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(54) Title: TRAILER AND METHOD FOR TRANSPORTING PERACETIC ACID

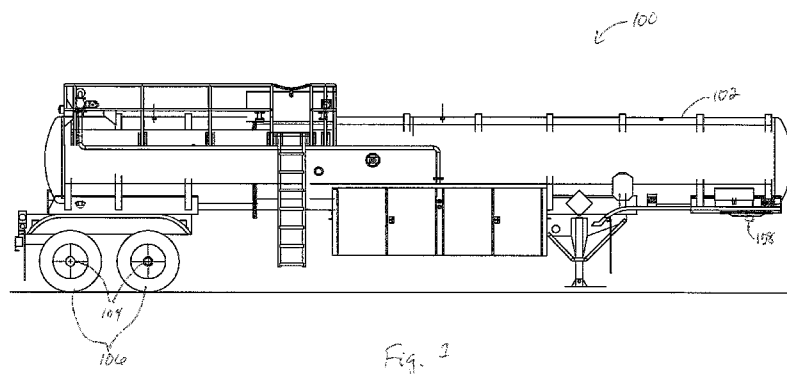


Fig. 1

(57) Abstract: A trailer for transporting a liquid mixture having at least about 5% peracetic acid by weight includes a stainless steel tank having an external spill containment enclosure and a predetermined maximum allowable working pressure. One or more pressure relief valves are included in a wall of the tank within the external spill containment enclosure and configured to provide pressure relief to the tank at a pressure of between about 20%-50% of the maximum working pressure of the tank, thereby preventing over-pressurization of a reactive and decomposing fluid during a fire event. Wheels and a kingpin are affixed to the tank to enable transportation over public roadways.

S P E C I F I C A T I O N

TRAILER AND METHOD FOR TRANSPORTING PERACETIC ACID

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The field of the present invention is vessels used for and methods of transporting peracetic acid.

2. Background

[0002] Hazardous materials in the liquid state are often transported in stainless steel containers, particularly 316 stainless, because stainless steel is inert to many such hazardous materials. The Department of Transportation (DOT) regulates all such shipments to ensure public roadway safety, and the type of regulatory restrictions vary depending upon the hazardous nature of the liquid being transported.

[0003] For example, 49 C.F.R. 173.225 sets forth packaging requirements for organic peroxides, and indicates that a DOT-412 cargo tank may be used for transporting certain organic peroxides. The DOT-412 cargo tank has a nominal capacity of 5000 gallons, and is constructed according to the requirements set forth in 37 CFR 178.320, 178.345, and 178.348, the design specifications of which are incorporated herein by reference in their entirety. However, the DOT-412 cargo tank is not authorized for transporting peracetic acid, as this Type F organic peroxide, ID No. UN 3109 (as listed in 37 C.F.R. 172.101) is limited to a bulk containers having a capacity of up to 1,500 liters (396 gallons).

[0004] Requirements for the DOT-412 cargo tank include a 316 stainless steel container having a maximum allowable working pressure (MAWP) of not more than 40 psig and a resealable pressure relief system. According to regulations, the pressure relief system on a DOT-412 cargo tank is to have a set pressure to provide pressure relief at between 120%–132% of the MAWP and a minimum venting capacity based upon the exposed area of the cargo tank, which is typically provided by one 3" reclosing pressure relief valve. The intent of these regulations is to equip the DOT-412 cargo tank

with a sufficient size and quantity of pressure relief devices so that an increase in pressure of the cargo tank, whether due to a self-accelerating decomposition or fire engulfment, would not result in a rupture of the cargo tank.

[0005] The DOT can make exceptions to the regulations for the transport of hazardous materials over public roadways on a case-by-case basis. As one example, Azko Nobel Polymer Chemicals, LLC, of Chicago, IL, has obtained an exemption for the transport of two types of Type F liquid organic peroxides, ID Nos. UN3109 and UN3119, both in Packing Group II, in a modified DOT-412 cargo tank. The modifications leading to approval of this special permit by the DOT include installation of six 12" diameter non-reclosing pressure relief devices (in the form of rupture discs) as a single unit without being installed in series with a reclosing pressure relief device.

[0006] Due to the hazardous nature of the organic peroxide subject to the Azko exemption, which is more reactive than peracetic acid, which is also a Type F liquid organic peroxide, ID No. UN3109, Packing Group II, and the increased risk of decomposition event if transferred in a standard DOT-412 cargo tank, the solution arrived at for the Azko special permit was to increase the overall pressure relief area to about 340 in². Although peracetic acid would not likely require as much pressure relief area as specified in the Azko special permit, a significantly large pressure relief area would be required. In view of the large pressure relief area required, a different solution has been sought for a cargo tank to transport peracetic acid, one which could also be implemented by modifying a DOT-412 cargo tank, and one which would also meet the DOT goals of having pressure relief devices of a sufficient size and quantity so that an increase in pressure of the cargo tank, whether due to a self-accelerating decomposition or fire engulfment, would not result in a rupture of the cargo tank.

SUMMARY OF THE INVENTION

[0007] The present invention is directed toward a trailer and a method or design tactic for transporting a liquid mixture having at least about 5% peracetic acid by weight. A stainless steel tank has an external spill containment enclosure and a predetermined maximum allowable working pressure. Wheels and a kingpin are affixed to the tank. One or more pressure relief valves are included in the wall of the tank within the spill containment enclosure, wherein the one or more pressure relief valves are configured to

provide pressure relief to the tank at a pressure of between about 20%–50% of the maximum allowable working pressure of the tank. Preferably, the pressure relief valves are configured to prevent internal pressure within the tank from exceeding a maximum pressure during a decomposition event or fire engulfment, thereby preventing over-pressurization of a reactive and decomposing fluid during a fire event. The pressure relief valves may have a pressure relief area greater or equal to 11.94 in², and they may be configured to provide pressure relief when a pressure inside the tank exceeds about 10 psig. Other combinations of set pressures and pressure relief areas may also be used. With such a trailer provided, the tank may be filled with a liquid mixture having at least about 5% peracetic acid by weight and transported over public roadways.

[0008] Accordingly, an improved trailer and method for transporting peracetic acid are disclosed. Advantages of the improvements will be apparent from the drawings and the description of the preferred embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] In the drawings, wherein like reference numerals refer to similar components:

- [0010]** Fig. 1 illustrates a trailer configured to transport peracetic acid;
- [0011]** Fig. 2 illustrates pressure relief valves for the trailer of Fig. 1;
- [0012]** Fig. 3 illustrates additional valves and returns for the trailer of Fig. 1;
- [0013]** Fig. 4 is a partial top elevation view of the trailer of Fig. 1; and
- [0014]** Fig. 5 is a rear view of the trailer of Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] Turning in detail to the drawings, Fig. 1 illustrates a trailer 100 configured for transporting a liquid mixture (shown implicitly inside the tank) having at least about 5% peracetic acid by weight. Although many different concentrations of peracetic acid may be transported using the trailer, the ensuing description will discuss the trailer in the context of transporting UN3109, nominal 15% peracetic acid/10% hydrogen peroxide (referred to as PAA below), which is a liquid organic peroxide of Type F, in Product Group II.

[0016] The trailer 100 has a stainless steel tank 102, to which is affixed dual axels 104 and associated wheels 106, and a kingpin 108 for securing the trailer 100 to a motorized rig (not shown) for transportation over public roadways. Except for the modifications described below, the trailer is constructed in conformance with the DOT-412 cargo tank requirements of set forth in 37 CFR 178.320, 178.345, and 178.348. Thus, the trailer may be constructed new with modifications to the manufacturing specifications, or it may be constructed by modifying an existing DOT-412 cargo tank. Following are the modifications made to an existing DOT-412 cargo tank to obtain the trailer 100 depicted in the figures.

[0017] The existing pressure relief valve (or rupture disk on older cargo tanks) of a standard DOT-412 cargo tank is removed, as is the ceramic breather vent. Two recloseable 4" diameter pressure relief valves 110 are installed in the side wall of the tank 102, as shown in Fig. 2. The two pressure relief valves 110 preferably conform with applicable DOT requirements under 37 CFR 178.345, and they have set pressure of 10 psig. They also provide a total pressure relief area of 13.65 in². An external spill containment enclosure 112 is placed on the outside of the tank 102 around the two pressure relief valves 110. This enclosure 112 prevents release of PAA onto the roadway in the event the pressure relief valves 110 activate in transit. Moreover, the combination of the pressure relief valves 110 and the enclosure 112 are anticipated to significantly contain discharge of PAA into the environment, even in the event of a rollover, thereby preventing over-pressurization of a reactive and decomposing fluid during a fire event. The enclosure 112 may also include internal splash baffles (not shown) to minimize PAA entrainment if/when the pressure relief valves 110 activate.

[0018] It has been determined that with PAA in a transport container, the internal pressure of the container will generally be in the range of about 5 psig to 10 psig during transit. The 10 psig set pressure of the pressure relief valve, or valves, is therefore sufficient to prevent PAA leakage during normal transport conditions. Further, through experimentation, it has been determined that with a set pressure of 10 psig, a total pressure relief area of 11.94 in² is sufficient to prevent internal pressure within the tank from exceeding the maximum tank pressure during a decomposition event or fire engulfment. Specifically, for PAA, the self-accelerating decomposition temperature in a

DOT-412 cargo tank has been calculated to be 61 °C. Liquids with lower amounts of peracetic acid are anticipated to have a higher self-accelerating decomposition temperature. With the two recloseable 4" diameter pressure relief valves 110 installed, it has been calculated that tank pressurization would be limited to no more than 42.2 psig during a decomposition event or fire engulfment.

[0019] At a set pressure of 44 psig, the calculated pressure relief area is 20.5 in² for PAA in a DOT-412 cargo tank. Although calculations of pressure relief area have not been performed for other set pressures, it is anticipated that the relationship between set pressure and pressure relief area is somewhat close to being linear for PAA in a DOT-412 cargo tank. Therefore, even with these two data points (10 psig, 44 psig), the calculations show that PAA can be contained, and internal pressure within the tank can be prevented from exceeding the maximum pressure of the tank during a decomposition event or fire engulfment, even when pressure relief valves having a pressure of 50% or less of the MWAP of the tank are used.

[0020] A quick connect coupling 114 and a valve 116 are added to the tank 102 within the enclosure 112, as shown in Fig. 3, along with a vapor return 118. The quick connect coupling 114 and the valve 116 enable the tank to be filled with PAA, and the vapor return 118 provides a vapor outlet from a storage tank into which the PAA is unloaded.

[0021] The tank 102 is also fitted with a manual bleed-off valve 120 within the enclosure 112, as shown in Figs. 3 & 4. This bleed-off valve 120 enables the internal tank pressure to be vented prior to offloading. In addition, the bleed-off valve 120 may be equipped with a suitable capture device to minimize operator exposure to PAA fumes when the tank is vented.

[0022] Gauges (not shown in the figures) to monitor the internal pressure, temperature, and level of the tank should be added to the trailer. The first two gauges enable the operator to monitor the internal pressure and temperature of the tank during transit, and the level gauge allows the operator to determine when loading and unloading operations are completed, since due to the hazardous nature of PAA, visual inspection of the tank is not an option.

[0023] As shown in Fig. 5, a valve 122 is installed at the top of the dip pipe 124, through which PAA is drawn by the unloading pump not shown. A second spill containment enclosure 126 may be constructed about the valve 122 at the rear of the trailer. A small pressure relief valve (not shown) may also be installed immediately upstream of the valve 122 to prevent PAA from being trapped during unloading, and a locking vented dust cap (not shown) may be installed at the discharge of the unloading pump. These additions to the inlet and discharge of the unloading pump, while optional, are intended to provide additional protection against siphoning of PAA through the trailer discharge line during transit, in the event that the valve 122 is left open or fails in the open position.

[0024] Finally, the discharge of the existing siphon break (not shown) on the unloading line is routed back to vapor space within the tank to prevent release of PAA into the environment in the event the siphon valve is left open.

[0025] By making the above modifications to the standard DOT-412 cargo tank, it is anticipated that PAA may be transported safely in greater quantities than the presently-allowed 1,500 liters (396 gallons) maximum. The transport of greater quantities would allow greater demands for PAA to be met. For example, PAA is being used increasingly as a microbial control agent by direct applications on meats, in aseptic packaging, and in oil and gas field applications. The bulk transportation of PAA also means less handling of the hazardous material during filling, transportation, and offloading. Finally, it is anticipated that the proposed modified DOT-412 cargo tank would be as safe, or safer, than containers which meet current regulations.

[0026] Thus, a trailer and method for transporting peracetic acid are disclosed. While embodiments of this invention have been shown and described, it will be apparent to those skilled in the art that many more modifications are possible without departing from the inventive concepts herein. The invention, therefore, is not to be restricted except in the spirit of the following claims.

CLAIMS

What is claimed is:

1. A trailer for transporting a liquid mixture having at least about 5% peracetic acid by weight, the trailer comprising:
 - a stainless steel tank having an external spill containment enclosure and a predetermined maximum allowable working pressure;
 - one or more pressure relief valves included in a wall of the tank within the external spill containment enclosure, wherein the one or more pressure relief valves are configured to provide pressure relief to the tank at a pressure of less than about 50% of the maximum allowable working pressure of the tank; and
 - wheels and a kingpin affixed to the tank.
2. The trailer of claim 1, wherein the maximum allowable working pressure is about 40 psig.
3. The trailer of claim 1, wherein the one or more pressure relief valves are configured to provide pressure relief when a pressure inside the tank exceeds about 10 psig.
4. The trailer of claim 3, wherein the one or more pressure relief valves have a combined relief area greater or equal to 11.94 in².
5. The trailer of claim 1, wherein a relief area of the one or more pressure relief valves are configured to prevent internal pressure within the tank from exceeding a maximum pressure during a decomposition event or fire engulfment.
6. The trailer of claim 1, wherein the one or more pressure relief valves includes two 4" diameter pressure relief valves, each configured to provide pressure relief to the tank at about 10 psig.
7. The trailer of claim 1, wherein the one or more pressure relief valves are reclosing pressure relief valves.

8. A method for transporting a liquid mixture having at least about 5% peracetic acid by weight, the method comprising:
- filling a trailer with peracetic acid, the trailer comprising:
 - a stainless steel tank having an external spill containment enclosure and a predetermined maximum allowable working pressure; and
 - one or more pressure relief valves included in a wall of the tank within the external spill enclosure, wherein the one or more pressure relief valves are configured to provide pressure relief to the tank at a pressure of less than about 50% of the maximum working pressure of the tank; and
 - transporting the trailer over a public roadway using wheels and a kingpin affixed to the tank.
9. The method of claim 8, wherein the maximum allowable working pressure is about 40 psig.
10. The method of claim 8, wherein the one or more pressure relief valves are configured to provide pressure relief when a pressure inside the tank exceeds about 10 psig.
11. The method of claim 10, wherein the one or more pressure relief valves have a combined relief area greater or equal to 11.94 in².
12. The method of claim 8, wherein a relief area of the one or more pressure relief valves are configured to prevent internal pressure within the tank from exceeding a maximum pressure during a decomposition event or fire engulfment.
13. The method of claim 8, wherein the one or more pressure relief valves includes two 4" diameter pressure relief valves, each configured to provide pressure relief to the tank at about 10 psig.
14. The method of claim 8, wherein the one or more pressure relief valves are reclosing pressure relief valves.
15. A combination comprising:

a liquid mixture having at least about 5% peracetic acid by weight; and
a trailer for transporting the liquid mixture, the trailer comprising:

a stainless steel tank having an external spill containment enclosure and a predetermined maximum allowable working pressure;

one or more pressure relief valves included in a wall of the tank within the external spill containment enclosure, wherein the one or more pressure relief valves are configured to provide pressure relief to the tank at a pressure of less than about 50% of the maximum allowable working pressure of the tank; and

wheels and a kingpin affixed to the tank.

16. The combination of claim 15, wherein the maximum allowable working pressure is about 40 psig.

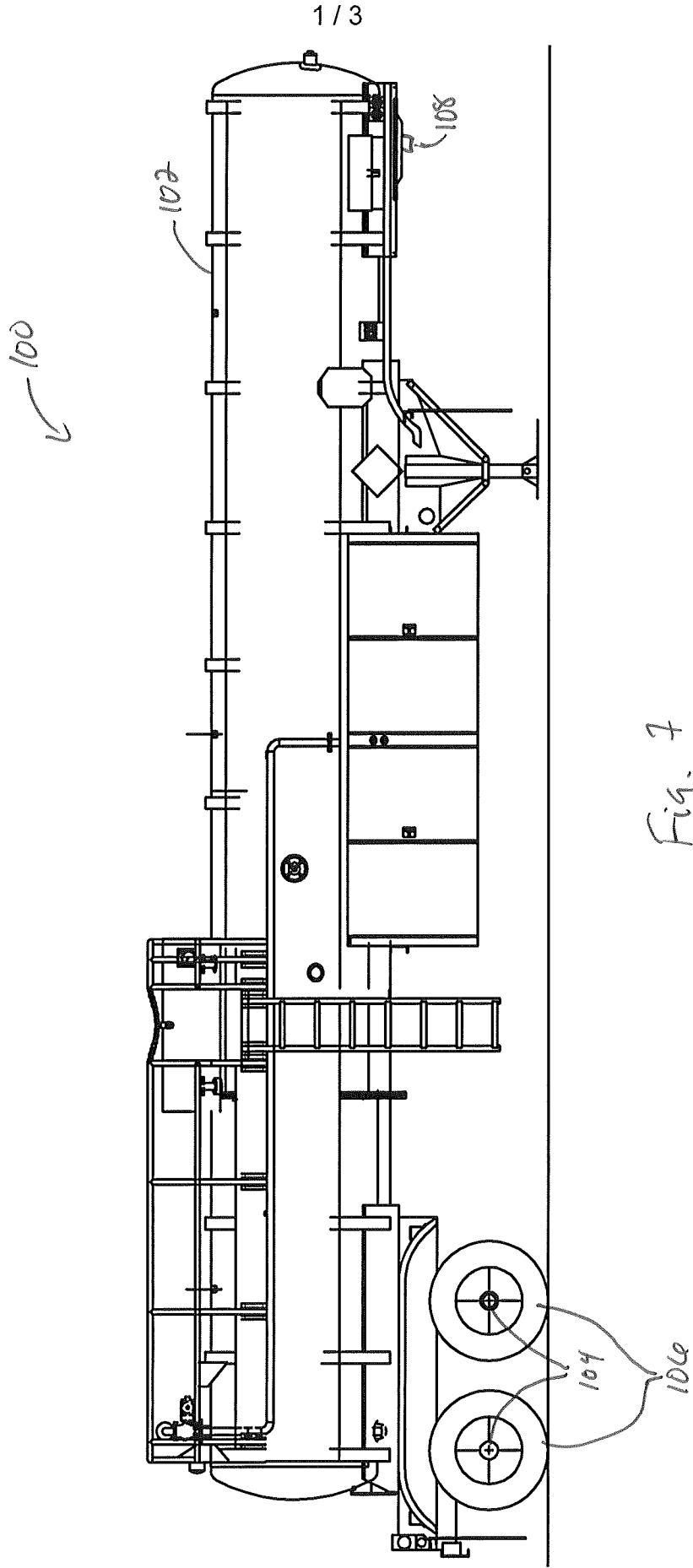
17. The combination of claim 15, wherein the one or more pressure relief valves are configured to provide pressure relief when a pressure inside the tank exceeds about 10 psig.

18. The combination of claim 17, wherein the one or more pressure relief valves have a combined relief area greater or equal to 11.94 in².

19. The combination of claim 15, wherein a relief area of the one or more pressure relief valves are configured to prevent internal pressure within the tank from exceeding a maximum pressure during a decomposition event or fire engulfment.

20. The combination of claim 15, wherein the one or more pressure relief valves includes two 4" diameter pressure relief valves, each configured to provide pressure relief to the tank at about 10 psig.

21. The combination of claim 15, wherein the one or more pressure relief valves are reclosing pressure relief valves.



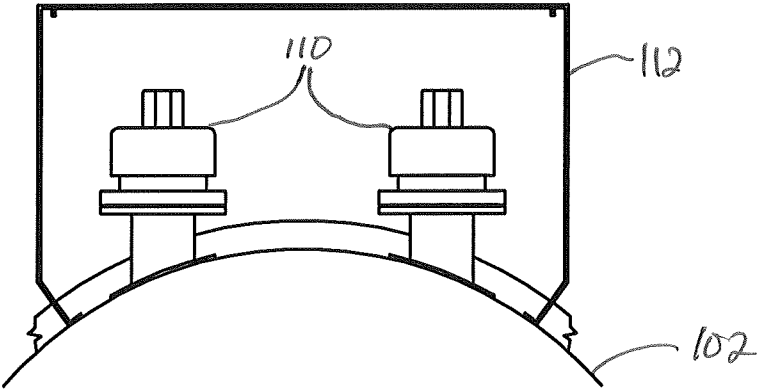


Fig. 2

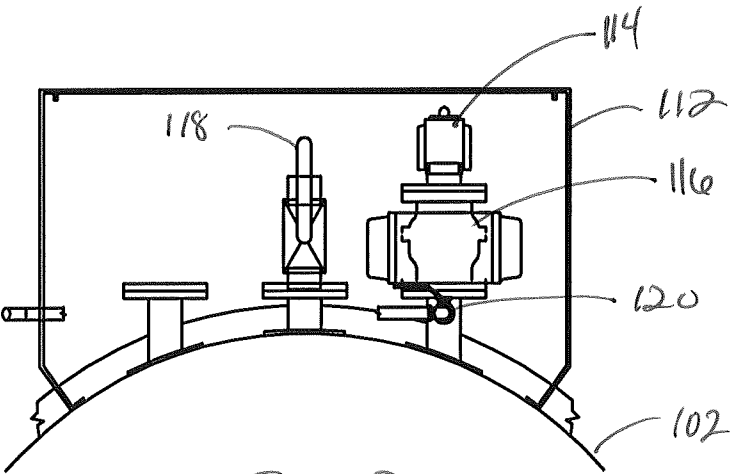
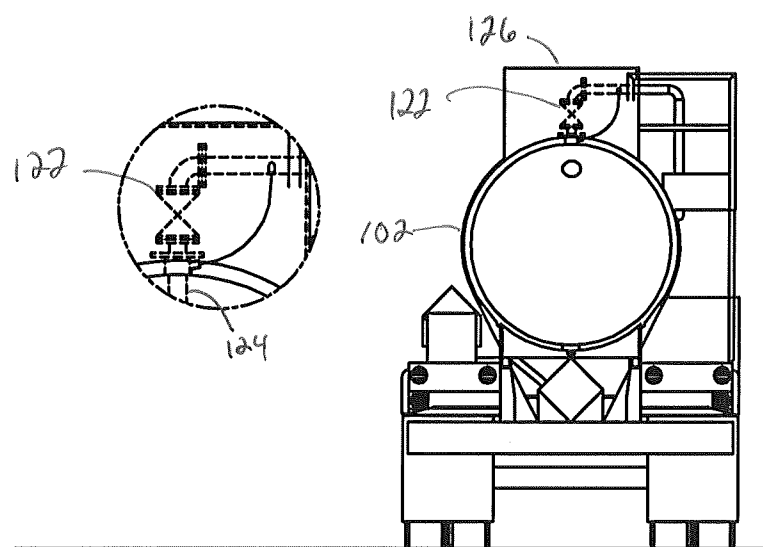
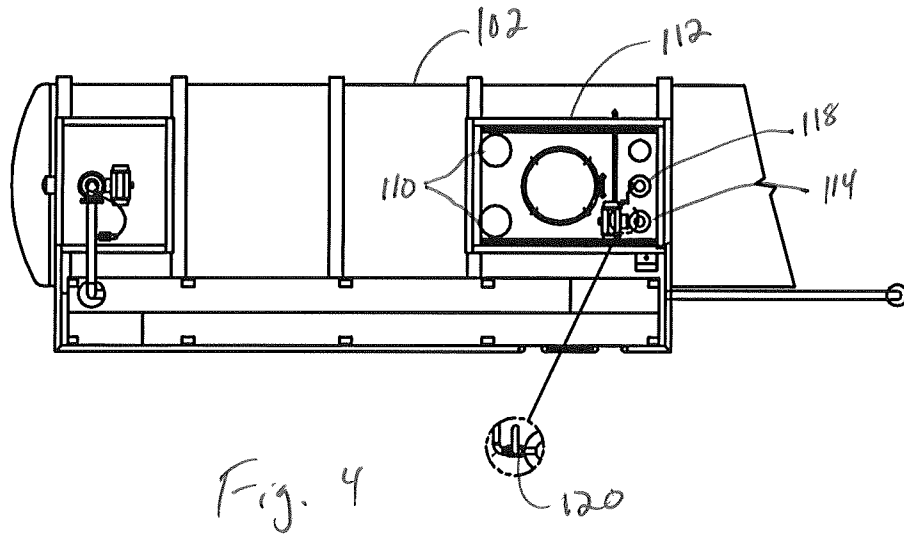


Fig. 3

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2013/058453

A. CLASSIFICATION OF SUBJECT MATTER		B65D 85/84 (2006.01) B65D 90/32 (2006.01) B60P 3/22 (2006.01) B65D 88/12 (2006.01) B62D 33/04 (2006.01)																				
According to International Patent Classification (IPC) or to both national classification and IPC																						
B. FIELDS SEARCHED																						
Minimum documentation searched (classification system followed by classification symbols)																						
B60P 3/00-3/22, B62D 33/00-33/04, B61D 5/00-5/02, B65D 88/00-88/12, B63B 25/00-25/14, B65D 85/84, 88/06, 90/32, 90/22																						
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched																						
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)																						
CIPO, DEPATISnet, DWPI, EAPATIS, Esp@cenet, JOPAL, K-PION, KIPRIS, PAJ, PatSearch (RUPTO internal), RUPAT, SCOPUS, SIPO, USPTO, Patentscope, VINITI																						
C. DOCUMENTS CONSIDERED TO BE RELEVANT																						
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.																				
Y	US 2003/0146616 A1 (GRAHAM FRANCIS TWOMEY et al.) 07.08.2003, paragraphs [0008] - [0010], [0032] - [0036], fig. 1-9	1-21																				
Y	EP 1820750 A2 (PODD STEPHEN D.) 22.08.2007, paragraphs [0033] - [0036], [0049] - [0055], fig. 1-6	1-21																				
Y	GB 832039 A (N.V. DE BATAAFSCHE PETROLEUM MAATSCHAPPIJ) 06.04.1960, p. 1, left col., line 10 - p. 2, right col., line 97, fig. 1	1-21																				
Y	EP 0114709 A1 (DYNATRANS AB) 01.08.1984, p. 2, lines 2-36, fig. 1	1-21																				
Y	Spetsializirovannye tsisterny dlya perevozki opasnykh грузов. Ministerstvo putey soobscheniya RF. Glavnoe upravlenie vagonnogo khozyaistva. Spravochnoe posobie. Moskva izdatelstvo standartov 1993, p. 1, 14-16, 19, 28-29	1-21																				
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.																						
* Special categories of cited documents: <table border="0"> <tr> <td>"A"</td> <td>document defining the general state of the art which is not considered to be of particular relevance</td> <td>"T"</td> <td>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>"E"</td> <td>earlier document but published on or after the international filing date</td> <td>"X"</td> <td>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L"</td> <td>document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"Y"</td> <td>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>"O"</td> <td>document referring to an oral disclosure, use, exhibition or other means</td> <td>"&"</td> <td>document member of the same patent family</td> </tr> <tr> <td>"P"</td> <td>document published prior to the international filing date but later than the priority date claimed</td> <td></td> <td></td> </tr> </table>			"A"	document defining the general state of the art which is not considered to be of particular relevance	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E"	earlier document but published on or after the international filing date	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family	"P"	document published prior to the international filing date but later than the priority date claimed		
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"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family																			
"P"	document published prior to the international filing date but later than the priority date claimed																					
Date of the actual completion of the international search		Date of mailing of the international search report																				
06 November 2013 (06.11.2013)		05 December 2013 (05.12.2013)																				
Name and mailing address of the ISA/ FIPS Russia, 123995, Moscow, G-59, GSP-5, Berezhkovskaya nab., 30-1		Authorized officer N. Nikitina																				
Facsimile No. +7 (499) 243-33-37		Telephone No. (495)531-64-81																				

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2013/058453

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7849801 B2 (TRINITY INDUSTRIES, INC.) 14.12.2010, col.4, lines 13-31, .col.6, lines 39-57, lines 39-57	1-21
A	RU 2211157 C2 (SULIMOV YURIY VIKTOROVICH et al.) 27.08.2003, abstract, fig. 1	1-21