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(54) **Double barrier for liquefied gas storage tank and method of constructing the same**

(57) A double-barrier for a land-based liquefied gas storage tank and a method of constructing the same are disclosed. The double-barrier includes an insulating wall inside a tank body of the storage tank, and a sealing wall disposed inside the insulating wall to primarily prevent leakage of a liquefied gas while directly contacting the liquefied gas in the storage tank. The insulating wall includes a plurality of insulating panels attached to the tank

body and separated from each other, and a space between the insulating panels is filled with an insulating material to secondarily prevent leakage of the liquefied gas. The double-barrier can doubly prevent leakage of the liquefied gas without additional installation of a secondary barrier outside the storage tank.

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Description

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from and the benefit of Korean Patent Application No. 10-2009-0106532, filed on November 5, 2009, which is hereby incorporated by reference for all purposes as if fully set forth herein.

BACKGROUND

Technical Field

[0002] The present disclosure relates to a double-barrier for a land-based liquefied gas storage tank and a method of constructing the same and, more particularly, to a double-barrier for a land-based liquefied gas storage tank and a method of constructing the same, which includes sealing and insulating barriers in a wall of the storage tank, thereby doubly preventing leakage of a liquefied gas without additional installation of a secondary barrier outside the storage tank.

Description of the Related Art

[0003] Generally, a liquefied gas storage tank on land has a substantially cylindrical flat bottom and is used to store liquefied gas for fuels, such as liquefied natural gas (LNG), liquefied petroleum gas, and the like, and other liquefied gases such as liquefied oxygen, liquefied nitrogen, and the like. Examples of such a cylindrical liquefied gas storage tank are disclosed in FR Patent No. 2398961 and JP Patent Laid-open Publication No. Hei 9-126393.

[0004] Figure 1 shows one example of a conventional full-containment type land-based liquefied gas storage tank. Referring to Figure 1, the storage tank includes a cylindrical tank body 3 formed through concrete casting on a foundation 1 and having an approximately dome-shaped cover.

[0005] The tank body 3 is provided with an insulating wall 4 and a sealing wall 5 disposed inside the insulating wall 4 to contain a cryogenic liquefied gas in a sealed state.

[0006] Since the sealing wall 5 directly contacts the liquefied gas, it may be made of a material, e.g. stainless steel, which can endure cryogenic conditions.

[0007] In such a conventional liquefied gas storage tank on land, a cylindrical wall 7 is constructed outside the storage tank to restrict leakage of the liquefied gas as much as possible even when the liquefied gas leaks accidentally due to breakage of the tank body 3. Therefore, the conventional storage tank occupies a significant area on land due to its large volume and requires many materials and significant costs in construction of the cylindrical wall.

BRIEF SUMMARY

[0008] The present disclosure is directed to solving the problems of the related art as described above, and one embodiment includes a double-barrier for a land-based liquefied gas storage tank and a method of constructing the same, which includes sealing and insulating barriers in a wall of the storage tank, thereby doubly preventing leakage of a liquefied gas without additional installation of a secondary barrier outside the storage tank.

[0009] In accordance with one aspect, a double-barrier for a land-based liquefied gas storage tank includes: an insulating wall inside a tank body of the storage tank, the insulating wall comprising a plurality of insulating panels attached to the tank body and separated from each other; and a sealing wall disposed inside the insulating wall to primarily prevent leakage of a liquefied gas while directly contacting the liquefied gas in the storage tank, wherein a space between the insulating panels is filled with an insulating material to secondarily prevent leakage of the liquefied gas.

[0010] The insulating wall may include a plurality of primary insulating panels disposed outside the sealing wall and a plurality of secondary insulating panels disposed on the tank body.

[0011] The primary insulating panels may be disposed to define a primary gap between adjacent primary insulating panels, and an insulator may be inserted into the primary gap.

[0012] The secondary insulating panels may be disposed to define a secondary gap between adjacent secondary insulating panels, and the insulating material may be injected into the secondary gap.

[0013] A glass cloth may be interposed between the primary insulating panel and the secondary insulating panel.

[0014] The secondary insulating panels may be disposed to define a secondary gap between adjacent secondary insulating panels, and the primary insulating panels and the secondary insulating panels may be disposed to define the primary gap and the secondary gap at different locations.

[0015] The primary insulating panel may include a plurality of filling holes formed at a location corresponding to the secondary gap to allow the insulating material to be injected into the secondary gap.

[0016] The insulating material filling the space between the insulating panels may be a foamed material.

[0017] The insulating panel and the insulating material may include polyurethane foam, and an adhesive may be applied to a lateral side of the insulating panel to facilitate attachment of the insulating material thereto.

[0018] In accordance with another aspect, a method of constructing a double-barrier for a land-based liquefied gas storage tank includes: stacking a plurality of insulating panels inside a tank body of the storage tank to be separated from each other; injecting and foaming an insulating material between the insulating panels; and

stacking a sealing wall inside the insulating wall.

[0019] The insulating panels may include primary and secondary insulating panels stacked in double layers, and a gap between the secondary insulating panels on the tank body is covered by the primary insulating panels on the sealing wall to define a space where the insulating material is foamed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020]

Figure 1 is a view of an example of a conventional full-containment type liquefied gas storage tank on land;

Figure 2 is a partial plan view of a double-barrier for a land-based liquefied gas storage tank in accordance with one embodiment of the present disclosure; and

Figure 3 is a partially cross-sectional view taken along line A-A of Figure 2.

DETAILED DESCRIPTION

[0021] Embodiments of the present disclosure will now be described in detail with reference to the accompanying drawings.

[0022] Referring to Figures 2 and 3, a double-barrier for a land-based liquefied gas storage tank includes a sealing wall 10 as a primary barrier which directly contacts a liquefied gas stored in the storage tank, and an insulating wall 20 as a secondary barrier which is disposed between a tank body 3 and the sealing wall 10 to prevent heat-transfer from an exterior of the tank and leakage of the liquefied gas.

[0023] The sealing wall 10, i.e. the primary barrier, is continuously formed of a metallic material such as SUS and the like, which can endure cryogenic conditions inside the storage tank. The sealing wall 10 may be formed with folds 11 to absorb thermal deformation of the storage tank which occurs during receipt of the liquefied gas.

[0024] The insulating wall 20 as the secondary barrier includes primary insulating panels 21 disposed outside the sealing wall 10 (i.e. an opposite side to the surface contacting the liquefied gas) and secondary insulating panels 25 disposed on the tank body 3. Herein, the term "inside" means a direction towards an inner space of the storage tank in which liquefied gas is stored, and the term "outside" means an opposite direction.

[0025] The primary and secondary insulating panels 21 and 25 may be composed of an insulating material such as polyurethane foam, hardened polyurethane foam, and the like. Protection layers 21a made of, for example, plywood or metal may be formed on an inner surface of the primary insulating panel 21 (i.e. a surface facing an outer surface of the sealing wall 10) and an outer surface of the secondary insulating panel 25 (i.e. a surface facing an inner surface of the tank body 3),

respectively (in Figure 3, the protection layer 21a is shown as being disposed only on the inner surface of the primary insulating panel 21).

[0026] A glass cloth 29 may, for example, be disposed between the primary insulating panel 21 and the secondary insulating panel 25. The glass cloth 29 can be attached to the insulating panel in a PU bonding manner.

[0027] The plural secondary insulating panels 25 may be stacked on the inner surface of the tank body 3, and the tank body 3 may be provided with an anchor member 3a to couple the secondary insulating panels 25 to the tank body 3.

[0028] The secondary insulating panels 25 may be separated from each other to define a secondary gap 26 between adjacent secondary insulating panels 25. In the secondary gap 26, as described below, a polyurethane-based insulating material may be foamed by injection via a filling hole 21b formed through the primary insulating panel 21. A filling member 21b, which is formed in the secondary gap 26 by foaming the insulating material, reliably prevents the liquefied gas from leaking outside via the insulating wall 20 even when leakage of the liquefied gas occurs due to breakage of the sealing wall 10, thereby allowing the insulating wall 20 to serve as the secondary barrier.

[0029] Inside the secondary insulating panels 25, the primary insulating panels 21 are stacked to be separated from each other to define a primary gap 22 between adjacent primary insulating panels 21 as in the secondary insulating panels 25. The primary gap 22 may be filled with an insulator 23 such as glass wool.

[0030] The primary insulating panels 21 and the secondary insulating panels 25 may be arranged in a different way such that the secondary gap 26 between the secondary insulating panels 25 and the primary gap 22 between the primary insulating panels 21 are formed at different locations, as shown in Figure 3.

[0031] In order to form the filling member 27 by injection-molding the polyurethane-based insulating material in the secondary gap 26 between the secondary insulating panels 25, as shown in Figure 2, the primary insulating panel 21 is formed with a plurality of filling holes 21b separated at constant intervals from each other along the secondary gap 26.

[0032] When injection-molding the insulating material into the secondary gap 26 to form the filling member 27, an operator can check how far filling of the insulating material into the secondary gap 26 has proceeded via another filling hole 21b adjacent to the filling hole 21b through which the insulating material is injected.

[0033] As described above, the polyurethane foam insulating material may be foamed in the secondary gap 26 via the filling hole 21b of the primary insulating panel 21. Here, an adhesive may be deposited between side surfaces of the secondary insulating panels 25 such that the foamed filling member 27 closely adheres to the side surfaces of the secondary insulating panels 25.

[0034] If the sealing wall 10 serving as the primary bar-

rier is broken so as to cause leakage of the liquefied gas, the gas can flow towards the secondary gap 26 via the primary gap 22 and a gap between the primary and secondary insulating panels 21, 25. However, since the temperature around the secondary insulating panel 25 is higher than a liquefaction temperature of the liquefied gas, the leaking solution is vaporized, thereby increasing pressure in the secondary gap 26. Since the secondary gap 26 is a closed space defined by the primary insulating panel 21, the secondary insulating panel 25, and the tank body 3, such an increase in pressure of the secondary gap 26 can restrict a flow of leaking solution into the secondary gap 26.

[0035] Even if leakage occurs as such and the leaking solution flows into the secondary gap 26, vaporization of the liquefied gas, which has previously leaked, causes an increase in pressure to prevent the leaking solution from continuously flowing, thereby allowing the insulating wall to serve as the secondary barrier.

[0036] As described above, according to the embodiment, in constructing one of two insulating layers (i.e. the secondary insulating layer near the concrete tank body undergoing minor thermal expansion), the same material as the insulating panels, which constitute the insulating layer, is foamed in-situ between the respective insulating panels (i.e. the secondary insulating panels), so that the insulating panels as well as the insulating panel and the concrete wall (i.e. tank body) can be integrated with each other. Therefore, the integrated insulating panels and the integrated insulating panel and concrete wall serve as the secondary barrier for preventing leakage of the liquefied gas.

[0037] Moreover, even when a crack is created in the secondary barrier, leakage of the liquefied gas can be sufficiently restricted because the insulating wall (i.e. the secondary insulating layer) is integrated with the concrete wall and because the leaking liquefied gas is vaporized due to a higher temperature of the concrete wall than the liquefaction temperature and causes an increase in pressure around the crack. Therefore, a very low temperature is not transferred through the tank body to prevent damage of the storage tank.

[0038] As described above, the secondary insulating panels are bonded together by foaming the same insulating material as the secondary insulating panel in-situ, and an adhesive or like may be applied onto the lateral side of the insulating panel so as not to create crack in the boundary between the foam insulating material and the insulating panel.

[0039] As such, according to the embodiments, leakage of a liquefied gas can be doubly prevented by the construction of the sealing and insulating walls which are attached inside the tank body.

[0040] Further, since there is no need for additional installation of a secondary barrier outside the storage tank, a space for a single storage tank is reduced and thus more storage tanks can be installed in the same space, which is advantageous in reduction in cost, time

and efforts in construction of the storage tank.

[0041] The various embodiments described above can be combined to provide further embodiments. All patents, patent application publications, patent applications, and non-patent publications referred to in this specification and/or listed in the Application Data Sheet are incorporated herein by reference, in their entirety. Aspects of the embodiments can be modified, if necessary, to employ concepts of the various patents, applications and publications to provide yet further embodiments.

[0042] These and other changes can be made to the embodiments in light of the above-detailed description. In general, in the following claims, the terms used should not be construed to limit the claims to the specific embodiments disclosed in the specification and the claims, but should be construed to include all possible embodiments along with the full scope of equivalents to which such claims are entitled. Accordingly, the claims are not limited by the disclosure.

Claims

1. A double-barrier for a land-based liquefied gas storage tank comprising:
 - an insulating wall inside a tank body of the storage tank, the insulating wall comprising a plurality of insulating panels attached to the tank body and separated from each other; and
 - a sealing wall disposed inside the insulating wall to primarily prevent leakage of a liquefied gas while directly contacting the liquefied gas in the storage tank,
 - wherein a space between the insulating panels is filled with an insulating material to secondarily prevent leakage of the liquefied gas.
2. The double-barrier according to claim 1, wherein the insulating wall comprises a plurality of primary insulating panels disposed outside the sealing wall and a plurality of secondary insulating panels disposed on the tank body.
3. The double-barrier according to claim 2, wherein the primary insulating panels are disposed to define a primary gap between adjacent primary insulating panels, and an insulator is inserted into the primary gap.
4. The double-barrier according to claim 2, wherein the secondary insulating panels are disposed to define a secondary gap between adjacent secondary insulating panels, and the insulating material is injected into the secondary gap.
5. The double-barrier according to claim 2, wherein a glass cloth is interposed between the primary insu-

lating panel and the secondary insulating panel.

6. The double-barrier according to claim 3, wherein the secondary insulating panels are disposed to define a secondary gap between adjacent secondary insulating panels, and the primary insulating panels and the secondary insulating panels are disposed to define the primary gap and the secondary gap at different locations. 5
7. The double-barrier according to claim 6, wherein the primary insulating panel comprises a plurality of filling holes formed at a location corresponding to the secondary gap to allow the insulating material to be injected into the secondary gap. 10
8. The double-barrier according to claim 1, wherein the insulating material filling the space between the insulating panels is a foamed material. 15
9. The double-barrier according to claim 1, wherein the insulating panel and the insulating material comprise polyurethane foam, and an adhesive is applied to a lateral side of the insulating panel to facilitate attachment of the insulating material thereto. 20
10. A method of constructing a double-barrier for a land-based liquefied gas storage tank, comprising:
 - stacking a plurality of insulating panels inside a tank body of the storage tank to be separated from each other; 25
 - injecting and foaming an insulating material between the insulating panels; and
 - stacking a sealing wall inside the insulating wall. 30
11. The method according to claim 10, wherein the insulating panels comprise primary and secondary insulating panels stacked in double layers, and a gap between the secondary insulating panels on the tank body is covered by the primary insulating panels on the sealing wall to define a space where the insulating material is foamed. 35

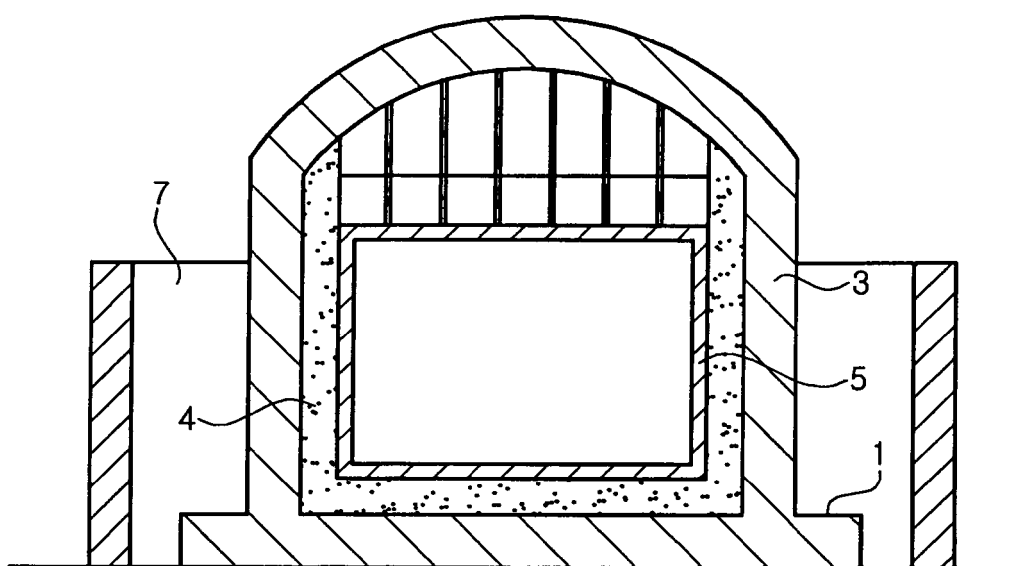
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Fig. 1



Prior Art

Fig. 2

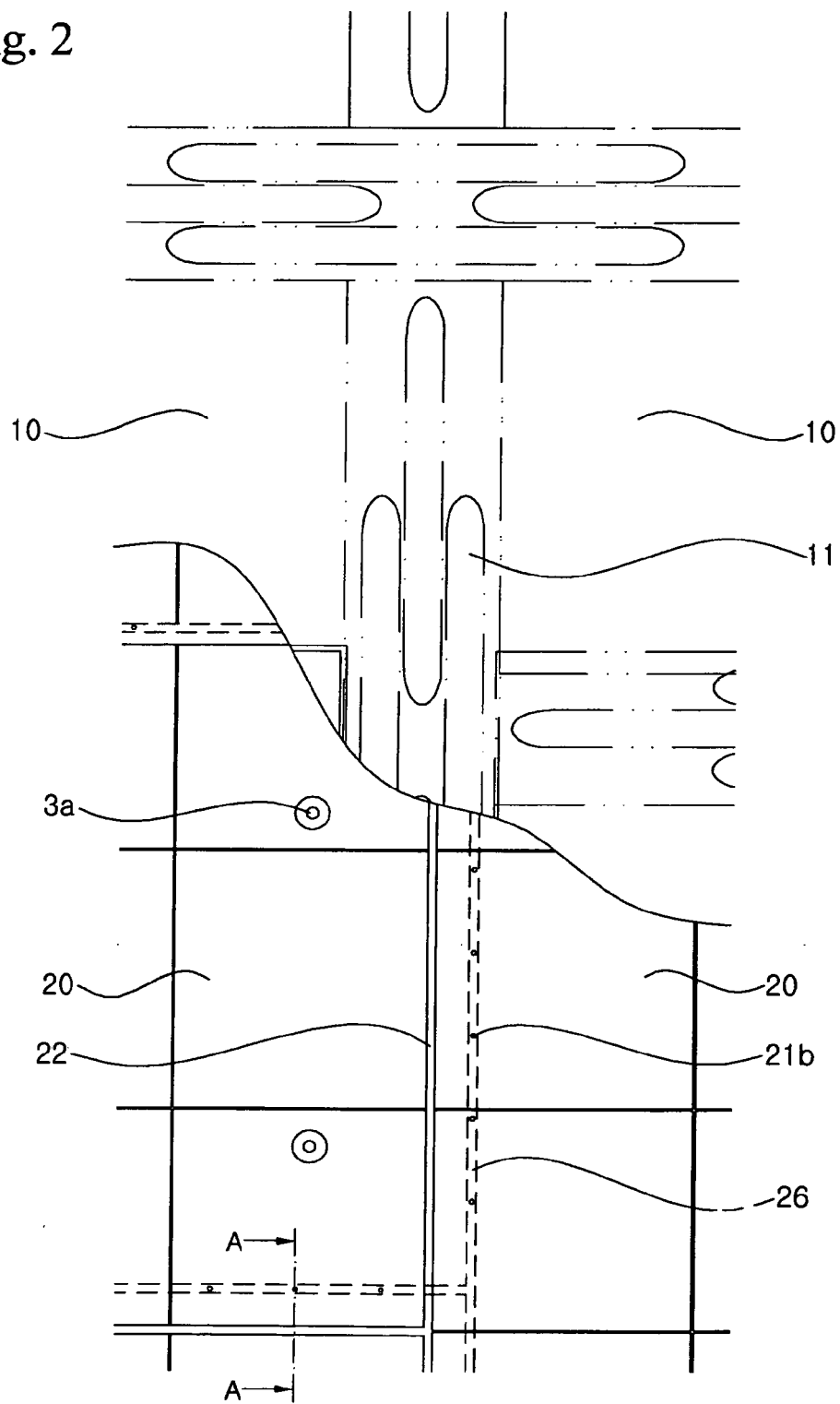
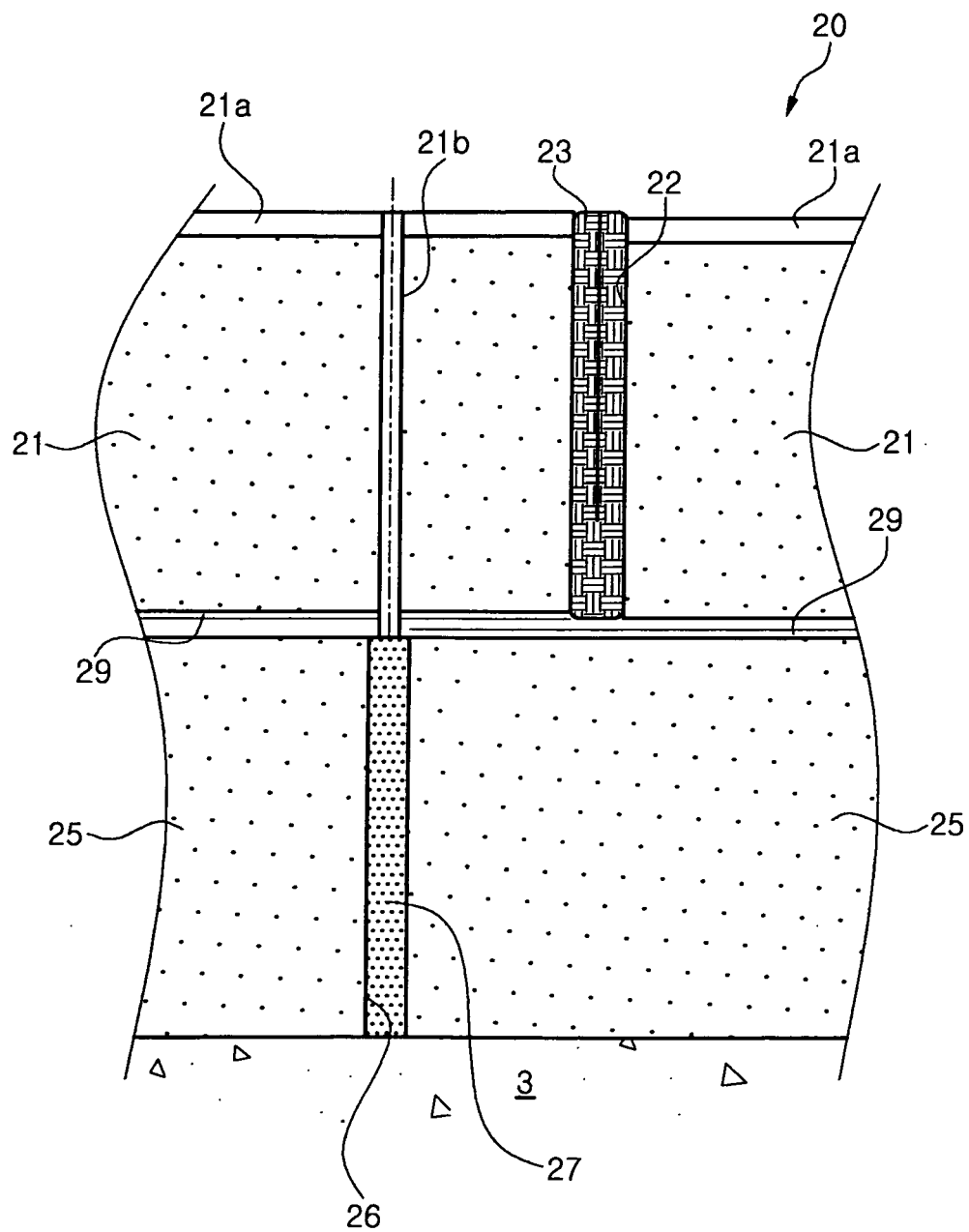


Fig. 3





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