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(54) Gas tank with protection system for underground installation

Schutzvorrichtung für in die Erde versenkbare Flüssiggasbehälter

Installation de protection pour citernes de gaz liquéfié destinées à être enterrées

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(56) References cited:
EP-A- 0 565 444 EP-A- 0 752 555
AT-B- 231 903 BE-A- 1 013 583
DE-A- 1 812 859 FR-A- 748 880

- **"UNE NOUVELLE GENERATION DE CITERNES
ENTERREES A NEW GENERATION OF BURIED
TANKS" PETROLE INFORMATIONS,
SOCIDOC-BIP. PARIS, FR, no. 29, 1 October 1993
(1993-10-01), pages 15-17, XP000403867 ISSN:
0150-6463**

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Description

[0001] The present invention concerns a gas tank with protection system for underground installation and a method of assembling the tank.

[0002] A known technique for the underground installation of a metal cylinder containing gas, for example liquefied petroleum gas (LPG) consists of excavating a trench wider than the diameter of the tank and deeper than the height of the tank, subsequently lowering the tank into the trench and backfilling the space between the tank and the walls of the trench with sand (a sand layer having a thickness of at least 30 cm is needed in the case of tank with a diameter of 110 cm). The tank is provided with short supporting legs and a closable hatch of which the top is level with the surface of the ground. Ballast, usually consisting of cement, is attached to the bottom of the tank to avoid it being lifted out of the ground by hydrostatic forces in case of flooding. For corrosion protection purposes the tank is usually covered with a paint layer, usually a layer of thermo-hardening epoxy paint, and, immediately after being buried, connected to a sacrificial anode, which usually consists of one or more sacks containing magnesium, in accordance with the known technique of cathodic protection.

[0003] Another known technique, as disclosed for example in EP-B-624752, envisages the formation or installation of a waterproof container capable of housing the tank after the excavation of the trench. This container may be an in-situ concrete structure or could be a prefabricated container made of plastics or some other rigid material. The tank is placed inside the container and fixed to it, possibly by means of a structure that comprises a watertight sleeve at the summit of the tank and a removable cover to close the free end of the sleeve.

[0004] This second technique offers better safety guarantees in case of accidental gas losses, especially as far as pollution of the surrounding ground is concerned, and does not call for cathodic protection, but is more complicated and therefore also more expensive.

[0005] It is also known, as disclosed for example in closest prior art AT 231903B, to coat an underground tank containing a contaminating liquid, such as crude oil, with a plastic foil separated by a sand layer from the tank surface. Any liquid coming out from the tank due to a leak accumulates in the sand layer and does not disperse in the surrounding ground. It is clear that as soon as the sand layer is saturated with liquid, the protective action of the coating fails and the liquid contaminates the surrounding ground.

[0006] One aim of the present invention is to provide a gas tank for underground installation complete with a protection system that will offer the same safety guarantees against pollution as are offered by the second solution described above, but will also be at least as simple and economic as the first solution.

[0007] Another aim of the invention is to provide a method for assembling such a tank.

[0008] These aims are attained by realizing the tank and adopting the method defined and characterized in general terms by, respectively, the characterising part of claim 1 and claim 22 hereinbelow, the preamble of these claims corresponding to the closest prior art.

[0009] The invention will be better understood from the detailed description about to be given of some embodiments thereof, which are to be considered as examples and not limitative in any way, said description making reference to the attached drawings, of which:

- Figures 1, 2 and 10 show side elevations, partly in section, of two embodiments of a cylindrical tank for liquefied petroleum gas with a protection system in accordance with the invention arranged in the ground with its axis in a vertical position;
- Figures 3, 4 and 5 show sections through a detail of the tank of Figures 1, 2 and 10 realized in three different ways;
- Figures 6 and 8 show side elevations, again partly in section, of two other embodiments of a cylindrical tank for liquefied petroleum gas with a protection system in accordance with the invention arranged in the ground with its axis in a horizontal position; and
- Figures 7 and 9 show two views - partly in section - from above of the tanks illustrated by Figures 6 and 8.

[0010] Referring to Figure 1, a tank 10 containing liquefied petroleum gas is enveloped in a sack made of a material that is substantially impermeable to gas and water, for example consisting of at least one layer of waterproofed synthetic jute and/or cloth capable of resisting substantial loads, separated from the walls of the tank by means of a layer 12 of some inert gas permeable material, sand for example. The sack 11 with its contents is buried in a trench. The tank 10 is a steel recipient consisting of a cylindrical part and two end caps and is arranged in the trench with its longitudinal axis in a vertical position. It is provided with an access pit 17 that contains the usual service, control and safety accessories, typically a pipe link for removing gaseous phase from the tank, a safety valve, a level gauge to indicate the level of the liquid phase, a filling valve and an outlet valve for the liquid phase. In this example the lower end cap is provided with supporting legs 13 welded or otherwise attached to the cap; nevertheless, the invention can be advantageously implemented also with a tank devoid of such supporting legs: in that case, as will be explained further on, the tank will be provided with means of support of some other type.

[0011] The access pit 17 consists of a metal sleeve attached to the upper end cap, the sleeve having its free upper end at the same level as the ground, where it is closed by a removable cover 18. The tank 10 and the sleeve 17 are lined by a protective layer of insulating material, for example a thermo-hardening epoxy resin paint.

[0012] The sleeve of the access pit 17 may also be

made of other corrosion-resisting materials, moulded plastic and high-density polyethylene being two cases in point.

[0013] The opening of the sack 11 is tightened around the upper end cap of the tank at the base of the sleeve 17, using appropriate means, for example, a cable contained in a channel formed by bending the edge of the sack opening backwards. Two or more handles 19, which could be straps of synthetic jute, are fixed to the sack 11 to permit it being lifted complete with its contents. Small sacks 20 containing magnesium are buried in the vicinity of the sack 11 and are electrically connected (though this is not shown on the drawing) to the tank 10, so that they may act as sacrificial anodes for cathodic protection purposes.

[0014] The sack 11, the sand layer 12, the epoxy paint layer covering the surface of tank 10 and the cathodic protection device jointly constitute an efficient protection system. More particularly, in case of losses due to a leak in tank 10, the impermeable bag 11 will prevent the gas passing into the ground, the sand layer 12 prevents the formation of potentially dangerous gas bubbles and at the same time, being permeable for gas, permits possible losses to rise out of the ground, so that they can be detected by appropriate sensors and alarm devices or directly by the supervisory personnel, always provided that the gas - as is required by safety regulations - contains odorizing substances. Any leak gas flows towards the outside through the sack opening, which usually is not gas tight although closed around the base of the sleeve of the access pit 17. However, it can be advisable to provide a suitable gas vent passage, for example a tube that connects the gap between tank and sack with the inside of the access pit 17. This tube can be used advantageously also for introducing into the gap a gauge to detect any gas leak. Furthermore, the lining layer of epoxy resin and the cathodic protection device prevent corrosion of the steel tank due to the effect of stray currents. All said and done, the resulting installation will have a long maintenance-free useful life.

[0015] It should be noted that if the permeable material has a specific weight greater than water, as is the case of the sand 12 utilized in the embodiment just described, there will be no need to attach ballast to the tank to counteract the hydrostatic forces set up if the ground were to become flooded. The sand itself, in fact, provides efficient weighting: in the case of a 1000-litre tank, for example, a sand layer about 3 cm thick will be quite sufficient to assure both this protective function and the ballast function. All that has to be done to perform the latter function is to close the sack 11 on the tank 10, as will be explained later. Whenever the ballast weight has to be limited, moreover, it is obviously possible to add some other granular material of low specific weight to the sand, for example, granules of expanded polystyrene.

[0016] In an alternative embodiment of the invention shown in Figure 10, where the same reference numerals as in figure 1 indicate identical or equivalent parts, the

sack, here indicated by 11', is comprised advantageously, at least in part, of a material with micrometric pores through which water cannot pass as a liquid but can pass only in molecular form. Once the assembly is buried, the moisture of the soil can migrate to the sand layer through the micrometric pores in the sack. Due to this effect the cathodic protection can be embodied into the gap between tank and sack, as shown in figure 10; therefore, the tank complete with cathodic protection can be assembled in the factory, which makes greatly easier its installation.

[0017] As known, the sacrificial anodes of a cathodic protection system are each made up of a metal core, typically magnesium, positioned into a small sack together with a granular backfill. The backfill comprises typically gypsum, bentonite and sodium sulphate and, when suitably moistened, has the function of reducing the anode electrical resistance towards ground. The water molecules passing through the micrometric pores provide the necessary moisture to carry out this function.

[0018] The granular backfill needs not to be concentrated into a small sack but can be placed loose in the gap between sack and tank, thus being part of the granular material that forms the gas permeable material. This latter material is preferably a differentiated granulometry material distributed in layers having granulometry that varies progressively from the bottom upward, i.e. in such a way that the material with higher granulometry is closer to the ground surface, i.e. to the edge of the trench that contains the assembly, and the material with lower granulometry is at the trench bottom. The sacrificial anodes together with the resistivity reducing granular material, either assembled in small sacks or in loose form, are disposed preferably in the lowest part of the trench.

[0019] Advantageously the backfill of the cathode protection system is moistened during assembling so that the cathodic protection can be activated before the tank is installed.

[0020] It should be noted that safety, as far as soil pollution due to any gas leak from the tank is concerned, is not reduced by the use of a sack made of a material with micrometric pores because gas tends to flow through the gap to the atmosphere rather than through the micrometric pores. Moreover, the flow through the gap is favoured by the differentiated granulometry of the gas permeable material.

[0021] The tank and the protection system in accordance with the invention can be assembled before being buried in the ground, so that the actual installation by the final user is greatly simplified. Indeed, he will have to do no more than excavate a trench just slightly greater than the volume of the fully assembled tank with its sack containing the gas permeable lining layer, possibly containing a cathodic protection system already wired and ready for activation, lower the assembly into the trench, burying the sacrificial anodes if they are not in the sack, and then backfilling the residual voids with appropriately compacted earth or other suitable material.

[0022] When the tank is devoid of legs attached to the lower end cap, as shown in Figure 2, an appropriate supporting structure 14 can be used to keep the tank in a vertical position in the trench during installation and permit its being readily moved also with hoist trucks before it is installed.

[0023] It should be noted that whereas the embodiment with legs integrally attached to the tank may be convenient when the tank to be installed is already provided with legs, the embodiment, without such legs makes it possible to obtain a more uniform distribution of the sand between the tank and the sack and avoids the local stresses to which the sack is subjected at the positions corresponding to the legs.

[0024] The tank and protection system in accordance with the invention may be assembled before the tank is installed. More particularly, a tank already painted in the customary manner, with a thermo-hardening epoxy resin for example, is inserted in a sack of waterproofed synthetic jute or a material with micrometric pores for example, that is slightly larger than the tank. During this operation, as also during the subsequent operation, the sack is kept open and detached from the surface of the tank, which can be done, for example, by inserting a removable frame. Thereafter sand and/or some other permeable inert material is filled into the space between the tank and the sack possibly in differentiated granulometry layers and with such a moisture grade to activate the cathodic protection.

[0025] The use of a frame for keeping the sack open may be avoided by spraying the sand, if necessary in combination with air, under pressure through a multiplicity of appropriate nozzles arranged around the open mouth of the sack.

[0026] During the filling of the sand it may be convenient to subject the tank, the sack and the sand to vibration, thereby facilitating a uniform distribution and compaction of the sand in the available space.

[0027] At the end of the sack-filling operation the sack is closed by tightening its mouth around the sleeve 17. Figures 3, 4 and 5 illustrate three possible conformations of the sleeve. In Figures 3 and 4 the sleeve has a lower edge 30 that is bent towards the interior and provided with through holes for fixing it to the upper end cap of the tank 10 by means of bolts 31 integral with the cap. In Figure 5 the sleeve 17 has similar lower edge 30, but bent outwards. In all three cases the sleeve 17 is shaped in such a way as to be provided with a perimetral groove that constitutes a seating 32 for the tightening cable 33 of the sack 11 within the loop formed by the folded edge of the sack mouth.

[0028] Figures 6 and 7, in which identical or corresponding parts are always identified by means of the reference numbers already used in Figure 1, show a cylindrical tank 10 substantially similar to the one in Figure 1, but designed to be buried with its axis horizontal rather than vertical. In particular, the sleeve 17 is here replaced by closed structure 50 that forms an access pit surround-

ing the service, control and safety accessories, which in this case are mounted on the cylindrical part of the tank.

[0029] The sack 11 in this case has a mouth that substantially extends for the entire length of the tank and is closed by superposing the flaps of the sack mouth and tightening a cable around the access pit 50, this cable being similar to the one of the embodiment illustrated by Figures 1 to 4.

[0030] Alternatively, the sack 11 may be similar to the one used for installation in the vertical position, with the sole exception of an additional opening that can be closed around the access pit before the sack is filled with sand; in this case the principal opening of the sack is closed completely (once again by means of a cable, for example) around a ringbolt 16 for lifting the tank that is normally provided at the top of one of the end caps of the tank, as is shown in Figures 8 and 9.

[0031] Two handles 51 constituted, for example, by strips of synthetic jute integral with the sack 11 make it possible for the tank assembly to be lifted.

[0032] The tank 10 in the embodiment of Figures 6 and 7 rests on two supporting cradles 52, which in the shown example are integral with the tank and are therefore situated within the sack 11, but - as can be seen from the embodiment shown in Figures 8 and 9 - could also be replaced by a structure 15 arranged at the bottom of the assembly in such a way as to constitute a support for the already assembled tank.

[0033] What has been said above makes it clear that the tank with protection system in accordance with the invention completely complies with the aims the invention set out to achieve. In particular, it assures complete safety as far as pollution of the surrounding ground is concerned, may be assembled in a very simple manner and can be installed underground in an equally simple manner, because it calls for nothing other than the excavation of a trench without any special containing or enveloping structures, nor does it require additional materials to be taken to the place where the tank is to be installed. Furthermore, it does not need any separate ballasting, because the function of the ballast is performed by the sand contained in the sack and the trench that has to be excavated is smaller than the one that would be needed to install the tank in accordance with the known techniques.

[0034] The tank in accordance with the invention also offers another advantage as compared with the prior art inasmuch as it makes it possible to wholly avoid a typical problem of tanks painted with thermo-hardening epoxy resins. As is well known, these resins rapidly lose their characteristics of protecting the surface to which they have been applied when they become exposed to ultraviolet radiation. Since this radiation is present in the radiation spectrum of the sun, tanks treated in this manner cannot be left for any substantial length of time in the open, and this creates serious storage problems. Since in accordance with the invention the pure and simple tank is placed inside a sack and is covered by a layer of sand immediately after being painted with an epoxy resin, the

paint is efficiently screened against the ultraviolet radiation and therefore this problem will never arise. If necessary the screen can be further improved by using a sack made of a material that is opaque to ultraviolet radiations. Moreover, it should be noted that factory assembly of the tank with its protection system completely eliminates the risk of the protective layer being damaged during transport and installation, which would be detrimental as far as corrosion protection of the underlying metal is concerned.

[0035] Although only some embodiments of the invention and a few variants have here been illustrated and described, it is clear that numerous further variants and modifications are possible without overstepping the underlying inventive concept.

Claims

1. A tank with a protection system for underground installation, the protection system comprising a sack (11) containing the tank (10) made of a material which is substantially impermeable to gas and water, said protection system further comprising gas permeable material (12) arranged into a gap between tank and sack in such a way as to constitute a layer around the tank,
characterized in that:
 - said tank is a gas tank;
 - said sack is has an opening closed on the tank; and
 - said protection means further include cathodic protection means embodied into the layer of gas permeable material (12).
2. A tank in accordance with Claim 1, wherein the gas permeable material (12) has a specific weight greater than that of water.
3. A tank in accordance with Claim 2, wherein the permeable material (12) comprises sand in quantity sufficient to constitute ballast to prevent the tank from floating in water.
4. A tank in accordance with any one of the preceding claims, wherein the sack (11) comprises at least one layer of synthetic jute.
5. A tank in accordance with any one of the preceding claims, wherein the sack (11) comprises cloth capable of resisting substantial loads.
6. A tank in accordance with any one of the preceding claims, wherein the sack (11) comprises a material which is opaque to ultraviolet radiation.
7. A tank in accordance with any one of the preceding claims, wherein a gas vent passage between the gap and the outside of the sack is provided.
8. A tank in accordance with claim 7, wherein the gas vent passage comprises a tube for a gas detecting gauge.
9. A tank in accordance with any one of the preceding claims, wherein the protection system comprises a layer of insulating material applied to the surface of the tank (10).
10. A tank in accordance with Claim 9, wherein the insulating material comprises a thermo-hardening epoxy resin.
11. A tank in accordance with any one of the preceding claims, wherein the protection system comprises means (20) of cathodic protection.
12. A tank in accordance with any one of the preceding claims, wherein the sack comprises a material (11') with micrometric pores through which water cannot pass as a liquid but can pass only in molecular form.
13. A tank in accordance with claim 12, wherein the gas permeable material (12) comprises a granular material with differentiated granulometry distributed in such a way that material with higher granulometry is closer to the sack opening.
14. A tank in accordance with claim 13, wherein the cathodic protection means comprise sacrificial anodic means, electroconductive means which connect the sacrificial anodic means with the tank and granular means for reducing electric resistance which are in contact with the sacrificial anodic means.
15. A tank in accordance with claim 14, wherein the granular means for reducing electric resistance are part of the granular material with differentiated granulometry.
16. A tank in accordance with claim 14 or 15, wherein the sacrificial anodic means comprise a metal body adapted to act as an anode relative to the metal of the tank.
17. A tank in accordance with claim 16, wherein the metal body comprises magnesium.
18. A tank in accordance with any one of claims 14 to 17, wherein the granular means for reducing electric resistance comprise gypsum, bentonite and sodium sulfate.
19. A tank in accordance with any one of claims 14 to 18, wherein the granular means for reducing electric

resistance have such a moisture grade to activate cathodic protection.

20. A tank in accordance with any one of the preceding claims, comprising supporting means (13, 52) integral with the tank. 5
21. A tank in accordance with any one of Claims 1 to 19, comprising supporting means (14, 15) outside the sack (11). 10
22. A method of assembling a gas tank with protection system for underground installation, **characterized in that** it comprises the following operations: 15
 - placing the tank (10) inside a sack (11) made of a material which is substantially impermeable to gas and water;
 - placing a cathodic protection system inside said sack (11);
 - connecting said cathodic protection system to said tank (10);
 - maintaining the sack (11) detached from the surface of the tank (10) in such a way that there remains a space between the tank and the sack, and
 - filling at least a part of said space with gas permeable material (12) in such a way as to form a layer around the tank between the tank and the sack, said cathodic protection system resulting embodied inside said layer. 25
23. A method in accordance with Claim 22, wherein the operation of at least partly filling said space with gas permeable material comprises the pouring of sand into said space. 30
24. A method in accordance with Claim 22 or Claim 23, comprising an action of vibrating the tank (10) and the permeable material (12) during the pouring. 35
25. A method in accordance with claim 22, 23 or 24, wherein the sack (11') comprises a material (11') with micrometric pores through which water cannot pass as a liquid but can pass only in molecular form. 40

Patentansprüche

1. Ein Tank mit einem Schutzsystem zur unterirdischen Installation, wobei das Schutzsystem einen Sack (11) aufweist, der den Tank (10) enthält, der aus einem Material hergestellt ist, das im Wesentlichen für Gas und Wasser impermeabel ist, wobei das Schutzsystem ferner ein gaspermeables Material (12) aufweist, das derart in einem Zwischenraum zwischen Tank und Sack angeordnet ist, um eine Schicht um den Tank zu bilden, 45

dadurch gekennzeichnet, dass:

- der Tank ein Gastank ist;
 - der Sack eine Öffnung aufweist, die an dem Tank geschlossen ist; und
 - die Schutzeinrichtung ferner eine kathodische Schutzeinrichtung umfasst, die in der Schicht von gaspermeablem Material (12) vorliegt.
2. Ein Tank gemäß Anspruch 1, bei dem das gaspermeable Material (12) ein spezifisches Gewicht aufweist, das größer als dasjenige von Wasser ist. 50
 3. Ein Tank gemäß Anspruch 2, bei dem das permeable Material (12) Sand in einer Menge aufweist, die ausreichend ist, um einen Ballast zu bilden, um zu verhindern, dass der Tank in Wasser schwimmt. 55
 4. Ein Tank gemäß einem der vorhergehenden Ansprüche, bei dem der Sack (11) zumindest eine Schicht synthetischer Jute aufweist.
 5. Ein Tank gemäß einem der vorhergehenden Ansprüche, bei dem der Sack (11) ein Gewebe aufweist, das in der Lage ist, erheblichen Belastungen zu widerstehen.
 6. Ein Tank gemäß einem der vorhergehenden Ansprüche, bei dem der Sack (11) ein Material aufweist, das für ultraviolette Strahlung undurchlässig ist.
 7. Ein Tank gemäß einem der vorhergehenden Ansprüche, bei dem ein Gasabzugsdurchlass zwischen dem Zwischenraum und der Außenseite des Sacks bereitgestellt ist.
 8. Ein Tank gemäß Anspruch 7, bei dem der Gasabzugsdurchlass ein Rohr für ein Gaserfassungsmessgerät aufweist.
 9. Ein Tank gemäß einem der vorhergehenden Ansprüche, bei dem das Schutzsystem eine Schicht von isolierendem Material aufweist, die auf die Oberfläche des Tanks (10) aufgebracht ist.
 10. Ein Tank gemäß Anspruch 9, bei dem das isolierende Material ein wärmehärtbares Epoxidharz aufweist.
 11. Ein Tank gemäß einem der vorhergehenden Ansprüche, bei dem das Schutzsystem eine Einrichtung (20) zum kathodischen Schutz aufweist.
 12. Ein Tank gemäß einem der vorhergehenden Ansprüche, bei dem der Sack ein Material (11') mit Mikrometerporen aufweist, durch die Wasser nicht als eine Flüssigkeit hindurchgehen kann, sondern nur in molekularer Form hindurchgehen kann.

13. Ein Tank gemäß Anspruch 12, bei dem das gaspermeable Material (12) ein granulares Material mit differenzierter Granulometrie aufweist, das so verteilt ist, dass sich ein Material mit höherer Granulometrie näher an der Sacköffnung befindet. 5
14. Ein Tank gemäß Anspruch 13, bei dem die kathodische Schutzeinrichtung eine anodische Opfereinrichtung, eine elektrisch leitfähige Einrichtung, die die anodische Opfereinrichtung mit dem Tank verbindet, und eine granulare Einrichtung zum Verringern von elektrischem Widerstand aufweist, die sich in Kontakt mit der anodischen Opfereinrichtung befindet. 10
15. Ein Tank gemäß Anspruch 14, bei dem die granulare Einrichtung zum Verringern von elektrischem Widerstand ein Teil des granularen Materials mit differenzierter Granulometrie ist. 20
16. Ein Tank gemäß Anspruch 14 oder 15, bei dem die anodische Opfereinrichtung einen Metallkörper aufweist, der angepasst ist, um als eine Anode relativ zu dem Metall des Tanks wirksam zu sein. 25
17. Ein Tank gemäß Anspruch 16, bei dem der Metallkörper Magnesium aufweist.
18. Ein Tank gemäß einem der Ansprüche 14 bis 17, bei dem die granulare Einrichtung zum Verringern von elektrischem Widerstand Gips, Bentonit und Natriumsulfat aufweist. 30
19. Ein Tank gemäß einem der Ansprüche 14 bis 18, bei dem die granulare Einrichtung zum Verringern von elektrischem Widerstand einen solchen Feuchtigkeitsgrad aufweist, um einen kathodischen Schutz zu aktivieren. 35
20. Ein Tank gemäß einem der vorhergehenden Ansprüche, der eine Trageeinrichtung (13, 52) aufweist, die mit dem Tank integriert ist. 40
21. Ein Tank gemäß einem der Ansprüche 1 bis 19, der eine Trageeinrichtung (14, 15) außerhalb des Sacks (11) aufweist. 45
22. Ein Verfahren zum Assemblieren eines Gastanks mit einem Schutzsystem für eine unterirdische Installation, **dadurch gekennzeichnet, dass** dasselbe die folgenden Operationen aufweist: 50
- Platzieren des Tanks (10) in einem Sack (11), der aus einem Material hergestellt ist, das im Wesentlichen für Gas und Wasser impermeabel ist;
 - Platzieren eines kathodischen Schutzsystems in dem Sack (11);

- Verbinden des kathodischen Schutzsystems mit dem Tank (10);
- Halten des Sacks (11) getrennt von der Oberfläche des Tanks (10), so dass ein Raum zwischen dem Tank und dem Sack bleibt, und
- Füllen zumindest eines Teils des Raums mit einem gaspermeablen Material (12), um eine Schicht um den Tank zwischen dem Tank und dem Sack zu bilden, wobei das kathodische Schutzsystem in der Schicht vorliegend resultiert.

23. Ein Verfahren gemäß Anspruch 22, bei dem die Operation des zumindest teilweisen Füllens des Raums mit einem gaspermeablen Material das Schütten von Sand in den Raum aufweist.

24. Ein Verfahren gemäß Anspruch 22 oder 23, das eine Aktion eines Rüttelns des Tanks (10) und des permeablen Materials (12) während des Schüttens aufweist.

25. Ein Verfahren gemäß Anspruch 22, 23 oder 24, bei dem der Sack (11') ein Material (11') mit Mikroporen aufweist, durch die Wasser nicht als eine Flüssigkeit hindurchgehen kann, sondern nur in molekularer Form hindurchgehen kann.

Revendications

1. Citerne équipée d'un système de protection pour une installation souterraine, le système de protection comprenant un sac (11) contenant la citerne (10) et constitué d'une matière essentiellement imperméable au gaz et à l'eau, ledit système de protection comprenant en outre une matière perméable au gaz (12) agencée dans un espace entre la citerne et le sac de manière à constituer une couche autour de la citerne, **caractérisée en ce que :**

- ladite citerne est une citerne de gaz ;
- ledit sac comporte une ouverture fermée sur la citerne ; et
- lesdits moyens de protection comprennent en outre des moyens de protection cathodique incorporés dans la couche de matière perméable au gaz (12).

2. Citerne selon la revendication 1, dans laquelle la matière perméable au gaz (12) présente un poids spécifique supérieur à celui de l'eau.

3. Citerne selon la revendication 2, dans laquelle la matière perméable (12) comprend du sable en une quantité suffisante pour constituer un ballast empêchant la citerne de flotter dans l'eau.

4. Citerne selon l'une quelconque des revendications précédentes, dans laquelle le sac (11) comprend au moins une couche de jute synthétique.
5. Citerne selon l'une quelconque des revendications précédentes, dans laquelle le sac (11) comprend un tissu capable de résister à des charges importantes.
6. Citerne selon l'une quelconque des revendications précédentes, dans laquelle le sac (11) comprend une matière opaque au rayonnement ultraviolet.
7. Citerne selon l'une quelconque des revendications précédentes, dans laquelle un passage d'évacuation de gaz est prévu entre l'espace et l'extérieur du sac.
8. Citerne selon la revendication 7, dans laquelle le passage d'évacuation de gaz comprend un tube pour une jauge de détection de gaz.
9. Citerne selon l'une quelconque des revendications précédentes, dans laquelle le système de protection comprend une couche de matière isolante appliquée à la surface de la citerne (10).
10. Citerne selon la revendication 9, dans laquelle la matière isolante comprend une résine époxy thermocurable.
11. Citerne selon l'une quelconque des revendications précédentes, dans laquelle le système de protection comprend des moyens (20) de protection cathodique.
12. Citerne selon l'une quelconque des revendications précédentes, dans laquelle le sac comprend une matière (11') comportant des pores micrométriques à travers lesquels l'eau ne peut pas passer sous forme liquide mais peut passer uniquement sous forme moléculaire.
13. Citerne selon la revendication 12, dans laquelle la matière perméable au gaz (12) comprend une matière granulaire présentant une granulométrie différenciée distribuée de telle manière que la matière présentant la granulométrie la plus élevée soit plus proche de l'ouverture du sac.
14. Citerne selon la revendication 13, dans laquelle les moyens de protection cathodique comprennent des moyens anodiques sacrificiels, des moyens électroconducteurs connectant les moyens anodiques sacrificiels avec la citerne et des moyens granulaires pour réduire la résistance électrique en contact avec les moyens anodiques sacrificiels.
15. Citerne selon la revendication 14, dans laquelle les moyens granulaires pour réduire la résistance électrique font partie de la matière granulaire présentant une granulométrie différenciée.
16. Citerne selon la revendication 14 ou 15, dans laquelle les moyens anodiques sacrificiels comprennent un corps métallique conçu pour agir comme une anode par rapport au métal de la citerne.
17. Citerne selon la revendication 16, dans laquelle le corps métallique comprend du magnésium.
18. Citerne selon l'une quelconque des revendications 14 à 17, dans laquelle les moyens granulaires pour réduire la résistance électrique comprennent du gypse, de la bentonite et du sulfate de sodium.
19. Citerne selon l'une quelconque des revendications 14 à 18, dans laquelle les moyens granulaires pour réduire la résistance électrique présentent un niveau d'humidité susceptible d'activer la protection cathodique.
20. Citerne selon l'une quelconque des revendications précédentes, comprenant des moyens de support (13, 52) intégrés à la citerne.
21. Citerne selon l'une quelconque des revendications 1 à 19, comprenant des moyens de support (14, 15) à l'extérieur du sac (11).
22. Procédé d'assemblage d'une citerne de gaz avec un système de protection pour une installation souterraine, **caractérisé en ce qu'il** comprend les opérations suivantes :
- la mise en place de la citerne (10) à l'intérieur d'un sac (11) constitué d'une matière essentiellement imperméable au gaz et à l'eau ;
 - la mise en place d'un système de protection cathodique à l'intérieur dudit sac (11) ;
 - la connexion dudit système de protection cathodique à ladite citerne (10) ;
 - le maintien du sac (11) détaché de la surface de la citerne (10) de telle manière qu'il reste un espace entre la citerne et le sac ; et
 - le remplissage d'au moins une partie dudit espace avec une matière perméable au gaz (12) de manière à former une couche autour de la citerne entre la citerne et le sac,
- ledit système de protection cathodique se retrouvant incorporé à l'intérieur de ladite couche.
23. Procédé selon la revendication 22, dans lequel l'opération de remplissage au moins partiel dudit espace avec la matière perméable au gaz comprend le versement de sable dans ledit espace.

24. Procédé selon la revendication 22 ou la revendication 23, comprenant une action de vibration de la citerne (10) et de la matière perméable (12) pendant le versement.

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25. Procédé selon la revendication 22, 23 ou 24, dans lequel le sac (11') comprend une matière (11') comportant des pores micrométriques à travers lesquels l'eau ne peut pas passer sous forme liquide mais peut passer uniquement sous forme moléculaire.

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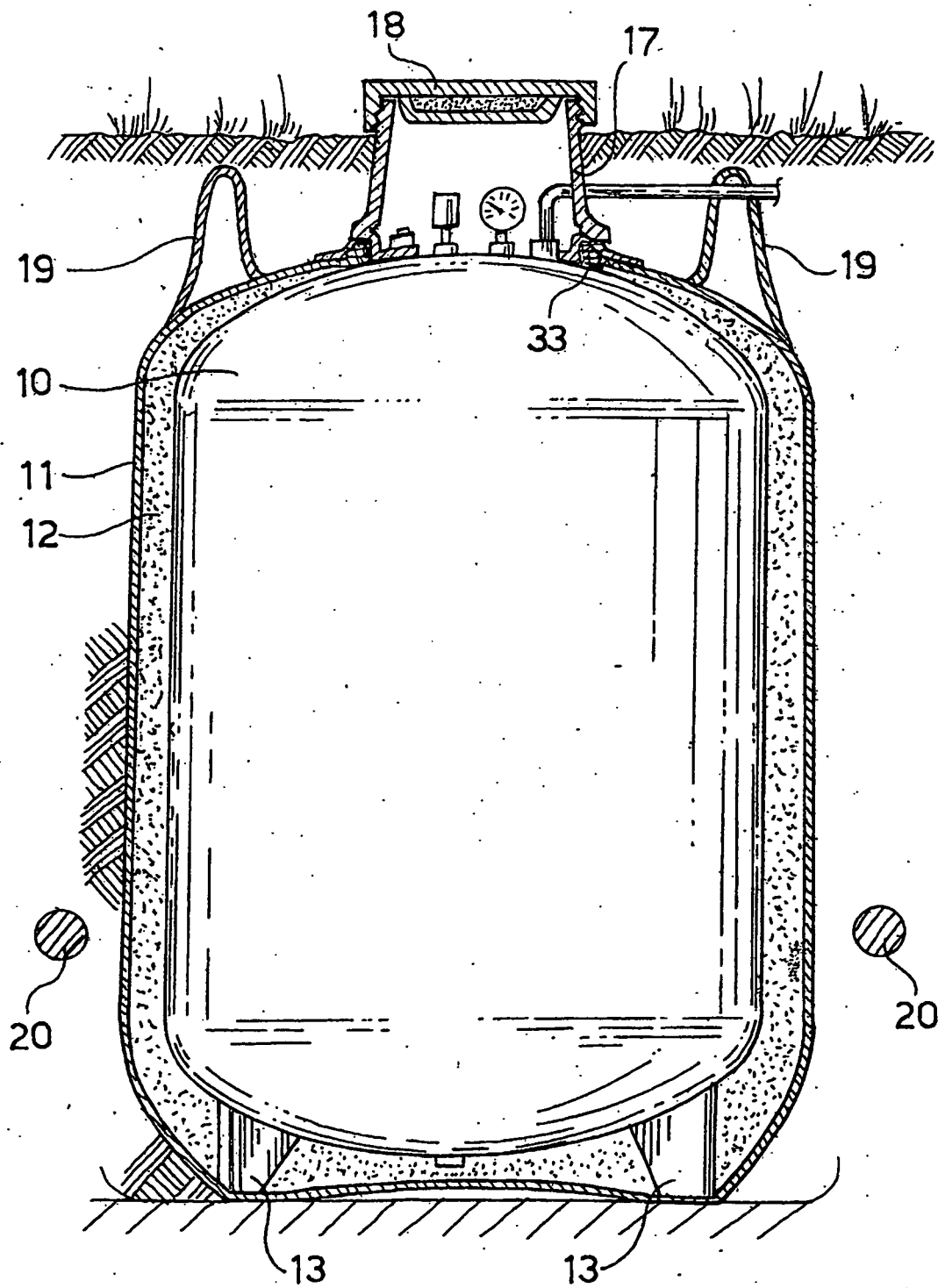


FIG. 1

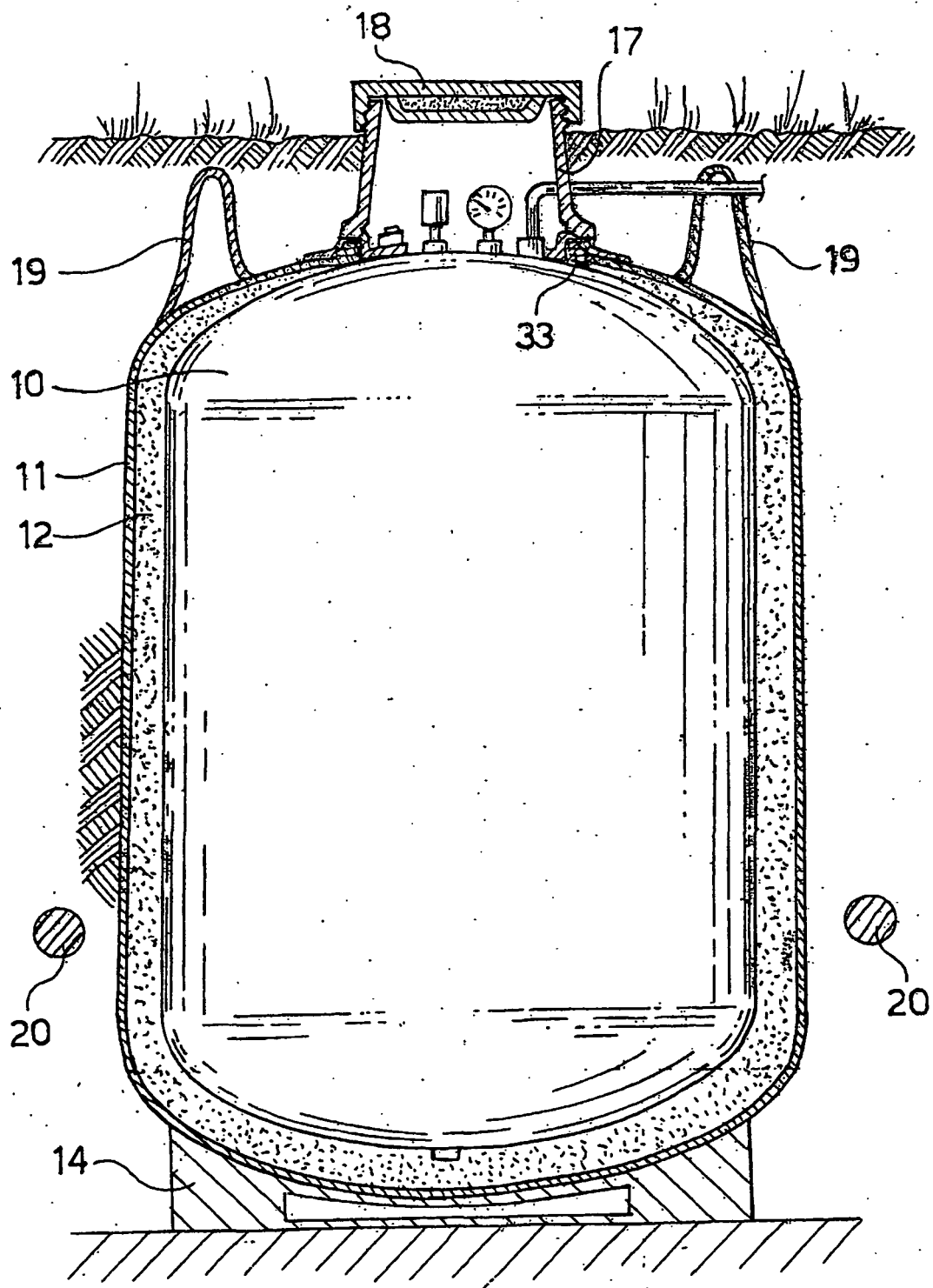


FIG. 2

FIG. 3

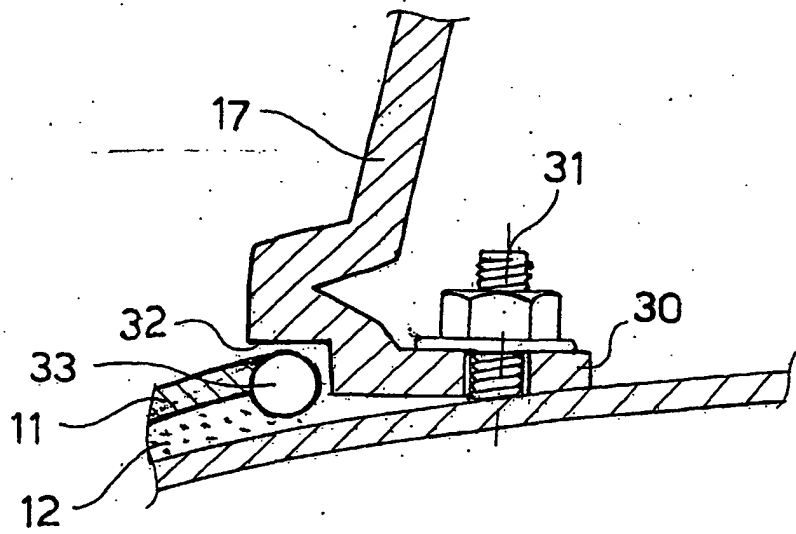


FIG. 4

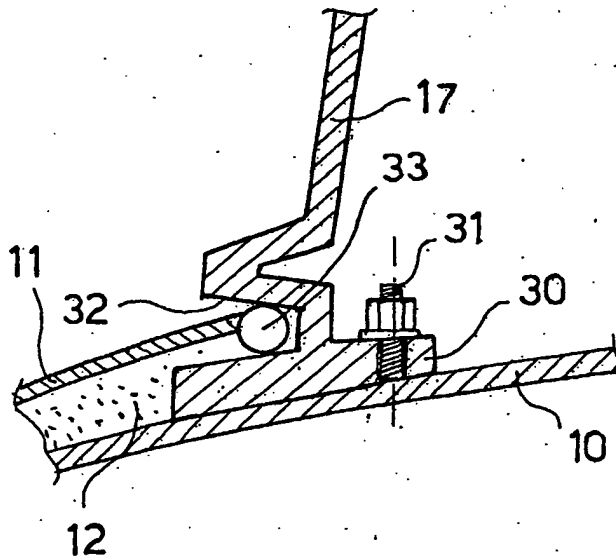


FIG. 5

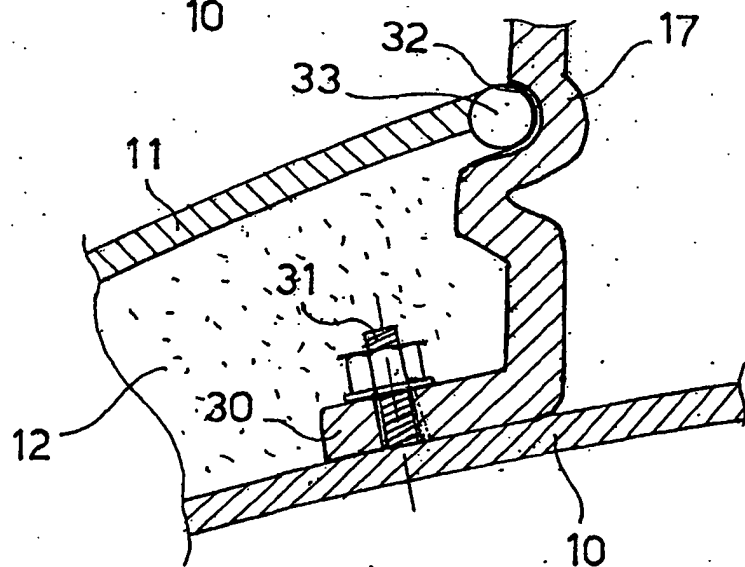


FIG. 6

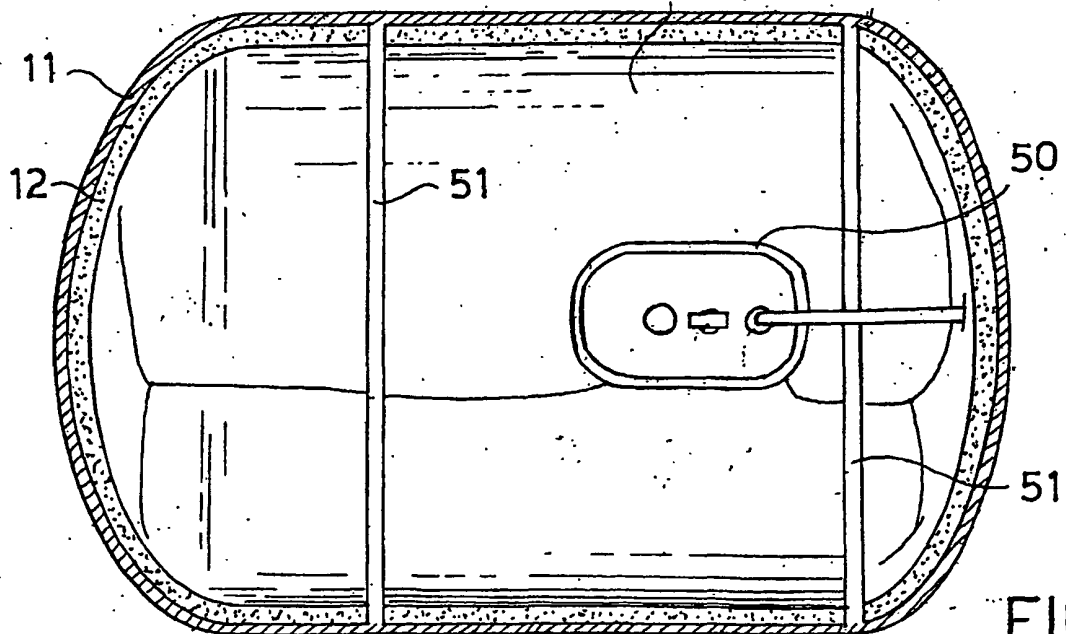
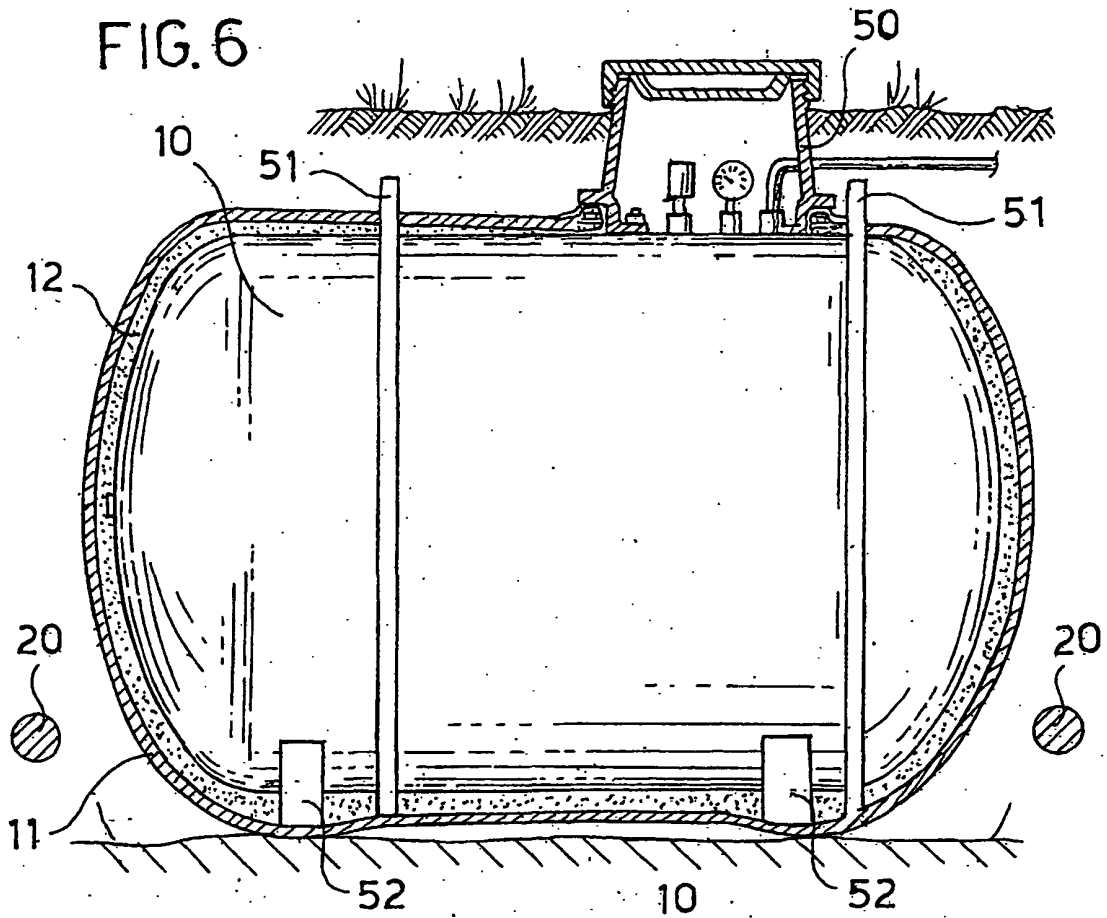


FIG. 7

FIG. 8

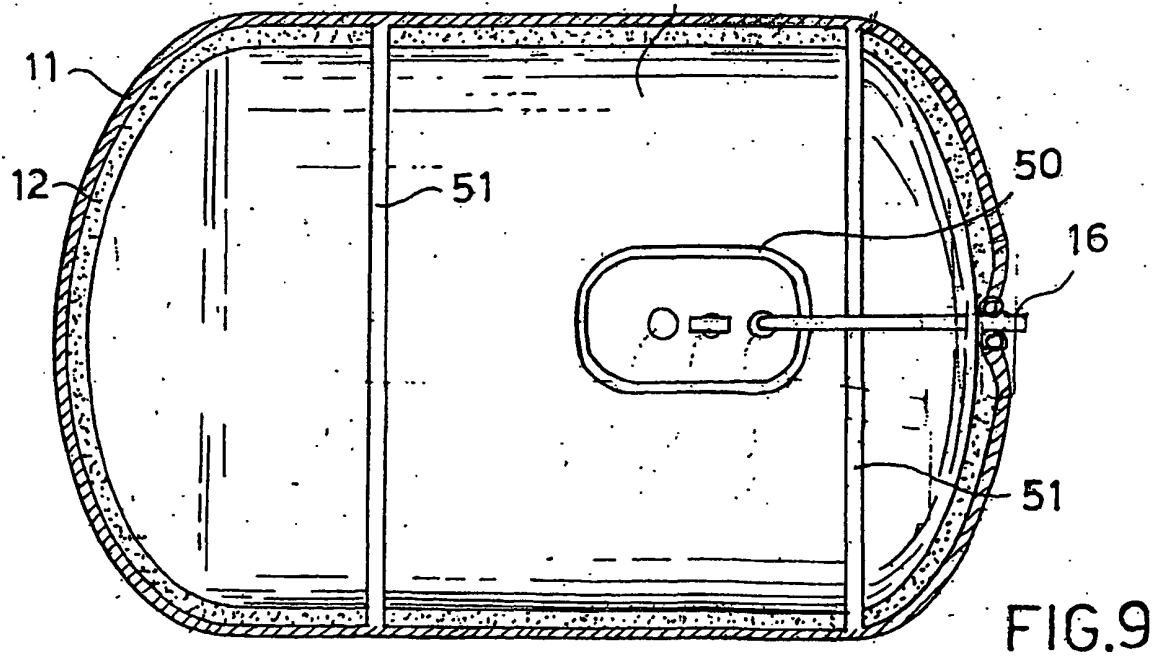
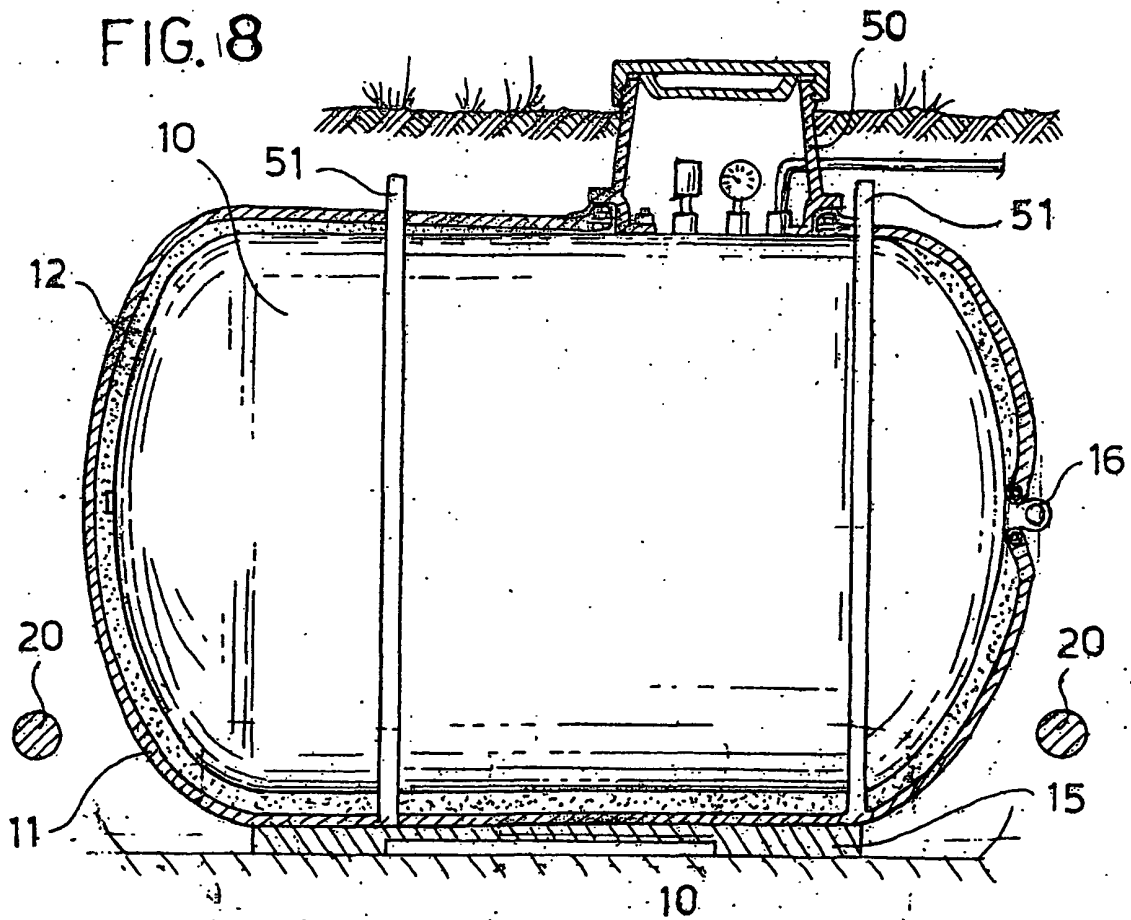


FIG. 9

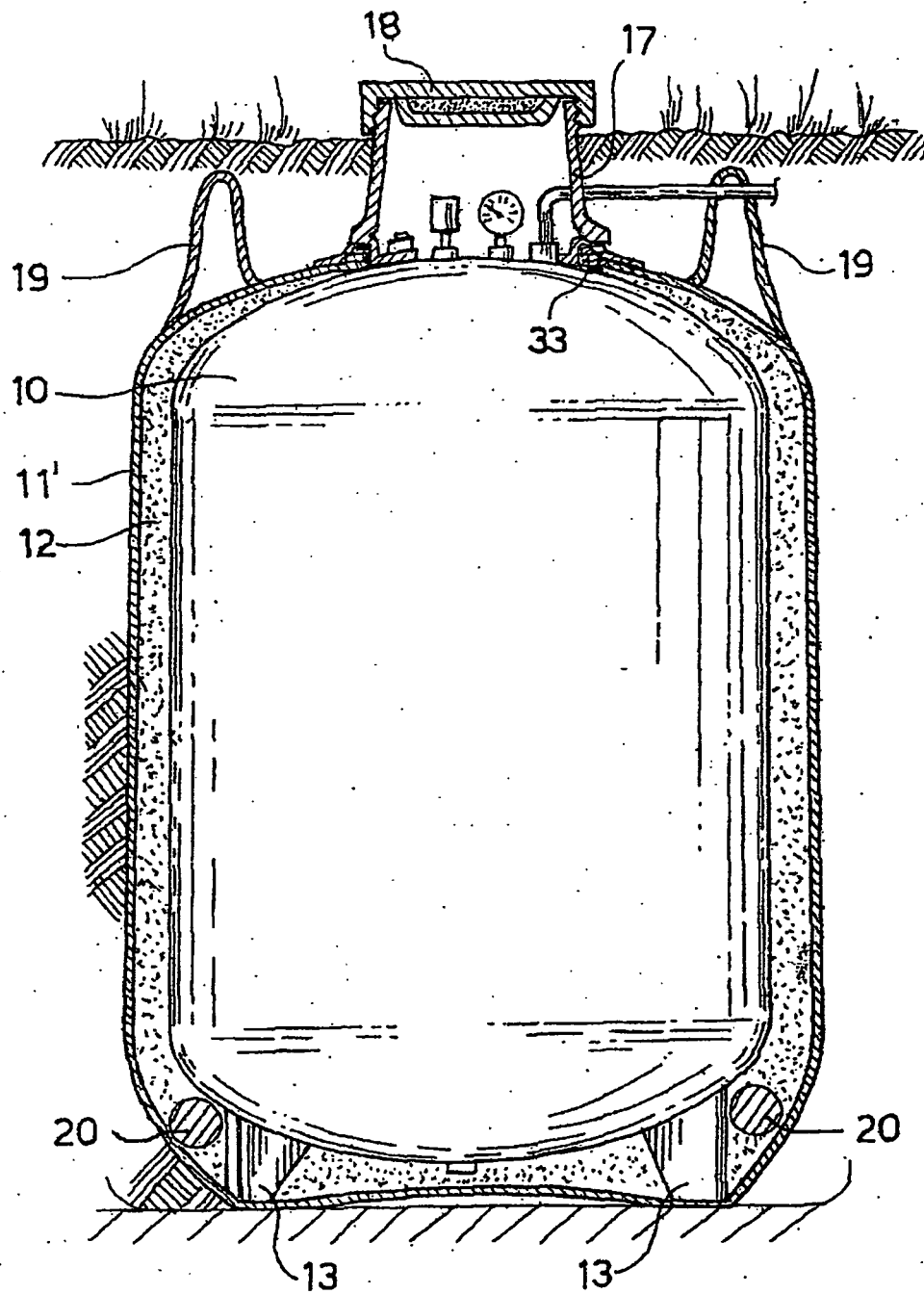


FIG. 10