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

(11) EP 2 712 961 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.04.2014 Bulletin 2014/14

(51) Int Cl.:
E01F 7/04 *(2006.01)*

(21) Application number: **12382378.3**

(22) Date of filing: **28.09.2012**

(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

(71) Applicant: **3S Geotecnia y Tecnologia S.L.**
20115 Astigarraga (ES)

(72) Inventor: **Torres Vila, Juan Antonio**
20115 ASTIGARRAGA (ES)

(74) Representative: **Igartua, Ismael**
Galbaian S.Coop.
Polo de Innovación Garaia
Goiru Kalea 1 - P.O. Box 213
20500 Arrasate-Mondragón (ES)

(54) **Netting for a slope stabilization system or for a protection kit against landslides**

(57) Netting for a slope-stabilisation system, comprising at least one metal cable (5) that extends substantially in a zig-zag along the netting (3) and in which the juxtaposed or bound lines or points of the cable (5) are joined by structural clips (1, 1'), forming a continuous netting (3) with a plurality of diamond-shaped inner grids (4). All the grids (4) comprise a substantially equal size, and said size is defined according to the traction strength that the netting (3) has to withstand.

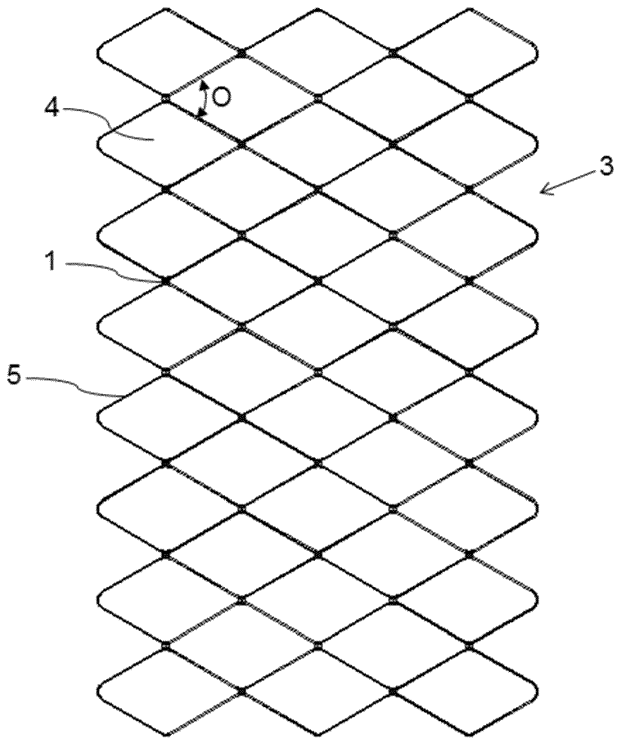

FIG. 1

EP 2 712 961 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to the field of geotechnics, in particular to nettings used in systems and solutions for stabilising and protecting slopes on natural clearings or hillsides in which flexible membranes are used for their combination with a ground-fixing system, both of the active or passive type, or in kits protecting against landslides and of the dynamic barrier or screen type. The invention also relates to systems and kits that comprise at least one of these nettings, and to procedures for installing these systems.

PRIOR ART

[0002] There are known precedents relating to flexible systems for stabilising and protecting slopes that use flexible membranes, generally formed by networks of steel cable or by steel wire mesh, combined in all cases with a system for fastening them to the ground, both active and passive.

[0003] The function of these stabilisation systems is to prevent landslides and the movement of soil masses and unstable rocks on the slope. Specifically, the flexible membrane acts as a cover of the surface of the area to be stabilised, operating as a member supporting or distributing the stabilising pressure.

[0004] There are also known kits protecting against landslides, and of the dynamic barrier or screen type, composed of a structure fastened to the ground and a collection element joined to the preceding structure of the flexible membrane type, formed by a steel cable network, steel wire mesh or networks of steel wire rings, the function of which is to act as an interposed element combating possible landslides.

[0005] Among the flexible membranes of the steel cable network type, ones in which an individual sector of the network, also known as netting, is formed by a single cable cross-linked orthogonally to form inner grids of specific sizes, usually between 150 mm by 300 mm, are known. At the intersections, the cross-linked cable is fixed on itself by metal pressure clips or with steel wire connections, maintaining the position of the cable by pressing an offshoot of it against the other to prevent its separation or movement when the netting is subjected to stresses.

[0006] Generally speaking, the pieces that form the metal pressure clip are substantially quadrangular, being capable of being different to each other or symmetrical, being provided with pins, allowing one to be inserted into another, and presenting a grooved interior or with perforations with a view to improving the fastening at the intersection of the offshoots of the cable.

[0007] As regards the steel wire connections, these comprise a knot or one or more steel wires with strong characteristics and properties that allow them to be wound on the cables they fix.

[0008] In general, in all cases the basis has been a type of pre-existing cable network originally developed for systems for containing falling rocks, being used directly as flexible membranes in slope-stabilisation systems without it being adapted to the specific application in which it is to be used.

[0009] However, the technology for forming and manufacturing the steel-cable netting has the drawback of having been developed for cables of a certain diameter, essentially of 8 millimetres, below specifications dictated by the pressure clips or fixing knots used traditionally.

[0010] Up to this point, with the aim of increasing the strength of the steel-cable netting and therefore its ability to support or distribute the steel-cable netting in a flexible stabilisation system or in protection kits against landslides, given the limitation of the pressure clip or fixing knot, the solution adopted is to reduce the size of the inner grid of the netting during its manufacture. This brings with it a substantial increase in the amount of cable used and the number of cable intersections and therefore the clips or fixing knots per square metre of surface, which makes the manufacturing process more laborious, while the consumption of materials, the weight of the netting and its rigidity are significantly increased, all this resulting in an increase in manufacturing and transport costs and the cost of installing the cable netting as a membrane in a flexible stabilisation system or collection surface in a protection kit against landslides.

[0011] Given the aforementioned considerations and determining factors, the steel-cable netting is generally manufactured in a rectangular form with reduced sizes of between 3.0 metres by 4.0 metres, although nettings of up to 3.0 metres by 5.0 metres may be produced. Their final characteristics determine the usual mode of transport used, forming large rolls that occupy a lot of space in comparison with the effective surface of the nettings.

[0012] As regards the use of the steel-cable nettings as a flexible membrane in a slope-stabilisation system, once these have been disposed on the surface of the slope, the nettings are joined to each other by spliced load-transmitting cables, due to the impossibility of their fastening directly on the network and to the technology for producing rectangular nettings of sizes equal to the fastening grid. The ends of these cables and the vertices of the connections between adjacent nettings are fixed by cable clips to guarantee the continuity of the flexible support or distribution membrane, which must in turn be strutted in a continuous manner on the entire perimeter of the surface to be treated. The ends of both the perimeter cables and the spliced load-transmitting cables between nettings must be fixed without fail on flexible cable anchors in order to transmit the stresses generated in a suitable manner.

[0013] With the type of flexible stabilisation systems currently in use it is strictly necessary that the inner steel-bar anchors are fitted coincidentally with the vertices of the cable netting itself and on the intersections of the spliced load-transmitting cables, these positions being conditioned and fixed by the size of the steel-cable netting. This represents a significant limitation in these types of flexible stabilisation systems given the rigid arrangement of the inner anchors.

[0014] Prior to the installation of the cable nettings on the ground, the surface of the ground must be covered with an intertwined steel wire mesh, usually hexagonal, which makes the netting easier to arrange on the slope.

[0015] The wire mesh then has a ground-support function inside each inner grid of the steel-cable netting. However, due to the small size of the inner grid used to manufacture the steel-cable netting, the steel wire mesh is structurally underused as a component of the flexible stabilisation system.

[0016] The stabilisation support provided by the membrane, regardless of the system of anchors, is determined by the diameter of cable used in the manufacture of the netting, the size and shape of the inner grid of the netting, and by the operating model according to which it has been installed (the manner of transmitting the stresses between the elements of the system).

[0017] Given the aforementioned considerations referring to the current prior art, the stabilisation support values offered by existing solutions are restricted to 30 kN/m^2, are not very effective and are expensive. In all cases, a type of cable network originally developed for systems for containing falling rocks and which have not been optimised for their use as flexible membranes in slope-stabilisation systems is used.

[0018] In stabilisation systems that use flexible membranes, two types may fundamentally be differentiated depending on their combination with passive or active anchors, varying the operating method and behaviour of the system's components.

[0019] The behaviour of a flexible stabilisation system combined with passive anchors involves the pressure exerted by the ground being transmitted to the wire mesh, which transmits the stresses to the cable nettings and from these to the spliced load-transmitting cables before reaching the anchors, on the head of which are disposed fixing plates, so that the bulb of the anchors finally dissipates the stresses in the stable area of the interior of the mass.

[0020] In a flexible stabilisation system combined with active anchors, which are initially pretightened and therefore loaded, a support is exerted on the entire surface of the ground through the membrane formed by the cable netting and the wire mesh. The membrane must be attached conveniently to the surface in such a way that it is capable of transmitting to the ground the load it receives from the anchors.

[0021] The spliced load-transmitting cables are tightened by the load of the anchors, on the head of which are disposed the fixing plates, which in turn tighten and deform the membrane formed by the steel-cable nettings, which presses the ground though the cables that form them and on the steel wire mesh itself.

[0022] In all cases, in order to guarantee that the flexible stabilisation system with a flexible membrane formed by steel-cable netting operates correctly, painstaking installation work is required, requiring the implementation of a rigorous installation procedure that strictly follows the sequence of operations to be carried out. This requires, on the part of the installation personnel, the on-site execution of a large number of operations (seam, connections, tightening of cables, etc.) hampered by unfavourable working conditions, mainly because the installation personnel are suspended on the slope, which means a great deal of time and therefore money is spent on the system's assembly operations.

[0023] The working conditions and the demanding nature of the operations to be performed mean that it is not easy to ensure that the flexible stabilisation system is executed correctly, that it complies with its design and calculation specifications, and therefore to subsequently check that it is operating correctly.

[0024] With the use of the steel-cable netting as a collection surface in a protection kit against landslides, once the structure of the kit has been erected and fastened to the ground, the steel-cable nettings are deployed as an interposed element combating possible landslides, said nettings being joined to each other by spliced load-transmitting cables in order to transmit the stresses generated by the impact of rocks in a suitable manner.

[0025] The retention capability provided by the flexible membrane, regardless of the manner of connection to the structure of the protection kit, is determined by the diameter of cable used in the manufacture of the netting, the size and shape of the inner grid of the netting, and by the operating model according to which it has been installed (the manner of transmitting the stresses between the elements of the system).

BRIEF DISCLOSURE OF THE INVENTION

[0026] It is an object of the invention to provide a netting, as described in the claims.

[0027] The netting of the invention is designed for flexible slope-stabilisation systems, as a flexible membrane of the system or part of a flexible membrane, or protection kits against landslides as a collection surface of the system. The netting comprises at least one metal cable, which extends substantially in a zig-zag across the netting and in which the juxtaposed or bound lines or points of the cable are joined by structural clips, forming a continuous netting with a plurality of diamond-shaped inner grids. All the grids comprise a size substantially equal to each other, and said size and the diameter and the strength of the cable are defined according to the traction strength the netting has to withstand.

[0028] The use of structural clips causes that not all the force is supported by the cables, rather that it is also supported by the structural clips, whose sole function is not now to hold the cable or the cables that form a netting.

[0029] In addition, the flexibility with regard to the size of the grids of the netting allows netting with a lower weight per square metre to be obtained, allows a reduction in the number of necessary connections in the netting, and allows a reduction in the length of the cable to be used, with the consequent reduction in the consumption of material in the manufacture of the netting in relation to the nettings of the prior art, and a reduction of costs. The possibility of manufacturing the netting with a smaller inner grid size and the fact that there is freedom to use larger cable diameters, allows the requirements of the netting to be adapted optimally to its strength requirements in accordance with the field of application: in a slope-stabilisation system it allows a wide range of supports to be covered, from the lightest (10 kN/m^2) up to 100 kN/m^2 for nettings of 500 mm by 500 mm and cable with a diameter of 18 mm, for example, with the advantage of making the flexible stabilisation system more efficient in terms of cost/support. In a protection kit against landslides it allows the strength of the collection surface to be varied, adapting it to the energy capacity requirements of the protection kit, and therefore, the traction strength requirement of the collection surface.

[0030] The netting may also be compressed in the manner of an accordion for its packaging and transport, occupying a compact space that is considerably smaller than current nettings, thus reducing transport costs in relation to them.

[0031] As a result, given the design of the netting of the invention, its weight, size and characteristics, it is possible to manufacture continuous nettings that are unlimited in length.

[0032] These and other advantages and characteristics of the invention will be made evident in the light of the drawings and the detailed description thereof.

DESCRIPTION OF THE DRAWINGS

[0033]

Figure 1 shows an embodiment of steel-cable netting with the position of structural clips used for its manufacture.

Figure 2 shows an embodiment of a continuous flexible membrane from the connection to each other of a plurality of nettings such as the one in Figure 1.

Figure 3a shows an embodiment of a closed structural clip.

Figure 3b shows the closed structural clip of Figure 3a, with cables in its interior.

Figure 4a shows an embodiment of an open structural clip with side bolts.

Figure 4b shows the open structural clip of Figure 4a, with cables in its interior.

Figure 5 shows a detail of a netting according to the invention, where a fixing plate is shown.

Figure 6a shows an embodiment of a hexagonal-type fixing plate.

Figure 6b shows an embodiment of a rectangular-type fixing plate.

Figure 7a shows a first embodiment of the slope-stabilisation system, using the steel-cable netting of the invention.

Figure 7b shows a second embodiment of the slope-stabilisation system using the steel-cable netting of the invention.

Figure 8 shows a detail of an embodiment of a protection kit against landslides using the netting, according to the invention.

DETAILED DISCLOSURE OF THE INVENTION

[0034] A first aspect of the invention relates to a netting for flexible slope-stabilisation systems.

[0035] The netting 3 of the invention, which comprises at least one metal cable 5, which may comprise a diameter of between approximately 12 mm and approximately 18 mm. Preferably the netting 3 is formed by a single cable 5 made of galvanised steel or another material offering suitable protection against corrosion, which extends substantially in a zig-zag across the netting 3. The juxtaposed or bound lines or points of the cable 5 are joined by structural clips 1, 1', forming a continuous netting 3 of a fixed width and free length with a plurality of diamond-shaped inner grids 4. All the grids 4 comprise a substantially equal size, and said size, as the diameter and the strength of the cable 5, is defined in accordance with the traction strength the netting 3 has to withstand. The width of the grids 4 may thus be comprised between approximately 500 mm and approximately 700 mm, with an acute angle O in the vertical apex of between approximately 50° and approximately 65°.

[0036] The cable 5 that forms the netting 3 has an inflexion point at the point of connection where each structural clip 1, 1' is found, as a result of which when stress is placed on the cable 5 a strain appears on the plane of the netting 3 which has to be supported by the structural clips 1, 1', which must offer a behaviour and mechanical strength that are appropriate to the diameter and strength of the cable 5 used.

[0037] The structural clip 1, 1' is designed for the manufacture of the nettings 3 without any restriction in the diameter of the cable 5, allowing the shape of the inner grid 4 to be modified, which makes it easier to adapt the netting 3a to the unevenness of the ground and to pack the nettings 3 during transport.

[0038] The structural clips 1, 1' may be of the closed or open type, and are connection members designed to withstand the stresses transmitted by the juxtaposed cables 5 with a greater safety factor of 2 in relation to the break load of the cables 5, in a safe and lasting manner, without the structural clip 1, 1' failing or the cables 5 sliding. The structural clips 1, 1' may be used both in the manufacture of the nettings 3, as is the case in the example shown in Figure 1, and in the installation of a flexible stabilisation system with said type of cable netting 3 for joining different nettings 3 to each other, as is the case in the example shown in Figure 2.

[0039] In the case of Figure 1, the structural clips 1, 1' form the basic elements for the manufacture of the nettings 3 given that the starting point for the manufacture of their inner grid 4 is the juxtaposed cables 5, as a result of which connection members are required that allow the cables 5 to be fixed in their position and withstand the stresses they transmit. The connection members correspond with the structural clips 1, 1'.

[0040] In the case of Figure 2, the structural clips 1' are the connection members between adjacent nettings 3, adapted to enable their arrangement, for example, as a flexible membrane inside a flexible stabilisation system, as described below. Said structural clips 1' are disposed coincidentally with the bows of cable 5 that form the vertices of the netting 3, fixing the cables 5 in their position and withstanding the stresses that they transmit, thereby obtaining a flexible continuous membrane over the entire surface to be treated, in the case, for example, of a membrane of a flexible stabilisation system, without the need for spliced cables or the transmission of additional loads for a specific application.

[0041] As mentioned above, the structural clips 1, 1' that allow the securing of the netting 3 may be of the closed or open type, with structural clips 1' that allow the connection of different nettings to each other being of the open type. Figures 3a and 3b show, by way of example, an embodiment of a closed structural clip 1, which comprises a single piece 6, preferably of galvanised steel, with a housing 6a, 6b for each section of cable 5, the housing 6a, 6b surrounding at least part of the perimeter of the section of the cable 5 that passes through it, and both housings 6a and 6b being separated from each other by a depression area 6c that prevents contact between both sections of cable 5. The dimensions of the piece 6 and its housings 6a and 6b, depend on the diameter of the cable 5 used in the manufacture of the netting 3. The creation of the piece 6 begins with a ring-shaped part and is deformed, preferably by compression by a press, at a certain load once the cables 5 have been inserted into it, preventing their subsequent movement.

[0042] Figures 4a and 4b show, by way of example, an embodiment of an open structural clip 1', comprising two pieces 7a and 7b with at least one connecting member for connecting them to each other. The two pieces 7a and 7b are preferably made of galvanised steel or a similar material, and may be symmetrical or not, and their dimensions, as with the quality of the material, depend on the diameter of the cable 5 used. The connecting member may correspond with bolts 8a and their corresponding nuts 8b, which may be disposed in a central position or on the sides, so that the cables 5 are compressed with a specific torque, preventing their subsequent movement. The two pieces 7a and 7b are open and comprise a C-shaped profile, and one piece 7b is housed or fitted inside the other piece 7a. Both pieces 7a and 7b also comprise at least one hole 7c to allow the connecting member to fix them in relation to each other.

[0043] The use of these types of structural clips 1, 1' allows the netting 3 to be fastened to the ground by anchors 9 in a more effective and flexible manner than in the prior art, as a anchor 9 may be fixed at any point of the netting 3 or of the series of juxtaposed nettings 3 joined to each other, where there is a structural clip 1, 1', offering more fastening points than known nettings 3. In these cases, the netting 3 or the netting of the series of juxtaposed nettings 3 joined to each other also comprises at least one fixing plate 10, 10' for each anchor 9 to be used. The anchor 9 is connected or fastened to the ground, and the fixing plate 10, 10' is fixed to the head of the anchor 9 at the point where there is a structural clip 1, 1', the structural clip 1, 1' being disposed between a fixing plate 10, 10' and a corresponding anchor 9, as shown by way of example in Figure 5.

[0044] Figures 6a and 6b show two examples of a fixing plate 10, 10' used in a netting 3 according to the invention. A fixing plate 10, 10' is used to fix the cables 5 of the netting 3 to the head of the anchors 9 and allow the transmission of the stresses of the anchors 9 to the netting 3 or vice versa, according to the direction of the stresses.

[0045] In the example of Figure 6a the fixing plate 10 is of the hexagonal type, whereas in the example of Figure 6b the fixing plate 10' is of the rectangular type. In both cases the fixing plate 10, 10' is preferably made of steel of special characteristics to withstand the stresses that are generated between the cables 5 of the different juxtaposed nettings 3 joined to each other, or between the different sections of the cable 5 of a netting 3, and in the heads of the anchors 9, keeping the cables 5 linked to the end of the anchor 9 in a secure manner. The cuts, folds and ribs have been designed to increase the flexural strength and reduce the weight of the element and make the process of its manufacture easier. The fixing of the fixing plates 10, 10' may be achieved by means of a nut with characteristics determined by the type of anchor 9 used, or by equivalent means.

[0046] A second aspect of the invention relates to a slope-stabilisation system. A flexible system of this type comprises at least one flexible membrane for containing possible slope landslides, and the system of the invention comprises at least one netting 3 such as the one described for the first aspect of the invention, in any of its configurations and/or embodiments. With the anchors 9, the flexible membrane is fastened to the ground to be protected. Once installed, loaded and attached correctly to the ground, the flexible membrane of the netting 3 with structural clips 1, 1' presents low levels of deformation when loaded as a result of the action of the ground pushing, which is an essential requirement for it to fulfil its functions from a geotechnical viewpoint. The flexible shape of the grids 4 allows better adaptation to the unevenness of the ground and of the surface to be treated. In addition, the possibility of using cable 5 of a larger diameter for the manufacture of netting 3 as described above allows the anchors 9 of the flexible stabilisation system to be fixed directly on the flexible membrane, making the position and the pattern of anchor 9 flexible, it being adapted suitably to the unevenness of the ground.

[0047] With the use of the cable netting 3 with structural clips 1, 1', a wire mesh 12 may be used as a structural part of the flexible support membrane and as an inner containing element in the case of ground with loose blocks with element component sizes smaller than the inner grid 4 of the netting 3, forming an active component of the flexible stabilisation system as the strength of the wire mesh 12 used is structurally balanced with the size of the inner grid 4 of the cable netting 3 and with the support that the flexible membrane must exert.

[0048] Figures 7a and 7b show by way of example two different embodiments of the slope-stabilisation system that is the object of this invention. The flexible system initially requires the arrangement on the ground of a wire mesh 12, preferably made of steel, with characteristics suited to the geotechnical support requirements of the system (in the event that it comprises a wire mesh 12), the function of which is to hold the ground inside the inner grid 4 and the distribution of this pressure to the cables 5 of the netting 3. On the wire mesh 12 are disposed the different individual nettings 3 manufactured with structural clips 1, 1' according to the preceding description, or the netting 3 in the case of just one being used.

[0049] A netting 3 may be fastened to the ground by the anchors 9 in two preferred manners: in a first case being joined directly to the head of the anchors 9 (pointed model), and in a second case forming horizontal strips joined by seam load-transmitting cables 16, preferably made of steel (cylindrical model).

[0050] Figure 7a shows by way of example a flexible stabilisation system where the nettings 3 (or the netting 3) are joined according to the pointed model referred to above. The nettings 3 are joined to each other by means of structural clips 1' of the open type, disposed on the bows of cable 5 that form the vertices of the netting 3 for the joint creation on the entire surface of a flexible continuous membrane supporting the flexible stabilisation system, without the need for additional elements. In this case fixing plates 10, 10' are used and are placed on the head of the anchors 9, for example by means of nuts, and allow the direct transmission of stresses between the anchors 9 and the flexible membrane created by the joining of the nettings 3 by structural clips 1'. The diameter of the cable 5 used for the manufacture of the netting 3 is determined by the stresses that are transmitted to the head of the anchors 9 in the flexible stabilisation system, as said flexible system has been designed to allow the inner anchor 9 to be fixed directly by means of the fixing plates 10, 10' on the flexible membrane formed by the individual nettings 3 manufactured with structural clips 1' and the wire mesh 12, the anchor 9 coinciding with its vertices from where four points of cable 5 generally pull, allowing the free arrangement of the anchors 9 on any vertex of the diamonds of the inner grid 4 of the netting 3. In this case, the design of the netting 3 allows, in some specific applications, a flexible continuous support membrane to be obtained using the open structural clips 1' or shackles at the points of connections between different nettings 3, without the need to use spliced load-transmitting cables or cable clips.

[0051] Figure 7b shows by way of example a flexible stabilisation system where the nettings 3 (or netting 3) are joined according to the cylindrical model referred above. In this case the flexible stabilisation system is completed with at least two horizontal loads transmission seamed cables 16 between nettings 3, which pass horizontally and alternately through adjacent grids 4, and which allow the transmission of the stresses of the netting 3 to the head of the anchors 9 through fixing plates 10, 10'. The horizontal loads transmission seamed cables 16 are connected, or connect, on the edge ends of the flexible system to flexible anchors 15 made of steel cable, for example. As the grids 4 are diamond-shaped, the acute angle of the diamond in the vertical direction allows the tension of the cables 5 of the netting 3 to be directed towards the horizontal loads transmission seamed cables 16 between two consecutive horizontal strips and from there to the anchors 9.

[0052] Although the two examples of the connection of the netting 3 to the ground have been described in relation to a flexible system that comprises said nettings 3, the two connection examples are also applicable to the nettings 3 as such and not only to when they are integrated in a flexible system.

[0053] The slope-stabilisation system may require for its operation, in both cases, a perimeter strut of the cable netting 3 for which is used a steel cable 13 of a suitable diameter, positioned along the edge of the netting 3, passing inside the vertices of the outer grids 4. The edge cables 13 are fixed to the ground by steel-bar anchors 14, unlike their ends, where flexible cable anchors 15 are used.

[0054] To summarise, the use of steel-cable netting 3 with structural clips 1, 1' as a flexible membrane inside a flexible stabilisation system allows an inexpensive and efficient system to be obtained.

[0055] In the fitting on the ground with the pointed-model arrangement, the nettings 3 are disposed on the ground, optionally with a previous disposing of a wire mesh 12, in an adjacent manner joined to each other by structural clips 1' or shackles, thereby creating a flexible continuous support membrane that is strutted around the perimeter, there passing through all the grids 4 of the netting 3 of the outer edge of the area to be treated horizontal cables 13, preferably made of steel, on the upper and lower edge, and vertical cables 17 on the side edges, which are fixed to previously installed flexible corner anchors 15 and corresponding perimeter anchors 14, as shown in Figure 5a. Subsequently, and with the flexible membrane in position and strutted around the perimeter, the inner anchors 9 of the netting 3 are installed, their position being adjusted to the ends of the inner grid 4 of the flexible membrane, according to the requisite density and characteristics. The netting 3 is then joined to the head of the anchors 9 by the fixing plates 10, 10' and corresponding nuts 8b, which allow the netting 3 to be attached and compressed against the ground to guarantee they are tightened at the end of the installation process, system support levels of up to 30 kN/m^2 being obtained with this installation procedure.

[0056] In the fitting on the ground with the cylindrical-model arrangement, the nettings 3 are disposed on the ground, optionally with a previous disposing of a wire mesh 12, in an adjacent manner joined to each other by the seamed cables 16, thereby creating a flexible continuous support membrane that is strutted around the perimeter, there passing through all the grids 4 of the netting 3 of the outer edge of the area to be treated horizontal cables 13, preferably made of steel, on the upper and lower edge, and vertical cables 17 on the side edges, which are fixed to previously installed flexible corner anchors 15 and corresponding perimeter anchors 14, as shown in Figure 5b. The inner anchors 9 and the perimeter anchors 14 of the flexible system are then installed, the cables 13 and 17 are fixed to the flexible side and corner anchors 15, the fixing plates 10, 10' are positioned, and finally the nuts 8b are fitted on in order to fix the fixing plates 10, 10', the netting 3 being brought closer to the surface of the ground. Tension is then applied to the horizontal cables 13 and 16 and then to the vertical perimeter cables 17 so that finally the head of the inner anchors 9 can be tightened for the attaching of the flexible membrane to the surface of the ground, system support levels of up to 100 kN/m^2 being obtained with this installation procedure.

[0057] In both cases, the optimisation of the assembly process is due to factors such as the reduction in the number of elements and components of the flexible stabilisation system, the use of larger, more flexible and easier-to-handle nettings 3, the substantial reduction in the number of seams and connections, the simplification of the connections between nettings 3 through the use of structural clips 1, 1' or shackles in the vertices of the nettings 3 and in general the smaller number of operations necessary at a single point for the assembly of the flexible stabilisation system.

[0058] The netting 3 may also be used as a collection surface for protection kits against landslides, a collection surface being understood as a surface adapted to be interposed and to contain possible landslides.

[0059] A kit comprises a structure, generally formed by various posts 18, which are connected to the ground by respective bases, and said structure is also supported by at least one support cable 19 to the ground. Once the structure of the protection kit against landslides has been installed in a suitable location for stopping stones that may fall from upper areas, and the support cables 19 have been installed, a collection surface 20 must be formed by disposing the nettings 3 as commented above, in any of their configurations and/or embodiments. The nettings 3 are hung from the support cables 19 of the structure, and a wire mesh (not shown in the figures) may optionally be added. Assembly is achieved by connecting adjacent nettings 3 connected to each other by structural clips 1' or shackles such as the ones described above, and passing additional cables (not shown in the figures) through all the grids 4 of the nettings 3 of the external upper and lower edge. These additional cables are connected by shackles and other means to the support cables 19 of the structure of the protection kit.

[0060] It should be pointed out that the invention has been described according to its preferred embodiment, and its form, size and materials may thus be changed, provided that said modifications do not alter the essential nature of the characteristics of the invention claimed below.

Claims

1. Netting for a slope-stabilisation system, comprising at least one metal cable (5), **characterised in that** it comprises a cable (5) extended substantially in a zig-zag across the netting (3) and in which the juxtaposed or bound lines or points of the cable (5) are joined by structural clips (1, 1') forming a continuous netting (3) with a plurality of diamond-shaped inner grids (4), all the grids (4) comprising a substantially equal size and the size of the grids (4) and the diameter and strength of the cable (5) being defined according to the traction strength that the netting (3) has to withstand.

2. Netting according to claim 1, wherein the cable (5) is made of steel and comprises a diameter comprised between approximately 12 mm and approximately 18 mm, and wherein the width of the grids (4) is comprised between approximately 500 mm and approximately 700 mm, with an acute angle (O) in the vertical apex of between approximately 50° and approximately 65°.

3. Netting according to any of the preceding claims, wherein the structural clip (1) comprises a single piece (6) with a housing (6a, 6b) for each section of cable (5), the housing (6a, 6b) surrounding at least part of the perimeter of the section of the cable (5) that passes through it, and both housings (6a, 6b) being separated from each other by a depression area (6c) that prevents contact between both sec-

tions of cable (5).

4. Netting according to claims 1 or 2, wherein the structural clip (1') comprises two ring-shaped and open pieces (7a, 7b) with a C-shaped profile, and at least one connecting member (8a, 8b) by means of which both pieces (7a, 7b) are connected to each other, one piece (7b) being housed or fitted in the interior of the other piece (7a) and both pieces (7a, 7b) comprising at least one hole (7c) to allow the connecting member (8a, 8b) to fix one in relation to the other and a respective housing (9) for each section of cable (5).

5. Netting according to any of claims 1 to 4, comprising attached to it a plurality of anchors (9) for its fixing to the ground, and at least one fixing piece (10, 10') attached to a anchor (9), each anchor (9) being attached to a structural clip (1, 1').

6. Netting according to according to any of the preceding claims, comprising at least two spliced cables (16) transmitting horizontal loads and spliced that pass horizontally and alternately through adjacent grids (4) of the netting (3), and which are adapted to transmit the stresses of the netting (3) to the head of the anchors (9) through the fixing plates (10, 10').

7. Slope-stabilisation system **characterised in that** it comprises, as a flexible membrane, at least one netting (3) according to any of the preceding claims or a plurality of juxtaposed nettings (3) according to any of the preceding claims, which are connected to each other.

8. Protection kit against landslides, **characterised in that** it comprises, as a collection surface (20), at least one netting (3) according to any of claims 1 to 4.

9. Procedure for attaching to the ground a netting or series of nettings connected to each other, according to any of claims 1 to 6, **characterised in that** the netting (3), or series of nettings (3), is strutted around the perimeter by means of horizontal cables (13) that pass through all the grids (4) of the netting (3), or series of nettings (3), the external upper and lower edges of the area to be treated, and by means of vertical cables (17) that pass through all the grids (4) of the netting (3), or series of nettings (3), of the external side edges of the area to be treated, the horizontal and vertical cables (13, 17) being fixed to corner anchors (15) and perimeter anchors (14) that have been fixed to the ground beforehand, and the interior of the netting (3), or series of nettings (3), is fixed to the ground.

10. Procedure according to the preceding claim, wherein, before the netting (3) or the series of nettings (3) is strutted, a wire mesh (12) is disposed on the ground to be treated, and the netting (3), or series of nettings (3), is disposed on the wire mesh (12) in a continuous manner, said netting (3) is connected to each other by connecting a netting (3) to its adjacent nettings in the case of a series of nettings (3), the netting (3) or the netting (3) is connected to the wire mesh (12), and the unit formed by the wire mesh (12) and the netting (3), or the series of nettings (3) connected to each other, is fastened to the ground.

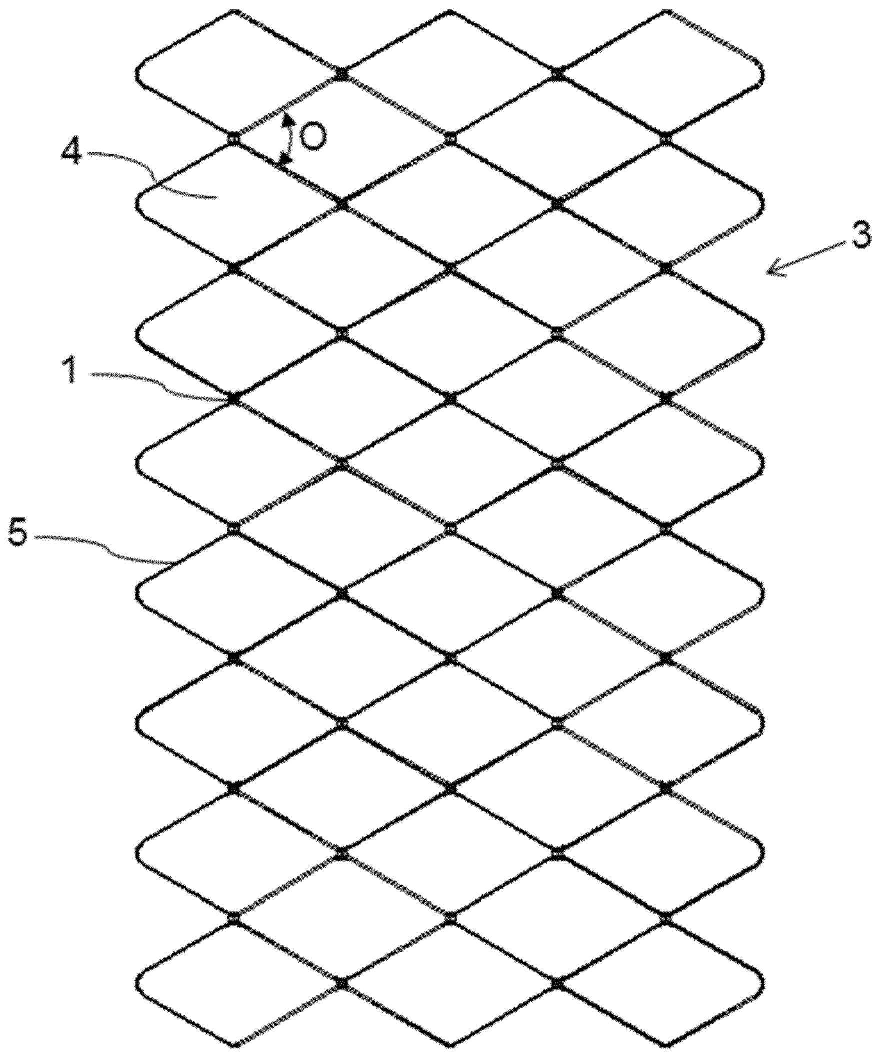

FIG. 1

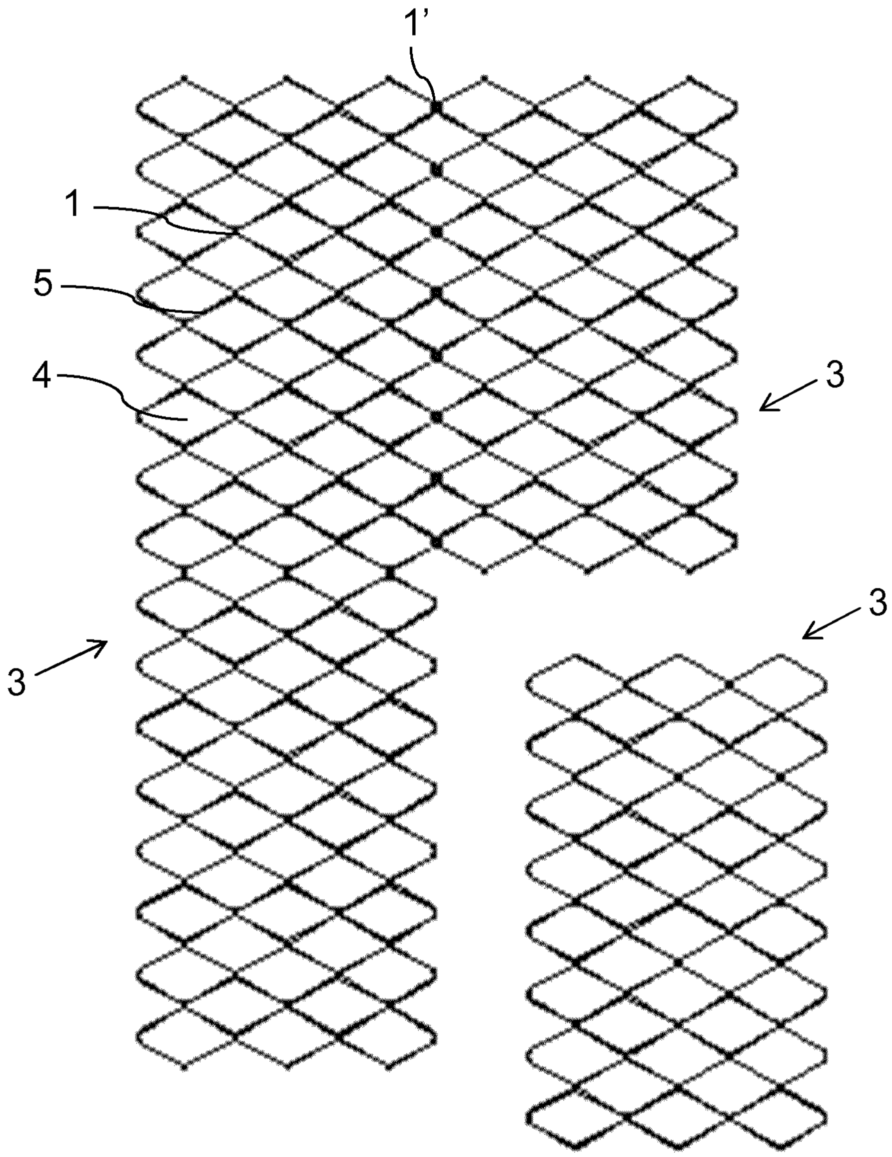

FIG. 2

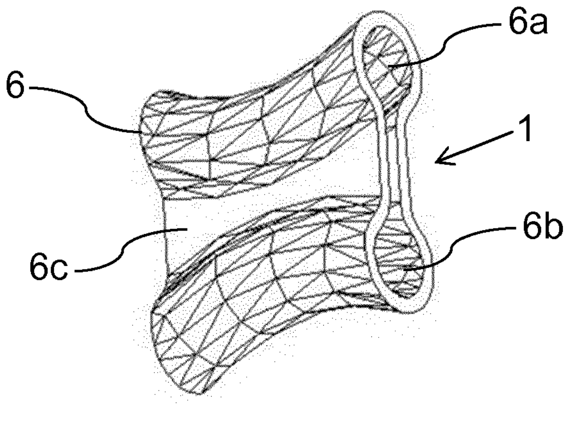

FIG. 3a

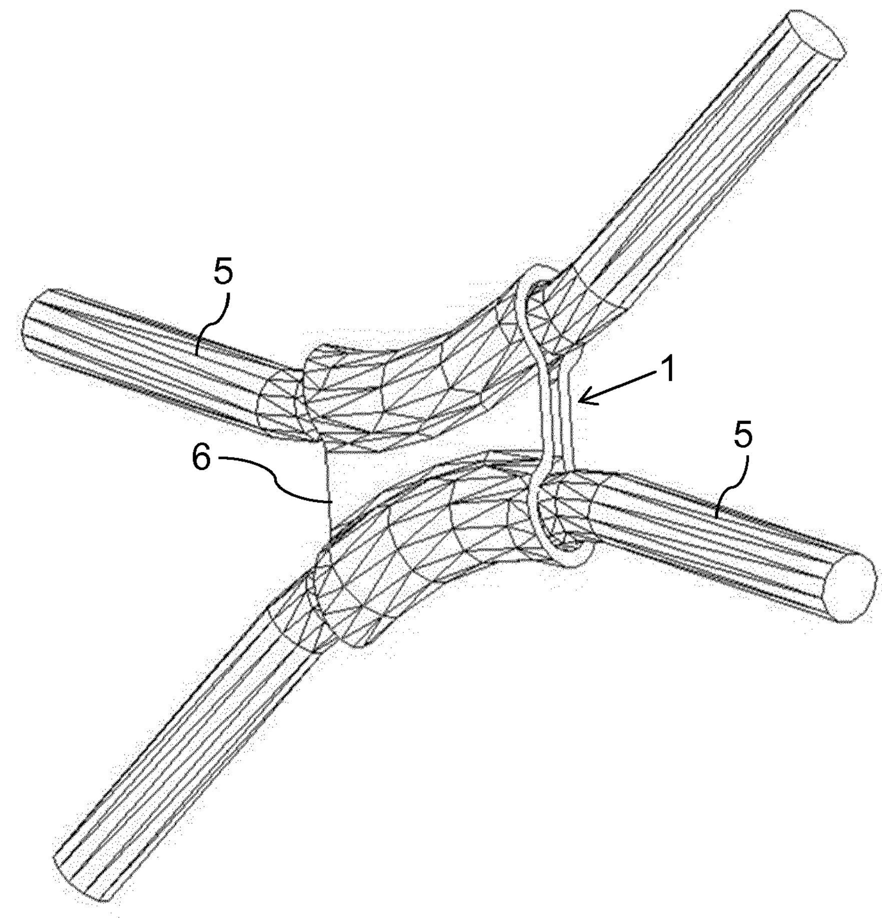

FIG. 3b

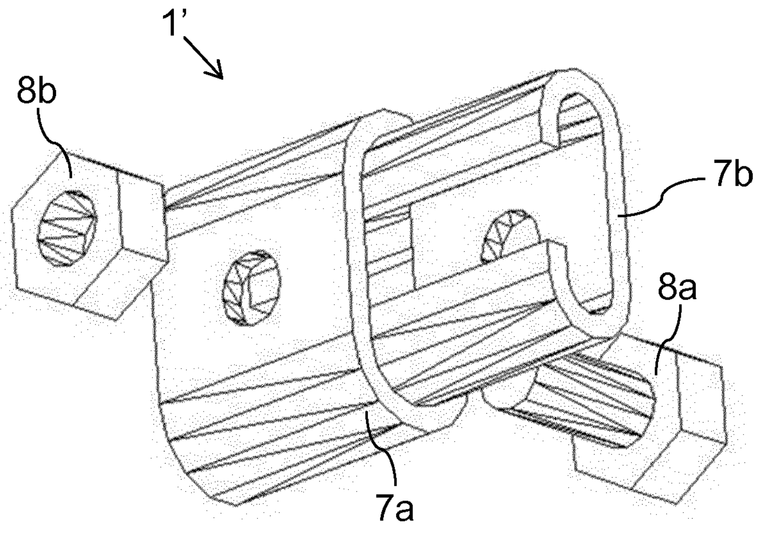

FIG. 4a

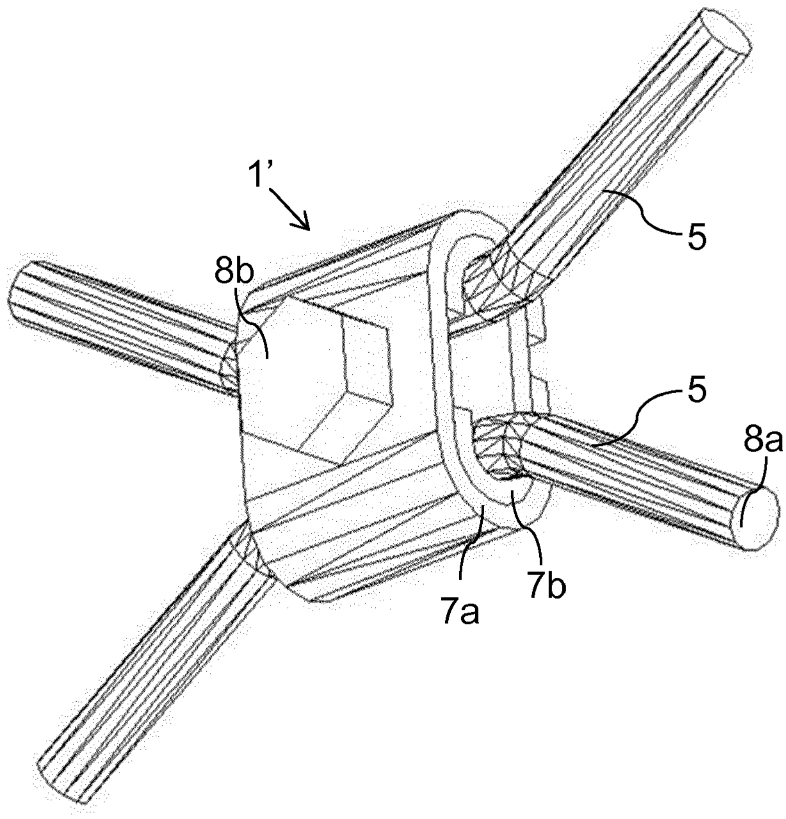

FIG. 4b

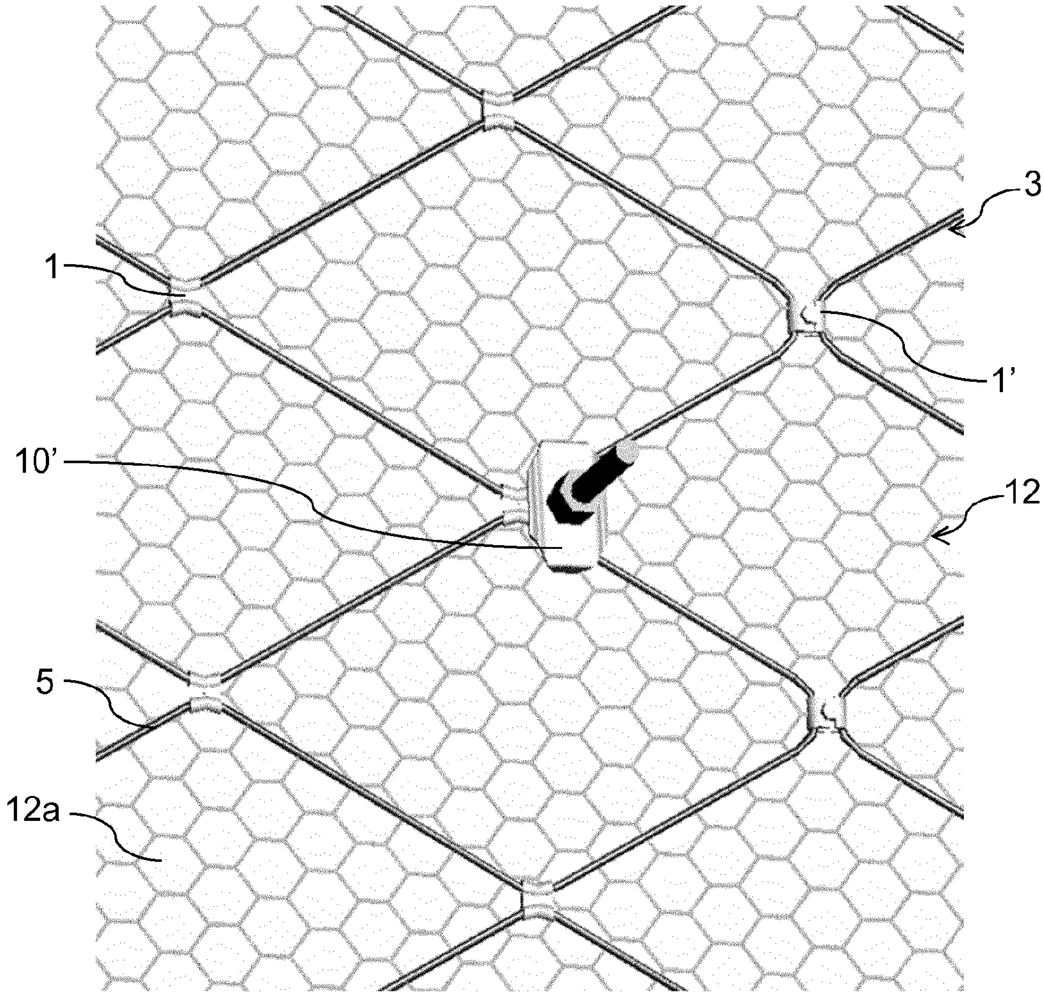

FIG. 5

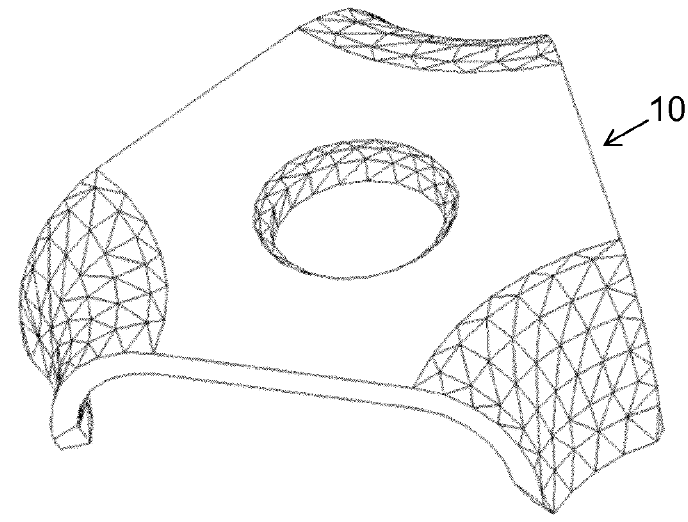

FIG. 6a

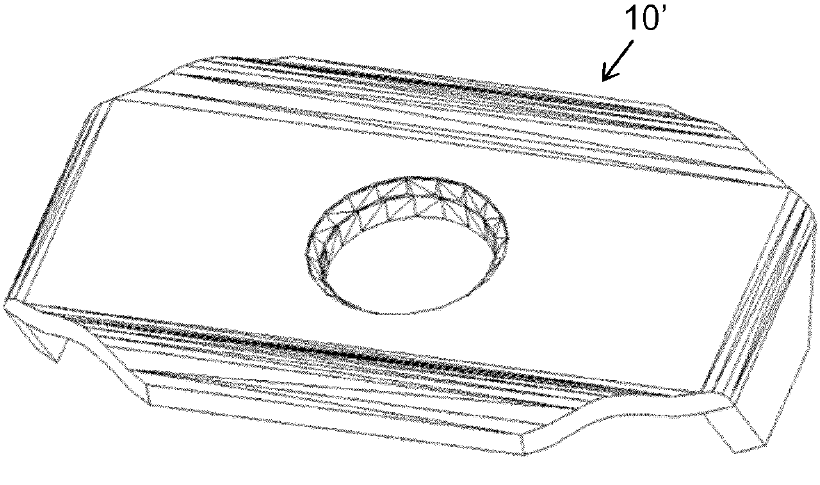

FIG. 6b

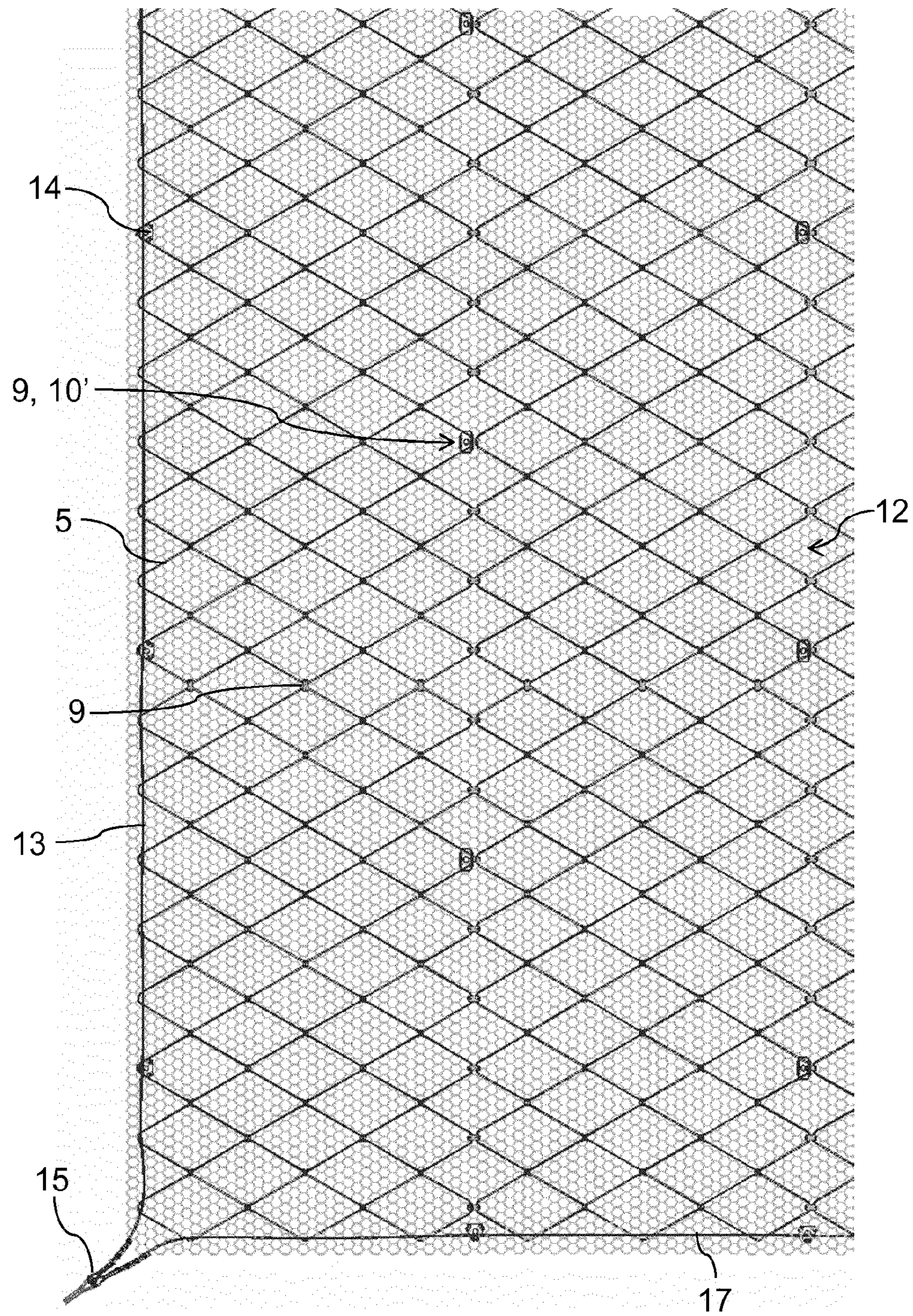

FIG. 7a

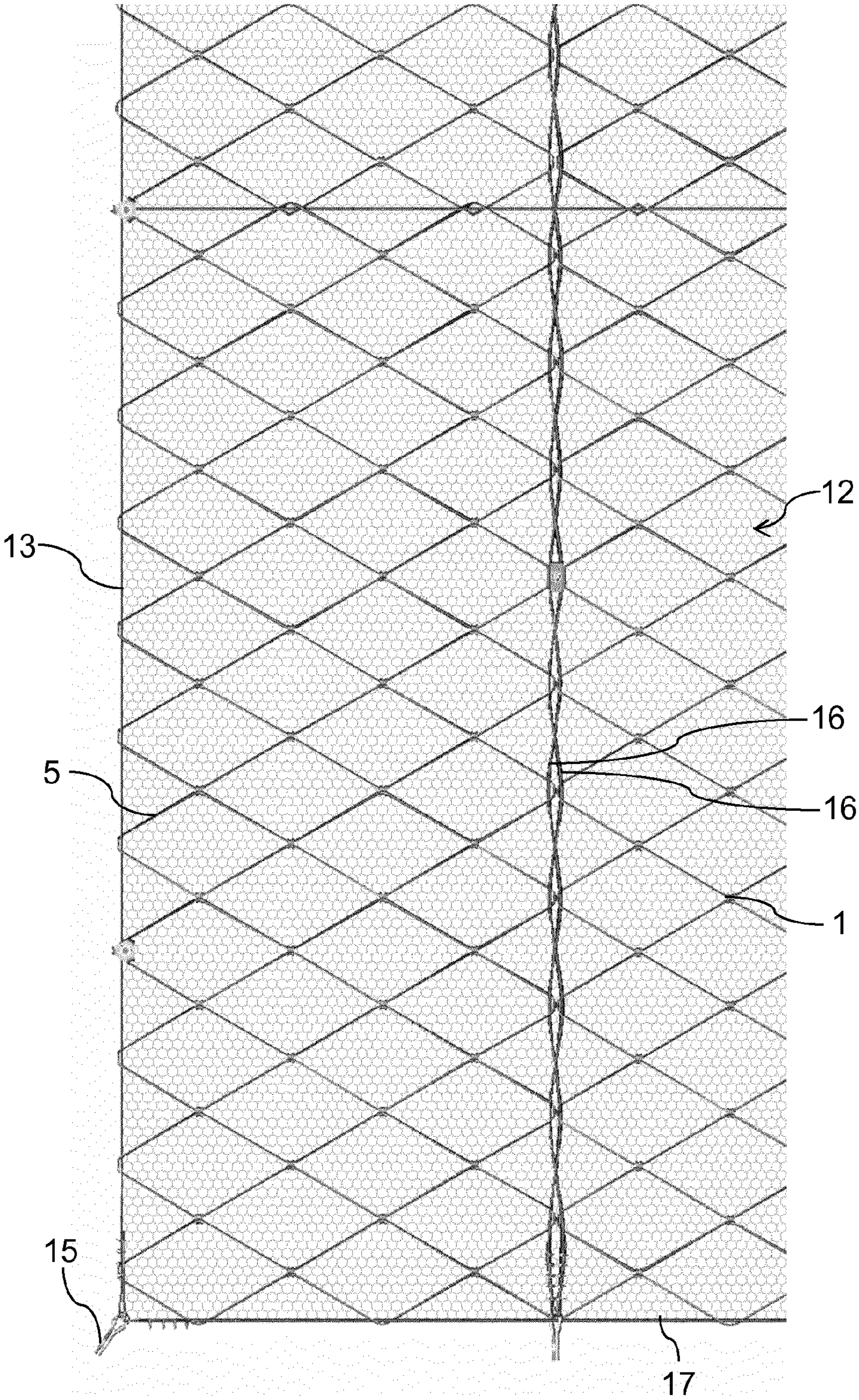

FIG. 7b

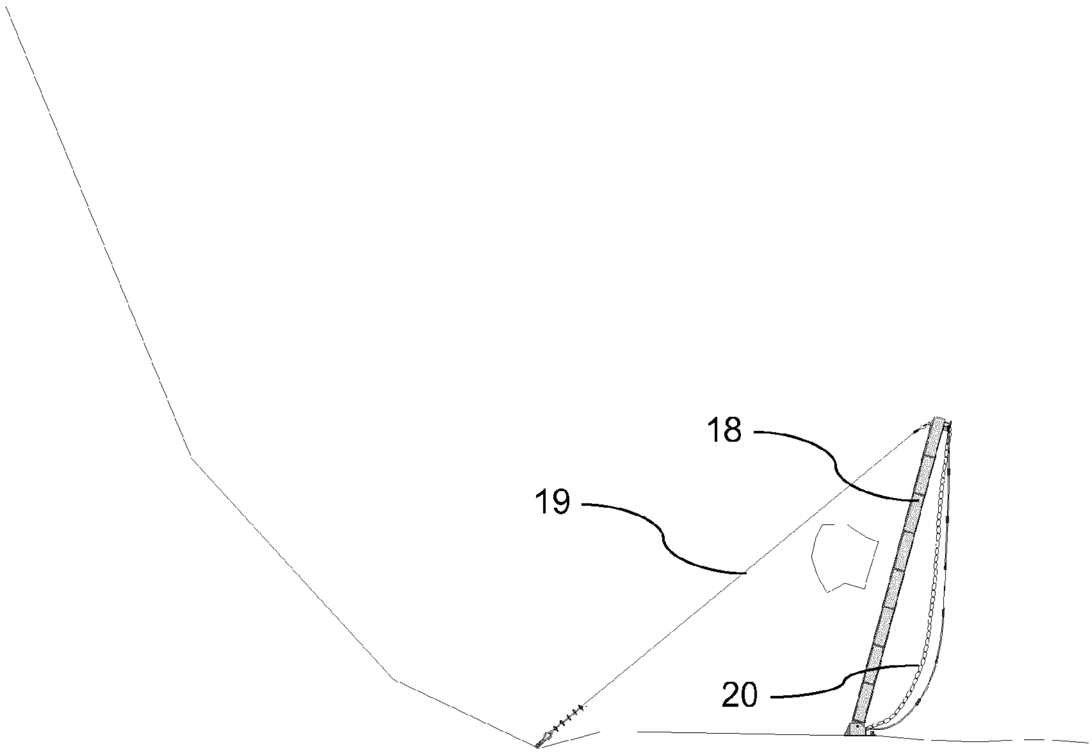

FIG. 8

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 12 38 2378

Category	DOCUMENTS CONSIDERED TO BE RELEVANT Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	KR 101 121 688 B1 (GEOTECH [KR]) 9 March 2012 (2012-03-09) * paragraphs [0016], [0017], [0032] * * figures 2-7 *	1,3-7,9, 10 2	INV. E01F7/04
Y	CN 201 162 222 Y (CHENGDU HANGFA HYDRAULIC CONST [CN]) 10 December 2008 (2008-12-10) * the whole document *	2	
X	KR 101 037 013 B1 (NA JAE SUL [KR]) 25 May 2011 (2011-05-25) * paragraphs [0001], [0009], [0016] - [0030] * * figures 2,7,11,13 *	1,8	
X	KR 2002 0007461 A (KWANG MYOUNG IND SAFETY CO LTD [KR]) 29 January 2002 (2002-01-29) * page 3, line 22 - line 31 * * figures 1-3 *	1	
A	FR 2 669 047 A1 (TETRA SARL [FR]) 15 May 1992 (1992-05-15) * page 4, line 5 - page 5, line 35 * * figures 3,4 *	1	TECHNICAL FIELDS SEARCHED (IPC) E01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	29 January 2013	Kremsler, Stefan

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

2

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 38 2378

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.

29-01-2013

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
KR 101121688	B1	09-03-2012	NONE	
CN 201162222	Y	10-12-2008	NONE	
KR 101037013	B1	25-05-2011	NONE	
KR 20020007461	A	29-01-2002	NONE	
FR 2669047	A1	15-05-1992	NONE	

EPO FORM P0459

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