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(19)

(54) A METHOD OF STORING PRESSURIED FLUID UNDERGROUND AND A RESERVOIR FOR EFFECTING THIS METHOD

(71) We, COMMMISSARIAT A L'ENERGIE ATOMIQUE, an organisation created in France by ordinance No. 45-2563 of 18th October 1945, of 29 rue de la Federation, 75752 Paris Cedex 15, France, and SOCIETE NATIONALE ELF AQUITAINE, a French Body Corporate, of Tour Aquitaine, Cedex 4, 92080 Paris La Defense, France, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

It is known to make underground tanks in which pressurized fluids can be left in transit or be stored until they are recovered later on. The idea of an underground storage of heat through pressurized hot water was expounded, in particular, during the 8th World Conference on Energy (Bucarest, 28th June 1971).

Other modes of storage, e.g. compressed air, gas or radioactive waste, have already been contemplated or put into practice.

In the present state of the art, it is most often resorted to that the hydrostatic pressure of the water contained in the ground counterbalance the pressure within the cavity, in order that a lack of tightness, always to be feared in view of stresses already existing or generated on coatings, cannot give rise to important leakages. Therefore, in the case of high pressures, the depth required soon becomes unrealistic.

By way of example, in the case of water to be stored at 300°C (570°F), pressure being then of about 90 bars, the crown of the cavity would have to be at a depth of about 1000 meters (3300ft).

Moreover, in the prior art, the fluid is usually in contact with the cavity walls as in French Patent 2,231,277 viz. with the rock or a protective concrete, which induces chemical and thermal phenomena likely to alter both the cavity behaviour and the fluid composition. In order to obviate such drawbacks, it has already been suggested to store a liquid, namely superheated water, in a metal tank open in the upper portion thereof and built within the cavity under air, or gas pressure. This solution has the double drawback of requiring a large investment of money for building a whole tank underground and high operation expenses in view of the necessity to maintain the cavity atmosphere under constant pressure, in spite of the volume variations of the stored material due to the temperature changes thereof (variations amounting to about 20% in the case of water raised from 20°C to 200°C).

In other instances, lithostatic pressure is resorted to for balancing internal pressure in various storage tanks, pressure-sustaining ducts or nuclear reactors (refer, in particular, to "Mécanique des roches et ses applicaitons" published by Dunod, Paris 1967, pages 377 to 389).

In French Patent 2,286,260, it is suggested to store hot water in underground tanks situated at a depth that is sufficient to enable the weight of the rocks above the tank to generate a lithostatic pressure adapted to counter-balance the pressure of the water to be stored. In said patent, it is suggested, for achieving tightness, to use etiher a plastic material foil or a metal tank constituted by rings of U-shaped cross-section.

In either case, the solution advocated leads, in practice, to severe troubles, especially if the storage of hot fluids under high pressure is contemplated. Indeed, a plain foil of plastic material, in general, is not sufficiently resistent for sustaining the high pressure involved (e.g. of about 100 bars and upwards) without being torn, when hot; as for the metal tank, since it is made of rings and merely rests on the cavity floor, it is allowed but a longitudinal expansion (in only one direction), which therefore preludes the possibility, for said tank, to adhere by all its point to the cavity wall under the pressure of the contents thereof and, later on, to follow the various "breathing" movements of said wall due, in particular, to thermal stresses generated in the sub-soil formations.

One object of the present invention is a method for storing a fluid under a maximum superatmospheric pressure p underground, said method obviating the above drawbacks, while in addition providing a few extra advantages.

Said storage method essentially comprises the steps of digging, at a depth at which the lithostatic pressure resulting from the weight of the soil formations is at least p, an underground cavity in which is made a deformable tight casing, fixed to the cavity wall by a few points only while being free to expand or retract in every direction between said points in order to follow closely corresponding movements of the cavity wall, then injecting the pressurized fluid into said casing in order that the latter lie flat by all the points thereof against the wall of the cavity, all the possible movements of which it follows subsequently by sliding, the pressure of said fluid being thus counterbalanced, at every moment, by the lithostatic pressure of the cavity wall transferred to the fluid through the thus-expanded casing.

The use of a very special tight diaphragm endowed, as a matter of fact, with two degrees of expansibility, namely the possibility of sliding along the rock-wall between its points of attachment to that wall and the possibility of "breathing" at right angles to said wall, in particular, by following the movements of the latter resulting from thermal expansions or contractions, permits one to obtain the storage of pressurized fluid together with a uniform distribution of the pressure at every moment and over the whole area of the cavity.

In case of need, moreover, a smoothing coat can be inserted between the deformable casing and the cavity wall.

The present invention also relates to a tank for carrying out the above method, characterized in that it comprises, in an underground cavity dug at a depth at which the lithostatic pressure resulting from the weight of the soil formations is at least p, a deformable tight casing, fixed to the cavity-wall by a few points only while being free to expand or retract in every direction between said points in order to follow closely corresponding movements of the cavity wall, said casing being adapted to receive the pressurized fluid in order that said casing lie flat by all the points thereof against the wall of the cavity, all the possible movements of which it follows subsequently by sliding, the pressure of said fluid being thus counterbalanded, at every moment, by the lithostatic pressure of the cavity wall transferred to the fluid through the thus-expanded casing.

The tank forming the object of the present invention advantageously turns to profit the fact that the pressure within the cavity is distributed over the surrounding sub-soil formations against which the deformable tight wall is applied. Accordingly, the internal pressure in said cavity no longer needs to be counterbalanded by the surrounding hydrostatic pressure as in the prior art. It is only sufficient that the lithostatic pressure, namely the pressure exerted by the sub-soil formations themselves, counterbalances said internal pressure. The minimum safety depth is thus divided by a coefficient that is at least equal to the mean specific weight of the above-jacent formations, viz. by about 2.

In the above mentioned example, relating to water at the temperature of 300°C (570°F) under a pressure of 90 bars, the crown of the cavity would have to be at a depth of about 500 meters (1650 ft) instead of 1000 meters as in the prior art, and, in addition, the digging operation that required a lot of technical skill in the prior art and was moreover quite expensive although uncertain as to the results obtained, becomes, according to the present invention, a conventional application of the mining technique, provided geological conditions be normal. Moreover in the case of smaller pressures the digging of the cavity that would have required underground operations in the prior art, can now be carried out from the ground level, according to the so-called "covered trenches" method or to any other appropriate method.

Preferably, the tight deformable casing comprises a set of metal plates that are arc-welded or welded according to any suitable method capable of providing a very good tightness. Said metal plates are provided with a suitable number of appropriately shaped ribs ensuring a free play of the plates between the anchoring points.

Said metal plates are constituted by steel sheets, the thickness of which is determined by the internal pressure and the radius of curvature of the corrugations forming said ribs, which permits said plates to withstand the pressure at the ribs. Stresses on the flat portions applied against the subjacent material have not to be taken into account for determining the thickness, since the internal pressure is balanced by the reaction of the sub-jacent material. Another advantageous feature of the present invention is to be noted, resulting from the fact that it is possible to make use of relatively thin metal sheets, since the reduction of thicknesses is limited only by the fact that the corrugations, of necessity, must have feasible radiuses of curvature, providing a sufficient play of the coating, and that account must be taken of welding requirements as well as of resistance to corrosion and abrasion.

Other features of the invention will appear from the following description, given merely by way of example, of the tank according to the invention with respect to the accompanying drawings, in which:

—figs 1*a*, 1*b* and 1*c* show three possible embodiments, respectively, corresponding to various uses;

—fig. 2 is a general view of a deformable tight casing formed of welded ribbed metal plates;

—fig. 3*a* is a detail view of a typical portion of said metal plates, and figs. 3*b* and 3*c* represent the main fittings;

—figs. 4 to 6 are various cross-sections of the coatings, showing how the tight deformable casing is anchored; and

— figs. 7*a* to 7*c* are detail views relating to advantageous fittings forming part of the coating according to fig. 6.

As shown in fig. 1*a* the tank for pressurized fluids according to the invention comprises a cavity 1 dug underground via mineshaft 2 and galleries 3. Fig. 1*a* shows the shape of cavity 1 and an arrangement of galleries 3 corresponding to the storage of a pressurized hot liquid according to the so called " balancing " conventional method, i.e. as follows:

The cavity being filled up to the top with hot liquid surmounting the cold liquid, of higher specific weight, filling the cavity-bottom, the whole unit operates through transfer of the cold liquid from the cavity lower portion towards transfer-and-heating means M, and transfer of the water heated by said means M towards the upper portion of cavity 1, in the storage step, on the one hand, and reverse flow through ducts 4 with absorption of heat by said means M, in the exhaust step.

Cavity 1, if necessary, is provided with a suitable coat 5; a tight deformable casing 6 spread over the cavity wall contains a liquid 7. The connection means M with a surface network providing the transfer of a coolant fluid from a source S to a station of use, is obtained through ducts 8. Fig. 1*b* shows a variant corresponding to lower pressures, the caving being dug directly from the ground-level according to the so-called " covered trench " method. Cavity 1 is closed, at the upper portion thereof, by a veil of concrete or a metal structure 9, capable of withstanding the weight of filling earth 10 and leaning against moulded walls 11. Tight deformable casing 6 is applied against said moulded walls 11 and veil 9 and also against the bottom of the excavation, either directly or through a suitable coat 5.

The above described means M of fig. 1*a* are mounted in a hole 12 defined by a moulded wall 13.

Fig. 1*c* shows a possible embodiment of tank for pressurized gas according to the invention. A cavity 1 has been dug via a shaft 2 and a gallery 3 and is no more than a horizontal gallery of larger cross-section.

Tight deformable casing 6 lines the wall of cavity 1, either directly or with a suitable intervening coat 5. Pressurized gas is fed into, and from, cavity 1 by means of a duct 14 connecting the tank to filling and exhaust means M′ via shaft 2.

While figs. 1*a* to 1*c* comprise but a single cavity, quite obviously a tank according to the invention can comprise a plurality of cavities of various shapes and arranged in a number of possible ways; in fact, the main feature of the tank according to the invention lies in the presence of tight deformable casing 6, whatever the use, shape and size of the thus defined space may be.

In fig. 2 is shown a possible embodiment o fa tight deformable casing, constituted by a plurality of metal sheets, arc-welded or welded according to any suitable method, comprising an appropriate number of ribs of suitable shape adapted to provide the free-play of said plurality of plates between their anchoring points. Preferably, said plurality of metal plates is constituted by an assembly of embossed metal sheets provided with ribs that comprise one or several corrugations, said sheets being of two different types, viz. anchoring sheets 15 and connecting sheets 16, the latter being joined by means of welds 17, either butt-welds or lap-welds, or by a metal strip (not shown).

Connecting sheets 16 are but plain flat sheets in which a median rib 18 has been embossed. Said connecting sheets are supported only by adjacent anchoring sheets and have no anchoring point whatever in the sub-jacent material.

Anchoring sheets 15 are provided with ribs 19 and 20 at right angles that meet at the sheet center through a distributing rib 21 surrounding anchorage device 22.

The tight deformable casing according to the latter embodiment has a number of advantages:

—The metal sheets can be formed merely by an embossing operation, contrary to those sheets for liquid-gas tanks, the latter sheets having to be treated according to more intricate methods, in view of the fact that they are subjected to temperatures at which the metal becomes brittle;

—Since but now types of metal-sheets are used, the present invention allows an easy prefabrication of said sheets;

—fig. 2 corresponds to the coating of a developable surface, but it is easy matter to adjust a seet to the accurate dimensions of the cavity and to cover non-developable surfaces. The anchoring sheets 15 are usually used in their entirely, but, in case of need, it is possible to tailor them, taking great care, however, not to cut distribution rib 21.

On the other hand, connecting sheets 16, being of simple structure with but a single rib, can be adjusted to the cavity dimensions. By cutting out portions of, e.g. triangular shape, in said connecting sheets, it is possible to warp the whole metal-coating of the cavity and apply same on surfaces of spherical or ogival shape or the like.

In fig. 3*a* are shown distribution-rib 21 and anchorage device 22 more in detail.

Distribution-rib 21 is in the shape of a polygon or a closed curved line, e.g. a circle as shown in the figure. It is substantially more portruding than adjoining perpendicular ribs 19 and 20.

At four places, in the vicinity of the intersections of distribution rib 21 with the bisectors of the angles defined by perpendicular ribs 19 and 20, said distribution rib 21 is provided with saddle-shaped carvings 23 adapted to lower the level of its ridge so as to give the latter substantially the same height as the tops of perpendicular ribs 19, 20.

Anchorage device 22 is constituted by a sleeve, or bushing, encircling anchorage hole 24.

For clearness sake, all the ribs of sheets 15 and 16 including distribution rib 21, have been shown in the figure as comprising but a single corrugation, or wave; however, it is quite abvious that larger movements can be obtained without increasing either the thickness (and, therefore, the weight) of the tight deformable casing, or the cost and stiffness thereof, by using sheets with ribs comprising several concentric ribs.

Figs. 3*b* and 3*c* show a possible embodiment of weldable fittings for rendering tight the deformable casing according to figs. 2 and 3*a*.

More precisely, fig. 3*b* shows a connecting member to be used for applying the tight deformable casing against the non developable surfaces, assuming ribs with only one corrugation (such as ribs 18, 19 and 20) are used. Quite obviously connecting members with several corrugations might be contemplated. This connecting member is used as follows: the cuttings of, e.g., triangular shape, made in connecting sheets 16 in the case of non developable surfaces obviously cause anchorage sheets 15 to draw nearer to each other. Whenever their spacing might become too narrow, it is advisable to exchange some of them (as a rule, every second one) for connecting sheets 16. The latter are usually welded as an extension of anchorage sheets, except at interrupted rib 20 where, for ensuring tightness, it is necessary to provide a connecting member, such as that of fig. 3*b*., welded astraddle both metal sheets.

Fig. 3*c* shows a cup shaped sealing cap 25 of thick metal sheet, the diameter of which is the same as that of anchoring sleeve, or bushing, 22 as shown in fig. 3*a*.

Once an anchoring sheet 15 has been fixed to the cavity wall (or to a suitable coat first applied to said wall), sealing cap 25 is welded to said sleeve of anchoring device 22. Fluid leakages through anchoring hole 24 are thus prevented.

It is to be noted that, in fig. 3*c*, an externally threaded pin 26, provided with a nut, is welded to sealing cap 25; in fact, a ring or any other suitable fastening device might be used instead of said threeded pin.

Such an optimal arrangement permits to use sealing caps 25 as fastening means for scaffolding or any devices used in the course of building the tank, or for maintenance operations or repairs.

As shown in fig. 4, tight deformable casing 6 (which can with advantage be of the type of figs. 2 and 3*a*) rests on a concrete lining 27 permitting to give a definitive shape to the cavity wall, applied before fixing tight deformable casing 6 by means of anchoring rods 28 passing through anchoring holes 24; anchoring nuts 29 are screwed on the externally threaded ends of said rods 28. Sealing cap 25 is subsequently welded to the sleeve of anchoring device 22.

Again in fig. 4 are shown anchoring bolts 30 provided with a distributing plate 31 and an anchoring device 32, the whole being arranged according to usual practice and constituting a paramount supporting means for such cavities as those used as tanks according to the invention.

It can be contemplated to insert a lubricant substance 33 (or any other product likely to lessen friction forces at the operating temperature involved) between tight metal casing 6 and the subjacent material.

Such an arrangement, which is to be found in figs. 5 and 6, makes it possible to restrict abrasion resulting from friction between the deformable casing and the subjacent material, and therefore proves to be favorable whatever the shape of said casing and of the subjacent material may be.

Fig. 5 shows another embodiment of the coat against which tight deformable casing 6 is applied. As in the case of fig. 4, anchoring bolts 30 are provided, with a distributing plate 31 and an anchoring device 32, said bolt still constituting a paramount supporting means. The cavity walls are rendered smoother by means of a concrete lining 27 as above. However, in the present instance, between tight deformable casing 6 and concrete lining 27, is sandwiched a thermally insulating material 34 of appropriate thickness, capable of withstanding the tank internal pressure transmitted through casing 6.

In fig. 5, such thermally insulating medium, by way of example, is constituted by a concrete layer of low thermal conductivity, in which can be provided expansion joints 35 since tightness is ensured by casing 6. Said thermally insulating medium 34 is fastened to concrete lining 27 by means of hooks 36, whereas the tight deformable casing is fixed, as shown in fig. 4, by means of anchoring rods 28 inserted into the thermally insulating material. Preferably, hooks 26 are not in alignment with anchoring bolts 30 and anchoring rods 30, nor in the immediate vicinity thereof, so as to avoid or restrict, thermal bridges. Such an arrangement permits to limit the thermal flow between the fluid in the tank and the surrounding sub-soil formations.

Fig. 6 shows a more elaborate embodiment of the coat against which deformable casing 6 is applied. Generally of a structure similar to that shown in fig. 5, the coat, between concrete lining 27 and thermally insulating material 34, additionally comprises a network of ducts 37 in which flows a coolant fluid. With a view to restricting the number of ducts 37, it is preferable to provide a metal grid, a lattice of expanded metal or any other suitable thermally conductive material 38, thermally connected to ducts 37 and hooks 36, e.g., by welding spots 39,40, respectively. Such grid, lattice or thermally conductive material constitute a substantially isothermal surface at the average temperature of the colant fluid flowing in ducts 37. The circulation and cooling down of said fluid are obtained through pumping means and exchangers, e.g. air coolants or means for exchanging heat with a heat sink (a river or the sea), such auxiliary means being outside the cavity and not shown.

The amount of heat thus dissipated varies only according to the temperature differential between coating 6 and the coolant fluid, to the thickness of thermally insulating medium 34 and to the thermal conductivity thereof. A coherent selection of the values of these parameters will make it possible to restrict the dissipation of heat to a reasonable value. In order to avoid troubles that might result from the thermal expansion of anchoring bolts 30, it is preferable to maintain said bolts at the same temperature as the coolant fluid. To this end is diagrammatically shown, in fig. 6, a connecting box 41 connected to ducts 37 around the head of an anchoring bolt 30. Thermal continuity between anchoring bolt 30 and connecting box 41 is preferably obtained through the contact of the latter with distributing box 31, of usual design, used for maintaining anchoring bolt 30 in traction by means of nut 42. Connecting box 41 is maintained in position by means of a counter-plate 43 contributing to ensure the requested thermal continuity, said counter-plate being attached to anchoring bolt 30 by means of an anchoring nut 44. The type of cavity coat as shown in fig. 6 is especially suited for high temperatures. Inserting a thermally insulating medium, although restricting the flow of heat, is not sufficient however for preventing the temperature of adjacent sub-soil formations from increasing gradually, which may give rise to troubles resulting from induced mechanical stresses.

While the calculation of such stresses is already intricate in the case of a well known medium, it can lead to a severe disappointment when applied to a natural medium, the parameters of which are, of necessity, not very well known. The rise of the soil temperature therefore leads to hazards which, in practice, it is impossible to assess as regards the tank stability. The arrangement of fig. 6 permits one to delete, or at least lessen, the soil temperature increase. Figs. 7*a* and 7*b* shown details of a possible embodiment of connecting box 41, in cross section and as seen from above, respectively. In fig. 7*a* are shown in dotted line an anchoring bolt 30, with its distributing plate 31 and its anchoring nut 42. Such a bolt is fixed as follows: after having drilled a bore of suitable length in the cavity wall, the bolt is provisionally fixed to the bore end.

A flexible tube is forced into the annular space defined between the anchoring bolt and the soil; distribution plate 31 is then inserted and anchoring nut 42 is only partially screwed so as to allow the flexible tube to penetrate freely. A yoke (not shown) provided with two jacks applied against the sub-soil formations is previously screwed instead of anchoring nut 44, then anchoring bolt 30 is put in tension by means of said jacks. Then concrete is injected through the flexible tube, the latter being gradually extracted from the bore.

Once a sufficient amount of concrete has been injected, the flexible tube is withdrawn and plate 31 is locked by means of nut 42.

When the concrete is set, the jacks are released and the yoke is unscrewed. It is then possible to mount box 41 and to lock the same by means of counter-plate 43 and anchoring nut 44. It is, then, only sufficient to make connections with ducts 37 by means of crooked fittings 45 (fig. *7a*).

Figs. *7a* and *7b* permit one to understand the principle of box 41. In these figures, said box 41 is assumed to be of circular shape and constituted by welded sheets; however, neither the shape of these boxes, nor the way they are manufactured, nor the material of which they are made, are specific features of the invention.

In the example reprsented in figs. *7a* and *7b*, the box is made of thin metal sheet and it is all the thinner as thermally insulating material 34 is thicker and stiffer. Box 41 is of annular shape and comprises several threaded ports in its upper surface. Figs. *7a* and *7b* represent a box with four ports, each of which is provided with a crooked fitting 45 (only one of which is shown in the figure).

Fig. *7c* shows, seen from above, a set of two half boxes (41*a*, 41*b*) adapted to ensure the cooling of anchorage bolt 30 via two distinct circuits, which, in some cases, can be advantageous as regards the general tank safety.

WHAT WE CLAIM IS:—

1. A method for storing fluid underground at maximum superatmospheric pressure p, comprising the steps of digging, at a depth at which the lithostatic pressure generated by the weight of the above-jacent soil formations is at least p, an underground cavity in which is made a tight deformable casing anchored to the cavity wall at some places only, while it can freely expand or contract in every direction between said anchoring places in order to follow closely corresponding movements of the cavity wall, then of injecting pressurized fluid into said casing in order that the latter be fully applied against the cavity wall, the possible movements of which said casing subsequently follows by sliding on the cavity wall, the pressure of said fluid being, at every moment, counterbalanced by the lithostatic pressure of the cavity walls transmitted to said fluid by the thus expanded casing.

2. A storing method according to claim 1, wherein a smoothing coat is inserted between said deformable casing and said cavity walls.

3. A tank for storing fluid underground at maximum superatmospheric pressure p, comprising, in an underground cavity dug at a depth at which the lithostatic pressure generated by the weight of the above jacent soil is at least p, a tight deformable casing anchored to the cavity wall at some places only while it can freely expand or contract in every direction between said anchoring places in order to follow closely corresponding movements of the cavity wall, said casing being adapted to receive pressurized fluid so as to be fully applied against the cavity wall, the possible movements of which said casing subsequently follows by sliding on the cavity wall, the pressure of said fluid being, at every moment, counterbalanced by the lithostatic pressure of the cavity wall transmitted to said fluid by the thus-expanded casing.

4. A tank for storing pressurized fluids according to claim 1, wherein said tight deformable casing is constituted by a plurality of welded metal plates, said plates being provided with an appropriate number of ribs of suitable shape allowing said plurality of plates to move freely between said anchoring places.

5. A tank for storing pressurized fluids according to claim 4, wherein said plurality of metal plates is constituted by an assembly of embossed plates of metal sheet provided with ribs comprising only one corrugation or several parallel corrugations said plates being of the following two types, viz.:

—anchoring sheets comprising two ribs at right angles meeting at the sheet center through a distributing rib having the following features: said distributing rib forms one or several corrugations substantially higher than said perpendicular ribs; it is provided, in the vicinity of the bisectors of the angles defined by said perpendicular ribs, with saddle shaped carvings that lower the height of the ridge of said distributing rib to the level of the tops of said perpendicular ribs; it surrounds a hole of said anchoring sheet permitting the anchoring thereof to the cavity wall, said hole being surrounded by a welded sleeve, or bushing, to which a sealing cap is fixed once said sheet has been fixed to the subjacent material;

—connecting sheets without anchoring points to the subjacent material, said sheets being provided with but one median rib, which permits one to cut said sheets, at will, in conformity with the dimensions and shape of the surface to be covered, said sheets being welded to one another or to said anchoring sheets, either by causing the ribs to be without solution of continuity, or by using a connecting part of suitable shape so as to maintain tightness wherever said ribs are interrupted.

6. A tank for storing pressurized fluids according to claim 5, wherein said sealing cap comprises a threaded rod, a ring or any other device capable of being used as

anchoring points for scaffoldings or various devices used when building said tank or for the maintenance thereof.

7.A tank for storing pressurized fluids according to any of claims 1 to 6, wherein, between said tight deformable casing and the subjacent material, is inserted a lubricant substance or any other substance likely to decrease friction at the operatng temperature involved.

8. A tank for storng pressurized fluids according to claim 2, wherein said smoothing coat contains a thermally insulating medium of appropriate thickness, capable of withstanding the fluid temperature and pressure.

9. A tank for storing pressurized fluids according to claim 8, wherein said thermally insulating medium is provided, on the face thereof opposite to said tight deformable casing, with a network of ducts in which flows a colant fluid maintained at suitable temperature by suitable auxiliary means.

10. A tank for storing pressurized fluids according to claim 9, wherein a metal grid, a lattice of expanded metal or any other casing of thermally conducting material is welded or thermally connected to said duct network.

11. A tank for storing pressurized fluids according to any of claims 9 or 10, wherein said network of ducts in which flows a coolant fluid comprises metal tubes and is provided with connecting boxes adapted to distribute the flow of coolant fluid and thermally connected with the heads of anchoring bolts supported said cavity so as to ensure the cooling thereof.

12. A tank for storing pressurized fluids according to claim 11, wherein, for each of said anchoring bolts, a counter plate locked by an achoring nut screwed on the free end of said anchoring bolt maintains said connecting box, or boxes, applied against the distributing plate applied against said wall by means of said anchoring bolt, or bolts, or of said anchoring devices.

13. Application of the tanks for storing pressurized fluids according to any of the above claims, to the underground storage of heat, compressed air, gas or radioactive waste.

14. A method for storing fluid underground substantially as described with reference to the accompanying drawings.

15. A tank for storing fluid underground substantially as described and as shown in the accompanying drawings.

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Fig. 1a   Fig. 1b

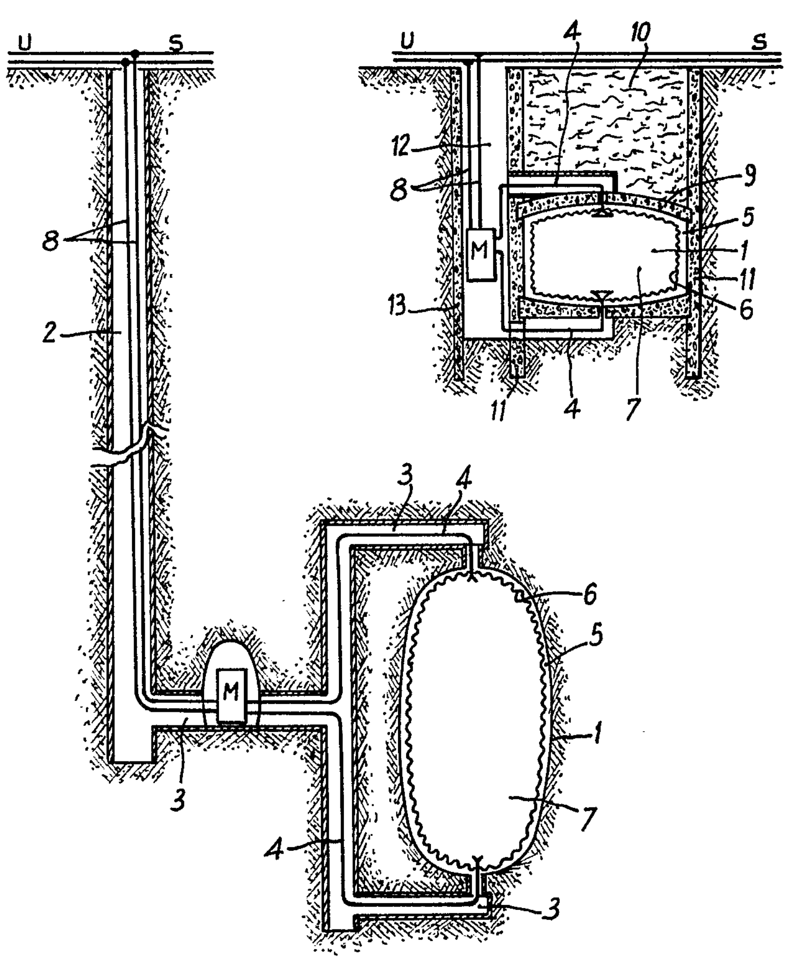


Fig: 1c

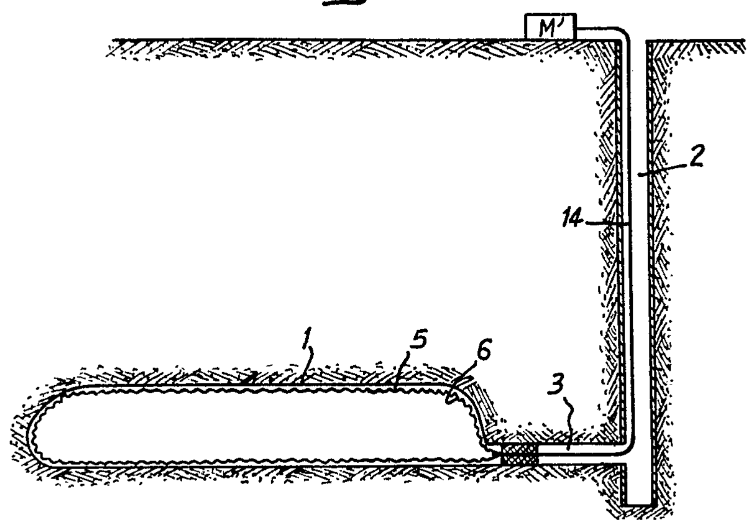
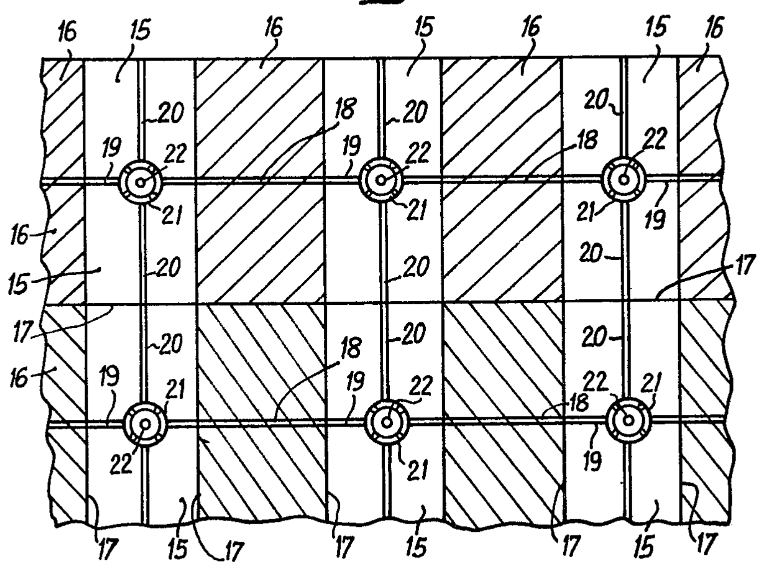


Fig: 2



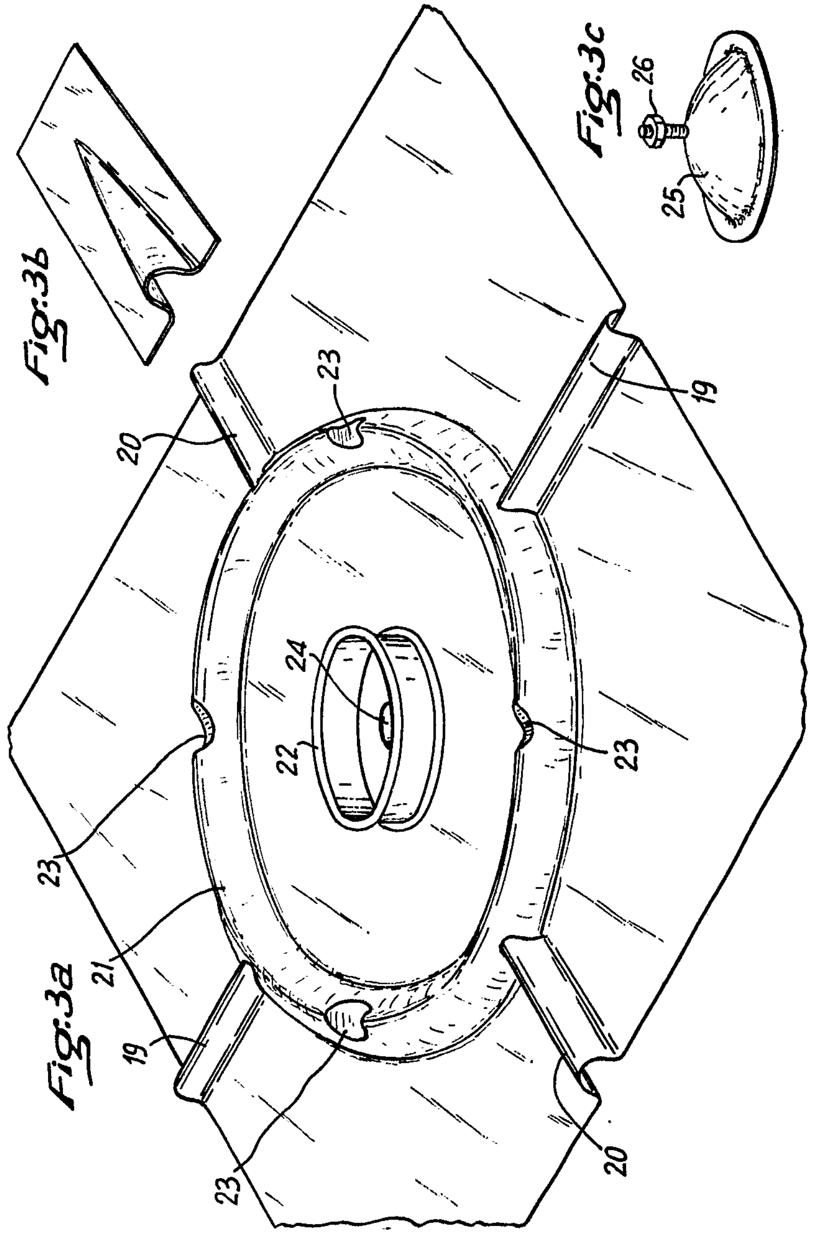


Fig.3a
Fig.3b
Fig.3c
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Fig:4

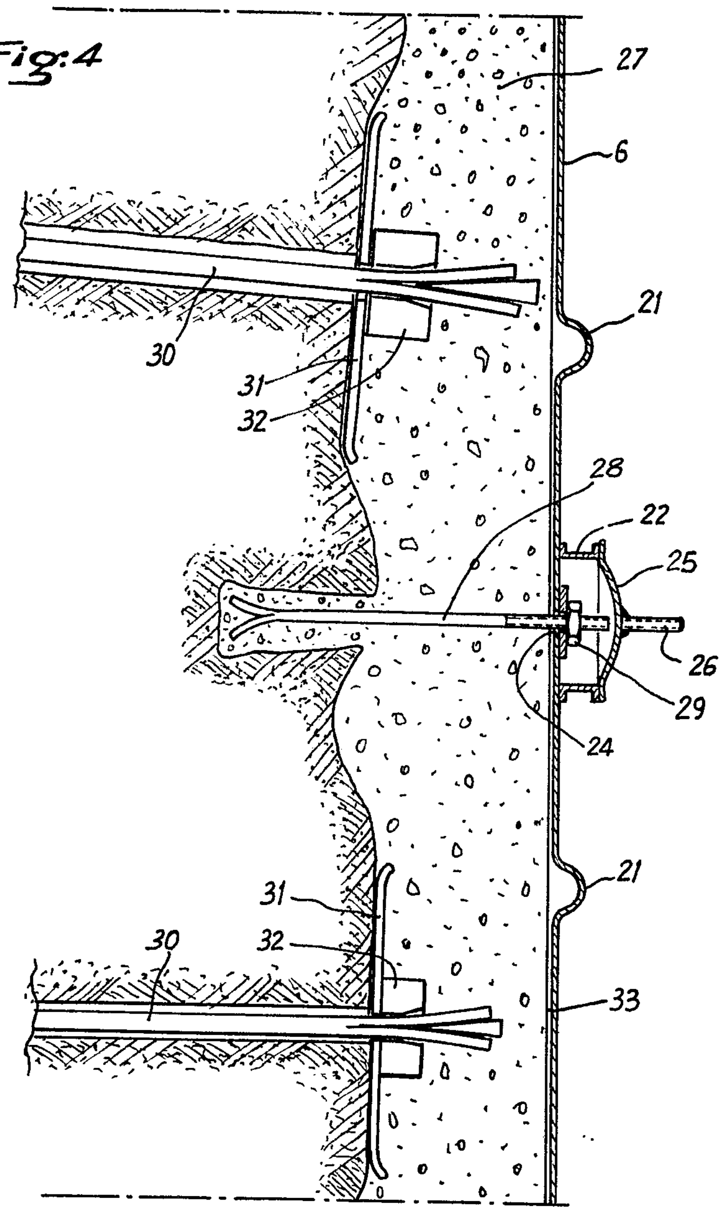

Fig:5

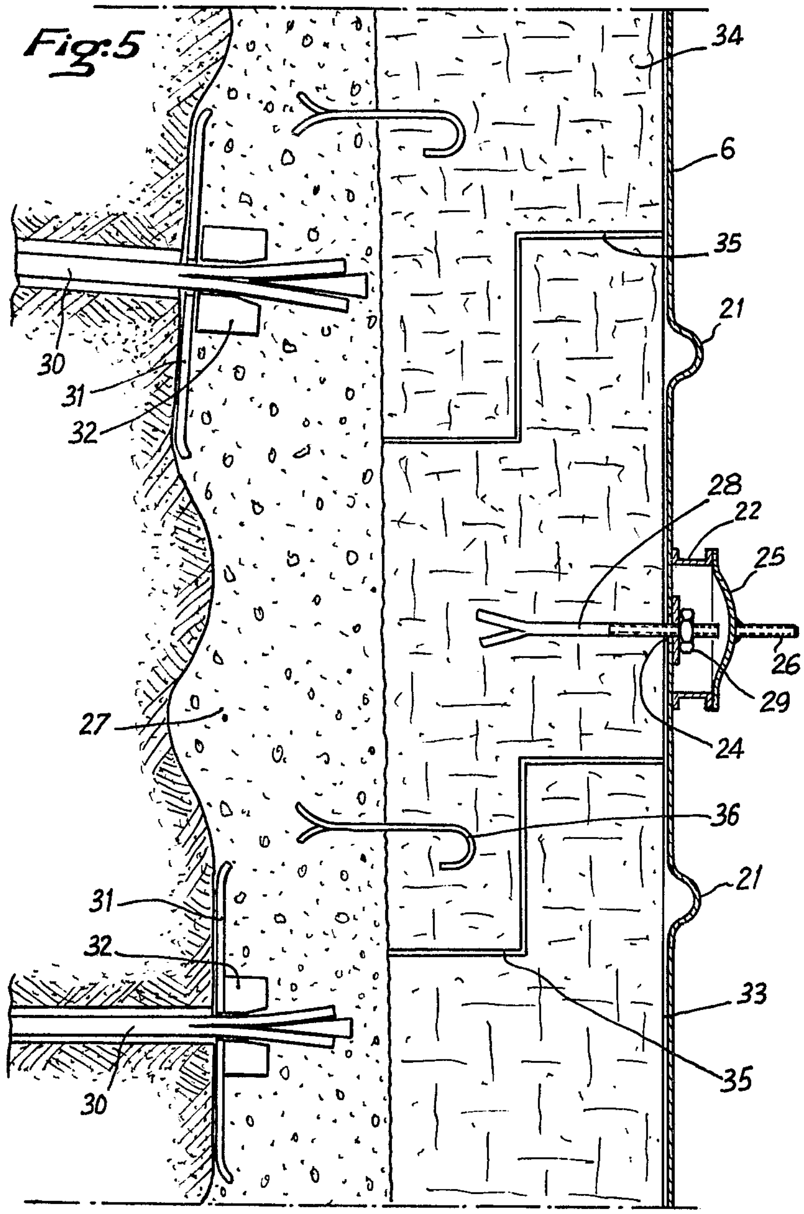

Fig:6

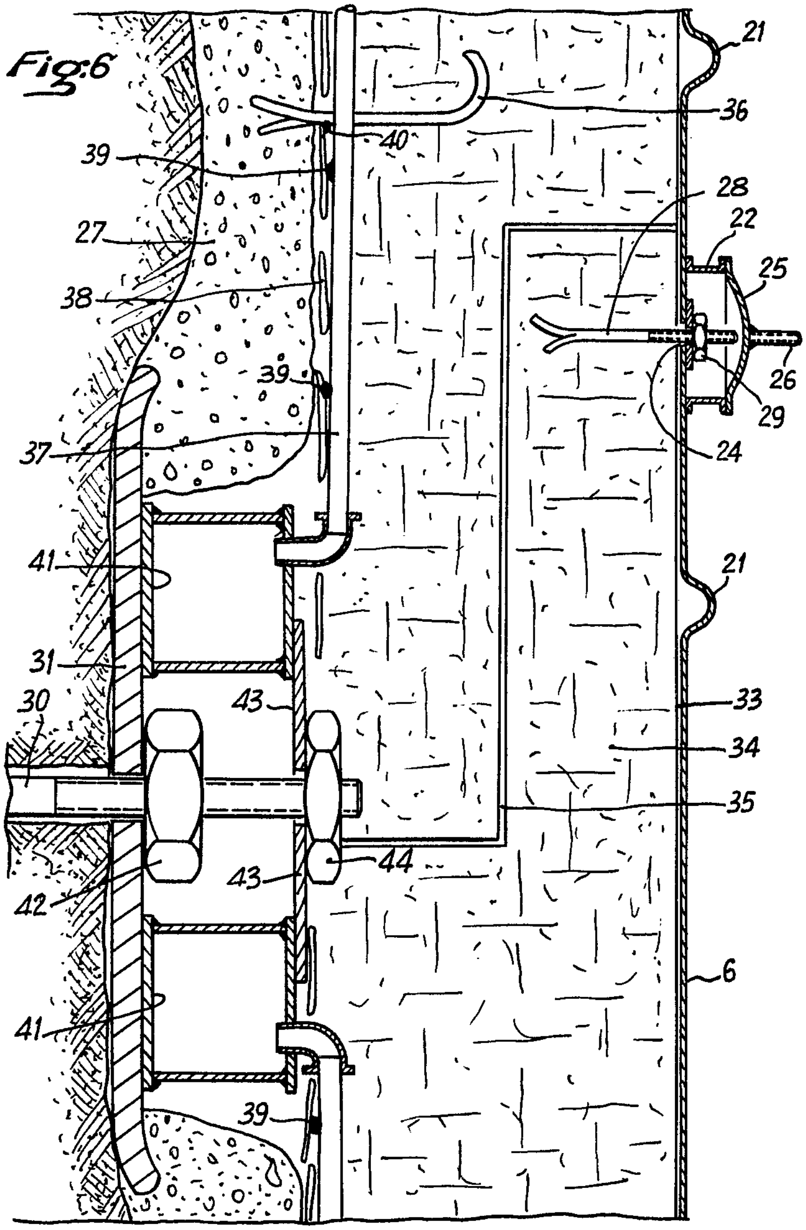
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Fig. 7a

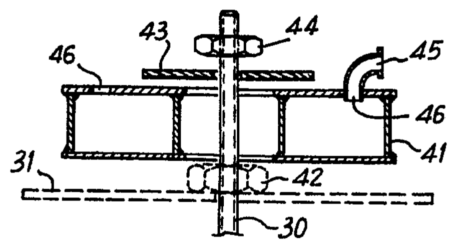

Fig. 7b

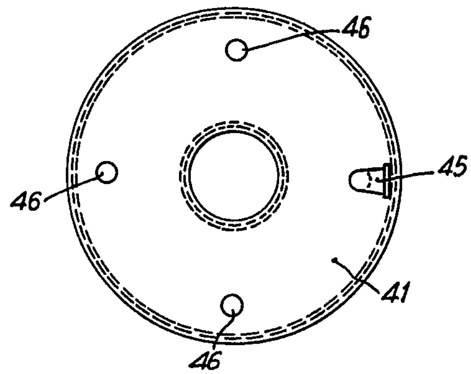

Fig. 7c