(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 944 213 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
16.07.2008 Bulletin 2008/29

(51) Int Cl.:
B61D 17/10 *(2006.01)* ***B61D 17/08*** *(2006.01)*

(21) Application number: **07250666.0**

(22) Date of filing: **16.02.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

(30) Priority: **10.01.2007 JP 2007002628**

(71) Applicant: **Hitachi, Ltd.**
Chiyoda-ku
Tokyo 100-8280 (JP)

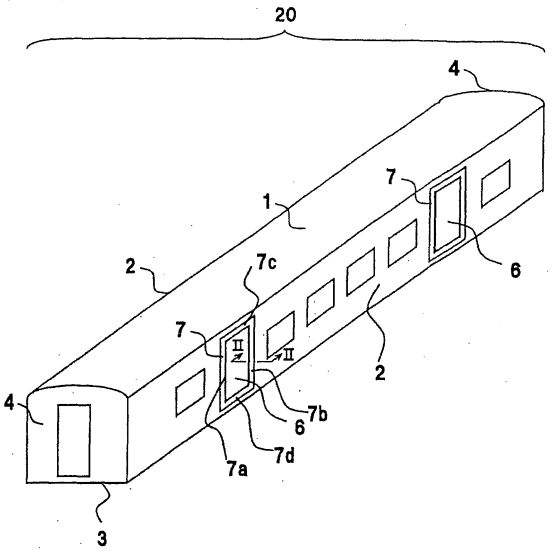
(72) Inventors:
- **Nakamura, Hideyuki**
  Chiyoda-ku
  Tokyo 100-8220 (JP)
- **Miyamoto, Toshiharu**
  Chiyoda-ku
  Tokyo 100-8220 (JP)
- **Mochida, Toshihiko**
  Chiyoda-ku
  Tokyo 100-8220 (JP)
- **Kawasaki, Takeshi**
  Chiyoda-ku
  Tokyo 100-8220 (JP)

(74) Representative: **Paget, Hugh Charles Edward et al**
Mewburn Ellis LLP
York House
23 Kingsway
London WC2B 6HP (GB)

(54) Car structure

(57) A car structure is provided which has the required strength against vertical load and vibration while avoiding increase in weight of the structure. At an entrance (6) of the railroad car structure (20) in which a side structure (2) is formed by a hollow member, the side structure (2) and a frame (7) are coupled via an L-shaped fitting (10). The L-shaped fitting (10) consists of a first joint part (10a) which is in the form of a plate and couples a vehicle outer face plate (8) and a vehicle inner face plate (9) and a second joint part (10b) which is in the form of a plate and butt welds a part of the first joint part (10a) near the vehicle outer face plate (8) and the frame (7). Plate thickness of the second joint plate (10b) is larger than plate thickness of the vehicle outer face plate (8). As a result, the required strength against vertical load can be ensured without increasing the plate thickness of the vehicle outer face plate (8), in other words, with little increase in weight of the structure.

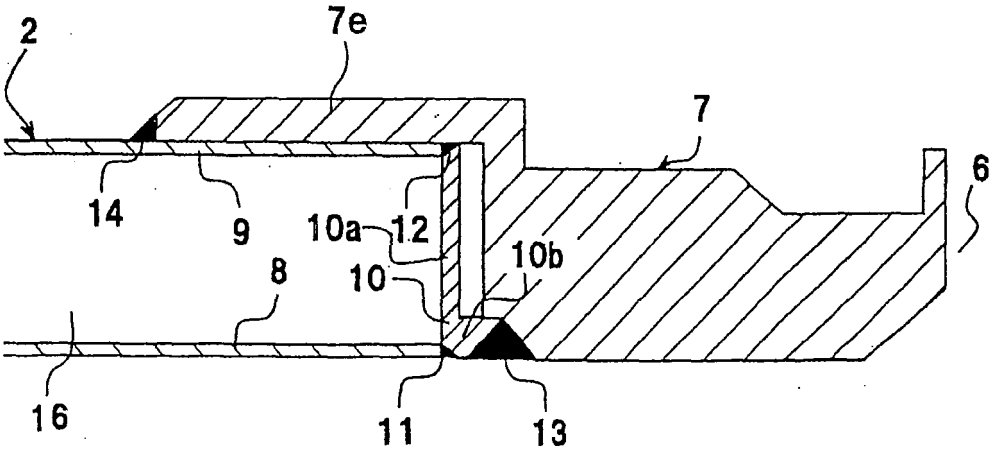
FIG. 1



EP 1 944 213 A1

(Cont. next page)

FIG. 2



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a car structure forming a rail vehicle such as a railroad vehicle or a monorail car, and in particular relates to a car structure configured by jointing hollow members made of aluminum alloy, for example.

Description of the Related Art

[0002] A car structure comprises a roof component forming an upper side, two side structures forming lateral sides, an underframe forming a lower side, and two end components forming end sides in a longitudinal direction.

[0003] Recently, for the main purposes of weight reduction and improvement in manufacturability of a rail vehicle, hollow extruded members made of aluminum alloy have been used for the roof component, the side structures, and the underframe and extruded members with ribs made of aluminum alloy have been used for the end components. Such a vehicle body structure of a rail vehicle is described in Japanese Patent Publication No. 2604226 (Patent Document 1), for example.

[0004] In addition, an entrance provided in the side structure of the car structure is formed by providing an opening in the hollow member of the side structure and welding an entrance frame having a large thickness to the opening for reinforcing. Such a structure of the entrance is described in Japanese Patent Publication No. 3751236 (Patent Document 2), for example.

[0005] A rail car structure is subjected to vertical static load due to passengers on the vehicle or dynamic load caused by vertical vibration or the like generated when the vehicle runs on rails. Therefore, it is necessary that the rail car structure has the required strength against these loads. Parts in the structure which may be in a severe condition in terms of strength due to these loads are two side structures which entirely bear these loads. Particularly, static or dynamic deformation occurs in a concentrated manner around an entrance of the side structure where a large opening is formed for passengers getting on or off and therefore this area is in the most severe condition in terms of strength. Thus, a robust frame is generally provided around the entrance of the side structure. The technical cause of this severe condition in terms of strength will be described again hereinafter with reference to FIG. 3.

[0006] Coupling of the entrance frame and the side structure is accomplished by extending a face plate of the hollow member forming the side structure towards the entrance frame and placing the face plate on a seat provided in the entrance frame and butt welding a tip of the face plate thereto. As a result, deformation due to vertical load is concentrated and high stress is generated on the face plate which is sandwiched between the robust hollow member and entrance frame. If plate thickness of the face plate of the hollow member is increased as a whole in order to prevent this, the weight of the structure is significantly increased accordingly.

[0007] It is an object of the present invention to provide a car structure which has the required strength against vertical load, particularly around the entrance of the side structure, while avoiding increase in weight of the rail car structure.

SUMMARY OF THE INVENTION

[0008] The above described object is accomplished by a car structure comprising a side structure formed by a hollowmember consisting of a vehicle outer face plate, a vehicle inner face plate, and a plurality of ribs coupling both face plates, the side structure comprising an entrance opened therein, in which an entrance frame is fixed to the vehicle outer face plate and the vehicle inner face plate of the hollow member along an opening edge of the entrance, wherein the vehicle outer face plate and the vehicle inner face plate are welded by a joint member along the opening edge, and the joint member consists of a first joint part which couples the vehicle outer face plate and the vehicle inner face plate and a second joint part which couples a part of the first joint part near the vehicle outer face plate and a vehicle outer side of the entrance frame.

[0009] According to the present invention, because it is not necessary to increase plate thickness of the vehicle outer face plate and the vehicle inner face plate of the side structure, a car structure having the required strength against vertical load can be provided while avoiding increase in weight of the structure.

[0010] In other words, according to this car structure, two face plates of the hollow member are coupled by the first joint part so that they can withstand the vertical load. Therefore, two face plates may be thin and thereby the side structure can be light in weight.

[0011] In addition, by increasing thickness of the second joint part, concentration of deformation and generation of high stress in this part can be suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a perspective view of a rail car structure of one embodiment of the present invention;
FIG. 2 is a II-II cross sectional view of FIG. 1;
FIG. 3 illustrates how the rail car structure is deformed due to vertical load;
FIG. 4 is a view equivalent to FIG. 2 of another embodiment of the present invention; and
FIG. 5 is a view equivalent to FIG. 2 of another embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] Now, embodiments 1 to 3 of a rail car structure according to the present invention will be described with reference to the drawings.

(Embodiment 1)

[0014] A first embodiment of the present invention will be described with reference to FIGS. 1 to 3.

[0015] In an embodiment shown in FIG. 1, a rail car structure 20 comprises a roof component 1 forming an upper side, two side structures 2, 2 forming lateral sides, an underframe 3 forming a lower side, and two end components 4, 4 forming end sides.

[0016] Each of the roof component 1, the side structures 2, 2, the underframe 3, and the end components 4, 4 is formed by jointing (welding or friction stir welding) a plurality of extruded members.

[0017] The extruded members forming the roof component 1, the side structures 2, 2, and the underframe 3 are hollow members made of aluminum alloy and the hollow members are extruded in a longitudinal direction of the railroad car structure 20. The extruded members forming the end components 4, 4 are single materials with ribs made of aluminum alloy and the single materials are extruded in a vertical direction of the railroad car structure 20.

[0018] FIG. 3 illustrates how the rail car structure 20 is deformed due to vertical load. FIG. 3 is a side view of the rail car structure. The rail car structure 20 is supported by running gears at the centers in a running direction (the longitudinal direction of the rail car structure) of body bolsters 17, 17. Load in the vertical direction of the rail car structure 20 is applied on the rail car structure 20, the load being caused by the rail car structure 20 itself as well as mounted members such as electrical equipments and passengers on the vehicle. The rail car structure 20 is deformed due to the vertical load so as to have a downwardly convex shape between the body bolsters 17, 17. Particularly, the deformation occurs in a concentrated manner at entrances 6, 6 which have large openings for the passengers getting on or off. Therefore, robust entrance frames (shortly referred to as "frames" hereinafter) 7, 7 are mounted and fixed around the entrances 6, 6.

[0019] As shown in FIG. 2, the side structure 2 is formed by a hollow member consisting of two face plates, i.e. a vehicle outer face plate 8 and a vehicle inner face plate 9 and a plurality of ribs 16 coupling the two face plates 8, 9. Further, an entrance 6 is opened in the side structure 2. Conventionally, a frame 7 disposed along an opening edge of the entrance 6 has been directly jointed to the vehicle outer face plate 8 and the vehicle inner face plate 9 of the hollow member for the side structure 2 by means of welding or friction stir welding. In the rail car structure 20 according to the present invention, the side structure 2 and the frame 7 are coupled via an L-shaped fitting. In this embodiment, the L-shaped fitting 10 is a member having an L-shape as a whole in a cross section perpendicular to the opening edge as shown in FIG. 2. The L-shaped fitting 10 consists of a first joint part 10a which is in the form of a plate and joins the vehicle inner face plate 9 and the vehicle outer face plate 8 of the side structure 2 in an end side of the side structure 2 in the side of the entrance 6 and a second joint part 10b which is in the form of a plate and is integrally connected to the first joint part 10a and formed to project towards the frame 7 in the side of the vehicle outer face plate 8. Thickness of the second joint part 10b is larger than thickness of the vehicle outer face plate 8.

[0020] The first joint part 10a is butt welded to the vehicle outer face plate 8 and the vehicle inner face plate 9, as shown by welded parts 11, 12, respectively. The second joint part 10b is butt welded to the frame 7, as shown by a welded part 13. Because the vehicle outer face plate 8 and the vehicle inner face plate 9 are coupled by the first joint part 10a, a distance between the vehicle outer face plate 8 and the vehicle inner face plate 9 in the edge of the side structure 2 is not changed and the face plates are firmly attached to each other, so that deformation in out-of-plane directions with respect to the vehicle outer face plate 8 and the vehicle inner face plate 9 can be suppressed which can be caused by vertical static or dynamic load acting around the opening of the entrance 6. Because the second joint part 10b having a large thickness firmly couples the entrance frame 7 and the vehicle outer face plate 8 by welding, the required strength can be ensured around the entrance.

[0021] The first joint part 10a of the L-shaped fitting 10 is vertically placed along a vertical opening edge of the entrance 6. The first joint part 10a may be also horizontally placed along upper and lower opening edges of the entrance 6, continuously.

[0022] On the other hand, with respect to the frame 7 and the vehicle inner face plate 9 of the side structure 2, an extended part 7e of the frame 7 is differently placed in relation to the vehicle inner face plate 9 in the side of the vehicle inside and they are coupled by fillet welding, as shown by a welded part 14.

[0023] Plate thickness (vertical dimension in FIG. 2) of the second joint part 10b of the L-shaped fitting 10, i.e. joint depth of butt welding by the welded part 13 is larger than plate thickness (vertical dimension in FIG. 2) of the vehicle outer face plate 8 of the side structure 2. With this relation between the plate thicknesses, local bend deformation which can occur on the face plate can be suppressed. Thus, the required strength against vertical static or dynamic load can be ensured without increasing the plate thickness of the vehicle outer face plate 8 of the side structure 2, in other words, with little increase in weight of the structure.

[0024] Outer surfaces of the L-shaped fitting 10 and the welded parts 11, 13 for butt welding are coplanar with an outer surface of the vehicle outer face plate 8 of the side structure 2 and an outer surface of the frame 7. Spe-

cifically, by machining the outer surfaces of the welded parts 11, 13 for butt welding, the outer surfaces of the vehicle outer face plate 8 of the side structure 2, the frame 7, and the L-shaped fitting 10 are flush with each other, i.e. coplanar.

[0025] In such a configuration, it is not necessary to extend the vehicle outer face plate 8 of the side structure 2 towards the frame 7 and the vehicle outer face plate 8 and the vehicle inner face plate 9 are firmly attached to each other in the edge of the side structure 2 by coupling via the first joint part 10a, so that deformation in out-of-plane directions with respect to the vehicle outer face plate 8 and the vehicle inner faceplate 9 can be suppressed which can be caused by the vertical load acting around the opening of the entrance 6. In addition, because the second joint part 10b having a large thickness firmly couples the entrance frame 7 and the vehicle outer face plate 8 by welding, the required strength can be ensured around the entrance. Thus, the required strength against the vertical static load or the dynamic load due to vibration or the like can be ensured without increasing the plate thickness of the vehicle outer face plate 8 of the side structure 2, inotherwords, with little increase in weight of the structure.

[0026] Further, because the outer surfaces of the vehicle outer face plate 8 of the side structure 2, the frame 7, the L-shaped fitting 10, and the welded parts 11, 13 for butt welding are coplanar, superior design can be provided without uneven portions on the outer surface of the side structure 2. Moreover, generation of vehicle exterior noise due to the uneven portions on the outer surface of the side structure 2 can thus be prevented.

[0027] The frame 7 is formed by an extruded member (a member extruded in the vertical direction in FIG. 2) or formed by cutting, and corner parts of vertical parts 7a, 7b and a horizontal part 7c of the frame 7 can be integrally formed by welding in FIG. 1. The welding line is oblique to the corner parts. Alternatively, at the corner parts of the vertical parts 7a, 7b and the horizontal part 7c, cut-out parts shaped as third corner parts are placed and coupled to the vertical parts 7a, 7b and the horizontal part 7c by welding.

[0028] Although FIG. 1 also shows the horizontal part 7d of the frame 7 in the lower end of the entrance 6, the lower horizontal part of the frame 7 is eliminated by welding the lower end of the frame to a side beam of the underframe 3.

(Embodiment 2)

[0029] A second embodiment of the present invention will be described with reference to FIG. 4.

[0030] In the second embodiment, the L-shaped fitting 10 in the embodiment in FIG. 2 is composed of a first joint part 10A and a second joint part 10B which are two separate members. In the embodiment in FIG. 4, the first joint part 10A and the second joint part 10B are in the form of plates and it is not necessary to form an L-shaped fitting 10 with cut-out members or extruded members as in FIG. 2. Therefore, the material and processing cost can be reduced. The first joint part 10A and the second joint part 10B are butt welded as shown by a welded part 15 so that they are coupled to form an L-shape in a cross section perpendicular to the opening edge as shown in the figure. Although the plate 10B is welded to the plate 10A here, the plate 10B may be welded to the face plate 8.

(Embodiment 3)

[0031] A third embodiment of the present invention will be described with reference to FIG. 5.

[0032] In the third embodiment, the second joint part 10B in the second embodiment is integrally formed with the frame 7. In other words, the second joint part is provided as a projecting part 7B which projects from the frame 7 towards the side structure 2. The first joint part 10A and the second joint part 7B are welded by a welded part 15 and coupled to form an L-shape in a cross section perpendicular to the opening edge. According to the third embodiment, the L-shaped fitting can be easily formed and the processes of jointing the second joint part 7B can be reduced, in comparison to the first embodiment shown in FIG. 2.

[0033] Although jointing of the plate members has been described as welding in the above described embodiments, friction stir welding may be used instead of welding. Here, jointing means welding or friction stir welding.

Claims

1. A car structure comprising a side structure formed by a hollow member consisting of a vehicle outer face plate, a vehicle inner face plate, and a plurality of ribs coupling both face plates, the side structure comprising an entrance opened therein, in which an entrance frame is fixed to the vehicle outer face plate and the vehicle inner face plate of the hollowmember along an opening edge of the entrance, wherein
the vehicle outer face plate and the vehicle inner face plate are welded by a joint member along the opening edge, and
the joint member consists of a first joint part which couples the vehicle outer face plate and the vehicle inner face plate and a second joint part which couples a part of the first joint part near the vehicle outer face plate and a vehicle outer side of the entrance frame.

2. The car structure according to claim 1, wherein
the first joint part and the second joint part of the joint member are integrally formed and form an L-shape as a whole in a cross section perpendicular to the opening edge.

3. The car structure according to claim 1, wherein

the first joint part and the second joint part of the joint member are separately formed and coupled by welding to form an L-shape in a cross section perpendicular to the opening edge.

4. The car structure according to claim 1, wherein
the first joint part and the second joint part of the joint member are separately formed and the second joint part is a member which is integral with the entrance frame and projects from the entrance frame towards the side structure, and
the first joint part and the second joint part are coupled by welding to form an L-shape in a cross section perpendicular to the opening edge.

5. The car structure according to claim 1, wherein
thickness of the second joint part is larger than thickness of the vehicle outer face plate.

FIG. 1

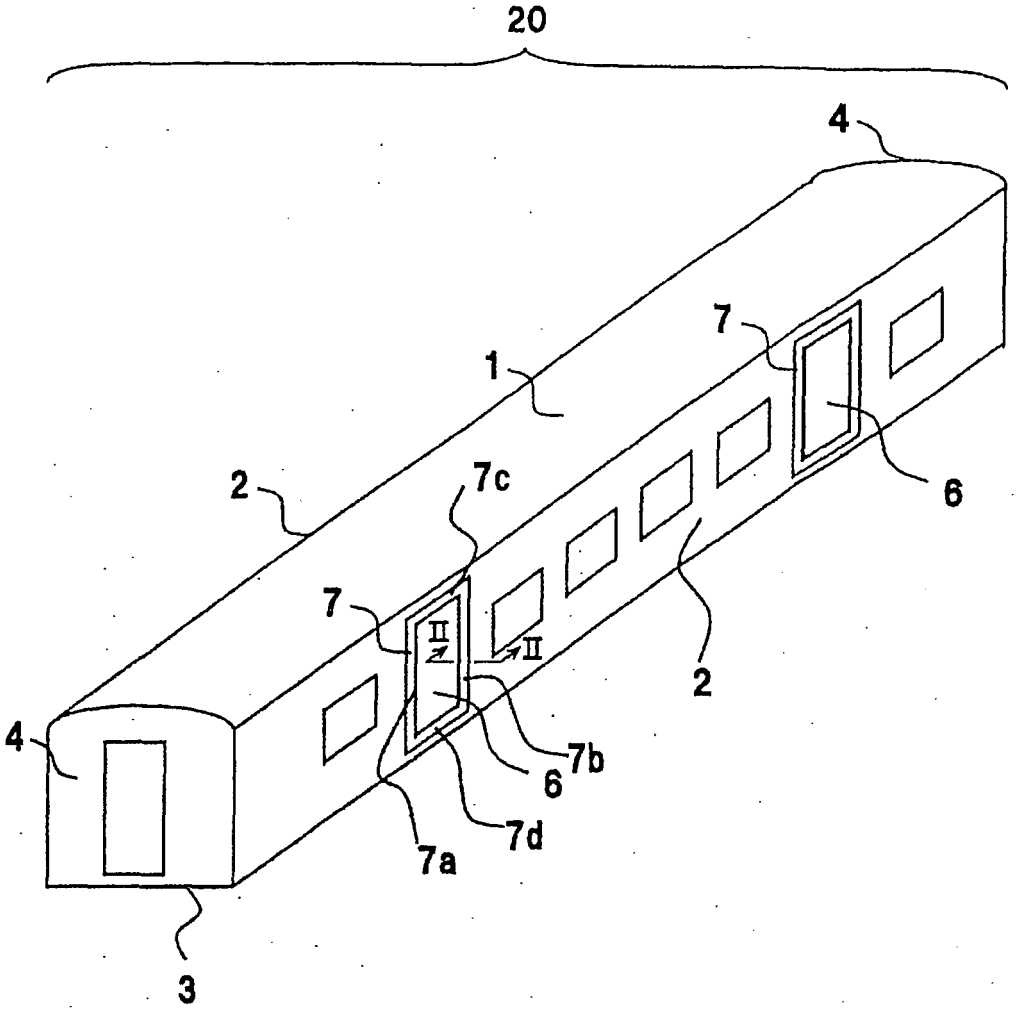


FIG. 2

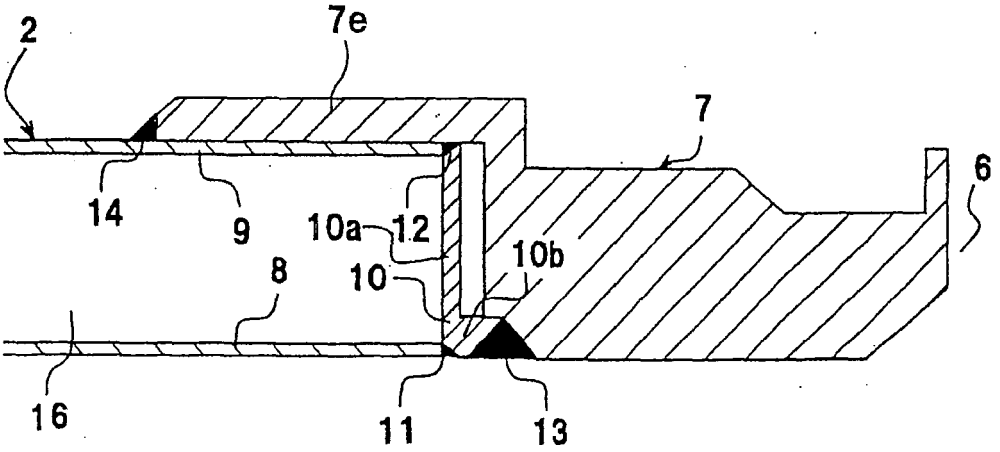


FIG. 3

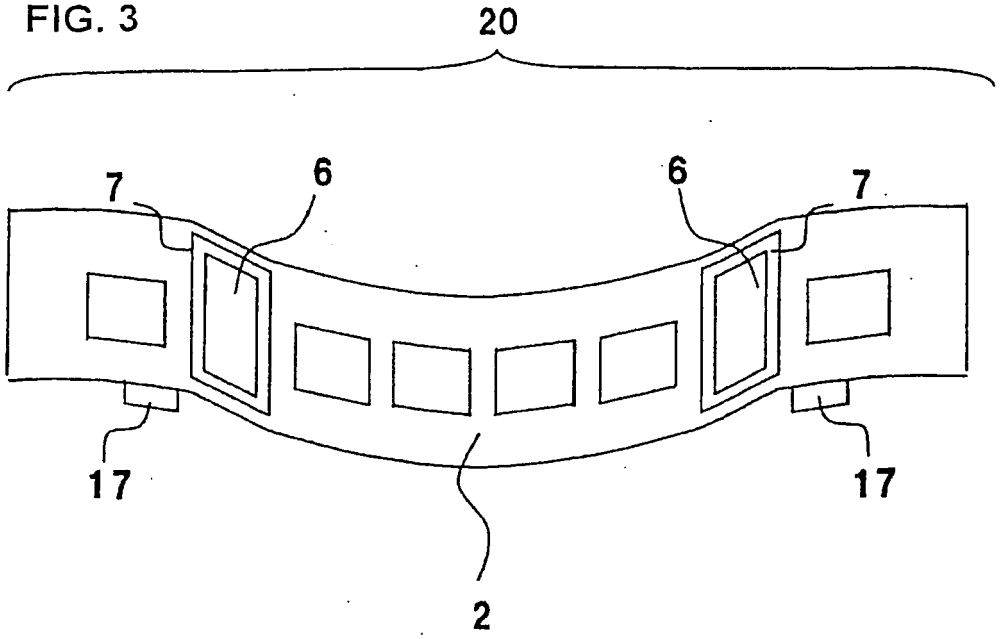


FIG. 4

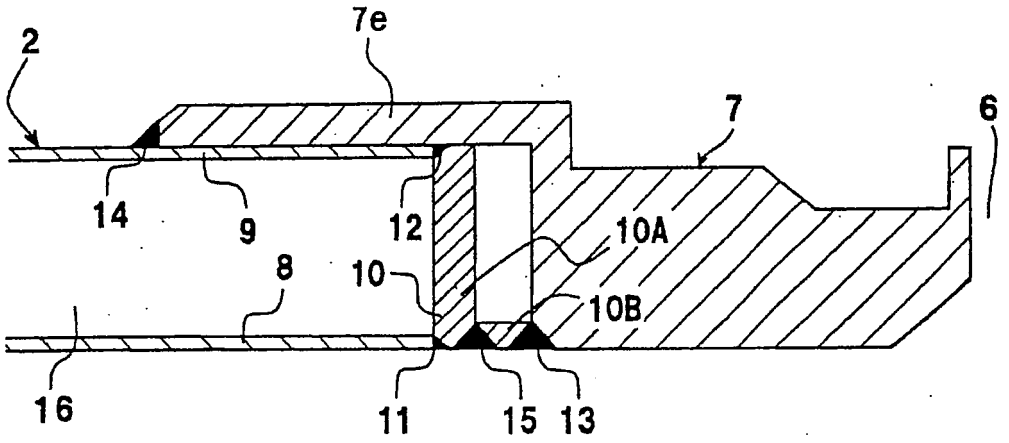
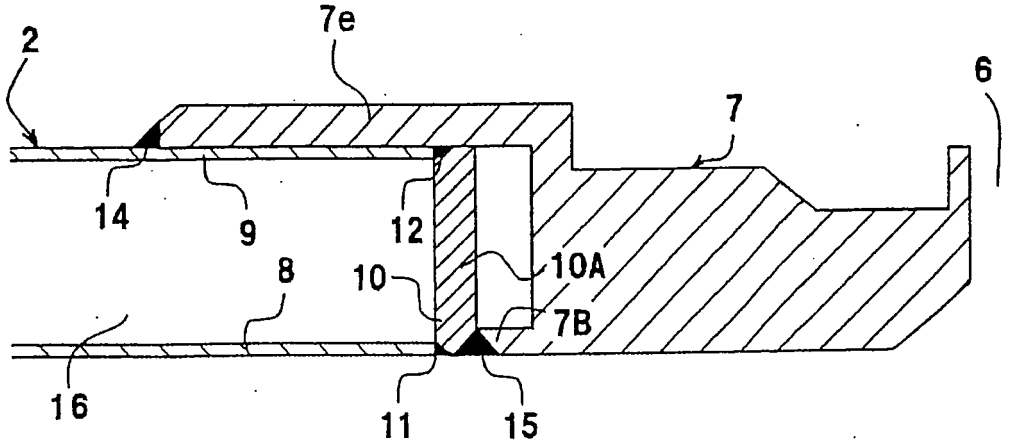


FIG. 5



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 25 0666

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 0 992 314 A (HITACHI LTD [JP]) 12 April 2000 (2000-04-12) * paragraph [0044] - paragraph [0056] * * figures 7-9 *	1,5	INV. B61D17/10 B61D17/08
X	US 5 199 632 A (TAKEICHI MICHIFUMI [US] ET AL) 6 April 1993 (1993-04-06) * abstract; figures 1-18a *	1-5	
A,D	JP 02 246863 A (RAILWAY TECHNICAL RES INST; NIPPON SHARYO SEIZO KK) 2 October 1990 (1990-10-02) * abstract *	1-5	
A,D	JP 2003 062680 A (HITACHI LTD; HITACHI KASADO KIKAI CO LTD) 5 March 2003 (2003-03-05) * abstract *	1-5	
A	EP 0 495 429 A (SUMITOMO LIGHT METAL IND [JP]; HITACHI LTD [JP]) 22 July 1992 (1992-07-22) * abstract; figures 8,9,16,17 *	1-5	

TECHNICAL FIELDS SEARCHED (IPC)

B61D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	23 April 2008	Awad, Philippe

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 07 25 0666

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-04-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0992314 A	12-04-2000	AU 733140 B2	10-05-2001
		AU 5011399 A	13-04-2000
		CN 1483546 A	24-03-2004
		CN 1249979 A	12-04-2000
		CN 1762638 A	26-04-2006
		DE 69933978 T2	14-06-2007
		KR 20000023529 A	25-04-2000
		US 6315187 B1	13-11-2001
US 5199632 A	06-04-1993	NONE	
JP 2246863 A	02-10-1990	JP 2604226 B2	30-04-1997
JP 2003062680 A	05-03-2003	AU 1469802 A	27-02-2003
		CN 1401455 A	12-03-2003
		CN 1636665 A	13-07-2005
		CN 1636666 A	13-07-2005
		DE 60205994 D1	13-10-2005
		DE 60205994 T2	22-06-2006
		EP 1287940 A2	05-03-2003
		ES 2244725 T3	16-12-2005
		JP 3751236 B2	01-03-2006
		KR 20030017301 A	03-03-2003
		TW 557241 B	11-10-2003
		US 2003038159 A1	27-02-2003
EP 0495429 A	22-07-1992	CA 2059243 A1	15-07-1992
		DE 69206427 D1	18-01-1996
		DE 69206427 T2	15-05-1996
		DK 495429 T3	08-01-1996
		US 5353502 A	11-10-1994

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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

- JP 2604226 B **[0003]**
- JP 3751236 B **[0004]**