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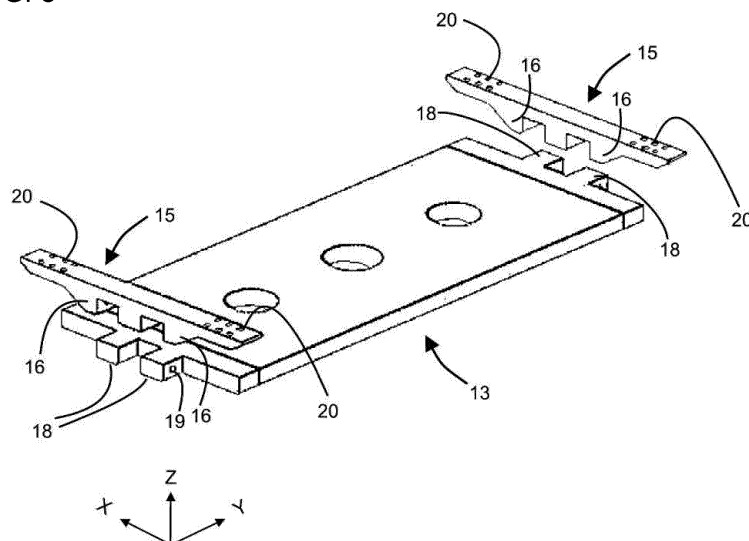
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(54) **RAIL VEHICLE UNDERFRAME STRUCTURE AND RAIL VEHICLE**

(57) To provide a rail vehicle and an underframe structure of a rail vehicle having a high assembling performance and high reliability. In an underframe structure of a rail vehicle having side beams 11 coupled to a vehicle structure 1 and bolster beams 13 coupled to a truck, adapters 15 each being attached to the side beam 11 and each having a plurality of projection portions 16 arranged along a vehicle longitudinal direction are provided,

the bolster beam 13 includes keys 18 protruding along the vehicle longitudinal direction, and the key 18 and the projection portions 16 are fastened, using bolts BT extending in the vehicle longitudinal direction, in a state where the key 18 is disposed between the projection portions 16 of the adapter 15.

FIG. 3



Description

Technical Field

[0001] The present invention relates to an underframe structure of a rail vehicle and a rail vehicle.

Background Art

[0002] In general, a vehicle structure (hereinafter, referred to as a structure) is a hexahedral structure composed of an underframe forming a floor surface, side structures disposed at both end portions of the underframe in a width direction thereof, end structures disposed at both end portions of the underframe in a longitudinal direction thereof, and a roof structure disposed on the side structures and the end structures.

[0003] The underframe (hereinafter, also referred to as a underframe structure) includes: side beams provided at both end portions of the underframe in the width direction along the longitudinal direction thereof; end beams each connecting both end portions of the side beams in the longitudinal direction; bolster beams each being provided, along the end beam, at a position away from a longitudinal end portion of the structure by a predetermined distance; a middle beam disposed along the longitudinal direction of the structure to connect the end beams and the bolster beams with the structure.

[0004] A center pin provided along a structure vertical direction on a lower surface of the bolster beam is connected to a truck frame constituting the truck. During acceleration and deceleration of the vehicle, a load in a vehicle front-rear direction is transmitted from the truck to the bolster beam via the center pin.

[0005] On the other hand, from the viewpoint of improving assemblability of a railway vehicle, it is required to facilitate attachment of wirings and ducts attached to the underfloor. In order to facilitate the attachment, it is effective to adopt a structure in which the middle beam is omitted, and to assemble the structure in a state where the bolster beams are attached to the truck. As a truck structure corresponding to a structure in which such a middle beam is omitted, PTLs 1 and 2 propose a truck including a bolster beam that is fastened only to the side beam using a bolt.

Citation List

Patent Literature

[0006]

PTL 1: European Patent Application Publication Number 2500231

PTL 1: European Patent Application Publication Number 2540592

Summary of Invention

Technical Problem

[0007] When the middle beam is omitted in the underframe structure of the railway vehicle, the load transmitted from the truck to the bolster beam is transmitted only to the side beam, so that the load applied to a connecting portion between the bolster beam and the side beam increases. Further, a load is also transmitted from the end beam to the side beam only at the time of coupling, so that the load applied to the connecting portion between the bolster beam and the side beam increases similarly as described above.

[0008] Therefore, in the truck structure described in PTLs 1 and 2, a shear load applied to a bolt for attaching the bolster beam to the structure increases when a vehicle body receives a load at the time of pulling or coupling, and thus reliability of a bolt fastening portion may be reduced.

[0009] The invention is made in view of the problems in the related art, and an object thereof is to provide a rail vehicle and an underframe structure of a rail vehicle that contributes to improving the assemblability of a vehicle body and has high reliability.

Solution to Problem

[0010] To solve the above problems, as one representative underframe structure of the invention, the underframe structure of a rail vehicle including a side beam and a bolster beam, and coupled to a truck via the bolster beam includes an adapter attached to the side beam and having a plurality of projection portions arranged along a vehicle longitudinal direction, the bolster beam includes a key, the key is disposed between the projection portions of the adapter, and the key and the projection portions are fastened using a bolt extending in the vehicle longitudinal direction.

Advantageous Effect

[0011] According to the invention, it is possible to provide a rail vehicle and an underframe structure of a rail vehicle that contributes to improving assemblability of a vehicle body and has high reliability.

[0012] Problems, configurations and effects other than the above will be apparent with reference to description of following embodiments.

Brief Description of Drawings

[0013]

[FIG. 1] FIG. 1 is a side view of a railway vehicle including an underframe structure according to a first embodiment.

[FIG. 2] FIG. 2 is a bottom perspective view of a

vehicle structure including the underframe structure according to the first embodiment.

[FIG. 3] FIG. 3 is an external view of a bolster beam and adapters in the underframe structure according to the first embodiment.

[FIG. 4] FIG. 4 is an external view of the adapter according to the first embodiment.

[FIG. 5] FIG. 5 is a cross-sectional view of the adapter according to the first embodiment.

[FIG. 6] FIG. 6 is a cross-sectional view of an underframe structure and a truck according to a second embodiment.

[FIG. 7] FIG. 7 is a cross-sectional view of an underframe structure and a truck according to a third embodiment.

[FIG. 8] FIG. 8 is an external view of a connecting portion of an end beam and a side beam according to a fourth embodiment.

Description of Embodiments

[0014] Embodiments disclosed in the invention relate to a structure in which a bolster beam is fastened to a side beam using a bolt. Directions used in the following description are defined as follows. In a structure 1 shown in the drawings, a vehicle longitudinal direction (front-rear direction, rail direction) is set as a X direction, a vehicle width direction (sleeper direction) is set as a Y direction, and a height direction is set as a Z direction. Further, in some cases, the directions are simply referred to as the X direction, the Y direction, and the Z direction.

[0015] A rail vehicle is a vehicle that moves along a laid rail, and includes a railway vehicle, a monorail vehicle, a tram, an automated guideway transit vehicle, and the like. The embodiments of the invention will be described by taking the railway vehicle as a representative example of the rail vehicle.

(First Embodiment)

[0016] As shown in FIG. 1, the structure 1 of the railway vehicle including an underframe 10 shown as a first embodiment in FIGS. 1 to 5 includes the underframe 10 forming a floor surface, side structures 30 disposed at both end portions of the underframe 10 in a width direction thereof, end structures 40 disposed at both end portions of the underframe 10 in a longitudinal direction thereof, and a roof structure 50 disposed on the end structures 40 and the side structures 30.

[0017] Further, as shown in FIG. 1 or 2, the underframe 10 has a pair of side beams 11 provided at both end portions of the underframe 10 in the width direction thereof and extending along the longitudinal direction thereof, end beams 12 each connecting both end portions of the side beams 11 in the vehicle longitudinal direction, and bolster beams 13 each being provided at a position facing a truck frame 3 under the underframe 10. As shown in FIG. 3, the underframe 10 is provided with portions pro-

truding in the Y direction from both end portions of the bolster beam 13 in the vehicle width direction. In the present specification, this protruding portion is referred to as a "key". In the following embodiments, a key 18 has a rectangular cross section in an X-Z plane, a rectangular cross section in an X-Y plane, and a rectangular cross section in a Y-Z plane. However, at least one of the cross sections may have a shape other than a rectangle. A screw hole 19 is provided on a side surface of the key 18 in the X direction.

[0018] Further, on lower surfaces of the side beams 11 (not shown in FIG. 3), adapters 15 each are disposed at a position facing the key 18. As shown in FIG. 5, the adapter 15 is provided with three projection portions 16 arranged along the vehicle longitudinal direction at a lower surface of a beam-shaped body 15a extending along the vehicle longitudinal direction. As shown in FIG. 5, the projection portions 16 on both end sides in the vehicle longitudinal direction each have a trapezoidal cross section, and the projection portion 16 at the center has a rectangular cross section. As shown in FIGS. 4 and 5, holes 17 each having a stepped shape for holding a head portion of a bolt BT are provided to penetrate in the X direction in the projection portions 16 which are at both end portions in the X direction.

[0019] The adapter 15 is fastened to the lower surface of the side beam 11 in advance by using bolts (not shown) inserted into a plurality of holes 20 (FIG. 3) penetrating in the Z direction in the vicinity of both end portions of the beam-shaped body 15a. At a time of assembling a truck, the bolster beam 13 to be coupled to a truck 2 and the adapter 15 attached to the side beam 11 are combined such that the key 18 is disposed between the projection portions 16 and the projection portion 16 and the key 18 intersect with each other, and two bolts BT (FIG. 5) are inserted through the holes 17 at both sides and screwed into the screw holes 19, respectively. By tightening the bolts BT, facing surfaces of the projection portion 16 and the key 18 are in close contact with each other, and the bolster beam 13 and the side beam 11 can be coupled via the adapter 15.

[0020] Therefore, a part of load transmitted to the connecting portion between the bolster beam 13 and the side beam 11 at the time of pulling or coupling is applied to the bolts BT for fastening the key 18 and the adapter 15 of the bolster beam 13 on a traveling direction forward side as a tensile load, and the remaining load is applied to contact surfaces between the projection portion 16 and the key 18 on a traveling direction rearward side. Therefore, the tensile load applied to the bolt BT is not excessively large. On the other hand, a bolt (not shown) for fastening the adapter 15 and the side beam 11 is applied with a shear load in addition to a load caused by friction of the contact surfaces, but many bolts (for example, 12 bolts per adapter 15) are used, so that the load received by the respective bolts can be distributed. As described above, according to the present embodiment, it is possible to avoid a concentration of the shear load on the bolts

for fastening the connecting portion of the bolster beam 13 and the side beam 11.

[0021] Further, the bolster beam 13 and the adapter 15 can also be fastened by providing coaxial holes penetrating all the projection portions 16 and the keys 18 in the X direction, inserting a single bolt having a length penetrating these holes, and screwing a nut to a penetrating end of the bolt.

(Second Embodiment)

[0022] In the underframe 10 shown as a second embodiment, a height position of a center portion of the bolster beam 13 in the vehicle width direction is higher than those at both end portions as shown in a cross sectional view of the truck 2 and the underframe 10 in FIG. 6, with respect to the underframe structure in the first embodiment. The center portion of the bolster beam 13 in the vehicle width direction is support with respect to the truck 2 via an air spring 4, and a center pin 14 provided on a lower surface of the center portion of the bolster beam 13 in the vehicle width direction is coupled to the truck 2.

[0023] According to the present embodiment, joint positions between the adapters 15 and both end portions of the bolster beam 13 in the vehicle width direction can be lowered, so that it is possible to minimize or eliminate a change in a height position of the structure 1 even when the adapter 15 is provided between the side beam 11 and the bolster beam 13. Further, the bending rigidity of the bolster beam 13 in the X direction can be improved, so that it is possible to reduce bending deformation of the bolster beam 13 due to vibration in a vehicle vertical direction.

(Third Embodiment)

[0024] In the underframe 10 shown as a third embodiment, a height position of a center portion of a floor structure 5 in the vehicle width direction is higher than those at both end portions as shown in a cross sectional view of the truck 2 and the underframe 10 in FIG. 7, with respect to the underframe structure in the second embodiment. A side beam 11 (FIG. 2) attached to a lower surface of the floor structure 5 is coupled to the adapter 15.

[0025] According to the present embodiment, an offset amount between height positions of a connector receiver 21 used for vehicle coupling and the floor structure 5 is reduced, and even when a middle beam is omitted, a load at the time of coupling can be efficiently transmitted to the floor structure 5. Further, it is possible to dispose a wiring/duct 6 in a space between a floor plate 7 and the floor structure 5, or to dispose a damping material or the like for noise reduction. Further, since the bending rigidity of the floor structure 5 in the X direction can be improved, deformation of the vehicle body due to an airtightness load and weight of passengers can be reduced. Further, the configuration of the third embodiment may be combined with the configuration of the first embodi-

ment.

(Fourth Embodiment 4)

[0026] The structure 1 having an underframe structure shown as a fourth embodiment includes plate members 22A and 22B provided on a connecting portion between the end beam 12 and the side beam 11 as reinforcement members that increase the strength when a coupling load is transmitted to the side beam 11 and the floor structure 5, as shown in a schematic view of a connecting portion of the end beam and the side beam in FIG. 8, and the present embodiment can be applied to any of the underframe structures of the first to third embodiments.

[0027] The plate member 22A includes a vertical plate 22a and a horizontal plate 22b. The vertical plate 22a bent at the center has a trapezoidal shape, which is narrowed as away from the end beam 12, on a distal end portion side, a proximal end portion is welded to the end beam 12, and a bottom edge is welded to the floor structure 5. Further, the horizontal plate 22b spaced apart from the floor structure 5 has a trapezoidal shape, which is narrowed as away from the end beam 12, on a distal end portion side, a proximal end portion is welded to the end beam 12, one side edge is welded to the vertical plate 22a, and the other side edge is welded to a side surface of the side beam 11. That is, a cross-sectional shape of the plate member 22A on the distal end portion side becomes smaller as away from the end beam 12.

[0028] The plate member 22B includes a vertical plate 22c and a horizontal plate 22d. The vertical plate 22c has a trapezoidal shape, which is narrowed as away from the end beam 12, on a distal end portion side, a proximal end portion is welded to the end beam 12, a bottom edge is welded to the upper surface of the side beam 11, and an upper edge is welded to the center of a lower surface of the horizontal plate 22d. Further, the rectangular horizontal plate 22d is bent at the center, and a proximal end portion is welded to the end beam 12. That is, a height of the plate member 22B on the distal end portion side reduces as away from the end beam 12.

[0029] The plate members 22A and 22B increase the strength of the connecting portion between the end beam 12 and the side beam 11, and even when the middle beam is omitted, a load at the time of coupling can be transmitted to the side beam 11 and the floor structure 5 while relaxing the stress. Further, it is sufficient to provide at least one of the plate members 22A and 22B.

[0030] In the embodiments described above, the adapter 15 is attached to the structure 1 by bolt fastening, but it is also possible to attach the adapter 15 to the structure by welding. Further, it is also possible to adopt a configuration in which a member for receiving a load from a yaw damper attached to the truck 2 is attached to the bolster beam 13.

[0031] The invention is not limited to the embodiments described above, and includes various modifications. For example, the above-described embodiments have been

described in detail for easy understanding of the invention, and the invention is not necessarily limited to one having all the described configurations. Further, a part of the configurations of one embodiment can be replaced with the configurations of another embodiment, and the configurations of a certain embodiment can be added to the configurations of another embodiment. Further, a part of the configurations of each embodiment may be added to, deleted from, or replaced with other configurations.

Reference Sign List

[0032]

1: structure
 2: truck
 3: truck frame
 4: air spring
 5: floor structure
 6: wiring/duct
 7: floor plate
 10: underframe
 11: side beam
 12: end beam
 13: bolster beam
 14: center pin
 15: adapter
 16: projection portion
 17: hole
 18: key
 19: screw hole
 20: hole
 21: connector receiver
 22A, 22B: plate member
 30: side structure
 40: end structure
 50: roof structure

Claims

1. An underframe structure of a rail vehicle, including a side beam and a bolster beam, and connected to a truck via the bolster beam, the underframe structure comprising:

an adapter attached to the side beam and having a plurality of projection portions arranged along a vehicle longitudinal direction, wherein the bolster beam includes a key, and the key is disposed between the projection portions of the adapter, and the key and the projection portions are fastened using a bolt extending in the vehicle longitudinal direction.

2. The underframe structure according to claim 1, wherein at least one of the projection portions of the adapter

has a through hole extending along the vehicle longitudinal direction, the key has a screw hole, and the bolt is inserted into the through hole and screwed into the screw hole.

3. The underframe structure according to claim 1 or 2, wherein a center portion of the bolster beam in a vehicle width direction is supported with respect to the truck, and the adapter is attached to both end portions of the bolster beam in the vehicle width direction, and the center portion of the bolster beam is positioned higher than the both end portions of the bolster beam.

4. The underframe structure according to any one of claims 1 to 3, wherein the underframe structure includes a floor structure disposed on the side beam, and a center portion of the floor structure in the vehicle width direction is positioned higher than both end portions of the floor structure in the vehicle width direction.

5. The underframe structure according to any one of claims 1 to 4, further comprising: a reinforcement member that reinforces a connecting portion of the side beam and an end beam.

6. A rail vehicle, comprising: the underframe structure according to claim 5.

FIG. 1

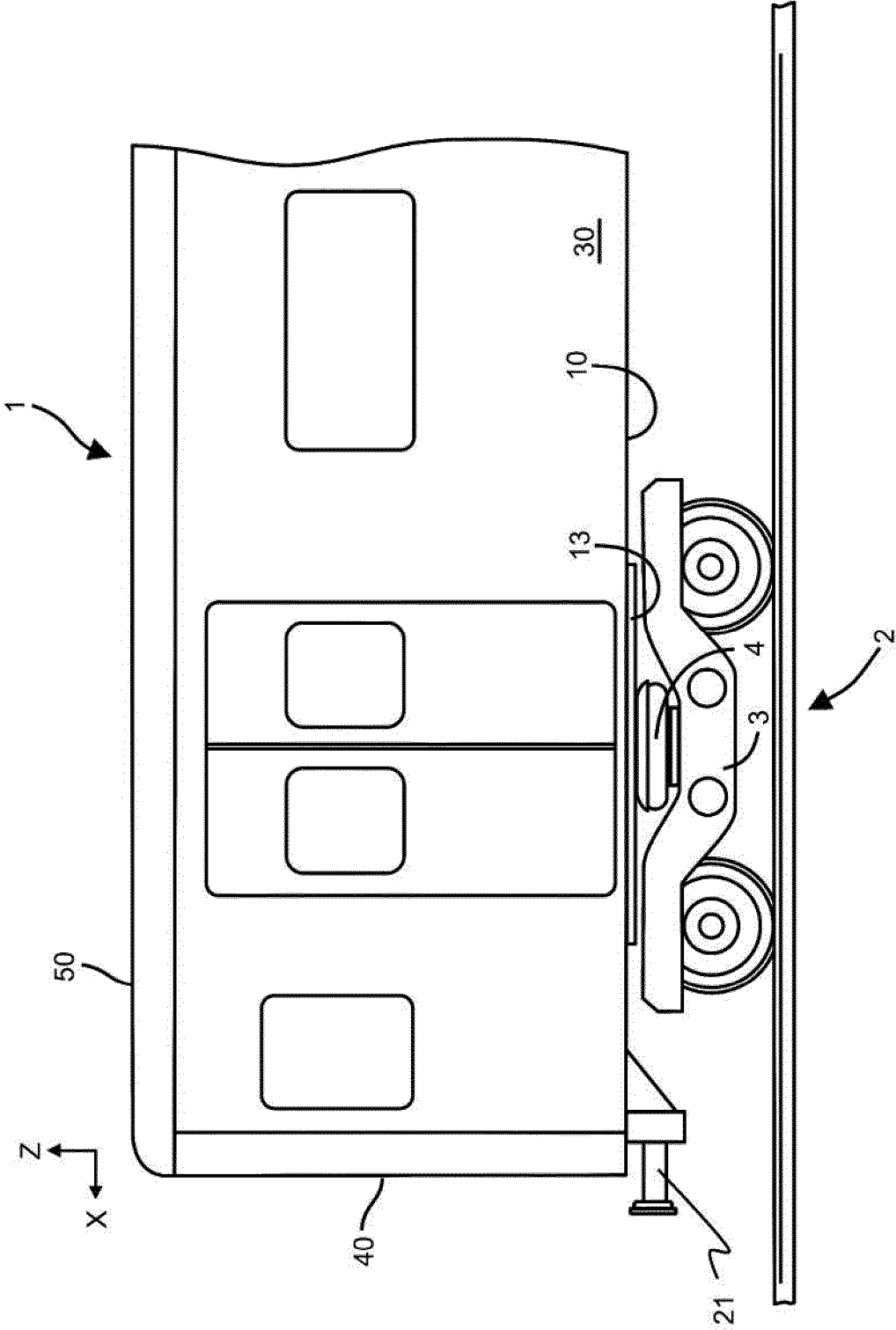


FIG. 2

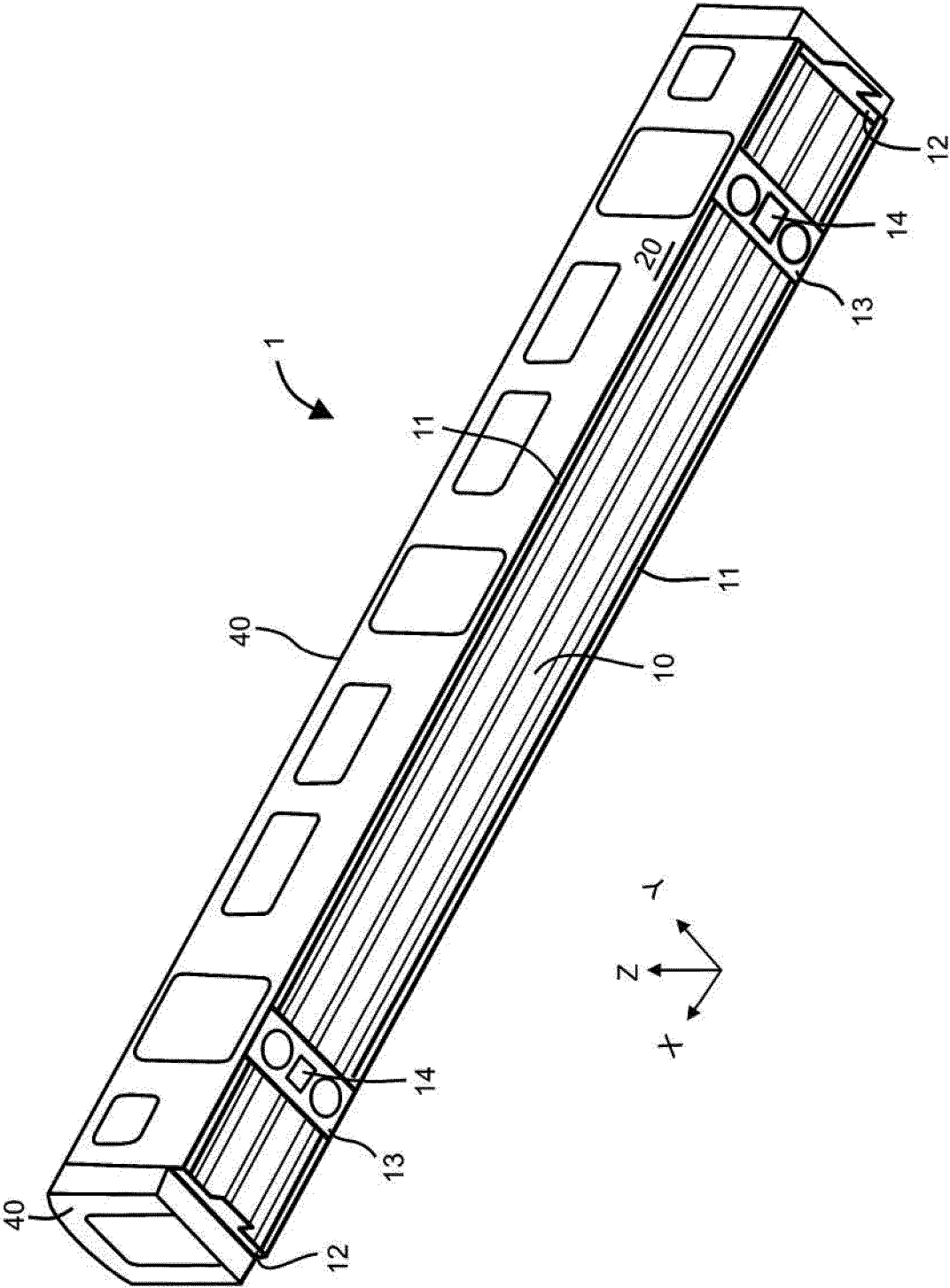


FIG. 3

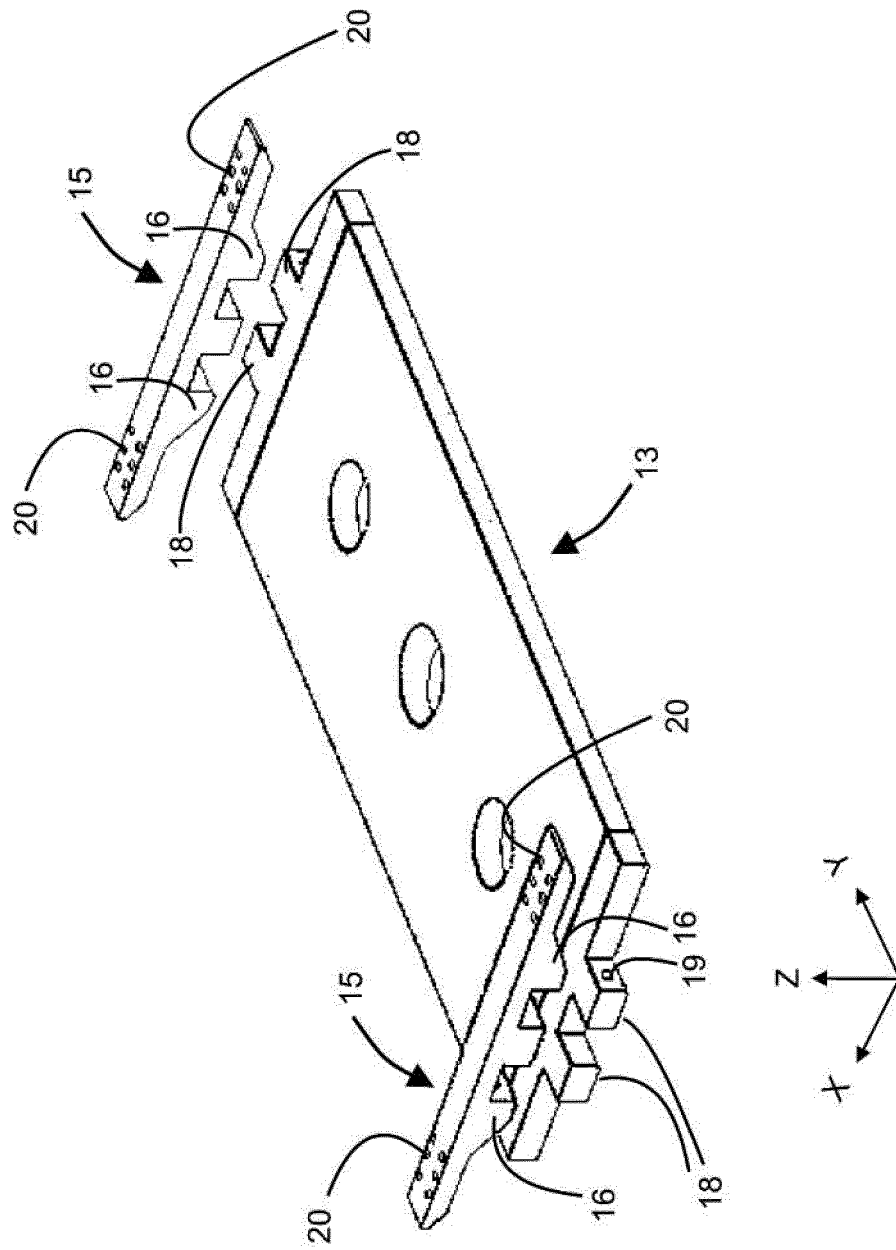
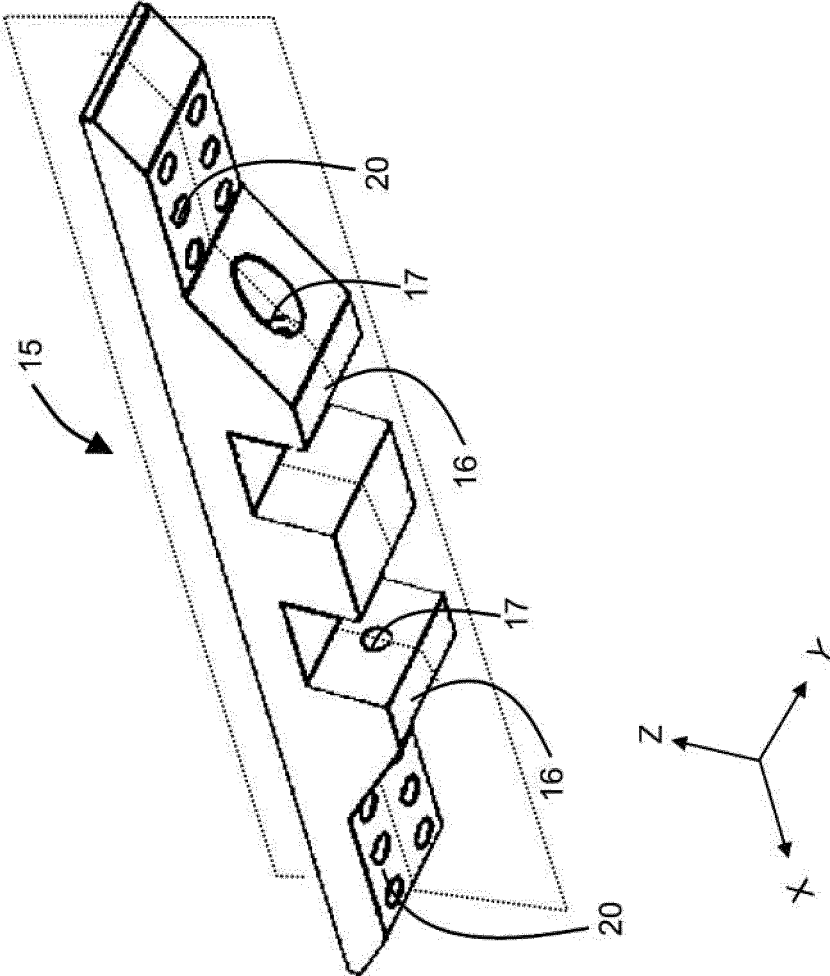


FIG. 4



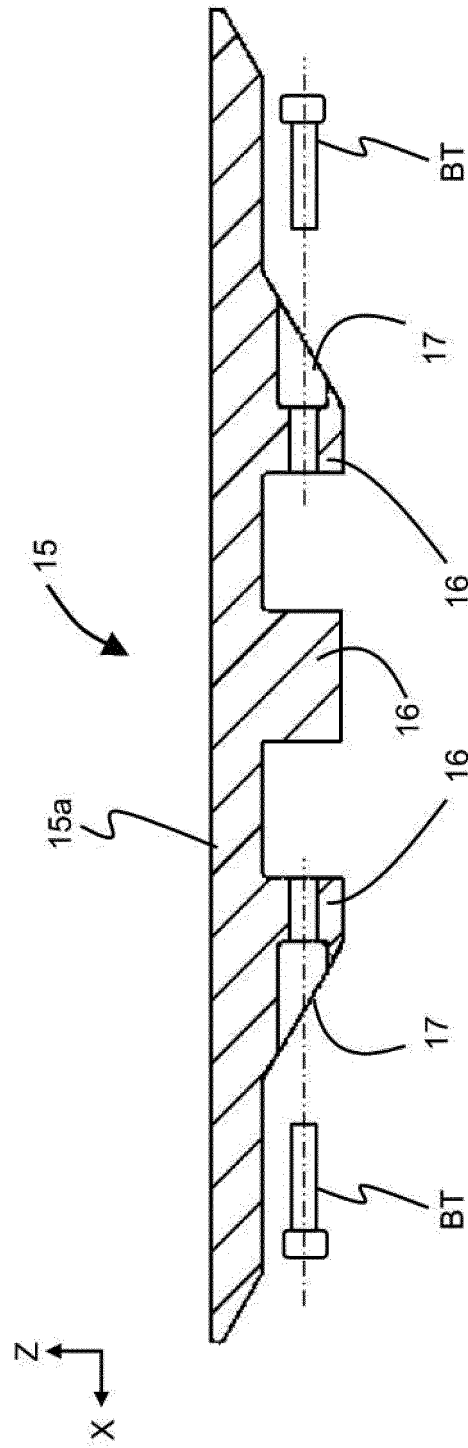


FIG. 5

FIG. 6

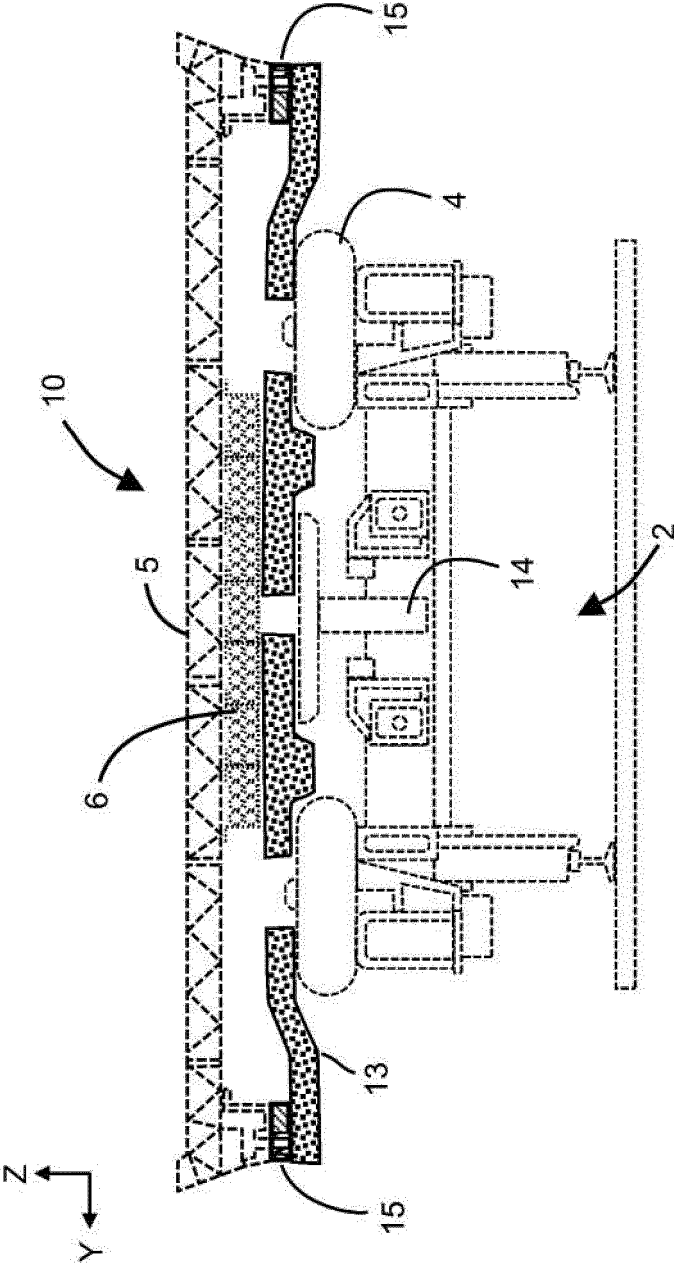


FIG. 7

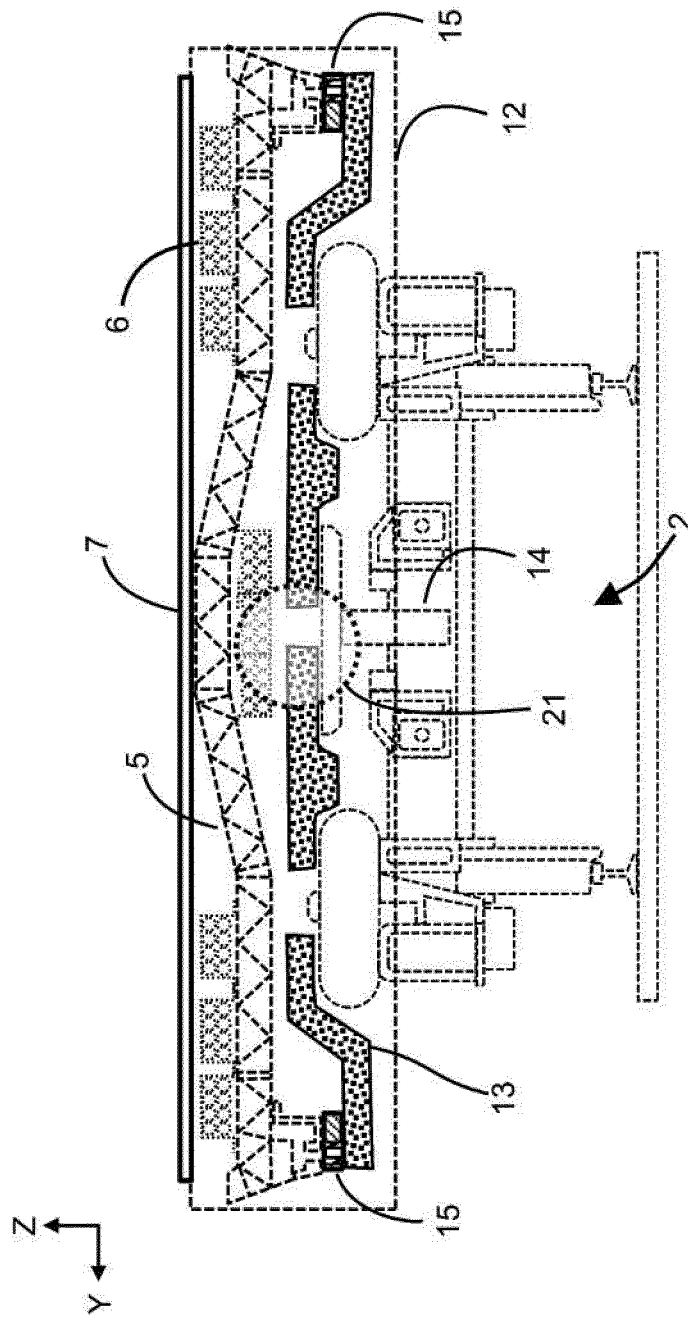
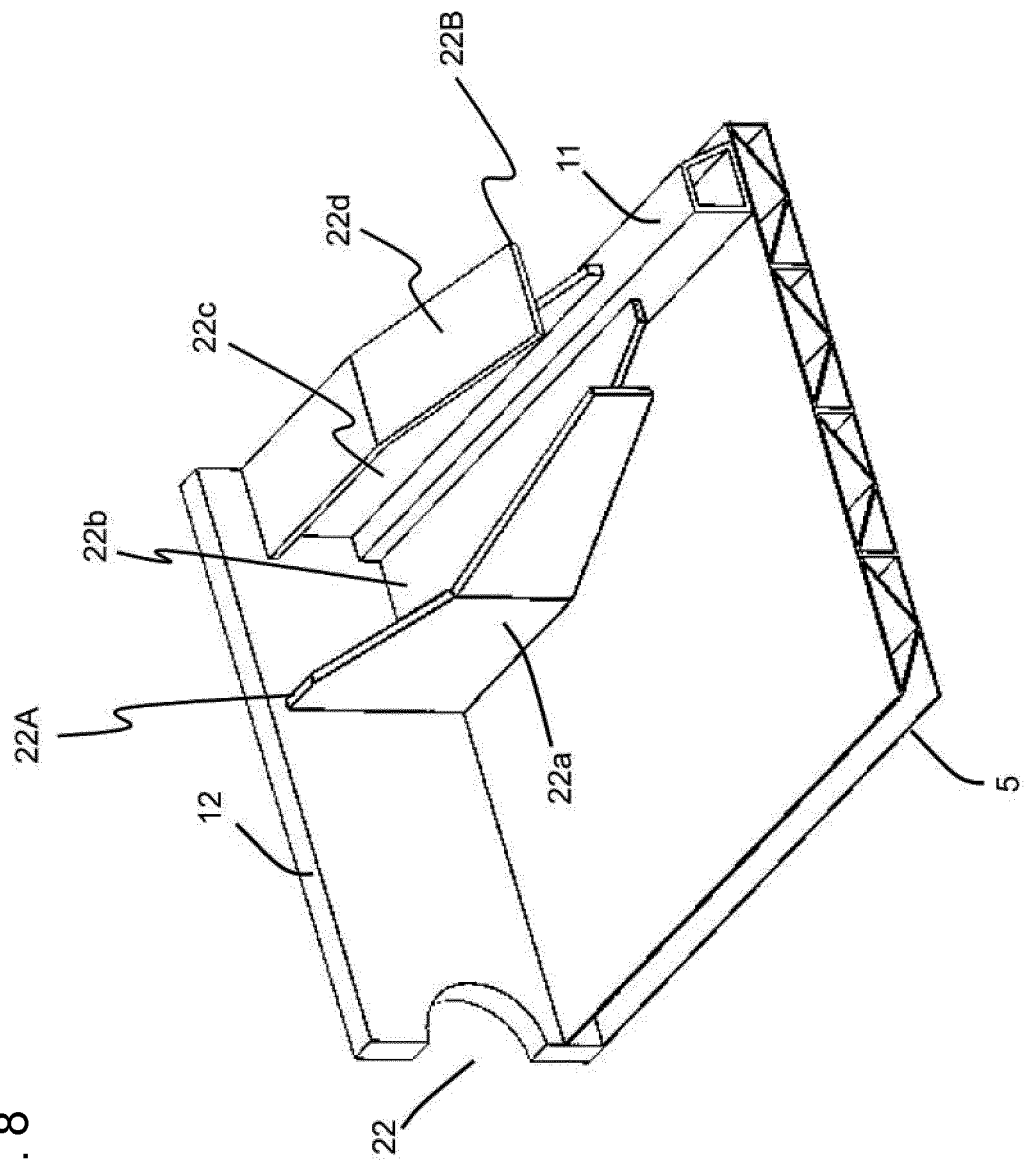


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2018/037904

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. B61F1/00(2006.01) i, B61F5/02(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)

Int.Cl. B61F1/00, B61F5/02

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

Published examined utility model applications of Japan 1922-1996

Published unexamined utility model applications of Japan 1971-2018

Registered utility model specifications of Japan 1996-2018

Published registered utility model applications of Japan 1994-2018

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2013/157464 A1 (HITACHI, LTD.) 24 October 2013 & GB 2514516 A & DE 112013002072 B4	1-6
A	JP 2018-58387 A (HITACHI, LTD.) 12 April 2018 (Family: none)	1-6
A	EP 2500231 A1 (BOMBARDIER TRANSPORTATION GMBH) 19 September 2012 & CN 102673594 A & ES 2547087 T3	1-6



Further documents are listed in the continuation of Box C.



See patent family annex.

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Patent documents cited in the description

- EP 2500231 A [0006]
- EP 2540592 A [0006]