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(71) Applicant: **Casadio, Gianluca**
40064 Ozzano dell'Emilia, BO (IT)

(72) Inventor: **Casadio, Gianluca**
40064 Ozzano dell'Emilia, BO (IT)

(74) Representative: **Modiano, Micaela Nadia et al**
Modiano & Partners
Via Meravigli, 16
20123 Milano (IT)

(54) METHOD FOR PROVIDING ARTIFICIAL BASINS, SWIMMING POOLS AND THE LIKE

(57) A method for providing artificial basins, swimming pools (1) and the like, which consists in performing an excavation (2) that corresponds to the artificial basin according to the design specifications, providing a substrate (3), on surfaces (4, 5, 6) of the excavation (2), of a type chosen preferably from a substrate (3) made of nonwoven fabric, a substrate (3) made of a material comprising silica, a substrate (3) made of gravel, a substrate (3) made of at least partially polymeric mineral material of non-organic origin, a substrate (3) made of composite material, a substrate (3) made of polymeric material, a substrate (3) made of compacted soil/sand, and combinations thereof, arranging the equipment (7) and the piping (8) for supplying and discharging water on the substrate (3); distributing on the substrate (3) and on the overlying equipment (7) and piping (8) a first layer (9) constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value, and acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, adapted to render said first layer (9) suitable for the optimum adhesion of additional layers for lining it, distributing a second layer (10), which is at least partially impermeable, constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value, acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, fibers of silica, glass, hemp and the like, having a length comprised between 1.0 cm and 6 cm, and a material that allows shaping and has a low relative density, chosen preferably from cork in chips, hemp fibers, natural fibers, granules of expanded polymeric material, and the like. After the consolidation of the second layer (10), the surface thereof is shaped with abrasive tools and instruments, until it is rendered completely uniform and compliant with the design standards. At least one third layer (11, 12) is spread which is constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value, acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, and at least one structural mesh made of fiber of silica, glass and the like, with at least unidirectional mechanical properties; a fifth layer (13) is spread which is impermeable and constituted by a mixture of water, light-colored mineral binder of non-organic origin, silica sands with low particle size value, acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, and fibers of silica, glass, hemp and the like, having a length comprised between 1.0 cm and 6 cm.

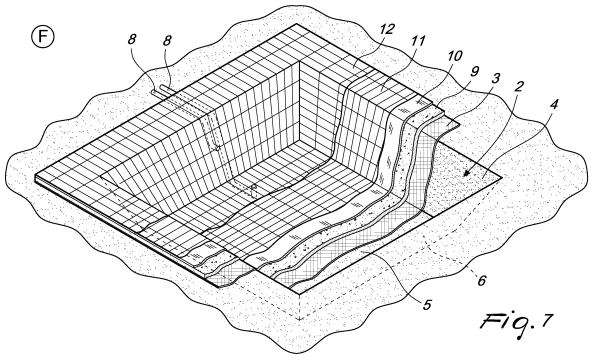

Fig. 7

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Description

[0001] The present invention relates to a method for providing artificial basins, swimming pools and the like.

[0002] In recent years there has been a significant spread of swimming pools and, more generically, of bathing basins provided with aesthetic criteria that remind of natural environments, such as for example beaches, cliffs and the like.

[0003] In order to provide this type of basins, construction technologies that are very similar to those used by set designers in reconstructing landscapes for cinema or theatrical use are used.

[0004] In other words, normal construction methods of masonry basins have been abandoned, using particular techniques for lining the excavations that constitute the reservoir of such basin.

[0005] The most appreciated techniques in use entail the arrangement of a lower impermeable liner that constitutes the water containment layer: the upper layers with structural, supporting and aesthetic function are then deposited on this liner.

[0006] In this manner the liner, compressed by the water pressure (which is applied through the lining and structural layers) on the walls of the excavation, is not subjected to any mechanical load but performs only the function of containing the liquid. The shape of the basin, the particular configuration of its surface, as well as the aesthetic appearance and the surface characteristics of the material that constitutes it depend solely on the raw materials used.

[0007] It is therefore possible to provide surfaces adapted to faithfully reproduce sandy shores, cliffs and other natural environments.

[0008] Unfortunately, even this embodiment has some important problems: first of all, the waterproofing performed with the deepest layer (the liner arranged so as to rest on the soil of the excavation) entails a constant impregnation of the structural, supporting and decorative layers. This impregnation entails the stagnation of water, with the consequent forming of algae and overall aesthetic deterioration (but also a functional one, since some surfaces can become slimy and, therefore, dangerous).

[0009] Moreover, algae consume the resin during their life cycle and therefore their presence requires the execution of operations for periodic maintenance for resin coating the surfaces and treatment with chlorine and its derivatives.

[0010] Moreover, during periodic drainings of the basin it is in practice impossible to perform a washing that eliminates the foulings and the deposits inside the structural and decorative layers. It is also not possible to exclude that such pockets of stagnant water might facilitate the proliferation of bacteria that might, in particularly negative cases, be harmful or pathogenic.

[0011] Prolonged impregnation might furthermore cause a degradation of the mechanical properties of such layers: the superimposed layers might lose elasticity and rigidity. The forming of a crack in these layers might generate a sharp edge which, in contact with the lower liner, might compromise the functionality of the artificial basin.

[0012] The aim of the present invention is to solve the problems described above, by providing a method for providing artificial basins, swimming pools and the like that is simple to implement.

[0013] Within this aim, an object of the invention is to devise a method for providing artificial basins, swimming pools and the like that requires low maintenance.

[0014] Another object of the invention is to devise a method for providing artificial basins, swimming pools and the like with high aesthetic value.

[0015] Another object of the invention is to devise a method for providing artificial basins, swimming pools and the like that can be performed with the aid of raw materials that can be transported and/or obtained easily.

[0016] Another object of the invention is to devise a method for providing artificial basins, swimming pools and the like that is particularly stable on the installation area.

[0017] A further object of the present invention is to provide a method for providing artificial basins, swimming pools and the like that has low costs and is relatively easy to provide and of assured application.

[0018] This aim and these and other objects which will become better apparent hereinafter are achieved by a method for providing artificial basins, swimming pools and the like, which consists in

- performing an excavation that corresponds to an artificial basin according to design specifications;
- providing a substrate, on surfaces of said excavation, of a type chosen preferably from a substrate made of non-woven fabric, a substrate made of a material comprising silica, a substrate made of gravel, a substrate made of at least partially polymeric mineral material of non-organic origin, a substrate made of composite material, a substrate made of polymeric material, a substrate made of compacted soil/sand, and combinations thereof;
- arranging equipment and piping for supplying and discharging water on said substrate;
- distributing on the substrate and on the overlying equipment and piping a first layer constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value, and acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, adapted to make said first layer suitable for the optimum adhesion of additional layers for lining it;
- distributing a second layer, which is at least partially impermeable, constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value, acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, fibers of silica, glass, hemp and the like, having a length comprised between 1.0 cm

and 6 cm, and a material that allows shaping and has a low relative density, chosen preferably from cork in chips, hemp fibers, natural fibers, granules of expanded polymeric material, and the like;

- after the consolidation of said second layer, shaping the surface thereof with abrasive tools and instruments, until it is rendered completely uniform and compliant with the design standards;
- spreading at least one third layer constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value, acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, and at least one structural mesh made of fiber of silica, glass and the like, with at least unidirectional mechanical properties;
- spreading a fifth layer, which is impermeable, constituted by a mixture of water, light-colored mineral binder of non-organic origin, silica sands with low particle size value, acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, and fibers of silica, glass, hemp and the like, having a length comprised between 1.0 cm and 6 cm.

[0019] Further characteristics and advantages of the invention will become better apparent from the description of a preferred but not exclusive embodiment of a method for providing artificial basins, swimming pools and the like, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a schematic view of a first step of the method according to the invention;
Figure 2 is a schematic view of a second step of the method according to the invention;
Figure 3 is a schematic view of a third step of the method according to the invention;
Figure 4 is a schematic view of a fourth step of the method according to the invention;
Figure 5 is a schematic view of a fifth step of the method according to the invention;
Figure 6 is a schematic view of a sixth step of the method according to the invention;
Figure 7 is a schematic perspective view of a sixth step of the method according to the invention;
Figure 8 is a schematic view of the seventh and eighth steps of the method according to the invention;
Figure 9 is a schematic perspective view of the seventh and eighth steps of the method according to the invention.

[0020] With reference to the figures, a swimming pool obtained applying a method for providing artificial basins, swimming pools 1 and the likeaccording to the invention, is generally designated by the reference numeral 1. Such basins/swimming pools 1 may have any shape and size: the accompanying figures have only a schematic illustrative function and do not constitute in any way a limitation related to the shapes and/or dimensions and/or geometries of the basin/swimming pool 1 that can be provided by means of the present invention.

[0021] In the present description, the expression "material comprising silica" is understood to mean any material comprising at least one binder that may be of the calcareous type, calcareous-siliceous type, calcium silicate-based type, calcium aluminate-based type and the like.

[0022] Materials comprising silica therefore also include any cement material, generically comprising calcite or lime: among these, a calcite-based mortar is of particular interest, although the present invention may be applied using any cement material.

[0023] In the present description, when reference is made to mineral materials of non-organic origin (including, for example, non-organic polymers and non-organic binders) these are understood as all mineral materials comprising siliceous aggregates, aluminous aggregates and the like (in general, therefore, any siliceous and/or silicate-comprising mineral is to be understood as included).

[0024] The method according to the invention consists of a series of consecutive steps.

[0025] During a first step A, which is preventive in nature, it is necessary to perform an excavation 2 that corresponds to an artificial basin that one wants to provide, according to the design specifications. The excavation 2 must be performed so that it is stable, using any measure to ensure that the soil from its upper rim and/or from its walls does not fall therein (on the bottom), drawn by gravity.

[0026] Obviously, the possibility of adding and piling up soil (originating from a different area) in a specific area, creating a small hill, on which to provide the excavation 2 (after the soil has been properly compacted and the walls of the hill have been properly consolidated) is not excluded.

[0027] Therefore, it is specified that constructive possibilities of so-called "above-ground" swimming pools may also be provided efficiently by using the method according to the invention.

[0028] In a second step B it is necessary to provide a substrate 3, on the surfaces of the excavation 2 (i.e., its side walls 4, on its bottom 5 and, optionally, also on a perimetric band 6 which surrounds the excavation 2).

[0029] The substrate 3 is conveniently of a type chosen preferably from a substrate made of non-woven fabric, a substrate made of a material comprising silica, such as in particular a material comprising a calcite-based binder, a substrate made of gravel (for example, lapillus, which might also be of volcanic origin, zeolite, silica gravel and the like), a substrate made of at least partially polymeric mineral material of non-organic origin (for example a mineral siliceous material), a substrate made of composite material, a substrate made of polymeric material, a sub-

strate made of compacted soil or sand, and combinations thereof.

[0030] Among the various possibilities of application of the method according to the invention in which the substrate 3 is constituted by material comprising silica (such as, in particular, a material comprising a calcite-based binder), the case of existing swimming pools made of concrete is also included. In particular, in other words, it is possible to use as substrate 3 on which the basin/swimming pool 1 will be provided the surfaces of an existing swimming pool made of concrete (providing a kind of renovation, requalification, thereof).

[0031] The substrate 3 made of non-woven fabric is particularly useful in all those cases where the soil that constitutes the walls 4, 5 and, optionally, 6 of the excavation 2 is predominantly constituted by sand, which may mix with the mixture of the layers that will be superimposed subsequently on the surfaces of the excavation 2: this mixing of sand originating from the surfaces of the excavation 2 would jeopardize the properties of the mixture. The presence of the substrate 3 made of fabric ensures the clean separation of the soil from the mixture that will be deposited thereon, facilitating a greater stability of the materials that will be subsequently laid to produce the basin/swimming pool 1.

[0032] Likewise, as an alternative to the non-woven fabric, a substrate made of a material comprising silica (for example, calcite-based calcareous/cement material) may be provided which, once cured, will ensure good adhesion to the surfaces of the excavation 2, maintaining a good structural flexibility of the substrate 3. As an alternative, the possibility is also provided to use a substrate 3 made of sand of various particle sizes (up to gravel) or a substrate 3 made of compacted soil/sand, which will allow to reach the necessary stability and solidity of the walls 4, 5 and, optionally, 6 of the excavation 2, but will require the intervention of operating machines for the spreading of the sand (or gravel) and its compaction and/or for the compaction of the soil which constitutes the walls 4, 5 and, optionally, 6.

[0033] Also, the possibility of providing a substrate 3 made of at least partially polymeric mineral material of non-organic origin (for example, of siliceous mineral and/or siliceous aluminous origin), which, not being subject to the action of bacteria, fungi and microorganisms present in the soil, will ensure optimum mechanical performance and good stability of the walls 4, 5 and optionally 6 is not excluded.

[0034] In any case the use of a substrate 3 made of composite material and/or of a substrate 3 made of polymeric material is not excluded.

[0035] Within the scope of step B, it is specified that it is possible to provide for the provision of a substrate 3 provided according to any combination of the examples mentioned above.

[0036] In a subsequent step C, it is advisable to arrange the equipment 7 and the piping 8 for supplying and discharging water on the substrate 3.

[0037] The equipment 7 is mainly of the electric type, for lighting, the optional supply of power to operating devices (control and management processors, pumps, sensors, water heating units, apparatuses for filtering and disinfection of water, speakers and others) and for the optional supply of transceivers for the remote control of the various components that are present. The presence of equipment for forced air conveyance for its use in massage or hydromassage areas is not excluded.

[0038] The piping 8 conveys the water (for filling operations, for the recycling thereof necessary for periodic filtering operations, and for discharging), although the presence of additional piping for conveying air from a respective compressor (as shown earlier) is not excluded.

[0039] A subsequent step D provides for distributing on the substrate 3 and on the overlying equipment 7 and piping 8 a first layer 9 constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value, and acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder.

[0040] The mineral binder of non-organic origin described throughout this description is of a type preferably selected from binders comprising silica, calcareous-siliceous binders, cement binders, geopolymeric binders, combinations thereof, and the like.

[0041] In the present description, all the silica-based binders, calcareous-siliceous binders and cement binders are referenced with a single (and common) expression, defining them always as binders and/or materials comprising silica.

[0042] In the present description, acrylic resin is absent in the mixtures constituting the stratifications that will be described, if such mixtures include a geopolymeric binder as a non-organic mineral binder. In this case the acrylic resin may be absent (i.e., in a percentage equal to 0%) since its function will be superfluous, because it is already fulfilled by the chemical-physical properties of the geopolymeric binder.

[0043] It is not excluded to use low percentages of acrylic resin even when a geopolymeric binder is used, if specific particularly severe design conditions must be met (although in general, as discussed above, acrylic resin is absent in mixtures that use geopolymeric binders).

[0044] Acrylic resin is present in a percentage comprised between 1% and 10% when instead a binder comprising silica is used (for example, calcite-based calcareous/cement binder).

[0045] The first layer 9 is preferably provided using a calcite-based binder, although different embodiments are not excluded.

[0046] In particular, it is specified that geopolymeric binders include the entire class of synthetic materials based on aluminosilicates.

[0047] By virtue of the adoption of geopolymeric binders in the provision of the substrate 3 or in the provision

of a first layer 9 it is possible to avoid the adoption of substrates 3 made of non-woven fabric or other materials deposited directly on the surfaces of the excavation 2 (although it is not excluded, anyway, to use such solutions in the case of specific embodiments).

[0048] The cohesive and chemical-physical characteristics of the geopolymeric binders allow to arrange the first layer 9 directly on a substrate 3 obtained exclusively through compaction and leveling of the soil in which the excavation 2 is made, with a consequent considerable simplification of the operating sequence according to the present invention, also eliminating the need for materials (for example, non-woven fabric) that are not easy to obtain and transport.

[0049] Mainly, the adoption of geopolymeric binders allows to place the first layer 9 directly on a substrate 3 obtained by compaction and leveling of the surfaces of the excavation 2, ensuring optimal cohesion and thus avoiding the easy separation of the swimming pool/basin 1 from the excavation 2 that might occur by adopting a non-woven fabric substrate 3 in the presence of underground water layers.

[0050] It is specified, with reference to the present description as a whole, that whenever calcareous-siliceous binders are used it is necessary to specify that inside the calcite (neutral calcium carbonate, whose chemical formula is $CaCO_3$) that constitutes them, a mineral substance known belite (dicalcium silicate, whose chemical formula is Ca_2SiO_4) is present (or can be formed by chemical reactions with water and siliceous materials). Belite plays a fundamental role in calcareous/cement agglomerates since by crystallizing in the presence of water it tends to close the water paths that can open accidentally (cracks, leaks, inclusions of soluble material), ensuring optimum watertightness of the structure under construction (basin/swimming pool 1, reservoir or other).

[0051] Acrylic resin is present in the first layer 9 only if a binder comprising silica (for example a calcite-based binder) is used, while it is generally not provided (0% present in terms of percentage) when a geopolymeric binder is used.

[0052] It is specified that what has been described in relation to the presence of acrylic resin only with a binder comprising silica (for example a calcite-based binder) must be considered valid also for the present description as a whole, therefore also hereinafter, when the possibility to introduce acrylic resin in some mixtures is mentioned.

[0053] In general, if a calcite-based binder is used, the acrylic resin has the goal of rendering it suitable for the optimum adhesion of additional layers for covering it: said binder behaves, therefore, as a "grip-promoting agent" or a "primer" in order to facilitate correct coupling with the upper layers.

[0054] If a geopolymer is used as a non-organic mineral binder, the presence of acrylic resin may be avoided, therefore, in each corresponding step of the present description.

[0055] In practice the first layer 9 ensures that the surface on which the subsequent lining layers are deposited is perfectly suitable to ensure the perfect adhesion thereof, allowing to obtain the best structural performance by the artificial basin 1 that will be provided.

[0056] During a subsequent step E one proceeds to distribute a second layer 10, which is at least partially impermeable and is constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value, acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, silica fibers, hemp fibers, glass fibers and the like, having a length comprised between 1.0 cm and 6 cm, and a material that allows shaping and has a low relative density, chosen preferably from cork in chips, hemp fibers, natural fibers (rich in silica), granules of expanded polymeric material, and the like.

[0057] The fact that the second layer 10 is at least partially impermeable is due to the intrinsic characteristics of the materials that constitute it in the particular formulation with which they are combined. Watertightness can be also ensured in a total manner, in relation to the specific requirements of each individual project to be executed. The material used is within the wide type of materials for constructing artificial basins devised by the same Applicant of the present application and known commercially by the name Idrocon® (and at least partially described in the following prior Italian patents: No. 1363172, No. 1363726 and No. 1417981).

[0058] This second layer 10, by virtue of fibers made of siliceous material, glass fibers, hemp fibers (or in general, any fiber of natural origin) and the like, has excellent mechanical properties and therefore is suitable to give to the basin/swimming pool 1 being provided the correct rigidity and the necessary dimensional stability.

[0059] At the end of the consolidation of the second layer 10, which can occur in a short time (substantially measurable in minutes and/or dozens of minutes) or even in a substantially longer time (days), depending on the climate conditions and the dosages of the various components of the mixture constituting the second layer 10, it is possible to proceed with shaping the surface thereof with abrasive tools and instruments, until it is rendered fully even and compliant with the design standards.

[0060] This shaping is possible because the second layer 10 is the thickest one (on the order of about ten centimeters, although versions in which the thickness of said second layer 10 is even much greater or smaller are not excluded).

[0061] Rasps, files, saws, and tools provided with abrasive, cutting disks and/or belts and the like can be used for the shaping operations.

[0062] Subsequently, during a step F, at least one third layer must be spread (according to the examples shown by way of non-limiting example in the accompanying figures, a third layer 11 and a fourth layer 12 are spread) which is constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value,

acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, and at least one structural mesh made of fiber of silica, glass and the like, with at least unidirectional mechanical properties.

[0063] In particular, the mesh used inside the third layer 11 and the fourth layer 12 can have, advantageously, a high mechanical tensile strength with respect to at least one particular predefined direction: in this manner the mesh, being embedded in the mixture of the third layer 11 and of the fourth layer 12, is rigidly coupled to the surfaces of the basin/swimming pool 1 being provided, giving the latter a high mechanical strength and a good flexibility in the privileged traction direction (or directions) identified thereby.

[0064] The third layer 11 and the fourth layer 12 may be substantially identical to each other, but the mesh made of silica fiber, glass fiber and the like may have different privileged directions of tensile strength, so as to provide a homogeneous mechanical behavior according to distinct and different directions.

[0065] This can be obtained simply by using a different orientation of the meshes of the various superimposed layers 11 and 12, so as to ensure that the finished basin/swimming pool 1 has mechanical properties that are as uniform as possible.

[0066] It is evident that if the basin/swimming pool 1 needs a greater mechanical strength with respect to a particular and specific direction (for design or installation reasons), the meshes may be arranged so as to privilege such direction.

[0067] One then proceeds to perform a step G by spreading a fifth layer 13, which is impermeable, constituted by a mixture of water, light-colored mineral binder of non-organic origin, silica sands with low particle size value, acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, and fibers of silica, glass, fibers of hemp and the like, having a length comprised between 1.0 cm and 6 cm.

[0068] In this case also, watertighteness can be partial or total according to the requirements expressed in the design; the level of watertightness is obtained from the particular dosage of the components of the mixture used to provide the fifth layer 13.

[0069] This fifth layer 13 (having structural properties) gives the walls 4 and the bottom 5 (optionally also the perimetric area 6) of the basin/swimming pool 1 the necessary elasticity, i.e., preventing impacts or mechanical loads from being able to produce fractures or cracks. The length of the reinforcement fibers used is in fact such to ensure the best cohesion between each portion of the basin/swimming pool 1 and the adjoining ones.

[0070] Finally, it is possible to perform a further step H of laying of a sixth, and last, finishing layer 14 constituted by a mixture of water, binder comprising silica (for example calcareous-siliceous binder based on calcite), sand, of the final color to be attributed to the artificial basin being provided, with a grain size ranging between 0.01 mm and 1.8 mm, acrylic resin in a percentage variable between 0% and 10% with respect to the silica-based binder (i.e., calcareous-siliceous and/or calcareous/cement, for example calcite-based).

[0071] This sixth layer 14 (also impermeable) has the purpose of contributing to the final appearance of the basin 1, having the color of the sand used in the mixture and also the surface roughness that depends on the particle size of the sand itself. The watertightness of the layer 13 is obtained by means of a higher dosage of silica sands in the constituting mixture and, eventually, by adding a calcite-based binder (which can exploit the impermeabilizing properties of the belite that will be formed therein in the presence of water, as already illustrated earlier).

[0072] As in the cases of the layers 9, 10, 11, 12, 13 described previously, the acrylic resin, when present in the mixture, ensures the mutual adhesion of the various layers 9, 10, 11, 12, 13, 14, while the watertightness is ensured by the crystals of silica (reference is made to what has been described earlier in relation to the forming of belite crystals with an impermeabilizing function within the calcareous/cement binder, for example based on calcite) that will form naturally during the "curing" of the layers (understood as the set of chemical-physical processes that occur in the layers 9, 10, 11, 12, 13, 14 during their consolidation).

[0073] It is specified that, unlike all the embodiments of the known type for providing basins and/or swimming pools 1 by stratification, the method according to the invention ensures that each one of the superimposed layers 9, 10, 11, 12, 13, 14 is independently water-repellent (at least partially), avoiding any impregnation of the layers 9, 10, 11, 12, 13, 14, consequently maintaining the initial mechanical properties and the original aesthetic characteristics of the basin and/or the swimming pool 1 for an indefinite duration. It is clear that this embodiment allows to obtain basins and/or swimming pools 1 that are substantially free from the forming of algae inside the layers 9, 10, 11, 12, 13, 14 and subject to minimum bacterial proliferation (since areas of porosity in which stagnant water could not be reached during cleaning are substantially absent).

[0074] It is specified that step A of providing the excavation 2 can conveniently provide that the side walls 4 can have an inclination comprised between 20° and 80° with respect to the bottom 5 and are surrounded by slightly downward-sloping areas 6 that constitute large steps and perimetric shores.

[0075] The specified inclinations ensure optimum adhesion of the layers 9, 10, 11, 12, 13, 14, which spread preferably by spraying the mixtures (by virtue of specific tools of any type and shape), although it is not excluded to use casting and/or manual distribution of the mixtures (by using geopolymer-based mineral binders or mineral binders comprising silica).

[0076] Optionally, it is not excluded that before arranging the piping 8 and the equipment 7 (this in relation to its greater mechanical strength which compensates the

so-called spray-mix method), it is possible to provide validly that at least one structural tension member for each surface module of predefined area is inserted and locked stably in the walls 4 and in the bottom 5 of the excavation 2.

[0077] In practice, the structural tension member is of the type of threaded bars (with the threaded portion arranged at the end for fixing it), rods, cables and the like, and can be subsequently secured in a rigid and stable manner to the layers 9, 10, 11, 12, 13, 14 subsequently superimposed on the substrate 3, for the rigid coupling thereof to the walls 4 of the excavation 2.

[0078] This option is particularly useful if in the area of the excavation 2 there is groundwater: in fact any influx of water from the water layers to the excavation 2 (in view of the at least partial water repellency of the layers 9, 10, 11, 12, 13, 14) would determine a thrust on the basin/swimming pool 1 that would tend to unseat it from the excavation 2; the tension members secure the basin/swimming pool 1 to the ground, preventing the water from the water layers from being able to remove it from its own installation seat.

[0079] It is also useful to point out that the equipment 7 and the piping 8 arranged above the substrate 3 can be conveniently coupled to it by means of castings provided by means of a mixture of inert materials (for example volcanic lapillus and pearlites and the like) and non-organic mineral binder (therefore calcareous-siliceous or geopolymeric or cement binder and the like), arranging the piping 8 so that only portions of rigid or flexible tubes protrude toward the inside of the concavity of the excavation 2.

[0080] In this manner the correct arrangement of the equipment 7 and of the piping 8 is ensured and stabilized and they do not risk being moved accidentally during the arrangement of the overlying first layer 9.

[0081] Furthermore, it is specified that the mixture used to provide the first layer 9 can conveniently be constituted by a part of solid premix, which comprises non-organic mineral binder (for example based on calcite or based on geopolymers) and sand with low particle size, and a part of a mixture of water and, optionally, acrylic resin (the latter, if present, in low percentage in order to prevent the layer 9, once finished, from having a rubber-like consistency: said first layer 9 in fact must be substantially rigid).

[0082] Acrylic resin may be present within the mixture in a percentage that varies from 0% to 10% with respect to the non-organic mineral binder (it is completely absent, 0%, when a geopolymeric binder is used).

[0083] The mixture of water and acrylic resin (both in the liquid state) simplifies the impregnation of the substrate 3, with consequent increase of the cohesion of the first layer 9 to the substrate 3.

[0084] According to an embodiment of unquestionable interest in practice and in application, it is specified that the fibers of silica, glass, hemp and the like, comprised in the second layer 10, can advantageously have a length comprised between 1.2 cm and 5 cm and be present in a percentage comprised between 3% and 5%.

[0085] This concentration and these lengths allow to obtain the mechanical characteristics most suitable for the aim, combining rigidity and elasticity of the material, without introducing tangible increases in its weight.

[0086] Moreover, it is noted that the material that constitutes the second layer 10 is mixed by means of a cement mixer, with the addition of water and acrylic resin (the latter, present when one uses a binder based on silica, for example based on calcite, is introduced in a low percentage in order to prevent that the layer 10, once finished, from having a rubber-like consistency: this layer 10 in fact also must be substantially rigid). In particular, the acrylic resin (in the presence of a calcareous/cement binder, for example a calcite-based binder) is present with respect to water in a percentage that can vary between 1% and 10% with reference to the weight of the non-organic mineral binder (more specifically in a percentage that can vary between 3% and 7% with respect to the non-organic mineral binder, for example a calcite-based binder). As already described previously several times, acrylic resin is generally absent if a geopolymeric binder is used.

[0087] The second layer 10 has a substantially uniform thickness of less than 10 cm (in some cases it may also have an infinitesimal thickness), preferably between 3 cm and 5 cm, fully lining the excavation 2 up to the end of the areas 6 (perimetric shores that constitute a contiguous and slightly downward-sloping portion arranged around the side walls 4 thereof).

[0088] With particular reference to an embodiment of unquestionable interest in practice and in application, the second layer 10 may favorably comprise solid shaped components made of a material with low relative density, of the type of an expanded polymer, and arranged so as to rest on the first layer 9.

[0089] The solid shaped components are preferably chosen from steps, seats, decorative shaped blocks, functional shaped blocks, and the like. By way of example the possibility is noted to provide slides, seats and/or areas with particular shapes having a scenic effect which, once lined by the subsequent layers 11, 12, 13, 14, have the same aesthetic appearance as the rest of the basin and/or swimming pool 1 (and therefore are completely embedded and integrated therein).

[0090] It is specified that the third layer 11 (and also any additional fourth layers 12 superimposed on the third layer 11) may validly comprise a superimposition of at least two stratifications: at least one first stratification comprises at least one mesh with at least unidirectional mechanical properties along the direction of the length of the basin/swimming pool 1, at least one second stratification comprising at least one mesh with at least unidirectional mechanical properties along the direction of the width of the basin/ swimming pool 1.

[0091] In practice each third layer 11 (and optionally also the fourth layer 12 superimposed thereon) may com-

prise multiple meshes distributed with different orientation in order to ensure that a mechanical behavior complying with the design requirements is obtained.

[0092] With reference to a possible embodiment illustrated by way of non-limiting example, it is noted that the meshes used may have a tensile strength, along the at least one direction of action, of no less than 2100 N for each strip of 5 cm of width.

[0093] Moreover, it is specified that at least one between the fifth layer 13 and the sixth layer 14, which are impermeable and finishing layers, may conveniently comprise sand with a particle size that can vary between 0.02 mm and 1.5 mm, acrylic resin in a percentage that can vary between 3% and 7% with respect to the water and anti-filming additives, in order to avoid the forming of surface films on the layer, and anti-cracking additives, in order to avoid cracks of said layer 13 (or the layer 14). If instead the fifth layer 13 and the sixth layer 14 adopt a geopolymeric binder, the presence of the acrylic resin is superfluous and therefore it may be omitted in the respective mixture.

[0094] Moreover, the sixth impermeable layer 14 (by virtue of the forming of silica crystals described previously and by virtue of the additional presence of calcite-based binder, which ensures the forming of belite in presence of water, which, as seen previously, has an impermeabilizing function, may advantageously be subjected, within 3-5 hours of its spreading, to a combing of the silica sands by means of polymeric spatulas in order to highlight and optimize aesthetically the surface and make it more uniform and smooth: this operation will make each granule of sand more visible, giving a particularly pleasant overall appearance. It is not excluded, in any case, that the same treatment might be performed on the fifth layer 13 as well.

[0095] It has thus been shown that the artificial basins/swimming pools 1 provided by following the method according to the invention are innovative and original since:

- they do not require the presence of preventive concrete castings (although it is not excluded, in some cases, to provide a substrate 3 at least even partially made of concrete);
- they can incorporate inside them scenic settings depicting rocks, stones, sand, and the like with particularly small thicknesses (even just 1 cm);
- they can incorporate inside them dedicated shapes, without the need to provide them in concrete, such as chaises longues, seats, islands, decorative walls, technical elements for whirlpool bath, and the like;
- they are impermeable from the surface without the need to use cement mixtures made impermeable by a high component of acrylic resin thereof, which, being rubbery, might be subject to great deterioration over time, losing the impermeabilizing properties (due to the deterioration caused by solar radiation, microorganisms and algae);
- they use the presence of crystals of silica in the mixture of the constituents of each layer in order to obtain the watertightness of each layer 9, 10, 11, 12, 13, 14, without assigning this task to the acrylic resin (the only goal of which is to allow better cohesion between sand of silica, limestone, fibers of silica, and which, if a geopolymeric binder is used, is even superfluous).

[0096] The mechanical performance of the basin/swimming pool 1 according to the invention are ensured also by the presence of the structural meshes made of fiber of silica (or glass fiber).

[0097] It is specified that, from a constructive point of view, the layers 9, 11, 12, 13, 14 have a thickness of few centimeters (indicatively between 1 and 5 cm); only the layer 10 will have a greater thickness up to even about ten centimeters (constructive solutions in which this layer 10 has a thickness even greater than 10 cm are not excluded, in the case of forming of specific volumes for design requirements).

[0098] In general, with reference to an embodiment that is particularly efficient and of optimum installation, all the layers 9, 10, 11, 12, 13, 14 may preferably comprise acrylic resin in a percentage comprised between 3% and 7% with respect to the binder comprising silica (for example a calcite-based binder).

[0099] The layers 9, 10, 11, 12, 13, 14, if a geopolymeric binder is adopted therein, do not require the presence of acrylic resin, which therefore becomes an optional ingredient (which generally will not be adopted).

[0100] Advantageously, the present invention solves the problems described above, devising a method for providing artificial basins, swimming pools 1 and the like of simple implementation.

[0101] Conveniently, the method according to the invention allows to provide swimming pools and artificial basins that require limited maintenance.

[0102] Positively, the method according to the invention allows to provide artificial basins, swimming pools 1 and the like of high aesthetic value.

[0103] Usefully, the method according to the invention can be performed with the aid of raw materials which are easily transportable and/or obtainable.

[0104] Favorably, the method according to the invention is particularly stable on the installation area.

[0105] Validly, the method according to the invention is relatively simple to provide in practice and of low cost: these characteristics make the method according to the invention an innovation of assured application.

[0106] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims; all the details may furthermore be replaced with other technically equivalent elements.

[0107] For example, it is not excluded, optionally and only in particular applications, to add to the layers 9, 10, 11, 12, 13, 14 silicone-based powder additives to in-

crease their degree of surface watertightness: such additives (if present) will be introduced in a percentage variable between 0.1% and 1% with respect to the non-organic mineral binder.

[0108] In the exemplary embodiments shown, individual characteristics, given in relation to specific examples, may actually be interchanged with other different characteristics that exist in other exemplary embodiments.

[0109] In practice, the materials used, as well as the dimensions, may be any according to the requirements and the state of the art.

[0110] The disclosures in Italian Patent Application No. 102020000029654 from which this application claims priority are incorporated herein by reference.

[0111] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A method for providing artificial basins, swimming pools and the like, which consists in

   - performing an excavation (2) that corresponds to an artificial basin according to design specifications;
   - providing a substrate (3), on surfaces (4, 5, 6) of said excavation (2), of a type chosen preferably from a substrate (3) made of nonwoven fabric, a substrate (3) made of a material comprising silica, a substrate (3) made of gravel, a substrate (3) made of at least partially polymeric mineral material of non-organic origin, a substrate (3) made of composite material, a substrate (3) made of polymeric material, a substrate (3) made of compacted soil/sand, and combinations thereof;
   - arranging equipment (7) and piping (8) for supplying and discharging water on said substrate (3);
   - distributing on the substrate (3) and on the overlying equipment (7) and piping (8) a first layer (9) constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value, and acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, adapted to render said first layer (9) suitable for the optimum adhesion of additional layers for lining it;
   - distributing a second layer (10), which is at least partially impermeable, constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value, acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, fibers of silica, glass, hemp and the like, having a length comprised between 1.0 cm and 6 cm, and a material that allows shaping and has a low relative density, chosen preferably from cork in chips, hemp fibers, natural fibers, granules of expanded polymeric material, and the like;
   - after the consolidation of said second layer (10), shaping a surface thereof with abrasive tools and instruments, until it is rendered completely uniform and compliant with the design standards;
   - spreading at least one third layer (11, 12) constituted by a mixture of water, mineral binder of non-organic origin, sand with low particle size value, acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, and at least one structural mesh made of fiber of silica, glass and the like, with at least unidirectional mechanical properties;
   - spreading a fifth layer (13), which is impermeable, constituted by a mixture of water, light-colored mineral binder of non-organic origin, silica sands with low particle size value, acrylic resin, in a percentage variable between 0% and 10% with respect to the non-organic mineral binder, and fibers of silica, glass, hemp and the like, having a length comprised between 1.0 cm and 6 cm.

2. The method according to claim 1, **characterized in that** said mineral binder of non-organic origin is of the type chosen from a binder comprising silica, a calcareous-siliceous binder, a calcareous/cement binder, a geopolymeric binder, a combination thereof, and the like.

3. The method according to claim 1, **characterized in that** it comprises a sixth and last impermeable finishing layer (14) constituted by a mixture of

   - water,
   - mineral binder of non-organic origin,
   - sand of the final color to be given to the artificial basin being provided, with particle size variable between 0.01 mm and 1.8 mm,
   - acrylic resin in a percentage variable between 0% and 10% with respect to the non-organic mineral binder.

4. The method according to claim 1, **characterized in that** the mixture used to provide said first layer (9) is constituted by a part of solid premix, which comprises non-organic mineral binder and sand with low particle size, and a part of a mixture of water and acrylic resin in a percentage variable between 0%

and 10% with respect to the non-organic mineral binder.

5. The method according to claim 1, **characterized in that** the fibers of silica, glass, hemp and the like comprised in said second layer (10) have a length comprised between 1.2 cm and 5 cm and are present in a percentage comprised between 3% and 5%.

6. The method according to claim 1, **characterized in that** the material of said second layer (10) is mixed by means of a concrete mixer, with the addition of water and acrylic resin in a percentage variable between 3% and 7% with respect to the binder comprising silica, and is distributed for a thickness comprised between 2 cm and 10 cm, preferably between 3 cm and 5 cm, coating completely the excavation (2) up to a portion (6) that is contiguous and slightly downward-sloping which is arranged so as to surround the side walls (4) of said excavation, said portion (6) providing perimetric shores.

7. The method according to claim 1, **characterized in that** said second layer (10) comprises shaped solid components made of a material with low relative density of the type of an expanded polymer and arranged so as to rest on said first layer (9), said shaped solid components being chosen preferably from steps, seats, decorative shaped blocks, functional shaped blocks, and the like.

8. The method according to claim 1, **characterized in that** said third layer (11) is constituted by the overlap of at least two stratifications, at least one first stratification comprising at least one mesh with mechanical properties which are at least unidirectional along the direction of the length of the basin, at least one second stratification comprising at least one mesh with mechanical properties which are at least unidirectional along the direction of the width of the basin, said meshes having a tensile strength, along the at least one direction of action, of no less than 2100 N for each strip of 5 cm of width.

9. The method according to claim 1, **characterized in that** at least one between said fifth layer (13) and said sixth layer (14), which are impermeable finishing layers, comprises sand with a particle size that can vary between 0.02 mm and 1.5 mm, acrylic resin in a percentage that can vary between 3% and 7% with respect to the binder based on calcite, preferably comprising belite to increase its degree of surface watertightness also in terms of durability, and anti-filming additives, in order to avoid the forming of surface films on the layer (13, 14), and anti-cracking additives, in order to prevent cracking of the layer (13, 14).

10. The method according to one or more of the preceding claims, **characterized in that** said geopolymeric binder comprises synthetic materials based on aluminosilicates.

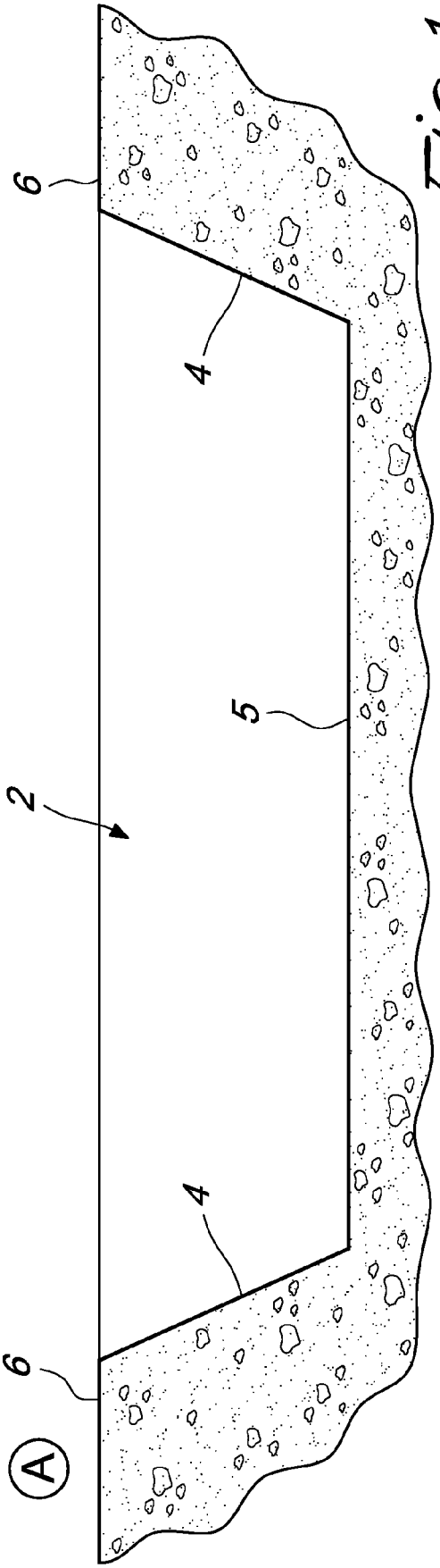

Fig. 1

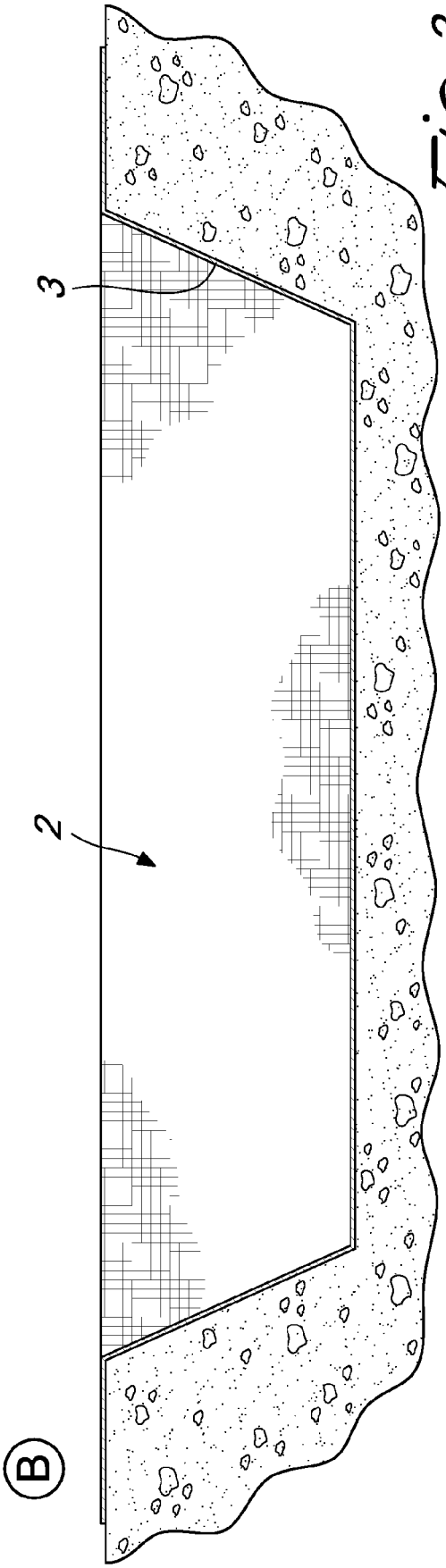

Fig. 2

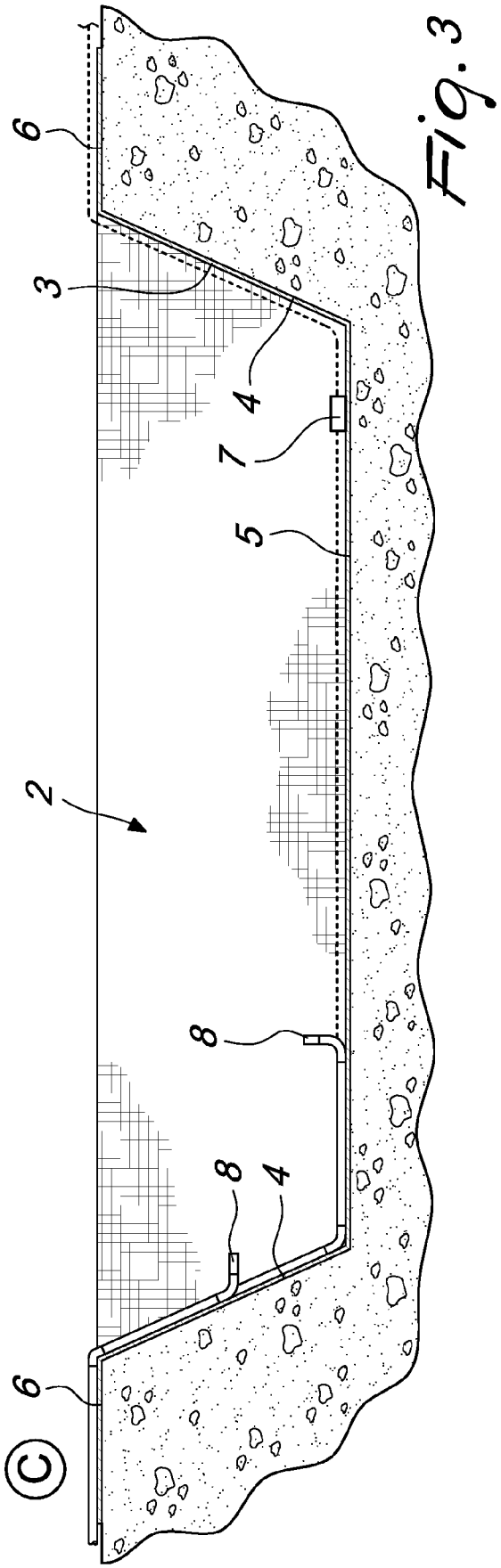

Fig. 3

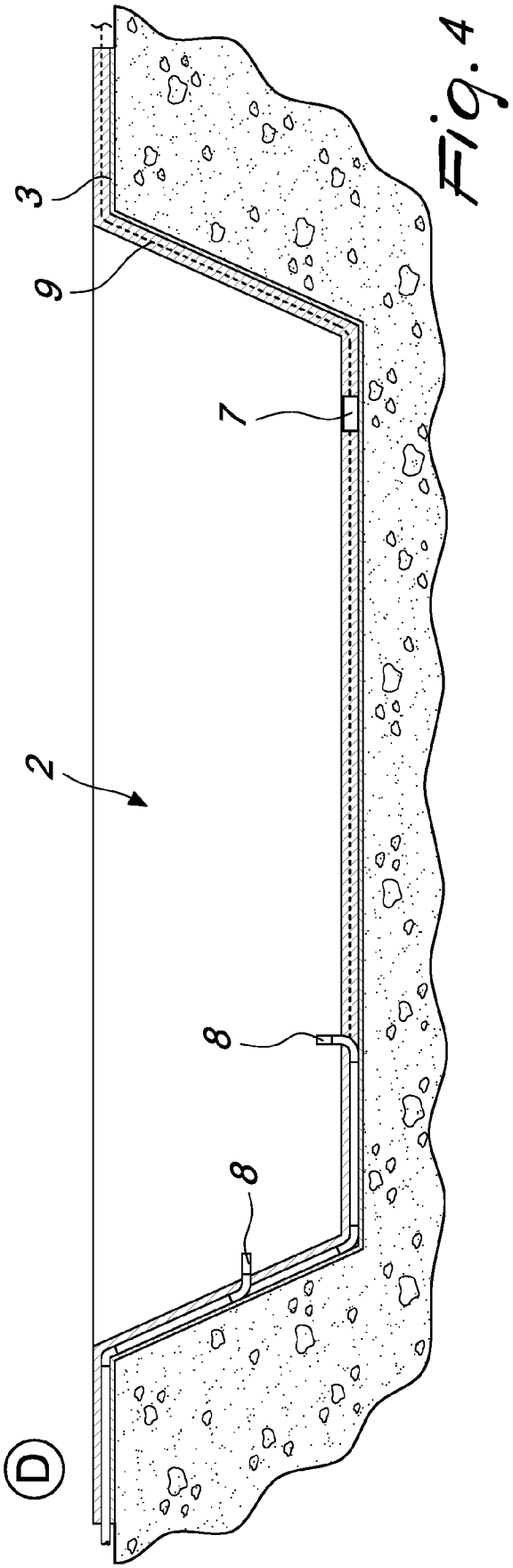

Fig. 4

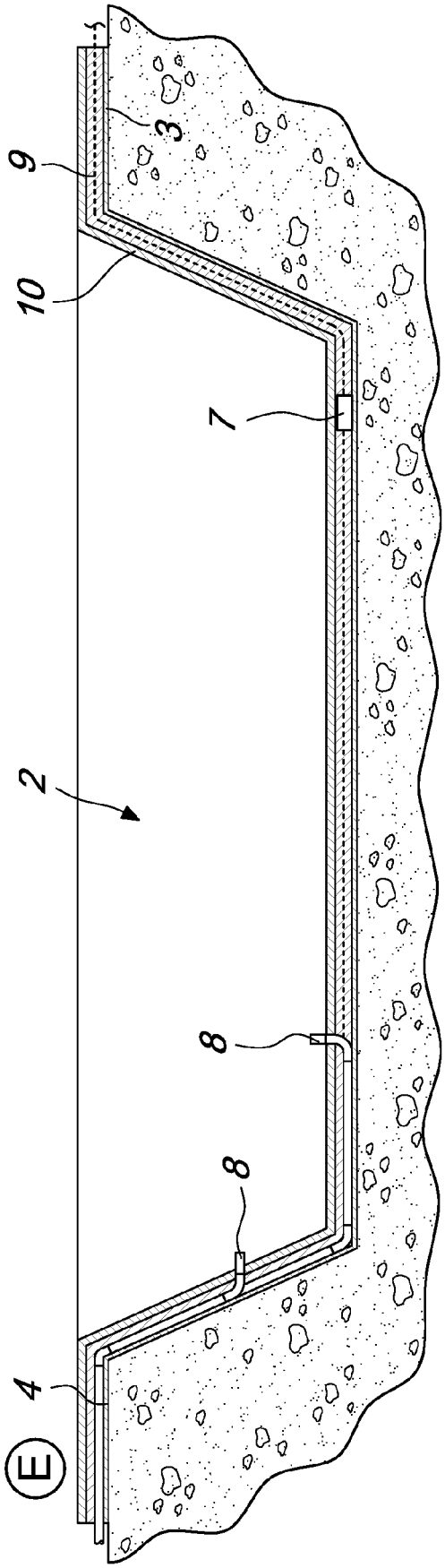

Fig. 5

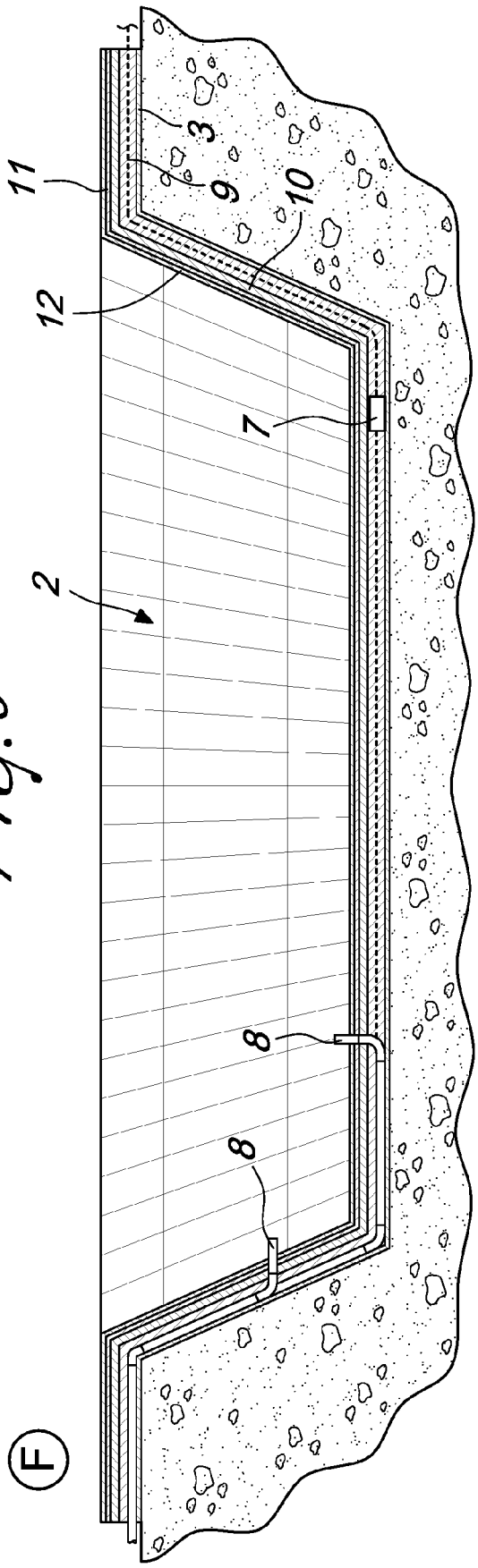

Fig. 6

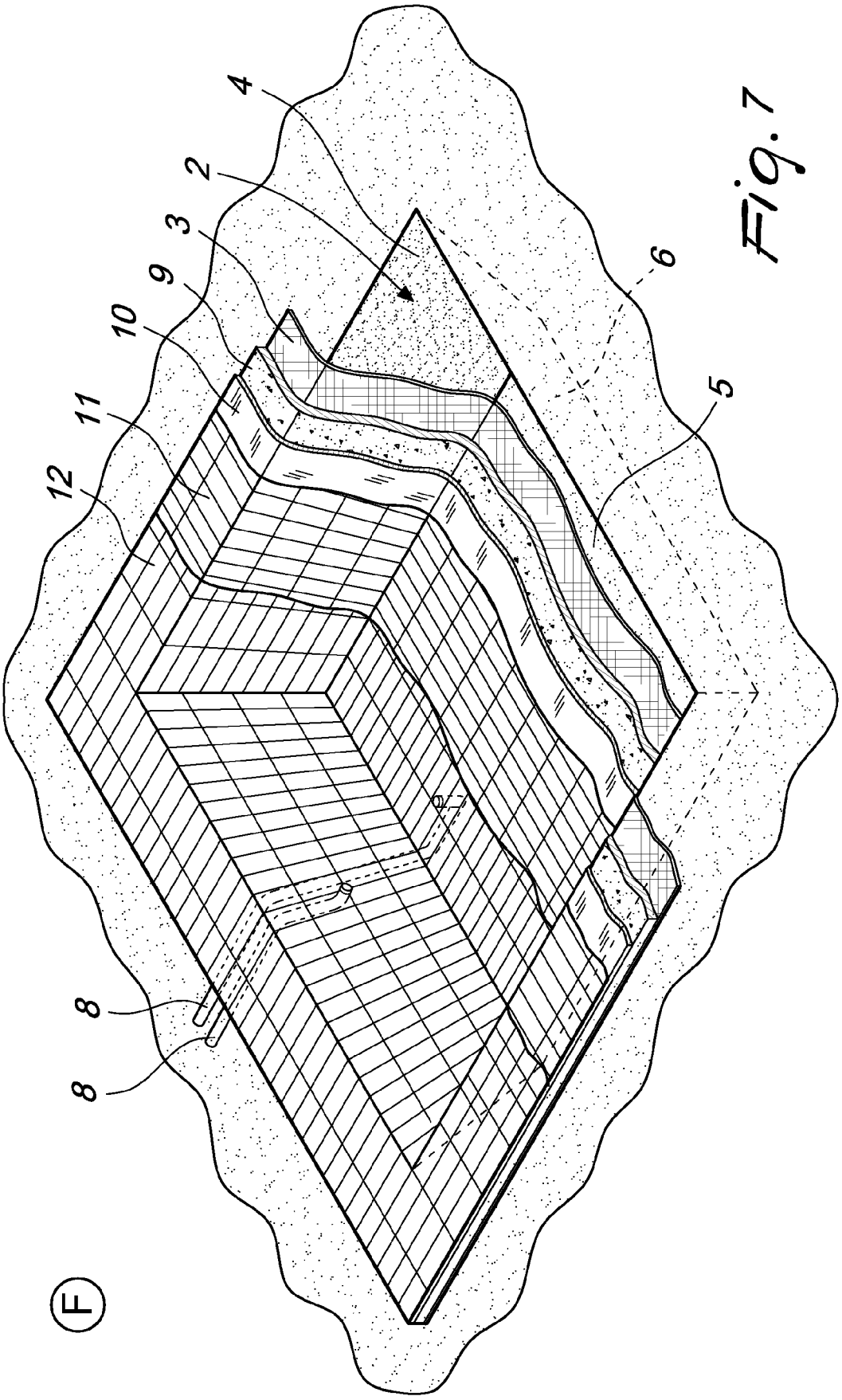

Fig. 7

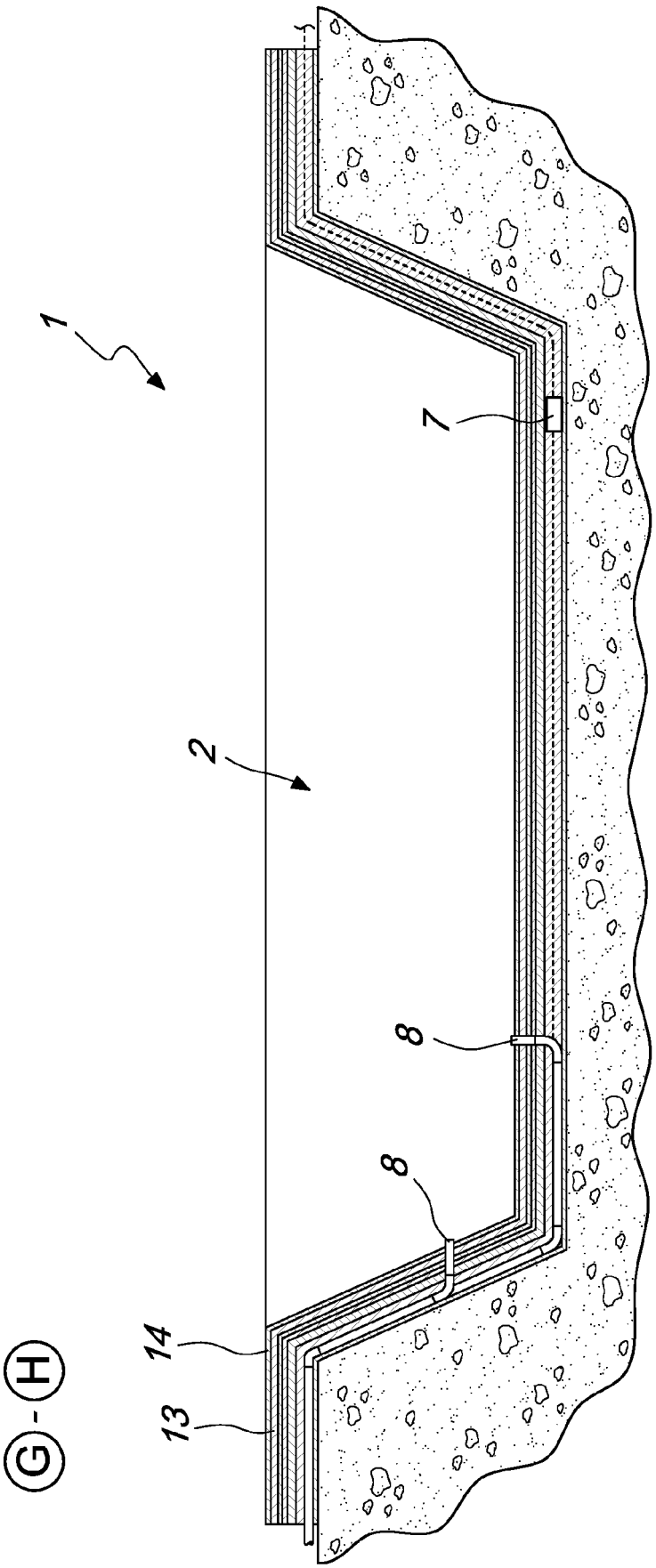

Fig. 8

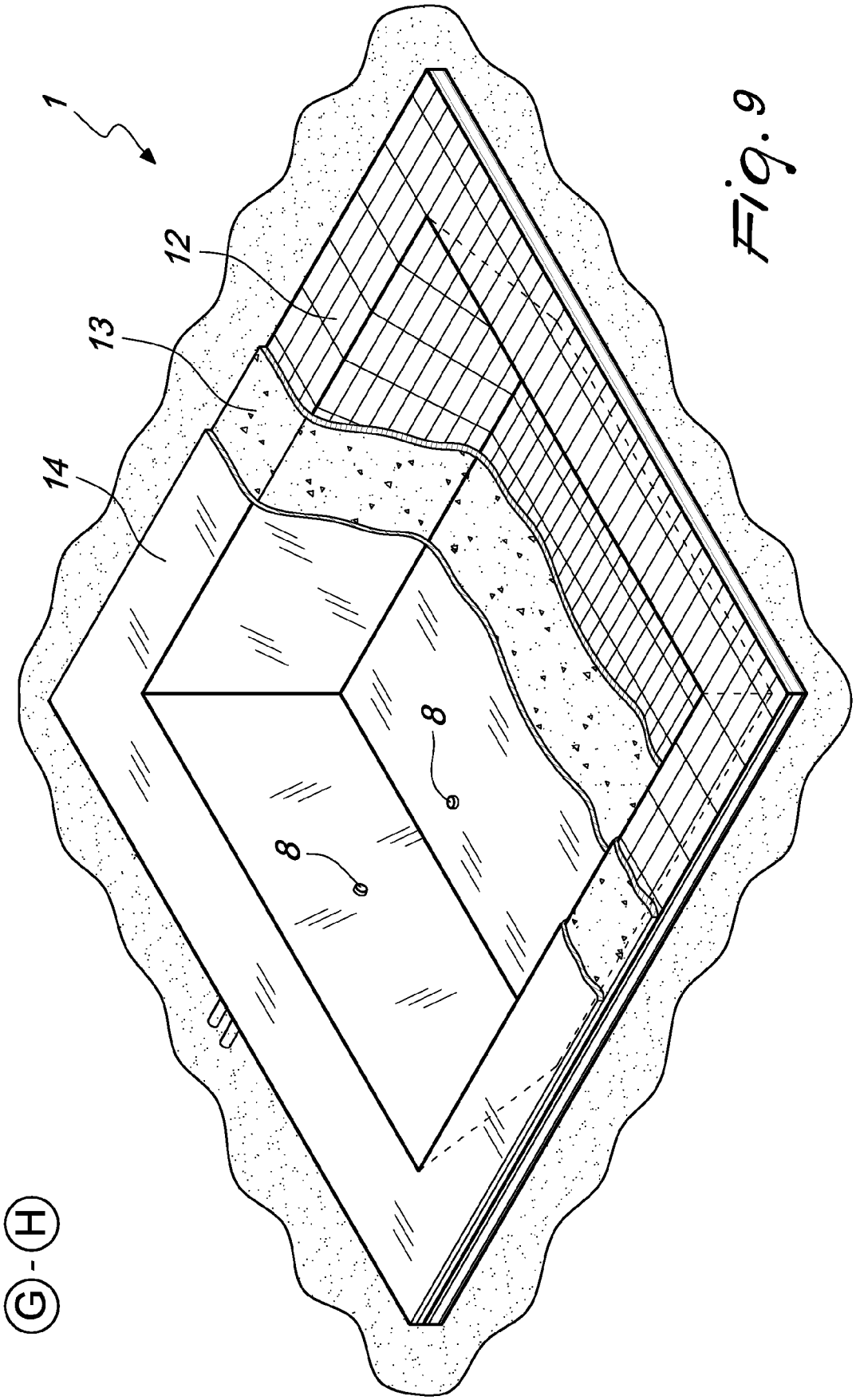

Fig. 9

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EUROPEAN SEARCH REPORT

Application Number
EP 21 21 1655

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 3 388 598 A1 (CASADIO GIANLUCA [IT]) 17 October 2018 (2018-10-17)	1-9	INV. E04H4/00
Y	* claims 1,2,6-11; figures 1-9 *	10	
Y	KR 102 041 976 B1 (KO HUNG JIN [KR]; LEE SUN YOUNG [KR]) 7 November 2019 (2019-11-07)	10	
A	* paragraphs [0014], [0016], [0028], [0029]; claim 1 *	1	

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	7 April 2022	Decker, Robert

CATEGORY OF CITED DOCUMENTS

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07-04-2022

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EP 3388598 A1	17-10-2018	NONE	
KR 102041976 B1	07-11-2019	NONE	

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

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- IT 102020000029654 **[0110]**