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(54) Tank for the storage of hydrocarbons and liquid of any nature

(57) Underground tank (tank-tunnel) or in the open (sunken or above ground) for the storage of hydrocarbons and liquids of any nature comprising a metallic structure (2) inside a static facing (3) suitable to separate the metallic structure from the surrounding ground (tank-tunnel) and to circumscribe the open-air tank, where said metallic structure comprises a plurality of metallic elements (6) in plating assembled with specific welded joints forming, around their perimeter, the mini longitudinal and transversal tubular ducts of the system suitable for the auto containment even of a possible leak of liquid (fuel) and where the mini, longitudinal, tubular ducts merge into the verticals or transversals that terminate on the bottom of the tank connected to a mini pipe, which comes out below the tank itself, on the terminal of which an electro-valve with hermetic seal (15) is inserted, connected to a stretch of transparent pipe (14), by which one activates the preliminary visual monitoring of any possible presence of liquid (fuel) at the level of drops, in turn the transparent stretch is connected to another stretch of mini pipe that flows into a suitable sealed recipient inside of which a sensor (12) is placed capable of signalling, to the monitoring display, the presence of liquid even in the state of vapours, where said sensor, in case of the presence of liquid (drops) in the mini piping, autonomously commands the closing of the electro-valve.

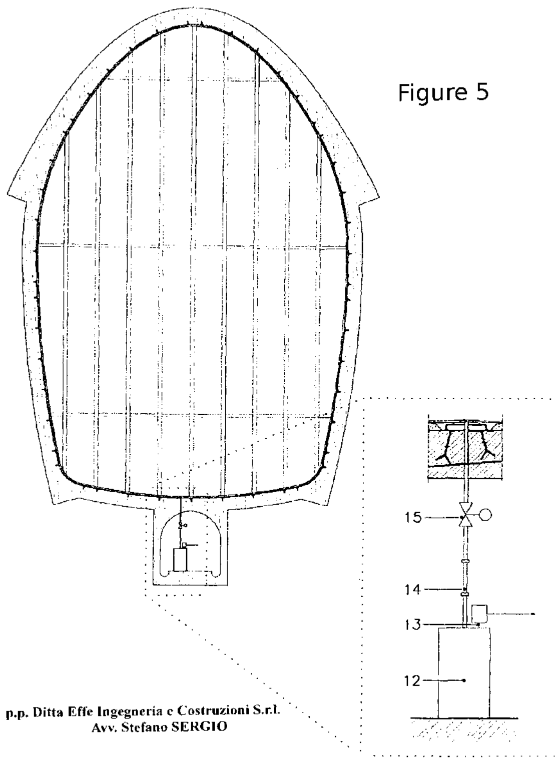

Figure 5

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Description

[0001] This invention concerns metallic tanks of large capacity for storage of hydrocarbons and other liquids of any nature, built underground (tank-tunnel) or the open, sunken or above ground.

[0002] Such tanks are generally cylindrical in shape with a horizontal or vertical axis and envisage a metallic structure for storage inside a static structure in simple or reinforced concrete, and a filler material interposed between the metallic storage structure and the masonry or static one.

[0003] The construction of large underground tanks is carried out, as well known, by means of rectangular, steel sheets of considerable size known as "ferrules".

[0004] With this invention, the welded joints, which are made on the four sides of the plating elements that make up the metallic storage structure, make up the structural components of the horizontal and vertical, mini tubular ducts which in intersecting with one another, form the grid system to keep autonomously closed, even "sine die", a possible leakage of liquid (fuel) caused by an executive flaw in the welding seam, its relative monitoring and the hydraulic tightness of the tank. On the rear side of each plating element, on its four edges, the flat sections (e.g. of 100 x 5 and of 100 x 5) are welded with which the lower base of the elements that make up the tubular ducts are made. On the longer sides of the plating, by means of welding of a flat section (e.g. 100 x 6), according to the protocol that is recalled in the following, the elements that make up the main, vertical mini tubular duct are formed. On the shorter edges of the sheets by means of the welding of a flat section (e.g. 100 x 5) the elements that make up the horizontal, mini tubular ducts, which are generally secondary, are formed. The element of the horizontal, mini tubular duct intersects the corresponding main vertical one, and merges into it, bringing continuity to the grid monitoring system. The flat sections, relative to the creation of the flat bottom of the tubular structure of the mini monitoring duct, are positioned on the rear face of the two elements of contiguous plating and welded along their edges. In order to create the space relative to the hollow of what will become the rectangular surface of out flow of the mini tubular duct, the two contiguous plating elements are positioned sufficiently separated, one from the other (e.g. 60 mm). In correspondence with the indentations the flat sections (e.g. 100 x 6) are overlapped to form, with the covering of the indentations, the tubular element of mini tubular duct of the system for autonomous storage, sealed from any possible leakage (drops) of liquid (fuel) caused by an executive flaw in a welding seam and monitoring of the hydraulic sealing of the tank, as well as total recovery of the liquid (drops of fuel).

[0005] With said innovation, to the complete advantage of the executive simplification of the set of the metallic structure compared to the previous patents no. GE 2007A000128 and no. GE2009A000019, relative to the main monitoring piping (vertical), envisaged with an omega shaped outflow cross-section, a simplified structure has been designed with only a rectangular cross-section, which permits minor dispersion also suitable for performing the function of keeping sealed, with minor dispersion, any possible leakage of liquid (fuel) coming from a weakness in a welding seam, and until its definitive annulment. This innovation brings considerable advantages:

1) in terms of costs and manufacturing times, the difficulty of retrieval of the omega shaped section is avoided which, being non standard, has to be made specifically by cold-rolling; the difficulty connected with the calendering of the omega shaped sections is avoided, which results maximum where the curvature radiuses are necessarily minimal.
2) in economic terms the gap between the two structures, metallic and masonry, is halved and therefore also the layer of oxidised bitumen is thinner.
3) furthermore a greater storage capacity is obtained for the tank equal to the lower volume occupied by the structural gap between the two (metallic and masonry) structures.
4) the unification of the outflow surface of the mini tubular ducts and the subsequent lower width is more suitable to collect and channel any possible leakage of liquid (fuel) which in practice is found at the level of a drop, decreasing instead the possible dispersion due to the excessive width of the previous omega shaped piping. What is more, it makes the mini tubular ducts more suitable to perform the new function of containment of the presence of liquid (fuel) which is autonomously sealed inside them until definitive annulment.

[0006] The tubular configuration of the welded joints, which make up the mini monitoring ducts, characterise the metallic storage structure created following this invention. Indeed, to the entire benefit of the hydraulic tightness of the tank being built, the metallic structure is fitted, innovatively, with a double element for the containment of fuel made up of double welded joints formed with two flat sections making up both the bottom of the hollows, which form the rectangular cross-section of outflow, and the cover of the same thereby creating the mini tubular duct. This substantial innovation imparts to the tank, created following this invention, compared to traditional tanks, a much higher safety level in terms of the hydraulic tightness, a condition that is found only in tanks with a double storage structure or with double plating.

[0007] The elements of the metallic storage structure that are of large dimensions have been designed to be positioned in adherence to the intrados of the masonry or static structure (tank-tunnel) or in the case of external tanks (sunken or above ground) positioned in adherence to the masonry structure that surrounds them. The metallic storage structure is fixed to the masonry or static structure in concrete (simple or reinforced) by means of a series of structural fixing elements made up of U-shaped clamp spacers, of flat section welded to another flat section which in turn is fixed by means of suitable anchoring elements (by expansion or cast) driven grouted in the masonry of the static structure. The gap resulting between the metallic and masonry structures, which, compared to that of previous inventions, therefore results halved. Said structural gap is filled by means of the gradual pouring of oxidised bitumen turned liquid at a maximum temperature of 210°C, or with material of another kind. The optimal condition in the building of large tanks and in particular tank-tunnels is reached with the combined effect of interaction between these four elements: the metallic storage structure, the filler material (oxidised bitumen) placed between them, the masonry or static structure and the surrounding rocky mass.

[0008] For this purpose, to achieve the maximum adherence between the plating elements (ferrules) and the filler material, prevailingly oxidised bitumen, on their rear facing lengths of steel sections of various shapes, generally rounded or angular, are arranged welded to the elements themselves.

[0009] The horizontal, mini tubular duct (main), which is positioned on the short side of the plating element, following occlusion of the outflow surface performed at the point of connection with the vertical duct (for instance on the right) joins the vertical duct at the point in which the two mini tubular ducts intersect. Consequently, the grid made up by the mini tubular monitoring ducts is subdivided into as many transversal sectors as there are plating elements, which with their short edges, cover the length of the tank, if it is horizontal (tank-tunnel) or the perimeter if it is circular. However, as already said, the horizontal, tubular monitoring ducts converge in the vertical tubular duct, which is then connected to the mini monitoring pipe that protrudes outside below the tank. Therefore, one repeats, leakage (drops) of liquid (fuel) caused by any possible executive flaw in a welding seam flows by gravity into the mini vertical tubular duct to which it is connected. In proximity of the bottom of the tank the mini tubular duct, which also performs the function of collector duct for any possible leakage (drops) of liquid (fuel) channelled by the mini-ducts pertaining to it, a mini pipe is inserted that protrudes outside the tank and below it.

[0010] The terminal of the mini pipe is fitted with a mini, transparent, hermetic recipient into which the leaking liquid (drops) can flow and in which it remains safely stored. In such case the mini tubular monitoring duct concerned in the aforesaid inconvenience is signalled and localised with absolute precision.

[0011] This device permits monitoring with certainty of the hydraulic tightness of the tank and guarantees that any possible liquid leaking from the mini monitoring pipe is stored in the appropriate hermetic recipient and therefore that it is not dispelled into the underlying ground. According to this invention, the monitoring system described above is, instead, radically modified as described hereinafter.

[0012] The terminal of the mini pipe is fitted with an electro-valve (solenoid) for hermetic closure to which the mini pipe is connected with a transparent length of pipe, of the same diameter, through which it is possible to visually monitor any possible dripping of liquid (fuel); in turn, the transparent element is connected to the terminal of the mini pipe flowing into an appropriate watertight container in which a specific sensor is inserted in order to signal, to the synoptic monitoring panel in the manoeuvring room of the depot even a minimal presence of liquid (fuel) even in a vaporous state, inside the well localised mini tubular duct in order to autonomously command the hermetic closing of the electro-valve (solenoid) that the mini pipe is fitted with. In this way the presence, even minimal, of liquid (fuel) remains securely sealed hermetically inside the mini tubular duct concerned, leakage from the tank being prevented absolutely.

[0013] Ultimately, the possible leakage (drops) of liquid (fuel) is doubly prevented from leaking from the tank, because, regardless of self-closing solenoid valve, the liquid is, however, stored tightly closed in the appropriate watertight recipient inside which the sensor that signals and locates the mini tubular monitoring duct concerned is installed. In practice, with this invention, a tank is made with a storage structure of "pseudo-intelligent" type operating completely autonomously blocking with certainty any leakage of liquid to the outside, thereby allowing avoidance with absolute certainty any and all risks of environmental pollution.

[0014] Besides the advantages mentioned above, the system subject of this invention allows, finally, the construction of large tanks in the open air, underground, above ground and covered with topsoil and so hidden, or rather tank-tunnels characterised by the total degree of concealment that provides the best guarantee of security from terrorist attacks or from wartime offensives.

[0015] The subject of this invention is a tank, both underground and in the open, for the storage of hydrocarbons and liquids in general having the features of the attached claim 1.

[0016] This invention will be illustrated in the following with reference to a form of example construction illustrated in the attached figures in which:

- in figure 1 a transversal cross-section of an example tank-tunnel with a horizontal axis is illustrated schematically.
- in figure 2 a cross-section of a zone of jointing between two ferrules is illustrated;
- in figure 3 a partial cross-section of the zone of the tank is illustrated in which the opening is applied for inputting of the filler material;
- in figure 4 a further cross-section of the zone of figure 3 is illustrated,
- in figure 5 a cross-section of a cylindrical, vertical axis, tank-tunnel is schematically illustrated along with the monitoring system for the localisation of any

possible leakage of liquid (fuel) subject of this invention.

[0017] With reference to the aforementioned figures, the tank according to this invention includes a metallic structure 2 connected to the masonry or static structure for instance, in simple or reinforced concrete 3 placed in contact, in the case of a tank-tunnel, with the surrounding ground. The metallic structure is supported inside a masonry or static structure by means of fixing structures with clamps or U-bolts 4 welded to the fixing plates inserted in the thickness of the masonry 3 or static structure by way of anchorages in steel reinforcing rods.

[0018] Between the metallic structure and the static facing 3 the interposing of a layer filler material 5 is envisaged, generally oxidised bitumen which is for instance poured gradually while hot, at a maximum temperature of 210°C and following the protocol illustrated in the following, through points of entry, made with, for example, threaded nipples 11 fitted with the relative threaded lid arranged opportunely in the body of the vertical, mini tubular monitoring ducts incorporated in the metallic storage structure. Said filler material must be suitable to form a structural element which when subjected to the stresses that the metallic storage structure is subjected to by the operating conditions, interacts with the masonry or static structure 3 and vice versa. To this end, the use of oxidised bitumen has been seen to be optimal, by means of which the passive protection of the metallic structure from electro-chemical corrosion is also achieved. This invention is correlated to the prescription that the bitumen used is exclusively of the oxidise type, which is turned liquid at the temperature strictly not higher than 210°C in that, within this limit, in the cooling phase the oxidised bitumen preserves a sufficient degree of cohesion so as not to provoke permanent deformations in the plating elements making up the metallic storage structure for fuel. The oxidised bitumen, having reached the maximum temperature of 210°C, must be poured gradually into the gap between the metallic and masonry structures through the special pouring points, taking scrupulous care that the layer does not exceed a height of 20 cm. interrupting the pouring operation without fail every time the temperature measured on the plating in correspondence with the level reached by the bitumen is higher than 80°C. This irrespective of the temperature measured at the pouring point which, evidently, will be much higher. In this way, the possible formation of permanent deformations in the plating element of the metallic structure is avoided, deformations which, instead, would be provoked should the limit of 80°C measured on the plating at the level reached by the oxidised bitumen be exceeded. As already mentioned, with adoption of this filler material, it is possible to guarantee the stability of the tank set with the metallic structure and static facing, which are calculated with inferior resistant cross-sections compared to tanks which do not have such a layer of filler.

[0019] Naturally what has been expressed with reference to the longitudinal body of the tank is also valid for the heads of the same tank both with a flat and rounded finish. Such a solution, described with regard to horizontal-axis, tank-tunnels is also valid for tanks of any other shape and arrangement (vertical, sub-vertical, spherical tanks etc.).

[0020] The mini tubular ducts, which circumscribe each plating element making up the metallic storage structure, and which intersect with one another, form the base of the grid system through which any possible leakage of liquid (fuel), stemming from an executive flaw of the welding seam of the welded joints, is kept sealed in the mini tubular duct concerned and monitoring of it and the hydraulic tightness of the tank is activated. Each row of metallic elements positioned vertically, for purposes of the monitoring system, corresponds to one of the circumscribed and easily identifiable sectors of the metallic storage structure. This by effect of the occlusion made on one of the two terminals of the horizontal mini tubular duct, relative to the short sides of the plating elements, the reason for which each horizontal mini tubular duct relative to that sector converges into the vertical mini tubular or main duct connected to the relative mini pipe protruding from below the tank.

[0021] The terminal of this mini pipe, fitted with an electro-valve (solenoid) for closing 15, is connected, downstream, to a transparent tubular element 14, through which it is easy to visually monitor any possible leakage of liquid (fuel) at the drop level which, in turn, is connected to another stretch of pipe that flows into a suitable watertight container inside which a sensor 12 is placed which, besides signalling the presence of liquid (fuel), even in the state of vapours, to the appropriate monitoring panel in the manoeuvring room of the depot, autonomously commands the closing of the electro-valve (solenoid) as above. Any possible presence of liquid is, therefore, autonomously held closed inside the mini tubular duct concerned and cannot materially leak from the tank.

[0022] Localisation of any possible flaw in a welding seam of the welded joints, once the tank has been emptied, is obtained putting the mini tubular duct concerned by the leakage of liquid, already previously signalled by the monitoring system, under pressure, with the inert gas contained in the cylinder that the tank is fitted with e.g. Helium, and noticing inside the same the position from which the pressurised inert gas leaks and then activating restoration of the continuity of the compromised welding seam.

[0023] The oxidised bitumen which is poured hot into the gap between the metallic structure 2 and the masonry or static structure 3, as mentioned above, following the specific protocol illustrated previously to avoid the formation of strains even precisely on the metallic structure, may provoke deformations that are permanent.

[0024] In order to avoid these issues, pre-established points are envisaged for the pouring of the heated oxidised bitumen fitted with suitable threaded nipples 11 positioned on the vertical mini tubular duct and sticking out from the relative flat section of cover. The nipples are fitted with a male threaded lid laid out in the closest position possible (see figure 4) to the support spacer fixed to the masonry structure 4. On the nipple is inserted the connection which allows the terminal of the hose through which the hot bitumen is poured to be engaged.

[0025] Upon completion of the pouring, the connection 11 is removed and the hole 10 is sealed with a specific disc of plating, of diameter corresponding to the hole made for insertion of the nipple.

Claims

1. Underground tank (tank-tunnel) or in the open (sunken or above ground) for the storage of hydrocarbons and liquids of any nature comprising a metallic structure (2) inside a static facing (3) suitable to separate the metallic structure from the surrounding ground (tank-tunnel) and to circumscribe the open-air tank, where said metallic structure is blocked to the static facing by means of a specific fixing system (4),

between the metallic structure and the static facing at least one filler layer of oxidised bitumen or other similar material is envisaged (5), where said metallic structure comprises a plurality of metallic elements (6) in plating assembled with specific welded joints forming, around their perimeter, the mini tubular ducts of the system suitable for the auto containment even of a possible leak of liquid (fuel) caused by an executive flaw in the welding seam of the welded joints, and to the relative monitoring system of the tightness of the set,

the bottom of the mini tubular ducts is made up of flat steel sections on which the edges of the plates are placed away from each other to form the grooves of the section of flow, with a single rectangular cross-section of the mini ducts which, after covering with the second flat section (7, 8) become tubular,

the two sections of the bottom and cover of the mini tubular ducts, formed with the special welded joints, make up a second element of storage of the liquid (fuel) of the tank which therefore turns out to be equivalent to a double storage shell,

the metallic elements, joined to one another by particular welded joints which make up the mini tubular ducts for monitoring are formed with a plurality of flat sections (7) onto which the edges of the metallic elements (6) are welded, separated from but joined to one another and also having the function of stiffening the metallic structure as a whole, these elements are assembled by means of the specific welded joints forming, around their perimeter, the mini ducts of the monitoring system, on the bottoms of which the edges of the plating elements are placed separated from one another (6) to form the grooves of the flow section, with a rectangular cross-section, and therefore covered with the flat section (8), which besides making the duct tubular makes up the second element for storage of the liquid (fuel) stored in the tank, the mini tubular ducts, perimeter transversal and longitudinal to each element of plating, making up the metallic storage element, accomplish both the function of autonomously keeping closed on their inside any possible leakage of liquid (drops of fuel) coming from an executive flaw in a welding seam of the welded joints and monitoring of this and of the hydraulic sealing of the tank set,

characterised by the fact that the mini, longitudinal, tubular ducts merge into the verticals or transversals that terminate on the bottom of the tank connected to a mini pipe, which comes out below the tank itself, on the terminal of which an electro-valve with hermetic seal (15) is inserted, connected to a stretch of transparent pipe (14), by which one activates the preliminary visual monitoring of any possible presence of liquid (fuel) at the level of drops, in turn the transparent stretch is connected to another stretch of mini pipe that flows into a suitable sealed recipient inside of which a sensor is placed (12) capable of signalling, to the monitoring display, the presence of liquid even in the state of vapours, coming from an executive flaw in a welding seam of the welded joints (13), where said sensor, in case of the presence of liquid (drops) in the mini piping, and therefore in the relative tubular duct, autonomously commands the closing of the electro-valve so that any possible liquid (drops of fuel) remain certainly and autonomously closed inside the mini tubular duct concerned and, thus, and possible leakage of fuel to the outside of the tank is prevented.

2. Underground tank (tank-tunnel) or in the open (sunken or above ground) according to claim 1, where, in the case in which the presence of liquid (fuel) is ascertained coming from any possible executive flaw in the welding seam of the welded joints, the functionality of the of the tank concerned is never interrupted in that the elimination of the inconvenience is postponed, with no negative consequence whatsoever, to the moment when it is possible to empty the tank in relation to the running needs of the fuel depot.

3. Underground tank (tank-tunnel) or in the open (sunken or above ground) according to claim 1, wherein the localisation and identification of any possible executive flaw in a welding seam of the welded joints is obtained by putting the mini tubular duct concerned under pressure by connecting the relative mini pipe to a tank of inert gas (H), that the tank is fitted with, and after having emptied it, one unequivocally localises inside it the point of leakage of the pressurised gas relative to the executive flaw in the welding so as to carry out its definitive elimination.

4. Underground tank (tank-tunnel) or in the open (sunken or above ground) according to claim 1, in which the metallic storage structure is **characterised by** a double element for the hydraulic tightness of the tank itself, a condition extended to all the welded joints of the metallic storage structure making up in practice the second storage element of the liquid (fuel) stored in the tank, which therefore turns out to be similar to a tank with double plating for liquid (fuel) storage.

5. Underground tank (tank-tunnel) or in the open (sunken or above ground) according to claim 1, in which the metallic storage structure is naturally protected from the electro-chemical corrosion of the ground due to the effect of the filler layer placed between the static structure and the metallic storage structure.

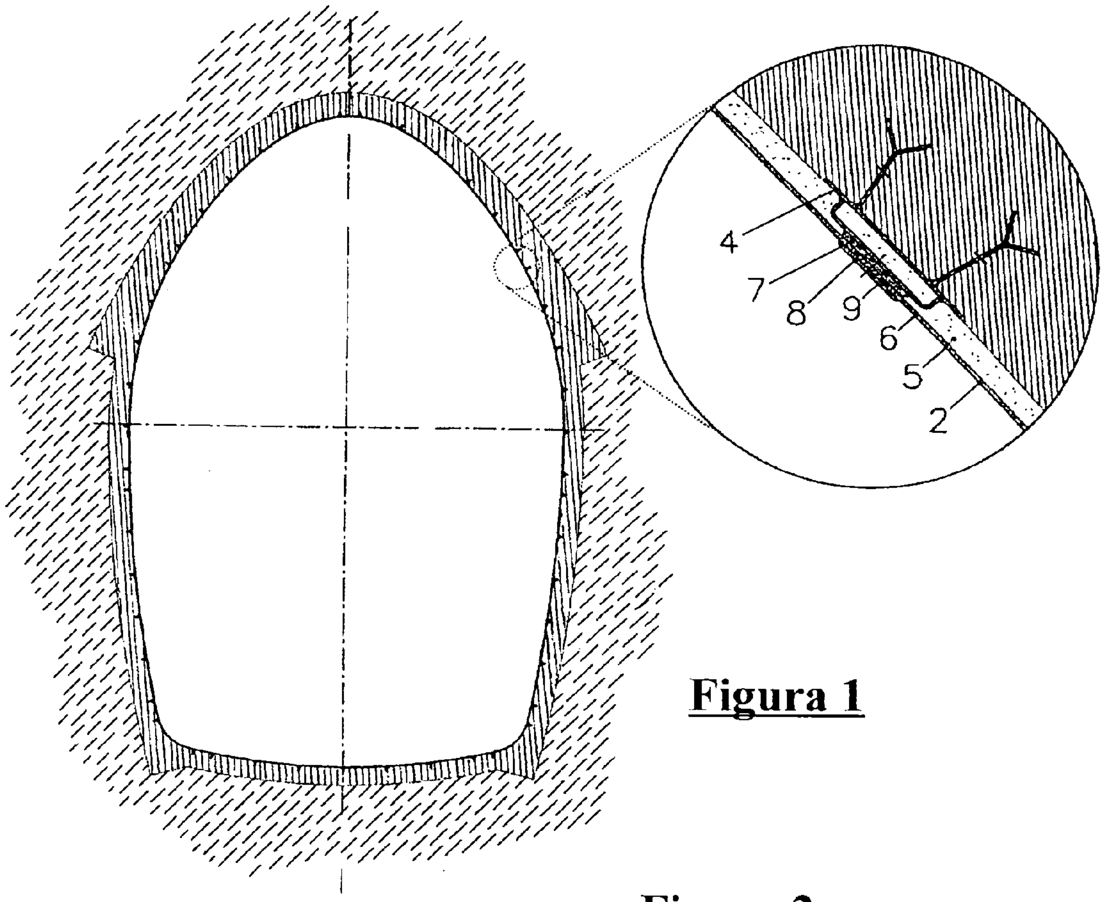
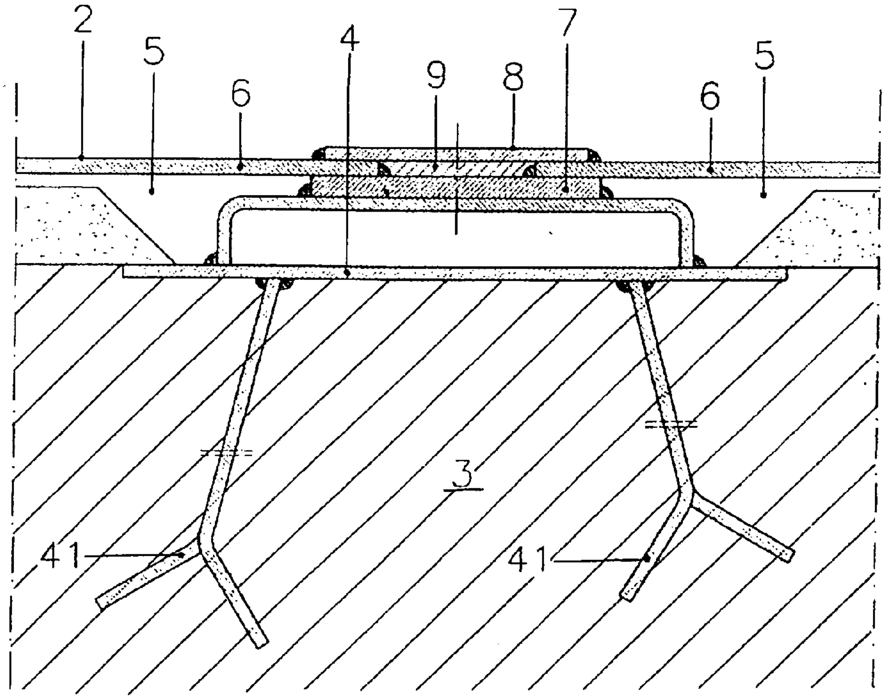


Figura 1

Figura 2



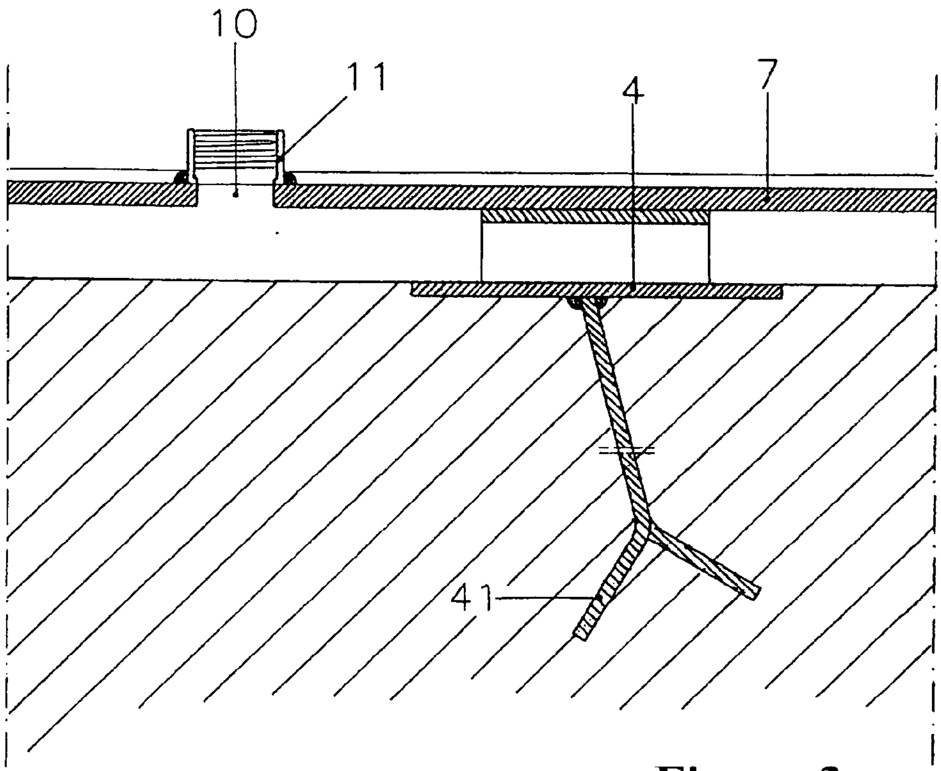


Figura 3

Figura 4

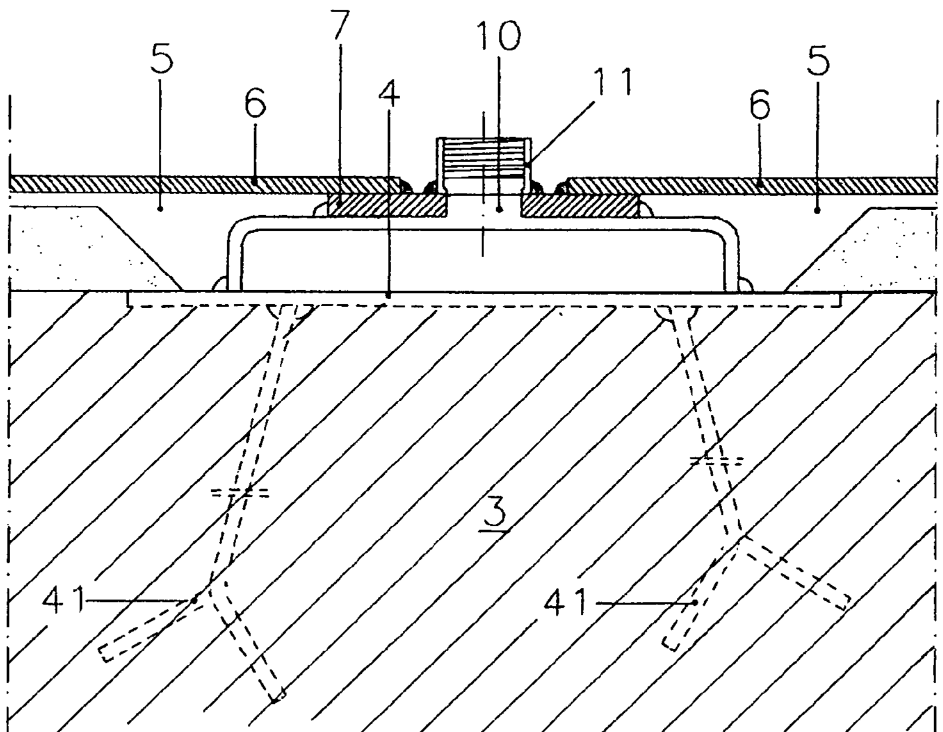
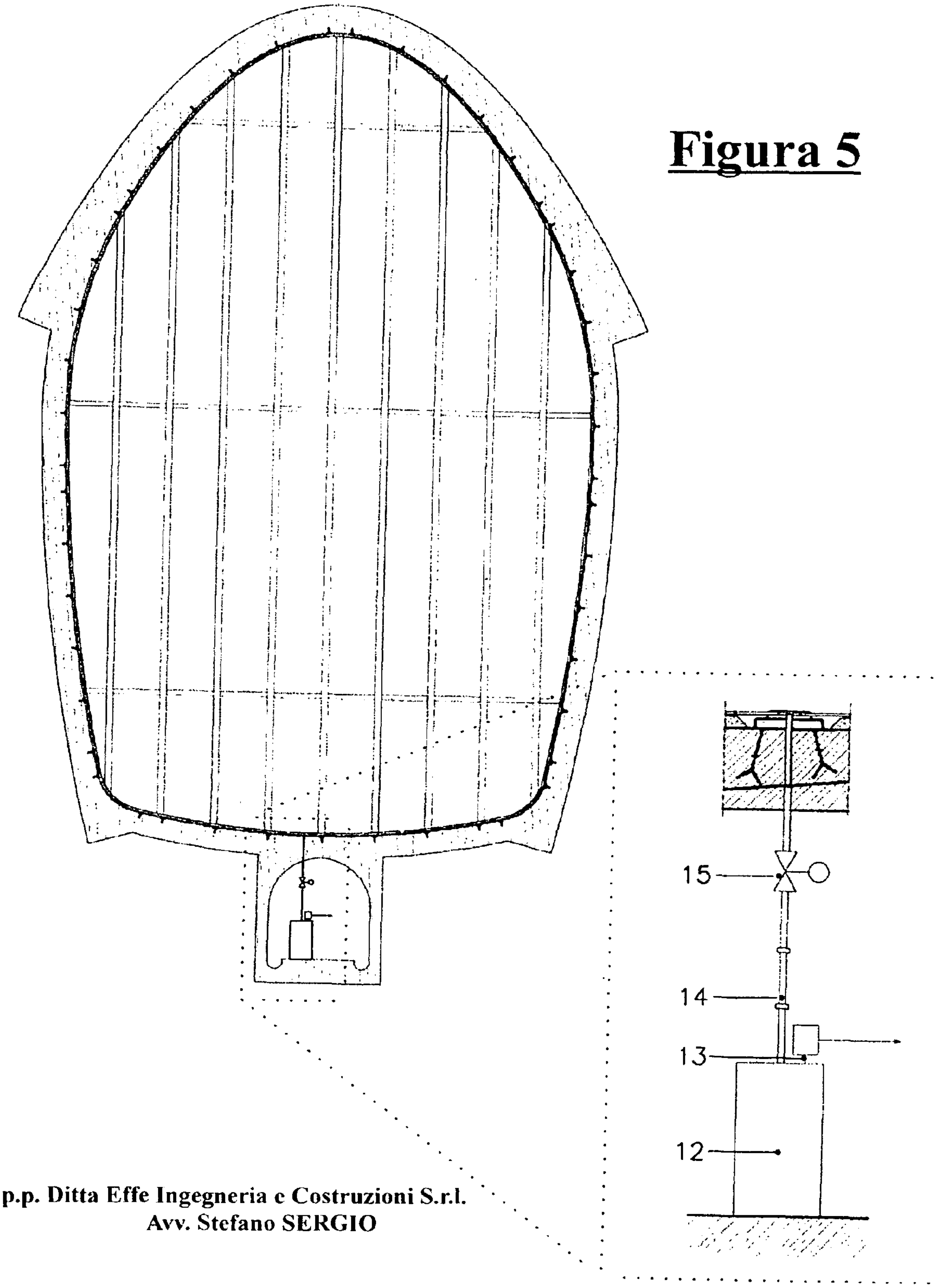


Figura 5



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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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CATEGORY OF CITED DOCUMENTS

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