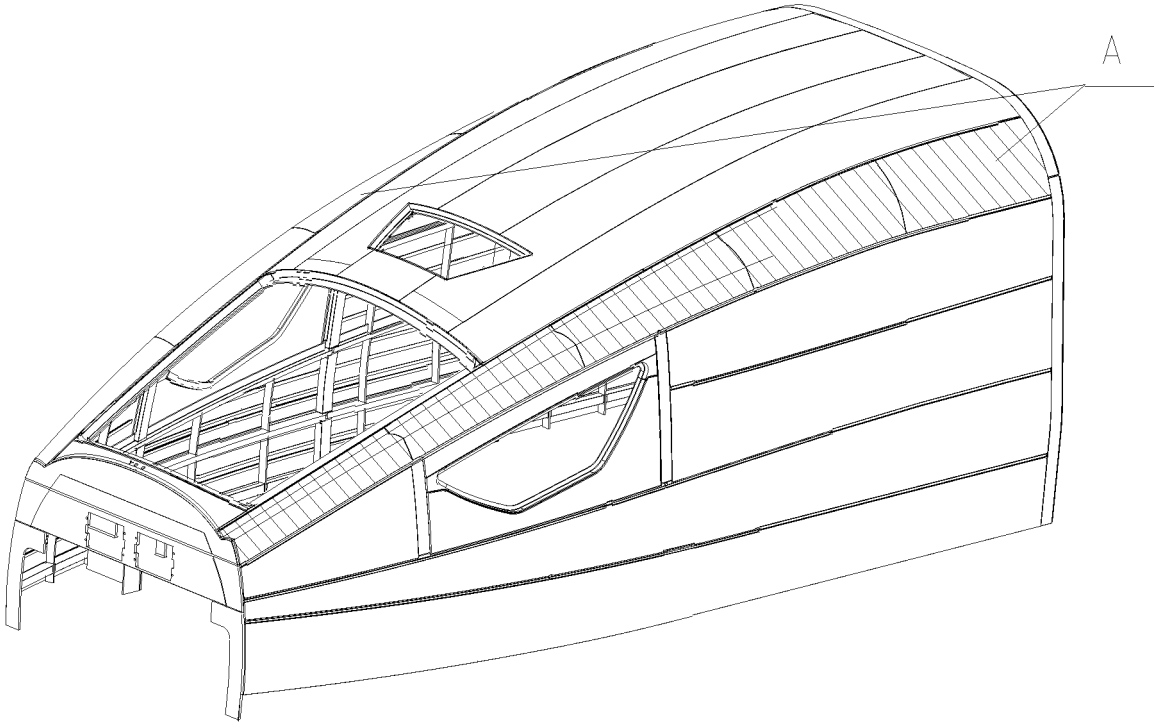

Figure 8

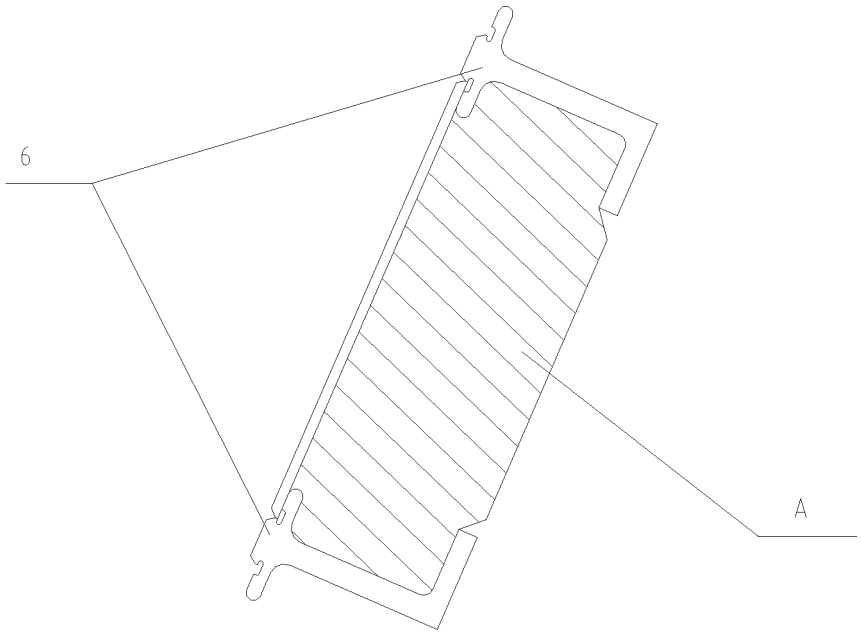

Figure 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2020/070884

A. CLASSIFICATION OF SUBJECT MATTER

B61D 17/08(2006.01)i; B61D 17/00(2006.01)i; B61F 1/08(2006.01)i; B61G 11/00(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)

B61D; B61F; B61G

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS; CNTXT; VEN; CNKI; USTXT; EPTXT; WOTXT: 中车长春轨道客车, 车头, 头车, 动车, 高铁, 火车, 列车, 侧墙, 纵梁, 竖梁, 横梁, 骨架, head+, rail+, train, frame+, wall, beam

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 109677436 A (CRRC CHANGCHUN RAILWAY VEHICLES CO., LTD.) 26 April 2019 (2019-04-26) claims 1-10	1-10
PX	CN 109483128 A (CRRC CHANGCHUN RAILWAY VEHICLES CO., LTD.) 19 March 2019 (2019-03-19) description, paragraphs [0003]-[0011], and figures 1-4	1-10
X	CN 204978668 U (CHANGCHUN INTER-CITY RAILWAY VEHICLE ACCESSORIES CO., LTD.) 20 January 2016 (2016-01-20) description, paragraphs [0017]-[0023], and figures 1-5	1-10
A	DE 102012213019 A1 (SIEMENS AG) 30 January 2014 (2014-01-30) entire document	1-10
A	CN 107472285 A (CRRC QINGDAO SIFANG CO., LTD.) 15 December 2017 (2017-12-15) entire document	1-10

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

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"P" document published prior to the international filing date but later than the priority date claimed
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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 January 2020	**01 April 2020**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration** **No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088** **China** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2020/070884

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	109677436	A	26 April 2019	CN	209700668	U	29 November 2019
CN	109483128	A	19 March 2019	CN	109483128	B	08 November 2019
CN	204978668	U	20 January 2016	None			
DE	102012213019	A1	30 January 2014	DE	102012213019	B4	04 December 2014
CN	107472285	A	15 December 2017	CN	207045350	U	27 February 2018

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- KR 201910141359 **[0001]**
- CN 201920243963 **[0001]**