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 [22] Filed **Oct. 31, 1968**
 [45] Patented **Dec. 15, 1970**
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- [54] **INSULATED RAILWAY TANK CAR AND METHOD OF FORMING SAME**
5 Claims, 11 Drawing Figs.

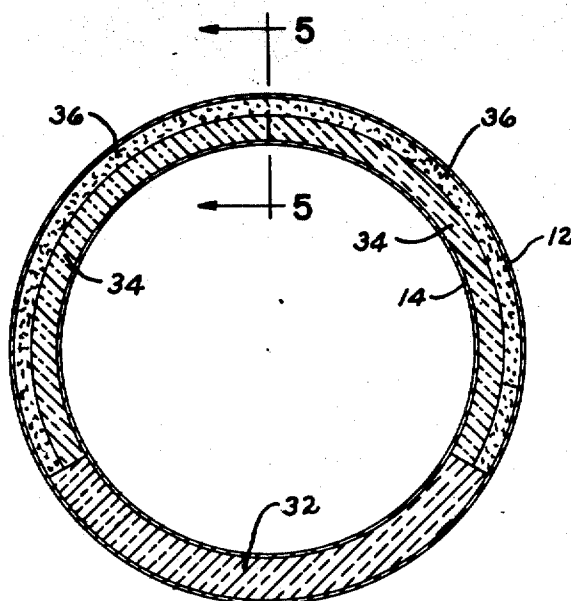
- [52] **U.S. Cl.**..... **105/358,**
29/455, 105/360
[51] **Int. Cl.**..... **B61d 5/04**
[50] **Field of Search**..... 105/358,
360; 220/9, 10; 280/5; 296/31, 31X; 29/455

[56] **References Cited**

UNITED STATES PATENTS

- | | | | |
|-----------|---------|---------------------|---------|
| 2,963,874 | 12/1960 | Means et al..... | 220/10 |
| 3,280,301 | 10/1966 | Anderson et al..... | 105/358 |
| 3,313,020 | 4/1967 | Krauskopf..... | 29/455 |
| 3,328,496 | 6/1967 | Graves..... | 29/455 |
| 3,338,185 | 8/1967 | Phillips..... | 105/358 |

ABSTRACT: An insulated tank comprising an inner container and an outer shell spaced from each other to form a generally annular space therebetween. A plurality of circumferential dividers are secured to the inner container before the inner container is telescoped within an outer shell, and after positioning of the inner container within the outer shell the dividers form a plurality of compartments which are subsequently filled with a foamed in place cellular insulating material. At least a portion of the upper arcuate segment of the dividers comprise a resilient open cell porous material which permits the escape of gases from the compartments and provides a relatively tight fit between the inner container and outer shell. Upon pouring an expandable foam material of liquid reactants within a compartment, the foam material penetrates the open cell divider material and upon setting effects a bond to the adjacent wall in addition to insulating the divider itself. In positioning the inner container within the outer shell for subsequent filling with foam, the upper resilient segments of the dividers are compressed against the outer shell to space the lower segments of the dividers from the outer shell and provide adequate clearance for telescoping the inner container within the outer shell.



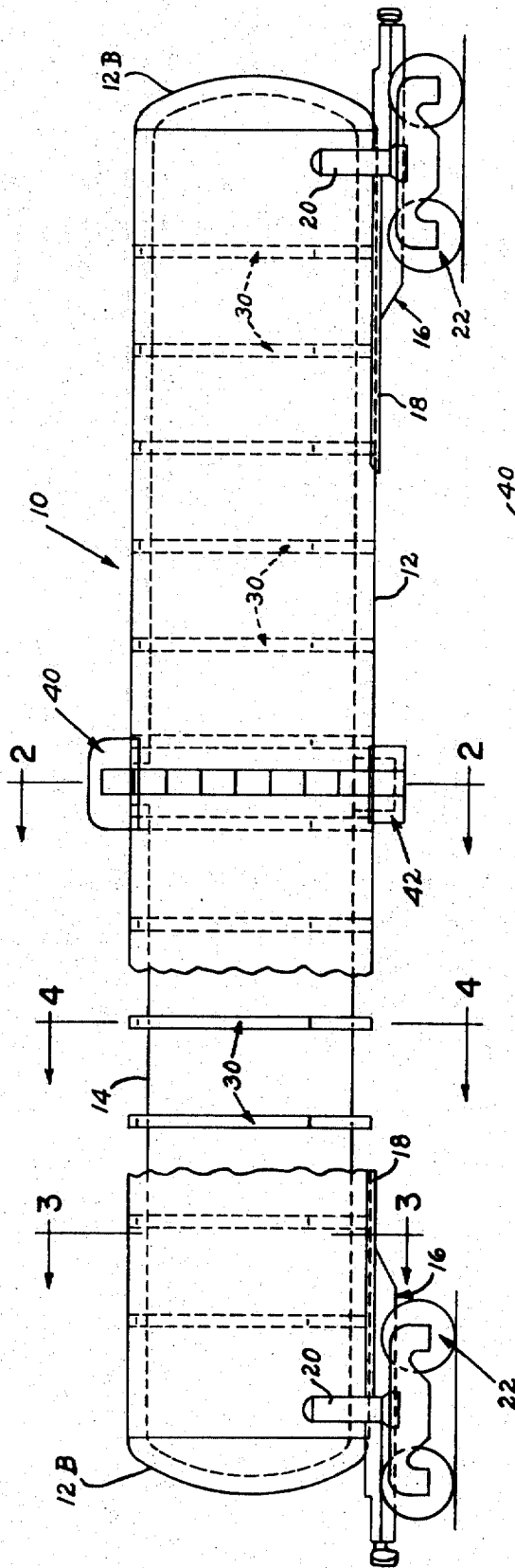


FIG. 1.

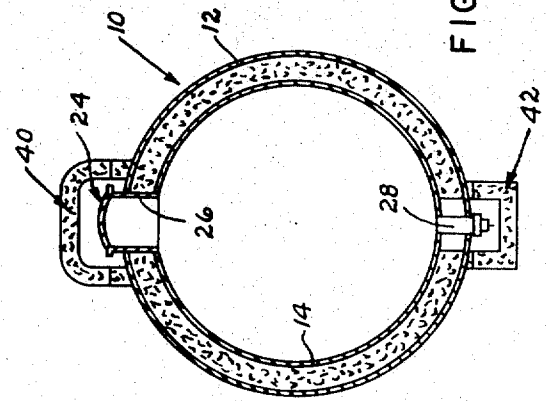


FIG. 2.

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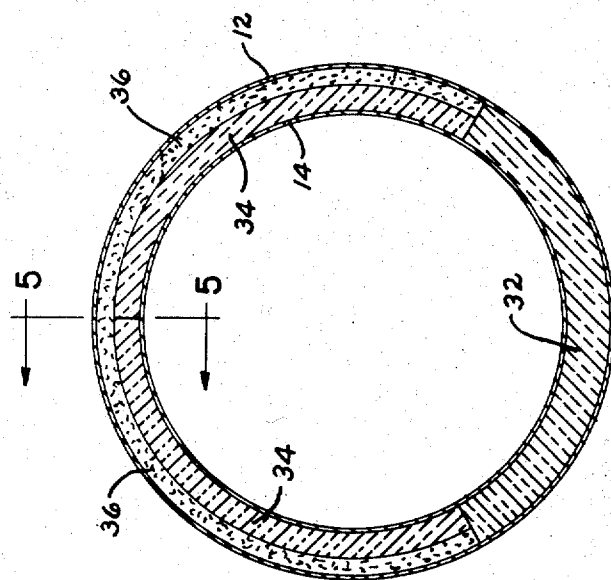


FIG. 4.

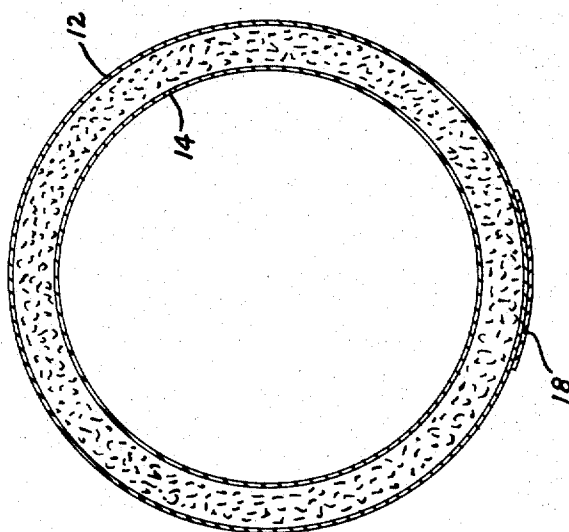


FIG. 3.

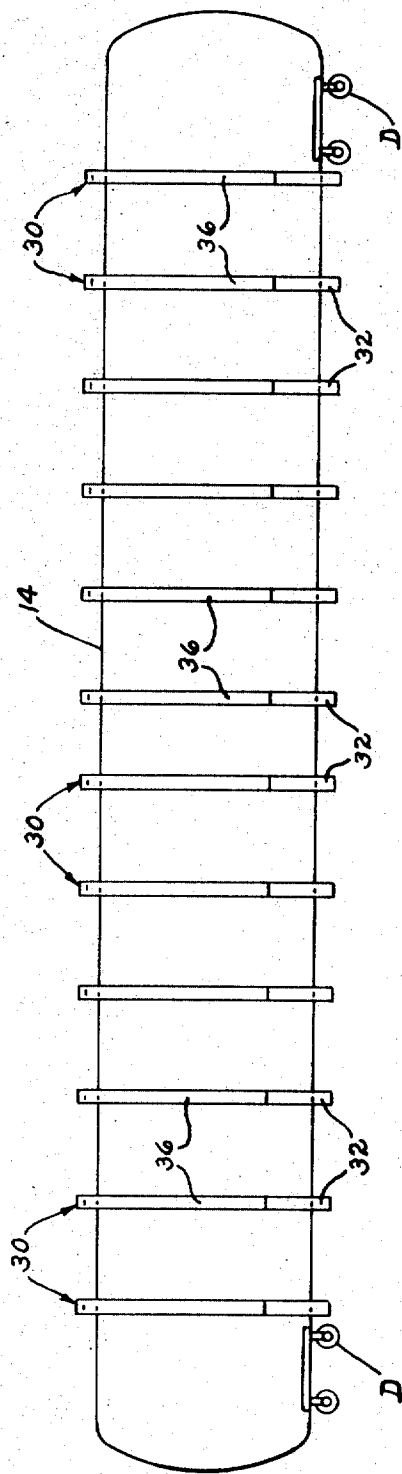


FIG. 6.

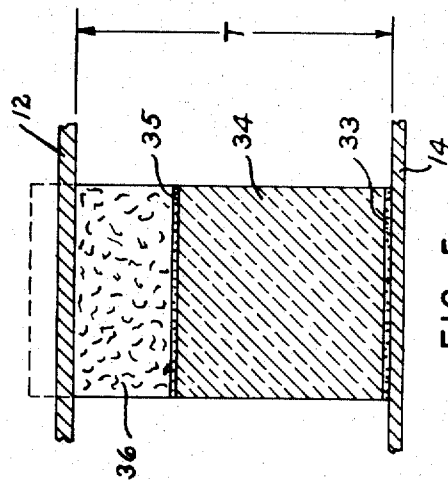


FIG. 5.

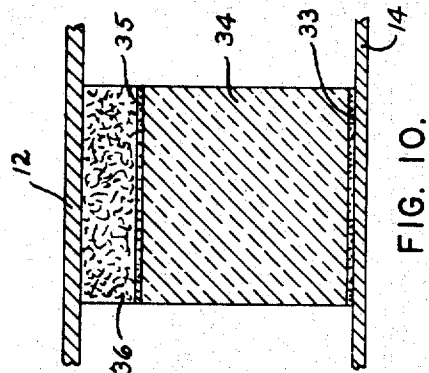
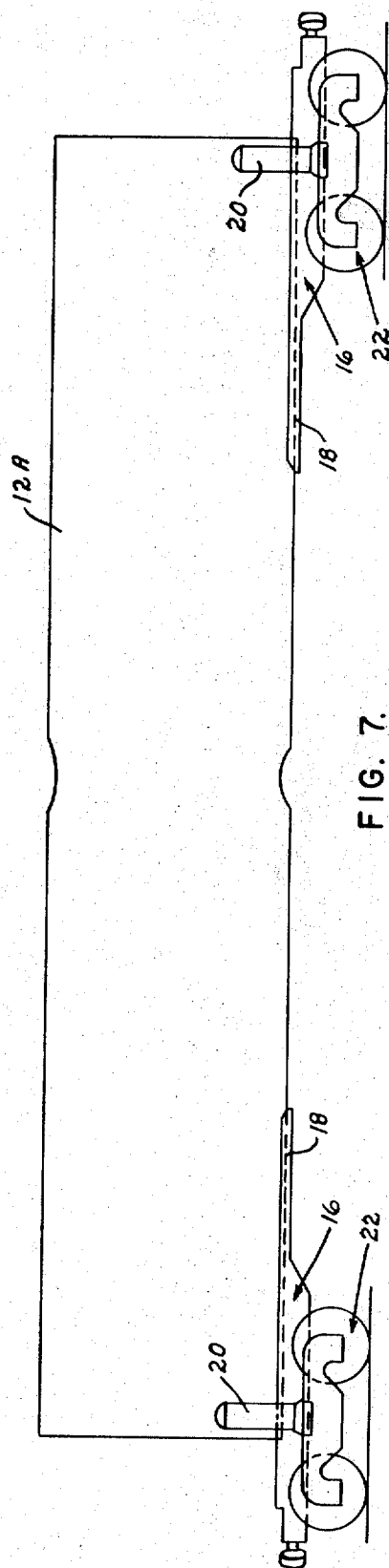
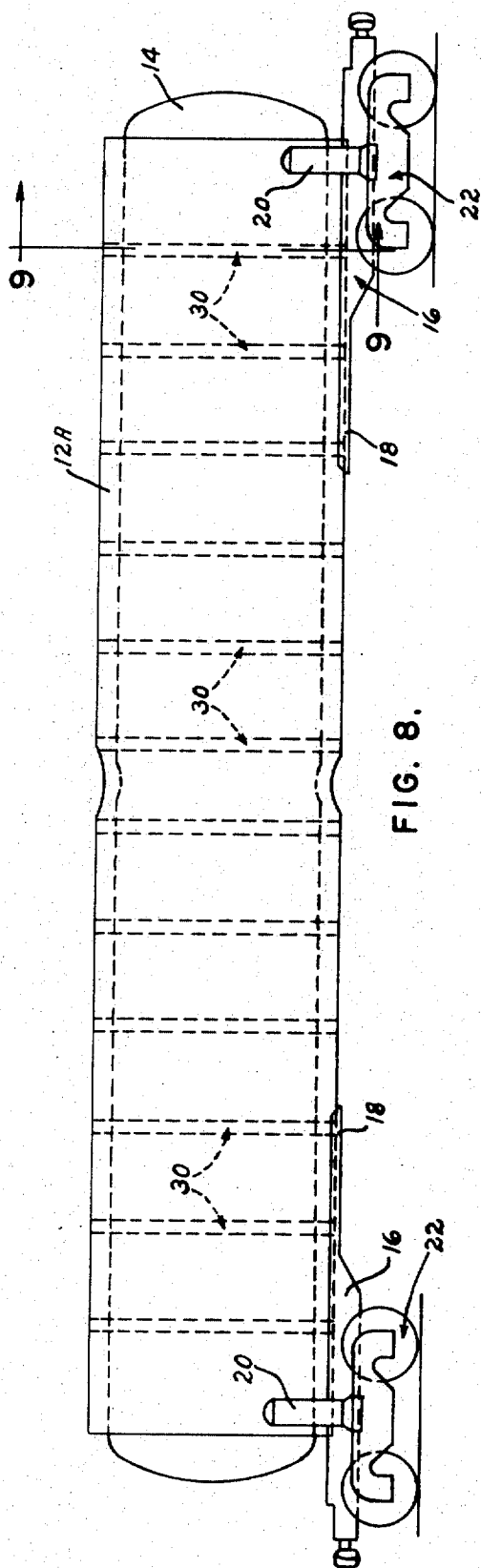


FIG. 10.



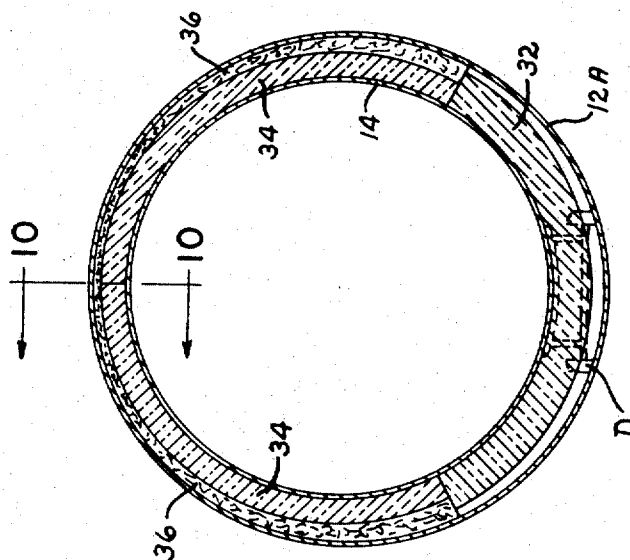


FIG. 9.

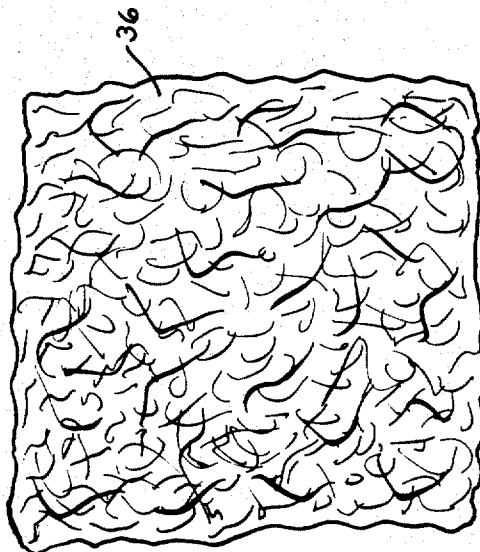


FIG. 11.

INSULATED RAILWAY TANK CAR AND METHOD OF FORMING SAME

BACKGROUND OF THE INVENTION

An insulated tank with a barrier therein to form compartments for filling with a foam material has been employed heretofore as shown in U.S. Pat. No. 3,313,020 dated Apr. 11 1967. However, the barriers heretofore have been formed of inflatable members, inflated by air or foam, or by rigid insulating material. Such barriers, particularly rigid blocks, make it difficult to mate the inner container and outer shell without leaving open spaces between the barriers and adjacent walls. Inflatable members have to be inflated or filled separately with a foam insulating material after the inner container and outer shell are mated.

BRIEF DESCRIPTION OF THE INVENTION

The present invention is directed to a divider in the annular space between the inner container and outer shell and the method of forming the insulated tank structure with such a divider. At least a portion of the upper arcuate segment of the divider comprises a resilient open cell or porous material, preferably formed of a polyurethane open cell foam material. Upon mating of the inner container and outer shell in which the inner container is telescoped within the outer shell, the resilient foam portion is compressed to provide clearance between the outer shell and container. Then, when the inner container is properly positioned lengthwise and is lowered onto the outer shell, the resilient foam portion expands to fill any open space between the shell and container. Any gases trapped in an enclosed compartment may pass through the porous divider portion to minimize the number of vent openings to the atmosphere required for the tank structure.

Upon filling of a compartment with liquid foam reactants, the foam material penetrates the open cell divider portion. The depth of penetration depends on the porosity and internal foam pressure. Upon the setting or curing of the foam material which has penetrated and filled the pores of the resilient divider portion, the foam forms a bond with the adjacent tank wall surface as well as insulating the porous divider thereby to increase the bond strength between the inner container and outer shell.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of the various possible embodiments of the invention is illustrated:

FIG. 1 is a side elevation of an insulated tank car including dividers comprising the present invention;

FIG. 2 is a section taken generally along line 2-2 of FIG. 1 and illustrating the insulation at the upper dome structure and the lower outlet structure;

FIG. 3 is a section taken generally along line 3-3 of FIG. 1 and illustrating the insulation between the dividers;

FIG. 4 is a section taken generally along line 4-4 of FIG. 1 and illustrating the divider;

FIG. 5 is an enlarged section generally along line 5-5 of FIG. 4;

FIG. 6 is a side elevation of the inner container having the dividers mounted thereon before positioning within the outer shell;

FIG. 7 is a side elevation of the outer shell and associated trucks before positioning of the inner container therein;

FIG. 8 is a side elevation of the railway car structure after the inner container has been positioned within the outer shell;

FIG. 9 is a section taken generally along 9-9 of FIG. 8 and illustrating means supporting the inner container as the inner container is telescoped within the outer shell;

FIG. 10 is an enlarged section taken generally along line 10-10 of FIG. 9 and showing the resilient portion of the divider being compressed against the adjacent surface of the outer shell to facilitate the insertion of the inner container within the outer shell; and

Fig. 11 is an enlarged fragment of a portion of the resilient open cell foam material illustrating the pores therein.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now to the drawings for a better understanding the invention, an insulated railway tank car is generally indicated 10 in FIG. 1 and includes an outer cylindrical shell 12 and an inner cylindrical container 14. Container 14 adapted to carry loadings, particularly liquid loadings, in which is desired to maintain a generally uniform temperature. The annular space between outer shell 12 and inner container 14 which may be between around 4 to 10 inches for example, filled with a cellular insulating material, such as a polyurethane foam material which has excellent insulating qualities. Stub center sill structures generally indicated 16 include saddle plates 18 and cradles 20 which are secured to outer shell 12. A wheeled truck 22 supports each stub center sill structure 16. As shown particularly in FIG. 2, an upper dome or manway structure 24 includes a manway 26 for the loading of loading. Lading is discharged from a bottom outlet valve generally indicated 28.

For forming tank car 10 and referring to FIGS. 4-6 particularly, a plurality of annular partitions or dividers 30 are spaced along the outer surface of inner container 14. Each divider 30 includes a lower arcuate segment 32 formed of a rigid foam material, such as a polyurethane material, and secured by a layer 33 of a suitable epoxy type adhesive to the lower surface of inner container 14, a pair of upper arcuate segments 34 of a reduced thickness also secured by a layer 33 of suitable epoxy type adhesive to inner container 14. Segment 32 and 34 each comprise a 120° arc about the circumference of inner container 14.

Secured to the outer surface of arcuate segments 34 by a layer 35 of suitable epoxy adhesive and forming an important part of this invention are outer segments 36 formed of an open cell resilient polyurethane material. Segments 36 are of an initial thickness slightly greater than the void space adjacent outer shell 12 in which segments 36 will be arranged. The open cell foam material forming segments 36 have around ten (10) pores per inch and have around a 97 percent void volume. Thus, segments 36 have a solid content of only around 3 percent. A suitable material is sold under the trade name "SCOTTFOAM" by Stephenson and Lawyer, Inc., Grand Rapids, Michigan. Dividers 30 may be of a width of 6 inches and a total thickness T of 10 inches. Segments 36 may be of a thickness of around 4 inches.

Referring to FIG. 7, outer shell portion 12A is positioned on stub center sill structure 16 on wheeled trucks 22. Then a pair of dollies D having rollers thereon as shown in FIGS. 6 and 9 are placed beneath inner shell 14 having dividers 30 thereon. A suitable crane then lifts and telescopes container 14 within an open end of outer shell portion 12A. Dollies D space lower rigid segments 32 from their inner surface of outer shell portion 12A as shown in FIG. 9, and upper resilient segments 36 are compressed against the inner surface of shell portion 12A. Upon the proper lengthwise positioning of inner container 14 within outer shell portion 12A, dollies D are removed and container 14 is lowered with rigid segments 32 supported on shell portion 12A. Resilient segments 36 expand to fill any void space adjacent the inner surface of outer shell portion 12A. A suitable pressure sensitive adhesive is preferably placed on the inner surface of outer shell portion 12A upon the removal of dollies D. This adhesive will develop a sufficient strength to equal or exceed the bond strength developed by the liquid foam subsequently poured in place.

Next the end heads 12B are welded onto the ends of outer shell portion 12A and outer shell portion 12A is then welded to stub center sill structures 16. Bottom outlet valve 28 and manway structure 24 are secured in place.

For filling the separate compartments formed between adjacent dividers 30, a pour hole is cut in the upper portion of outer shell 12 for each compartment. A cellular foam plastic in liquid form, such as a reaction product of organic polyisocyanate and a polyester or polyether, is poured within each compartment. The liquid plastic foam material rises to fill the void space between adjacent dividers 30 and cures after a

predetermined time period. Any gas within the compartments may escape through the porous resilient segments 36 and suitable vent holes are provided adjacent the ends of outer shell 12 to release any excessive gases to atmosphere. As segments 36 are porous, the liquid foam fills the open cells to provide segments 36 with suitable insulation. Also, the foam material forms a bond at the dividers with the adjacent inner surface of outer shell 12. When the compartments have been filled, the pour holes are closed. After all the compartments have been filled, an insulated structure 40 is positioned over manway structure 24 and an insulated structure 42 is positioned over bottom outlet valve 28. Structure 40 and 42 may be removed to provide access to manway 24 and outlet valve 42. In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results obtained.

I claim:

1. A method of manufacturing an insulated railway tank car comprising the steps of: securing a plurality of spaced dividers about the circumference of an inner cylindrical container with an upper segment of the dividers being resilient and the lower segment of the dividers being generally rigid, telescoping the inner container within an outer cylindrical shell with the lower segments of the dividers being spaced from the outer shell and the upper segments of the dividers being compressed against the adjacent inner surface of the outer shell, lowering the inner container onto the outer shell with said lower segments contacting the outer shell and supporting the inner container thereon and said resilient upper segments expanding to maintain contact with the adjacent surface of the outer shell, and charging the compartments formed between the dividers with a cellular insulating material for foaming in place.

2. A method of manufacturing an insulated railway tank car comprising the steps of: securing a plurality of longitudinally spaced dividers about the circumference of an inner cylindrical container with an upper segment of the dividers being resilient and the lower segment of the dividers being generally rigid, placing a pair of dollies having rollers thereon beneath the inner container, moving the inner container supported on the dollies within an outer cylindrical shell with the lower segments of the dividers being spaced from the outer shell and the upper segments of the dividers being compressed against the adjacent inner surface of the outer shell, removing the dollies from the inner container, lowering the inner container onto the outer shell with said lower segments contacting the outer shell and supporting the inner container thereon and said resilient upper segments expanding to maintain contact with

the adjacent surface of the outer shell, and charging the compartments formed between the dividers with a liquid cellular insulating material for foaming in place.

3. An insulated railway tank car comprising, a cylindrical inner container, 2 cylindrical outer shell surrounding said inner container and spaced therefrom to form an annular space therebetween, a plurality of generally annular dividers spaced longitudinally of the railway car in the annular space between the outer shell and inner container to form a plurality of compartments, at least some of said dividers including a resilient fluid permeable upper arcuate segment comprising an open cell polyurethane material for permitting the escape of gases from the compartment, said compartments and at least a portion of the width of the resilient arcuate segment being filled with cellular insulating material to form generally rigid dividers.

4. An insulated railway tank car comprising, an inner container, an outer shell surrounding said inner container and spaced therefrom to form a circumferential space therebetween, a plurality of generally circumferential dividers spaced longitudinally of the railway car in the space between the outer shell and inner container to form a plurality of compartments, at least some of said circumferential dividers including a lower arcuate segment of a rigid foam material beneath the inner container for supporting the inner container and an upper resilient porous segment adjacent the inner surface of said outer shell comprising an open cell polyurethane material having a void volume of over around 75 percent for permitting the escape of gases from the associated compartment, and at least a portion of the width of said upper resilient porous segment being filled with cellular insulating material upon charging of the associated compartment with foam reactants to form generally rigid dividers upon curing of the insulating material.

5. An insulated railway tank car comprising, an inner container, an outer shell surrounding said inner and spaced therefrom to form a circumferential space therebetween, and a plurality of generally annular dividers spaced longitudinally of the railway car in the space between the outer shell and inner container to form a plurality of compartments, at least some of said dividers including a resilient fluid permeable portion having a void volume of over around 75 percent for permitting the escape of gases from the compartments, said compartments, and at least a portion of the width of the fluid permeable portion being filled with cellular insulating material to form generally rigid dividers upon curing of the insulating material.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,547,047 Dated Dec. 15, 1970

Inventor(s) Robert F. Needham

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 5, delete "1", second occurrence; line 47, "structure" should read -- structures --; line 52, "their" should read -- the --; line 61, after "the" insert -- outer surface of lower divider segment 32 and contacts the --.
Column 3, line 12, "Structure" should read -- Structures --
Column 4, line 5, "2" should read -- a --; line 31, "insulting" should read -- insulating --; line 36, after "inner" insert -- container --; line 40, "leas" should read -- least --; line 44, delete ", ,".

Signed and sealed this 30th day of March 1971.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents