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(71) Applicant: **Hitachi, Ltd.**
Chiyoda-ku, Tokyo 101-8010 (JP)

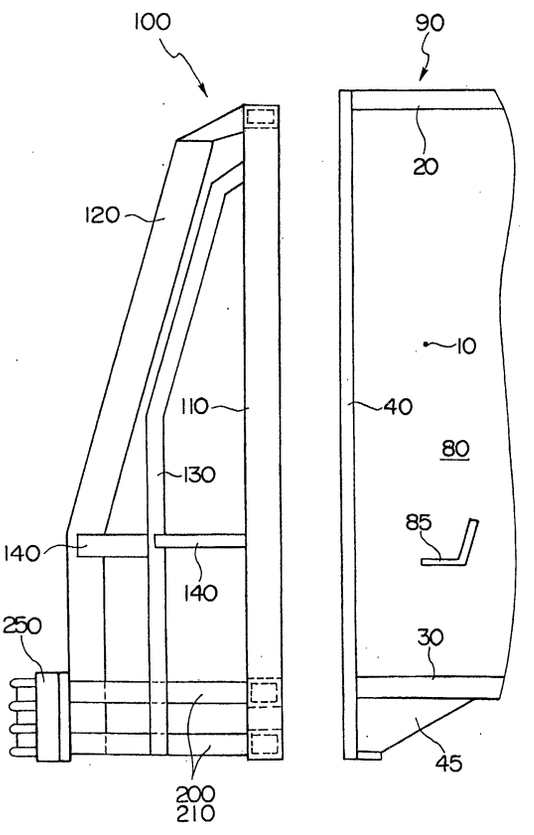
(72) Inventors:
- **Yamaguchi, Takeshi, c/o Hitachi Ltd, Int Prop Grp**
  Tokyo 100-8220 (JP)
- **Ohba, Hideshi, c/o Hitachi Ltd, Int Prop Grp**
  Tokyo 100-8220 (JP)
- **Okuno, Sumio, c/o Hitachi Ltd, Int Prop Grp**
  Tokyo 100-8220 (JP)
- **Yamamoto, Takahisa, Hitachi Ltd, Int Prop Grp**
  Tokyo 100-8220 (JP)

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

(54) Railway car

(57) A front end portion 100 is disposed on the front end of a car body. The floor thereof consists of hollow shape members 200 that construct a shock absorber 200. The shock absorber 200 includes an upper shock absorber 200 and a lower shock absorber 200. Annealed hollow shape members are used to form the hollow shape member 210. The hollow shape members 210 have their longitudinal directions disposed along the longitudinal directions of the car body. Plural hollow shape members 210 are arranged next to one another in the width direction, and bonded together by friction stir welding. When the hollow shape members receive impact load, the members 210 deform into an accordion-like shape, absorbing the impact force. At this time, the friction stir welded portions also receive the impact force, but dislike other weld joints, cracks are not created at the friction-stir-weld joints, and the weld joints do not prevent the hollow shape members 210 from deforming into an accordion-like shape.

Fig. 2



EP 1 295 772 A1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a body of a railway car that travels on rails, and is especially preferable for forming a railway car body using hollow shape members made of light alloy.

DESCRIPTION OF THE RELATED ART

[0002] In forming a railway car, it is required to consider applying means for absorbing and easing the impact force loaded to the passengers on board when collision occurs. Japanese Patent Laid-Open Publication No. H7-186951 (USP 5715757) discloses absorbing the energy generated by the impact of the collision to the front end of the leading car by the deformation thereof. This reliever comprises triangular elements and honeycomb panels disposed within a plane perpendicular to the direction of impact, and has various designs. A plural number of relievers is positioned either in parallel relations against the direction of impact or linearly along the direction of impact.

[0003] A welding method called a friction stir welding method is proposed as a means to weld members, and this method is also applied to forming railway cars. This method is disclosed in Japanese Patent No. 3014654 (EP 0797043 A2).

[0004] According to the disclosure of Japanese Patent Laid-Open Publication No. H11-51103, when friction stir welding is performed to members, the metal constitution of the friction-stir-welded portion becomes refined, and the energy absorption rate is improved.

[0005] In the disclosure, friction stir welding is performed in a ring-like or spiral-like manner to the extruded hollow shape member made of aluminum alloy, and the welded member is used as the steering shaft of an automobile. Friction stir welding is performed in the direction perpendicular to the direction of the impact energy, and the friction-stir-welded portion absorbs the impact force. Moreover, a plurality of short pipe-like members is arranged linearly along the direction of impact energy, and the members are friction-stir-welded so as to form a shaft.

SUMMARY OF THE INVENTION

[0006] The above-mentioned Japanese Patent Laid-Open Publication No. H7-186951 (USP 5715757) proposes a reliever to be mounted on a railway car that is meant to absorb the impact of collision. This reliever comprises plural relieving devices, thereby realizing the safety of the passengers on board.

[0007] Since the reliever is mounted on the railway car body, the length of the reliever should preferably be short so as to secure space for the passengers.

[0008] The present invention aims at providing a railway car that is capable of absorbing the impact energy.

[0009] The above object can be achieved by a railway car characterized in that:

a member constituting the floor at an end portion of the car body is a shock absorber;
the shock absorber comprises plural extruded shape members having hollow portions;
the hollow extruded shape members include plural hollow portions arranged along the width direction of the car body;
the hollow extruded shape members are disposed so that the direction of extrusion thereof is disposed along the longitudinal direction of the car body;
the hollow shape members are opposed to the underframe of said car body; wherein
the shock absorber is disposed as upper and lower layers,
or by providing no hollow shape member to the region equipped with the shock absorber corresponding to side sills provided to other regions,
or by not connecting the coupler for coupling cars together with the shock absorber,
or by increasing the number or the vertical cross-sectional area of the shock absorbers provided to the leading car compared to the number or the vertical cross-sectional area of the shock absorbers provided to the middle cars.

[0010] Moreover, the object of the present invention can be achieved by a car formation comprising plural car bodies being connected;

a member supporting the floor at an end portion of each of said car bodies is a shock absorber; wherein

an entrance or a control panel is positioned above the shock absorber, or

the vertical cross-sectional area of the shock absorber near the leading car is greater than the vertical cross-sectional area of the shock absorber equipped in the middle cars.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

FIG. 1 is a side view showing the car formation of the railway car according to one embodiment of the present invention;
FIG. 2 is a side view showing the state in which the front end portion of FIG. 1 is separated;
FIG. 3 is a plan view showing the front end portion of FIG. 2;
FIG. 4 is a left side view of FIG. 2;
FIG. 5 is a V-V cross-sectional view of FIG. 3;
FIG. 6 is a VI-VI cross-sectional view of FIG. 4;
FIG. 7 is a VII-VII cross-sectional view of FIG. 6;
FIG. 8 is a VIII-VIII cross-sectional view of FIG. 6;
FIG. 9 is a drawing showing the method of welding

the shock absorber of FIG. 1;

FIG. 10 is an explanatory view showing the impact energy of the material; and

FIG. 11 is a stress-flexure diagram of the materials.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0012] One embodiment of the present invention will now be explained with reference to FIGS. 1 through 9. In FIG. 1 and FIG. 2, the leading portion is separated from the car body so that the present invention can be understood more easily.

[0013] The present car formation comprises two leading cars A that are disposed at the front and back ends of the car formation, and middle cars B, the number of which varies according to need. A front end portion 100 of the leading car A is curved and projected in an arc-like shape toward the forward direction. A shock absorber 200 is mounted to the front end portion 100. Further, shock absorbers 400, 400 are respectively arranged between the rear end (other end) of each leading car body A and the end of the middle car B adjacent thereto. First, the shock absorber 200 mounted to the front end portion 100 will be explained in detail.

[0014] A car body 90 excluding the front end portion 100 comprises side structures 10 that constitute the sides of the car body, the roof structure 20, an underframe 30 that constitutes the floor thereof, and so on. The side structures 10, the roof structure 20, and the underframe 30 are all formed by welding plural hollow shape members together. Each hollow shape member is an extruded shape member made of light alloy (such as aluminum alloy), and the direction of extrusion (that is, the longitudinal direction) is arranged along the longitudinal direction of the car body. Plural hollow shape members are arranged along the circumference direction of the car body with the width direction of the members positioned adjacent to each other, and the members are welded to form a single structure. At the end of the car body 90 is provided a seat 40 for fixing the front end portion 100. The space 80 provided at the forward end of the car body 90 is the driver's cab, and a driver's seat 85 is mounted to the floor formed above the underframe 30.

[0015] The front end portion 100 comprises a frame 110 for locking the portion to the car body, plural pillars 120, 130, plural cross beams 140, a shock absorber 200, an anticlimber 250, and so on. The frame 110 has four sides, and the upper side is U-shaped. The frame 110 is removably fixed to the seat 40 of the car body 90 by bolts. The pillars 120 connect the upper end of the frame 110 and the front end of the shock absorber 200. The pillars 120 are positioned near the center of the car body when seen from the front of the body. The pillars 120 are disposed on both sides of a coupler 70. The pillars 130 connect the upper portion of the frame 110 and the sides of the shock absorber 200. The pillars 130 are placed at the center portion in the longitudinal direction of the shock absorber 200, and is connected to both side surfaces of the car body. Since the pillars 120 are likely to collide against obstacles, they are designed to be larger and stronger than the pillars 130. The cross beam 140 is disposed at the center of height of the frame 110 and connects the frame 110 and the pillars 130, 120. These connecting portions are welded together. The area composed of the frame 110, the pillars 120 and 130, and the cross beam 140 is covered smoothly by plates or glass material (not shown).

[0016] The rear end of the shock absorber 200 is abutted against and welded to the lower edge of the frame 110. The shock absorber 200 is composed of two layers, an upper layer and a lower layer. The lower portion of the shock absorber 200 is welded onto a seat 115 arrange in parallel therewith at a position below the lower edge of the frame 110. The seat 115 is welded onto the lower edge of the frame 110.

[0017] The side structure 10, the roof structure 20, and the underframe 30 are made by welding plural hollow extruded shape members made of light alloy (such as aluminum alloy). Especially, the underframe 30 is formed strongly. The lower edge of the seat 40 is designed to have the same shape as the seat 115. The back surface of the seat 40 and the lower surface of the underframe 30 are connected strongly by plural stays 45.

[0018] The upper shock absorber 200 is opposed to the seat 40 of the underframe 30 through the lower edge of the frame 110. The lower shock absorber 200 is opposed to the lower portion of the seat 40 of the underframe 30 through the seat 115.

[0019] The front end of the upper and lower shock absorbers 200, 200 is welded onto an anticlimber 250. The front end of the anticlimber 250 has projections and recesses, preventing the obstacle that collides against the body from moving upward. A rubber shock absorbing unit is mounted between the front end of the anticlimber 250 and the shock absorbers 200, 200.

[0020] The shock absorber 200 is not only designed to have two (upper and lower) layers, but is also divided into left and right portions when observed from the front of the car body. The space between the left and right shock absorbers 200, 200 of the lower layer constitutes the space through which the coupler 70 of the car passes. The upper shock absorbers 200, 200 also have a space formed therebetween, the upper portion of which mounting a plate 150 that is used as the floor for mounting equipment. The plate 150 is fixed to the upper shock absorbers 200, 200. Further, the plate 150 is mounted on a support seat 151 fixed to the upper shock absorbers 200, 200. There are plural support seats 151 at predetermined intervals along the longitudinal direction of the car body. The plate 150 can cover the whole surface of the shock absorbers 200, 200.

[0021] Moreover, it is also possible to place a shock absorber between the two upper layer shock absorbers

200, 200, being integrally formed with the left and right shock absorbers 200, 200. In this case, there is no need to provide the plate 150 and support seats 151. Moreover, the anticlimber 250 can be mounted on the front end side of the added shock absorber 200.

[0022] The shock absorber 200 comprises a hollow extruded shape member 210 made of light alloy (such as aluminum alloy). The hollow shape member 210 is arranged so that the direction of extrusion thereof is arranged along the direction of travel (the longitudinal direction) of the car body. The hollow portion is oriented along the longitudinal direction. A plurality of hollow shape members 210, 210 are assembled along the width direction of the car body. The width-direction-ends of the hollow shape members 210 are welded to one another. Each shock absorber 200 comprises two hollow shape members.

[0023] The hollow shape member 210 comprises two face plates 211 and 212, connecting plates 213 connecting the two face plates and being slanted against the two face plates 211 and 212, and a connecting plate 215 substantially orthogonal to the face plates 211 and 212 disposed at the width-direction-end thereof. The face plates 211, 212 and the connecting plates 213 constitute trusses. The connecting plate 215 is disposed to one of the two hollow shape members at the joint between the two members.

[0024] The hollow shape members 210 are welded together by friction stir welding. The welding direction is along the longitudinal direction thereof. A segment 216 protrudes toward the end side at the joint between the face plate 211 (212) and the connecting plate 215. The end side portion of the connecting plate 215 is recessed than the outer surface of the face plates 211, 212. The projecting segment 216 is formed to this recessed position. The face plates 211, 212 of the other hollow shape member 210 overlap with the recessed portion. The face plates 211 and 212 of the two hollow shape members are each abutted against the corresponding face plate, respectively. The end surface of the face plates 211, 212 of the hollow shape member 210 where the connecting plate 215 is formed (the surface including the recessed portion) is substantially disposed on the extension of the center of plate thickness of the connecting plate 215. The outer surfaces at the end of face plates 211 and 212 being abutted against the other hollow shape member are provided with projections 217 that protrude in the thickness direction of the hollow shape member. The projections 217 on the two hollow shape members are also abutted against one another.

[0025] Friction stir welding will now be explained. One pair of hollow shape members 210, 210 is mounted on a bed 300. The lower projections 217, 217 of the members are mounted on the bed 300. The butt joint is temporarily welded by arc welding along the longitudinal direction thereof. The upper abutted portion is friction-stir-welded using a rotary tool 310. The lower end of a large-diameter portion of the rotary tool 310 is positioned between the outer surface of the face plate 211 (212) and the apex of the projections 217, 217. The remaining projection can be removed if necessary by cutting. After friction-stir-welding the upper portion, the hollow shape members 210, 210 are turned up-side down, and friction stir welding is performed to the opposite side in a similar manner. The projections 217 can be omitted.

[0026] The hollow shape member 210 is for example a member for forming the underframe 30. One or more hollow shape members are used to form the necessary width of the shock absorber 200 (the width direction of the car body). If necessary, the width of the hollow shape member can be cut off. It is best that the with direction of the shock absorber 200 is flat, so the hollow shape member for the underframe 30 is preferred. However, the side sill of the underframe 30 will not be used. Further, the side structure 10 also includes linear hollow shape members, which can also be used as the present shock absorber. The cost of the shock absorber is inexpensive since the hollow shape members for forming the other parts of the car body can be applied.

[0027] The hollow shape member 210 of the shock absorber 200 is softer than the hollow shape members constituting the underframe 30, the side structures 10, or the roof structure 20, and can easily collapse during collision, thereby absorbing the energy of the impact. The hollow shape member 120 is formed by annealing and softening the hollow shape member used to create the underframe.

[0028] The annealing can be, for example, an O-material treatment (temper of annealed metal). In general, various heat treatments are provided to the extruded member after the extrusion. If the material of the extruded member is A6N01, an artificial aging and hardening process of T5 is performed. The annealing of the O-material is performed thereafter. The annealing treatment to the O-material is performed for two hours at 380 °C, and the strength is 36.8 MPa. T5 has a strength of 245 MPa. The annealing of the O-material is meant to soften the material as the hollow shape member. The elongation of the hollow shape member 210 is greater than that of the general hollow shape member. The strength of the hollow shape member 210 is smaller than that of the general hollow shape member. In order to provide necessary strength and softness to the member, annealing other than the O-material can also be performed. Further, the plate thickness of the hollow shape member can also be chosen to provide the best performance.

[0029] The lowermost end of the pillars 120 and 130 are welded to the upper and lower hollow shape members 210, 210. Welding is performed by forming notches to the upper and lower hollow shape members 210 having a shape corresponding to the pillars 120 and 130, and then welding the members. The width-direction-ends of the upper and lower hollow shape members 210, 210 are welded to plural members 250.

[0030] The surface of the anticlimber 250 facing the hollow shape members 210 is provided with plural pipes

256, which are inserted to the plural hollow portions of the hollow shape members 210. The outer diameter of each pipe 256 is substantially equal to the inscribing circle of the hollow portion having a triangular cross-section. The pipes 256 are inserted to every other triangular hollow shape portion. The pipes 256 are welded onto the seat 253 of the anticlimber 250 while being inserted to the holes formed to the seat 253. The frame 110 and the seat 115 also have pipes 256, which are inserted to the hollow portion of the hollow shape member 210.

[0031] The upper half of the front end portion 100 is provided with windows and the like, and the lower front end space thereof stores equipment for operating the railway car. The lower end of the plates constituting the side surfaces of the front end portion 100 covers the sides of the upper and lower shock absorbers 200, 200.

[0032] In the underframe 30, side sills (not shown) are provided to both width-direction-ends of the car body. The side sill is a large and firm hollow shape member. The front end portion 100 does not have hollow shape members corresponding to the size of the side sill. Further, the front end portion 100 does not include a member having the strength corresponding to that of the hollow shape member forming the side sill of the underframe 30. A member (not shown) for connecting the coupler 70 is equipped to the lower surface of the underframe 30. However, the front end portion 100 is not equipped with such member. This member is equipped along both the longitudinal direction and the width direction of the car body. This member and the hollow shape member constituting the side sill is strong against the compressive load in the longitudinal direction of the car body. Moreover, there is also a member for supporting the coupler 70.

[0033] When the railway car crashes into an obstacle, impact load occurs. When the coupler 70 collides, the impact causes the coupler 70 to drop off from the car, and causes the shock absorber 200 to exert its shock absorbing function. When the anticlimber 250 collides, the impact acts on the hollow shape members 210 constituting the shock absorbers 200, 200.

[0034] Since the hollow shape members 210 are soft, they deform upon receiving impact before deformation of the underframe 30 occurs, thereby relieving the impact. According thereto, the safety of the passengers is ensured. The impact causes the length of the hollow shape members 210 to shrink to about half to one-third of their original length. At such time, the equipment provided above the hollow shape members 210 is prevented from entering the driver' s cab and harming the driver. This is realized for example by appropriately designing the position and size of the equipment. Moreover, a partition wall for separating the equipment and the driver's cab 80 can be equipped to the frame 110, the upper shock absorbers 200, 200 and the plate 150, so as to ensure the safety of the driver. The partition wall can be constituted by the box enclosing the equipment. The partition wall can be equipped to the seat 40 and the underframe 30. Moreover, the driver's seat 85 can be set to a position where it is clear of any equipment that may enter the driver's cabin upon impact. According to another example, sufficient space is provided between the seat 85 and the equipment that may enter the cabin.

[0035] We will now explain the impact-relieving characteristic of the hollow shape member 120. When compressive load is added thereto, the hollow shape member shows the load-deformation behavior as shown in FIG. 10. Three types of material characteristics is considered as shown in FIG. 11, a material i having high strength (such as pull strength, yield strength) and small elongation (brittle), a material iii having less strength but better elongation, and a material ii having a property intermediate those of materials i and iii. The material shown by the curve X (X1, X2) of FIG. 10 (the material corresponding to strength property i of FIG. 11) has better withstand load, but the withstand load drops rapidly when the value exceeds the maximum load. On the other hand, when the material has low strength and high elongation (the material corresponding to strength property iii of FIG. 11), the maximum withstand load is smaller but the withstand load does not rapidly drop after the maximum value, as shown by the curved line Y of FIG. 10.

[0036] The shaded area shown in FIG. 10 corresponding to curved line Y indicates the breaking energy of this material. When comparing the X curve with the Y curve, the material having less strength and more elongation (in this case, the material of curved line Y) has higher breaking energy according to the deformation behavior after exceeding the maximum withstand load. It is important to select as shock absorbing member B a material having such strength characteristic Y. A material having the Y-curve property can be obtained easily by providing an O-material treatment to an extruded member, for example.

[0037] In case of the curved line X, since the material has high strength and small elongation, the elongation of the member cannot correspond to the imbalance of the stress within the cross-section of the member, causing partial breaking thereof, and reducing the withstand load rapidly. On the other hand, in the case of the curved line Y, the maximum withstand load of the member is lower than the material of the curve X, but since the elongation of the material is greater, plastic deformation of the material (elongation of the member) occurs partially corresponding to the scattered stress within the cross-section of the material, preventing the withstand load from dropping rapidly. According to this material, the material can deform greatly while maintaining a certain level of withstand load.

[0038] When such material is utilized, the hollow shape member 210 deforms into a concertinas (into an accordion-form), relieving the shock loaded to the car body. Moreover, since a hollow-shape form is applied, in comparison to the general thin-plate structure, the member has higher inner-plate and outer-plate flexural

rigidity, and since it has a composite structure including two face plates and cross (oblique) plates, it has higher breaking-energy absorption property against the compressive load (per unit planar area).

[0039] Plural hollow shape members 210, 210 are welded together by friction stir welding along the longitudinal direction of the car body in the direction of the impact. If the welding is performed by arc welding, the weld portion may break during impact and the members cannot deform into an accordion form, and the energy absorption characteristic of the members drop. This is because by arc welding, the impact value of the weld portion is greatly reduced compared to the impact value of the base material. On the other hand, the impact value of the friction-stir-welded portion is higher compared to the arc-weld portion, and the joint will not break by impact. The reason for this is considered to be that the metal constitution of the joint is refined by the friction stir welding, and the energy absorption value is improved. Therefore, when the hollow shape members are welded by friction stir welding, each hollow shape member deforms in a desired manner, absorbing the impact energy.

[0040] Since the shock absorbers 200 are provided in upper and lower layers, the impact energy can be absorbed by applying existing hollow shape members.

[0041] The upper and lower hollow shape members 210 are notched in the form of pillars 120, 130, so as to weld the pillars. According to this structure, the impact of the collision can be transmitted effectively to the hollow shape members 210, 210 from the pillars 1200, 130 that collide with an obstacle.

[0042] Since the anticlimber 250 is overlapped with the hollow shape member 210 by its pipes 256, the anticlimber 250 can transmit the impact to the hollow shape member 210 even when it collides slantwise against the obstacle.

[0043] According to the above-mentioned embodiment, friction stir welding is performed from both sides of the hollow shape member, but it is also possible to weld the second face plates of two members from the first face plate side of the members, and then weld the first face plates via a connecting material, as shown in FIG. 9 of the above-mentioned Japanese Patent No. 3014654 (EP 079743 A2).

[0044] Now, the shock absorber 400 mounted between the rear end of the leading car A and the end of a middle car B will be explained. The shock absorber 400 has a similar composition as the shock absorber 200. A plate 150 and a support seat 215 is disposed between and on top of the left and right shock absorbers 200, 200 (400, 400), constituting the floor of the passage for the crew, etc. An anticlimber 250 is disposed on the front end of the shock absorber 400. When a shock absorber 400 is disposed also between the left and right shock absorbers 400, 400, the anticlimber 250 is mounted to the front end of this shock absorber 400.

[0045] The area above the shock absorbers 400 and the seat 215 can be the space where the entrance 510 is provided. The area can also provide space for the switch board (control panel). Moreover, it can be a space having no passenger seats. Such use of the upper area of the absorbers 400 enables minimum damage to the passengers upon collision.

[0046] The end portion 500 comprising the shock absorbers 400 is removably connected to the car body 90 by bolts, similarly as the front end portion 100. The front end of the portion 500 is not curved or protruded as portion 100, but is perpendicular.

[0047] The number of the shock absorbers 400 can be less than the number of shock absorbers disposed at the front end portion. Since the energy to be absorbed differs according to the position in the car body in which the shock absorbers are disposed, the number of shock absorbers is determined correspondingly. For example, the shock absorber 400 only has an upper layer. Moreover, the cross-sectional area of the hollow shape members 210 in the shock absorber (the area composed of the cross-sectional area of the face plates 211, 212 and the connecting plates 213, 215) is varied according to position. The shock absorbers equipped to the middle cars disposed near the center of the railway car comprises smaller number of members and smaller cross-sectional areas compared to the shock absorber 200 equipped at the front end 100. The above explains the relation between the leading car and the middle car, but even when comparing the shock absorbers 500 of the middle cars, the shock absorber 500 disposed to the middle car near the center of the railway car body has smaller number of members and smaller cross-sectional area compared to the middle car 500 disposed near the end of the railway car body.

[0048] There is no member for connecting the coupler 70 disposed on the end portion 500, similar to the front end portion 100. Upon collision, the coupler 70 drops off so that the shock absorber 400 exerts its shock absorbing function. Moreover, the end portion 500 is not equipped with a strengthening member corresponding to the hollow shape member constituting the side sill of the underframe 30. The lower end of the plates constituting the outer sides of the end portion 500 covers the sides of the shock absorber 400. However, the area of the end portion 500 receiving load, from the entrance 510 and the like, is equipped with members for supporting this load at the floor. This member collapses simultaneously as when the shock absorbers 400 collapse. The floor of the passenger entrance 510 and the like is supported by the shock absorbers 400.

[0049] The end portion 500 can include soft side sills. Such soft side sills can be formed by annealing or punching appropriate holes thereto. The front end portion 100 and the end portion 500 are formed separately from the car body 90 in the above embodiment, but they can also be formed integrally with the car body 90. The hollow shape members 210 can be softened by providing holes thereto at predetermined intervals, or by selecting an appropriate plate thickness. Moreover, the

construction of a common conventional shock absorber can be applied to the shock absorber of the present invention.

[0050] The technical scope of the present invention is not restricted to the language used in the claims or in the summary of the present invention, but is extended to the range in which a person skilled in the art could easily substitute based on the present disclosure.

[0051] The present invention enables to provide a railway car that ensures safety by absorbing the impact energy upon collision.

Claims

1. A railway car **characterized in that**:

a member constituting the floor at an end portion of the car body is a shock absorber;
said shock absorber comprises plural extruded shape members having hollow portions;
said hollow extruded shape members include plural hollow portions arranged along the width direction of the car body;
said hollow extruded shape members are disposed so that the direction of extrusion thereof is arranged along the longitudinal direction of the car body;
said hollow shape members are opposed to the underframe of said car body; and
said shock absorber is disposed as upper and lower layers.

2. A railway car according to claim 1, wherein
the front ends of said upper and lower layers of shock absorbers are connected to one member.

3. A railway car according to claim 1, wherein
the shock absorber constituting the lower layer is divided into left and right parts; and
a coupler for connecting cars is disposed between the left and right shock absorbers.

4. A railway car according to claim 1, wherein
the shock absorber disposed at the front end portion of a leading car is positioned ahead of the seat of a driver's cab.

5. A railway car according to claim 4, wherein
driving equipment is mounted above said shock absorber.

6. A railway car according to claim 4, wherein
the front and rear ends of said hollow shape members are fixed to one or more pillars supporting a roof structure at said front end portion.

7. A railway car according to claim 6, wherein
said pillars fixed to the front end of said hollow shape members are welded to spaces formed by notching said hollow shape members.

8. A railway car **characterized in that**:

a member constituting the floor at a front end portion of a leading car is a shock absorber;
said shock absorber comprises plural extruded shape members having hollow portions;
said hollow extruded shape members include plural hollow portions arranged along the width direction of the car body; said hollow extruded shape members are disposed so that the direction of extrusion thereof is arranged along the longitudinal direction of the car body;
said hollow shape members are opposed to the underframe of said car body; and
said shock absorber disposed at the front end portion is positioned ahead of the seat in a driver's cab.

9. A railway car according to claim 8, wherein
driving equipment is mounted above said shock absorber.

10. A railway car **characterized in that**:

a member constituting the floor at an end portion of the car body is a shock absorber;
said shock absorber comprises plural extruded shape members having hollow portions;
said hollow extruded shape members include plural hollow portions arranged along the width direction of the car body; said hollow extruded shape members are disposed so that the direction of extrusion thereof is arranged along the longitudinal direction of the car body;
said hollow shape members are opposed to the underframe of said car body; and
said underframe comprises side sills, and said end portion does not include hollow shape members having the same size as said side sills disposed on the line of extension of said side sills.

11. A railway car according to claim 10, wherein
at said end portion, the plates constituting the width-direction side surfaces of the car body covers the side surfaces of said shock absorber.

12. A railway car **characterized in that**:

a member constituting the floor at an end portion of the car body is a shock absorber;
said shock absorber comprises plural extruded shape members having hollow portions;
said hollow extruded shape members include

plural hollow portions arranged along the width direction of the car body; said hollow extruded shape members are disposed so that the direction of extrusion thereof is arranged along the longitudinal direction of the car body;
said hollow shape members are opposed to the underframe of said car body; and
a member used in a coupler for connecting the cars together is equipped to the lower surface of said underframe.

13. A railway car **characterized in that**:

said railway car comprises a car formation in which plural car bodies are connected;
a member constituting the floor at an end portion of each of said car bodies is a shock absorber;
said shock absorber comprises plural extruded shape members having hollow portions;
said hollow extruded shape members include plural hollow portions arranged along the width direction of the car body; said hollow extruded shape members are disposed so that the direction of extrusion thereof is arranged along the longitudinal direction of the car body;
said hollow shape member is opposed to the underframe of said car body; and
the number of shock absorbers equipped in a car body disposed near the end of said car formation is greater than the number of shock absorbers equipped in a car body disposed near the center of said car formation.

14. A car formation **characterized in that**:

said car formation comprises plural car bodies being connected;
a member supporting the floor at an end portion of each of said car bodies is a shock absorber; and
the vertical cross-sectional area of the member constituting said shock absorber equipped in a car body disposed near the end of said car formation is greater than the vertical cross-sectional area of the member constituting said shock absorber equipped in a car body disposed near the center of said car formation.

15. A car formation according to claim 14, **characterized in that**:

said shock absorber comprises plural extruded shape members having hollow portions;
said hollow extruded shape members include plural hollow portions arranged along the width direction of the car body;
said hollow extruded shape members are disposed so that the direction of extrusion thereof is arranged along the longitudinal direction of the car body; and
said hollow shape members are opposed to the underframe of said car body.

16. A railway car **characterized in that**:

said railway car comprises a car formation in which plural car bodies are connected;
a member supporting the floor at an end portion of each of said car bodies is a shock absorber; and
an entrance is formed above said shock absorber.

17. A railway car according to claim 16, **characterized in that**:

said shock absorber comprises plural extruded shape members having hollow portions;
said hollow extruded shape members include plural hollow portions arranged along the width direction of the car body;
said hollow extruded shape members are disposed so that the direction of extrusion thereof is arranged along the longitudinal direction of the car body; and
said hollow shape members are opposed to the underframe of said car body.

18. A railway car **characterized in that**:

said railway car comprises a car formation wherein plural car bodies are connected;
a member supporting the floor at an end portion of each of said car bodies is a shock absorber; and
a control panel is equipped above said shock absorber.

19. A railway car according to claim 18, wherein
a member constituting the floor at an end portion of the car body is a shock absorber;
said shock absorber comprises plural extruded shape members having hollow portions;
said hollow extruded shape members include plural hollow portions arranged along the width direction of the car body;
said hollow extruded shape members are disposed so that the direction of extrusion thereof is arranged along the longitudinal direction of the car body; and
said hollow shape members are opposed to the underframe of said car body;

Fig. 1

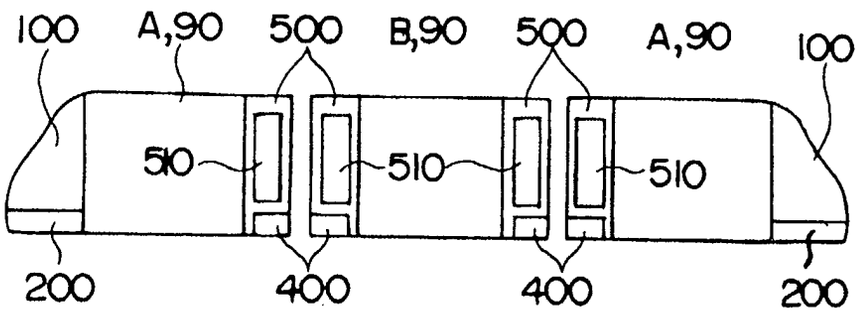


Fig. 2

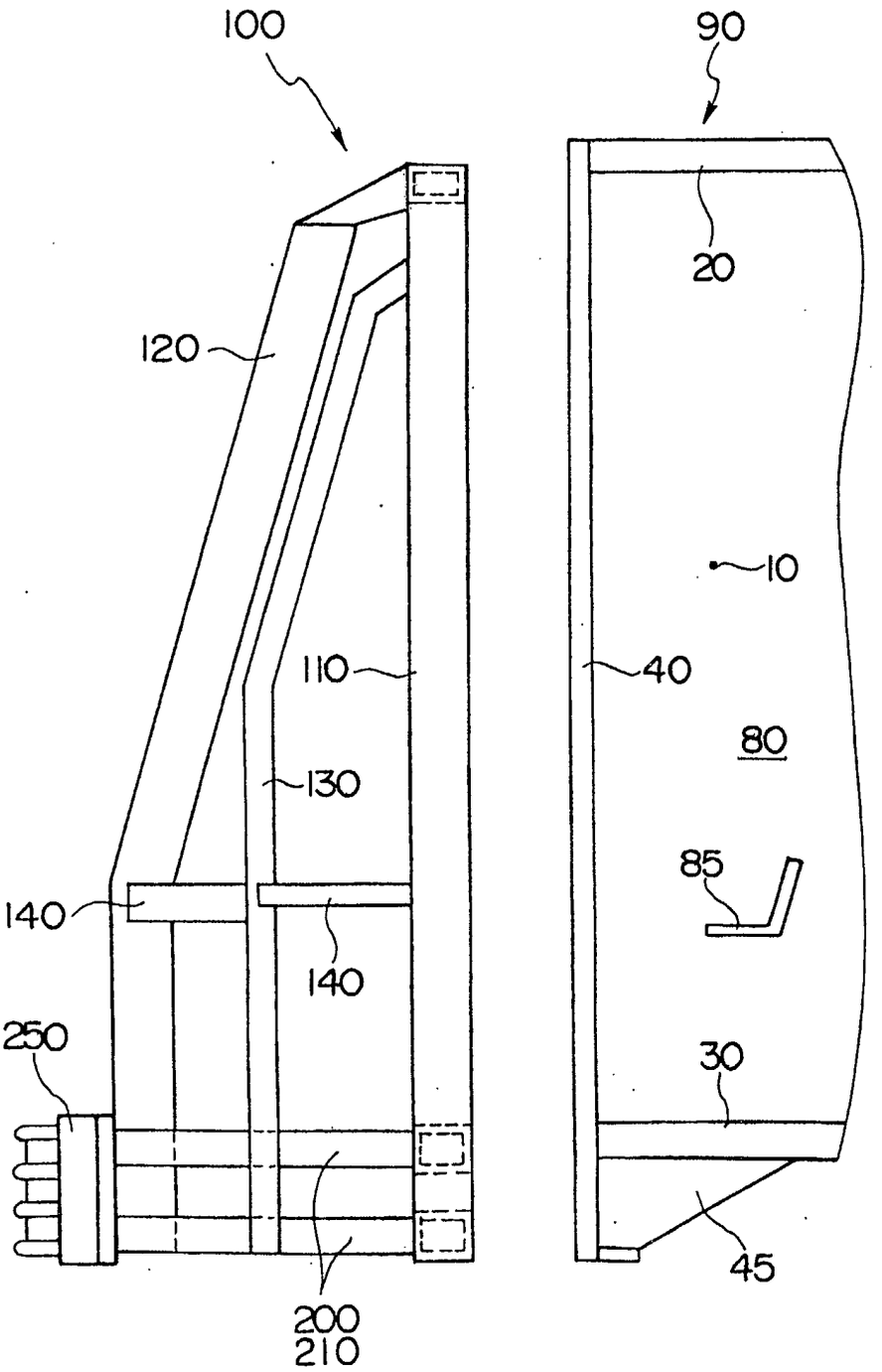


Fig. 3

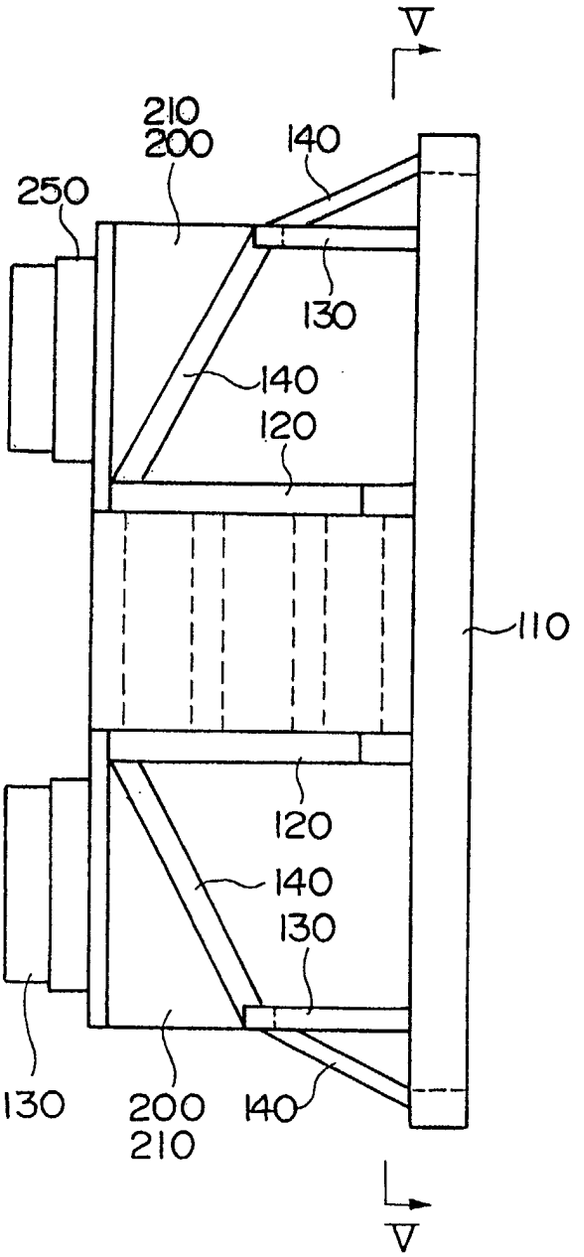


Fig. 4

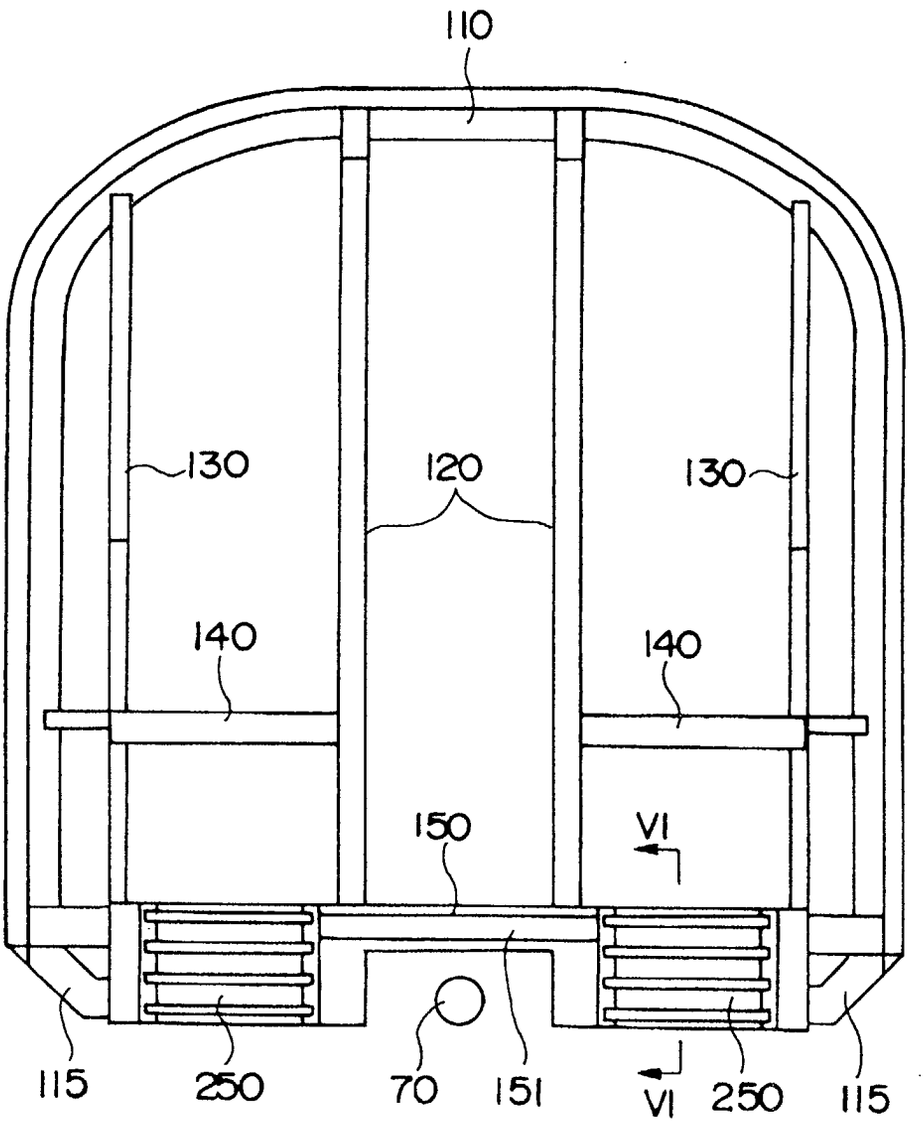
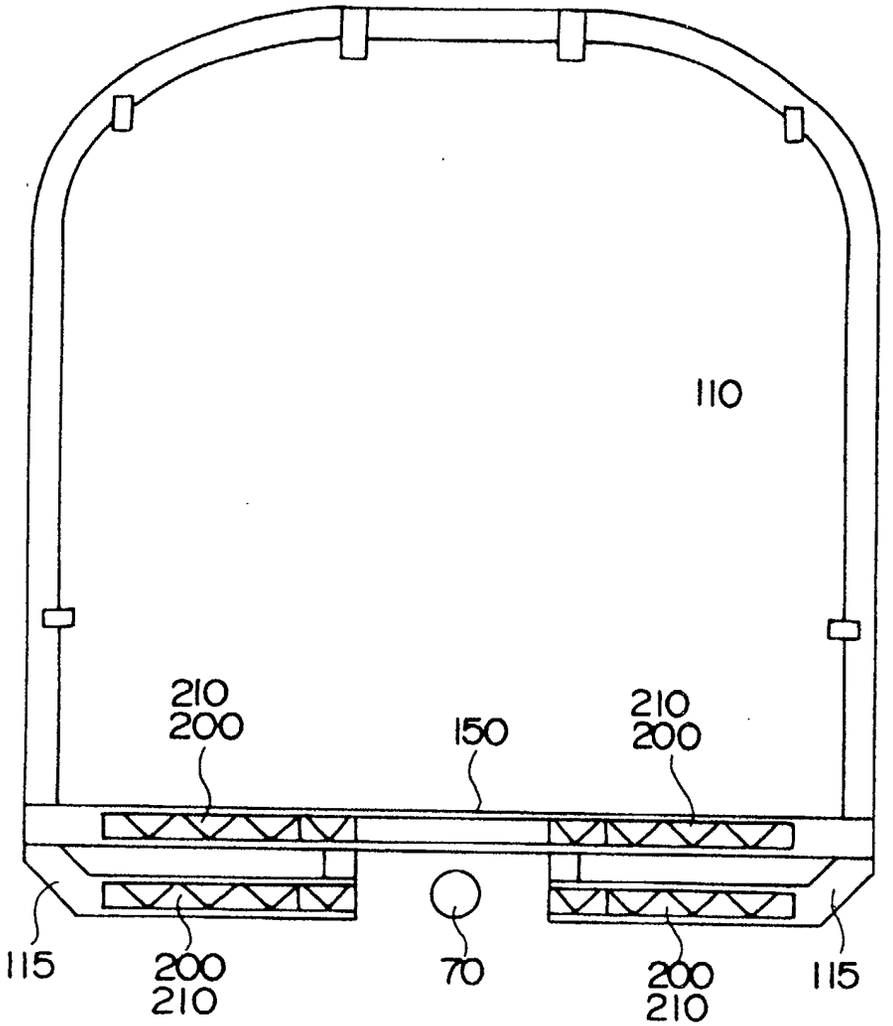


Fig. 5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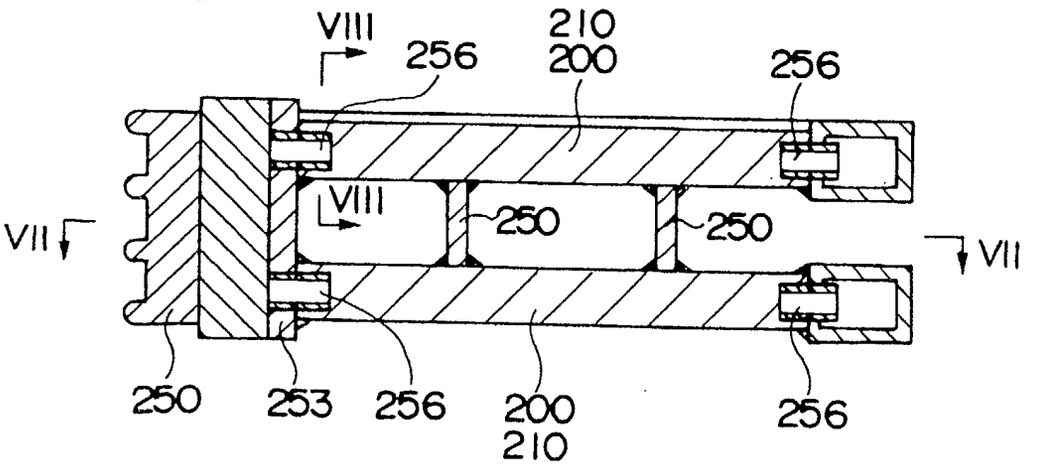
115

Fig. 6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VII
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VII
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Fig. 7

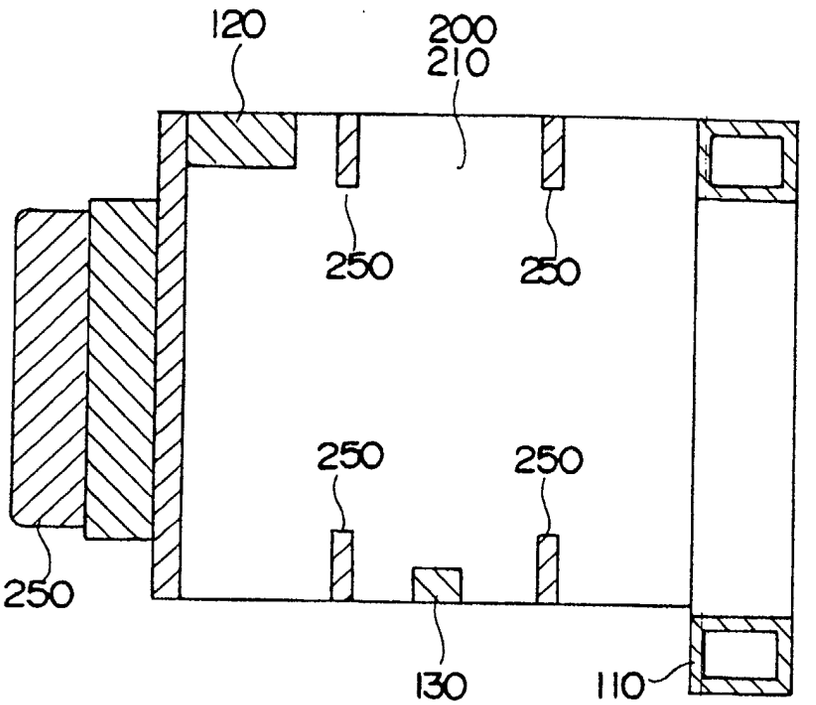

Fig. 8

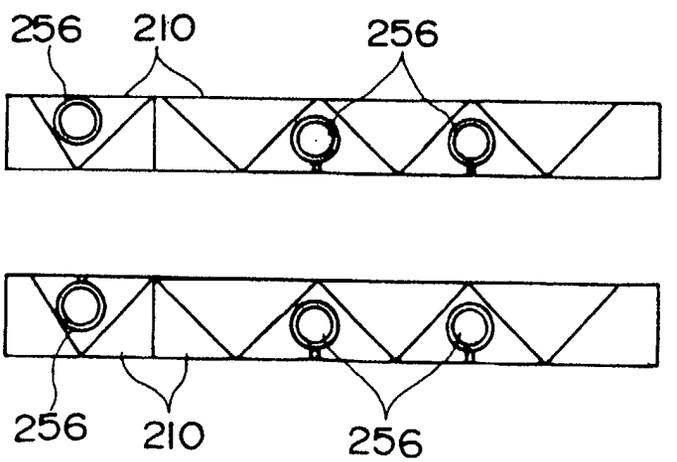

Fig. 9

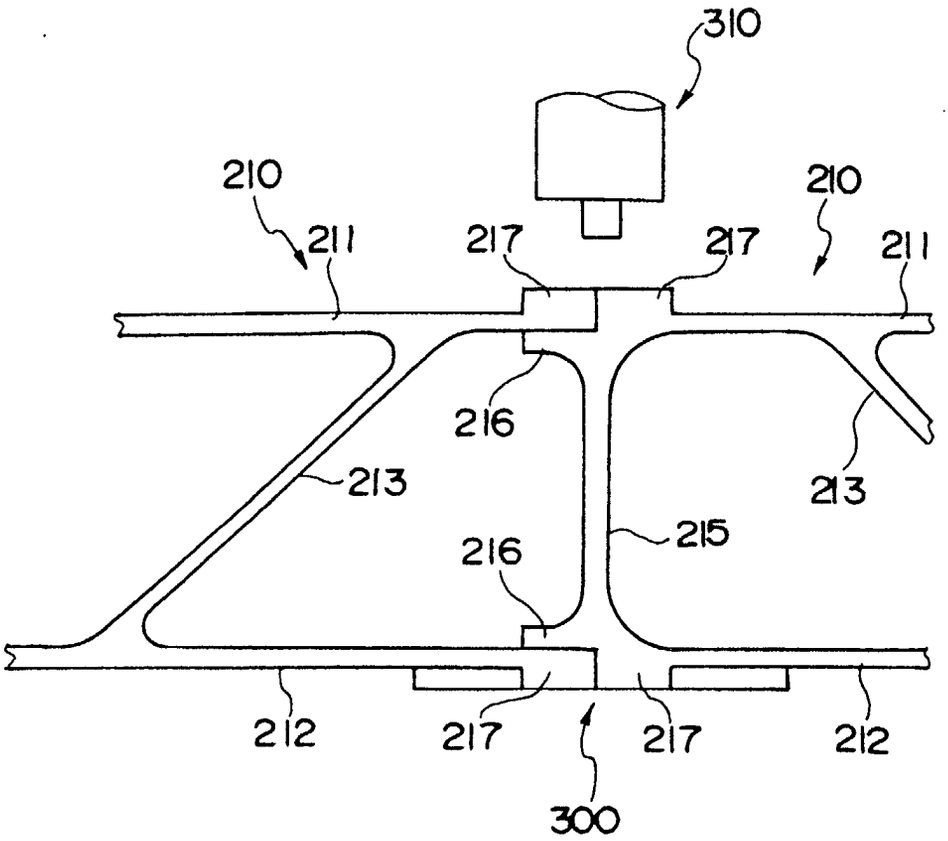
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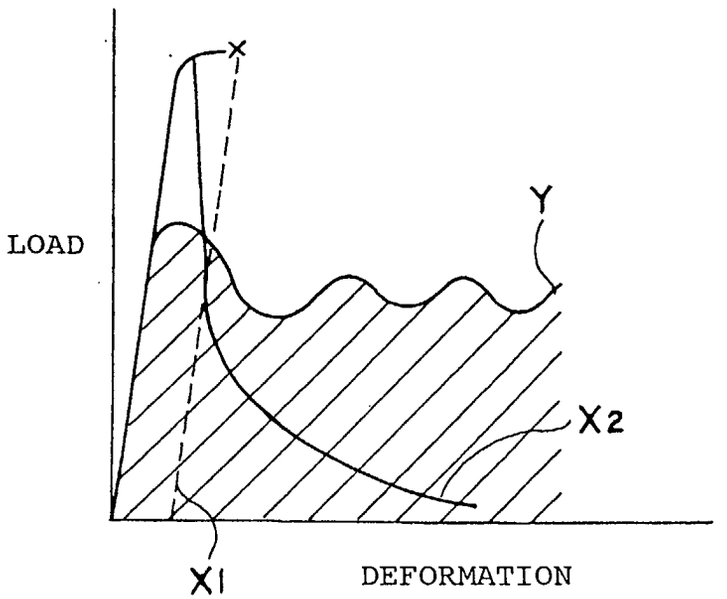
Fig. 10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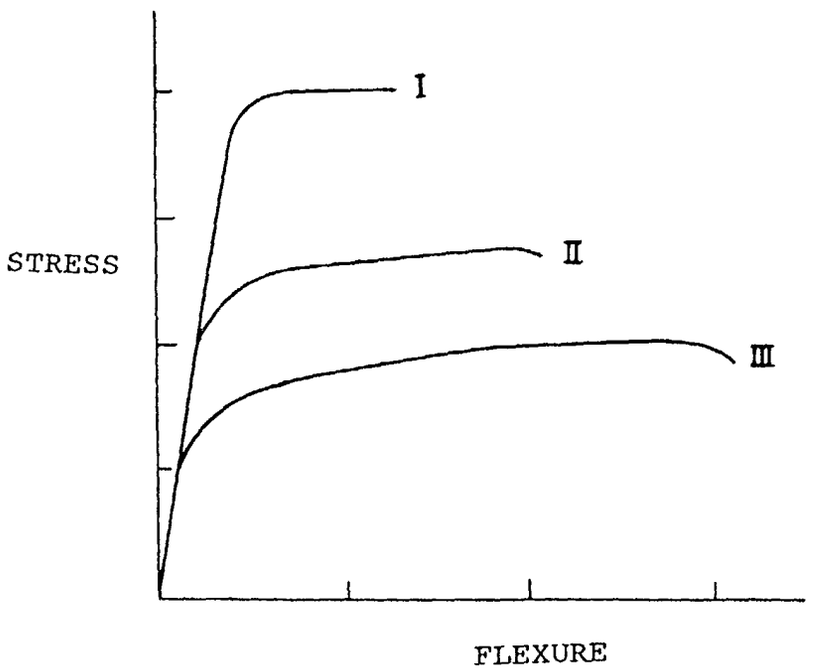
Y
LOAD
X2
X1
DEFORMATION

Fig. 11



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EUROPEAN SEARCH REPORT

Application Number
EP 02 25 0822

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 6 196 135 B1 (KASHIMA JUN ET AL) 6 March 2001 (2001-03-06) * column 8, line 37 - column 9, line 43; figures 4-6 *	1,2,8, 10, 12-14, 17,19	B61D15/06 B61F1/10
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 December 2002	Chlosta, P

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