A transport inner bag and a pressure inner bag are loaded in a tank body of a tank container. A supply-discharge opening for the transport inner bag is provided in a position corresponding to a tank supply-discharge opening, and cargo is filled through the opening. A supply-discharge opening for the pressure inner bag is provided in a position corresponding to a hatch of the tank body, and air is filled through the opening to expand the pressure inner bag, so that a space between the transport inner bag and an inner surface of the tank body is filled as well as the gap in between. This prevents the transport inner bag from moving in the tank body in transporting in a state that the cargo is not fully loaded in the transport inner bag, so that the breakage of the transport inner bag caused by the movement is prevented.
FIG. 6

1. Cutting Tubular Film
2. Doubling Tubular Film
3. Forming Attachment Hole for Supply-Discharge Opening of Inner Bag
4. Attaching Supply-Discharge Opening
5. Welding One End Portion of Tubular Film
6. Venting Air
7. Welding Other End Portion of Tubular Film
8. Recording Positioning Mark
9. Folding/Bagging Inner Bag Body
TRANSPORT TANK AND TRANSPORTING METHOD THEREOF

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a transport tank to be transported with containing a cargo in a transport inner bag, and more specifically, a transport tank having a pressure inner bag for preventing the transport inner bag from moving in a tank body of the transport tank during transportation, and transporting method thereof.

[0003] 2. Description of the Prior Arts

[0004] In cargo transportation by sea, railroad, road and so forth, a tank container is generally used for liquid materials (cargo). As the tank container, a 20 foot container (hereinafter referred to as a tank container), which conforms to the ISO Standards is ordinarily used, for example. The tank container has a 20 foot length, 8 foot width, and 8 foot height, so that about 20 tons of liquid can be filled therein.

[0005] In the container transportation to use this kind of tank container, it is necessary to wash the inside of the tank after transportation, and in addition, to produce the tank by using a high quality stainless steel plate with chemical resistance. In order to solve the problems, Japanese Patent Laid-Open Publication No. S61-104983 discloses that an inner bag or liner bag made of soft synthetic resin to have the chemical resistance is loaded in the tank produced from the general steel plate. In addition, Japanese Patent Laid-Open Publication No. 2001-354292, Japanese Utility-Model Laid-Open Publication No. S61-48190, Japanese Patent Laid-Open Publication No. S50-4615, and Japanese Utility-Model Laid-Open Publication No. S57-46492 also disclose to load the inner bag in the tank in order to save the trouble for washing the inside of the tank.

[0006] However, with respect to the prior art inner bag to be used in the tanks and tank containers, it is so difficult to produce appropriate inner bags for large tanks including the 20 foot container that has no practical application. Namely, it has been difficult to produce the inner bag fitting in the cylindrical 20 foot container easily and affordably. The ideal inner bag to fit within the tank container properly would be a cylindrical-shaped inner bag having approximately the same shape as the tank container. However, it is necessary to prepare circular lid films, and in addition, to weld the circular lid films on both ends of a tubular film. To make matters worse, since the circular lid film has to be welded not in a two-dimensional direction, but in a three-dimensional direction, the exclusive guide apparatus for welding the circular lid film is required.

[0007] In contrast, an envelope type inner bag is easily produced only by welding both ends of the tubular film. This type of inner bag prevents the liquid from directly contacting with the inside of the tank by joining supply-discharge openings of the inner bag and the tank. Therefore, changing the inner bag makes it unnecessary to wash the inside of the tank.

[0008] However, the following problem occurs in process of developing the above-mentioned inner bag. The inner bag may move during transportation and the movement varies depending on whether the inner bag is in an approximately fully loaded condition where an amount of the cargo reaches the transport tank volume or it is in a non-fully loaded condition. Namely, if the tank is transported in the non-fully loaded condition, the cargo moves in the inner bag, and at the same time, the inner bag moves in the tank. Consequently, the inner bag may be ruptured, the supply-discharge opening may crack, or the cargo may not be discharged due to twist or inversion of the inner bag. Accordingly, some kind of measure has been required.

SUMMARY OF THE INVENTION

[0009] An object of the present invention is to provide a transport tank in which a transport inner bag hardly moves if the transport tank is transported with the transport inner bag which is not fully loaded with a cargo, and a transporting method thereof.

[0010] In order to achieve the above object, at least one second inner bag is disposed between a first inner bag containing a cargo and an inner surface of the tank body. The second inner bag will expand by filling of filler for holding the cargo to prevent the first inner bag from moving in said tank body during transportation.

[0011] According to the preferred embodiment of the present invention, the first and second inner bags are made from a synthetic resin. The cargo is any of gasses, liquids, and powder and granular materials, which is put into the first inner bag after or while pre-filling the filler in the second inner bag. Although the size of the second inner bag adapts to the amount of the cargo, if the second inner bag has the approximately same size as the tank body, it expands when the cargo is discharged from the first inner bag.

[0012] According to the present invention, the second inner bag will expand by the filler to prevent the first inner bag from moving in the tank body during transportation, so that it is possible to settle such drawbacks as the breakage of the first inner bag due to the movement or the discharge failure of the cargo due to twist or inversion of the cargo during the transportation of the first inner bag which is not fully loaded with the cargo. In addition, a specific amount of the filler is preliminarily filled in the second inner bag to arrange the shape of the second inner bag before or while containing the cargo in the first inner bag, so that the folded second inner bag is not sandwiched between the first inner bag and the inner surface of the tank body when the cargo is put into the first inner bag. Therefore, it is possible to prevent the filling failure due to the sandwiched portion at the time of filling the filler in the second inner bag or to prevent the second inner bag from being ruptured.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The above and other subjects and advantages of the present invention will become apparent from the following detailed description of the preferred embodiments when read in association with the accompanying drawings, which are given by way of illustration only and thus are not limiting the present invention. In the drawings, like reference numerals designate like or corresponding parts throughout the several views, and wherein:

[0014] FIG. 1 is a front view of a tank container having a transport tank to which the present invention is applied;
[0015] FIG. 2A is an explanatory view of the size of a transport inner bag fitting in a tank body of the transport tank, wherein a plan view of the tank body and the transport inner bag is shown;

[0016] FIG. 2B is an explanatory view of the size of the transport inner bag fitting in the tank body, wherein a longitudinal cross-sectional surface of the tank body in a longitudinal direction is shown;

[0017] FIG. 2C is an explanatory view of the size of the transport inner bag fitting in the tank body, wherein a longitudinal cross-sectional surface of the tank body in a width direction is shown;

[0018] FIGS. 3A, 3B, 3C and 3D are schematic perspective views showing procedure for producing the transport inner bag;

[0019] FIG. 4 is a plan view of a pressure inner bag;

[0020] FIG. 5 is a cross-sectional view, partly in section, showing a filler supply-discharge opening, a connector and a connecting hose of the pressure inner bag;

[0021] FIG. 6 is a flow chart showing the procedure for producing the transport inner bag;

[0022] FIG. 7 is an explanatory view showing procedure for welding an inner bag supply-discharge opening;

[0023] FIG. 8 is a cross-sectional view showing a state where an inner bag supply-discharge opening is attached to a tank supply-discharge opening;

[0024] FIG. 9A is a perspective view showing process for welding one end of a tubular film;

[0025] FIG. 9B is a perspective view showing process for venting air from the tubular film;

[0026] FIG. 9C is a perspective view showing process for welding the other end of the tubular film after the air venting;

[0027] FIG. 10A is an enlarged plan view showing a welding line of the inner bag body, wherein the inner and outer tubular films are thermally welded all together into four layer;

[0028] FIG. 10B is an enlarged plan view showing the welding line of the inner bag body, wherein the inner and outer tubular films are thermally welded all together into four layer after the end of the inner tubular film have been thermally welded into two layer;

[0029] FIG. 10C is an enlarged plan view showing the weld line of the inner bag body, wherein the ends of the inner and outer tubular films are thermally welded together into two layer; and

[0030] FIGS. 11A, 11B, 11C, 11D and 11E are explanatory views showing process for folding the transport inner bag to contain it in a packaging bag.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0031] In FIG. 1, a twenty-foot ISO container 10 is constituted of a tank body 11 and a rectangular parallelepiped frame 12 for holding the tank body 11. A hatch 13 is formed at the top face of the tank body 11. The maintenance and filling of liquid are performed through the hatch 13. At the time of transporting, a lid 14 is locked by a locking member in order to prevent the lid 14 covering the hatch 13 from opening. A tank supply-discharge opening 15 is formed in one end of a lower portion of the tank body 11. A foot valve 16 is fixed through a flange 15A of the tank supply-discharge opening 15.

[0032] A transport inner bag 20 is loaded in a lower portion of the tank body 11, while a pressure inner bag 19 is loaded in an upper portion thereof. These inner bags 19, 20 are brought into the tank body 11 from the hatch 13 by an operating person to set in the tank body 11. The transport inner bag 20 upswells in the tank body 11 by pouring the liquid as cargo therein from the tank supply-discharge opening 15 through the foot valve 16, so that the transport inner bag 20 operates as a lining to the tank body 11. In addition, the pressure inner bag 19 is filled with air supplied through a filling hose 17 and a filler supply-discharge opening 18, and presses the transport inner bag 20 against the tank body 11, thus, the transport inner bag 20 hardly moves during transportation. As the transport inner bag 20 stands still in the tank body 11 against the movement of the liquid in transporting, the transport inner bag 20 is not ruptured.

[0033] As shown in FIG. 2A, the transport inner bag 20 is constituted of an inner bag body 21 having an envelope shape and an inner bag supply-discharge opening 22 to be fitted in the tank supply-discharge opening 15. Since the transport inner bag 20 is formed to the envelope shape, the inner bag body 21 can be easily formed as shown in FIGS. 3A-3D. In FIG. 3B, a tubular film 23 is cut into a predetermined length after being drawn from a film roll 24 which is the roll of the tubular film 23, and then both end portions 23a and 23b of the tubular film 23 are closed by thermally welding or the like (see FIGS. 9A and 9C).

[0034] In FIG. 2A, a longitudinal cross-sectional surface including a central line CL1 extending in the longitudinal direction of the tank body 11 (B-B arrowed cross-section) is referred to as a longitudinal cross-sectional surface in the longitudinal direction, while a longitudinal cross-sectional surface including a central line CL2 extending in the width direction of the tank body 11 (C-C arrowed cross-section) is referred to as a longitudinal cross-sectional surface in the width direction. A line CL3 shown in FIG. 2B is a central line extending in a height direction of the tank body 11.

[0035] The tank body 11 is formed to a tubular shape whose both ends are closed to be placed transversally, while the transport inner bag 20 is formed to the envelope shape. Therefore, if the transport inner bag 20 is smaller than the appropriate size corresponding to the size of the tank body 11, a predetermined filling capacity is not ensured. To make matters worse, the smaller inner bag creates a gap between the inner peripheral surface of the tank body 11 and the transport inner bag 20 together with the liquid can move to damage the welded portion of the inner bag supply-discharge opening 22 and the welded lines of the both ends of the transport inner bag 20. Whereas, if the transport inner bag 20 is larger than the appropriate size corresponding to the size of the tank body 11, the raw material of the transport inner bag 20 is wasted. Moreover, if an extra portion such as the end portion of the transport inner bag 20 is under the liquid filled in the
transport inner bag \(20\), the extra portion is sandwiched between the inner bag body \(21\) filled with the liquid and the peripheral surface of the tank body \(11\) due to the weight of the liquid. As a result, it becomes impossible to fill liquid furthermore. If the liquid is kept filled while the extra portion is sandwiched, the internal pressure of the transport inner bag \(20\) rises to possibly damage the transport inner bag \(20\).

[0036] In the present embodiment, the size of the envelope type transport inner bag \(20\) is limited within a specific range based on the size of the tank body \(11\) for the purpose of preventing the filling failure and the damage of the transport inner bag \(20\). When the length of the transport inner bag \(20\) is \(1L\), the width thereof is \(1W\), the inner peripheral length (first inner peripheral length) of the tank body \(11\) in the longitudinal cross-sectional surface in the longitudinal direction is \(TL1\), and the inner peripheral length (second inner peripheral length) of the tank body \(11\) in the longitudinal cross-sectional surface in the width direction is \(TLr\), the following conditions are satisfied:

\[ \begin{align*}
0.47 \leq TLl & \leq 1L \leq 0.6 \cdot TLl; \\
0.47 \leq TLr & \leq 1W \leq 0.6 \cdot TLr.
\end{align*} \]

[0039] \(1L\) and \(1W\) preferably satisfy the following conditions:

\[ \begin{align*}
0.49 \leq TLl & \leq 1L \leq 0.55 \cdot TLl; \\
0.49 \leq TLr & \leq 1W \leq 0.58 \cdot TLr.
\end{align*} \]

[0042] As above-mentioned, the size of the transport inner bag \(20\) is limited based on the inner peripheral length of the tank body \(11\), so that the tank body \(11\) may have different shapes than tube such as an elliptical shape or others.

[0043] The inner bag supply-discharge opening \(22\) is provided on the central line extending in the longitudinal direction at a position apart from one end of the transport inner bag \(20\) by the distance \(1L=1750\) mm or adjacent thereto. The distance \(1L\) is limited within a range \(0.44 \cdot 1W \leq 1L \leq 0.50 \cdot 1W\) based on the width \(1W\) of the transport inner bag \(20\), so that it is possible to position the central positions in the longitudinal direction of the tank body \(11\) and the transport inner bag \(20\) with each other if the transport inner bag \(20\) is attached to the tank body \(11\) with reference to the tank supply-discharge opening \(15\), which is formed in the end of the lower portion of the tank body \(11\). Thereby, the extra portions in both ends of the transport inner bag \(20\) can be distributed approximately evenly in the tank body \(11\). Accordingly, the extra portion of the transport inner bag \(20\) does not build up on one side to be sandwiched between the tank body \(11\) and the inner bag body \(21\), so that the filling failure and the damage of the transport inner bag \(20\) are eliminated.

[0044] As shown in FIG. 4, the pressure inner bag \(19\) is constituted of an inner bag body \(19a\) having an envelope shape and a filler supply-discharge opening \(18\). Although the pressure inner bag \(19\) is formed into the envelope shape having the same size as the transport inner bag \(20\) shown in FIG. 2, since the liquid as the cargo is not filled in the pressure inner bag \(19\) unlike the transport inner bag \(20\), the pressure inner bag \(19\) has a single-layer structure, and in addition, has the filler supply-discharge opening \(18\) instead of the inner bag supply-discharge opening \(22\).

[0045] As shown in FIG. 5, the filler supply-discharge opening \(18\) is constituted of a cylindrical body \(18a\) made of a synthetic resin. A welding flange portion \(18b\) is formed in an end of the filler supply-discharge opening \(18\), while an attachment female screw \(18c\) is formed in an inner peripheral surface of the other end. A bottom attachment screw \(51a\) of a hose connector \(51\) having a valve \(50\) is screwed into the filler supply-discharge opening \(18\) through the attachment female screw \(18c\). A hose connection opening \(51b\) and a cap attachment screw \(51c\) are formed above the hose connector \(51\).

[0046] The hose connection opening \(51b\) uses a snap type connection to hold the end of the hose removably. The valve \(50\) is closed by rotating a handle \(50a\) at the time of removing the filling hose \(17\) from the hose connector \(51\). After removing the filling hose \(17\), a cap \(52\) is fitted in the cap attachment screw \(51c\). Note that a screw type of the hose connection opening may be used instead of the snap type. In addition, with regard to the shape and structure of the filler supply-discharge opening \(18\), the valve \(50\) and the hose connector \(51\) and the attaching method for them, various embodiments may be applied to the present invention. Moreover, the pressure inner bag \(19\) may be formed in a multilayer structure to have two or more layers.

[0047] Next, the procedure for producing the transport inner bag \(20\), which is shown in FIG. 6, is explained. As shown in FIGS. 3A and 3B, the tubular film \(23\) is drawn from the film roll \(24\) to be put on a work table \(25\) and then cut into the length \(1L\) by a cutter \(26\) or the like. The tubular film \(23\) is made from LLDPE (linear low density polyethylene), and wound into a roll shape to be stored. Since the transport inner bag \(20\) is doubled in the present embodiment, it is necessary to form the two tubular films \(23\) by cutting the tubular film \(23\) twice into the length \(1L\). The transport inner bag \(20\) of the present invention is used for the 20 foot container, so that the first inner peripheral length \(TL1=15500\) mm, and the second inner peripheral length \(TLr=7100\) mm, while \(1L=8300\) mm and \(1W=3900\) mm based on the above-mentioned appropriate size range. The thickness of a single layer of the tubular film \(23\) is 120 \(\mu\)m. Since the tubular film \(23\) of the present embodiment has two layers, the entire thickness of the tubular film \(23\) is 240 \(\mu\)m. The thickness of the film is preferably 80-500 \(\mu\)m, especially 100-300 \(\mu\)m.

[0048] As shown in FIG. 3C, in doubling the tubular film \(23\), one tubular film is inserted into another tubular film. Subsequently, as shown in FIG. 3D, a hole \(27\) corresponding to the inner bag supply-discharge opening \(22\) is opened on only the upper two layers of films by a punch or a cutter. The inner bag supply-discharge opening \(22\) is located at the center in the width direction and apart from other end portion \(23b\) by the distance \(1L=1750\) mm.

[0049] As shown in FIG. 7, when the inner bag supply-discharge opening \(22\) is attached to the inner bag body \(21\), the opening \(22\) is thermally welded to a peripheral edge of the hole \(27\). At this time, only the upper two layers of the films are thermally welded. The inner bag supply-discharge opening \(22\) is constituted of a supply-discharge mouth \(22a\) having a truncated conical and cylindrical shape, a welding flange \(22b\) and an attachment flange \(22c\) which are attached to both the ends of the supply-discharge mouth \(22a\), and integrally formed by using LLDPE for example. The welding flange \(22b\) and the inner bag body \(21\) are thermally
welded by a thermal welding apparatus (not shown) to form welding lines 28 and 29. As shown in FIG. 8, when the inner bag supply-discharge opening 22 is inserted to the tank supply-discharge opening 15 from the inside of the tank, the attachment flange 22c protrudes outside the flange 15a of the tank supply-discharge opening 15 to be fixed firmly to the flange 15a.

[0050] As shown in FIG. 8, an attachment flange 30a of an inner bag suction preventing member 30 and the foot valve 16 are attached to the flange 15a of the tank supply-discharge opening 15, so that the inner bag supply-discharge opening 22 is attached firmly to the tank supply-discharge opening 15. The supply-discharge mouth 22d is formed along the inner peripheral surface of the tank supply-discharge opening 15.

[0051] As shown in FIG. 9A, in welding the one end portion of the tubular film 23, all four layers of films in the end portion 23a of the tubular film 23 are thermally welded simultaneously by the thermally welding apparatus 33 to seal the end portion 23a. The thermally welding apparatus 33 is constituted of a receiving stage 33a and a welding head 33b. The heat is applied to the end portion 23a, which is held by the welding head 33b and the receiving stage 33a after the welding head 33b has been moved down.

[0052] As shown in FIG. 10A-C, two stripes of thermal welding lines 35a and 35b of 5 mm in width are formed linearly at an interval of 5-10 mm. Note that one or three or more thermal welding lines may be formed. In addition, a corrugated thermal welding line may be applied to the present embodiment instead of the linear one. If the plural thermal welding lines are formed, all lines may be formed together, or each line may be formed one by one. In FIG. 10B, a thermal welding line 36a is formed by welding the one end portion of the inner tubular film 23 into two layer, and then a thermal welding line 36b is formed by welding the one end portion of both the inner and outer tubular films 23 into four layer. The thermal welding line 36b is positioned outside the thermal welding line 36a. In FIG. 10C, thermal welding lines 37a and 37b are formed by welding each end portion of the tubular film 23 into two layers separately wherein the inner tubular film is slightly shorter in length than the outer one. Although the thermal welding line may be welded at a time, if the length of the welding head 33b is limited, the thermal welding line may be welded sequentially every length of the welding head 33b. Note that ultrasonic welding or other welding method may be applied to the present embodiment instead of the thermal welding by using the heat-sealing type thermal welding apparatus 33.

[0053] As shown in FIG. 9B, a pressing roller 38 is rotated on the work table 25 from the welded end portion 23a toward the other end portion 23b to vent air 39 in the doubled tubular film 23. Instead of rotating the pressing roller 38, the air may be vented by folding the inner bag body 21 from one end side to the other end side. Since the inner bag supply-discharge opening 22 is attached close to the other end portion 23b so as to protrude from the inner bag body 21, the air between the inner bag supply-discharge opening 22 and the other end portion 23b is vented by using a small roller for avoiding the supply-discharge opening 22.

[0054] As shown in FIG. 9C, the other end portion 23b of tubular film 23, in which the air has been vented, is welded by the thermal welding apparatus 33 as well as the case of the end portion 23a. Thereby, the transport inner bag 20 shown in FIG. 1A is completed. A positioning mark 45 is recorded thereon along a central line extending in the longitudinal direction of the transport inner bag 20 by using an oil-based ink or the like. The inner bag body 21 is folded, and then contained in a packaging bag 40 as shown in FIG. 11E. Although the positioning mark 45 is formed linearly in the present embodiment, the shape or size of the positioning mark is not limited especially.

[0055] As shown in FIG. 11A, the inner bag body 21 with the supply-discharge opening 22 directed downward is folded inward along inward folding lines 21e in parallel with the positioning mark 45 so as to make both the side edge portions 21a and 21b approach the central line. Likewise, as shown in FIG. 11B, the inward-folded portions are folded inward again along inward folding lines 21f in parallel with the central line extending in the longitudinal direction so as to make the inward folding line 21e approach the central line. Thereby, the inner bag body 21 is double folded. Subsequently, as shown in FIG. 11C, the inner bag body 21 is folded plural times along the inward folding lines 21g toward the inner bag supply-discharge opening 22 from both the end portions 21e and 21f of the inner bag body 21, so that the inner bag body 21 is folded into a small size as shown in FIG. 11D. The inner bag body 21 may be rewound from the one end to be a roll shape instead of being folded inward along the inward folding lines 21g. After folding the inner bag body 21 into the small size, the transport inner bag 20 is put in the packaging bag 40 as shown in FIG. 11E. Since the inner bag body 21 is double folded along the inward folding lines 21e and 21f, it can be contained compactly. Note that the inner bag body 21 may be folded once or three times and above along the central line extending in the longitudinal direction.

[0056] As aforementioned, since the inner bag body 21 is folded such that the inner bag supply-discharge opening 22 is directed outside the inner bag body 21, the inner bag supply-discharge opening 22 can be inserted to the tank supply-discharge opening 15 easily. In addition, the inner bag body 21 is folded inward along the inward folding lines 21g, so that the inner bag body 21 can be expanded easily in the longitudinal direction of the tank body 11 in a state that the inner bag supply-discharge opening 22 is set in the tank supply-discharge opening 15. Furthermore, since the inner bag body 21 is folded inward along each of the inward folding lines 21e and 21f in a state that the inner bag supply-discharge opening 22 is directed downward, the inner bag body 21 is expanded by itself by filling the liquid from the inner bag supply-discharge opening 22.

[0057] Although the pressure inner bag 19 is produced by a procedure similar to the transport tank 20, the doubling of the tubular film 23 and the recording of the positioning mark 45 are not required and would be omitted. The filler supply-discharge opening 18 is attached instead of the inner bag supply-discharge opening 22. The filler supply-discharge opening 18 is attached so as to correspond to the position of the hatch 13 of the tank body 11, so that it becomes possible to attach and remove the filling hose 17 and also open and close the valve 50 at the hatch 13.

[0058] Next, the method of loading the transport inner bag 20 and the pressure inner bag 19 in the tank body 11 is explained. First, the inner bags 19, 20 in the packaging bag
are brought into the tank body 11 by the operating person, and then the transport inner bag 20 is taken out from the packaging bag 40. The positioning mark 45 is recorded linearly on the transport inner bag 20 so as to correspond to the central line CL1 extending in the longitudinal direction of the tank body 11. After the foot valve 16 has been removed from the flange 15a of the tank supply-discharge opening 15, the inner bag supply-discharge opening 22 is inserted in the tank supply-discharge opening 15 so as to conform the positioning mark 45 to the central line CL1. Thereby, the attachment flange 22c is attached firmly to the flange 15a. Second, the inner bag body 21 folded along the inward folding lines 21g is unfolded in the longitudinal direction of the tank body 11, and then the folded portions along the inward folding line 21f are unfolded. Both the side edge portions which are folded along the inward folding lines 21e are not unfolded. Since the approximately overall width of the inside of the tank body 11 is covered by the inner bag body 21 of which the both side edge portions are folded along the inward folding lines 21e, even if the both side edge portions are unfolded, they are unfolded again by their weight.

Next, the pressure inner bag 19 is lapped over the unfolded transport inner bag 20 to be unfolded in the same manner as the transport inner bag 20. Subsequently, as shown in FIG. 5, the filling hose 17 is connected with the filler supply-discharge opening 18 of the pressure inner bag 19. As shown in FIG. 1, the filling hose 17 is inserted inside the tank body 11 through the hatch 13. After that, the operating person goes outside the tank body 11 from the hatch 13 to finish the loading operation for the inner bags 19, 20. Then, as shown in FIG. 8, the inner bag suction preventing member 30 and the foot valve 16 are attached to the tank supply-discharge opening 15 from the outside of the tank body 11.

The liquid as the cargo is filled from the tank supply-discharge opening 15. The filling speed is 50 liters per minute, for example. The inner bag body 21 is extended in the longitudinal direction in the tank body 11, so that the inner bag body 21 upswells by filling the liquid in the inner bag body 21 smoothly. The both side edge portions of the inner bag body 21, which are folded inward, are gradually unfolded with the filling of the liquid, so that the end portions of the inner bag body 21 are not accidentally caught between the inner bag body 21 and the tank body 11 by the weight of the portion in which the liquid is filled. Therefore, the inner bag body 21 upswells smoothly by the filling of the liquid. In the fully loaded condition, about 20 tons of liquid is contained in the inner bag body 21; however, the present embodiment premised the transportation in the non-fully loaded condition, 10 tons of liquid is contained in the inner bag body 21 for an example of the non-fully loaded conditions.

The air is put up to 10-20% of the filling capacity, for example, in the pressure inner bag 19 before or at the same time as the onset of the liquid filling in the transport inner bag 20. The pre-filling of the pressure inner bag 19 is performed in order to arrange the shape of the pressure inner bag 19 so that the pressure inner bag 19 avoids to be sandwiched between the transport inner bag 20 and the inner surface of the tank body 11 due to the filling of the liquid. The filling of the air is temporarily stopped at the time of reaching the pre-filling amount. After the predetermined transportation amount, 10 tons of liquid for example, has been flowed in the transport inner bag 20, the air is filled again in the pressure inner bag 19. The air is stopped filling after a gap between the inner surface of the tank body 11 and the transport tank 20 has been filled by the air. The filling hose 17 is removed after closing the valve 50, and the cap 52 is placed on the filler supply-discharge opening 18. After that, the hatch 13 is closed, and then the filling operation for the tank body 11 is finished. Note that the air to be preliminarily filled in the pressure inner bag 19 may be equal to or slightly exceed the capacity which subtracts the predetermined transportation amount from the capacity of the tank body 11 before the liquid filling in the transport inner bag 20. If the air is preliminarily filled in the pressure inner bag 19 to slightly exceed the above-mentioned capacity, the liquid is filled in a state that the valve 50 is slightly open to discharge the extra air in the pressure inner bag 19 while the liquid is filled in the transport inner bag 20. Thereby, it is possible to alleviate or eliminate the air filling operation in the place for the liquid filling. Note that an air vent valve such as a one-way valve may be provided instead of or in addition to the valve 50.

In the present embodiment, the inner bag body 21 is loaded in the tank body 11 to extend in the longitudinal direction, and its side edge portions are folded inward toward the central line extending in the width direction of the inner bag body 21. That prevents the air from entering the inner bag body 21 and the inner bag body 21 can be used for the anaerobic liquid. In addition, since the inner bag body 21 and the inner bag supply-discharge opening 22 are made from LLDPE having high chemical resistance, the tank body 11 has more choices in material. Furthermore, it is unnecessary to line the inner peripheral surface of the tank body 11 with fluorocarbon resin such as polytetrafluoroethylene.

When the inner bag body 21 dwindles to close with the inner bag supply-discharge opening 22 after the remaining amount of the liquid is reduced, the inner bag body 21 may be accidentally sucked into the inner bag supply-discharge opening 22 to cover the opening 22. In order to prevent the inner bag body 21 from covering the inner bag supply-discharge opening 22 in discharging the liquid from the tank supply-discharge opening 15, when the liquid is discharged from the tank supply-discharge opening 15, a passage between the inner bag body 21 and the inner bag supply-discharge opening 22 is ensured by the inner bag suction preventing member 30. The inner bag suction preventing member 30 is integrally constituted of a semi-spherical end 30b arranged to protrude toward the inside of the tank body 11, a tubular portion 30d whose peripheral surface has plural continuous holes 30c, and the attachment flange 30a provided on the base of the tubular portion 30d. The semi-spherical end 30b protrudes toward the inside of the inner bag body 21, so that the residual liquid in the inner bag body 21 can be surely discharged through the continuous holes 30c without the inner bag body 21 stick to the inner bag supply-discharge opening 22.

In the above embodiment, the inner bags 19, 20 are made from LLDPE, they may be made from LDPE (low-density polyethylene), OP (biaxially oriented polypropylene) and other synthetic resin. In addition, although the inner bag body 21 is doubled in the present embodiment, it may have a multilayer or single-layer structure. Moreover, the tank body 11 may have different shapes than tube such
as an elliptical shape or others. Furthermore, the inner bags 19, 20 may be used not only for the tank container, but also for a tanker lorry and so forth. The present invention is not limited only to the inner bag having an envelope shape in the above embodiment, but is also applicable to a cylindrical shape or other shapes.

[0065] In the above embodiment, although the pressure inner bag 19 has the same size as the transport inner bag 20 capable of carrying 1-19 tons of cargo in the non-fully loaded condition, the pressure inner bags may be provided with, for example, four sizes accommodating to 1-5 tons, 5-10 tons, 10-15 tons and 15-19 tons of cargo in accordance with the transportation amount. Thereby, the pressure inner bag 19 the size of which is unnecessarily large is not required, so that it is possible to prevent the material thereof from being wasted. In addition, not only one pressure inner bag but plural ones may be used in the present invention. In this case, plural filling hoses are connected to each inner pressure bag 19 when the liquid as the cargo is filled.

[0066] The pressure inner bag 19 and the transport inner bag 20 may be folded together in a state that the pressure inner bag 19 is lapped over the transport inner bag 20 not as loading these inner bags separately. Thereby, the folding and the loading of the inner bag can be performed at a time, so that the operation time is reduced in comparison with the case in which these operations are performed separately. When folding together, the portions of these inner bags may be temporarily attached each other by a two-sided adhesive tape.

[0067] The air is used as the filler in the above embodiment; however, gas emission from a track engine or inert gas such as nitrogen gas may be used. In addition, the air may be filled by connecting a cartridge directly instead of using the filling hose. Moreover, not only gasses but also liquids such as water or powder and granular materials made of a synthetic resin foam may be used as the filler. Furthermore, the cargo is not limited to only the liquids, but powdery or granular cargo may be applied to the present embodiment.

[0068] Note that the back pressure may be applied to the cargo by expanding the pressure inner bag, which has the approximately same capacity as the tank body, when the cargo is discharged from the tank body. Thereby, the cargo having high viscosity can be discharged smoothly and rapidly.

[0069] Although the present invention has been fully described by the way of the preferred embodiments thereof with reference to the accompanying drawings, various changes and modifications will be apparent to those having skill in this field. Therefore, unless otherwise these changes and modifications depart from the scope of the present invention, they should be construed as included therein.

What is claimed is:

1. A transport tank having a tank body and a first inner bag to be loaded inside of said tank body removably, said first inner bag having a second supply-discharge opening to be fitted in a first supply-discharge opening of said tank body for loading a cargo, said transport tank comprising:

   - at least one second inner bag, disposed between said first inner bag containing said cargo and an inner surface of said tank body, to expand by filling of filler for holding said cargo to prevent said first inner bag from moving in said tank body during transportation.

2. A transport tank as claimed in claim 1, wherein said first and second inner bags are made from a synthetic resin.

3. A transport tank as claimed in claim 2, wherein said cargo is put into said first inner bag after or while pre-filling said filler in said second inner bag.

4. A transport tank as claimed in claim 3, wherein size of said second inner bag adapts to an amount of said cargo.

5. A transport tank as claimed in claim 3, wherein said second inner bag has the same capacity as said tank body and expands when said cargo is discharged from said first inner bag.

6. A transport tank as claimed in claim 5, wherein said filler is any of gasses, liquids or powder and granular materials.

7. A transporting method for transporting cargo by use of a first inner bag to be loaded inside of a tank body removably, said first inner bag having a second supply-discharge opening to be fitted in a first supply-discharge opening of said tank body for loading said cargo, said transporting method comprising the step of:

   - expanding at least one second inner bag, which is disposed between said first inner bag containing said cargo and an inner surface of said tank body, by filling of filler for holding said cargo to prevent said first inner bag from moving in said tank body during transportation.

8. A transporting method as claimed in claim 7, wherein said first and second inner bags are made from a synthetic resin.

9. A transporting method as claimed in claim 8, wherein said cargo is put into said first inner bag after or while pre-filling said filler in said second inner bag.

10. A transporting method as claimed in claim 9, wherein size of said second inner bag adapts to an amount of said cargo.

11. A transporting method as claimed in claim 9, wherein said second inner bag has the same capacity as said tank body and expands when said cargo is discharged from said first inner bag.

12. A transporting method as claimed in claim 11, wherein said filler is any of gasses, liquids or powder and granular materials.

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