

INSULATION STRUCTURE OF CRYOGENIC LIQUEFIED GAS STORAGE

TANK

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit and priority to Korean Patent Application No. 10-2017-0043666 filed on April 4, 2017 with the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

TECHNICAL FIELD

[0002] The present disclosure relates to an insulation structure of a cryogenic liquefied gas storage tank, and more particularly, to an insulation structure of a cryogenic liquefied gas storage tank which absorbs displacement of gaps between primary insulation panels by using an elastic sheet made of an elastically deformable material at an ultra-low temperature, thereby preventing a fluid produced outside a tank body from leaking to the outside.

BACKGROUND

[0003] In general, liquid oxygen (-183°C), liquid nitrogen (-196°C), liquid argon (-186°C), LNG (-162°C), or the like having a low boiling point is stored in a cryogenic liquefied gas storage tank due to the nature thereof.

[0004] The cryogenic liquefied gas storage tank mostly has a structure for preventing evaporation of a cryogenic liquid by preventing heat penetration from the outside.

[0005] A cryogenic liquefied gas storage tank in the related art has a tank body which is made of a metal material and stores therein a cryogenic liquid, and an

insulation structure which is coupled to an outer portion of the tank body to ensure an insulation performance.

[0006] The insulation structure in the related art includes multiple insulation panels which are attached to an outer surface of the tank body, insulators which are coupled in gaps between the insulation panels, and fastening members which couple the insulation panels to the tank body.

[0007] However, in the insulation structure in the related art, there is concern that a fluid produced on the outer surface of the tank body leaks to the outside through the gaps between the insulation panels when the gaps between the insulation panels are deformed due to an influence of a temperature of the cryogenic liquid stored in the tank body.

[0008] An edge portion of the tank body of the cryogenic liquefied gas storage tank in the related art is formed to have a curved surface, or the like, such that it is difficult to install the insulation panel on the edge portion of the tank body, and as a result, it takes a lot of time and costs during a process of installing the insulation panel.

[0009] As a document in the related art associated with the present disclosure, there is Korean Patent No. 10-0166608 (September 24, 1998) that discloses an insulating structure for a liquefied gas tank.

SUMMARY

[0010] The present disclosure has been made in an effort to provide an insulation structure of a cryogenic liquefied gas storage tank which absorbs displacement of gaps between primary insulation panels by using an elastic sheet made of an elastically deformable material at an ultra-low temperature, thereby preventing a fluid produced outside a tank body from leaking to the outside.

[0011] The present disclosure has also been made in an effort to provide an insulation structure of a cryogenic liquefied gas storage tank, in which a deformable flexible foam material is attached to a curved portion of a tank body where there is difficulty in installing an insulation panel, and then an outer insulation layer is formed by spraying spray foam onto an outer portion of the tank body, thereby reducing time and costs required for construction and improving working efficiency.

[0012] An exemplary embodiment of the present disclosure provides an insulation structure of a cryogenic liquefied gas storage tank, the insulation structure including: multiple primary insulation panels which are coupled along outer planar portions of a tank body and have first insulators correspondingly inserted into first gaps at edges adjacent to each other; multiple inner protective plates which are coupled along outer surfaces of the primary insulation panels and have first end portions at edges that are positioned in the first gaps so as to be adjacent to each other; secondary insulation panels which are coupled along the outer surfaces of the primary insulation panels and have second insulators correspondingly inserted into second gaps at edges adjacent to each other; multiple outer protective plates which are coupled along outer surfaces of the secondary insulation panels and have second end portions at edges that are positioned in the second gaps so as to be adjacent to each other; and elastic sheets which are positioned between the inner protective plates and the secondary insulation panels, continuously attached along the first end portions so that the first insulators are not exposed to the outside, and flexible so as to cope with displacement of the first end portions.

[0013] The elastic sheet may be attached to have a width larger than a width of the first gap, and a center of the first gap may be positioned collinearly with a center of the elastic sheet.

[0014] The elastic sheet may be made of a rubber material and attached by a silicon bonding agent.

[0015] Outer sheets may be further attached to the outer surfaces of the outer protective plates, and the outer sheets may be continuously attached along the second end portions.

[0016] One or more first gap pads may be further attached to the inner surfaces of the primary insulation panels so as to form first flow paths on an outer surface of the tank body, and one or more second gap pads may be further attached to the inner surfaces of the secondary insulation panels so as to form second flow paths on outer surfaces of the inner protective plates.

[0017] Outer edge portions, which connect the planar portions, may be formed outside the tank body, and flexible foam materials, which have edges abutting against the first flow paths, absorb a fluid produced on the outer surface of the tank body, and move the fluid to the first flow paths, and spray foams, which are sprayed onto outer surfaces of the flexible foam materials and have edges attached to the edges of the primary insulation panels and the edges of the secondary insulation panels, may be further formed at the edge portions.

[0018] The spray foam may be made of polyurethane foam (PUF).

[0019] Joint fillers having a predetermined thickness may be further coupled to the edge of the primary insulation panel and the edge of the secondary insulation panel, and the joint fillers may be disposed between the spray foams and the primary insulation panels and between the spray foams and the secondary insulation panels.

[0020] First fastening holes may be penetratively formed in the primary insulation panel and the inner protective plate, second fastening holes may be penetratively formed in the secondary insulation panel and the outer protective plate, and fastening members

may be coupled to the first fastening holes and the second fastening holes in order to couple the primary insulation panels and the secondary insulation panels to the outer surface of the tank body.

[0021] The fastening member may include: a stud bolt which protrudes from the outer surface of the tank body; a receiving member which is inserted into the first fastening hole and has a first through hole penetratively formed in the receiving member; an insertion member which is coupled into the first through hole and has a second through hole to which the stud bolt is penetratively coupled; a fixing plate which is attached to the inner surface of the secondary insulation panel and has a third through hole that is penetratively formed in the fixing plate so as to be collinear with the second through hole so that the stud bolt is penetratively coupled to the third hole; and a nut which is coupled to one end of the stud bolt penetrating the fixing plate in the second fastening hole, and couples the fixing plate to the stud bolt.

[0022] According to the present disclosure, it is possible to prevent a fluid produced outside the tank body from leaking to the outside, by absorbing the displacement of the gaps between the primary insulation panels by using the elastic sheet made of an elastically deformable material at an ultra-low temperature.

[0023] According to the present disclosure, the elastic sheet is attached by applying a bonding agent and performing a rolling operation, such that a separate compressing process is not required, and as a result, it is possible to reduce working time.

[0024] According to the present disclosure, it is possible to reduce time and costs required for construction and to improve working efficiency, by attaching the deformable flexible foam material to a curved portion of the tank body where there is difficulty in installing the insulation panel, and then forming the outer insulation layer by spraying the spray foam onto the outer portion of the tank body.

[0025] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects, embodiments, and features described above, further aspects, embodiments, and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] FIG. 1 is a cut-out cross-sectional view of a ship including a cryogenic liquefied gas storage tank according to an exemplary embodiment of the present disclosure.

[0027] FIG. 2 is an exploded perspective view illustrating an outer planar portion and an outer edge portion of a tank body in an insulation structure of the cryogenic liquefied gas storage tank according to the exemplary embodiment of the present disclosure.

[0028] FIG. 3 is a coupled perspective view illustrating the outer planar portion and an outer edge portion of the tank body in the insulation structure of the cryogenic liquefied gas storage tank according to the exemplary embodiment of the present disclosure.

[0029] FIG. 4 is a coupled cross-sectional view illustrating the outer planar portion and an outer edge portion of the tank body in the insulation structure of the cryogenic liquefied gas storage tank according to the exemplary embodiment of the present disclosure.

[0030] FIG. 5 is an exploded perspective view illustrating an outer planar portion of the tank body in the insulation structure of the cryogenic liquefied gas storage tank according to the exemplary embodiment of the present disclosure.

[0031] FIG. 6 is a coupled cross-sectional view illustrating the outer planar portion of the tank body in the insulation structure of the cryogenic liquefied gas storage tank

according to the exemplary embodiment of the present disclosure.

DETAILED DESCRIPTION

[0001] In the following detailed description, reference is made to the accompanying drawing, which forms a part hereof. The illustrative embodiments described in the detailed description, drawing, and claims are not meant to be limiting. Other embodiments may be utilized, and other changes may be made, without departing from the spirit or scope of the subject matter presented here.

[0002] Hereinafter, exemplary embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

[0032] Advantages and features of the present disclosure and methods of achieving the advantages and features will be clear with reference to exemplary embodiments described in detail below together with the accompanying drawings.

[0033] However, the present disclosure is not limited to the exemplary embodiment disclosed herein, but will be implemented in various forms. The exemplary embodiments are provided so that the present disclosure is completely disclosed, and a person with ordinary skill in the art to which the present disclosure pertains can fully understand the scope of the present disclosure. Therefore, the present disclosure will be defined only by the scope of the appended claims.

[0034] In the description of the present disclosure, a detailed explanation of publicly known related technologies may be omitted so as to avoid unnecessarily obscuring the subject matter of the present disclosure.

[0035] FIG. 1 is a cross-sectional view schematically illustrating a cross section of a ship 1000 including a liquefied gas storage tank according to an exemplary embodiment of the present disclosure, FIG. 2 is an exploded perspective view illustrating an outer

planar portion and an outer edge portion of a tank body in an insulation structure of a cryogenic liquefied gas storage tank according to an exemplary embodiment of the present disclosure, and FIG. 3 is a coupled perspective view illustrating the outer planar portion and an outer edge portion of the tank body in the insulation structure of the cryogenic liquefied gas storage tank according to an exemplary embodiment of the present disclosure.

[0036] FIG. 4 is a coupled cross-sectional view illustrating the outer planar portion and an outer edge portion of the tank body in the insulation structure of the cryogenic liquefied gas storage tank according to an exemplary embodiment of the present disclosure, FIG. 5 is an exploded perspective view illustrating an outer planar portion of the tank body in the insulation structure of the cryogenic liquefied gas storage tank according to the present disclosure, and FIG. 6 is a coupled cross-sectional view illustrating the outer planar portion of the tank body in the insulation structure of the cryogenic liquefied gas storage tank according to an exemplary embodiment of the present disclosure.

[0037] Referring to FIG. 1, the ship 1000 having the liquefied gas storage tank according to the present exemplary embodiment includes a hull 1, a tank body 10, an insulation unit 30, gap pads 50, and drip trays 70.

[0038] The hull 1 may be configured as a double hull including an outer hull and an inner hull, and the liquefied gas storage tank for storing a liquefied gas is positioned in the inner hull of the hull 1.

[0039] The liquefied gas storage tanks may be classified into an independent type storage tank and a membrane type storage tank. Here, in the independent type storage tank, the storage tank is not formed integrally with the hull and a support device of the hull supports the independent storage tank, and the independent type storage tanks are

classified into Types A, B, and C.

[0040] Among Types A, B, and C, the present disclosure discloses, as an example, the independent type storage tank of Type B, that is, a self-supporting, prismatic-shape IMO type B (SPB) storage tank having a prismatic tank shape as illustrated in FIG. 1.

[0041] Referring to FIG. 1, the liquefied gas storage tank according to the present exemplary embodiment includes the tank body 10, the insulation unit 30, the gap pads 50, and the drip trays 70, the liquefied gas storage tank may be manufactured together with the hull 1 or may be manufactured separately from the hull 1 and then mounted in the hull 1.

[0042] The tank body 10 serves to define a sealed container for maintaining gastight sealability of the liquefied gas storage tank, and an internal space 12 is formed in the tank body 10 so that the liquefied gas is hermetically stored in the internal space 12.

[0043] As illustrated in FIG. 1, the insulation unit 30 is installed outside the tank body 10 so as to block heat transfer between inner and outer sides of the tank body 10. For example, the insulation unit 30 may be made of a material such as polyurethane foam. As illustrated in FIG. 2, the insulation unit 30 may include two separated panel systems. The configuration of the insulation unit 30 will be more specifically described below with reference to FIGS. 2 to 6.

[0044] The gap pad 50 is a member which is disposed between the insulation unit 30 and the tank body 10 and forms a predetermined separation space between the insulation unit 30 and the tank body 10 so that when the liquefied gas stored in the liquefied gas storage tank leaks to the outside, the leaking liquefied gas flows downward along the tank body 10.

[0045] The liquefied gas, which leaks to the outside, flows downward along the tank body 10 through the separation space formed between the insulation unit 30 and the

tank body 10.

[0046] If the liquefied gas stored in the liquefied gas storage tank leaks because the tank body 10 is damaged or cracked, this configuration allows the leaking liquefied gas to flow downward along the surface of the tank body 10 and to be collected at a predetermined position at a lower side of the liquefied gas storage tank, thereby preventing direct damage to the hull 10.

[0047] The liquefied gas, which has flown to the lower side of the liquefied gas storage tank, is collected by the drip trays 70 installed at the lower side of the storage tank. The drip tray 70 is a member capable of collecting the liquefied gas, which leaks from the tank body 10, at one position when the liquefied gas leaks from the tank body 10. The drip trays 70 are disposed between the inner surface of the hull 1 and the tank body 10 so as to receive the liquefied gas leaking from the tank body 10.

[0048] Referring to FIGS. 2 to 6, the insulation structure of the cryogenic liquefied gas storage tank according to the present disclosure includes primary insulation panels 100, secondary insulation panels 200, elastic sheets 300, and outer sheets 400.

[0049] The insulation structure of the cryogenic liquefied gas storage tank according to the present disclosure may further include joint fillers 500, flexible foam materials 600, spray foams 700, protection coating layers 800, and fastening members 900.

[0050] First, the tank body 10 has a storage space having a predetermined area so that a cryogenic liquid (liquefied natural gas (LNG)) may be stored in the storage space, and the tank body 10 is made of a metal (steel) material having predetermined strength.

[0051] Outer planar portions C having straight surfaces may be formed at a lateral portion, an upper portion, and a lower portion of the tank body 10, and an outer edge portion D having a curved surface may be formed at an edge portion of the tank body 10.

[0052] A primary insulation structure and a secondary insulation structure, which

will be described below, are sequentially coupled to the planar portion C of the tank body 10, and the flexible foam material 600 and the spray foam layer 700, which will be described below, are sequentially attached to the edge portion D of the tank body 10.

[0053] The primary insulation panel 100 is coupled along an outer surface of the tank body 10 to form a primary insulation layer, and prevents heat penetration into the cryogenic liquid by ensuring an insulation performance.

[0054] To this end, the primary insulation panel 100 may be made of a hard insulation material such as polyurethane foam (PUF).

[0055] The primary insulation panel 100 may have a polyhedral shape having a predetermined area and may be coupled to the outer surface of the tank body 10, but the shapes or the like of the primary insulation panel 100 may be variously modified as necessary.

[0056] A first gap 110 having a predetermined area is formed at the edge where the primary insulation panels 100 are adjacent to each other, and a first insulator 120 having a shape corresponding to the first gap 110 is inserted into the first gap 110.

[0057] In this case, the first gap 110 may be formed to be divided in the form of a lattice, and the first insulator 120 having the shape corresponding to the first gap 110 is inserted into the first gap 110.

[0058] First fastening holes 130 into which the fastening members 900 to be described below are coupled are penetratively formed in the primary insulation panel 100 in a direction in which the fastening members 900 are coupled.

[0059] A space into which a receiving member 920 and an insertion member 930 of the fastening member 900 to be described below may be coupled is formed in the first fastening hole 130.

[0060] One or more inner protective plates 140 made of a metal (steel) material may

be further attached to an outer surface of the primary insulation panel 100.

[0061] The inner protective plate 140 is positioned between the primary insulation panel 100 and the elastic sheet 300 to be described below, and protects the outer surface of the primary insulation panel 100.

[0062] Here, the inner protective plate 140 may be attached in the form of a quadrangular sheet having the same shape and the same size as the primary insulation panel 100 and the secondary insulation panel 200 to be described below.

[0063] First end portions 141 of the inner protective plates 140 adjacent to the edge are disposed to be adjacent to each other, and the first end portions 141 may be divided in the form of a lattice.

[0064] Meanwhile, one or more first gap pads 150 may be attached to an inner surface of the primary insulation panel 100 so as to form a predetermined gap between the inner surface of the primary insulation panel 100 and the outer surface of the tank body 10.

[0065] Here, the first gap pad 150 may be made of melamine foam, and the one or more first gap pads 150 may be disposed in a section between the first fastening holes 130 and the first gaps 110 into which the first insulators 120 are inserted.

[0066] Here, the first gap pad 150 has a predetermined length as illustrated in FIG. 2, and a first flow path A having a predetermined length is formed between the first gap pads 150 so that a fluid W may be discharged to the outside.

[0067] The secondary insulation panel 200 is coupled along the outer surface of the primary insulation panel 100 to form a secondary insulation layer, and prevents heat penetration into the cryogenic liquid by ensuring an insulation performance.

[0068] To this end, the secondary insulation panel 200 may be made of a hard insulation material such as polyurethane foam (PUF).

[0069] The secondary insulation panel 200 may have a polyhedral shape having a predetermined area and may be coupled to the outer surface of the tank body 10, but the shapes or the like of the secondary insulation panel 200 may be variously modified as necessary.

[0070] A second gap 210 having a predetermined area is formed at the edge where the secondary insulation panels 200 are adjacent to each other, and a second insulator 220 having a shape corresponding to the second gap 210 is inserted into the second gap 210.

[0071] In this case, the second gap 210 may be formed to be divided in the form of a lattice, and the second insulator 220 having the shape corresponding to the second gap 210 is inserted into the second gap 210.

[0072] Second fastening holes 230 into which filling materials 231 are coupled after installing the fastening members 900 to be described below are penetratively formed in the secondary insulation panel 200 in the direction in which the filling materials 231 are coupled.

[0073] One or more outer protective plates 240 made of a metal (steel) material may be further attached to an outer surface of the secondary insulation panel 200.

[0074] The outer protective plate 240 is positioned between the secondary insulation panel 200 and the outer sheet 400 to be described below, and protects the outer surface of the secondary insulation panel 200.

[0075] Here, the outer protective plate 240 may be attached in the form of a quadrangular sheet having the same shape and the same size as the secondary insulation panel 200.

[0076] Second end portions 241 of the outer protective plates 240 adjacent to the edge are disposed to be adjacent to each other, and the second end portions 241 may be

divided in the form of a lattice.

[0077] Meanwhile, one or more second gap pads 250 may be attached to an inner surface of the secondary insulation panel 200 so as to form a predetermined gap between the inner surface of the secondary insulation panel 200 and the outer surface of the primary insulation panel 100.

[0078] Here, the second gap pad 250 may be made of melamine foam, and the one or more second gap pads 250 may be disposed in a section between the second fastening holes 230 and the second gaps 210 into which the second insulators 220 are inserted.

[0079] The second gap pad 250 has a predetermined length as illustrated in FIG. 2, and a second flow path B having a predetermined length is formed between the second gap pads 250 so that the fluid W may be discharged to the outside.

[0080] The elastic sheet 300 is attached to an outer surface of the inner protective plate 140, and the elastic sheet 300 is continuously attached along the first end portion 141 so that the first insulator 120 is not exposed to the outside.

[0081] Here, the elastic sheet 300 is made of a flexible material so as to prevent a leak of the fluid W and cope with the displacement of the first gap 110.

[0082] To this end, the elastic sheet 300 may be made of a rubber material and is attached to the outer surface of the inner protective plate 150 by using a silicon bonding agent.

[0083] The elastic sheet 300 may be attached along the first end portion 141 to have a lattice shape, and a center of the elastic sheet 300 may be positioned collinearly with a center of the first end portion 141.

[0084] The elastic sheet 300 absorbs the displacement of the gap of the first end portion 141 which is caused by an influence of a low-temperature environment, thereby preventing the fluid W in the first flow path A from leaking to the outside through the

first fastening hole 130 and the first end portion 141.

[0085] The outer sheet 400 is attached along the outer surface of the outer protective plate 240, and the outer sheet 400 may be made of a metal material (aluminum, or the like).

[0086] Here, the outer sheet 400 may be made of an aluminum butyl tape sheet (also called butyl laminate sheet) material.

[0087] The outer sheet 400 is continuously attached along the second end portion 241 so that the second insulator 220 is not exposed to the outside.

[0088] The outer sheet 400 is attached to the outer surface of the outer protective plate 240 so as to have a width larger than a width of the second end portion 241, and a center of the outer sheet 400 may be positioned collinearly with a center of the second end portion 241.

[0089] The outer sheet 400 may be attached to the outer surface of the outer protective plate 240 by using a silicon bonding agent.

[0090] The outer sheet 400 prevents the fluid W in the second flow path B from leaking to the outside through the second fastening hole 230 and the second end portion 241.

[0091] The joint fillers 500 are coupled along the edge of the primary insulation panel 100 and the edge of the secondary insulation panel 200 and each have a predetermined thickness.

[0092] In this case, the joint fillers 500 are disposed between the spray foam 700 and the primary insulation panel 100 and between the spray foam 700 and the secondary insulation panel 200.

[0093] The joint filler 500 may be made of a polyurethane (PU) material.

[0094] The joint filler 500 fills gaps of the primary insulation panel 100 and the

secondary insulation panel 200 adjacent to the edge, thereby preventing heat penetration from the outside and absorbing thermal displacement of the gaps which is caused by contraction of the primary insulation panel 100 and the secondary insulation panel 200 which are exposed to an ultra-low temperature.

[0095] The flexible foam material 600 is attached to the outer edge portion D of the tank body 10, and both ends of the flexible foam material 600 adjacent to the edge are positioned to abut against the first flow path A.

[0096] Here, the flexible foam material 600 is attached to the edge portion D of the tank body 10 by a separate bonding agent so as to have a shape corresponding to the edge portion D of the tank body 10.

[0097] The bonding agent may be made of a polyurethane (PU) material, but various materials may be used as the bonding agent as necessary.

[0098] The flexible foam material 600 may be made of an opened porous material so that the fluid W produced on the outer surface of the tank body 10 may move along the interior of the flexible foam material 600.

[0099] For example, the flexible foam material 600 may be made of a material, such as melamine foam, which allows the fluid W to penetrate therethrough and is deformable to have a predetermined shape.

[0100] As illustrated in FIG. 4, the flexible foam material 600 absorbs the fluid W produced on the outer surface of the tank body 10, and then moves the fluid W to the first flow path A.

[0101] Thereafter, the fluid W introduced into the first flow path A moves a predetermined distance, and then may be discharged to the outside through a drain port (not illustrated) connected to the first flow path A.

[0102] The flexible foam material 600 is coupled to the edge portion D where there is

difficulty in coupling the primary insulation panel 100 and the secondary insulation panel 200, and the flexible foam material 600 serves to drain the fluid W.

[0103] In addition, the flexible foam material 600 is deformed into a shape corresponding to the edge portion D, such that it is easy to install the flexible foam material 600, and as a result, it is possible to reduce construction time and costs and to improve working efficiency

[0104] The spray foam 700 is sprayed to the outer surface of the flexible foam material 600, thereby forming an outer insulation layer of the tank body 10.

[0105] In this case, the spray foam 700 is attached to an outer surface of the flexible foam material 600 to have a shape corresponding to the outer surface of the flexible foam material 600, and an edge of the spray foam 700 is attached to the edge of the primary insulation panel 100 and the edge of the secondary insulation panel 200.

[0106] Here, the spray foam 700 may be made of a closed porous material which disables penetration of the fluid W in order to prevent the fluid W from moving along the interior of the spray foam 700.

[0107] To this end, the spray foam 700 may be made of a polyurethane foam (PUF) material.

[0108] The protection coating layer 800 may be applied onto an outer surface of the spray foam 700, the outer surface of the outer protective plate 240, and the outer surface of the outer sheet 400 so as to have a predetermined thickness.

[0109] The fastening members 900 serve to couple the primary insulation panel 100 and the secondary insulation panel 200 to the outer surface of the tank body 10.

[0110] To this end, the fastening member 900 may include a stud bolt 910, the receiving member 920, the insertion member 930, a fixing plate 940, and a nut 950.

[0111] First, the stud bolt 910 protrudes from the outer surface of the tank body 10,

and one end of the stud bolt 910 is coupled to the outer surface of the tank body 10 by welding or the like.

[0112] The receiving member 920 is coupled to the interior of the first fastening hole 130 so as to have a shape corresponding to the interior of the first fastening hole 130, and a first through hole 921 is penetratively formed in the receiving member 920.

[0113] As illustrated in FIGS. 5 and 6, the first through hole 921 may have a tapered shape having a diameter that gradually decreases toward the outer surface of the tank body 10.

[0114] The insertion member 930 is coupled to the first through hole 921 so as to have a shape corresponding to the first through hole 921, and a second through hole 931 is penetratively formed in the insertion member 930 so that the stud bolt 910 is penetratively coupled to the second through hole 931.

[0115] Here, an outer surface of the insertion member 930 may have a tapered shape having a diameter that gradually decreases toward the outer surface of the tank body 10 like the first through hole 921.

[0116] For example, the stud bolt 910 is penetratively positioned in the second through hole 931 when the receiving member 920 is coupled into the first fastening hole 130 and the insertion member 930 is coupled into the first through hole 921.

[0117] The fixing plate 940 is attached to the inner surface of the secondary insulation panel 200, and a third through hole 941 is penetratively formed in the fixing plate 940 so that the stud bolt 910 may be penetratively coupled to the third through hole 941.

[0118] Here, the third through hole 941 of the fixing plate 940 is formed collinearly with the second through hole 931 and the second fastening hole 230, and as illustrated in FIGS. 5 and 6, the fixing plate 940 may be inserted, at a predetermined depth, into the inner surface of the secondary insulation panel 200.

[0119] The nut 950 is coupled to one end of the stud bolt that penetrates the fixing plate 940 in the second fastening hole 230, such that the nut 950 may be caught by one surface of the fixing plate 940, and as a result, the fixing plate 940 may be coupled to the stud bolt 910.

[0120] For example, one protruding end of the stud bolt 910 is penetratively positioned in the third through hole 941 of the fixing plate 940 when the secondary insulation panel 200 is coupled to the outer surface of the primary insulation panel 100.

[0121] In this state, the nut 950 is inserted through the second fastening hole 230 and then coupled to one end of the stud bolt 910, and as a result, the nut 950 may be caught by one surface of the fixing plate 940.

[0122] The nut 950 is also coupled to the stud bolt 910 positioned between the fixing plate 940 and the insertion member 930, such that the nut 950 may press the insertion member 930 in a direction toward the tank body 10.

[0123] In this process, the nut 950 may be positioned at one end of the insertion member 930 by coupling the nut 950 to the stud bolt 910 protruding toward one end of the insertion member 930 before coupling the secondary insulation panel 200.

[0124] Thereafter, the filling material 231 having a shape corresponding to the second fastening hole 230 is inserted into the second fastening hole 230, and as a result, the second fastening hole 230 may be finished so that the second fastening hole 230 is not exposed to the outside.

[0125] Consequently, according to the present disclosure, it is possible to prevent the fluid W produced outside the tank body 10 from leaking to the outside, by absorbing the displacement of the gaps between the primary insulation panels 100 by using the elastic sheet 300 made of an elastically deformable material at an ultra-low temperature.

[0126] According to the present disclosure, it is possible to reduce time and costs

required for construction and to improve working efficiency, by attaching the deformable flexible foam material 600 to the edge portion D of the tank body 10 where there is difficulty in installing the primary insulation panel 100 and the secondary insulation panel 200, and then forming the outer insulation layer by spraying the spray foam 700 onto the outer portion of the tank body 10.

[0127] From the foregoing, it will be appreciated that various embodiments of the present disclosure have been described herein for purposes of illustration, and that various modifications may be made without departing from the scope and spirit of the present disclosure. Accordingly, the various embodiments disclosed herein are not intended to be limiting, with the true scope and spirit being indicated by the following claims.

WHAT IS CLAIMED IS:

1. An insulation structure of a cryogenic liquefied gas storage tank, the insulation structure comprising:

multiple primary insulation panels which are coupled along outer planar portions of a tank body and have first insulators correspondingly inserted into first gaps at edges adjacent to each other;

multiple inner protective plates which are coupled along outer surfaces of the primary insulation panels and have first end portions at edges that are positioned in the first gaps so as to be adjacent to each other;

secondary insulation panels which are coupled along the outer surfaces of the primary insulation panels and have second insulators correspondingly inserted into second gaps at edges adjacent to each other;

multiple outer protective plates which are coupled along outer surfaces of the secondary insulation panels and have second end portions at edges that are positioned in the second gaps so as to be adjacent to each other; and

elastic sheets which are positioned between the inner protective plates and the secondary insulation panels, continuously attached along the first end portions so that the first insulators are not exposed to the outside, and flexible so as to cope with displacement of the first end portions,

wherein one or more first gap pads are attached to the inner surfaces of the primary insulation panels so as to form first flow paths on an outer surface of the tank body, one or more second gap pads are attached to the inner surfaces of the secondary insulation panels so as to form second flow paths on outer surfaces of the inner protective plates, outer edge portions, which connect the planar portions, are formed

outside the tank body, and flexible foam materials, which have edges abutting against the first flow paths, absorb a fluid produced on the outer surface of the tank body, and move the fluid to the first flow paths, and spray foams, which are sprayed onto outer surfaces of the flexible foam materials and have edges attached to the edges of the primary insulation panels and the edges of the secondary insulation panels, are further attached to the edge portions.

2. The insulation structure of claim 1, wherein the elastic sheet is attached to have a width larger than a width of the first gap, and a center of the first gap is positioned collinearly with a center of the elastic sheet.

3. The insulation structure of claim 1, wherein the elastic sheet is made of a rubber material and attached by a silicon bonding agent.

4. The insulation structure of claim 1, wherein outer sheets are further attached to the outer surfaces of the outer protective plates, and the outer sheets are continuously attached along the second end portions.

5. The insulation structure of claim 1, wherein the spray foam is made of polyurethane foam (PUF).

6. The insulation structure of claim 1, wherein joint fillers having a predetermined thickness are further coupled to the edge of the primary insulation panel and the edge of the secondary insulation panel, and the joint fillers are disposed between the spray foams and the primary insulation panels and between the spray foams and the secondary

insulation panels.

7. The insulation structure of claim 1, wherein first fastening holes are penetratively formed in the primary insulation panel and the inner protective plate, second fastening holes are penetratively formed in the secondary insulation panel and the outer protective plate, and fastening members are coupled to the first fastening holes and the second fastening holes in order to couple the primary insulation panels and the secondary insulation panels to the outer surface of the tank body.

8. The insulation structure of claim 7, wherein the fastening member includes:

- a stud bolt which protrudes from the outer surface of the tank body;
- a receiving member which is inserted into the first fastening hole and has a first through hole penetratively formed in the receiving member;
- an insertion member which is coupled into the first through hole and has a second through hole to which the stud bolt is penetratively coupled;
- a fixing plate which is attached to the inner surface of the secondary insulation panel and has a third through hole that is penetratively formed in the fixing plate so as to be collinear with the second through hole so that the stud bolt is penetratively coupled to the third hole; and
- a nut which is coupled to one end of the stud bolt penetrating the fixing plate in the second fastening hole, and couples the fixing plate to the stud bolt.