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Maroshick

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[54] **ARTICULATED RAILWAY VEHICLE CONNECTING PASSAGE**

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[52] **U.S. Cl.** ..... **105/4 R;** 105/1 A; 105/3; 105/8; 105/17; 105/210

[51] **Int. Cl.²** **B61D 17/14;** B61D 17/20; B61F 3/12; B61F 5/16

[58] **Field of Search** ..... 105/1 A, 3, 4 R, 15, 8, 105/17, 164, 210

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Assistant Examiner—Howard Beltran
Attorney, Agent, or Firm—Joseph M. Corr, Esq.

[57] **ABSTRACT**

A joint connecting the cars of an articulated rail vehicle to provide a wide smooth-walled passage therebetween regardless of the relative attitudes of the cars. The joint and ends of each car are journaled on the bolster of a common truck. A rigid-walled tunnel assembly mounted on the bolster includes inner and outer telescoping tunnel shell members which are pivoted for relative pitch movement at the bolster. The tunnel shell members each include vertical arcuate surfaces cooperating with similar surfaces on the car ends to seal the ends of the tunnel passage. Side panels vertically hinged to the joint frame assembly are slidable within slots in the car bodies to externally seal the joint and provide a flush external appearance of the vehicle.

20 Claims, 6 Drawing Figures

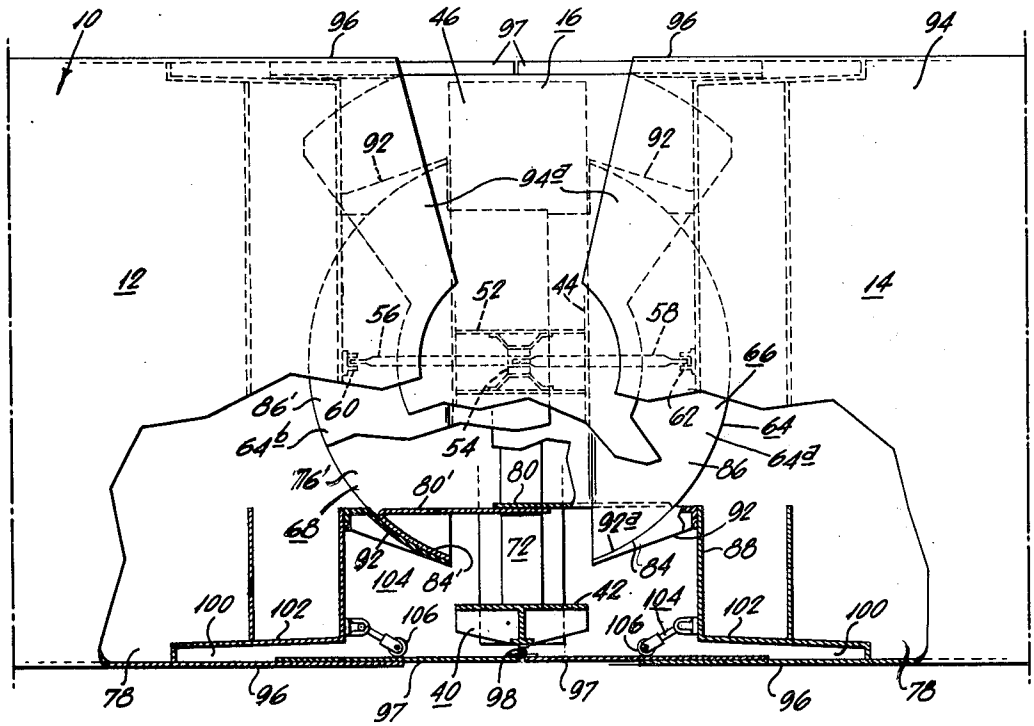


FIG. 1.

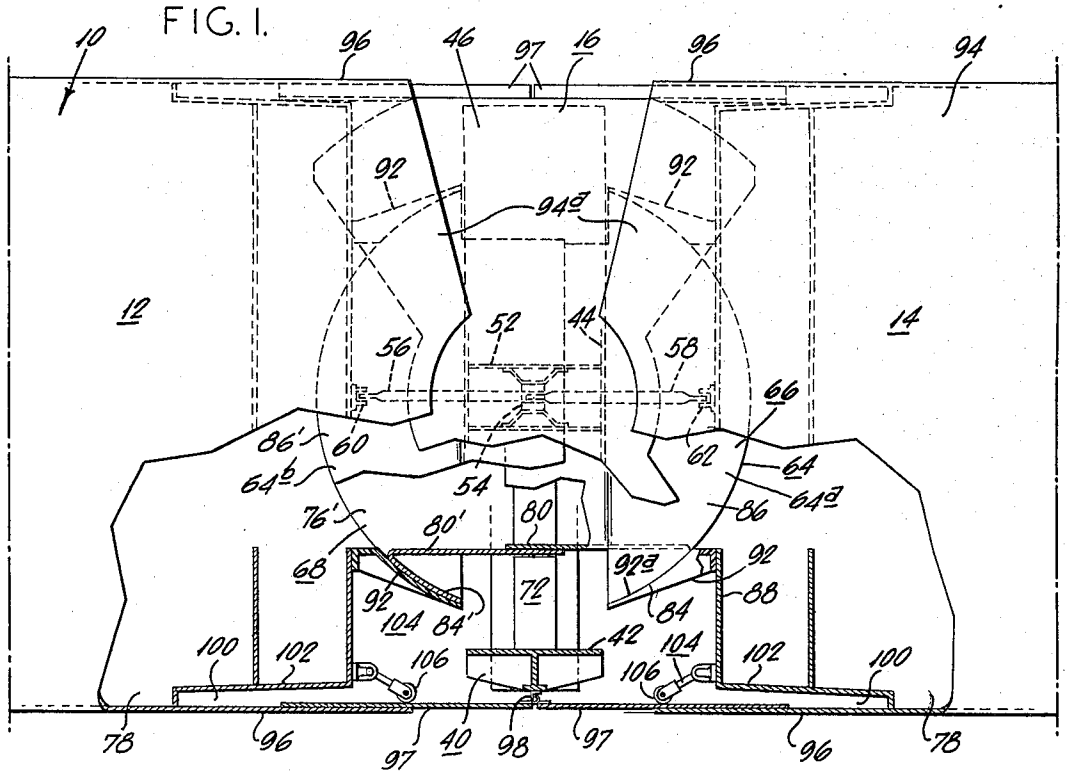

10
96
46
97
16
96
94
92
92
94a
12
14
52
44
56
58
66
86'
60
62
64
64b
54
64a
76'
80'
80
86
68
92a
92
72
92
88
84'
84
104
42
104
100
102
106
106
102
100
78
96
97
40
98
97
96
78

FIG. 2.

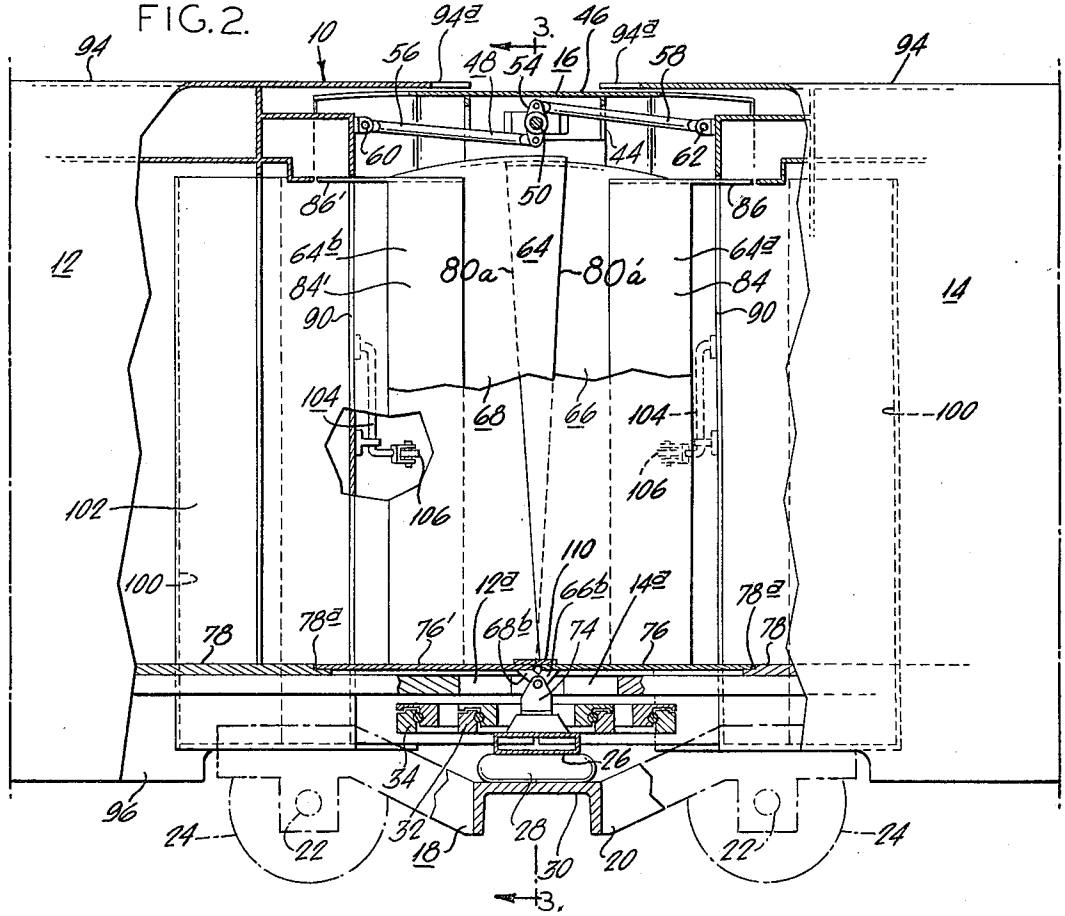

94a
3.
46
94a
94
10
94
56
48
54
16
58
60
44
62
50
86'
86
64b
64
64a
12
80a
80a
84'
84
14
90
90
104
68
66
104
100
106
106
102
110
100
102a
66b
14a
78a
78a
78
78
76'
68b
74
76
78
26
34
96
24
22
32
18
28
30
20
22'
24
3.

FIG. 3.

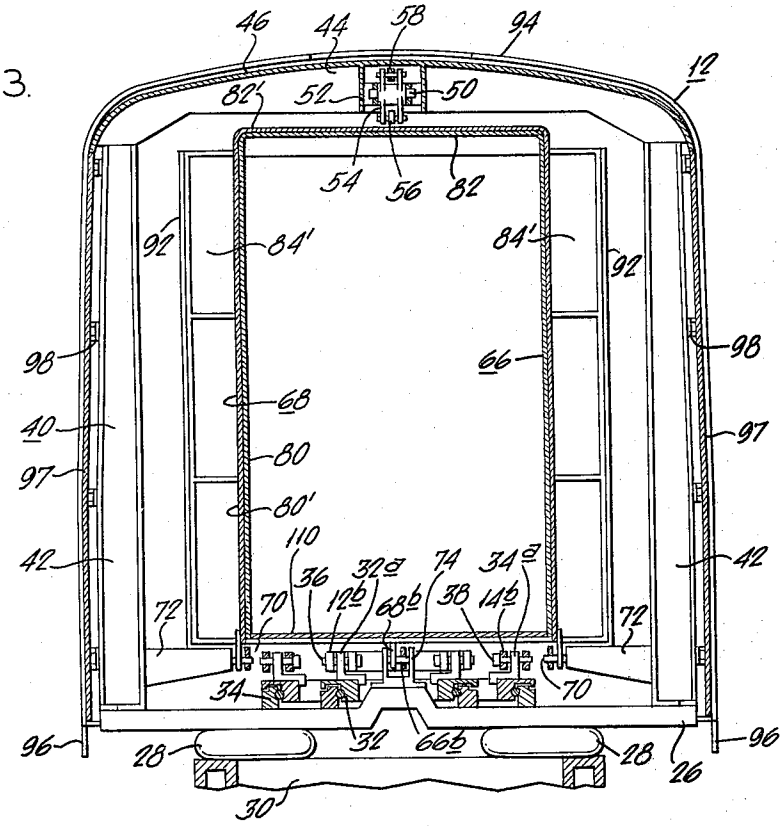


FIG. 5.

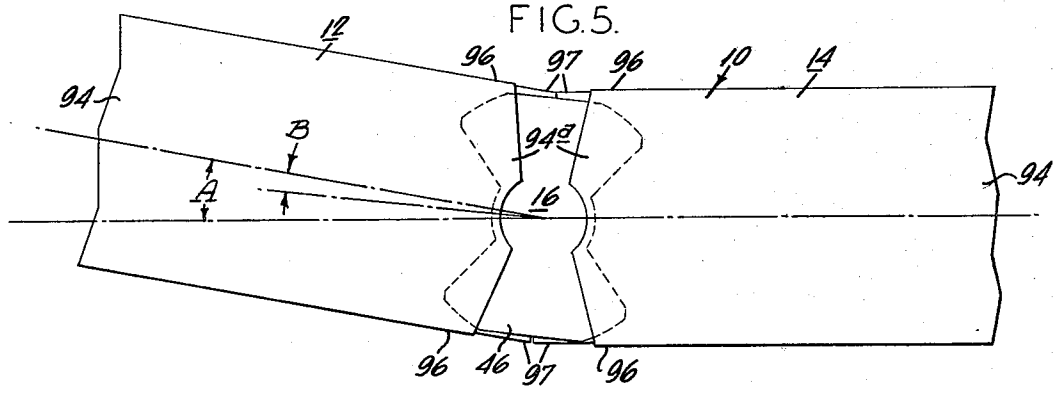
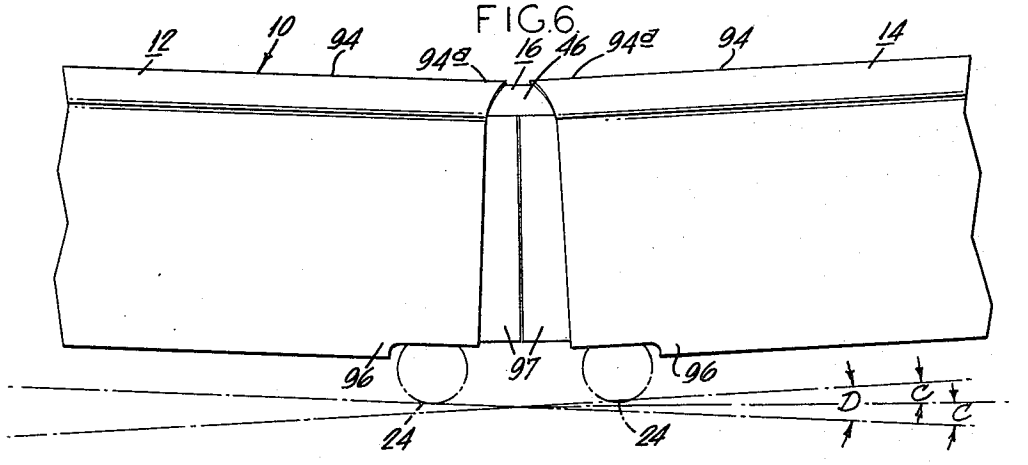


FIG. 6.



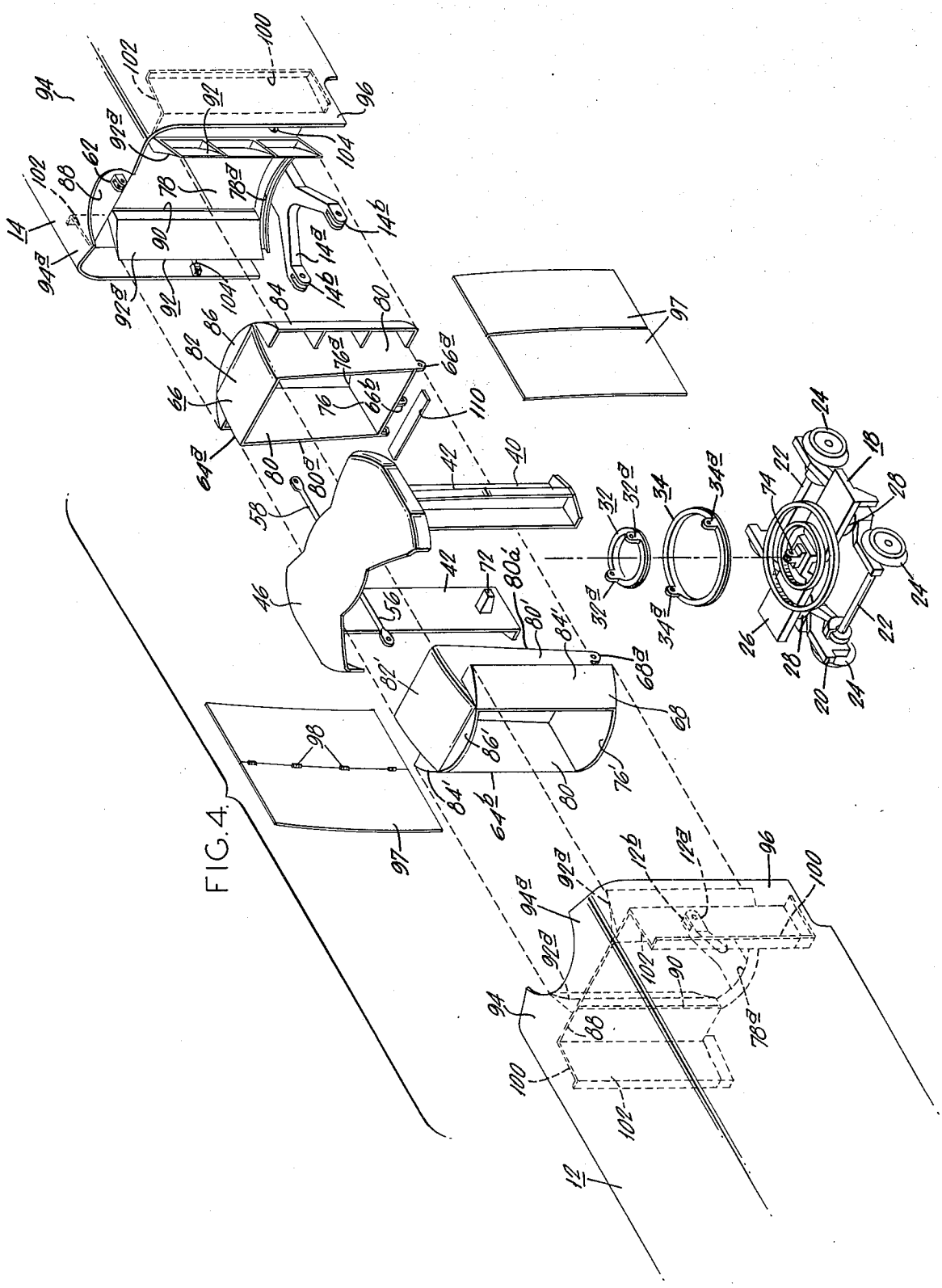


FIG. 4.

ARTICULATED RAILWAY VEHICLE CONNECTING PASSAGE

The present invention relates generally to articulated railway vehicles for passenger service, and relates more particularly to a novel joint for connecting the adjacent ends of the vehicle car sections.

Multi-car rail vehicles for use in passenger service are conventionally made up of cars having a truck at each end and which are separable from the adjacent cars. An advantage of this type of car is the permitted variation in length of the vehicle depending upon the traffic demand and the ready separability of individual cars for service.

A major shortcoming of the conventional rail vehicle is the arrangement at the car ends which permits passenger movement between the cars. The typical car terminates in a vestibule, from which a narrow portal leads to the portal and vestibule of the adjoining car. In intercity trains, the passage between the car vestibules typically consists of an accordian-pleated fabric covering to protect the traversing passenger from wind, rain, and the danger of falling between the cars. In the case of intracity commuter trains, the passage protection may consist only of a few chains limply extending between the car ends. With either arrangement, the passage from one car to the next while the train is moving, and particularly on a curve, can be an unsettling experience due to the substantial and unpredictable relative movements between the adjoining car ends. The principle cause of the relative movement is the fact that the car frames are connected to the trucks at a point spaced from the car ends which accordingly do not follow the path of the track. There is thus a considerable amount of lateral relative movement at the car connection and also a certain amount of vertical relative movement, particularly over a rough roadbed. To cope with these relative motions, the conventional car connection includes an array of sliding, pivoting, and squeeking floorplates subject to abrupt movement, negotiation of which is at best unpleasant and at worst hazardous.

The above-described disadvantages of conventional car connections are particularly evident with rail systems characterized by relatively sharp curves such as those found in street railways and subway systems. On many lines, passage between the cars is considered to be sufficiently hazardous that such passage is prohibited except to crew members or for emergency use. As a result, on multi-car street rail vehicles, it becomes necessary to provide a separate crew member for each car to receive fares and generally assist and supervise the conduct of the passengers.

To avoid the relative transverse and vertical movements of the adjoining car ends, the present invention utilizes a single truck to support both car ends. This concept is not broadly new, being shown for example in the early U.S. Pat. No. **566,712** which issued on Aug. **25, 1896.** This patent featured a common vestibule between the cars which was generally cylindrical in shape having a vertical axis aligned with the pivot point of the cars on the truck. Curved doors on each side of the vestibule accommodated the transverse relative angular movement of the cars. Sliding doors in the bulkheads at each end of the car separated the vestibule from the car proper.

In U.S. Pat. No. **2,225,951** issued Dec. **24, 1940,** a common truck is also illustrated supporting the adjoining ends of rail vehicle cars. The passage between the cars comprises spaced flexible diaphragms and the fairing strip between the car sides and roofs is similarly an elastic flexible member.

In the present invention, a rail vehicle joint comprises a common truck on the bolster of which the ends of adjoining cars are journaled for relative horizontal and vertical angular movement. A rigid smooth-walled tunnel assembly is disposed on the truck bolster and provided with arcuate surfaces for engagement with cooperating surfaces on the end of each car to accommodate lateral angular movement of the cars with respect to the truck. An arch-shaped frame assembly mounted on the truck supports a dome which cooperates with overhanging portions of the car roofs to shield the tunnel assembly from the elements and present a substantially smooth appearance of the roof of the vehicle. Side sealing panels hinged to the frame assembly slide within slots interiorly adjacent the car sides and are held against the car sides by suitable spring means to seal and maintain a continuous flush appearance of the sides of the cars.

The tunnel assembly opens at each end directly into the joined cars, providing a relatively wide, smooth-walled uninterrupted passage between the adjoining cars. The relative movement of each car with respect to the tunnel assembly is only half of the movement between the cars since the tunnel assembly is carried by the truck. Means are provided for assuring that the truck bolster pitch movement is similarly one-half of the relative pitch movement between the connected cars. This latter means includes a stabilizing linkage connecting the upper ends of the cars with the frame assembly on the truck bolster.

It is accordingly a first object of the present invention to provide a novel joint for articulated rail vehicles for passenger service.

A further object of the invention is to provide a rail vehicle joint having a novel tunnel assembly providing an uninterrupted rigid smooth-walled passage between the vehicle sections regardless of the orientation of the sections.

Another object of the invention is to provide a rail vehicle joint as described which will present a flush, attractive external surface connecting the vehicle sections.

A still further object of the invention is to provide a rail car joint as described which is economical to manufacture and install.

Still another object is to provide a joint as described which is exceptionally durable, practically maintenance free, and which is difficult to vandalize.

Additional objects and advantages of the invention will be more readily apparent from the following detailed description of an embodiment thereof when taken together with the accompanying drawings wherein:

FIG. **1** is a partial plan view of an articulated rail vehicle embodying the present joint, a portion of the vehicle being broken away and in section to show construction details;

FIG. **2** is a side elevational view of the vehicle as shown in FIG. **1,** a portion thereof being broken away and in section to show construction details;

FIG. **3** is a sectional view taken along line **3—3** of FIG. **2;**

FIG. 4 is an exploded perspective view on a reduced scale of the vehicle joint components;

FIG. 5 is a schematic plan view of the vehicle joint illustrating the relative movement of the major vehicle components during a transverse angular displacement of the connected vehicle cars; and

FIG. 6 is a schematic side elevational view of the vehicle joint illustrating the relative movement of the major vehicle components during a vertical angular displacement of the connected vehicle cars.

Referring to the drawings and specifically FIGS. 1–4 thereof, a rail vehicle generally designated **10** is illustrated which includes a pair of adjoining cars **12** and **14** which are connected by a joint generally designated **16** in accordance with the present invention. The ends of both of the cars **12** and **14** as well as the joint **16** are supported on a common truck **18** which is of a conventional four wheel design. As shown schematically in FIG. **2**, the truck includes a truck frame **20** supported by the axles **22** and wheels **24**. The truck bolster **26** as most readily illustrated in FIG. **3** is supported on pnuematic suspension members **28** mounted on the transverse truck member **30**.

The underframes of the cars **12** and **14** are supported on the bolster **26** by means of a universal bearing arrangement which permits free rotational movement of each car with respect to the truck in both a horizontal and vertical direction. This universal connection comprises inner and outer circular bearing ring assemblies **32** and **34** concentrically mounted with respect to the vertical center line of the bolster. Each of the bearing assemblies includes a diametrically opposed pair of upwardly directed ears **32***a* and **34***a* which are connected to the car frames to journal the cars on the truck. As shown in FIG. **4**, the cars **12** and **14** respectively include bifurcated frame members **12***a* and **14***a* which terminate at their outer ends in jaws **12***b* and **14***b*. As shown in FIG. **5**, the jaws **12***b* are connected to the ears **32***a* by pins **36** while the jaws **14***b* are similarly connected to the ears **34***a* by pins **38**. The pin connection of the jaws with the ears permits the cars to pivot vertically with respect to the bolster, while the bearing ring assemblies **32** and **34** permit transverse rotation of the cars with respect to the bolster.

The joint **16** includes an arch-shaped frame assembly generally designated **40** which includes a pair of transversely spaced vertical frame elements **42**, the lower ends of which are secured to the bolster **26**. The frame elements **42** are joined at their upper ends by a transverse frame member **44** on which is mounted a dome **46**.

The bolster **26** is transversely stabilized by the spaced disposition of the pneumatic suspension elements **28**. However, in view of the universal connection of the car frames to the bolster, the bolster would in the absence of stabilizing means, be free to pivot about its transverse horizontal axis. A stabilizing assembly generally designated **48** is accordingly provided at the top of the frame assembly **40** to control the pitch movement of the bolster. The stabilizing assembly **48** as most readily viewed in FIGS. **2** and **3** comprises a transverse shaft **50** carried by the shaft support assembly **52** on the frame element **44**. A rocker arm **54** is rotatably mounted on the shaft **50** and as shown in FIG. **2** is normally in a vertical position. Stabilizing bars **56** and **58** are pivotally connected to the opposite ends of the rocker arm **54** and are respectfully pivotally connected at their opposite ends to the cars **12** and **14** by the pin and clevis connectors **60** and **62**. Since the stabilizing arms **56** and **58** are of equal length, the stabilizing assembly insures a longitudinal centered relationship of the upper end of the frame assembly **40** with respect to the cars **12** and **14** and accordingly stabilizes the bolster pitching movement with respect to the truck frame.

The joint **16** further includes a tunnel assembly **64** which comprises telescoping inner and outer tunnel shell members **64***a* and **64***b*. As shown most clearly in FIG. **4**, the tunnel shell members each comprise a hollow box-like member having a substantially rectangular internal vertical transverse section. The tunnel shell members respectively include downwardly extending ears **66***a* and **68***a* at the sides thereof which are adapted for pivotal connection to pins **70** extending interiorly from supports **72** on each of the frame elements **42**. Additional central ears **66***b* and **68***b* of the tunnel shell members extend downwardly between the spaced ears **66***a* and **68***a* and are pivotally connected to the transversely disposed pin of the clevis **74** which is centrally mounted on the bolster **26**.

The inner and outer shell assemblies are identical in structure except that the inner shell members is slightly smaller in certain dimensions to permit pivoting telescoping movement within the outer shell member. Considering in detail the inner shell member **66**, this member includes a floor panel **76** which as shown in FIG. **2** is aligned in flush relationship with the floor **78** of the adjoining car **14**. The edge **76***a* of the floor panel **76** has an arcuate configuration, the radius of which is centered on the vertical center line of the truck bolster **26**. An arcuate groove **78***a* of the adjoining car floor **78** is of a similar arcuate curvature and as shown in FIG. **2** is adapted to receive the edge **76***a* of the floor panel. Upon transverse rotation of the car **14** with respect to the truck **20**, the edge **76** will slide in the groove **78***a* to accommodate the relative movement between the adjacent flooring sections.

The sidewalls **80** of the tunnel shell member **66** are of a smooth rigid material, preferably sheet metal, as is the top panel **82** thereof, which as shown most clearly in FIG. **2**, follows an arcuate longitudinal curve centered on the axis of the pivot pins **70**. Extending vertically along each side of the tunnel shell member adjacent the adjoining car end are the arcuate shield plates **84** which continue the curvature of the floor edge **76***a*. A lip portion **86** adjacent the top **82** of the tunnel shell member also continues this curvature from one shield plate **84** around the opposite shield plate.

Attached to bulkheads **88** of the car **14** and flanking an aperture **90** therein, which is aligned with and of a size equal to the passage through the tunnel shell members, are vertical closure shields **92** which have concave surfaces **92***a* extending the full height of the contiguous tunnel shell member **66** and which are adapted to engage the shield plates **84** to prevent any gap from appearing between the tunnel and car end. It will be apparent that any lateral pivotal movement of the car **14** with respect to the truck will result in a sliding movement of the shield plates **84** along the surfaces **92***a*. As shown in FIG. **2**, the inner edges **80***a* and **80***a'* of the tunnel shell member side panels **80** are inclined to provide a substantial overlap of the tunnel shell members.

The components of the outer tunnel shell member **68** are identical in shape to those described with respect to the inner tunnel shell member **66**. However, the

outer tunnel shell member is slightly wider and higher as may be seen in FIGS. **2** and **5** to permit a telescoping of the inner into the outer tunnel shell member. The corresponding parts of the outer tunnel shell member **68** have thus been accorded the same designating numbers with a prime suffix. The cars **12** and **14** are identical except for the frame members **12***a* and **14***a* being of a different width. The corresponding parts thereof are accordingly identified by the same numerals.

In view of the fact that the adjoining cars of an articulated vehicle employing the present joint are not designed for uncoupling, the ends of the cars adjoining the joint as shown in FIG. **4** are relatively open and do not, of course, employ the usual vestibule. The roof **94** and sides **96** of the cars extend beyond the bulkheads **88** to substantially overlap the joint components. With respect to the roof, as shown in FIG. **2**, a portion **94***a* of the roof extends in substantially overlapping relation with respect to the dome **46** of the joint. As shown in FIGS. **2** and **3**, the dome is convex on its upper surface to conform with the curvature of the car roofs and, in the longitudinal direction, to permit the relative rotation of the cars in a longitudinal plane. The edges of both the dome and the car roofs are irregularly shaped to accommodate the relative movement of the adjacent parts without contact.

To enclose the sides of the joint in flush relationship with the car sides **96**, side sealing panels **97** extending the full height of the car sides are hingedly mounted at **98** along the vertical center of the framing elements **42**. The sealing panels **97** extend in interiorly overlapping relation to the car side panels **96** within slots **100** formed by the inner wall of the side panels and an interior wall **102** of the car. Torsion bar spring assemblies **104** mounted on the bulkhead **88** include rollers **106** bearing against the side panels **97** to hold the side panels resiliently against the car sides **96**, thereby preventing rattling of the panels and insuring a flush appearance.

The operation of the joint is schematically illustrated in FIGS. **5** and **6** which respectively show the manner in which the joint accommodates transverse and vertical angular displacement of the cars as would occur during passage of the vehicle around a curve and on encountering a grade. Considering first the joint disposition on a curve, it will be noted that in FIG. **5** the cars are displaced at an angle A, although the angle between the car **12** and the joint **16** is a considerably smaller angle B. On a large curve of uniform radius, the truck and joint will assume an angular position with respect to each car which is equal to one-half of the angle between the two cars. Even on relatively abrupt curves of the type found in street railways, the truck and joint will throughout substantially the entire curve be disposed at an angle to each car less than the total angular displacement between the cars. As a result, the tunnel shell members will due to their mounting on the truck assume an intermediate angular position between that of either car, thereby minimizing the turning effect experienced by a passenger passing through the joint.

Considering in further detail the mechanics of the transverse articulated movement shown in FIG. **5**, as indicated above, the car frames are free to pivot on the bearing ring assemblies **32** and **34** about the vertical centerline passing through the truck. The common truck **20** will, of course, be disposed tangentially to the curve being traversed and once the truck has entered the curve, the adjacent cars **12** and **14** will subtend chords of the curve. The transverse displacement as shown in FIG. **5** will cause a relative rotation of the shell members with respect to the adjoining car ends. However, since the arcuate shell member edges **76***a* and surfaces **84** and **84'** are centered about the vertical center line of the truck, these surfaces will remain in engagement with the cooperating surfaces of the car ends, namely the slot **78***a* and the surfaces **92***a* of the closure shields **92**. The passage through the tunnel shell members may be slightly restricted by one of the closure shields **92** during the negotiation of a curve although the diminution of the passage size will be minimal. There will not be any gaps between the tunnel shell members and the closure shields which could create a hazard to passengers.

The side sealing panels **97** by virtue of their hinged connection at **98** to the framing elements **42** will swing to accommodate the angular displacement of the cars. The torsion bar spring assemblies **104** will through the rollers **106** maintain a constant resilient force on the panels **97**, urging them into engagement with the extending car side panels **96**. The sealing panels **97** in addition to pivotal movement about the hinge line **98** will also slide longitudinally along the inner walls of the car side panels **96** as the angular relationship of the cars with respect to the truck and joint changes. The rollers **106** and the extra depth of the pockets **100** are provided to accommodate this relative sliding movement.

Considering the vertical angular displacement of the cars in FIG. **6**, the truck and joint are disposed at an angle C to each of the cars which is half of the angular displacement D between the cars proper. In nearly all circumstances, the angular displacement between the truck and each car will be substantially smaller than that between the cars, and will usually be about one-half of that angle.

Considering the specific details of the vertical angular displacement of the cars, the cars may pivot vertically with respect to the truck about the pivot pins **36** and **38** connecting the frames to the fairing ring assemblies **32** and **34**. The tunnel shell members similarly are rotatable about the same horizontal transverse axis. Since each shell member is supported at one end on the pivot pins and at the other end on the adjoining car floor, the tunnel shell members will pivot so as to maintain the alignment of the floor panels **76** and **76'** with the car floors **78**. The described telescoping construction of the tunnel shell members permits the relative movement of the shell members to accommodate changes in the vertical angular relationship of the cars. The overlap of the tunnel side walls insures a sealed tunnel passage regardless of the relative disposition of the tunnel shell members. A slight spacing of the tunnel shell member floor panels **76** and **76'** is required to allow relative movement of the shell members. This spacing is covered by a cover plate **110** which may be fixed to one of the floor panels and slidable over the other.

Although the pivoting action of the cars with respect to the truck and joint has been described with respect to its horizontal and vertical components, it will be apparent that the joint will accommodate a combination of these components, in effect serving as a universal joint. The present joint will serve effectively to connect and seal the cars for horizontal curves up to **40°** and vertical curves up to **10°** (measured between the two

cars), which angles exceed the operating conditions to which rail vehicles are normally subjected.

In view of the universal bearing connection of the cars to the bolster, a stabilizing linkage is required to restrain pitching movement of the bolster. The stabilizing assembly **48**, by maintaining the upper end of frame assembly **40** equidistant from the car ends, insures a stable pitch attitude of the bolster, normally level with the truck.

The overlapping relation of the car roof extensions over the dome will obviously not prevent rain water from reaching the inner edges of the dome. Suitable seals and drains (not shown) of a conventional type are accordingly provided to prevent water from reaching the tunnel assemblies.

Manifestly, changes in details of construction can be effected by those skilled in the art without departing from the spirit and the scope of the invention.

I claim:

1. An articulated rail vehicle comprising a pair of cars, a common truck supporting the juxtaposed ends of said cars, a joint on said truck connecting said cars, said joint comprising a tunnel assembly defining an enclosed passage between said car ends, said tunnel assembly including telescoping inner and outer hollow tunnel shell members, connecting means for connecting said tunnel shell members to said truck and including means to enable said tunnel shell members to pivot with respect to said truck about a horizontal transverse axis, and arcuate sealing surfaces on said tunnel shell members engaging arcuate sealing surfaces on said car ends in sliding relation to accommodate transverse angular movement of said cars with respect to said truck and joint.

2. The invention as claimed in claim **1** wherein said juxtaposed car ends are pivotally mounted on said truck for relative transverse rotation about the vertical center line of said truck, said arcuate sealing surfaces on said tunnel shell members and said car ends comprising surfaces of revolution having an axis coinciding with the vertical center line of said truck when said cars are longitudinally aligned.

3. The invention as claimed in claim **2** wherein said arcuate sealing surfaces on each of said tunnel shell members are disposed at each side of the tunnel passage.

4. The invention as claimed in claim **3** wherein each said tunnel shell member comprises a rigid, smooth-walled structure.

5. The invention as claimed in claim **1** wherein said cars are supported on said common truck for relative vertical angular rotation about a transverse horizontal axis, said latter horizontal axis coinciding with the horizontal transverse axis about which said inner and outer tunnel shell members are pivotally rotatable when said cars are longitudinally aligned.

6. The invention as claimed in claim **1** including means disposed externally of said tunnel assembly for sealing said joint and providing substantially flush outer surfaces connecting said car ends.

7. The invention as claimed in claim **6** wherein said means disposed externally of said tunnel assembly for sealing said joint and providing substantially flush outer surfaces connecting said car ends comprises extending end portions of the car roofs and car sides, an arch-shaped frame assembly on said truck disposed in spaced relation around said tunnel assembly, a dome on said frame assembly cooperating with the extending ends of said car roofs to seal the top of said joint, and side sealing panels hinged along vertical pivot axes to said frame assembly in cooperative sealing relationship with the extending sides of said cars.

8. The invention as claimed in claim **7** wherein said car ends include slots adjacent the side walls thereof to accommodate said side sealing panels, and means for resiliently urging said side sealing panels into engagement with the inner faces of said extending car sides.

9. An articulated rail vehicle for passenger service comprising a pair of cars, a common truck supporting the juxtaposed ends of said cars, said truck including a bolster supported thereon by resilient suspension means, bearing means on said bolster connecting each of said car ends independently to said bolster, said bearing means providing pivotal horizontal movement of each said car ends about the vertical center line of said truck, said bearing means providing vertical pivotal movement of each of said cars with respect to said truck along a common horizontal axis transversely centered on said truck when said cars are longitudinally aligned, a joint on said truck connecting said cars, said joint comprising a tunnel assembly defining an enclosed passage between said car ends, said tunnel assembly including telescoping inner and outer tunnel shell members, said tunnel shell members each including floor panels aligned with and forming a continuation of the floors of the adjacent car ends, means for connecting said tunnel shell members to said bolster including means to enable said tunnel shell members to pivot with respect to said bolster about a transverse horizontal axis coinciding with the transverse axis of vertical movement of said cars with respect to said truck, arcuate sealing surfaces on said tunnel shell members engaging arcuate sealing surfaces on said car ends in sliding relation to accommodate transverse angular movement of said cars with respect to said truck end joint, said arcuate sealing surfaces on said tunnel shell members and said car ends comprising surfaces of revolution having an axis coinciding with the vertical center line of said truck when said cars are longitudinally aligned, an arch-shaped frame assembly mounted on said bolster externally of said tunnel assembly, stabilizing means connecting the upper end of said frame assembly with the end of each of said cars for maintaining a centered disposition of said frame assembly between said car ends and controlling the pitch attitude of said bolster.

10. The invention as claimed in claim **9** including means disposed externally of said tunnel assembly for sealing said joint and providing substantially flush outer surfaces connecting said car ends.

11. The invention as claimed in claim **10** wherein said means for sealing said joint and providing substantially flush outer surfaces connecting said car ends comprises extending end portions of the car roofs and car sides, a dome on said frame assembly cooperating with the extending ends of said car roofs to seal the top of said joint, and side sealing panels hinged along vertical pivot axes to said frame assembly in cooperative sealing relationship with the extending sides of said cars.

12. The invention as claimed in claim **11** wherein said car ends include slots adjacent each side wall thereof to accommodate said side sealing panels, and means for resiliently urging said side sealing panels into engagement with the inner faces of said extending car sides.

13. The invention as claimed in claim 12 wherein said means for resiliently urging said side sealing panels into engagement with the car sides comprises a torsion bar spring assembly mounted on each side of each car adjacent one of said side sealing panels, said torsion bar spring assembly including a roller engaging said side sealing panel and urging said panel into engagement with the inner face of the car side.

14. The invention as claimed in claim 12 wherein said side sealing panels comprise a pair of substantially rectangular panels hingedly mounted to said frame assembly along their vertical adjoining edges.

15. The invention as claimed in claim 9 wherein said stabilizing means comprises a transverse shaft centrally mounted on said frame assembly above said tunnel assembly, a rocker arm rotatably mounted on said shaft, and a pair of stabilizing bars, each bar connecting one end of said rocker arm to one of the car ends.

16. The invention as claimed in claim 9 wherein each of said tunnel shell members comprises a rigid, smooth-walled structure.

17. The invention as claimed in claim 9 wherein the roof of each of said tunnel shell member comprises a surface of revolution having an axis coinciding with the pivotal mounting axis of said tunnel shell members.

18. The invention as claimed in claim 9 wherein said arcuate sealing surfaces on each of said tunnel shell members are disposed at each side of the tunnel passage.

19. The invention as claimed in claim 9 wherein the pivotal axis of each said tunnel shell member lies beneath and closely adjacent the juncture of the tunnel floor panels.

20. The invention as claimed in claim 9 wherein said car ends each include a bulkhead extending transversely thereacross, an aperture in each said bulkhead aligned with the passage of said tunnel assembly, vertical closure shields extending the full height of said bulkhead aperture adjacent said aperture on the outer side of said bulkhead, said vertical closure shields including said arcuate sealing surfaces engaging said tunnel shell member sealing surfaces.

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