Oct. 11, 1966 F. W. HORNER ET AL 3,277,843

RAILWAY TANK CARS

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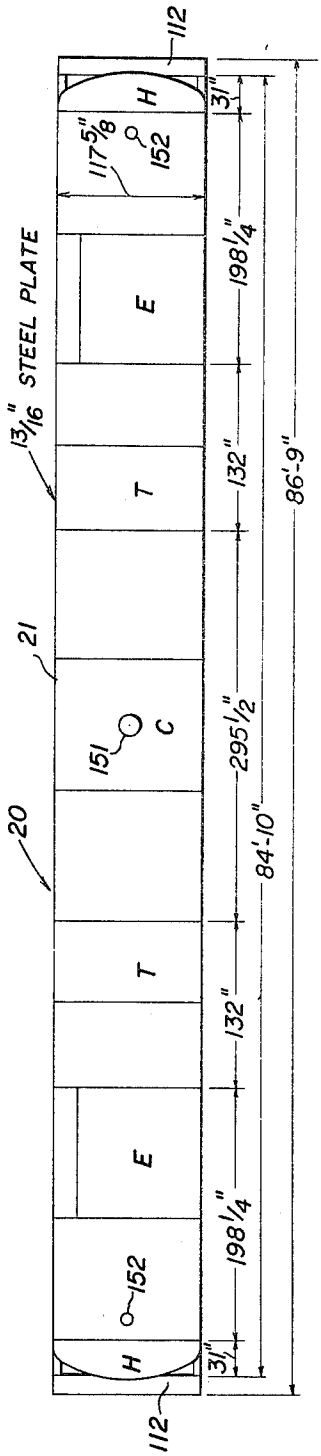


FIG. 1

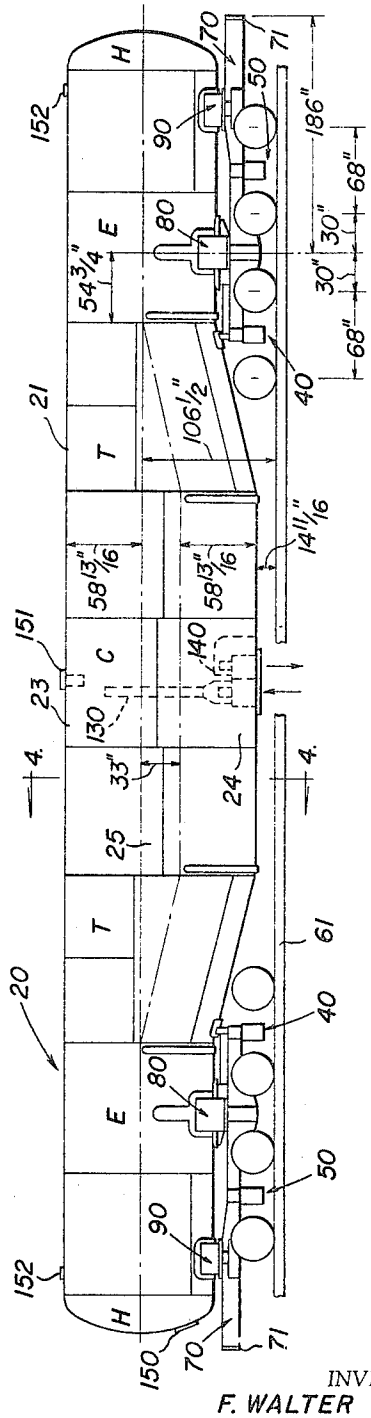


FIG. 2

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RAILWAY TANK CARS

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FIG. 4

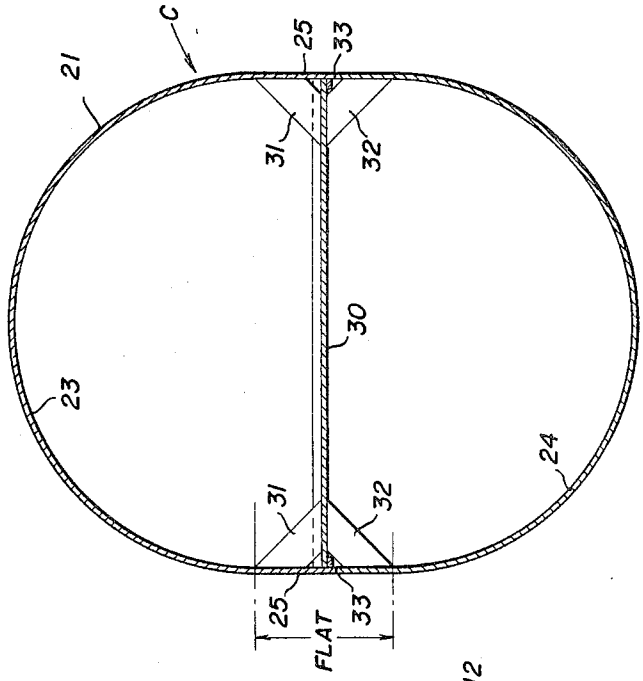
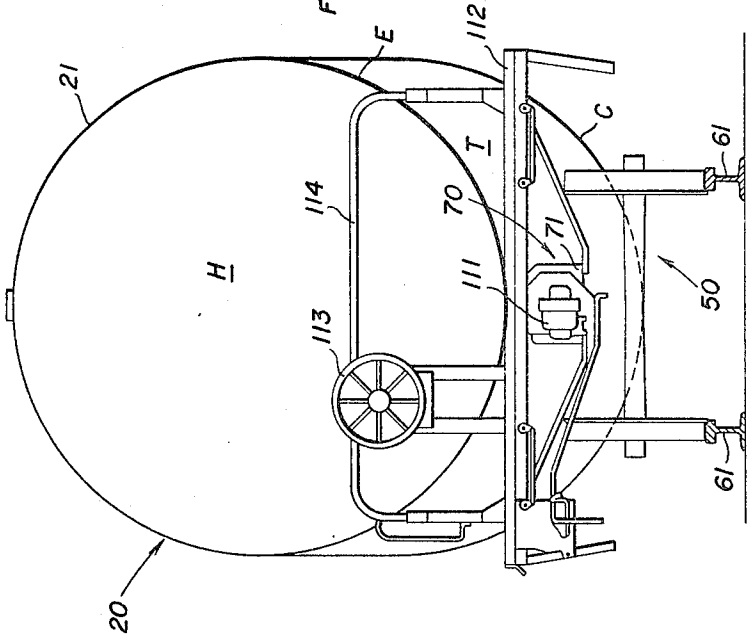


FIG. 3



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RAILWAY TANK CARS

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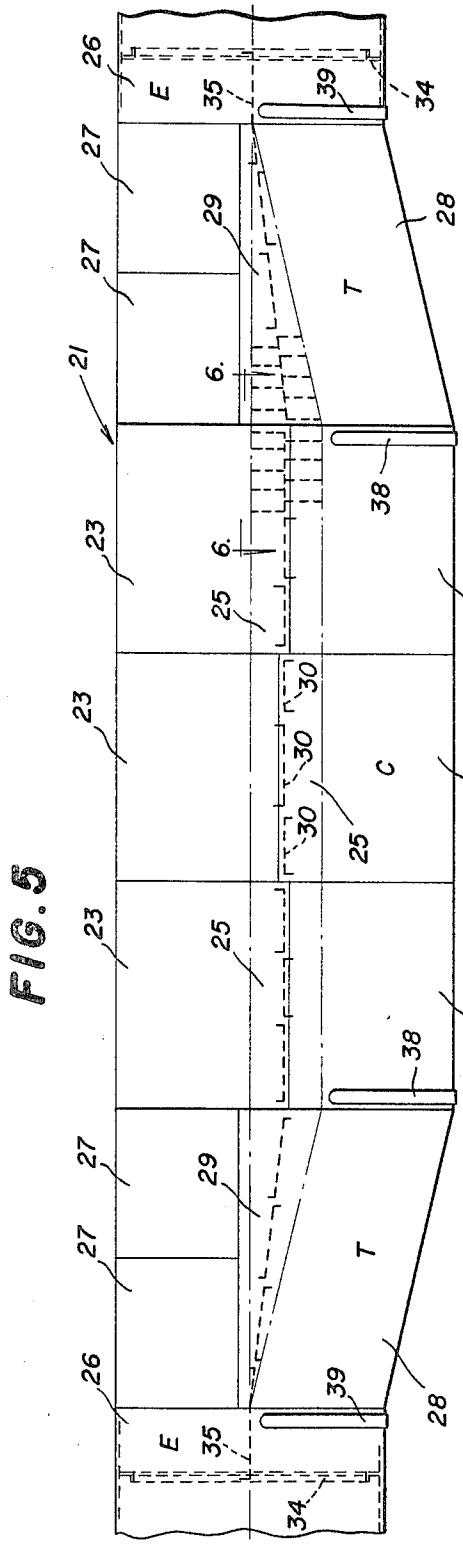


FIG. 5

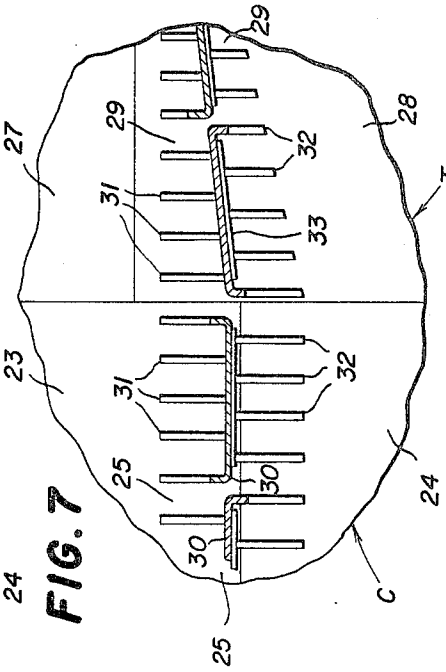


FIG. 7

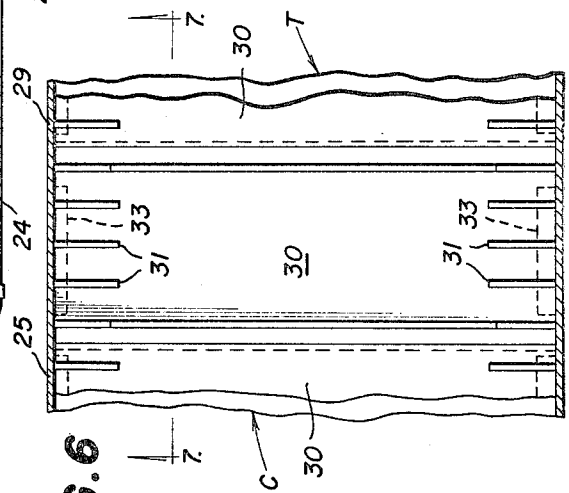


FIG. 6

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RAILWAY TANK CARS

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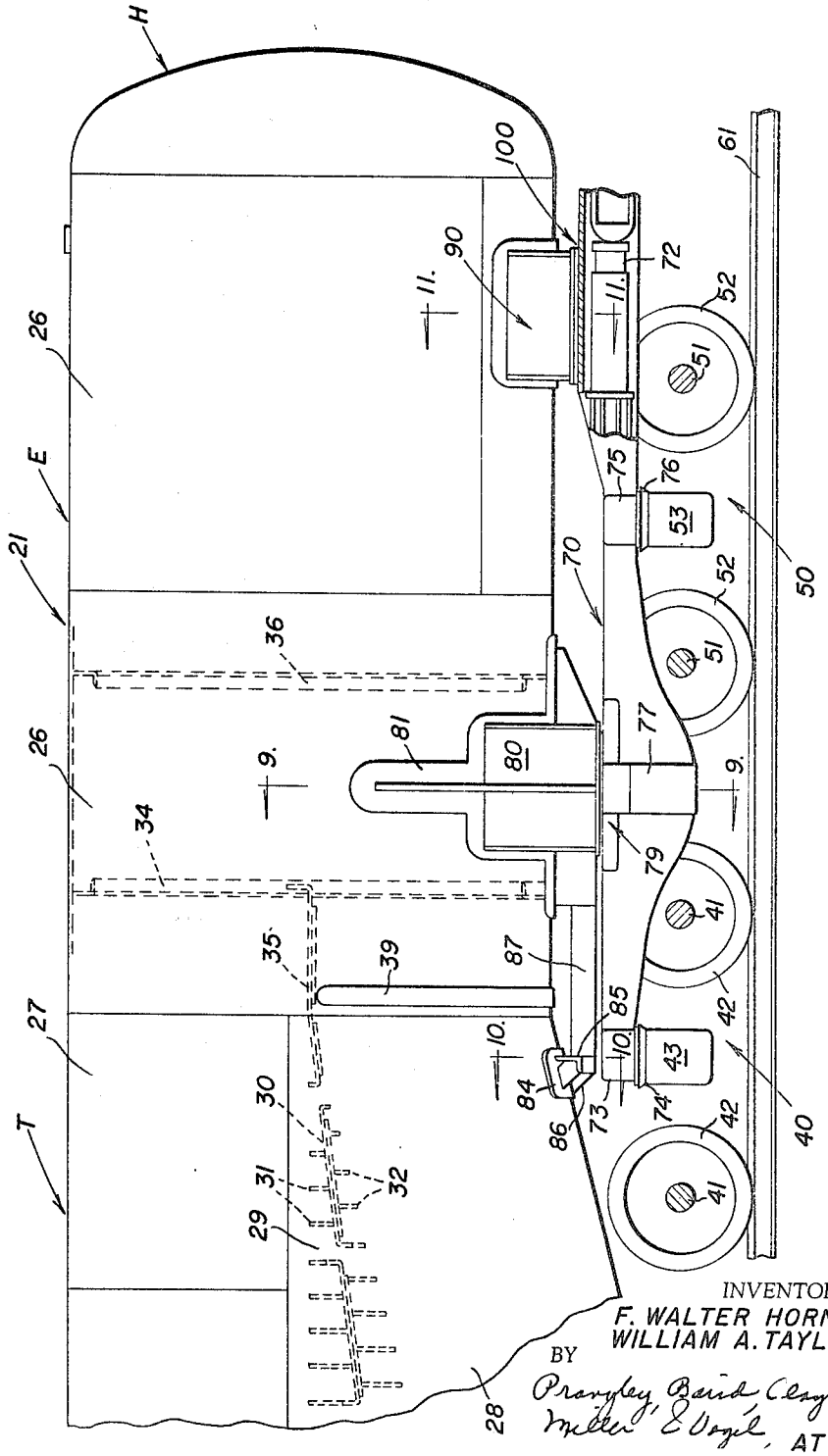


FIG. 8

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RAILWAY TANK CARS

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FIG. 10

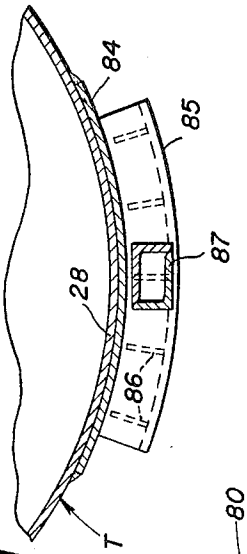
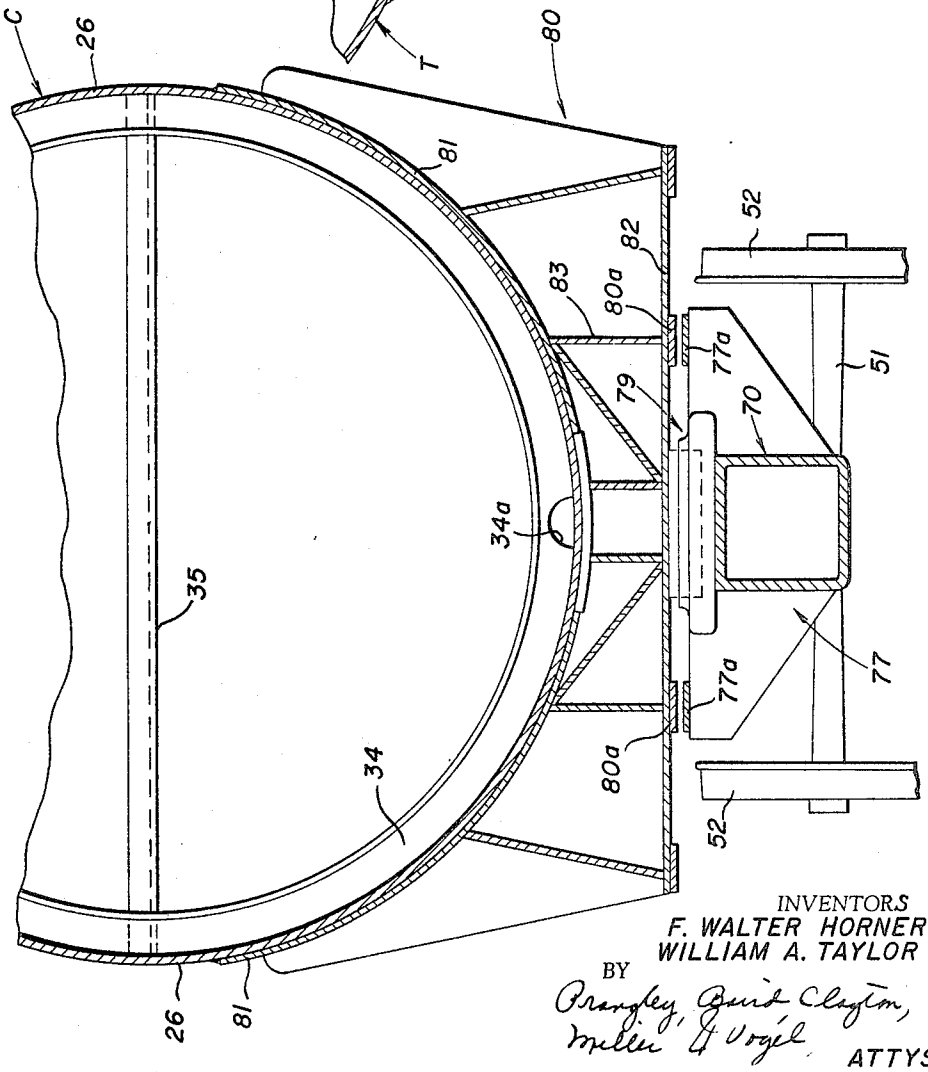


FIG. 9



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RAILWAY TANK CARS

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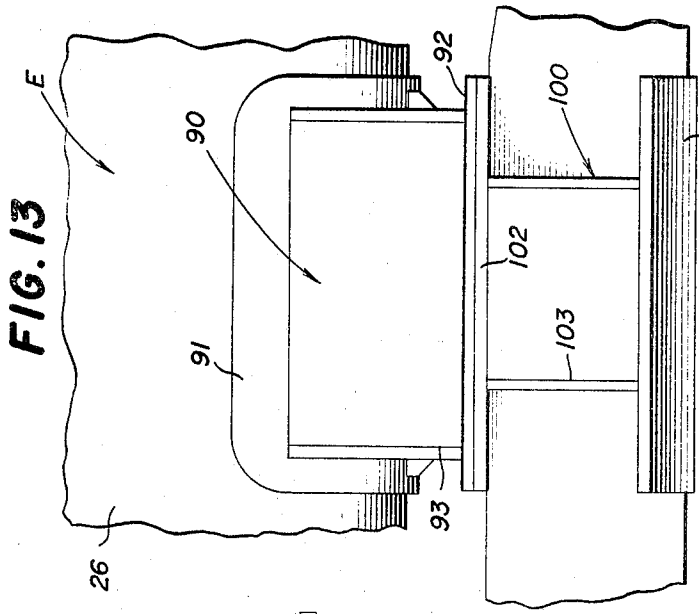


FIG. 13

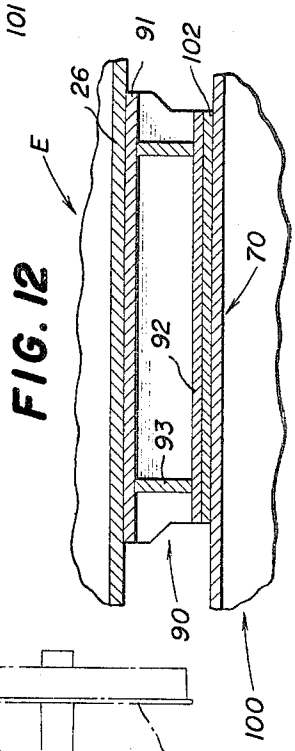


FIG. 12

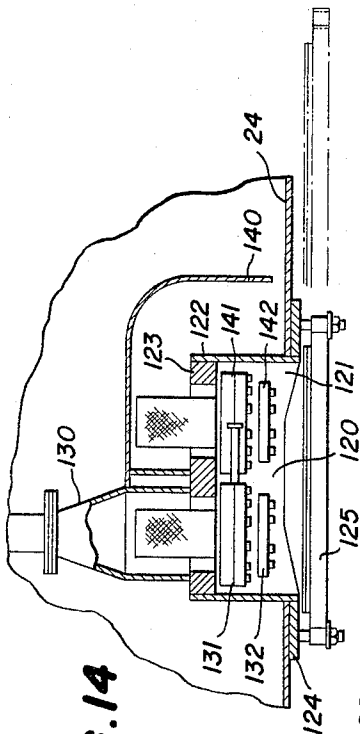


FIG. 14

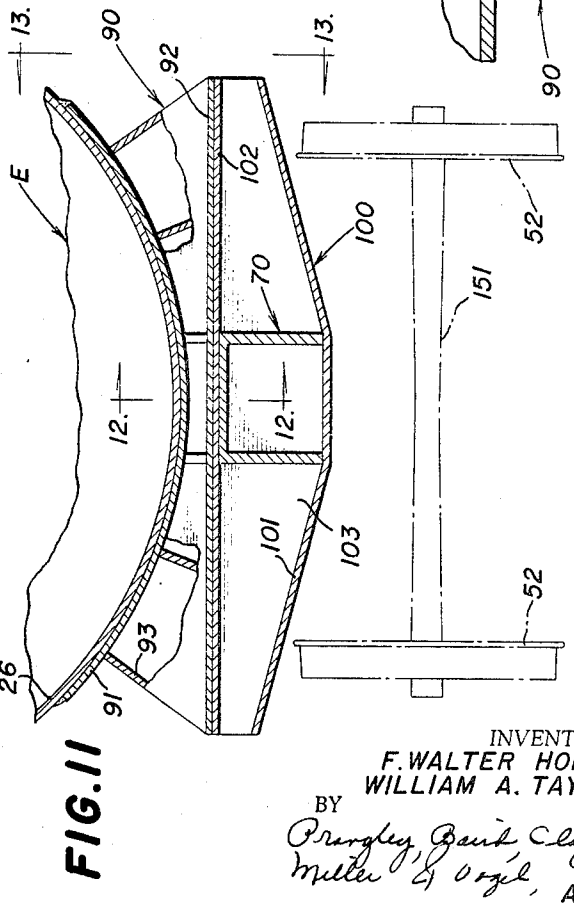


FIG. 11

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United States Patent Office 3,277,843 Patented Oct. 11, 1966

3,277,843

RAILWAY TANK CARS

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Filed Nov. 13, 1962, Ser. No. 236,917
6 Claims. (Cl. 105—360)

The present invention relates to railway tank cars, and particularly to such cars of exceedingly large volume.

It is a general object of the invention to provide a tubular body shell for a railway tank car, which body shell is of improved construction and arrangement and geometry affording the same substantially maximum volume within predetermined dimensions with respect to total height above the rails, total width and total length over the striker plates.

Another object of the invention is to provide a railway tank car comprising a tubular body shell incorporating an improved arrangement for reinforcing the body shell in order that the same is of strong rigid construction, so that it is capable of withstanding substantial hydraulic pressures and vapor pressures produced by volatile liquid ladings transported therein.

Another object of the invention is to provide a railway tank car comprising a tubular body shell of improved construction and arrangement that is especially adapted to the transporting of liquid petroleum gas, such as butane, propane, etc.

A further object of the invention is to provide a railway tank car that incorporates an improvement stub draft sill arrangement for transmitting the draft forces to and from the adjacent ends of the body shell, whereby the tank car comprises no continuous center sill, or equivalent structure extending from end to end thereof, but rather the body shell itself transmits the total draft force between the stub draft sills.

Yet another object of the invention is to provide a railway tank car comprising a tubular body shell of fish-belly configuration and incorporating an improved arrangement of the trucks at the opposite ends of the body shell.

Still another object of the invention is to provide a railway tank car of the character described that is provided with two trucks, each having two axles at the adjacent end of the body shell and incorporating an improved bolster arrangement for mounting the two trucks upon the adjacent stub draft sill for independent articulation and for mounting the stub draft sill upon the adjacent end of the body shell for articulation with respect thereto.

Still a further object of the invention is to provide a railway tank car comprising a tubular body shell of exceedingly large volume, wherein the tank car is of simple and economical construction and arrangement, notwithstanding the exceeding large volume of the body shell thereof.

Further features of the invention pertain to the particular construction and arrangement of the element of the railway tank car and of the tubular body shell thereof, whereby the above-outlined and additional operating features thereof are attained.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification, taken in connection with the accompanying drawings, in which:

FIGURE 1 is a plan view of a railway tank car embodying the present invention;

FIG. 2 is a side elevational view of the railway tank car;

FIG. 3 is an enlarged end elevational view of the railway tank car;

FIG. 4 is an enlarged lateral sectional view of the railway tank car, this view being taken in the direction of the arrows along the line 4—4 in FIG. 2;

FIG. 5 is an enlarged fragmentary side elevational view of the central portion of the body shell of the railway tank car;

FIG. 6 is a further enlarged fragmentary horizontal sectional view of tie structure incorporated in the central portion of the body shell, this view being taken in the direction of the arrows along the line 6—6 in FIG. 5;

FIG. 7 is a further enlarged fragmentary vertical sectional view of the tie structure, this view being taken in the direction of the arrows along the line 7—7 in FIG. 6;

FIG. 8 is a greatly enlarged fragmentary side elevational view, partly broken away, of one end portion of the body of the shell of the railway tank car;

FIG. 9 is a greatly enlarged fragmentary vertical sectional view taken through the tank bolster of the body shell, this view being taken in the direction of the arrows along the line 9—9 in FIG. 8;

FIG. 10 is a greatly enlarged fragmentary vertical sectional view taken through the saddle plate carried by the bottom outer end of the intermediate transition section of the body shell, this view being taken in the direction of the arrows along the line 10—10 in FIG. 8;

FIG. 11 is a greatly enlarged fragmentary vertical sectional view taken through the pedestal carried by the bottom outer end of the end section of the body shell, this view being taken in the direction of the arrows along the line 11—11 in FIG. 8;

FIG. 12 is a greatly enlarged fragmentary vertical sectional view of the pedestal, this view being taken in the direction of the arrows along the line 12—12 in FIG. 11;

FIG. 13 is a greatly enlarged fragmentary side elevational view of the pedestal, this view being taken in the direction of the arrows along the line 13—13 in FIG. 11; and

FIG. 14 is an enlarged side elevational view, partly broken away and partly in section, of the bottom central portion of the body shell and illustrating the facility for filling a liquid lading into the body shell and the facility for emptying a liquid lading from the body shell.

Referring now to FIGS. 1 to 3, inclusive, of the drawings, the railway tank car 20 there illustrated and embodying the features of the present invention is especially designed for transporting liquid petroleum gases (butane, propane, etc.). The tank car 20 comprises an elongated tubular body shell 21 of exceedingly large volume and of fish-belly construction, the illustrated embodiment of the body shell being of 52,000 U.S. gallons. More particularly, the body shell 21 defines independently of other structural elements a complete fluid-tight enclosure adapted to contain the L.P. gas in the liquid state and under the corresponding gauge pressure, the body shell 21 being of self-supporting rigid welded steel plate construction. More particularly, the longitudinal axis of the body shell 21 extends substantially horizontally; and the body shell 21 comprises a central section C, two substantially identical intermediate transition sections T, two substantial identical end sections E, and two substantially identical end heads H. The central section C is generally cylindrical; each of the transition sections T is generally frusto-conical; each of the end sections E is generally cylindrical; and each of the end heads H is convex. The inner ends of the transition sections T are respectively joined to the adjacent outer ends of the central section C; the outer ends of the transition sections T are respectively joined to the adjacent inner ends of the end

sections E; and the outer ends of the end sections E are respectively joined to the adjacent ends of the end heads H. The central section C is of relatively large cross sectional area, and each of the end sections E is of relatively small cross sectional area. The tops of the central section C, the transition sections T and the end sections E are disposed in a substantially horizontal upper plane; the bottom of the central section C is disposed in a substantially horizontal lower plane; the bottoms of the end sections E are disposed in a substantially horizontal intermediate plane; and the bottoms of the transition sections T are respectively disposed in two other planes upwardly and oppositely outwardly inclined from the lower plane mentioned.

As best shown in FIGS. 2, 4 and 5, the central section C is formed of a plurality of steel sheets defining an upper semi-cylindrical wall **23**, a lower semi-cylindrical wall **24**, and two oppositely disposed substantially rectangular side flat walls **25**; whereby the lateral cross section of the central section C is hereinafter referred to as being generally "elliptic," although the boundary thereof does not comprise a true "ellipse" as defined in classical geometry, as explained above. However, this terminology is quite appropriate since the word "elliptic" is sufficiently broad to embrace those closed curves that are like an ellipse, without qualifying as a true ellipse. As best shown in FIG. 4, the generally elliptic cross section of the central section C comprises a major lateral axis that extends in the vertical direction and a minor lateral axis that extends in the horizontal direction, these two lateral axes intersecting each other at the center of the central section C and substantially in the longitudinal axis of the body shell **21**. As best shown in FIGS. 1, 2, 5 and 9, each of the end sections E is formed of a plurality of steel sheets defining a substantially cylindrical wall **26**; whereby the lateral cross section of each end section E is circular. Also, the radius of the wall **26** of each end section E is identical to the radii of the walls **23** and **24** of the central section C. As best shown in FIGS. 2, 3 and 5, each of the transition sections T is formed of a plurality of steel sheets defining an upper semi-cylindrical wall **27**, a lower trough-like semi-cylindrical wall **28**, and two oppositely disposed substantially triangular side flat walls **29**; whereby the lateral cross section of the inner end of the transition section T is generally elliptic and the lateral cross section of the outer end of the transition section T is circular. Also, the dimensions of the walls **27**, **28** and **29** of each transition section T are selected, so that the lateral cross section of the inner end thereof conforms to the lateral cross section of the adjacent outer end of the central section C and so that the lateral cross section of the outer end thereof conforms to the lateral cross section of the adjacent inner end of the adjacent one of the end sections E.

Referring again to FIG. 5, it will be understood that the walls **25** and **29** of the central section C and of the two transition sections T enclosed by the dashed line there shown, are disposed in a flat plane in the "near" side of the body shell **21**; whereas the adjoining walls **24**, **25**, **26**, **27** and **28** in the central section C, in the end sections E and in the transition sections T are curved with respect to this flat plane. Of course, the "far" side of the body shell, not shown, is identical to the "near" side thereof, as described above.

A group of reinforcing ties **30** are arranged within the central section C and the transition sections T, as best shown in FIGS. 4 to 8, inclusive. This group of ties **30** comprises a central subgroup arranged in a substantially horizontal median plane passing through the central section C and two end subgroups respectively arranged in two other planes extending upwardly and oppositely outwardly from the ends of the median plane mentioned and through the respective transition sections T, as clearly indicated in FIG. 5; whereby the group of ties **30** extends longitudinally through the central section C and the transition sections T, and actually into the inner ends of the end sections E, as explained more fully subsequently. The individual ties **30** extend laterally between the flat walls **25** and **29** and are arranged in longitudinally spaced-apart relation, so as not to interfere with filling and emptying of the liquid lading from the body shell **21**. As best shown in FIGS. 6 and 7, each of the ties **30** essentially comprises a steel reinforcing element having a channel-shaped cross section. A pair of groups of upper gussets **31** and a pair of groups of lower gussets **32** are respectively arranged at the opposite ends of each of the ties **30**. Each individual upper gusset **31** is rigidly secured at the outer end thereof to the adjacent upper portion of the flat wall **25** or **29** and is rigidly secured at the inner end thereof to the adjacent end of the adjacent tie **30**; in a similar manner, each individual lower gusset **32** is rigidly secured at the outer end thereof to the adjacent lower portion of the flat wall **25** or **29** and is rigidly secured at the inner end thereof to the adjacent end of the adjacent tie **30**. As best shown in FIGS. 4, 6 and 7, the opposite ends of the ties **30** may be conveniently located and supported upon the flat walls **25** and **29** by short bars **33** rigidly secured thereto.

The body shell **21** is further reinforced by a pair of inner rings **34** respectively arranged within the inner ends of the end sections E, as best shown in FIGS. 5, 8 and 9; and a pair of ties **35** are also respectively arranged in the inner ends of the end sections E. The ties **35** are arranged in a substantially horizontal median plane passing through the longitudinal axis of the body shell **21**; the individual ties **35** extend laterally between the opposite side portions of the walls **26** of the end sections E; the opposite ends of each individual tie **35** are rigidly secured to the adjacent side portions of the wall **26**; and the outer portion of each individual tie is rigidly secured to the adjacent portions of the adjacent ring **34**. Further, each individual ring **34** is rigidly secured about the circumference thereof to the adjacent annular portion of the associated wall **26** of the corresponding end section E. Also, a pair of outer rings **36** are respectively arranged in the inner ends of the end sections E and respectively positioned longitudinally outwardly with respect to the inner rings **34**, as best shown in FIG. 8; and each individual ring **36** is rigidly secured about the circumference thereof to the adjacent annular portion of the associated wall **26** of the corresponding end section E. In order to insure proper emptying of the body shell **21** suitable holes are formed in the bottoms of the rings **34** and **35**, the hole **34***a* being formed in the bottom of the ring **34**, as shown in FIG. 9. The body shell **21** is also reinforced by a pair of semi-circular bands **38** respectively encircling the bottoms of the opposite outer ends of the walls **24** of the central section C and by a pair of semi-circular bands **39** respectively encircling the bottoms of the inner ends of the walls **26** of the end sections E, as best shown in FIG. 5.

The reinforcing arrangements described above that are incorporated in the body shell **21** render the same of strong rigid construction so that it may withstand the weight of the large volume of liquid lading, the hydraulic pressures involved, and also the gas pressures produced by such L.P. gases at ambient temperature, all without wall spread, or other undesirable deformation, thereof. Also, as explained more fully hereinafter, the draft forces are applied directly to the body shell **21**, whereby the same must resist deformation to any substantial degree as a result of these forces. which is also accomplished by the strong reinforced body shell **21**.

Considering now the mounting and incorporation of the body shell **21** into the railway tank car **20**, reference is made to FIGS. 2, 3 and 8; whereby it is noted that the opposite ends of the body shell **21** are respectively supported by a pair of inner trucks **40** and a pair of outer trucks **50** that are carried upon an associated rail-

way track provided with track rails, indicated at 61. Preferably, the two trucks 40 and the two trucks 50 are identical and of standard construction and arrangement. As best shown in FIG. 8, the inner truck 40 is of the two-axle type, including two individual axles 41 extending in the lateral direction and disposed in longitudinally spaced-apart relation, and carrying track wheels 42 at the outer ends thereof. Of course, the outer ends of the axles 41 are supported by roller bearings, not shown, that are carried by side frames, not shown, that are secured to a laterally extending truck bolster, indicated at 43, all in a conventional manner. Thus, the identical outer truck 50 also comprises the corresponding elements, including the illustrated elements 51, 52 and 53. Further, the tank car 20 comprises a pair of stub draft sills 70 arranged at the opposite ends of the body shell 21 and disposed in longitudinal alignment with each other, the inner ends of the stub draft sills 70 being respectively disposed below the end sections E, and the outer ends of the stub draft sills 70 projecting longitudinally outwardly beyond the respective end heads H and respectively terminating in striker plates, indicated at 71 in FIG. 2. The outer end of each stub draft sill 70 is hollow and receives a draft gear, as indicated at 72 in FIG. 8. Each of the draft gears 72 is preferably of conventional construction and arrangement, such, for example, as the draft gear "Mark 80" manufactured by Cardwell-Westinghouse. This draft gear 72 comprises two tandem related resilient units that act in parallel in response to draft forces and act in series in response to buff forces. Thus, the draft gear 72, while resilient in both draft and buff, is substantially stiffer in draft than in buff; which well-known characteristics of this particular draft gear 72 are highly advantageous in an extremely heavy railway car, and the railway tank car 20 is certainly a heavy railway car.

Continuing the reference to FIG. 8, the extreme inner end of the stub draft sill 70 carries a laterally extending bolster 73 rigidly secured thereto and disposed in superimposed relation with the truck bolster 43; which sill bolster 73 is connected to the truck bolster 43 by a conventional center pin-bearing mechanism 74, so that the inner truck 40 is mounted upon the stub draft sill 70 for articulation about the vertical axis of the mechanism 74 in a well-known manner. Similarly, the front portion of the inner end of the stub draft sill 70 carries a laterally extending bolster 75 rigidly secured thereto and disposed in superimposed relation with the truck bolster 53; which sill bolster 75 is connected to the truck bolster 53 by a conventional center pin-bearing mechanism 76, so that the outer truck 50 is mounted upon the stub draft sill 70 for articulation about the vertical axis of the mechanism 76 in a well-known manner. Thus the two trucks 40 and 50 cooperate jointly to support the adjacent stub draft sill 70, while preserving independent articulation thereof with respect to the stub draft sill 70.

Also the stub draft sill 70 carries a laterally extending bolster 77 rigidly secured to the intermediate portion of the inner end thereof, the sill bolster 77 being located substantially midway between the two sill bolsters 73 and 75. As best shown in FIGS. 2, 8 and 9, the opposite end sections E of the body shell 21 respectively carry a pair of body bolsters 80 that are respectively rigidly secured to the bottoms thereof and that respectively cooperate wtih the sill bolsters 77 respectively carried by the stub draft sills 70. More particularly, and continuing the reference to FIGS. 8 and 9, the lower wall 26 of the end section E there illustrated carries a substantially semicylindrical saddle plate 81 rigidly secured thereto and forming a part of the bolster 80. Further, the bolster 80 comprises a substantially horizontal bottom plate 82 disposed immediately above the substantially horizontal top of the sill bolster 77 and upstanding pedestal structure 83 rigidly interconnecting the saddle plate 81 and the bottom plate 82. The top of the sill bolster 77 and the bottom of the body bolster 80 are interconnected by a conventional center pin-bearing mechanism 79, so that the stub draft sill 70 is mounted upon the adjacent end section E of the body shell 21 for articulation about the vertical axis of the mechanism 79 and with respect to the adjacent end of the body shell 21 in a well-known manner. In the arrangement the body bolster 80 is located substantially centrally between two lateral planes disposed in longitudinally spaced-apart relation and respectively passing through the two reinforcing rings 34 and 35 arranged within the adjacent end section E of the body shell 21.

In order to lend further rigidity to the body shell 21, the transition section T disposed adjacent to the end section E carrying the body bolster 80, is also rigidly secured to the body bolster 80 by structure including a saddle plate 84 rigidly secured to the bottom of the wall 28 at the outer end of the transition section T, as best shown in FIGS. 8 and 10. The saddle plate 84 is also rigidly secured to an arcuate shaped angle member 85 by a plurality of plates 86; and the angle member 85 is rigidly secured to the adjacent side of the body bolster 80 by a rigid interconnecting arm 87.

As best shown in FIGS. 8, 11, 12, 13 and 14, the outer portion of the end section E is supported against sag or downward deflection by the associated stub draft sill 70, notwithstanding the articulation of the stub draft sill 70 about the mechanism 79 and laterally with respect to the adjacent end sections E, by an arrangement comprising a laterally extending pedestal 90 carried by the end section E and a plinth 100 carried by the stub draft sill 70. More particularly, the pedestal 90 comprises a saddle plate 91 rigidly secured to the bottom of the wall 26 of the end section E adjacent to the outer end thereof, a flat bottom plate 92, and intervening rigid structure 93. The plinth 100 is rigidly secured to the stub draft sill 70 adjacent to the outer portion of the inner end thereof and directly below the pedestal 90. Specifically, the plinth 100 comprises a bottom plate 101, a top plate 102, and intervening rigid structure 103. The top plate 102 of the plinth 100 directly engages and supports the bottom plate 92 of the pedestal 90, and accommodates universal movement between the engaging plates 92 and 102, so as to accommodate the articulation of the stub draft sill 70 relative to the adjacent end of the body shell 21, and also to accommodate expansion and contraction movements of the adjacent end of the body shell 21 relative to the stub draft sill 70 that occur, particularly during filling and emptying of the liquid lading with respect to the body shell 21. Also, the upper surface of the top plate 102 of the plinth 100 carries a suitable layer of molybdenum disulfide, or the equivalent, not shown, so as to lubricate the engaging or faying surfaces of the two plates 92 and 102 in order to minimize friction and to prevent galling therebetween.

The opposite outer ends of the draft gears 72 respectively carry couplers 111 disposed longitudinally outwardly with respect to the adjacent striker plates 71 respectively carried by the extreme outer ends of the stub draft sills 70, as indicated in FIG. 3. Also, the opposite outer ends of the stub draft sills 70 carry laterally extending platforms 112 disposed at the opposite ends of the tank car 20, as indicated in FIGS. 1 and 3. Also the one end of the tank car 20 illustrated in FIG. 3, carries the usual hand brake operating wheel, indicated at 113; and also the opposite ends of the tank car 20 are provided with the usual hand rails 114 respectively associated with the end platforms 112, as indicated in FIG. 3.

Considering now the general mode of operation of the tank car 20, the draft force is applied from the front coupler 111 to the associated resilient draft gear 72 and thence to the associated stub draft sill 70 at the front or drawn end of the tank car 20, whereby the front stub draft sill 70 draws the connected trucks 50 and 40 directly through the respective mechanisms 76 and 74 and applies a draft force through the associated mechanism 79 to the

front body bolster **80**. This draft force applied to the front body bolster **80** is applied directly to the front end section E and through the saddle plate **84** to the front transition section T; the front end section E draws the front transition section T; and the drawn front transition section T draws through the center section C the rear transition section T. The rear transition section T draws the rear body bolster **80** directly through the rear saddle plate **84** and also draws directly the rear end section E; whereby the rear body bolster **80** is drawn forwardly effecting a draft of the rear stub draft sill **70** through the associated mechanism **79**. The rear stub draft sill **70** draws the connected trucks **40** and **50** directly through the respective mechanisms **74** and **76** and applies a draft force via the associated draft gear **72** to the rear coupler **111**. The rear coupler draws the coupled rear railway car in the string in a similar manner. Of course buff forces are transmitted between the stub draft sills **70** through the body shell **21** in a similar manner, which description is omitted in the interest of brevity. During the transit of the railway tank car **20** the stub draft sills **70** are articulated with respect to the body shell **21**, and the trucks **40** and **50** are articulated with respect to the stub draft sills **70**, as required by curves in the railway track in a well-known manner; whereby the railway car is capable of turning a fairly short radius curve in the railway track, notwithstanding the substantial length thereof between the striker plates **71**.

In connection with FIG. 9, it is pointed out that the sill bolster **77** is provided with the usual laterally spaced-apart side bearings **77***a* that cooperate with the usual laterally spaced-apart side plates **80***a* carried by the body bolster **80**; which side bearings **77***a* and side plates **80***a* limit lateral tilt of the body bolster **80** upon the sill bolster **77** in the usual manner when the railway tank car **20** is traversing a banked curve in the railway track or in the event the body shell **21** rocks or tilts laterally excessively with respect to the trucks **40** and **50**.

Also, it is noted that the arrangement of the ties **30** and **35** within the body shell **21** not only reinforce the same to prevent spreading of the flat side walls **25** and **29** in the manner as previously explained, but these ties **30** and **35** also minimize surging of the liquid lading from end to end of the body shell **21** in a desirable manner. Specifically, the ties **30** and **35** break-up and damp-out such surges of the liquid lading that occur during transit of the railway tank car **20**.

Turning now to the handling of the liquid lading incident to filling and emptying of the body shell **21**, it is first noted that wall structure is provided in the bottom central portion of the bottom wall **24** of the central section C to define a control compartment **120** therein, as best shown in FIGS. 2 and 14. Specifically, the bottom central portion of the bottom wall **24** mentioned has an opening **121** therein communicating with the control compartment **120**; and the structure mentioned includes an upstanding substantially cylindrical tube **122**, and a top wall **123**. The bottom of the tube **122** is sealed to the bottom wall **24** in surrounding relation with the bottom opening **121**, and the top wall **123** serves as a plug in the top end of the tube **122**. The lower outer surface of the bottom wall **24** is reinforced by a substantially annular collar **124** rigidly secured thereto and to the extreme lower end of the tube **122**; which collar **124** is disposed exteriorly of the body shell **21** and carries a hatch cover **125** that is selectively movable between open and closed positions with respect to the hatch opening **121**, so as selectively to control access to the control compartment **120** from the exterior. A filling tube **130** is arranged in upstanding position in the central portion of the central section C, the upper open end of the filling tube **130** terminating somewhat below the upper wall **23** of the central section C, and the lower end of the filling tube **130** being sealed to the plug **123**. Also, the plug **123** carries a manually operable control valve, indicated at **131** in FIG. 14, that is sealed to the lower end of the filling tube **130** and arranged within the control compartment **120**; which control valve **131** is provided with a selectively removable cover plate, indicated at **132** in FIG. 14. An emptying tube **140** is arranged in the central portion of the center section C, the emptying tube **140** being subbstantially L-shaped and including an open outer end communicating with the interior of the body shell **21** adjacent to the bottom wall **24** and an inner end sealed to the plug **123**. Also, the plug **123** carries a manually operable control valve, indicated at **141** in FIG. 14, that is sealed to the inner end of the emptying tube **140** and arranged within the control compartment **120**; which control valve **141** is provided with a selectively removable cover plate, indicated at **142** in FIG. 14.

In carrying out a filling operation of the body shell **21**, the hatch cover **125** is operated into its open position; and the cover plates **132** and **142** are removed from the valves **131** and **141**. The valve **141** is closed; and the L.P. gas container is connected to the valve **131**. The valve at the L.P. container is opened; and then the valve **130** is opened. The L.P. gas then passes under pressure from the L.P. container through the open valve **131** and thence through the filling tube **130** is a stream onto the top wall **23** of the central section C, and thence in the form of a spray back into the bottom of the body shell **21**. After complete filling of the body shell **21** with the liquid lading, the valve **130** is closed; the valve at the L.P. container is closed; and the L.P. container is disconnected from the valve **131**. Thereafter, the cover plates **132** and **142** are replaced upon the valve **131** and **141**; and the hatch cover **125** is operated into its closed position.

In carrying out an emptying operation of the body shell **21**, the hatch cover **125** is operated into its open position; and the cover plate **142** is removed from the valve **141**; and the L.P. receiver is connected to the valve **141**. The valve at the L.P. receiver is opened; and then the valve **140** is opened. The L.P. gas then passes under pressure from the body shell **21** through the emptying tube **140** and the open valve **141** into the L.P. receiver. After complete emptying of the body shell **21** of the liquid lading, the valve **140** is closed; the valve at the L.P. receiver is closed; and the L.P. receiver is disconnected from the valve **141**. Thereafter, the cover plate **142** is replaced upon the valve **141**; and the hatch cover **125** is operated into its closed position.

In a constructional example of the body shell **21** that is adapted to contain a liquid lading and having a volume of 52,000 U.S. gallons, the same may have the fundamental dimensions as disclosed in FIGS. 1 and 2; whereby the body shell **21** has an overall length over the end heads H of 84'—10"; the central section C has a length of 295½"; each of the transition sections T has a length of 132"; each of the end sections E has a length of 198¼"; and each of the end heads H has a length of 31". The body shell **21** may be fabricated throughout of $^{13}/_{16}$" steel plate; and welded joints are employed altogether. In the central section C: the top wall **23** may have a height of 58$^{13}/_{16}$" (corresponding to an inside radius of 58"); the bottom wall **24** may have a height of 58$^{13}/_{16}$" (corresponding to an inside radius of 58"); and the flat wall **25** may have a height of 33". In each end section E, the inside radius may be 58". In each transition section T, the other dimensions are established by the adjacent central section C and the adjacent end section E, in an obvious manner. Thus, the body shell **21** has an overall width of 117⅝".

Continuing with the constructional example of the railway tank car **20** embodying the body shell **21**, as described above, the overall length of the car **20** over the striker plates is 86'—9"; the bottom of the center section C clears the rails **61** by 14$^{11}/_{16}$"; and the longitudinal center line of the body shell **21** is positioned 106½" above the rails **61**. The center line of the body bolster **80** is disposed 186" rearwardly of the striker plate **71** at the

adjacent end of the car **20** and 54¾" forwardly of the junction between the adjacent end section E and the adjacent end of the transition section T. The axles **41** of the rear truck **40** and the axles **51** of the front truck **50** are spaced on 68" centers; the center line of the rear axle **51** of the front truck **50** is spaced 30" forwardly of the center line of the body bolster **80**; the center line of the front axle **41** of the rear truck **40** is spaced 30" rearwardly of the center line of the body bolster **80**; and all of the track wheels **42** and **52** are of 33" diameter. Thus, the tank car **20** has a maximum length of 86'—9" and a maximum width of 117⅝".

Finally, it is pointed out that the railway tank car **20** comprises the usual applicances and equipment that is conventional in this art; for example: the left-hand end head H, as shown in FIG. 2, comprises a manway **150** to facilitate cleaning of the interior of the body shell **21**; the top central portion of the central section C is provided with a conventional safety valve **151** of the high-pressure relief type; and the top outer end portions of the end sections E are respectively provided with a pair of purge line caps **152**.

In view of the foregoing, it is apparent that there has been provided a railway tank car of improved construction and arrangement that is especially designed to transport an exceedingly large volume of liquid lading, particularly a liquid petroleum gas, such as butane, propane, etc. Also, the railway tank car comprises a body shell of improved strong rigid fish-belly construction and arrangement that is capable of transmitting therethrough the draft forces involved in an ordinary railway train, notwithstanding the fact that the railway car includes no center sill or equivalent structural member extending from end to end of the body shell. Further, the railway tank car comprises an improved arrangement for respectively mounting a pair of stub draft sills below the opposite ends of the body shell of fish-belly construction. Furthermore, the railway tank car comprises an improved arrangement for respectively mounting trucks below the opposite ends of the body shell of fish-belly construction.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A railway tank car comprising a longitudinally extending tubular body shell defining independently of other structural elements a complete fluid-tight enclosure, said body shell being of self-supporting rigid construction and including a central section and a pair of substantially identical intermediate transition sections and a pair of substantially identical end sections and a pair of substantially identical end heads, said central section being generally cylindrical and having a relatively large maximum lateral dimension, each of said end sections being generally cylindrical and having a relatively small maximum lateral dimension, each of said intermediate transition sections being generally frusto-conical and including an inner end substantially conforming to the adjacent outer end of said central section and an outer end substantially conforming to the inner end of the adjacent one of said end sections, each of said end heads being substantially cup-shaped and including an inner end substantially conforming to the outer end of the adjacent one of said end sections, the top of said central section and the tops of said intermediate transition sections and the tops of said end sections being disposed in a substantially horizontal upper plane, the bottom of said central section being disposed in a substantially horizontal lower plane and the bottoms of said end sections being disposed in a substantially horizontal intermediate plane and the bottoms of said intermediate transition sections being respectively disposed in two other planes generally upwardly and oppositely outwardly inclined from said lower plane, whereby said body shell is of fish-belly configuration, a pair of longitudinally aligned narrow stub draft sills respectively arranged adjacent to the opposite ends of said body shell with the inner ends of said stub draft sills respectively disposed below the bottoms of said end sections and with the outer ends of said stub draft sills respectively projecting longitudinally outwardly beyond said end sections, a pair of laterally extending body bolsters respectively rigidly secured to the bottoms of said end sections, a pair of laterally extending first sill bolsters respectively rigidly secured to the inner ends of said stub draft sills, the opposite ends of each one of said first sill bolsters respectively extending laterally outwardly from the opposite sides of the corresponding one of said stub draft sills, a pair of first center pin-bearing structures respectively interconnecting said body bolsters and said first sill bolsters, whereby each of said stub draft sills is mounted for articulate motion about the vertical axis of the adjacent one of said first center pin-bearing structures with respect to the adjacent end of said body shell, a pair of trucks respectively arranged below the inner ends of said stub draft sills and respectively carrying a pair of laterally extending truck bolsters, a pair of laterally extending second sill bolsters respectively rigidly secured to the inner ends of said stub draft sills, the opposite ends of each one of said second sill bolsters respectively extending laterally outwardly from the opposite sides of the corresponding one of said stub draft sills, a pair of second center pin-bearing structures respectively interconnecting said truck bolsters and said second sill bolsters, whereby each of said trucks is mounted for articulate motion about the vertical axis of the adjacent one of said second center pin-bearing structures with respect to the adjacent one of said stub draft sills, and a pair of draft gears respectively carried by the outer ends of said stub draft sills.

2. The railway tank car set forth in claim **1**, wherein said second sill bolsters are respectively disposed longitudinally inwardly with respect to said first sill bolsters so that said truck bolsters are respectively disposed longitudinally inwardly with respect to said body bolsters.

3. The railway tank car set forth in claim **1**, wherein said second sill bolsters are respectively disposed longitudinally outwardly with respect to said first sill bolsters so that said truck bolsters are respectively disposed longitudinally outwardly with respect to said body bolsters.

4. The railway tank car set forth in claim **1**, and further comprising a pair of laterally extending saddle plates respectively rigidly secured to the bottoms of said intermediate transition sections adjacent to the outer ends thereof, and a pair of longitudinally extending rigid arms respectively interconnecting said saddle plates and said body bolsters.

5. A railway tank car comprising a longitudinally extending tubular body shell defining independently of other structural elements a complete fluid-tight enclosure, said body shell being of self-supporting rigid construction and including a central section and a pair of substantially identical intermediate transition sections and a pair of substantially identical end sections and a pair of substantially identical end heads, said central section being generally cylindrical and having a relatively large maximum lateral dimension, each of said end sections being generally cylindrical and having a relatively small maximum lateral dimension, each of said intermediate transition sections being generally frusto-conical and including an inner end substantially conforming to the adjacent outer end of said central section and an outer end substantially conforming to the inner end of the adjacent one of said end sections, each of said end heads being substantially cup-shaped and including an inner end substantially conforming to the outer end of the

adjacent one of said end sections, the top of said central section and the tops of said intermediate transition sections and the tops of said end sections being disposed in a substantially horizontal upper plane, the bottom of said central section being disposed in a substantially horizontal lower plane and the bottoms of said end sections being disposed in a substantially horizontal intermediate plane and the bottoms of said intermediate transition sections being respectively disposed in two other planes generally upwardly and oppositely outwardly inclined from said lower plane, whereby said body shell is of fish-belly configuration, a pair of longitudinally aligned narrow stub draft sills respectively arranged adjacent to the opposite ends of said body shell with the inner ends of said stub draft sills respectively disposed below the bottoms of said end sections and with the outer ends of said stub draft sills respectively projecting longitudinally outwardly beyond said end sections, a pair of laterally extending body bolsters respectively rigidly secured to the bottoms of said end sections, a pair of laterally extending first sill bolsters respectively rigidly secured to the inner ends of said stub draft sills, the opposite ends of each one of said first sill bolsters respectively extending laterally outwardly from the opposite sides of the corresponding one of said stub draft sills, a pair of first center pin-bearing structures respectively interconnecting said body bolsters and said first sill bolsters, whereby each of said stub draft sills is mounted for articulate motion about the vertical axis of the adjacent one of said first center pin-bearing structures with respect to the adjacent end of said body shell, a pair of inner trucks respectively arranged below the inner ends of said stub draft sills and respectively carrying a pair of inner truck bolsters, a pair of outer trucks respectively arranged below the inner ends of said stub draft sills and respectively carrying a pair of outer truck bolsters, a pair of laterally extending second sill bolsters respectively rigidly secured to the inner ends of said stub draft sills and respectively positioned longitudinally inwardly with respect to said first sill bolsters, the opposite ends of each one of said second sill bolsters respectively extending laterally outwardly from the opposite sides of the corresponding one of said stub draft sills, a pair of laterally extending third sill bolsters respectively rigidly secured to the inner ends of said stub draft sills and respectively positioned longitudinally outwardly with respect to said first sill bolsters, the opposite ends of each one of said third sill bolsters respectively extending laterally outwardly from the opposite sides of the corresponding one of said stub draft sills, a pair of second center pin-bearing structures respectively interconnecting said inner truck bolsters and said second sill bolsters, whereby each of said inner trucks is mounted for articulate motion about the vertical axis of the adjacent one of said second center pin-bearing structures with respect to the adjacent one of said stub draft sills, a pair of third center pin-bearing structures respectively interconnecting said outer truck bolsters and said third sill bolsters, whereby each of said outer trucks is mounted for articulate motion about the vertical axis of the adjacent one of said third center pin-bearing structures with respect to the adjacent one of said stub draft sills, and a pair of draft gears respectively carried by the outer ends of said stub draft sills.

6. A railway tank car comprising a longitudinally extending tubular body shell defining independently of other structural elements a complete fluid-tight enclosure, said body shell being of self-supporting rigid construction and including a central section and a pair of substantially identical intermediate transition sections and a pair of substantially identical end sections and a pair of substantially identical end heads, said central section being generally cylindrical and having a relatively large maximum lateral dimension, each of said end sections being generally cylindrical and having a relatively small maximum lateral dimension, each of said intermediate transition sections being generally frusto-conical and including an inner end substantially conforming to the adjacent outer end of said central section and an outer end substantially conforming to the inner end of the adjacent one of said end sections, each of said end heads being substantially cup-shaped and including an inner end substantially conforming to the outer end of the adjacent one of said end sections, the top of said central section and the tops of said intermediate transition sections and the tops of said end sections being disposed in a substantially horizontal upper plane, the bottom of said central section being disposed in a substantially horizontal lower plane and the bottoms of said end sections being disposed in a substantially horizontal intermediate plane and the bottoms of said intermediate transition sections being respectively disposed in two other planes generally upwardly and oppositely outwardly inclined from said lower plane, whereby said body shell is of fish-belly configuration, a pair of longitudinally aligned narrow stub draft sills respectively arranged adjacent to the opposite ends of said body shell with the inner ends of said stub draft sills respectively disposed below the bottoms of said end sections and with the outer ends of said stub draft sills respectively projecting longitudinally outwardly beyond said end sections, a pair of laterally extending body bolsters respectively rigidly secured to the bottoms of said end sections adjacent to the inner ends thereof, a pair of laterally extending pedestals respectively rigidly secured to the bottoms of said end sections adjacent to the outer ends thereof, a pair of laterally extending first sill bolsters respectively rigidly secured to the inner ends of said stub draft sills, the opposite ends of each one of said first sill bolsters respectively extending laterally outwardly from the opposite sides of the corresponding one of said stub draft sills, a pair of first center pin-bearing structures respectively interconnecting said body bolsters and said first sill bolsters, whereby each of said stub draft sills is mounted for articulate motion about the vertical axis of the adjacent one of said first center pin-bearing structures with respect to the adjacent end of said body shell, a pair of laterally extending sill plinths respectively rigidly secured to the inner ends of said stub draft sills and respectively positioned longitudinally outwardly with respect to said first sill bolsters and respectively located below said pedestals, the opposite ends of each one of said sill plinths respectively extending laterally outwardly from the opposite sides of the corresponding one of said stub draft sills, each one of said sill plinths engaging the bottom of the adjacent one of said pedestals and accommodating sliding movement therebetween, whereby said draft sills respectively support the opposite ends of said body shell notwithstanding articulate motions of said stub draft sills with respect to the adjacent opposite ends of said body shell, a pair of trucks respectively arranged below the inner ends of said stub draft sills and respectively carrying a pair of laterally extending truck bolsters, a pair of laterally extending second sill bolsters respectively rigidly secured to the inner ends of said stub draft sills, the opposite ends of each one of said second sill bolsters respectively extending laterally outwardly from the opposite sides of the corresponding one of said stub draft sills, a pair of second center pin-bearing structures respectively interconnecting said truck bolsters and said second sill bolsters, whereby each of said trucks is mounted for articulate motion about the vertical axis of the adjacent one of said second center pin-bearing structures with respect to the adjacent one of said stub draft sills, and a pair of draft gears respectively carried by the outer ends of said stub draft sills.

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