(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 647 515 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
06.05.2020 Bulletin 2020/19

(51) Int Cl.:
E04H 4/00 *(2006.01)*

(21) Application number: **19206675.1**

(22) Date of filing: **31.10.2019**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **31.10.2018 IT 201800009988**

(71) Applicant: **Milani, Alessandro**
35036 Montegrotto Terme (PD) (IT)

(72) Inventor: **Milani, Alessandro**
35036 Montegrotto Terme (PD) (IT)

(74) Representative: **Gallo, Luca**
Gallo & Partners S.r.l.
Via Rezzonico, 6
35131 Padova (IT)

(54) PROCESS FOR MAKING A TANK FOR CONTAINING WATER AND TANK FOR CONTAINING WATER OBTAINED WITH SAID PROCESS

(57) This is a new process for making tanks, swimming pools, fountains and artificial lakes in general, comprising the step of shaping all or part of a solidified shaped surface (A) by means of positioning one or more shaped compact bodies (1, 1') of lightened material, said shaped compact bodies (1, 1') being adapted to maintain the shaped form as a function of the desired form of said solidified shaped surface (A) to be obtained, and wherein said lightened material has characteristics of specific weight and permeability as a function of the surrounding terrain. The present patent also regards the obtained tank.

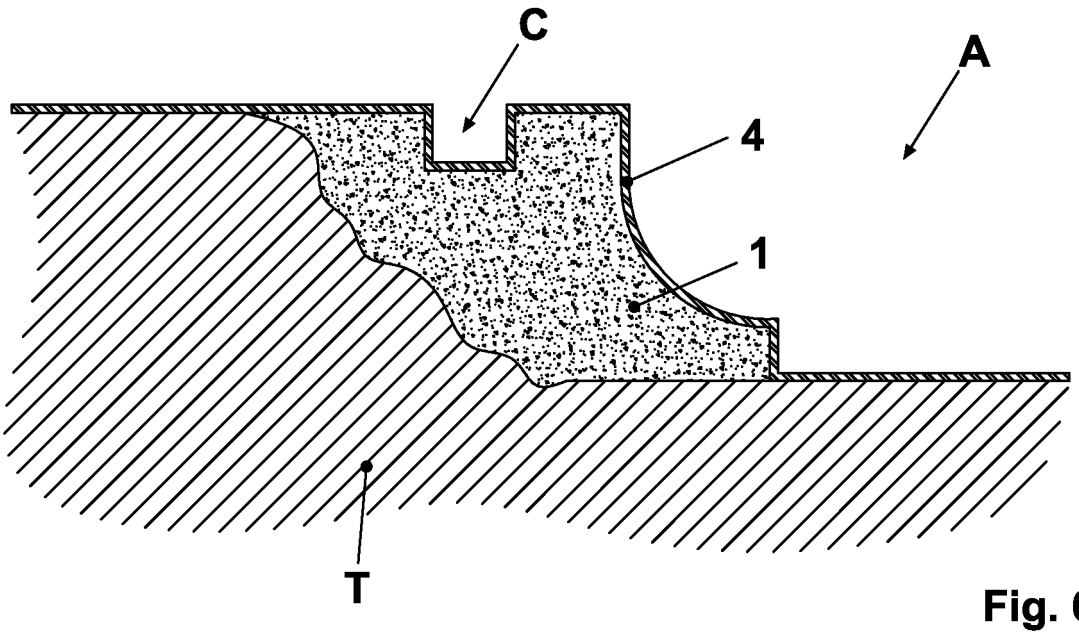


Fig. 6

EP 3 647 515 A1

Description

Field of application

[0001] The present patent regards a new process for making tanks for containing water and a tank for containing water obtained with said process, according to the preamble of the respective independent claims.

[0002] In particular the process described in the present patent is particularly usable for modeling the terrain for making tanks or swimming pools without heavy structures, for modeling excavations of the terrain or forms for containing a tank or swimming pool, for making overflow channels, compensation tanks, vertical walls and equipment wells for the construction of tanks or swimming pools without the use of reinforced concrete or load-bearing structures.

[0003] The present process is also applicable for making tanks or swimming pools that are in-ground or aboveground, where the solidified shaped surface of the tank is obtained from the modeling and shaping of lightened material, as described and claimed hereinbelow.

State of the art

[0004] Tanks and swimming pools are known, in-ground or otherwise, where the walls and the bottom are made of reinforced concrete which is treated with water-resistant products and coated with ceramic elements.

[0005] Tanks and swimming pools are also known that have walls and bottom attained with suitably-treated panels, e.g. made of steel, and waterproofed with cloths or the like. Prefabricated swimming pools and tanks are also known, made for example of fiberglass or another suitable material.

[0006] In order to complete tanks and swimming pools, it is also provided to install equipment such as filters, inlet and outlet mouths, overflows, collection channels, pumps, equipment for cleaning, filtering and cleaning the water, and other items for the correct functioning and use of the swimming pool.

[0007] The known tanks and swimming pools made of reinforced concrete and covered with tiles require frequent and costly maintenance and repair operations, made necessary by the occurrence of inevitable phenomena of cracking and separation of the cladding, mainly due to non-uniform movements of the surrounding and underlying terrain. Tanks and swimming pools are known comprising bottom and walls made with elements that are bonded and coated, fully or partly, by resins or other binders, such as concrete. Such tanks and swimming pools provide that the thrust of the water is absorbed by the cladding directly applied on the structure, and this - in particular situations with yieldable terrain and in any case due to the action of water itself over time - can cause cracks or fractures with consequent separation of elements or water losses.

[0008] Further drawback occurs in winter months, when the water introduced into the cracks is frozen and is expanded, involving inevitable separations of the cladding.

[0009] The known tanks and swimming pools typically have regular form, with the bottom horizontal or with gradual slope and vertical lateral walls.

[0010] Known and increasingly widespread and appreciated today are in-ground tanks and swimming pools, fountains, as well as artificial lakes in general, attained according to teachings described and claimed in the Italian patent No. 0001361065 (see also WO2007/029277A1) in the name of Milani Alessandro.

[0011] Such in-ground tanks and swimming pools, or fountains or artificial lakes, are made by means of a method which provides for

- excavating the solidified shaped surface,
- possible arranging, on the bottom of the basin, of a leveling layer made of sand, clay or another similar and suitable material,
- positioning the hydraulic plant and the electrical plant,
- extending a protection layer of the internal surface of the basin, for example comprising at least one cloth made of fabric, or non-woven fabric, such as geotextiles, geogrids or other similar products, per se known,
- coating the solidified shaped surface with a layer of waterproofing material, with zones of superimposition of the employed cloths, in a manner such that the waterproofing layer can be deformed via elongation in order to compensate for possible movements of the terrain due to geological factors or to load factors,
- covering the waterproofing layer with a coating layer comprising natural or artificial stones, fit next to each other and possibly joined by binders, positioned in a manner such to define interstices for the passage of water up to the waterproofing layer, in a manner such that the thrust of water finishes on such layer without compromising the integrity of the covering made of stones or the like.

[0012] Such system for making tanks and swimming pools, lakes and the like is increasingly widespread and rather appreciated for the great advantages in terms of very low environmental impact, due to the substantial lack of use of cement structures, and due to the overall weight of the structure which is considerably lower than the classic tanks and swimming pools made of cement, and also due to the connected advantages in terms of building permits, being in fact an easily removable structure. All of these advantages render such tanks or swimming pools or lakes particularly inexpensive with respect to other types.

[0013] Notwithstanding the abovementioned advantages, the tanks, the swimming pools and the lakes attained with such method have a limit, tied to the substan-

tial impossibility of making a basin which has at least one vertical wall. It is in fact impossible to make substantially vertical walls since - with tank or swimming pool empty - the thrust of the surrounding terrain would lead to the breakage of the vertical walls towards the interior. On the contrary, with the above-described method, it is possible to make only basins whose depth progressively increases from the edge to the center.

[0014] It frequently happens that a buyer wishes to have a tank or swimming pool or lake with at least one vertical wall.

[0015] It often happens that the terrain of the site intended for the attainment of the tank or swimming pool cannot be shaped with tilted or vertical sides, in accordance with design requirements. This occurs in particular in the presence of sandy terrain or in the presence of rocky terrain or in the presence of sites that have already been covered with concrete or in any case, in general, where it is not possible to excavate.

[0016] Tanks and swimming pools are known which comprise a base made of reinforced concrete or the like on which the walls are then applied or built.

[0017] Tanks and swimming pools are known with walls made of metal plate or the like, EPS structures and concrete, cemented block walls or walls filled with earth, brick walls, formworks made of plastic, wood or the like.

[0018] Processes are known for making tanks and swimming pools which provide for the positioning of metal nets on the terrain, from which they are separated by means of cloths. Cement is then sprayed on the nets, such cement having structural function for making the structure. The process finally provides for the possible step of coating with materials that are usually resinous and stony.

[0019] Presently, in order to make a tank or a swimming pool in a conventional manner, structures are made with completely smooth walls and floors, which are obtained by means of shaving with cement material or by means of application of panels which must be laid perfectly coplanar with each other and generally constrained via fitting with the bottom foundation. In order to ensure that the obtained walls are perfectly smooth, it is necessary to provide for the extension of waterproofing cloths or claddings that must in turn be perfectly taut and flat.

[0020] Alternatively, the cladding elements, such as tiles or mosaic blocks, must be positioned in an entirely precise manner so to be able to ensure that the obtained surface is smooth, so as to not create blemishes or small discontinuities which can be annoying or even cause injury to bathers.

[0021] Therefore, the processes known up to now provide for attaining structures made of concrete, also reinforced concrete, rigid paneling, normally made of steel, etcetera, which however introduce unnatural and often undesired architectural elements.

[0022] The current trend is in fact to consider that concrete and hence also the manufactured items made of concrete are polluting products, especially those inground, due to various terrain loading reasons, with possible hydrogeological damage and mainly because they reduce the natural draining action of the terrain.

[0023] Currently, there are also many structural constraints regarding in particular the reduction of the natural permeability of the terrain, which limit covering with concrete, for the purpose of preserving minimum values of surface area capable of draining rainwater. For example, the use of normal concrete, which has practically zero permeability, for making swimming pools or tanks or floors in general, is strongly limited since it significantly affects the natural capacities of the terrain to absorb and drain rainwater.

[0024] In addition, the concrete elements must, at the end of their lifetime, be demolished and removed, involving significant costs for bringing them to the dump.

[0025] Analogously, there is the problem of the future disposal of the paneling and of all the architectural elements introduced into the terrain or into the environment in general for attaining the tank or the swimming pool.

Presentation of the invention

[0026] In order to overcome all of the aforesaid drawbacks, a new process has been designed and attained for making tanks for containing water, such as swimming pools, fountains and artificial lakes in general, and a tank obtained with the aforesaid process.

[0027] The main task of the present finding is to make tanks on natural terrain, in a manner so as to minimize the effects on the natural permeability and instability of the terrain itself, using materials which have limited specific weight and preferably high permeability, as a function of the characteristics of the surrounding terrain.

[0028] By actuating the present process, together with the teachings of the Italian patent of the same applicant No. 0001361065, a tank is therefore made which is integrated in the surrounding environment according to the structural and environmental constraints dictated by modern laws.

[0029] One of the most important tasks of the present finding is to use light materials that are binded together in order to make swimming pools, lakes or the like. For example, it is provided to use expanded clay, which is a material considered eco-compatible, therefore more easily disposable at lifetime end, and which can be possibly binded with extremely limited quantities of cement or with resins.

[0030] The expanded clay, in particular, has optimal thermal insulation characteristics.

[0031] There are also other materials such as EPS or the like, which have relatively low specific weights.

[0032] Another object of the present finding is to be able to shape also the perimeter and the lateral walls of the tank in a simpler and more effective manner, allowing the creation of precision forms and shapes, for design and/or technical and/or environmental and/or scenographic requirements.

[0033] The material used in fact has characteristics of viscosity, workability and thixotropy suitable for its shaping, which can be suitably made by means of positioning forms/shapes in the mass of material, in order to make molds of any shape and size, e.g. for making overflow channels, also with function of compensation tanks, equipment rooms, as well as variously-shaped walls, curved, with stairs, seats, etcetera.

[0034] One advantage of the present finding is that of reducing the loads on the terrain, by means of the use of light materials, thus considerably reducing the movements due to the weight of the structure and of the water contained therein, once the tank has been filled.

[0035] For example, expanded clay has a specific weight of 300-500 Kg/m^3 against a specific weight of 1500-1800 Kg/m^3 of the terrain.

[0036] Another object of the new process is that it can also be used for making tanks with one or more vertical walls without using, as normally occurs, cementitious load-bearing structures or walls, for example made of steel, anchored to a foundation made of reinforced concrete.

[0037] Such process then involves the advantage of not requiring the installation of such reinforced concrete structures, considered quite invasive, often polluting for the terrain and in any case subjected to hydrogeological constraints.

[0038] Such process also allows making tanks that are not only in-ground, but also partly-in-ground or above-ground, without using heavy structures for making walls.

[0039] Further advantage deriving from the application of the new process consists of the fact that compensation tanks also can be used without having to install dedicated reservoirs, which require suitable spaces for their installation and for the hydraulic connection with the tank, and which increase the overall cost of the plant.

[0040] Further advantage following the use of the new process is that of reducing the costs of demolition and disposal of the attained tanks.

[0041] These and other objects, direct and complementary, are attained by the new process for making a tank for containing water, such as a swimming pool, a fountain or an artificial lake in general, and a tank for containing water obtained with the aforesaid process.

[0042] In particular, the process, according to a first solution, preferably comprises the following steps:

- executing an excavation in a terrain with the formation of an excavation surface, where the lateral walls of the excavation surface are advantageously tilted, with a tilt angle determined for example by the type of terrain;
- positioning one or more shaped compact bodies of lightened material over all or part of said excavation surface, in order to shape it as a function of the requirements, thus obtaining a solidified shaped surface of the desired form for the obtainment of the tank.

[0043] The process can be usefully applied also for making partly-in-ground or above-ground tanks, by applying the same inventive concept in a second solution which possibly comprises the excavation step, if the tank to be made is partly-in-ground, and then comprises the step of positioning and shaping one or more shaped compact bodies of said lightened material, in order to make all or part of the solidified shaped surface of the tank itself.

[0044] Preferably, the process provides for, in both solutions, also the shaping of said shaped compact bodies of lightened material in order to make the structures necessary for the operation of the tank, such as compensation tanks, overflow channels, equipment rooms and more.

[0045] Said lightened material can be, by way of a non-limiting example, expanded clay, which has extraction and expansion characteristics, i.e. from 1 m^3 of extracted material, over 5 m^3 are obtained therefrom.

[0046] In addition, said lightened material has high permeability characteristics, obtained by way of a non-limiting example by using materials with grain size for example ranging from 8 to 20 mm and employing limited quantities of binder.

[0047] A non-limiting example of lightened material is reported hereinbelow:

- expanded clay in granules of 8-20 mm dimensions; specific weight of 350 Kg/m^3;
- aliphatic polyurethane resin or bicomponent epoxy resin or another binder, also cementitious, in a quantity equal to 25 kg per cubic meter of clay;

The lightened material thus obtained has a specific weight of 375 kg/m^3.

[0048] The lightened material ensures ease of working, high permeability, reduced thermal conductivity (in the above-reported example, the thermal conductivity coefficient is 0.126 W/m K), high frost resistance, high fire resistance since it is non-combustible and is produced without any harmful substance.

[0049] Other materials are also known with similar characteristics, such as cellular glass, or other materials coming from recycled materials which can be subsequently expanded.

[0050] The applicant has also executed use tests of expanding filler foams, polyurethane and otherwise, which have weight even lower than the abovementioned materials, a higher laying speed, a lower porosity and draining effect. The expanding foams or resins used as binders can also be used in combination with each other and with materials with low specific weight such as expanded clay.

[0051] Said lightened material is for example constituted by discrete elements, of various shape and size, possibly but not necessarily amalgamated with each other with a suitable quantity of sealing binders.

[0052] The lightened material thus obtained has a specific porosity and a specific viscosity and fluidity.

[0053] Said lightened material is in any case such to allow making the shaped compact bodies adapted to maintain a specific shaped form, as desired.

[0054] For example, said lightened material is clay, mineral foam, expanding foams or resins, expanded polyurethane, EPS, expanded polystyrene, XPS extruded polystyrene, cellulose fiber, cellular glass, expanded perlite, cellular concrete, expanded verriculite, natural and synthetic fibers, etcetera.

[0055] Said binders can be resins, cements, foams or other.

[0056] It is in any case possible to provide that said lightened material is obtained without the use of binders, if it is well-constrained.

[0057] In summary, said lightened material has characteristics of specific weight, permeability and viscosity/workability suitably for the characteristics of the terrain on which it is laid, for the purpose of adapting the draining capacities and the weight of the lightened material to the terrain itself.

[0058] Lightened material is thus defined as a material that is possibly but not necessarily mixed with binders and preferably overall having the following characteristics:

- specific weight lower than 1000 Kg/m^3;
- permeability, intended as percentage of voids over the total, greater than 3% or intended as drainability greater than 3 l/min per m^2.

[0059] Once the operations of shaping the solidified shaped surface are completed, one then proceeds with the making of the tank, for example according to the technology described in the Italian patent No. 0001361065 of Milani Alessandro.

[0060] Then, provision is made for extending a possible protection layer on the obtained solidified shaped surface, a waterproofing layer, electrical and hydraulic plants and then positioning the cladding, for example made with natural stones and binders.

[0061] The present process allows making tanks of any form, also with one or more vertical walls.

[0062] As a function of the natural degree of friction of the terrain, it is for example possible to make a solidified shaped surface with vertical walls by simply superimposing a shaped compact body of said lightened material on the tilted wall of the excavation and suitably shaping it.

[0063] An important inventive aspect of the present process then consists of the fact that, by simply abutting said one or more shaped compact bodies of lightened material on the terrain, having a natural tilt, it is possible to make beds with any geometry, without any need to intervene on the terrain itself by means of creation of foundations.

[0064] On the contrary, the techniques currently used for making tanks with vertical or semi-vertical walls require the installation of foundation structures with high costs and loads on the terrain, as well as long attainment times.

[0065] Said lightened material is for example manually laid and shaped, in layers, or cast with suitably-positioned filling formworks, of disposable or removable type, or applied by means of devices for example by spraying.

[0066] The lightened material, possibly treated with binder, for example resin, can be laid directly on the terrain of the excavation, or on an interposed layer, for example a net, a sheet of suitable material, like TNT or another material, which separates the terrain of the excavation from the shaped compact body of lightened material.

[0067] By using such process, the permeability of the terrain is maintained as unchanged as possible, without saturating the terrain and hence without compromising the natural capacity of the terrain to absorb rain.

[0068] In particular cases, in order to prevent slipping and keep stable said one or more shaped compact bodies of lightened material, the possible but not obligatory use of fixing means of various type may be conveniently provided for, such as stakes made of steel or another material or other devices, for example uniformly arranged along the interface surface between the terrain and the lightened material or concentrated in the points of greater load or slipping risk.

[0069] It is also possible to provide for the use of containment panels of said lightened material, where said panels can be of disposable or removable type, and in turn comprise means for fixing to the ground, which contribute to keeping stable the shaped compact body of lightened material.

[0070] Said shaped compact body of lightened material is also usable for making one or more storm water storage tanks adapted to house the water within the interstitial holes between the elements constituting the lightened material.

[0071] Indeed, said lightened material, formed by said elements mixed with small quantities of binder, is advantageously porous and permeable due to the presence of interstitial spaces.

[0072] In this case, said shaped compact body of lightened material is suitably contained by at least one layer of waterproofing material for containing the water.

[0073] Said lightened material can in turn be modeled as required, such that in the shaped compact body defined by the lightened material it is possible to make overflow channels, compensation tanks or equipment rooms, by inserting, in the step of casting the lightened material, forms or molds of disposable type or to be extracted once the casting is completed.

[0074] Said forms or molds can in turn be made of very thin materials, also inexpensive due to the fact that the used lightened material has rather small lateral thrusts.

[0075] In the case of making overflow channels and/or compensation tanks, the process advantageously also provides for waterproofing the small channels thus made, suitably by means of positioning waterproofing cloths.

[0076] By making the compensation tanks according

to the present process, one attains the advantage of not having to install dedicated reservoirs, with considerable savings of installation costs and times.

[0077] In the case of making equipment areas or wells, these can instead be left without waterproofing the walls, by exploiting the draining characteristic of the used material. Steps, seats or other forms can also be made within the solidified shaped surface of the tank and also in proximity thereto and along the edge.

[0078] The used lightened material also has good heat-insulating capacities, thus limiting the heat dispersion of the water in contact with the terrain.

[0079] Such process is also applicable for remodeling pre-existing tanks.

Brief description of the drawings

[0080] In the enclosed tables, a practical embodiment of the finding is presented, by way of a non-limiting example.

Figure 1 illustrates an exemplified form of a generic excavation S executed in a terrain T, in order to obtain an excavation surface, for example provided with a horizontal flat bottom surface S1 and with one one or more lateral walls S2 that are generically tilted, for example with a suitable tilt angle, dictated by the characteristics of stability of the terrain.

Figure 2 illustrates how it is possible to make a solidified shaped surface by arranging a shaped compact body 1 of lightened material on at least one portion of said excavation surface. In particular, such solidified shaped surface is provided with a vertical lateral surface 11 and is aimed to define a bed A of a tank to be obtained.

Figure 3 shows the use of fixing means 2, in particular for stabilizing the shaped compact body 1 of lightened material on the terrain T.

Figure 4 shows how it is possible to provide for using a thin containment wall 3 with disposable formwork function for the casting of lightened material, said wall 3 having an end part 31 anchored to the terrain T.

Figure 5 illustrates the possible use of a waterproofing layer 4 arranged on the tilted lateral surface S2 of the excavation surface, which contains said shaped compact body 1 of lightened material, thus attaining a storage tank V.

Figure 6 shows the possible attainment of an overflow channel C made in the shaped compact body 1 of lightened material, with internal walls coated with a flexible waterproofing layer 4.

Figure 7 shows the possible attainment of an equipment space P made in the shaped compact body 1 of lightened material, with non-coated internal walls.

Figure 8 shows a shaped compact body 1' of lightened material that is variously shaped, for example in order to make stairs.

Figure 9 illustrates how it is possible to make a small channel operating as compensation tank C1, having dimensions sufficient for collecting the water overflowing from the interior of the bed A and suitably connected to a filtering and pumping system F that recirculates the water within the bed A of the tank.

Detailed description of a preferred embodiment

[0081] With reference to the enclosed drawings, reference numbers 1, 1' overall indicate a shaped compact body intended to be employed in the process for making a tank for containing water, according to the present invention.

[0082] In particular, with the term "tank" hereinbelow it is intended to identify tanks, swimming pools, fountains or artificial lakes in general, whether they are intended for swimming or otherwise, and whether they are made fully in-ground or partly in-ground or completely above-ground.

[0083] Advantageously, moreover, the tanks made with the present process lack heavy structures since, as better described hereinbelow, such tanks do not require foundations. The process, object of the present invention, comprises a step of executing an excavation S in a terrain T with the formation of an excavation surface. In particular, the aforesaid excavation surface is provided with one or more lateral walls S2, preferably tilted with a specific tilt angle. In addition, the excavation surface is preferably provided with a bottom surface S1, which is generally represented flat and horizontal in the enclosed figures.

[0084] According to the idea underlying the present invention, the present process also comprises a step of arranging at least one shaped compact body 1, 1' of lightened material on at least one portion of the excavation surface with the formation of a solidified shaped surface, which is advantageously provided with a desired form.

[0085] More in detail, the solidified shaped surface formed in such step of arranging the shaped compact body 1, 1' is advantageously adapted to define a bed A for containing the water of the tank to be obtained with the present process.

[0086] According to the present invention, moreover, the shaped compact body 1, 1' is provided with specific weight lower than 1000 Kg/m^3. In particular, such shaped compact body 1, 1' is made with lightened material comprising preferably discrete elements, of different shape and size, which are advantageously joined together with a binder.

[0087] More in detail, the lightened material of the shaped compact body 1, 1' comprises for example discrete bodies of one or more of the following materials: expanded clay, expanded perlite, EPS, mineral foam, expanding foams or resins, expanded polyurethane, expanded polystyrene, XPS extruded polystyrene, cellulose fiber, cellular glass, expanded perlite, cellular concrete, expanded vermiculite, natural and synthetic fibers and recycling material.

[0088] Preferably, moreover, the discrete bodies that form the lightened material of the shaped compact body 1, 1' are joined together with a binder selected among acrylic resins, epoxy resins, polyurethane resins, cement, expanding foams and glues.

[0089] It is in any case possible to provide that the shaped compact body 1, 1' is obtained without the use of binders, if the discrete bodies of the lightened material are well-constrained to each other.

[0090] Advantageously, moreover, the shaped compact body 1, 1' of lightened material thus obtained is permeable to water for the purpose of adapting the draining capacities and the weight of the shaped compact 1, 1' to the terrain itself.

[0091] More in detail, the shaped compact body 1, 1' has permeability, intended as percentage of voids over the total, greater than 3% or, intended as drainability, greater than 3 l/min per m^2.

[0092] In particular, the permeability of the shaped compact body 1, 1' is advantageously obtained, by way of a non-limiting example, by using materials with grain size comprised between 8 and 20 mm and by employing reduced quantities of binder.

[0093] A non-limiting embodiment of a shaped compact body 1, 1' is composed of expanded clay, in granules with 8-20 mm dimensions and specific weight of 350 Kg/m^3, and of an aliphatic polyurethane resin, in a quantity equal to 25 kg per cubic meter of clay. The shaped compact body 1, 1' thus obtained has a specific weight of 375 kg/m^3. Advantageously, moreover, the lightened material of the shaped compact body 1, 1' is adapted to ensure ease of working, high permeability, reduced thermal conductivity (in the above-reported example the thermal conductivity coefficient is 0.126 W/m K), high frost resistance, high fire resistance since it is non-combustible and reduced or zero harm for the terrain T on which it is arranged.

[0094] In accordance with the enclosed figure 3, the present process advantageously provides for at least one step of anchoring the shaped compact body 1, 1' to the terrain T by means of fixing means 2, such as for example stakes made of steel, which are preferably distributed along the interface surface between the terrain T and the shaped compact body 1, 1' itself.

[0095] According to the invention, the present process also comprises a step of extending a flexible waterproofing layer 4 on the solidified shaped surface and a step of coating the flexible waterproofing layer 4 with at least one coating layer to at least partially reproduce the solidified shaped surface.

[0096] More in detail, the step of extending the flexible waterproofing layer 4 advantageously provides for extending one or more flexible waterproofing cloths on the solidified shaped surface of the bed A, as indicated in the enclosed figure 6, in which the waterproofing layer is extended both on top of the shaped compact body 1, and on top of the bottom surface S1 of the excavation surface.

[0097] Advantageously, moreover, the step of extending the flexible waterproofing layer 4 also provides for superimposing several portions of the employed flexible waterproofing cloths, in a manner such that the flexible waterproofing layer 4 thus obtained can be deformed via elongation, compensating for possible movements of the terrain T due to geological or load factors.

[0098] Preferably, moreover, the coating layer placed to coat the flexible waterproofing layer 4 comprises natural or artificial stones joined together by a binder, defining interstices for the passage of water up to the flexible waterproofing layer 4 itself, in a manner such that the thrust of the water contained within the completed tank finishes on the flexible waterproofing layer 4 without compromising the integrity of the coating layer, as indicated in the patent application of the same applicant No. WO 2007/029277.

[0099] In accordance with the example of figure 2, the step of executing the excavation S provided in the present process determines the formation of the excavation surface with at least one tilted lateral surface S2. Advantageously, therefore, the step of arranging the shaped compact body 1, 1' on the tilted lateral surface S2 provides for the shaping of the shaped compact body 1, 1' itself to determine a vertical lateral surface 11 of the solidified shaped surface.

[0100] In particular, in such example of figure 2, the shaped compact body 1 is suitably shaped in a manner such that, on one side, it is adapted to the tilted lateral surface S2 of the excavation S and, on the other side, it defines the vertical lateral surface 11 of the solidified shaped surface.

[0101] Advantageously, in fact, the lightened material of the shaped compact bodies 1, 1' is provided with a viscosity or fluidity such to allow an easy shaping of the shaped compact body 1, 1' itself. At the same time, moreover, such lightened material is provided with a viscosity or fluidity such to maintain the specific form with which the shaped compact body 1, 1' is shaped.

[0102] In accordance with the examples illustrated in the enclosed figures 6 to 9, the step of arranging the shaped compact body 1, 1' can also provide for the shaping of such shaped compact body 1, 1' in the form of one or more overflow channels C and/or compensation tanks C1, and/or one or more equipment spaces or wells P and/or variously-shaped walls, for example in the form of seats and/or in the form of stairs. More in detail, in accordance with the enclosed figure 6, the shaped compact body 1 can be shaped in order to make one or more overflow channels C, with the flexible waterproofing layer 4 advantageously arranged to cover the internal walls of the overflow channel C itself.

[0103] In accordance with the enclosed figure 7, the shaped compact body 1 can be shaped in order to make an equipment room or well P, whose internal walls can also be left without waterproofing, exploiting the draining characteristic of the lightened material used for making the shaped compact body 1.

[0104] In accordance with the enclosed figure 8, the

shaped compact body 1' can be variously shaped, for example in order to make steps, seats or other forms within the solidified shaped surface of the tank, for example at its lateral portions or at a bottom portion thereof.

[0105] In accordance with the enclosed figure 9, the shaped compact body 1 can be shaped in order to also make one or more small channels operating as compensation tanks C1, having dimensions sufficient for collecting a volume of water equal to the volume of the bathers. Such compensation tanks C1, thus attained, advantageously make it unnecessary to install the compensation reservoirs that are currently used.

[0106] Preferably, moreover, such compensation tank C1 is suitably connected to a pumping and filtering system F that recirculates the water within the bed A of the tank made with the present process.

[0107] Advantageously, moreover, so as to arrange the shaped compact body 1, 1' provided with a form such to obtain the desired solidified shaped surface, the step of arranging the shaped compact body 1, 1' of the present process can provide for a casting of the discrete elements and of the binder incorporating at least one disposable or removable shape.

[0108] For example, such shapes can be removed once the consolidation of the casting has occurred or they can be left installed with support function, or they can be removed and repositioned in place after the positioning of possible waterproofing and/or protection layers.

[0109] More in detail, in accordance with the enclosed figure 4, the step of arranging the shaped compact body 1, 1' can provide for the use of containment walls 3, which can also be very thin and be made of inexpensive material, and which preferably are anchored with one end part 31 thereof to the terrain T.

[0110] In accordance with the enclosed figure 5, the shaped compact body 1 of lightened material is also usable for making one or more storm water storage tanks V, by means of the positioning of a further flexible waterproofing layer 4 on the terrain T, to contain the shaped compact body 1 itself.

[0111] More in detail, as illustrated in figure 5, the flexible waterproofing layer 4 is positioned in a manner such that a first part 41 thereof is extended on the tilted lateral surface S2 of the excavation surface S and a second part 42 thereof is extended to delimit the vertical lateral surface 11 of the shaped compact body 1. It is also possible to provide for inserting, within such storage tank V, one or more tubes or reservoirs for collecting and draining water that are not illustrated in figure 5.

[0112] Once the form of the solidified shaped surface is defined and made, the process for making the tank advantageously also provides for extending a possible protection layer to cover such solidified shaped surface, in addition to laying electrical and hydraulic plants and possible accessories such as mouths, lights, etcetera.

[0113] More in detail, the present process can provide for one or more steps of extending a protection layer.

[0114] In particular, such protection layer can be extended between the terrain T and the shaped compact body 1, 1', so as to protect the body itself from the action of erosion carried out by the terrain.

[0115] Otherwise, the protection layer can be extended between the shaped compact body 1, 1' and the flexible waterproofing layer 4. Otherwise, additionally, the protection layer can be extended to enclose the shaped compact body 1, 1', so as to fully protect such shaped compact body 1, 1'.

[0116] The tank obtained with the new process then comprises a bed A for containing the water, where one or more portions of said bed A are obtained from the positioning and shaping of one or more shaped compact bodies 1, 1' of lightened material laid directly or indirectly within an excavation S in the terrain T or on an abutment surface in general.

[0117] Indeed, the present process can also be identically applied for making tanks that are above-ground or partly in-ground. For example, in the case of above-ground tanks to be made on a pre-existing platform or on a surface in general, it is sufficient to position the shaped compact bodies 1, 1' of lightened material, suitably shaped for making all or part of the solidified shaped surface and also all the necessary structures, as described above.

[0118] Also forming the object of the present invention is a tank for containing water obtained with the above-described process and regarding which, for the sake of description simplicity, the same nomenclature will be maintained.

[0119] According to the idea underlying the present invention, the present tank comprises at least one shaped compact body 1, 1' of lightened material, which is arranged on at least one portion of the excavation surface within which the tank itself is intended to be made, and it is adapted to form the solidified shaped surface.

[0120] In addition, as specified above, the aforesaid shaped compact body 1, 1' is provided with specific weight lower than 1000 Kg/m^3 and preferably is permeable to water. In particular, the aforesaid shaped compact body 1, 1' can be made in accordance with the above-reported examples, for example with a plurality of discrete elements joined together with a binder.

[0121] The present tank also comprises a flexible waterproofing layer 4 extended to cover the solidified shaped surface, such as for example indicated in the enclosed figures 6 and 9. In addition, the present tank comprises at least one coating layer placed to coat the flexible waterproofing layer 4 and at least partially reproducing the solidified shaped surface.

[0122] Preferably, moreover, the coating layer is of the type described above, i.e. it comprises natural or artificial stones joined together by a binder and defining interstices for the passage of water up to the flexible waterproofing layer 4 itself, in a manner such that the thrust of the water contained within the completed tank finishes on the flexible waterproofing layer 4 without compromising

the integrity of the coating layer.

[0123] The invention thus conceived therefore attains the pre-established objects.

[0124] The tank obtained with the present process is advantageously provided with a bed A for containing water, where one or more portions of said bed A are obtained by arranging one or more shaped compact bodies 1, 1' of lightened material and by the subsequent reproduction of such shaped compact bodies 1, 1' by the flexible waterproofing layer 4 and by the coating layer.

[0125] In addition, the tank obtained with the present process advantageously lacks heavy structures and does not require foundations.

Claims

1. Process for making a tank for containing water comprising the step of:

   - executing an excavation (S) in a terrain (T) with the formation of an excavation surface;

   characterized in that it also comprises the following steps:

   - arranging at least one shaped compact body (1, 1') of lightened material provided with specific weight lower than 1000 Kg/m^3 on at least one portion of said excavation surface with the formation of a solidified shaped surface;
   - extending a flexible waterproofing layer (4) on said solidified shaped surface;
   - coating said flexible waterproofing layer (4) with at least one coating layer to at least partially reproduce said solidified shaped surface.

2. Process according to claim 1, **characterized in that** said shaped compact body (1, 1') of lightened material is permeable to water.

3. Process according to claim 1 or 2, **characterized in that** the lightened material of said shaped compact body (1, 1') comprises discrete elements, of different shape and size, joined together with a binder.

4. Process according to one or more of the preceding claims, **characterized in that** the lightened material of said shaped compact body (1, 1') comprises one or more materials selected from among: expanded clay, expanded perlite, EPS, mineral foam, expanding foams or resins, expanded polyurethane, expanded polystyrene, XPS extruded polystyrene, cellulose fiber, cellular glass, expanded perlite, cellular concrete, expanded vermiculite, natural and synthetic fibers and recycling material.

5. Process according to claim 3, **characterized in that** said binder is selected from among acrylic resins, epoxy resins, polyurethane resins, cement, expanding foams and glues.

6. Process according to one or more of the preceding claims, **characterized in that** said step of arranging at least one shaped compact body (1, 1') provides for shaping said shaped compact body (1, 1') in the form of one or more overflow channels (C), and/or one or more equipment spaces or wells (P) and/or variously-shaped walls and/or in the form of seats and/or in the form of stairs.

7. Process according to claim 3, **characterized in that** said step of arranging at least one shaped compact body (1, 1') provides for a casting of said discrete elements and of said binder, and such casting incorporates at least one disposable or removable shape.

8. Process according to one or more of the preceding claims, **characterized in that**:

   - the execution of said excavation (S) determines the formation of the excavation surface with at least one tilted lateral surface (S2);
   - the arranging said at least one shaped compact body (1, 1') on said tilted lateral surface (S2) provides for shaping said shaped compact body (1, 1') to determine a vertical lateral surface (11) of said solidified shaped surface.

9. Process according to one or more of the preceding claims, **characterized in that** it comprises at least one step of anchoring said at least one shaped compact body (1, 1') to said terrain (T) by means of fixing means (2).

10. Process according to one or more of the preceding claims, **characterized in that** it comprises at least one step of extending a protection layer between said terrain (T) and said at least one shaped compact body (1, 1').

11. Process according to one or more claims 1 to 9, **characterized in that** it comprises at least one step of extending a protection layer between said at least one shaped compact body (1, 1') and said flexible waterproofing layer (4).

12. Process according to one or more claims 1 to 9, **characterized in that** said at least one shaped compact body (1, 1') is enclosed by a protection layer.

13. Process according to one or more of the preceding claims, **characterized in that** said coating layer comprises natural or artificial stones joined together by a binder, defining interstices for the passage of water up to said flexible waterproofing layer (4).

14. Tank for containing water obtained with the process as in one or more of the preceding claims, **characterized in that** it comprises:

- at least one shaped compact body (1, 1') of lightened material, which is provided with specific weight lower than 1000 Kg/m^3, is arranged on at least one portion of said excavation surface and is adapted to form said solidified shaped surface;
- a flexible waterproofing layer (4) extended to cover said solidified shaped surface;
- at least one coating layer placed to coat said flexible waterproofing layer (4) and at least partially reproducing said solidified shaped surface.

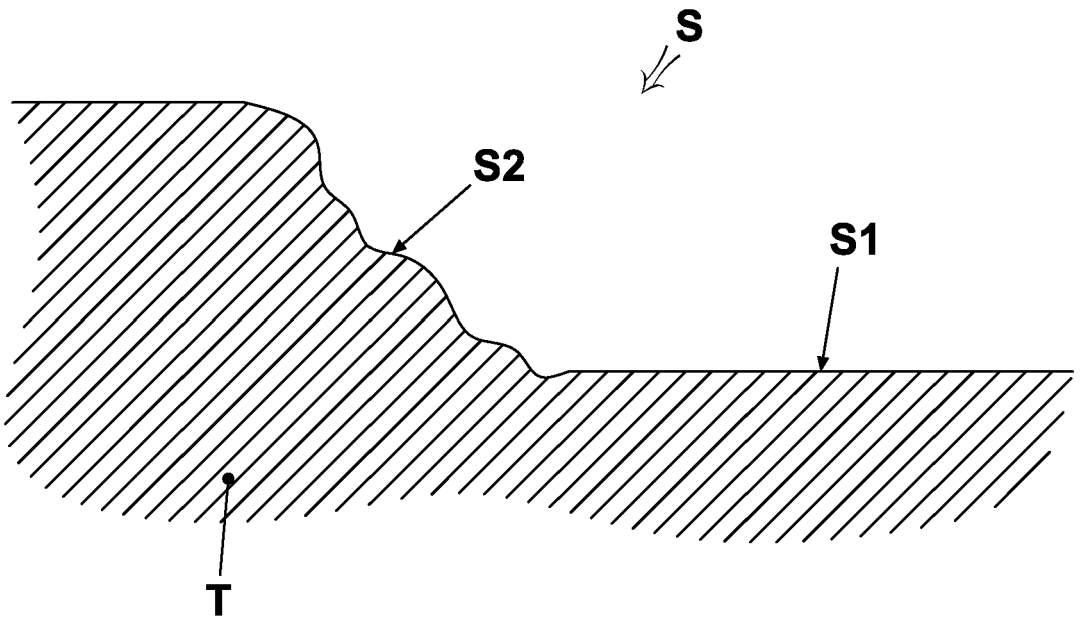


Fig. 1

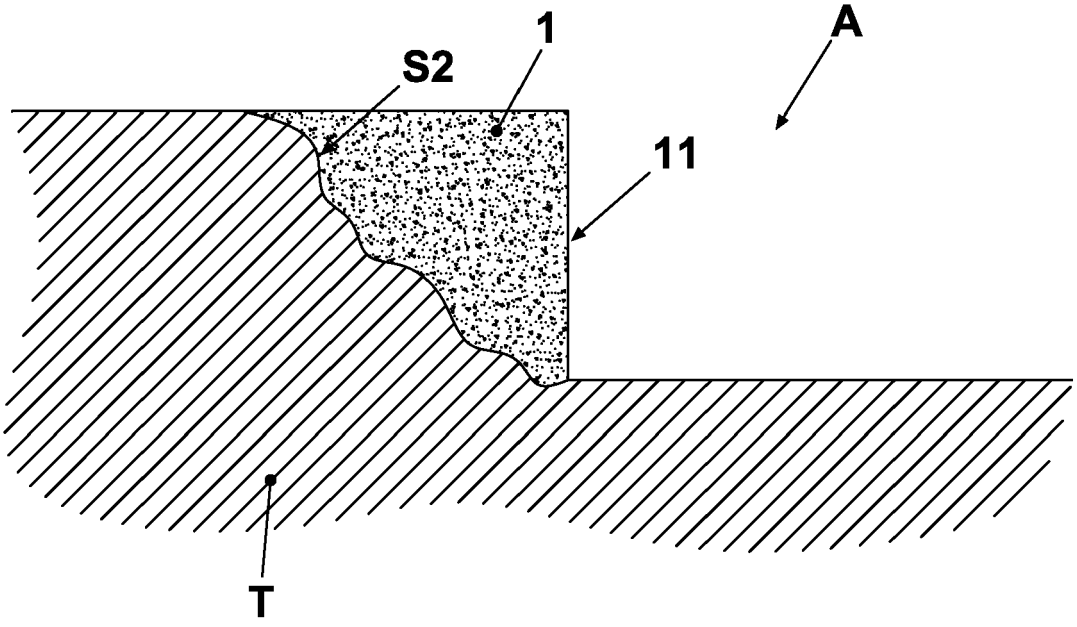


Fig. 2

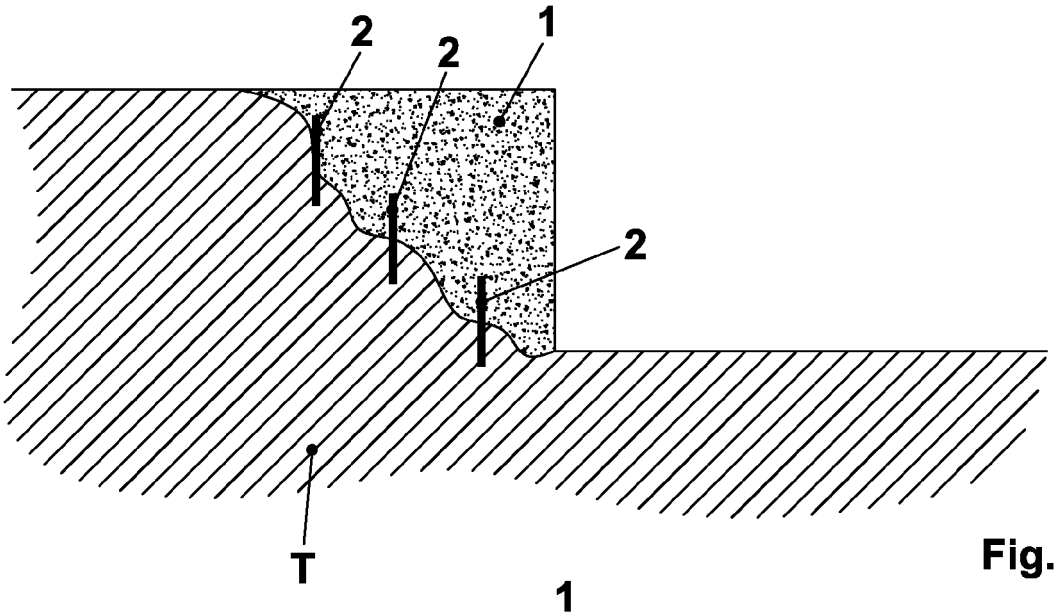


Fig. 3

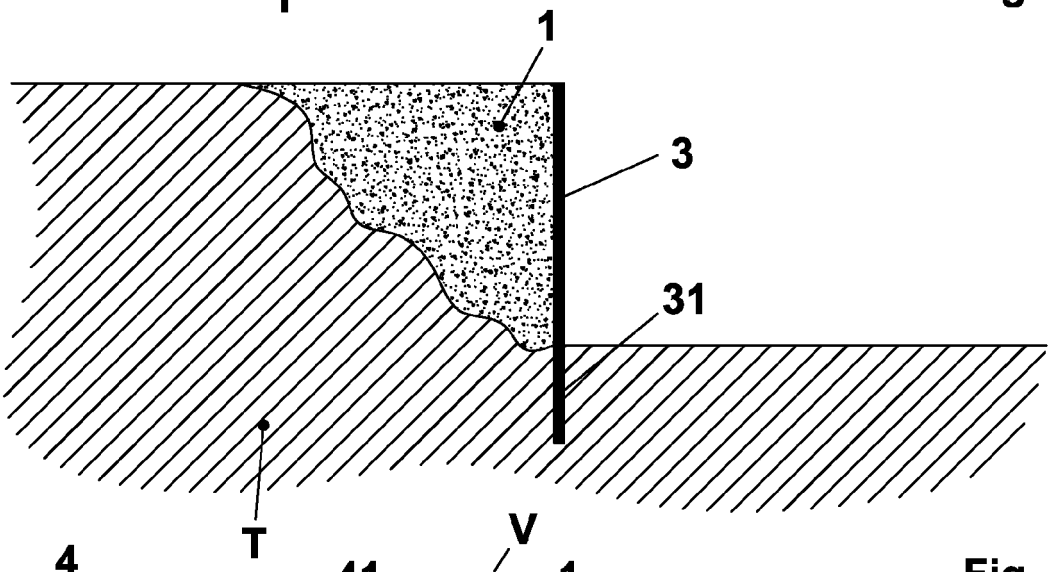


Fig. 4

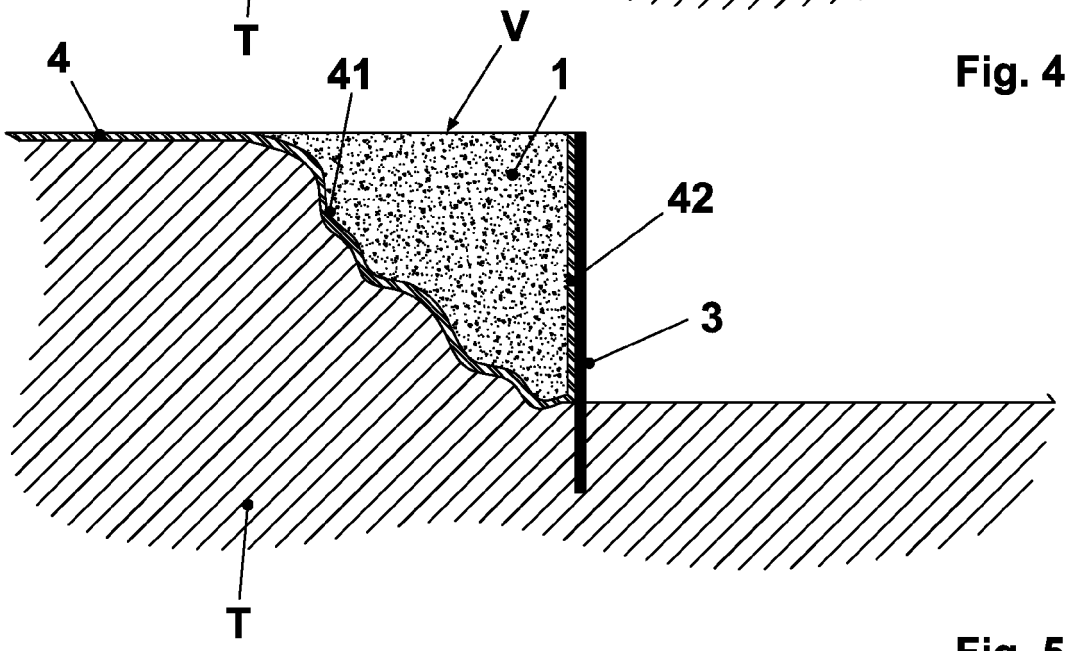


Fig. 5

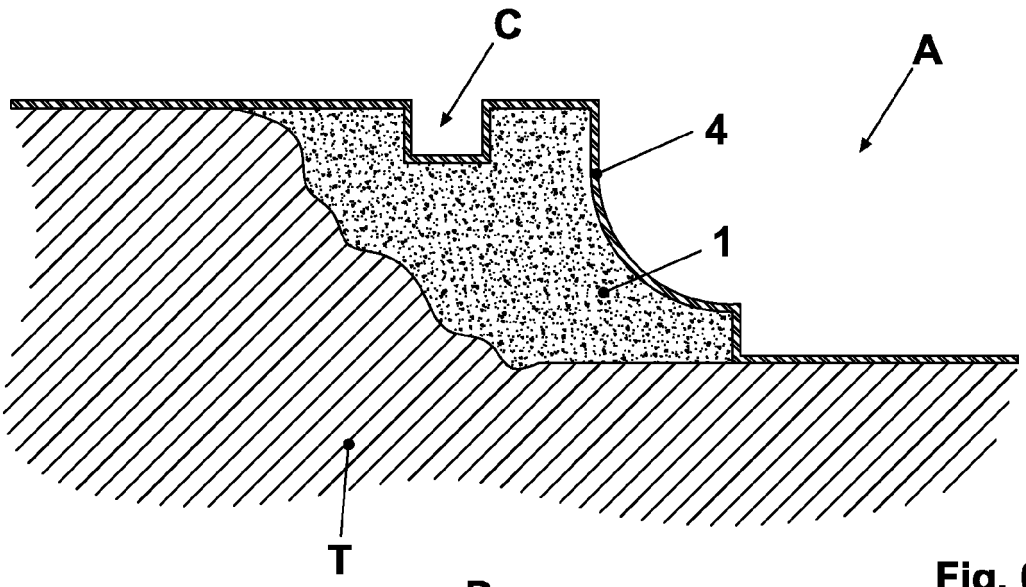


Fig. 6

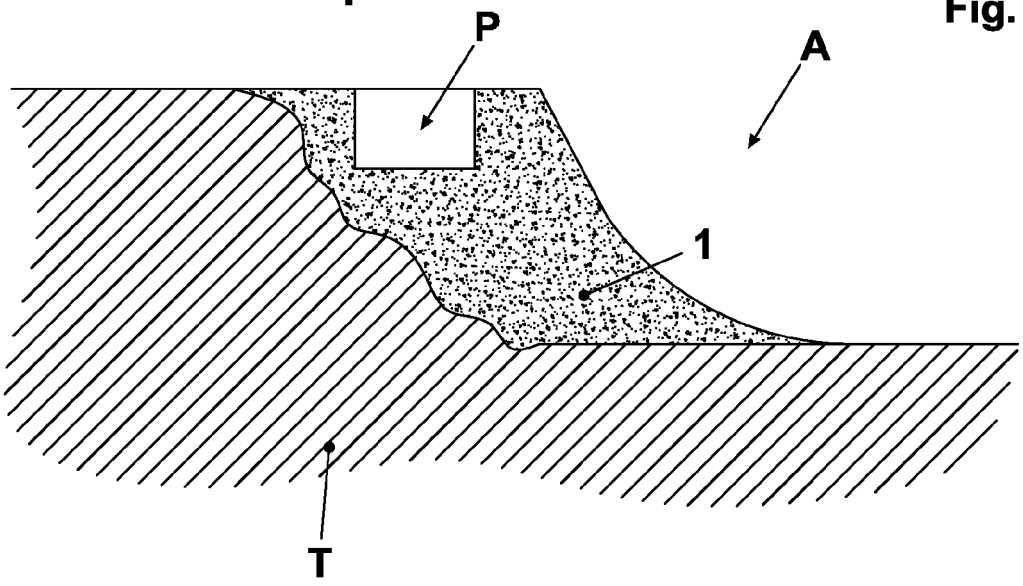


Fig. 7

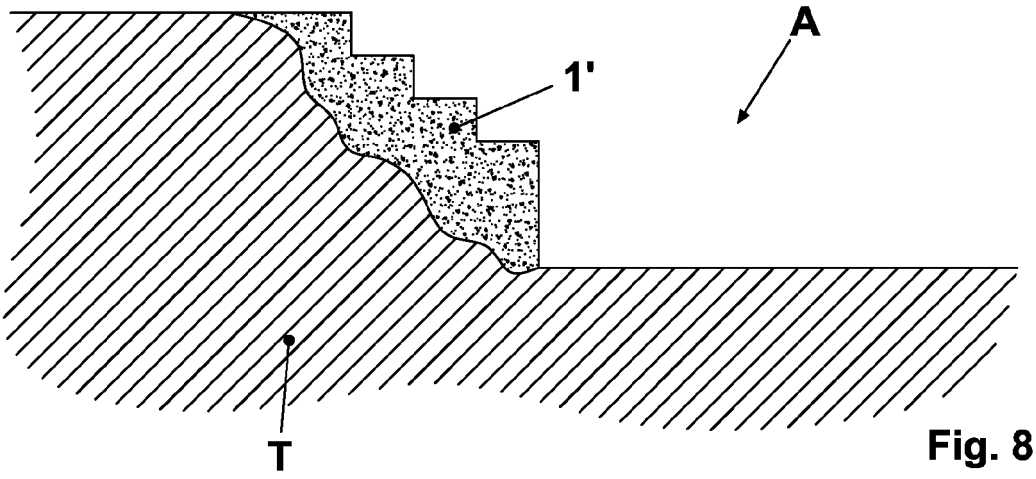
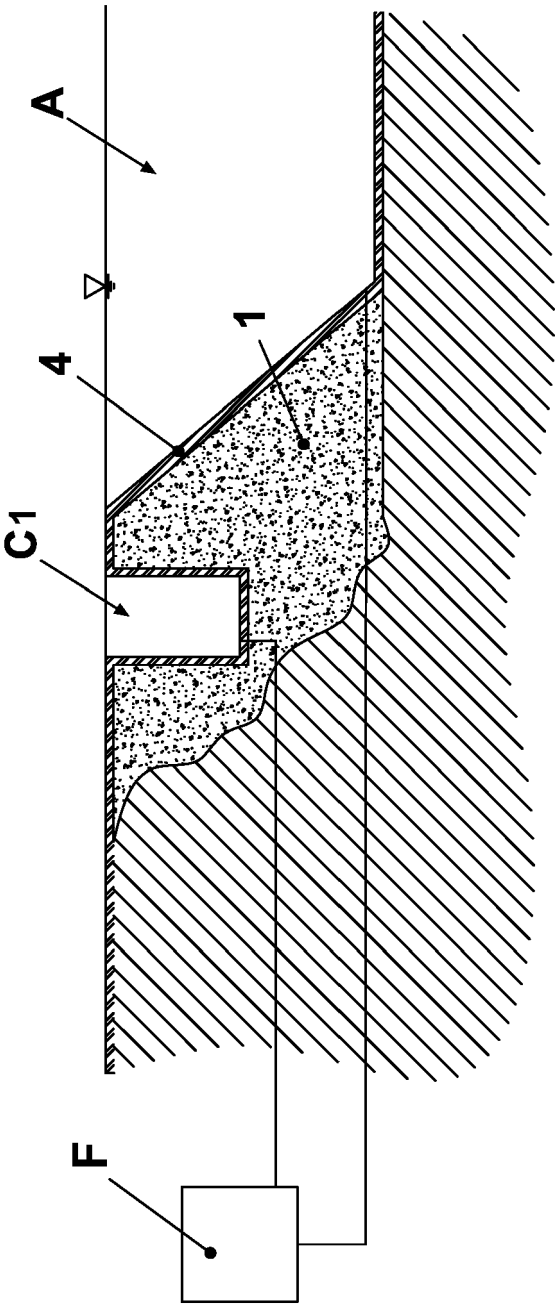


Fig. 8

Fig. 9



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 20 6675

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	WO 2007/029277 A1 (MILANI ALESSANDRO [IT]) 15 March 2007 (2007-03-15)	1-7,9-14	INV. E04H4/00
A	* figures 1, 2 *	8	
Y	AU 2009 203 120 A1 (LAMONDE CONST AUSTRALIA PTY LTD) 17 February 2011 (2011-02-17)	1-7,9-14	
A	* page 4, line 4 - page 5, line 15 *	8	
Y	US 3 800 487 A (ELIASSON E) 2 April 1974 (1974-04-02)	1-7,9-14	
A	* column 2, line 45 - line 68 *	8	
Y	EP 2 888 423 A1 (GROLA CAMILLO [IT]) 1 July 2015 (2015-07-01) * figure 3 *	10,12	

TECHNICAL FIELDS SEARCHED (IPC)

E04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 February 2020	Brucksch, Carola

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 20 6675

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

24-02-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2007029277 A1	15-03-2007	AT 430236 T	15-05-2009
		AU 2006288673 A1	15-03-2007
		CN 101258293 A	03-09-2008
		EP 1922457 A1	21-05-2008
		ES 2326436 T3	09-10-2009
		PT 1922457 E	06-08-2009
		SI 1922457 T1	31-10-2009
		US 2008245465 A1	09-10-2008
		WO 2007029277 A1	15-03-2007
AU 2009203120 A1	17-02-2011	NONE	
US 3800487 A	02-04-1974	NONE	
EP 2888423 A1	01-07-2015	AU 2013353664 A1	09-07-2015
		EP 2888423 A1	01-07-2015
		ES 2561383 T3	25-02-2016
		HR P20160088 T1	25-03-2016
		US 2015337552 A1	26-11-2015
		WO 2014087330 A1	12-06-2014

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- IT 0001361065 **[0010] [0028] [0059]**
- WO 2007029277 A1 **[0010]**
- WO 2007029277 A **[0098]**