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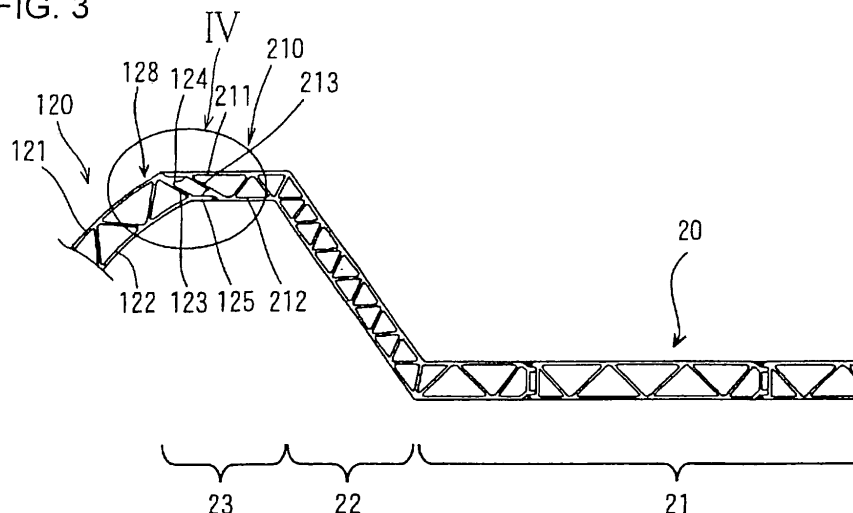
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(54) **Rail vehicle, manufacturing method thereof, and hollow shape member used for the same**

(57) A rail vehicle capable of preventing reduction in strength and noise occurrence in a connecting portion of a low roof construction body to a roof construction or a side construction body, and facilitating mounting of the low roof construction body to the roof construction body or the side construction body, its manufacturing method and a hollow shape member used for the same are provided. In joining a hollow shape member (120) constructing a side construction body and a hollow shape member (210) constructing a low roof construction body (20), an uppermost portion above a spot to be a joint portion of the hollow shape member (120) to the low roof construction body (20) is cut, and a first protruded rib (124) and

a second protruded rib (125) are left at an upper end portion (128) of the hollow shape member (120) toward the low roof construction body (20). Next, the low roof construction body (20) is lowered from above the side construction body (12), the first engaging rib (214) and the second engaging rib (215) of the low roof construction body (20) are mounted on the first protruded rib (124) and the second protruded rib (125), and butted portions (220 and 221) are welded from a vehicle outer side or a vehicle inner side. Occurrence of a level difference of the welding spot which becomes a noise generation source can be prevented, and manufacture of the vehicle body can be facilitated.

FIG. 3



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a railroad vehicle, a vehicle traveling on a monorail track, namely, a rail vehicle, manufacturing method thereof and a hollow material used for the same.

Description of the Related Art

[0002] A rail vehicle is generally constructed by a rail vehicle construction body including a roof construction body constructing a top surface of a vehicle body, side construction bodies constructing side surfaces, a base frame constructing a bottom surface, and end construction bodies constructing end surfaces. In recent years, with reduction in weight and enhancement in manufacturability as the main purpose, each of the roof construction body, the side construction bodies and the base frame which construct the rail vehicle construction body is formed by joining a hollow extruded shape member of an aluminum alloy formed by two face plates and a plurality of connecting ribs connecting the face plates. For the end construction body, a ribbed extruded shape member made of an aluminum alloy is used. The structure of each of the construction bodies is shown in, for example, Japanese Patent Publication No. 2604226 (Patent Document 1).

[0003] In a rail vehicle, a current collector (pantograph) and an air conditioning device (air conditioner) are installed on a top surface of a roof construction body for the purpose of securing power and comfortability. The installation spots of the roof construction body for such devices have a low roof structure (hereinafter, called "low roof construction body") as compared with the other region of the vehicle construction body (hereinafter, called "general construction body") to avoid contact of the devices and an aerial line, except for the current collector of a pantograph.

[0004] The low roof construction body is usually manufactured separately from the general construction body, and is joined to the general construction body which is provided with a large opening on the top surface by cutting a hollow extruded shape member constructing the roof construction body or the side construction bodies in such a manner as to be fitted into the opening. The low roof construction body is constructed of a plate material and a hollow extruded shape member in accordance with the required conditions such as strength and mass. Here, in order to facilitate understanding, a method of joining the low roof construction body constructed of a plate material to the general construction body will be described.

[0005] The case where the low roof construction body is mounted from above for the purpose of simplification of manufacture of a vehicle body is assumed. In this case,

an end portion of the plate material constructing the low roof construction body is fillet-welded to the surface of the face plate at the vehicle outer side of the hollow extruded shape member constructing the roof construction body or the side construction body. Therefore, a level difference occurs to the welded portion, which may cause reduction in strength of the vehicle body, or cause a noise from the level difference portion.

[0006] On the other hand, the case where the low roof construction body is mounted from below is assumed in order to avoid these problems. In this case, by providing a level difference of a height equivalent to the plate thickness of the face plate of the vehicle outer side of the hollow extruded shape member constructing the roof construction body or the side construction body at an end portion of the plate material constructing the low roof construction body, butt joint of the general construction body and the low roof construction body becomes possible. However, in mounting the low roof construction body from below, it is necessary to mount the low roof construction body from inside of the general construction body, which makes production of the vehicle body difficult.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to prevent reduction in strength and noise occurrence in a connecting portion of a low roof construction body to a roof construction body or a side construction body, and to facilitate mounting of the low roof construction body to the roof construction body or the side construction body.

[0008] In order to attain the above-described object, according to a rail vehicle of the invention, in a rail vehicle construction body in which a roof construction body providing a top surface of a vehicle body and a side construction body providing a side surface of the vehicle body each comprise a hollow shape member formed by two face plates and a plurality of ribs connecting the face plates, a low roof construction body loaded with an on roof apparatus is joined at both its end portions in its vehicle width direction, to an upper end portion of the side construction body, in joint portions of the side construction body and the low roof construction body, the low roof construction body is mounted on the side construction body by engaging portions formed at both end portions in the vehicle width direction being mounted on mounting portions formed on the upper end portion of the side construction body, and a vehicle outer side face plate and a vehicle inner side face plate of a first hollow shape member constructing the side construction body are respectively welded to a vehicle outer side face plate and a vehicle inner side face plate of a second hollow shape member respectively constructing the low roof construction body.

[0009] A manufacturing method of a rail vehicle according to the invention is a manufacturing method of a rail vehicle construction body in which a roof construction body providing a top surface of a vehicle body and a side

construction body providing a side surface of the vehicle body each comprise a hollow shape member formed by two face plates and a plurality of connecting ribs connecting the face plates, comprising the steps of by cutting off an upper end portion corresponding to an on roof apparatus to be loaded on the vehicle with the roof construction body out of a first hollow shape member constituted of a vehicle outer side face plate and a vehicle inner side face plate and the connecting ribs connecting both the face plates and constructing the side construction body, exposing mounting portions in cutoff portions which appear, by lowering a low roof construction body loaded with the on roof apparatus from above, and mounting engaging portions formed at both end portions in its vehicle width direction on the mounting portions appearing in the cutoff portions of the side construction body, joining the low roof construction body to the upper end portion of the side construction body, and further welding the vehicle outer side face plate and the vehicle inner side face plate of the first hollow shape member are welded to a vehicle outer side face plate and a vehicle inner side face plate of a second hollow shape member respectively constructing the low roof construction body.

[0010] Further, a hollow shape member according to the invention is a hollow shape member formed by two face plates, and a plurality of connecting ribs connecting both the face plates, and including a first protruded rib formed to protrude toward a hollow portion of the hollow shape member from a joint spot of one of the face plates and the connecting rib, and a second protruded rib formed to protrude toward outside from a joint spot of the other face plate and the connecting rib.

[0011] According to the rail vehicle and its manufacturing method which are the present invention, in the rail vehicle construction body of the rail vehicle, the roof construction body constructing the top surface of the vehicle body and the side construction body constructing the side surface of the vehicle body are each constructed by the hollow shape member formed by two face plates and a plurality of ribs connecting the face plates. By lowering the low roof construction body loaded with the on roof apparatus from above, the engaging portions formed at both end portions in the vehicle width direction of the low roof construction body are mounted on the mounting portions formed at the upper end portion of the side construction body, and thereby, the low roof construction body is mounted on the side construction body. The side construction body and the low roof construction body are welded at the welded part where the engaging portions are mounted on the mounting portions. Accordingly, a special complicated operation is not required for mounting both of them, and the side construction body and the low roof construction body can be fixed by performing welding to the vehicle outer side face plate and the vehicle inner side face plate from the surface side at both the vehicle outer side and the vehicle inner side in the obtained joint state.

[0012] According to the hollow shape member of the

invention, when it is applied as the side construction body, the spot which becomes the upper end portion of the side construction body is matched with the spot where the protruded rib is formed, and the hollow shape member is cut off at the spot, whereby the first protruded rib protruding toward the hollow portion of the hollow shape member from the joint spot of one of the face plates and the connecting rib can be exposed to the surface. By mounting the respective engaging portions of the low roof construction body onto the first protruded rib and the second protruded rib protruding toward outside from the joint spot of the other face plate and the connecting rib, the low roof construction body can be joined to the upper end portion of the side construction body.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is a perspective view of a railroad vehicle construction body being one embodiment of a rail vehicle according to the present invention;

FIG. 2 is a view showing a part of the II-II section of the rail vehicle shown in FIG. 1;

FIG. 3 is a view showing a part of the III-III section of the rail vehicle shown in FIG. 1;

FIG. 4 is an enlarged sectional view of a part of IV in FIG. 1; and

FIG. 5 is a view showing one example of connection in the longitudinal direction of a low roof construction body and a roof construction body of the rail vehicle shown in FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] One embodiment of the present invention will be described with reference to FIGS. 1 to 5. FIG. 1 is a perspective view showing one embodiment of a rail vehicle according to the invention. As shown in FIG. 1, a rail vehicle construction body 1 is constructed by a general construction body 10 and a low roof construction body 20 for loading apparatuses. The ordinary construction body 10 is constructed by a roof construction body 11 constructing a top surface, two side construction bodies 12 and 12 constructing side surfaces, a base frame 13 constructing a bottom surface, and two end construction bodies 14 and 14 constructing end surfaces. The roof construction body 11, the side construction bodies 12 and 12, the base frame 13, the end construction bodies 14 and 14 and the low roof construction body 20 are constructed by joining a plurality of extruded shape members, respectively.

[0015] The extruded shape members constructing the roof construction body 11, the side construction bodies 12 and 12, the base frame 13 and the low roof construction body 20 are hollow shape members made of an aluminum alloy, and the extruding direction coincides with

the longitudinal direction of the rail vehicle construction body 1. The longitudinal direction is the fore-and-aft direction of the vehicle, and the traveling direction of the vehicle. The extruding shape members constructing the end construction bodies 14 and 14 are ribbed shape members made of an aluminum alloy, and the extruding direction is in the vertical direction of the rail vehicle construction body 1.

[0016] FIG. 2 is a view showing a part of the II-II section of the rail vehicle shown in FIG. 1. As shown in FIG. 2, an uppermost portion 129 of the side construction body 12 is welded to the roof construction body 11 at a welded part 30. The uppermost portion 129 of the side construction body 12 becomes flat so as to connect to the roof construction body 11 smoothly continuously. The roof construction body 11 and the side construction body 12 have the face plates at the vehicle outer side and the vehicle inner side butted to each other, and upper and lower (vehicle inner and outer) face plates of the roof construction body 11 and vehicle inner and outer face plates (a face plate 121 at the vehicle outer side and a face plate 122 at the vehicle inner side) of the side construction body 12 are welded so that the surfaces of the face plates of the roof construction body 11 and the side construction body 12 are flush with each other in the butted portions, and are joined as the welded part 30. The welded part 30 is formed by welding, but may be formed by the other joint means, for example, joint by, friction stir welding. In FIG. 2, the structures other than the uppermost portion 129 of the side construction body 12 are previously included for joint with the low roof construction body 20 which will be described later, and is not used for joint with the roof construction body 11.

[0017] Each of the roof construction body 11 and the side construction body 12 is made by joining a plurality of hollow extruded shape members to one body by welding or friction stir welding.

[0018] Next, joint of the side construction body 12 and the low roof construction body 20 will be described. FIG. 3 is a view showing a part of the III-III section of the rail vehicle shown in FIG. 1. FIG. 4 is an enlarged view of a part shown by IV in FIG. 3. As shown in FIG. 3, the low roof construction body 20 is made by joining a plurality of hollow extruded shape members to be one body by welding or friction stir welding.

[0019] The low roof construction body 20 is constructed by a flat part 21, a raised part 22 raised to be joined to the side construction body 12 at both sides of the width direction of the flat part 21, and a protruded part 23 that flatly protrudes toward the joint portion with the side construction body 12 from the raised part 22. The protruded part 23 becomes the end portion in the vehicle width direction, and is joined by butting to an upper end portion 128 of the side construction body 12.

[0020] Explaining the joint portion of the side construction body 12 and the low roof construction body 20 in detail, the extruded shape member of the side construction body 12 is cut at the portion to be joined to the low

roof construction body 20, and the uppermost portion 129 at the upper end side from the cut portion is removed, as can be understood by comparison with FIG. 2. The protruded part 23 of the low roof construction body 20 is joined to the spot exposed at the upper end portion 128 by cutoff to be joint portions, and the joint portions are finally bonded by welding as will be described in detail later.

[0021] As shown in FIGS. 2 to 4, in the hollow shape member 120 prepared for constructing the side construction body 12, a first protruded rib 124 and a second protruded rib 125 are formed at spots to be joined to the protruded part 23 of the low roof construction body 20 before cutoff of the uppermost portion 129. The first protruded rib 124 is formed to be protruded toward a hollow portion 126 in the hollow shape member 120 from the portion in the vicinity of the joint spot of an outer surface side face plate 121 and a connecting rib 123 for connecting the outer surface side face plate 121 and a vehicle inner side face plate 122. The protruding direction of the first protruded rib 124 is the direction which is the horizontal direction in the state where the hollow shape member 120 is vertically provided as the side construction body 12. The connecting rib 123 is formed in the hollow portion 126 of the hollow shape member 120. Protruding toward the hollow portion 126 means protruding in the horizontal direction when the uppermost portion 129 of the side construction body 12 is cut off to be exposed to the front to construct the vehicle body.

[0022] A second protruded rib 125 is formed to protrude toward an inside of a vehicle compartment from a joint spot of the vehicle inner side face plate 122 of the side construction body 12 and the connecting rib 123. The protruding direction of the second protruded rib 125 is the horizontal direction in the same meaning as in the case of the first protruded rib 124. The reason why the second protruded rib 125 protrudes to the inside of the vehicle compartment instead of the inside of the hollow portion 126 is that the corresponding portion of the hollow shape member 120 is in an arc shape. The first and the second protruded ribs 124 and 125 of the side construction body 12 do not play any role when joined to the roof construction body 11. The first and the second protruded ribs 124 and 125 function as mounting portions only when the side construction body 12 is joined to the low roof construction body 20. When the low roof construction body 20 is joined to the side construction body 12, in the upper end portion 128 of the first hollow shape member 120 constituting the side construction body 12, the vehicle outer side face plate 121 and the vehicle inner side face plate 122 are cut at both the protruded ribs 124 and 125 and removed. The remaining hollow shape member 120 is integrally joined as the side construction body 12.

[0023] Next, the low roof construction body 20 is joined to the hollow shape member 120 from which the face plates 121 and 122 at the upper end side are cut. On the occasion of the joint, a plurality of hollow shape members constructing the low roof construction body 20 are joined

to be already an integrated hollow shape member 210. Engaging portions protruding in the direction to be horizontal toward the upper end portion 128 of the first hollow shape member 120 in the joined state to the low roof construction body 20 are formed at end portions in the vehicle width direction of the protruded part 23 of the low roof construction body 20. The engaging portions are engaging ribs 214 and 215 which are respectively formed corresponding to the first and the second protruded ribs 124 and 125 that are the mounting portions. The joint portions are provided as two sets of joint portions distantly placed at the vehicle inner and outer sides. Namely, the engaging rib 214 and the protruded rib 124 construct a set of joint portions at the vehicle outer side, and the engaging rib 215 and the protruded rib 125 construct a set of joint portions at the vehicle inner side.

[0024] The set of joint portions at the vehicle outer side are disposed at the outer side in the vehicle width direction from the set of the joint portions at the vehicle inner side. Namely, the first protruded rib 124 is at the outer side in the vehicle width direction from the second protruded rib 125, and the first protruded rib 124 is at the outer side in the vehicle width direction from the second engaging rib 215. The first engaging rib 214 is at the outer side in the vehicle width direction from the second engaging rib 215. By such disposition, on the occasion of lowering the low roof construction body 20, it does not interfere with the sets of joint portions at the vehicle inner side and outer side.

[0025] When the low roof construction body 20 is lowered from above, the first engaging rib 214 and the second engaging rib 215 of the low roof construction body 20 are placed to be overlaid on the top surface of the first projected rib 124 of the hollow shape member 120 constructing the side construction body 12 and on the top surface of the second protruded rib 125, respectively. The first protruded rib 124 and the second engaging rib 215 define a hollow portion 127 formed in the joint portions with the connecting ribs 123 and 213.

[0026] The first protruded rib 124 is formed to protrude in a position recessed by a predetermined depth from a surface of the vehicle outer side face plate 211 of the first hollow shape member 120. The predetermined depth is specifically the dimension corresponding to the thickness of the first engaging rib 214. Accordingly, the first protruded rib 124 is protruded from the position recessed by the amount corresponding to the thickness of the first engaging rib 214 from the surface of the vehicle outer side face plate 121 of the first hollow shape member 120. The second engaging rib 215 is formed to protrude in the position raised by a predetermined height from the vehicle inner side surface of the second hollow shape member 210. The predetermined height is specifically the dimension corresponding to the thickness of the second protruded rib 125. Accordingly, the second engaging rib 215 is formed to protrude in the position raised from the position recessed by the amount corresponding to the thickness of the second protruded rib 125, from the sur-

face of the vehicle inner side face plate 212 of the second hollow shape member 210.

[0027] By setting the above described dimension in each set of joint portions at the vehicle inner side and outer side, the surfaces at the joint portions at the inner side and outer side of the vehicle become smooth, and occurrence of a level difference can be avoided. When the low roof construction body 20 is overlaid on the hollow shape member 120 of the side construction body 12, the surfaces of the face plate 121, the first engaging rib 214 and the face plate 211 become continuous without forming a level difference at the vehicle outer side. At the vehicle inner side, the surfaces of the face plate 122, the second protruded rib 125 and the face plate 212 also become continuous without forming a level difference. In this explanation, the continuous surface without generating a level difference is called the coplanarity.

[0028] In each set of joint portions at the vehicle inner and outer sides, the butted portions of the overlaid first protruded rib 124 and the first engaging rib 214, and the second protruded rib 125 and second engaging rib 215, are joined by welding or friction stir welding. A butted portion 220 occurring to the set at the vehicle outer side is formed between the connecting portion of the vehicle outer side face plate 121 of the first hollow shape member 120 and the connecting rib 123, and the tip end portion of the first engaging rib 214 at the side of the second hollow shape member 210. The butted portion 220 occurring to the set at the vehicle inner side is formed between the tip end portion of the second protruded rib 125 at the side of the first hollow shape member 120 and the connecting portion of the vehicle inner side face plate 212 at the side of the second hollow shape member 210 and the connecting rib 213.

[0029] Welding of the butted portion 220 at the vehicle outer side can be performed from the vehicle outer side. The butted portion 220 has a groove. The groove is filled with a welding bead 222. The welding bead 222 may be protruded slightly upward from the face plate 211. Welding of a butted portion 221 at the vehicle inner side can be performed from the vehicle inner side. A groove present in the butted portion 221 is filled with a welding bead 223. The welding bead 223 may be protruded from the face plate 212 or the second protruded rib 125.

[0030] The first protruded rib 124 and the second engaging rib 215 become backings on the occasion of welding in the butted portions 220 and 221, respectively.

[0031] As for welding of the butted portions 220 and 221, when the grooves of the butted portions are large, the first protruded rib 124 and the second protruded rib 125 may be fillet-welded.

[0032] In FIG. 4, the first engaging rib 214 of the hollow shape member 210 constructing the low roof structure 20 is thicker than the face plate 211 at the other spots. The first engaging rib 214 is the vehicle outer side end portion of the projected part 23, but is not the vehicle outer side face plate 211 itself, and therefore, can be called a rib. The first engaging rib 214 is protruded from

the rib 213 which connects the face plate 211 and the face plate 212.

[0033] In the hollow shape member 120 constructing the side construction body 12, the protruded ribs 124 and 125 can be said to protrude from the vicinity of the intersection points of connection of the connecting rib 123 and the face plates 121 and 122. In the hollow shape member 210, the engaging ribs 214 and 215 can be also said to protrude from the vicinity of the intersection points of the connecting portions of the face plates 211 and 212 and the connecting rib 213.

[0034] According to this, by inserting the low roof construction body 20 downward from above, the low roof construction body 20 is supported with the side construction body 12, and therefore, the mounting operation can be easily performed.

[0035] The welding beads 222 and 223 are practically in the same planes as the face plates 211 and 212 in the hollow shape member 210, and therefore, they do not become the noise generating sources.

[0036] In the above described embodiment, the protruded ribs 124 and 125 are previously provided at the first hollow shape member 120 constructing the side construction body 12, and are exposed by deleting the face plates 121 and 122, and therefore, the first hollow shape member 120 becomes large in weight. In order to prevent this, it is suitable to provide the protruded ribs 124 and 125 at only the hollow shape member 120 at the position where the low roof construction body 20 is connected without providing the protruded ribs at the first hollow shape member 120 at the position where the low roof construction body 20 is not connected at the side construction body 12. The first hollow shape member 120 with the protruded ribs 124 and 125 and the hollow shape member 120 without the protruded ribs 124 and 125 are welded at the butted portions at the end portions in the longitudinal direction. Since the butted portions are welded, the welding beads protrude, which becomes the factor of noise generation. In order to prevent this, the welding beads are cut and removed.

[0037] Next, connection in the longitudinal direction of the low roof construction body 20 and the roof construction body 11 will be described based on FIG. 5. Since a space occurs between both of them, the space is bridged by a connecting plate 40. The connecting plate 40 is constructed by a hollow shape member. End portions of the hollow shape member of the connecting plate 40 are butt-welded to end portions in the longitudinal direction of the roof construction body 11 and the low roof construction body 20. An end portion (upper end) in the longitudinal direction of the connecting plate 40 is along the shape in the width direction of the roof construction body 11. The other end portion (lower end) in the longitudinal direction of the connecting plate 40 is along the shape of an end portion in the longitudinal direction of the low roof construction body 20. The upper end of the connecting plate 40 is orthogonal to a vehicle outer side face plate 141 of a hollow shape member 140 of the roof construction body

11. A vehicle inner side face plate 142 and the rib are removed. The face of the connecting plate 40 at the low roof construction body 20 side and the vehicle outer side face plate 141 are fillet-welded to a rib 48.

[0038] Connection of the connecting plate 40 and the hollow shape member 210 of the low roof structure 20 is the same. However, the connecting plate 40 is connected to the vehicle inner side face plate 212 of the low roof construction body 20. A rib 49 is welded between the vehicle inner side face plate 212 and the connecting plate 40. In FIG. 5, the connecting plate 40 is constructed by a hollow shape member, but its rib is not shown.

[0039] In the above embodiment, the low roof construction body 20 is described as the hollow shape member 210, but it may be constructed by a flat plate instead of the hollow shape member 210.

Claims

1. A rail vehicle in a rail vehicle construction body in which a roof construction body constructing a top surface of a vehicle body and a side construction body constructing a side surface of the vehicle body are each constructed by a hollow shape member formed by two face plates and a plurality of ribs connecting the face plates, wherein a low roof construction body loaded with an on roof apparatus is joined at both its end portions in its vehicle width direction, to an upper end portion of the side construction body; wherein in joint portions of the side construction body and the low roof construction body, the low roof construction body is mounted on the side construction body by engaging portions formed at both end portions in the vehicle width direction being mounted on mounting portions formed on the upper end portion of the side construction body; and wherein the joint portions are welded in a state in which the engaging portions are mounted on the mounting portions.
2. The rail vehicle according to claim 1, wherein the engaging portions are engaging ribs formed to protrude toward the upper end portion of the side construction body; and wherein the mounting portions formed at the upper end portion of the side construction body are protruded ribs that are respectively formed to protrude toward both end portions in the vehicle width direction of the low roof construction body, and have upper surfaces made mounting surfaces on which the engaging ribs are mounted.
3. The rail vehicle according to claim 1, wherein the engaging portions are engaging ribs formed to protrude toward the upper end portion of the side construction body;

wherein the mounting portions formed at the upper end portion of the side construction body are protruded ribs that are respectively formed to protrude toward both end portions in the vehicle width direction of the low roof construction body, and have upper surfaces made mounting surfaces on which the engaging ribs are mounted;
 wherein the engaging ribs and the protruded ribs are provided as two joint sets distantly placed at the vehicle outer side and the vehicle inner side in the respective joint portions; and
 wherein the joint set located at the vehicle outer side is disposed at an outer side in the vehicle width direction at a distance which makes it possible to avoid interference with the joint set at the vehicle inner side on an occasion of mounting the low roof construction body on the side construction body.

4. The rail vehicle according to claim 1,
 wherein the engaging portions are engaging ribs formed to protrude toward the upper end portion of the side construction body;
 wherein the mounting portions formed at the upper end portion of the side construction body are protruded ribs that are respectively formed to protrude toward both end portions in the vehicle width direction of the low roof construction body, and have upper surfaces made mounting surfaces on which the engaging ribs are mounted;
 wherein the engaging ribs and the protruded ribs are provided as two joint sets distantly placed at the vehicle outer side and the vehicle inner side in the respective joint portions;
 wherein the joint set located at the vehicle outer side is disposed at an outer side in the vehicle width direction at a distance which makes it possible to avoid interference with the joint set at the vehicle inner side on an occasion of mounting the low roof construction body on the side construction body;
 wherein the joint set at the vehicle outer side is constructed by a first protruded rib protruded in a position recessed by a predetermined depth from a vehicle outer side surface of the side construction body, and a first engaging rib which is formed to extend with a thickness corresponding to the predetermined depth from the face plate at the vehicle outer side, of the low roof construction body and is mountable on the first protruded rib; and
 wherein the joint set at the vehicle inner side is constructed by a second protruded rib which protrudes by extending from the face plate at the vehicle inner side of the side construction body, and a second engaging rib which is formed in a position raised by a height corresponding to a thickness of the second protruded rib from a vehicle inner side surface of the low roof construction body, and is mountable on the second protruded rib.

5. The rail vehicle according to claim 1,
 wherein the engaging portions are engaging ribs formed to protrude toward the upper end portion of the side construction body;
 wherein the mounting portions formed at the upper end portion of the side construction body are protruded ribs that are respectively formed to protrude toward both end portions in the vehicle width direction of the low roof construction body, and have upper surfaces made mounting surfaces on which the engaging ribs are mounted;
 wherein the engaging ribs and the protruded ribs are provided as two joint sets distantly placed at the vehicle outer side and the vehicle inner side in the respective joint portions;
 wherein the joint set located at the vehicle outer side is disposed at an outer side in the vehicle width direction at a distance which makes it possible to avoid interference with the joint set at the vehicle inner side on an occasion of mounting the low roof construction body on the side construction body;
 wherein the joint set at the vehicle outer side is constructed by a first protruded rib protruded in a position recessed by a predetermined depth from a vehicle outer side surface of the side construction body, and a first engaging rib which is formed to extend with a thickness corresponding to the predetermined depth from the face plate at the vehicle outer side of the low roof construction body and is mountable on the first protruded rib;
 wherein the joint set at the vehicle inner side is constructed by a second protruded rib which protrudes by extending from the face plate at the vehicle inner side of the side construction body, and a second engaging rib which is formed in a position raised by a height corresponding to a thickness of the second protruded rib from a vehicle inner side surface of the low roof construction body, and is mountable on the second protruded rib;
 wherein in the joint set at the vehicle outer side, the face plate of the side construction body at the vehicle outer side and the first engaging rib of the low roof construction body are welded from the vehicle outer side; and
 wherein in the joint set at the vehicle inner side, the second protruded rib of the side construction body and the vehicle inner side face plate of the low roof construction body are welded from the vehicle inner side.
6. The rail vehicle according to claim 1,
 wherein the mounting portion is also formed at the side construction body at a position where the low roof construction body is not provided.
7. The rail vehicle according to claim 1,
 wherein an end portion in a longitudinal direction of the roof construction body and the low roof construction

tion body are connected via a connecting plate; and wherein the connecting plate is fillet-welded to a vehicle outer side face plate of a hollow shape member constructing the roof construction body, and the vehicle inner side face plate, which is at the roof construction body side and constructs the low roof construction body.

8. A manufacturing method of a rail vehicle in a manufacturing method of a rail vehicle construction body in which a roof construction body constructing a top surface of a vehicle body and a side construction body constructing a side surface of the vehicle body are each constructed by a hollow shape member formed by two face plates and a plurality of connecting ribs connecting the face plates, comprising the steps of:

by cutting off an upper end portion corresponding to an on roof apparatus to be loaded on the vehicle with the roof construction body out of the hollow shape member constituted of a vehicle outer side face plate and a vehicle inner side face plate and the connecting ribs connecting both the face plates and constructing the side construction body, exposing mounting portions in cutoff portions which appear;

by lowering a low roof construction body loaded with the on roof apparatus from above, and mounting engaging portions formed at both end portions in its vehicle width direction on the mounting portions appearing in the cutoff portions of the side construction body, joining the low roof construction body to the upper end portion of the side construction body; and welding the joint portion in a state in which the engaging portions are mounted on the mounting portions.

9. The manufacturing method of a rail vehicle according to claim 8, wherein the mounting portions are a first protruded rib protruding in a horizontal direction from a vicinity of an intersection point of the connecting rib and the vehicle outer side face plate, and a second protruded rib protruding in a horizontal direction from an intersection point of the vehicle inner side face plate and the connecting rib; and wherein the engaging portions are a first engaging rib formed from the face plate at a vehicle outer side of the low roof construction body as its extension and mountable on the first protruded rib, and a second engaging rib formed in a position raised from a vehicle inner side surface of the low roof construction body by a height corresponding to a thickness of the face plate at a vehicle inner side of the side construction body and mountable on the second protruded rib.

10. The manufacturing method of a rail vehicle according to claim 8,

wherein the mounting portions are a first protruded rib protruding in a horizontal direction from a vicinity of an intersection point of the connecting rib and the vehicle outer side face plate, and a second protruded rib protruding in a horizontal direction from an intersection point of the vehicle inner side face plate and the connecting rib;

wherein the engaging portions are a first engaging rib formed from the face plate at a vehicle outer side of the low roof construction body as its extension and mountable on the first protruded rib, and a second engaging rib formed in a position raised from a vehicle inner side surface of the low roof construction body by a height corresponding to a thickness of the face plate at a vehicle inner side of the side construction body and mountable on the second protruded rib;

wherein in a joint portion where the low roof construction body is joined to the upper end portion of the side construction body, the face plate at the vehicle outer side of the side construction body and the first engaging rib of the low roof construction body are welded from a vehicle outer side; and wherein the second protruded rib of the side construction body and the face plate at a vehicle inner side of the low roof construction body are welded from the vehicle inner side.

11. A hollow shape member comprising two face plates, and a plurality of connecting ribs connecting both the face plates, comprising:

a first protruded rib formed to protrude toward a hollow portion of the hollow shape member from a joint spot of one of the face plates and the connecting rib; and

a second protruded rib formed to protrude toward outside from a joint spot of the other face plate and the connecting rib.

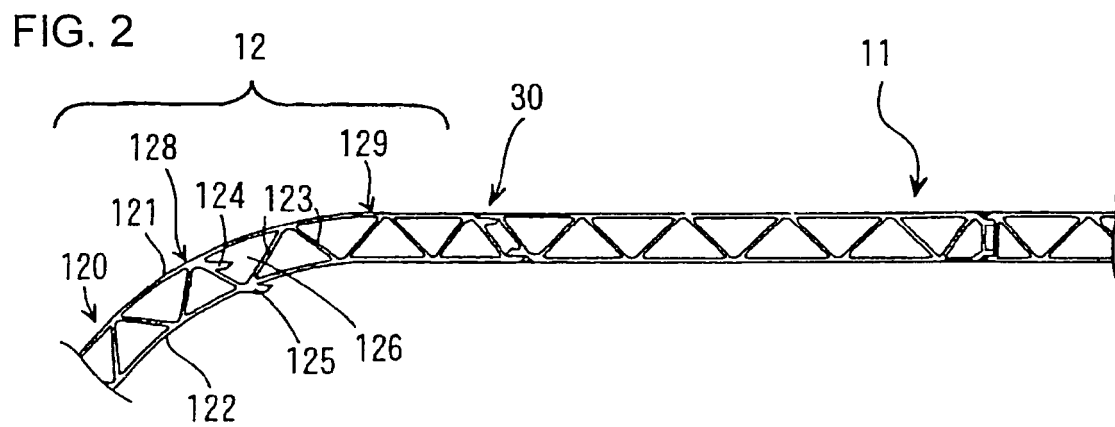
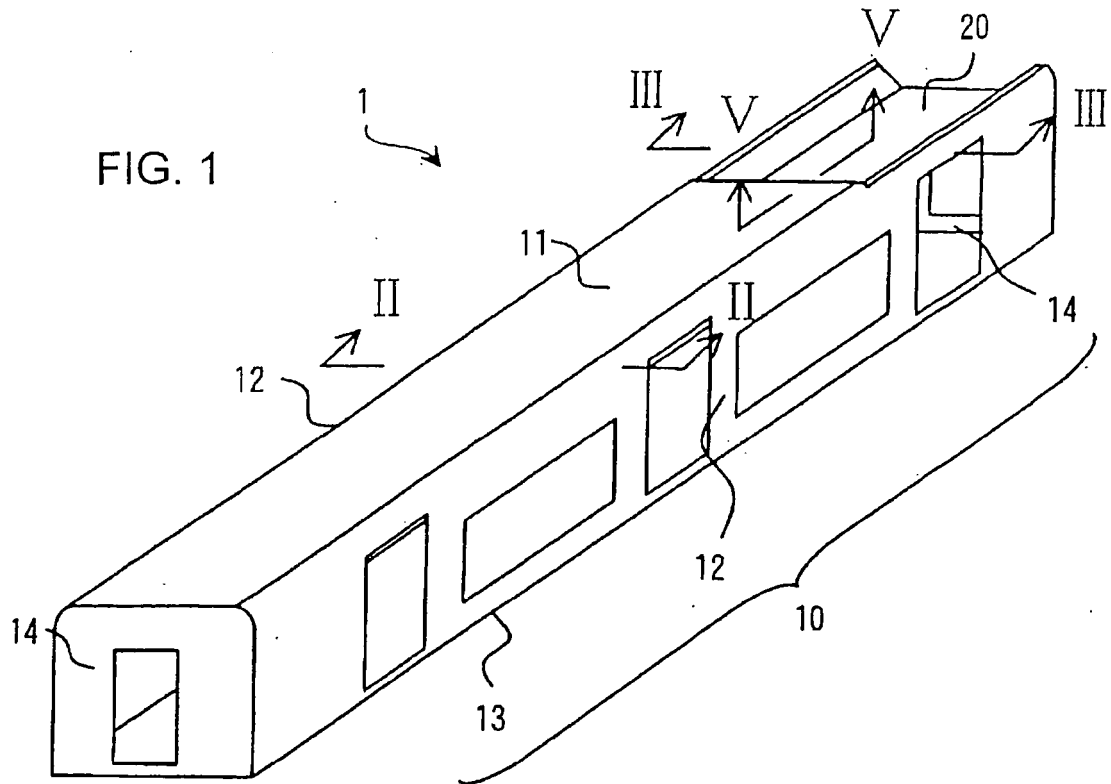


FIG. 3

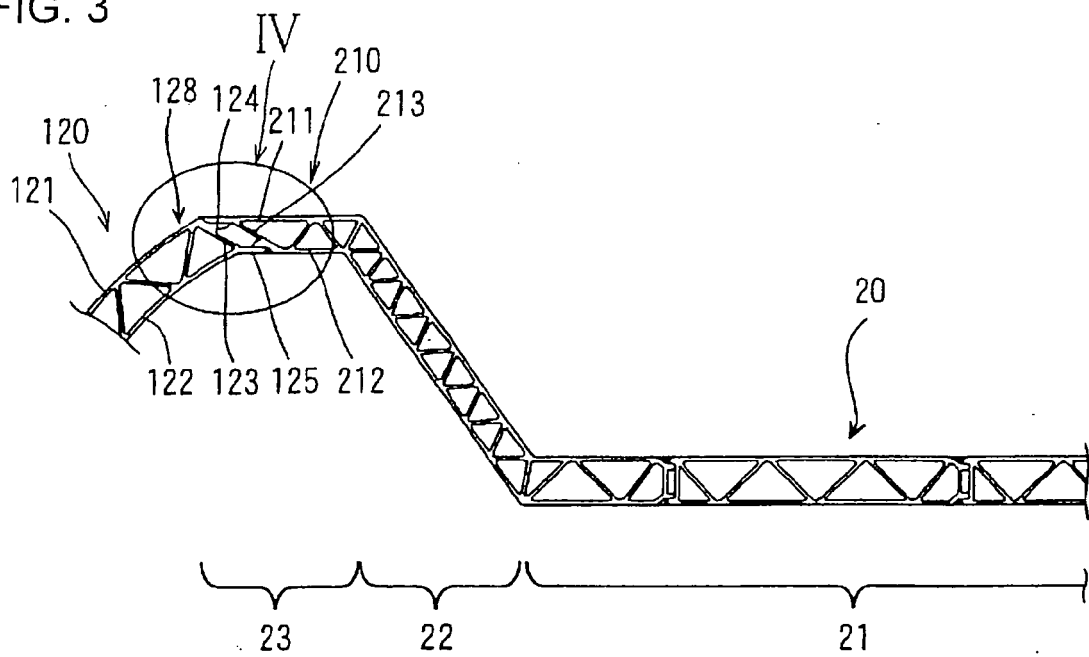


FIG. 4

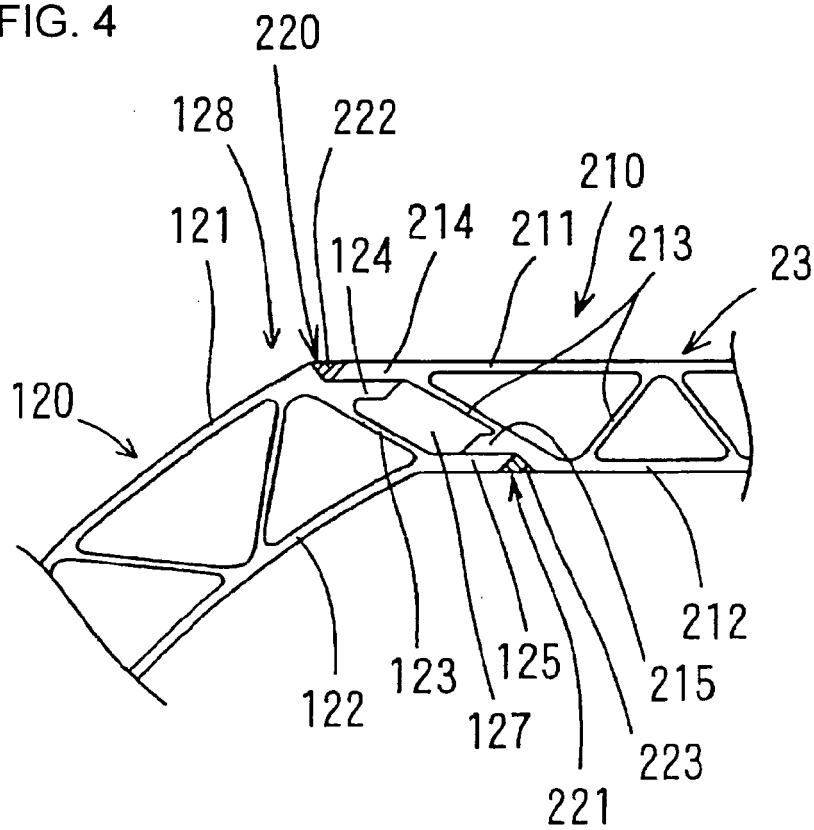
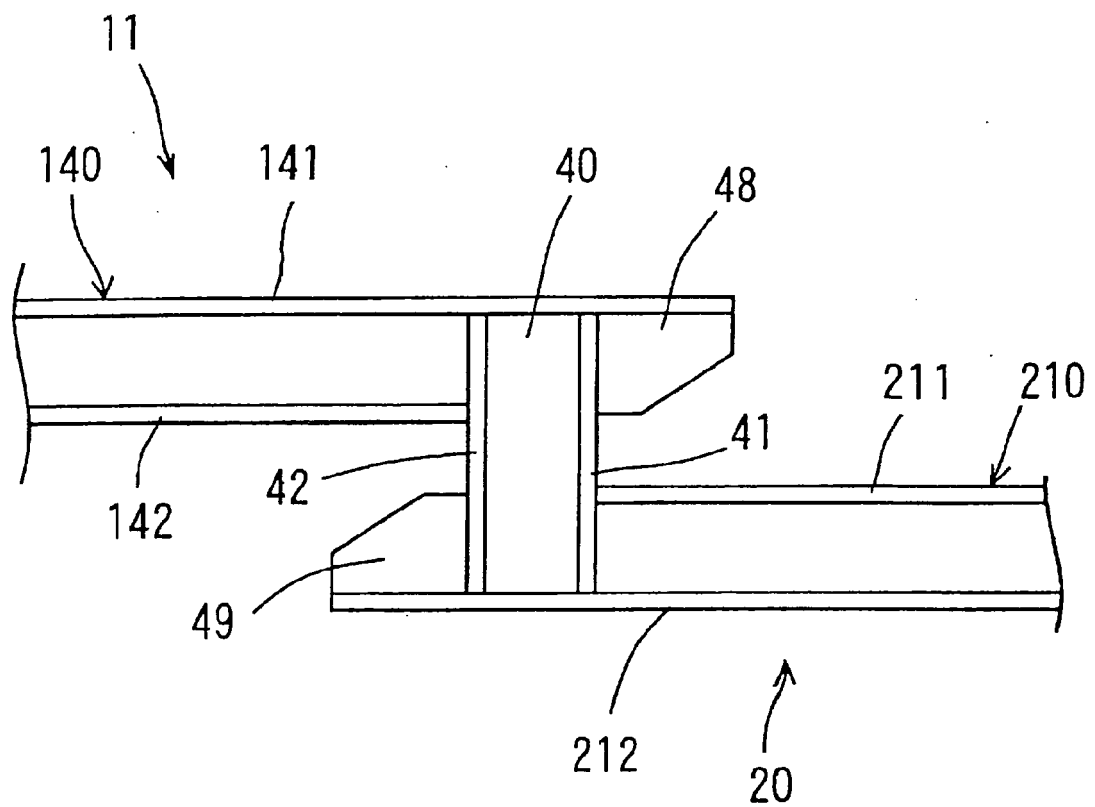


FIG. 5



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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