May 24, 1966 E. A. PHILLIPS 3,252,431

RAILROAD HOPPER-TYPE TANK CAR

Filed March 30, 1964 2 Sheets-Sheet 1

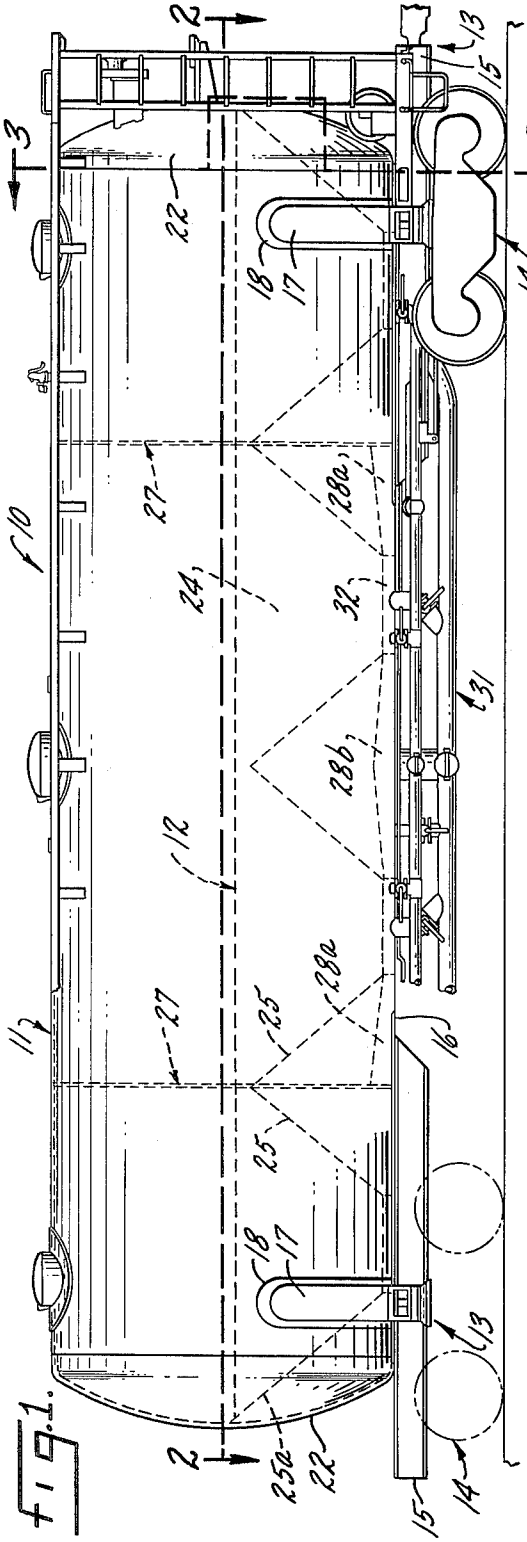


Fig. 1.

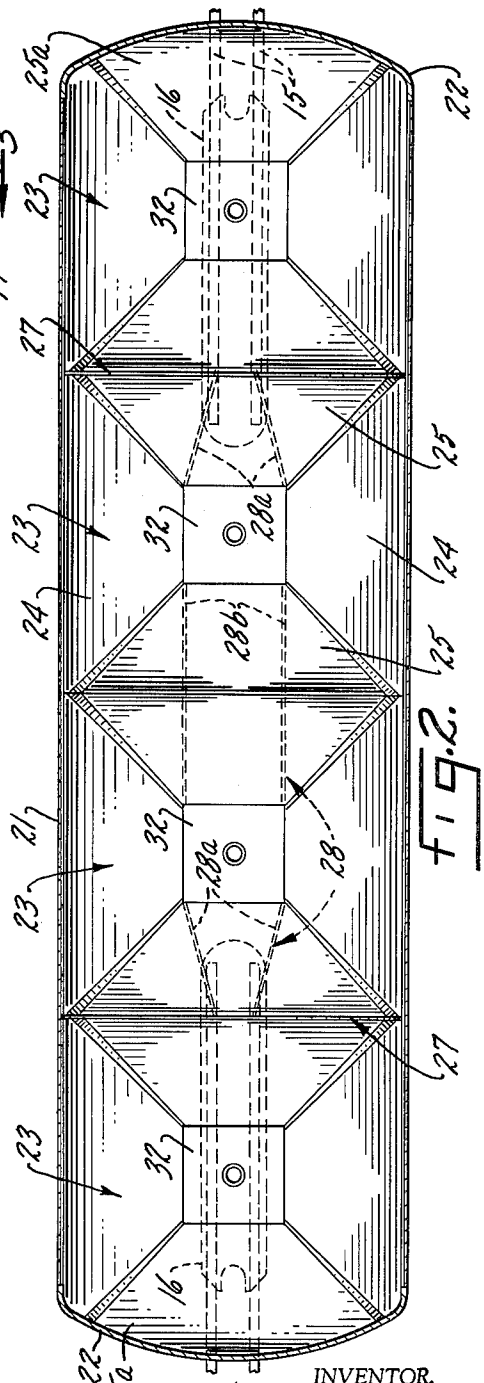


Fig. 2.

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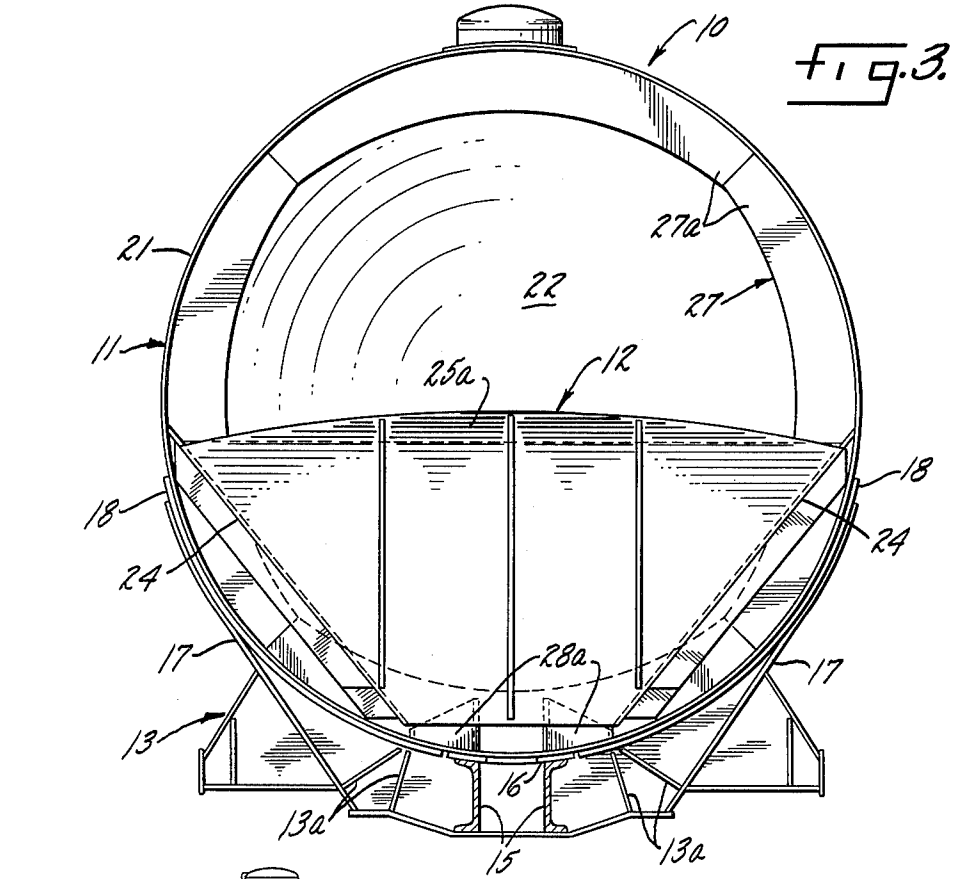


Fig. 3.

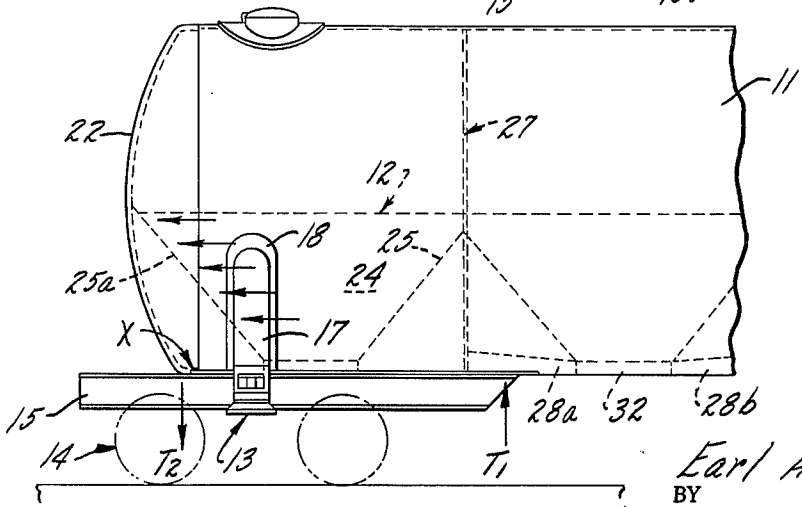


Fig. 4.

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RAILROAD HOPPER-TYPE TANK CAR

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5 Claims. (Cl. 105—360)

This invention relates to railroad cars generally of the type disclosed in United States Letters Patent No. 2,907,-284. More particularly, the invention is directed toward an improved reinforced hopper-type tank car of this general type.

The aforementioned United States patent is directed to railroad tank cars which do not require the conventional underframing that had previously been typical of tank car constructions. Although the conventional underframe was eliminated by way of the invention disclosed and claimed in this patent, the tank cars so constructed are structurally stable even when employing a thin shelled tank construction. Employing the concept presented in this patent, it has now been recognized that an even thinner shell construction can be realized and utilized in the transportation of dry bulk materials when suitable reinforcing means is provided for the tank car. Such reinforcing means must be able to insure the structural stability of the thin shelled tank without adding substantial weight to the completed car and without inhibiting the free flow of material into or out of the tank.

It is a prime object of the present invention to provide an improved reinforced hopper-type tank car which does not require the usual reinforcing underframe.

It is a further object of the present invention to provide an extremely thin shelled tank car construction that is internally reinforced so that surge and impact loads applied to the tank are effectively compensated for and do not cause structural failure of the tank car.

Still another object of the present invention is to provide a reinforced hopper-type tank car which can be readily constructed at relatively low cost and which is ideally suited for effecting high capacity transportation of dry bulk materials such as powdered, granular or pelletized materials.

A more specific object of the present invention is to provide an improved reinforcing means for thin shelled railroad tank cars, which structure provides the car with the necessary structural stability without adding substantial weight thereto.

Other objects and advantages of the present invention will become apparent from the following description of one preferred embodiment thereof when considered in conjunction with the accompanying drawings wherein:

FIGURE 1 is a side elevational view of a reinforced hopper-type railroad tank car embodying various features of the present invention;

FIGURE 2 is a cross sectional view taken along the line 2—2 in FIGURE 1;

FIGURE 3 is a simplified and enlarged cross sectional view taken generally along the line 3—3 in FIGURE 1; and

FIGURE 4 is a fragmentary illustration of one end of the car shown in FIGURE 1 and depicts certain of the surge and impact load force components for which effective compensation is provided by the reinforcing structure of the present invention.

Referring generally to the drawings, there is shown a thin shelled hopper-type railroad tank car that employs suitable reinforcing means so that the desired thin shell construction can be realized while at the same time insuring the structural stability of the car. The reinforcing means employed in this hopper-type tank car is designed to withstand substantial forces of the type that are imparted to the thin shelled, material confining tank when impact loading occurs (e.g. during coupling) and/or that are caused by the shifting of the material within the tank and against the confining walls thereof.

To facilitate a clear understanding of the reinforced hopper-type tank car construction of the present invention, the following description will deal with a tank car that is adapted to effect the high speed unloading of dry bulk materials through the use of a high speed pressurized unloading system that does not, per se, form a part of the invention. This description of the improved reinforced tank car construction is not intended to limit the applicability of the invention to other forms of tank cars employing different types of unloading means. On the other hand, one skilled in the art will appreciate that a number of the structural features of a thin shelled tank car embodying the present invention correspond substantially to those of the tank car disclosed in the aforementioned United States patent. Accordingly, a detailed treatment of certain of these structural features will not be presented herein.

Referring more specifically to FIGURES 1–4, there is shown a hopper-type railroad tank car generally designated by the numeral 10. The tank car 10 is preferably comprised of a reinforced, relatively thin shelled tank 11 that serves as the confining enclosure for a hopper structure 12. The reinforced tank 11 is supported at its opposite ends by a combined draft rigging and body bolster assembly 13. The assembly 13, which functions both as the supporting means for the ends of the tank 11 and as the means for linking the tank to conventional truck assemblies 14, is substantially identical to the corresponding structure as disclosed in aforementioned Patent No. 2,907,284.

In this connection and as shown in FIGURE 3, each of the assemblies 13 includes a pair of spaced apart support channels or draft sills 15. The draft sills 15 provided at each end of the car 11 are secured to a tank reinforcing plate 16 that is welded or otherwise secured to the underside of the tank adjacent the corresponding end thereof. A plurality of additional reinforcing members 13*a*, which in a conventional manner are welded together to form a substantial portion of the assembly 13, are suitably joined to and support a pair of side plates 17 that are in turn integrally secured to the tank 11.

More particularly, aligned peripheral side portions at each end of the tank 11 are reinforced by suitable saddle plates 18 that are preferably integrally secured to the tank. These saddle plates 18 extend from adjacent the lower base or reinforcing plates 16 to a location approximately midway up the sides of the tank, and the plates 18 cover a sufficient area so that local stress concentration in the tank shell is minimized. The saddle plates 18 serve as the means whereby the side plates 17 are integrally joined to the tank (i.e. the side plates are preferably welded to the saddle plates in a conventional manner) so that the tank 11 and supporting assemblies 13 are an integral unit.

Although not described in detail, it will be appreciated that the draft gears, truck assemblies, and other conventional components typically employed in railroad tank cars would be suitably joined to the aforedescribed tank supporting structure to complete the car for operation. Preferably, this would be effected as described in Patent No. 2,907,284, since the reinforcing structure of the present invention particularly complements this and similarly constructed tank supporting undercarriage structures.

Referring in detail to the reinforcing means for the tank car, the tank 11 has a central cylindrical shell section 21 that may either be of a one piece construction or formed from a plurality of suitably joined smaller cylindrical units. The central section 21 is adapted to be joined to and enclosed by suitable end caps or tank heads 22 that

are preferably welded in overlapping relationship to the otherwise open ends of the central section.

In the illustrated embodiment and as generally set forth above, the tank **11** is proportioned to readily receive a hopper structure **12** that is preferably comprised of a plurality of hopper compartments **23**. Each of the compartments **23** is defined by suitably reinforced and diverging hopper side wall members **24** and front and rear wall members **25** that are preferably joined together (e.g. by welding) to form an integral unit.

With reference to FIGURES 1 and 3, it will be noted that the two end-most hopper defining wall members, hereinafter designated by the numeral **25***a*, have a suitably proportioned arcuate configuration along the upper diverging edge thereof. This configuration insures that these end wall members properly merge and mate with the arcuate inner surface of the heads **22** after the latter elements have been joined to the central section **21**. As hereinafter described in detail, these wall members effectively distribute surge loads that are a natural result of impact loading and preclude the distortive forces that are otherwise imparted to the tank from being compounded.

A variety of techniques may be employed to fabricate the hopper structure and/or to effect the mounting thereof within the tank. Preferably, the hopper structure **12** is partially formed as a unitary structure and thereafter positioned within the central section **21** of the tank **11** through one of the open ends thereof. More particularly, enough of the hopper structure is formed as a unit to insure an efficient fabrication process; however, the assembly is not completed until all of the other reinforcing means are properly located as hereinafter described. The positioning and final fixed mounting of the hopper structure within the section **21** is preferably effected by welding the upper edge portions of the side walls **24** to the adjacent inner wall portions of the section **21**.

The hopper defining wall members including the end wall members **25***a* merge at and are joined to the lower inner wall surface of the central tank section **21** so as to define suitable discharge ports. In the illustrated embodiment of a reinforced tank car, which embodiment employs a pressurized unloading system including a plurality of air circulating and product discharge conduits **31** (FIG. 1), the hopper defining wall members of the structure **12** are joined together and to the lower inner surface of the tank so as to define subchambers **32** to which various of the conduits **31** are connected in a conventional manner.

A pair of suitable reinforcing rings **27** (FIGURE 3) and a plurality of suitably arranged additional reinforcing members **28** are positioned within and suitably joined to the inner wall of the central section of the tank **11** in conjunction with the mounting of the hopper structure therein. Preferably, the reinforcing rings **27** are formed of a plurality of arcuate segments **27***a* that are suitably joined together (e.g. by welding) and to the internal wall surface of the central section **21**.

One each of the circular reinforcing rings **27** is preferably positioned adjacent the location of the inward extremity of each of the lower reinforcing plates **16** and so as to be aligned with the crests of the joined hopper defining wall members **25** of the end and centrally disposed hoppers **23**. This preferred positioning of the internal reinforcing rings in alignment with the crests of the joined hopper defining walls minimizes any obstruction to the free flow of material within the car during loading and/or unloading and eliminates regions whereat the material might otherwise become trapped and accumulate. It will be appreciated that at least a portion of the internal reinforcing rings **27** (i.e. certain of the segments **27***a*) might be joined to and integrally formed with the hopper structure **12** prior to the positioning and mounting of the hopper structure within the central tank section **21** as previously described.

The additional reinforcing members **28** are perhaps best illustrated in FIGS. 1 and 2. As shown, these members include angularly disposed end reinforcing plates **28***a* that are welded in place to the lower inner surface of the central tank section **21** adjacent each of the oppositely disposed ends thereof. The positioning of the end plates **28***a* is effected so that the plates contact the lower portion of the reinforcing rings **27** and overlap the inner end portions of the base plate **16**. These end plates **28***a* extend outwardly from the location adjacent the rings **27** and merge with the subchamber defining walls of the centrally disposed hoppers **23** so that the underside of the central tank section is fully reinforced from the ends thereof (i.e. primarily by the plates **16**) to adjacent the central-most portion thereof (i.e. primarily by the end plates **28***a* and subchamber defining hopper walls **24** and **25**). Finally, the central-most portion of the underside of the tank section **21** is reinforced by a pair of spaced apart reinforcing plates **28***b*. These plates **28***b*, as shown in FIG. 2, extend in parallel relation between the subchamber defining walls of the centrally disposed hoppers **23** to complete the continuous reinforcement of the underside of the central tank section **21**.

The height of both the end and intermediate reinforcing plates **28***a* and **28***b* varies in accordance with the anticipated structural load which must be borne by these members at various locations along their length. In any event, these vertically extending plates are selected along with the reinforcing base plates **16** to insure adequate reinforcing for the underside of the central tank section without adding substantial weight to the car and without in any way inhibiting the discharge of material from the various hopper compartments **23**.

Referring to FIGURE 4, the manner in which the aforedescribed structure provides suitable reinforcement for the thin shelled tank car **10** will now be fully described. It will be appreciated that impact loading (i.e. as occurs during coupling) results in various force components being transmitted from the assembly **13** to the tank **11**. Among other forces, the tank experiences force components **T1** and **T2** which correspond essentially to a pivoting of the rearward end of the assembly **13** upwardly toward the central tank section **21** and the separation of the forward end of the assembly from the head of the tank particularly at the location designated X whereat the reinforcing plate **16** terminates.

Because of the reinforcing structure provided by the present invention, these force components are precluded from damaging the tank **11** even when this tank is of an extremely thin shelled construction, which is highly desirable from the standpoint of construction and operating costs and overall efficiency. That is, the reinforcing rings **27** along with the reinforcing members **28***a* and **28***b* stiffen the tank **11** and withstand the force component **T1** which tends to cause a buckling or a puncture of the underside of the central section **21**. Similarly, by joining the assembly **13** through the side plates **17** and saddle plates **18** to the tank **11** at a location adjacent the otherwise reinforced tank heads **22** effective compensation is provided for the force component **T2**.

However, when impact loading occurs and the car is filled with material being transported, surge loads resulting from a shifting of the material can compound the effects of the force components **T1** and **T2**, and compensation for such surge loads must also be provided. To this end, the reinforced hopper defining end plates **25***a* are provided and located so as to distribute the surge load to a location inwardly of the location X whereat the force component **T2** has its deleterious effects. By combining the various reinforcing means as previously described in cooperative relationship with one another, an extremely thin shelled tank car construction can be employed while at the same time insuring the structural stability of the car.

One preferred embodiment of a hopper-type railroad tank car constructed in accordance with the present in-

vention has the following specifications when designed to effect the transportation of granular materials such as cement, lime, flour, starch and when utilizing a pressurized unloading system:

Nominal capacity	100 tons (2800 cu. ft.).
Length over strikers	44'-6 3/16".
Length over truck centers	33'-6 3/16".
Extreme width	10'-8".
Extreme height	15'-7/8".
Light weight	63,500 lbs. (est.).
Maximum weight on rails	263,000 lbs.
Loading hatches	Top loading hatches for gravity or pneumatic loading.
Unloading arrangement	6-inch discharge tube, 3-inch air inlet line. Car is brought up to the desired unloading pressure, maximum of which can be 42 p.s.i. Discharge valves are opened, and commodity is discharged along with pressurized air through 6-inch line. Air and discharge tube connections are 3-inch and 6-inch quick connecting couplers.
Safety valve	At top of car set to relieve at 45 p.s.i.
Tank	Constructed in accordance with ASME Pressure Vessel Code.
Pressure gauges	Enclosed at body bolster jacking pad extension.
Hatch covers	Steel, pressure type, hinged.
Running boards	AAR approved steel grating.
Trucks	100-ton Barber stabilized.
Wheels	Steel, one wear, 36-inch diameter.
Journal bearings	Roller type.

It will be appreciated that thin shelled tank cars embodying the invention are constructed of materials which meet the various standards of the industry. For example, tank cars designed to transport granular food products are preferably provided with an internal protective coating of a material such as plastic, while various of the components of the piping arrangement are formed of stainless steel or similar non-corrosive material.

It should be understood that the foregoing description of an improved reinforced thin shelled tank car is merely illustrative of the invention. Various modifications of the reinforcing structure might be devised by one skilled in the art without departing from the invention, various features of which are set forth in the accompanying claims.

What is claimed is:

1. A reinforced, thin shelled railroad tank car which comprises in combination an enclosed self-supporting horizontally disposed cylindrical tank shell; said tank shell having an elongated central section enclosed by reinforced end walls; a pair of reinforcing base plates; one each of said reinforcing base plates being secured to the underside of said tank shell adjacent one each of said end walls and extending beneath only a portion of the extremities of said elongated central section; a pair of short draft sill and wheel assembly structures; one each of said draft sill and wheel assembly structures being secured to one each of said base plates adjacent the extremities of said elongated central section of said tank shell; a pair of tank shell supporting cradle structures; one each of said cradle structures being secured to one each of said base plates and to adjacent portions of the outer peripheral surface of said elongated tank shell central section so as to provide spaced apart supports for the end portions of said tank shell; a pair of surge arresting plate members secured in angularly disposed relation relative to the inner wall surfaces of said tank shell adjacent the ends thereof; one each of said plate members being joined to one each of said end walls so as to extend between the inner surface of said corresponding end wall and the bottom inner surface of said tank shell at a location inwardly of the outer termination point of said corresponding reinforcing base plate; and a pair of reinforcing rings; one each of said reinforcing rings being secured to said elongated central tank shell section in concentric relation therewith and in substantial alignment with the inner termination points of one each of said base plates; said angularly disposed surge arresting plate members functioning to distribute surge loads inwardly of the outer termination point of said reinforcing base plates so as to minimize stress forces normally imparted to said tank shell at this location and said reinforcing rings functioning to stiffen the tank shell adjacent the inwardmost end portions of each of said reinforcing base plates so as to provide a resistive force to deflection of the innermost ends of said reinforcing base plates.

2. A reinforced, thin shelled railroad tank car which comprises in combination an enclosed self-supporting horizontally disposed cylindrical tank shell; said tank shell having an elongated central section enclosed by reinforced end walls; a pair of reinforcing base plates; one each of said reinforcing base plates being secured to the underside of said tank shell adjacent one each of said end walls and extending beneath only a portion of the extremities of said elongated central section; a pair of short draft sill and wheel assembly structures; one each of said draft sill and wheel assembly structures being secured to one each of said base plates adjacent the extremities of said elongated central section of said tank shell; a pair of tank shell supporting cradle structures; one each of said cradle structures being secured to one each of said base plates and to adjacent portions of the outer peripheral surface of said elongated tank shell central section so as to provide spaced apart supports for the end portions of said tank shell; a pair of surge arresting plate members secured in angularly disposed relation relative to the inner wall surfaces of said tank shell adjacent the ends thereof; one each of said plate members being joined to one each of said end walls so as to extend from a location approximately midway up the inner surface of said corresponding end wall to a location on the bottom inner surface of said tank shell inwardly of the outer termination point of said corresponding reinforcing base plate and outwardly from the inner termination point thereof; and a pair of reinforcing rings; one each of said reinforcing rings being secured to said elongated central tank shell section in concentric relation therewith and in substantial alignment with the inner termination point of one each of said base plates; said angularly disposed surge arresting plate members functioning to distribute surge loads inwardly of the outer termination point of said reinforcing base plates so as to minimize stress forces normally imparted to said tank shell at this location and said reinforcing rings functioning to stiffen the tank shell adjacent the inwardmost end portions of each of said reinforcing base plates so as to provide a resistive force to deflection of the innermost ends of said reinforcing base plates.

3. A reinforced, thin shelled railroad tank car which comprises in combination an enclosed self-supporting horizontally disposed cylindrical tank shell; said tank shell having an elongated central section enclosed by reinforced end walls; a pair of reinforcing base plates; one each of said reinforcing base plates being secured to the underside of said tank shell adjacent one each of said end walls and extending beneath only a portion of the extremities of said elongated central section so that a substantial portion of said central section extends between the inner termina-

tion points of said base plates; a pair of short draft sill and wheel assembly structures; one each of said draft sill and wheel assembly structures being secured to one each of said base plates adjacent the extremities of said elongated central section of said tank shell; a pair of tank shell supporting cradle structures; one each of said cradle structures being secured to one each of said base plates and to adjacent portions of the outer peripheral surface of said elongated tank shell central section so as to provide spaced apart supports for the end portions of said tank shell; a pair of surge arresting plate members secured in angularly disposed relation relative to the inner wall surfaces of said tank shell adjacent the ends thereof; one each of said plate members being joined to one each of said end walls so as to extend between the inner surface of said corresponding end wall and the bottom inner surface of said tank shell at a location inwardly of the outer termination point of said corresponding reinforcing base plate; and a pair of reinforcing rings; one each of said reinforcing rings being secured to said elongated central tank shell section in concentric relation therewith and in substantial alignment with the inner termination point of one each of said base plates; said angularly disposed surge arresting plate members functioning to distribute surge loads inwardly of the outer termination point of said reinforcing base plates so as to minimize stress forces normally imparted to said tank shell at this location and said reinforcing rings functioning to stiffen the tank shell adjacent the inwardmost end portions of each of said reinforcing base plates so as to provide a resistive force to

deflection of the innermost ends of said reinforcing base plates.

4. A reinforced thin shelled railroad tank car in accordance with claim 3 and wherein a plurality of plate members are mounted along the bottom inner surface of said central tank shell section to effect reinforcement thereof between the inner termination points of said reinforcing base plates.

5. A reinforced thin shelled railroad tank car in accordance with claim 3 and wherein a multi-compartment hopper structure is mounted within said tank shell so that said surge arresting plate members define the endmost hopper compartment defining walls of said structure.

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