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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
F17C 1/00, 1/10, 1/04

A1

(11) International Publication Number: WO 97/45672

(43) International Publication Date: 4 December 1997 (04.12.97)

(21) International Application Number: PCT/EP97/02773

(22) International Filing Date: 23 May 1997 (23.05.97)

(30) Priority Data:
96/06490 24 May 1996 (24.05.96) FR

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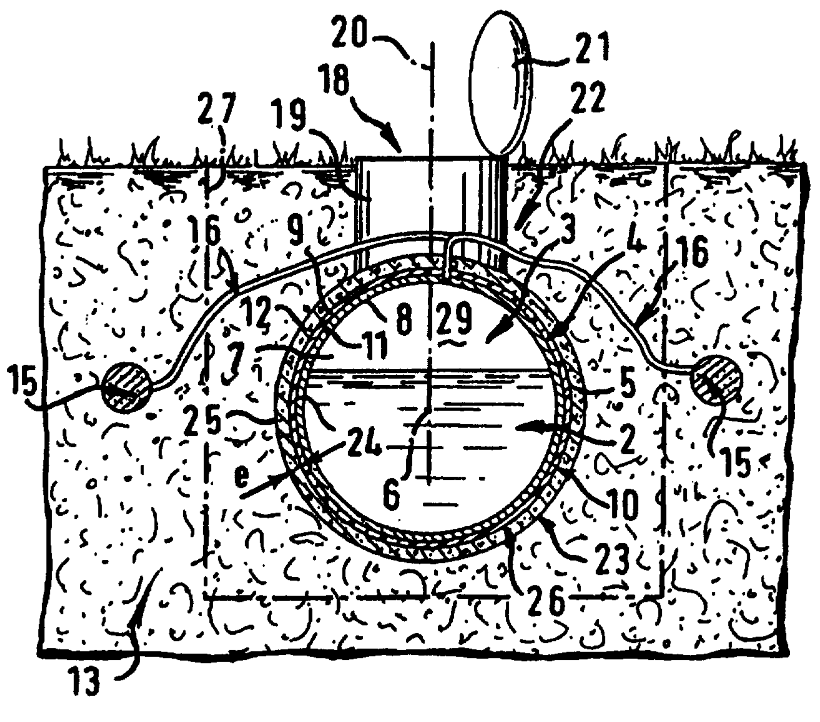
(81) Designated States: HU, NO, PL, RO, TR, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: CISTERN FOR STORING LIQUEFIED PETROLEUM GAS



(57) Abstract

The cistern consists of an airtight tank (4) made of sheet steel having on its outer surface a layer of passive anticorrosion sheathing (10) which itself is covered by a layer of hydraulic mortar sheathing (23) which is designed to come in direct contact with the natural soil (13) in the ground without requiring the use of a layer of sand (17) but offering the same possibilities of cathodic protection for the cistern (22) by means of sacrificial anodes (15).

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CISTERN FOR STORING LIQUEFIED PETROLEUM GAS

The present invention relates to a cistern for storing liquefied petroleum gas, and more in particular to a pressurized cistern of the type not subject to a flame which is designed to hold liquefied petroleum gas and to be buried in the ground with an attached cathodic protection system including at least one sacrificial anode, comprising an airtight tank made of sheet steel having an inner surface making up the chamber where the liquefied petroleum gas is stored, and having an outer surface; and a layer of passive anticorrosion sheathing, that covers the entire outer surface of the tank.

It has been the traditional approach to protect a conventional cistern by means of an anticorrosion sheathing made of passive organic material which partly electrically insulates, and an active cathodic protection system including at least one sacrificial anode. In addition, a large amount of sand is generally added to the pits where a cistern is to be buried. This sand is placed around the entire cistern thereby creating a homogeneous layer which prevents the cistern's anticorrosion sheathing from coming into contact with the natural soil in the ground but does not hinder the functioning of the cathodic protection system. The sacrificial anode(s), generally two of them, is (are) electrically connected to the tank and buried in the natural soil in the ground around the tank.

The problem that arises when sand is used to fill in the pits is that such pits must be a great deal larger than the size of the cisterns themselves. This implies, firstly, that the excavated earth must be removed from the site and, secondly, that a significant amount of sand must be brought onto the site. The final result of all of this is that installing a buried liquefied petroleum gas cistern is a long and costly process requiring a lot of workers and equipment for an extended period of time. Furthermore, until the cistern has been completely buried in the ground, it is exposed to impact, namely during storage, transport, and handling.

The present invention is designed to remedy these problems.

To this end the cistern designed to hold liquefied petroleum gas and to be buried in the ground with an attached cathodic protection system including at least one sacrificial anode according to the present invention, comprises an airtight tank made of sheet steel having an inner surface making up a chamber where the liquefied petroleum gas is stored, and having an outer surface; and a layer of passive anticorrosion sheathing that covers the entire outer surface of the tank, characterized in that it has an extra layer of hydraulic mortar sheathing which covers the entire anticorrosion sheathing and designed to come in direct contact with the natural soil in the ground.

The present invention involves a conventional cistern with the only difference being that it has an extra layer of hydraulic mortar sheathing that covers the cistern's anticorrosion sheathing. This hydraulic mortar sheathing comes in direct contact with the natural soil in the ground around the cistern.

It was surprisingly found that when the extra layer of hydraulic mortar sheathing was added onto the cistern's anticorrosion sheathing, preferably having a constant thickness of no more than 20 mm, is enough to protect the anticorrosion sheathing from impact during storage, transport, and handling. This does allow the natural soil in the ground to be used to cover the cistern instead of sand. The additional hydraulic mortar sheathing resulted in only a slight cost for hydraulic mortar and only a slight increase in the cistern's overall weight thereby offering favourable conditions for transport and installation.

Moreover the extra layer of hydraulic mortar sheathing is hard enough to protect the cistern's anticorrosion sheathing, made of a passive organic material chosen from a group containing epoxide paint, from dents and nicks caused by falling rocks and other things contained in natural soil in the ground when covering the cistern or caused by the slow movement of the ground when stabilizing the cistern. The hydraulic mortar sheathing is also sufficiently supple to absorb these impacts without transferring the percussion energy to the cistern's anticorrosion sheathing.

It even contributes to the protection of the tank itself since its alkaline nature generates a range of pH values near the steel that makes it insensitive to corrosion.

Also, the hydraulic mortar sheathing does not hinder the functioning of the cathodic protection system since it conducts electricity. In fact, its electrochemical behaviour is similar to that of the sand provided that the hydraulic mortar sheathing is in homogeneous and constant contact with the cistern's anticorrosion sheathing which, in turn, is in homogeneous and constant contact with the tank itself. It does not add an electrical insulation barrier to that provided by the organic anticorrosion sheathing the resistance of which is controlled. This means that the cathodic protection currents are sufficient and therefore easily measurable on site and directly comparable to the measurable values for sand. Not only is the hydraulic mortar sheathing compatible with sacrificial anode cathodic protection systems, namely the one described above, but experience obtained from the installations carried out according to the traditional method may be directly applied to take into account hydraulic mortar sheathing. There is no significant difference between the control values for cathodic protection in a cistern installed with the traditional method and a cistern installed using the present invention.

Because of its constant and conductive nature, caused by the fact that it contains water, the hydraulic mortar prevents the occlusion of air that may occur with other types of additional insulating sheathing layers.

Finally, the hydraulic mortar sheathing does not have any effect on the cistern's ability to evaporate liquefied petroleum gas because of its favourable heat exchange coefficients.

Naturally, the hydraulic mortar sheathing that makes up the additional layer may be reinforced. It is possible to use any of the known materials used for reinforcement. Fibrous material, for instance, can be mixed with the hydraulic mortar when the cistern is manufactured, more specifically when the extra layer of sheathing is added by spraying the hydraulic mortar, for example, onto the cistern's anticorrosion sheathing.

However, it is also possible, even preferable, for the tank itself act as the frame for the hydraulic mortar sheathing by bonding the hydraulic mortar sheathing to the anticorrosion sheathing at all points. This can be done by adding a thin intermediate layer of an adhesive substance between the hydraulic mortar sheathing and the anticorrosion sheathing in such a way that the layers are bonded together at all points. The adhesive substance used may be any of a number of resin compositions, such as epoxides, acrylics, styrene-butadiene. The adhesive substance is sprayed in liquid form onto the anticorrosion sheathing layer and later harden. Fresh hydraulic mortar is then added onto the adhesive substance while it is still sticky and viscous and when it hardens, the hydraulic mortar sheathing will be securely bonded at all points to the anticorrosion layer. It is possible to obtain the same bonding effect without such an intermediate adhesive layer. This is due to the fact that the anticorrosion sheathing layer itself is sprayed in liquid form onto the tank and later hardens. If the hydraulic mortar is added directly onto the anticorrosion sheathing layer while it is still sticky and viscous the two layers will be bonded just as securely as if there were an adhesive substance between them. In both cases the hydraulic mortar sheathing is added to the cistern before it is buried in the ground.

Given the fact that a cistern making use of the present invention will no longer require sand, the procedure followed for the installation and burial of a liquefied petroleum gas tank is different.

The present invention offers the revised procedure to be followed for installing a pressurized cistern of the type not subject to a flame that is designed to hold liquefied petroleum gas, and to be buried in the ground, comprising: an airtight tank made of sheet steel having an inner surface making up the chamber where the liquefied petroleum gas is stored, and having an outer surface; and a layer of passive anticorrosion sheathing, that electrically insulates and covers the entire outer surface of the tank.

At least one sacrificial anode, buried in the ground is electrically connected to the tank with such connection passing through the hydraulic mortar sheathing as well as the intermediate adhesive layer, if used. The cistern is then buried with the outside hydraulic mortar sheathing coming into direct contact with the natural soil in the ground.

The manner in which the installation is carried out is original with respect to traditional cistern installations and the present invention also offers a buried installation of liquefied petroleum gas storage making use of a pressurized cistern of the type not subject to a flame that is designed to hold liquefied petroleum gas, and to be buried in the ground, comprising: an airtight tank made of sheet steel having an inner surface making up the chamber where the liquefied petroleum gas is stored, and having an outer surface; and a layer of passive anticorrosion sheathing, that covers the entire outer surface of the tank, and electrical wires to connect the tank to at least one sacrificial anode that is also buried and placed directly in contact with the natural soil in the ground, which electrical wires pass through the anticorrosion layer.

The cistern according to the invention has a layer of hydraulic mortar sheathing through which the electrical wires also pass and this hydraulic mortar sheathing forms the outer surface of the cistern is in direct contact with the natural soil in the ground.

If there is an intermediate adhesive layer disposed between the anticorrosion sheathing and the hydraulic mortar, the electrical wires run through this intermediate adhesive layer.

Other properties and advantages of these different aspects will be described by way of example with reference to the accompanying drawings, wherein

Figure 1 shows a frontal cut view of a pressurized liquefied petroleum cistern that was buried according to the traditional method; and

Figure 2 shows a frontal cut view of a pressurized liquefied petroleum cistern that was buried using the present invention.

In both Figures, certain dimensions have been exaggerated so as to better illustrate the various components.

Reference is now made to Figure 1 showing the traditional concept of a buried cistern 1, designed to hold a variable amount of liquefied petroleum gas 2 with a space for evaporated petroleum gas 3 which is obtained by the natural vaporization of the liquid product for which the very high pressure to which the gas is subjected with respect to the outside air pressure is equal to the pressure of the saturating vapour of the petroleum gas and for which the value depends on the temperature of the upper layer of the liquid product.

In such a cistern 1, the airtight confinement of the liquefied petroleum gas 2 in its gaseous state 3 is assured by an airtight tank 4 made of sheet steel which provides the mechanical resistance for the cistern 1 with respect to the very high pressure to which the gas is subjected with respect to the outside air pressure. It generally has a tubular side wall 5 having an inner surface and an outer surface which run cylindrically around a generally horizontal axis 6 (which extends perpendicular to the plane of drawing). It has furthermore partially spherical end walls 7 having an inner surface and an outer surface, which surfaces run hemispherically around the horizontal axis 6 and are concave to one another along this axis. The inner surfaces of the walls 5 and 7 form an surface 8 which makes up the inner chamber 29 where the liquefied petroleum gas 2 is kept with the evaporated petroleum gas 3. The outer surfaces of the walls 5 and 7 form the outer surface 9 of the tank 4 which, in turn, is entirely covered by a complete layer of passive anticorrosion sheathing 10. This anticorrosion sheathing 10 acts as electrical insulation for the tank 4 and is made of a passive organic material chosen from a group containing epoxide paint. The anticorrosion sheathing 10 has an inner surface 11 which is in direct and continuous contact with the outer surface 9 of the tank 4, both at the tubular side wall 5 level and at the end walls 7 level. The anticorrosion sheathing 10 also has an outer surface 12 which in the case of the traditional cistern 1, also constitutes the outer layer of the cistern 1.

In order to bury the traditional cistern 1, it is necessary to dig a large rectangular-shaped pit 14 in the natural soil 13 in the ground. This pit 14 is much larger than the outer surface 12 of the cistern 1 itself due to the fact that contact with the natural soil 13 must be avoided. The cistern 1 is suspended or wedged in the pit 14 so that it does not touch the natural soil 13. Two sacrificial anodes 15 are then buried in the natural soil 13 to either side of the cistern 1 within the pit 14. These sacrificial anodes 15 are placed at approximately the same level as and parallel to the horizontal axis 6. Electrical wires 16 are then run from the sacrificial anodes 15 to the tank 4, passing through the anti-corrosion sheathing 10. Once this has been done, the pit 14 is filled with sand 17 until it completely surrounds and covers the cistern 1. The sand acts as a barrier between the outer surface 12 of the anticorrosion sheathing 10 and the natural soil 13 in the ground thereby preventing any sort of contact to take place.

Although not shown in Figure 1, the inner chamber 29 of the tank 4 is connected to user devices by means of a system of conduits and valves housed in an inspection hole 18 made up of a large airtight tube 19 which is attached to the tank 4 in an airtight manner by means of the anticorrosion sheathing 10. This inspection hole 18 runs around a vertical axis 20 which is perpendicular to the horizontal axis 6. When the cistern 1 is placed in the pit 14, it is positioned according to the vertical axis 20 so that the inspection hole 18 with its airtight tube 19 sticks out from the sand 17 after the pit 14 has been filled with sand 17. The inspection hole has a removable lid 21 that is situated above the level of the sand 17.

Reference is now made to Figure 2, showing the cistern according to the present invention. A similar cistern 22 as that shown in Figure 1 is shown with the same numerical references for identical constituents.

The difference, however, is that the outer surface 12 of the anticorrosion sheathing 10 does not form the outer layer of the cistern 22 because an extra layer of hydraulic mortar sheathing 23 has been added. This extra layer of hydraulic mortar sheathing 23 forms a new inner surface 24 which completely covers the outer surface 12 of the anticorrosion sheathing 10. A new outer surface 25 is formed and this now constitutes the outer layer of the cistern 22.

The inner surface 24 of the hydraulic mortar sheathing 23, obtained by projection of hydraulic mortar, for example, is uniformly distributed and closely bonded at all points along the outer surface 12 of the anti-corrosion sheathing 10. This is done by using one of two methods. The first of the two methods entails the direct application of hydraulic mortar onto the anticorrosion sheathing 10 shortly after this anticorrosion sheathing 10 has been sprayed in liquid form onto the outer surface 9 of the tank 4. Because the anticorrosion sheathing 10 is still sticky and viscous when the hydraulic mortar sheathing 23 is added, both sheathings 10 and 23 will be securely bonded at all points when the anticorrosion sheathing 10 dries and hardens. The second method involves the adding a thin intermediate layer of an adhesive substance 26 between the hydraulic mortar sheathing 23 and the outer surface 12 of the anticorrosion sheathing 10 in such a way that the two sheathings 10 and 23 are bonded together at all points. The adhesive substance 26 used may be any of a number of resin compositions, such as epoxides, acrylics, styrene-butadiene, without being an exhaustive list, that are sprayed in liquid form onto the outer surface 12 of the anticorrosion sheathing 10. Fresh hydraulic mortar, that is, containing mixing water, is then added onto the intermediate layer of the adhesive substance 26 while it is still sticky and viscous and when it hardens, the hydraulic mortar sheathing 23 will be securely bonded at all points to the outer surface 12 of the anticorrosion sheathing 10.

Tests have demonstrated that each of the two methods provides a sufficiently efficient bonding of the hydraulic mortar sheathing 23 to the anticorrosion sheathing 10 which, itself, is sufficiently bonded to the tank 4, to provide a strong enough assembly which does not require any support frames. The mechanical properties described for the cistern 22, being used to hold liquefied petroleum gas 2 and evaporated gas 3 under very high pressure with respect to outside air pressure, are sufficient for this purpose. However, it is recommended that additional reinforcement be added to the hydraulic mortar sheathing 23, for instance, in the form of fibrous material mixed with the hydraulic mortar before it is applied to the anticorrosion sheathing 10.

Preferably, the hydraulic mortar sheathing 23 should be applied uniformly and over the entire anticorrosion sheathing 10. Tests have demonstrated that a uniform thickness no greater than 20 mm provides the anti-corrosion sheathing 10 with the same protection offered by the sand layer 17 used in the traditional method shown in Figure 1 to mechanically insulate the cistern 1 from the natural soil 13.

Under these conditions, the cistern 22 may be buried in the manner described below.

A pit 27 is dug in the natural soil 13 in the ground in exactly the same manner as the pit 14 in Figure 1, that is, having the same dimensions and large enough to receive the cistern 22. When manufactured, the cistern 22 is coated with its hydraulic mortar sheathing 23 and is placed in the pit 27 in such a way that the inspection hole 18 is turned towards the top and aligned with the vertical axis 20. On either side of the cistern 22, two sacrificial anodes 15 are buried into the natural soil 13 at the level of the horizontal axis 6. Electrical wires 16 are then run from these sacrificial anodes 15 to the tank 4 passing through both the hydraulic mortar sheathing 23 and the anticorrosion sheathing 10, and the intermediate layer of the adhesive substance 26 that bonds the two sheathings 10 and 23 together, if such a layer has been added. The pit 27 is then filled with natural soil 13 removed when digging the pit 27. As a result, the outer surface 25 of the hydraulic mortar sheathing 23 which constitutes the outer layer of the cistern 22 is now in direct contact with the natural soil 13 in the ground.

Anyone who works in the trade will understand the significance of this right away. By comparing Figures 1 and 2 and the corresponding comments provided above, one can easily see that the excavation work required to install and bury the cistern 22 in Figure 2 according to the invention is significantly less than that required to install and bury the cistern 1 in Figure 1 according to the traditional method. In fact, if one uses a portion of the natural soil 13 extracted from the pit 27 to fill it, there is much less excavated earth to remove from the site and there is no need to bring sand 17 onto the site.

This results in a significant reduction of transport taking place on the site.

Naturally, the manner in which the invention described above is implemented is by no means a limited example. It should be stressed that the constituents making up the cistern 22 in Figure 2 have exactly the same dimensions as those making up the cistern 1 in Figure 1. This cistern 22 according to the invention may be manufactured in exactly the same manner as described for the cistern 1 according to the traditional method, namely with respect to the thickness of the walls of the tank 4 and anticorrosion sheathing 10. Furthermore, it is possible to add a hydraulic mortar sheathing 23 that is thicker than 20 mm without having any impact on the present invention. It should be mentioned that the figure 20 mm was chosen as a thickness that could provide the desired degree of mechanical protection without having a negative impact in terms of added weight when handling the cistern 22. If an intermediate layer of an adhesive substance 26 is provided, its thickness may be much less, perhaps a few micrometers, but again, this figure is only provided as an example with many other possibilities existing.

CLAIMS

1. A cistern designed to hold liquefied petroleum gas and to be buried in the ground with an attached cathodic protection system including at least one sacrificial anode (15), comprising an airtight tank (4) made of sheet steel having an inner surface (8) making up a chamber (29) where the liquefied petroleum gas (2 and 3) is stored, and having an outer surface (9); and a layer of passive anticorrosion sheathing (10) that covers the entire outer surface (9) of the tank (4), characterized in that it has an extra layer of hydraulic mortar sheathing (23) which covers the entire anticorrosion sheathing (10) and designed to come in direct contact with the natural soil (13) in the ground.

2. The cistern according to claim 1, characterized in that the layer of hydraulic mortar sheathing (23) has a uniform thickness.

3. The cistern according to claim 2, characterized in that the thickness is no greater than 20 mm.

4. The cistern according to any one of the claims 1-3, characterized in that the layer of hydraulic mortar sheathing (23) is bonded to the layer of anticorrosion sheathing at all points(10).

5. The cistern according to claim 4, characterized in that the layer of hydraulic mortar sheathing (23) is bonded directly to the layer of anticorrosion sheathing (10) at all points.

6. The cistern according to claim 4, characterized in that there is an intermediate layer of an adhesive substance (26) that is bonded to the layer of hydraulic mortar sheathing (23) and that bonds the layer of hydraulic mortar sheathing (23) to the layer of

anticorrosion sheathing (10) at all points.

7. The cistern according to any one of the claims 1-6, characterized in that the layer of anticorrosion sheathing (10) is made of a passive organic material chosen from a group containing epoxide paint.

8. The cistern according to claim 7 in combination with claim 6, characterized in that the adhesive substance (26) is a material chosen from the group comprising epoxide resins, acrylic resins, and styrene-butadiene.

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FIG.1

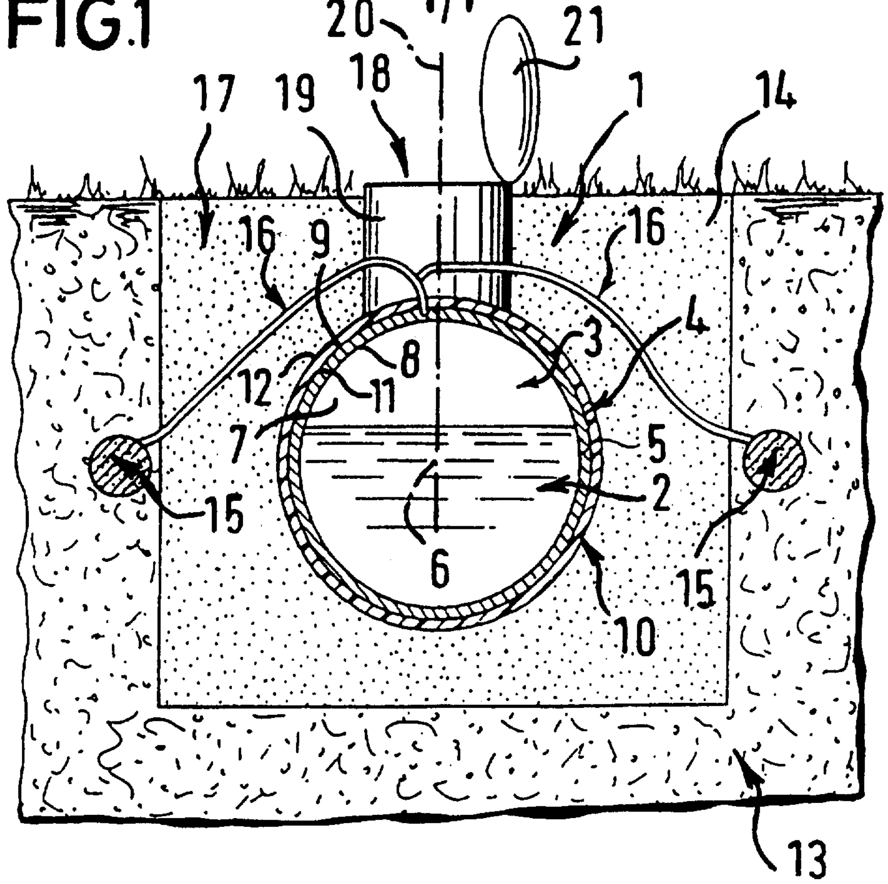
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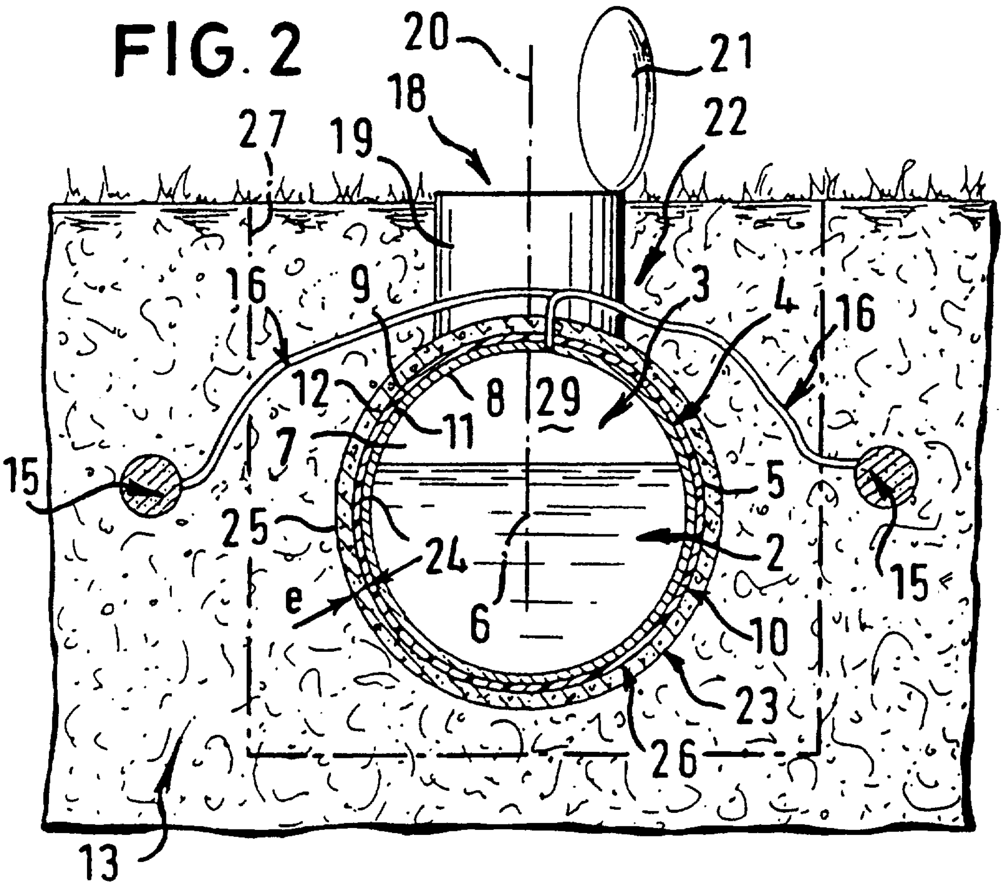
FIG. 2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INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/EP 97/02773

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F17C1/00 F17C1/10 F17C1/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F17C E04H B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0 601 947 A (SCHNEIDER IND S I SA ;CORSOLAC IND S A (FR)) 15 June 1994 see column 3, line 37 - column 4, line 6; claims; figures see column 5, line 13-27	1-8
Y	US 5 207 530 A (BROOKS GREGORY L ET AL) 4 May 1993 see claims; figures 1,2	1-8
A	EP 0 713 051 A (SCHNEIDER IND S I SA) 22 May 1996	
A	FR 2 641 844 A (LIOTARD FRERES STE METALLURG) 20 July 1990	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
10 September 1997	22.09.97

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 97/02773

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0601947 A	15-06-94	FR 2699258 A	17-06-94
		AT 151852 T	15-05-97
		DE 69309867 D	22-05-97
		ES 2100507 T	16-06-97
US 5207530 A	04-05-93	CA 2095308 C	04-07-95
EP 0713051 A	22-05-96	FR 2726889 A	15-05-96
		FR 2731264 A	06-09-96
FR 2641844 A	20-07-90	NONE	