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(54) **Multi-axial textile grid for technical or geotechnical use and method to manufacture same**

Multiaxiales Textilgitter für technische oder geotechnische Anwendung und Verfahren zu dessen Herstellung

Grille multiaxiale en textile pour utilisation technique ou géotechnique et procédé de sa fabrication

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Description

FIELD OF THE INVENTION

[0001] The invention concerns a multi-axial textile grid, for technical or geotechnical use, characterized by a mesh structure which allows it to resist both cutting forces acting on several axes in the same plane as the grid, and also torque forces acting thereon. Such grids, if used in the geotechnical field, are called "geogrids".

[0002] To be more exact, the textile grid according to the invention has a multi-axial structure reinforced and stabilized both along two axes orthogonal to each other and also along two further axes oblique and rotated with respect to the first two.

[0003] The invention also concerns the method to manufacture said multi-axial grids.

BACKGROUND OF THE INVENTION

[0004] The state of the art includes bi-axial textile grids used to impart stability and compactness to elements which are disconnected, incoherent and liable to slide or similar.

[0005] Such grids generally include a structure with orthogonal elements defined by a plurality of apertures which allow them to interact with the relative surfaces or supports on which they rest.

[0006] Conventional bi-axial textile grids, however, are not generally resistant either to cutting forces distributed over several axes or to torque forces on the plane, inasmuch as their mesh structures form a repetition of "articulated parallelograms" which resist the cutting forces only on two axes of geometry, that is, those along which the warp and weft elements are arranged, and yield to the torque forces which are in any case arranged on their plane.

[0007] Such bi-axial textile grids, in certain conditions of use, are therefore subject to limited efficiency.

[0008] It is known from US-A-5,795,835 a bonded composite knitted structural textile formed of knitted polymeric components. The first component is a high tenacity, high modulus, low elongation mono- or multifilament yarn. The second component is a fusible polymer in yarn which encapsulates and bonds adjacent load bearing yarns. The third component is an optional effect or bulking yarn. The fourth component is a multifilament warp knit stitch forming yarn to form the ground structure of the knitted textile. This structural textile has the disadvantage not to provide sufficient free area between the different links and not to have great features of resistance to the cutting forces in several directions and to the torque forces insisting on the same plane.

[0009] It is known from US-A-2, 244,835 a textile material for foundations which has woven therein a component of hair to increase the rigidity or stiffness. The resultant fabric is formed by the classic weave of weft yarns and warp yarns and by an additional yarn. The three yarns define a woven structure having a plurality of substantially square apertures, on which the point of crossing of weft yarns and warp yarns are disposed, which square apertures are separated, checker-wise, by a plurality of substantially hexagonal openings.

[0010] The present Applicant has devised and embodied this invention to overcome the shortcomings of the state of the art and to obtain further advantages.

SUMMARY OF THE INVENTION

[0011] The invention is set forth and characterized in the respective main claims, while the dependent claims describe other innovative characteristics of the invention.

[0012] The purpose of the invention is to achieve a textile grid characterized by great planar stability on a plurality of axes, and therefore suitable to guarantee great efficiency of use even in conditions of stress and high cutting forces and considerable torque forces.

[0013] To be more exact, the purpose of the invention is to achieve a multi-axial textile grid or geogrid suitable to considerably increase, with respect to the conventional multi-axial textile, the anchorage of the surface on which it rests, or of the elements incorporated therein and also to increase the friction coefficient or cohesion, in order to obtain extremely good results of dimensional stability, also with respect to conventional bi-axial grids.

[0014] The multi-axial textile grid according to the invention can be employed in every type of intervention where planning resistance and flexibility are required in the case of composite materials, both active and passive processes of protection and consolidation in the geotechnical field or in other technical solutions concerned.

[0015] This grid is therefore applied in achieving interventions of flexibility or resistance, reinforcement or stabilization in the field of industry, roads, railways, or airports and similar, reclamation and protection against the erosion of banks of rivers, streams, canals, water courses and similar, reinforcement and protection against sea and wind erosion.

[0016] The invention provides to make this multi-axial textile grid by means of using the technology "warp knitting with weft insertion".

[0017] To be more exact, the multi-axial textile grid according to the invention is achieved by means of sequences of "three-hinge arches", and therefore absolutely stable, arranged in such a manner as to obtain and therefore exploit an ample area, open and free, which allows to apply the grid for the specific functions, of a technical and geotechnical type, which it has to perform.

[0018] The multi-axial textile grid for technical or geotechnical use according to the present invention comprises a first mesh structure formed by the orthogonal braiding of a plurality of weft elements and a corresponding plurality of warp elements, and a second mesh structure formed by further bundles of yarn disposed obliquely with respect to said weft elements and to said warp elements. Such further bundles of yarn are orthogonal to each other

and are disposed in such a manner that said second mesh structure together with said first mesh structure define groups of three-hinge arches located checkerwise inside the apertures of said first mesh structure, with respect to apertures of said first mesh structure, which are free from any of said further bundles of yarn. Moreover, the weft and warp elements and the bundles of yarn are attached to each other by another yarn disposed according to a joining chain.

[0019] According to the invention, the multi-axial textile grid is made with apertures with a minimum dimension of about 10x10 mm of free area, with a thickness varying from a minimum of about 0.2 mm to a maximum of about 10 mm, and with a resistance varying from about 10 kN/m to about 10,000 kN/m and more, with the materials and yarns available today.

[0020] In making said multi-axial textile grids, the invention provides to use, as a basic material, the following types of yarns:

- synthetic yarns of different polymeric derivation and/or their combinations;
- composite yarns characterized by a heat sensitive or heat opponent cuticle;
- natural yarns of mineral derivation;
- natural yarns of biological derivation.

[0021] The choice of using the various types of yarns, synthetic and non-synthetic, satisfies the capacity which they have of meeting the specific planning requirements, since the physical/chemical characteristics of the various materials mentioned, and their interactions with the environment for which they are mainly intended, are known.

[0022] The production process of said multi-axial textile grids advantageously provides finishing and enhancing steps, by means of the impregnation of the yarns mentioned above with resins, whether they be polyolefin in origin, such as ethylene vinyl acetate, polyurethane, polystyrene, polyvinyl, such as polyvinyl chloride, or other types, or by means of heat treatments or otherwise. These finishing and enhancing steps allow to obtain a specific arrangement of the multi-axial textile grid according to the different purposes of use.

[0023] In all cases, the result is to obtain, thanks to the specific nature of the invention, a greater suitability both of use and of durability in the specific fields and sectors indicated above.

[0024] Therefore, the multi-axial textile grid according to the invention combines, in a non-obvious fashion, the advantages of conventional bi-axial textile grids, such as the quality of cohesion, with the advantages of multi-axial textile, such as the resistance to cutting and torque forces, at the same time eliminating the shortcomings of both, such as weakness for bi-axial textile grids and low cohesion for multi-axial textiles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] These and other characteristics of the invention will be apparent from the description of a preferential form of embodiment of the invention, given as a non-restrictive example with reference to the attached drawings wherein:

Fig. 1 shows a schematic plane view of a multi-axial textile grid according to the invention;

Fig. 2 shows a schematic side view of the grid in Fig. 1 showing the multi-axial DOS textile.

DETAILED DESCRIPTION OF A PREFERENTIAL EMBODIMENT

[0026] With reference to Figs. 1 and 2, a multi-axial textile grid 10 according to the invention comprises a first mesh structure 11 formed by the orthogonal braiding of a plurality of weft yarns 13 and a corresponding plurality of warp yarns 12. We hereby specify that in this description the term yarns is intended to mean both yarns as such, and also strands, straps and any other element suitable to be woven.

[0027] The yarns with which the weft 13 and warp 12 is formed are chosen from among various solutions of synthetic yarns of differing polymeric derivation, such as for example polyester, polyethylene terephthalate (PET), polyamide (PA), polypropylene (PP), polyethylene (PE), liquid crystal polymers (LCP), polyvinyl alcohol (PVA), oxidized polyacrylonitril (PAN), carbon fibre, polyethylene naphthalene (PEN) or similar, natural yarns of mineral derivation (glass fibre, ceramic yarns, metal yarns) or natural yarns of biological derivation (cotton, hemp, animal fleeces) or their combinations. Advantageously synthetic yarns and yarns of mineral derivation are mainly used.

[0028] The weft 13 and warp 12 yarns are grouped together in bundles, separated from each other so as to form a net with apertures which can vary according to the field of use of the grid 10 and are indicatively greater than or equal to 10 x 10 mm.

[0029] The grid 10 in addition comprises further bundles of yarns 15 and 16 disposed obliquely at 45°, with respect to the bundles of weft 13 and warp 12, in particular arranged so as to be aligned with determinate crossing points of the bundles of weft 13 and warp 12. The method used to achieve this crossing is known as "warp knitting with multi-axial DOS (Directionally oriented structures) system weft insertion".

[0030] The bundles of weft 13 and warp 12 yarns, and the diagonal yarns 15 and 16, are attached to each other by a yarn 14 shaped so as to form a joining chain, intended to obtain a textile structure formed by three-hinge arches, which confers on the first mesh structure 11 characteristics of great resistance to the cutting forces in several directions and to the torque forces acting on the same plane.

[0031] In fact, the further bundles of yarn 15 and 16 are orthogonal to each other and form a second mesh structure 17 which defines groups of three-hinge arches located checkerwise inside the apertures of the first meshstructure formed by the bundles of weft 13 and warp 12, leaving the adjacent areas free.

[0032] The grid 10 can also be subjected to subsequent finishing and/or enhancing steps, as shown above.

Claims

1. - Multi-axial textile grid for technical or geotechnical use, comprising a first mesh structure (11) formed by the orthogonal braiding of a plurality of weft elements (13) and a corresponding plurality of warp elements (12), and a second mesh structure (17) formed by further bundles of yarn (15, 16) disposed obliquely with respect to said weft elements (13) and to said warp elements (12), wherein said weft elements (13) and said warp elements (12) are grouped together in bundles and separated from each other in such a manner that said weft elements (13) lie on a first plane and said warp elements (12) lie on a second plane parallel and adjacent to said first plane, so as to form a net with apertures, and wherein said further bundles of yarn (15, 16) are orthogonal to each other and are disposed on two adjacent different planes parallel to said first and second planes, **characterized in that** said further bundles of yarn (15, 16) are disposed with respect to said first mesh structure (11) so as to be aligned with the points of crossing of said weft (13) and warp elements (12), so that the crossing points of said second mesh structure (17) are disposed inside said apertures of said net, in such a manner that said second mesh structure (17) together with said first mesh structure (11), define groups of three-hinge arches inside apertures of said net ; located checker-wisewith respect to apertures of said net, which are free from any of said further bundles of yarn (15, 16), and **in that** said weft (13) and warp elements (12) and said bundles of yarn (15, 16) are attached to each other by another yarn (14) disposed according to a chain stitch along said weft (13), said warp elements (12), or said bundles of yarn (15, 16), provided that said another yarn (14) crosses said points of crossing of said weft (13) and warp elements (12).

2. - Grid as in claim 1, **characterized in that** each of said apertures of said net has a minimum dimension of about 10 x 10 mm.

3. - Grid as in claim 1, **characterized in that** said weft and warp elements (12, 13) comprise at least one of the following types of yarn: synthetic yarns of differing polymeric derivation and/or their combinations; composite yarns having heat sensitive or heat opponent cuticle; natural yarns of mineral derivation; natural yarns of biological derivation.

4. - Method to make a multi-axial textile grid for technical and geotechnical use, comprising a first step to make a first mesh structure (11) formed by the orthogonal braiding of a plurality of weft elements (13) and a corresponding plurality of warp elements (12), wherein said weft elements (13) and said warp elements (12) are grouped together in bundles and separated from each other in such a manner that said weft elements (13) lie on a first plane and said warp elements (12) lie on a second plane parallel and adjacent to said first plane, so as to form a net with apertures, and a second step to make a second mesh structure (17) formed by further bundles of yarn (15, 16) disposed obliquely with respect to said weft elements (13) and to said warp elements (12), wherein said further bundles of yarn (15, 16) are arranged orthogonal to each other and are disposed on two adjacent different planes parallel to said first and second planes, **characterized in that** said second step provides that said further bundles of yarn (15, 16) are disposed with respect to said first mesh structure (11) so as to be aligned with the points of crossing of said weft (13) and warp elements (12), so that the crossing points of said second mesh structure (17) are disposed inside said apertures of said net, in such a manner that said second mesh structure (17) together with said first mesh structure (11), define, groups of three-hinge arches inside said apertures of said net, located checker-wise, with respect to apertures of said net, which are free from any of said further bundles of yarn (15, 16), and **in that** said method further comprises a third step wherein said weft (13) said warp elements (12) and said bundles of yarn (15, 16) are attached to each other by another yarn (14) disposed according to a chain stitch along said weft (13), said warp elements (12) or said bundles of yarn (15, 16), provided that said another yarn (14) crosses said points of crossing of said weft (13) and warp elements (12).

5. - Method as in claim 4, **characterized in that** the methodology used to make the braiding of said weft elements (13) and warp elements (12) and said further bundles of yarn (15, 16) is that known as warp knitting with multi-axial DOS system weft insertion.

6. - Method as in claim 4, **characterized in that** it comprises finishing and enhancing steps, by means of the impregnation of said elements or yarns with resins or by means of heat treatments.

7. - Method as in claim 6, **characterized in that** said resins are indifferently polyolefines, polyurethanes, polystyrenes, or polyvinyls.

8. - Use of a multi-axial textile grid as in any claim from 1 to 3 inclusive, for a geotechnical field.

Patentansprüche

1. Multiaxiales Textilgitter für technische oder geotechnische Anwendung, umfassend eine erste Maschenstruktur (11), gebildet durch das orthogonale Flechten einer Mehrzahl von Schusselementen (13) und einer korrespondierenden Mehrzahl von Kettenelementen (12), sowie eine zweite Maschenstruktur (17), gebildet durch weitere Bündel von Garn (15, 16), angeordnet schräg bezüglich der Schusselemente (13) und der Kettenelemente (12), wobei die Schusselemente (13) und die Kettenelemente (12) miteinander in Bündel gruppiert sind und voneinander in einer derartigen Weise getrennt sind, dass die Schusselemente (13) auf einer ersten Ebene liegen und die Kettenelemente (12) auf einer zweiten Ebene, parallel und benachbart zu der ersten Ebene, liegen, so dass sie ein Netz mit Öffnungen bilden, und wobei die weiteren Bündel von Garn (15, 16) orthogonal zueinander sind und auf zwei benachbarten unterschiedlichen Ebenen parallel zu den ersten und zweiten Ebenen angeordnet sind, **dadurch gekennzeichnet, dass** die weiteren Bündel von Garn (15, 16) bezüglich der ersten Maschenstruktur (11) so angeordnet sind, dass sie mit den Kreuzungspunkten der Schuss- (13) und Kettenelemente (12) ausgerichtet sind, so dass die Kreuzungspunkte der zweiten Maschenstruktur (17) innerhalb der Öffnungen des Netzes in einer derartigen Weise angeordnet sind, dass die zweite Maschenstruktur (17) zusammen mit der ersten Maschenstruktur (11) Gruppen von drei-gelenkigen Bögen innerhalb der Öffnungen des Netzes definiert, die schachbrettmusterartig bezüglich der Öffnungen des Netzes, die frei von beliebigen weiteren Bündeln von Garn (15, 16) sind, angeordnet sind, und **dadurch**, dass die Schuss (13) und Kettenelemente (12) und die Bündel von Garn (15, 16) aneinander mittels eines weiteren Garns (14) befestigt sind, der gemäß einem Kettenstich entlang der Schuss- (13), der Kettenelemente (12) oder der Bündel von Garn (15, 16) angeordnet ist, vorausgesetzt, dass der weitere Garn (14) die Kreuzungspunkte der Schuss- (13) und Webelemente (12) kreuzt.

2. Gitter nach Anspruch 1, **dadurch gekennzeichnet, dass** jede der Öffnungen des Netzes eine Minimaldimension von ca. 10 x 10 mm aufweist.

3. Gitter nach Anspruch 1, **dadurch gekennzeichnet, dass** die Schuss- und Kettenelemente (12, 13) zumindest einen der folgenden Typen von Garn umfassen: synthetische Garne von sich unterscheidendem polymeren Ursprung und/oder deren Kombinationen; Kompositgarne mit wärmesensitiver oder warmewiderstehender Oberhaut; natürliche Garne von mineralischem Ursprung; natürliche Garne von biologischem Ursprung.

4. Verfahren zur Herstellung eines multiaxialen Textilgitters für technische und geotechnische Anwendung, umfassend einen ersten Schritt zur Herstellung einer ersten Maschenstruktur (11), gebildet durch das orthogonale Flechten einer Mehrzahl von Schusselementen (13) und einer korrespondierenden Mehrzahl von Kettenelementen (12), wobei die Schusselemente (13) und die Kettenelemente (12) miteinander in Bündeln gruppiert sind und voneinander in einer derartigen Weise getrennt sind, dass die Schusselemente (13) auf einer ersten Ebene liegen und die Kettenelemente (12) auf einer zweiten Ebene, parallel und benachbart zur ersten Ebene, liegen, so dass sie ein Netz mit Öffnungen bilden, sowie einen zweiten Schritt zur Herstellung einer zweiten Maschenstruktur (17), gebildet durch weitere Bündel von Garn (15, 16), angeordnet schräg bezüglich der Schusselemente (13) und der Kettenelemente (12), wobei die weiteren Bündel von Garn (15, 16) orthogonal zueinander angeordnet sind und auf zwei benachbarten unterschiedlichen Ebenen parallel zu den ersten und zweiten Ebenen angeordnet sind, **dadurch gekennzeichnet, dass** der zweite Schritt bereitstellt, dass die weiteren Bündel von Garn (15, 16) bezüglich zur ersten Maschenstruktur (11) so angeordnet sind, dass sie mit den Kreuzungspunkten der Schuss- (13) und Kettenelemente (12) ausgerichtet sind, so dass die Kreuzungspunkte der zweiten Maschenstruktur (17) innerhalb der Öffnungen des Netzes in einer derartigen Weise angeordnet sind, dass die zweite Maschenstruktur (17) zusammen mit der ersten Maschenstruktur (11) Gruppen von drei-gelenkigen Bögen innerhalb der Öffnungen des Netzes definiert, die schachbrettmusterartig bezüglich der Öffnungen des Netzes, die frei von beliebigen weiteren Bündeln von Garn (15, 16) sind, angeordnet sind, und **dadurch**, dass das Verfahren ferner einen dritten Schritt umfasst, wobei die Schuss-(13), die Kettenelemente (12) und die Bündel von Garn (15, 16) aneinander durch einen weiteren Garn (14) befestigt sind, der gemäß einem Kettenstich entlang der Schuss- (13), der Kettenelemente (12) oder der Bündel von Garn (15, 16) angeordnet ist, vorausgesetzt, dass der weitere Garn (14) die Kreuzungspunkte der Schuss- (13) und Kettenelemente (12) kreuzt.

5. Verfahren nach Anspruch 4, **dadurch gekennzeichnet, dass** das Verfahren, das zur Herstellung des Flechtens der Schusselemente (13) und Kettenelemente (12) und der weiteren Bündel von Garn (15, 16) verwendet wird, jenes ist, das als Kettenwirken mit multiaxialem DOS-Systemschusseintrag be-

kannt ist.

6. Verfahren nach Anspruch 4, **dadurch gekennzeichnet, dass** es Fertigbearbeitungs- und Verbesserungsschritte umfasst mittels der Impragnierung der Elemente von Garn mit Harzen oder mittels Wärmebehandlungen.

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** die Harze indifferent Polyolefine, Polyurethane, Polystyrole oder Polyvinyle sind.

8. Verwendung eines multiaxialen Textilgitters nach einem der Ansprüche 1 bis einschließlich 3 für ein geotechnisches Feld.

Revendications

1. Grille textile multiaxiale pour une utilisation technique ou géotechnique, comprenant une première structure maillée (11) formée par l'entrelacement orthogonal d'une pluralité d'éléments de trame (13) et d'une pluralité correspondante d'éléments de chaîne (12), et une deuxième structure maillée (17) formée par des faisceaux de fils supplémentaires (15, 16) disposés obliquement par rapport auxdits éléments de trame (13) et auxdits éléments de chaîne (12), dans laquelle lesdits éléments de trame (13) et lesdits éléments de chaîne (12) sont regroupés en faisceaux et séparés les uns des autres de telle sorte que lesdits éléments de trame (13) se trouvent sur un premier plan et que lesdits éléments de chaîne (12) se trouvent sur un deuxième plan, parallèle et adjacent audit premier plan, de façon à former un filet ayant des ouvertures, et dans laquelle lesdits faisceaux de fils supplémentaires (15, 16) sont orthogonaux entre eux et sont disposés sur deux plans différents adjacents, parallèles auxdits premier et deuxième plans,
caractérisée en ce que lesdits faisceaux de fils supplémentaires (15, 16) sont disposés, par rapport à ladite première structure maillée (11), de façon à être alignés avec les points de croisement desdits éléments de trame (13) et de chaîne (12), de telle sorte que les points de croisement de ladite deuxième structure maillée (17) soient disposés à l'intérieur desdites ouvertures du filet, de telle manière que ladite deuxième structure maillée (17) associée à ladite première structure maillée (11) définissent des groupes d'arcs à trois articulations à l'intérieur des ouvertures dudit filet, disposées en damier par rapport aux ouvertures dudit filet qui ne comportent aucun desdits faisceaux de fils supplémentaires (15, 16), et **en ce que** lesdits éléments de trame (13) et de chaîne (12) et lesdits faisceaux de fils (15, 16) sont fixés les uns aux autres par un autre fil (14) disposé selon un point de chaînette le long desdits éléments de trame (13), de chaîne (12) ou desdits faisceaux de fils (15, 16), du moment que ledit autre fil (14) croise lesdits points de croisement desdits éléments de trame (13) et de chaîne (12).

2. Grille selon la revendication 1, **caractérisée en ce que** chacune desdites ouvertures dudit filet a une dimension minimale d'environ 10 x 10 mm.

3. Grille selon la revendication 1, **caractérisée en ce que** lesdits éléments de trame et de chaîne (12, 13) comprennent au moins l'un des types de fil suivants : des fils synthétiques de différentes origines polymères et/ou leurs combinaisons ; des fils composites ayant des cuticules sensibles à la chaleur ou résistantes à la chaleur ; des fils naturels d'origine minérale ; des fils naturels d'origine biologique.

4. Procédé de fabrication d'une grille textile multiaxiale pour une utilisation technique ou géotechnique, comprenant une première étape de fabrication d'une première structure maillée (11) formée par l'entrelacement orthogonal d'une pluralité d'éléments de trame (13) et d'une pluralité correspondante d'éléments de chaîne (12), dans lequel lesdits éléments de trame (13) et lesdits éléments de chaîne (12) sont regroupés en faisceaux et séparés les uns des autres de telle sorte que lesdits éléments de trame (13) se trouvent sur un premier plan et que lesdits éléments de chaîne (12) se trouvent sur un deuxième plan, parallèle et adjacent audit premier plan, de façon à former un filet ayant des ouvertures, et une deuxième étape de fabrication d'une deuxième structure maillée (17) formée par des faisceaux de fils supplémentaires (15, 16) disposés obliquement par rapport auxdits éléments de trame (13) et auxdits éléments de chaîne (12), dans lequel lesdits faisceaux de fils supplémentaires (15, 16) sont orthogonaux entre eux et sont disposés sur deux plans différents adjacents, parallèles auxdits premier et deuxième plans, **caractérisé en ce que** ladite deuxième étape fait en sorte que lesdits faisceaux de fils supplémentaires (15, 16) soient disposés, par rapport à ladite première structure maillée (11), de façon à être alignés avec les points de croisement desdits éléments de trame (13) et de chaîne (12), de telle sorte que les points de croisement de ladite deuxième structure maillée (17) soient disposés à l'intérieur desdites ouvertures du filet, de telle manière que ladite deuxième structure maillée (17) associée à ladite première structure maillée (11) définissent des groupes d'arcs à trois articulations à l'intérieur des ouvertures dudit filet, disposées en damier par rapport aux ouvertures dudit filet qui ne comportent aucun desdits faisceaux de fils supplémentaires (15, 16), et **en ce que** ledit procédé comprend, en outre, une troisième étape dans laquelle ladite trame (13), lesdits éléments de chaîne (12) et lesdits

faisceaux de fils (15, 16) sont fixés les uns aux autres par un autre fil (14) disposé selon un point de chaînette le long de ladite trame (13), desdits éléments de chaîne (12) ou desdits faisceaux de fils (15, 16), du moment que ledit autre fil (14) croise lesdits points de croisement desdits éléments de trame (13) et de chaîne (12).

5. Procédé selon la revendication 4, **caractérisé en ce que** la méthodologie utilisée pour réaliser l'entrelacement desdits éléments de trame (13) et éléments de chaîne (12) et desdits faisceaux de fils supplémentaires (15, 16) est la méthodologie connue comme le tricot à mailles jetées, avec une insertion de trame à système DOS multiaxial.

6. Procédé selon la revendication 4, **caractérisé en ce qu'**il comprend des étapes de finissage et d'amélioration, au moyen de l'imprégnation desdits éléments ou fils par des résines ou au moyen de traitements thermiques.

7. Procédé selon la revendication 6, **caractérisé en ce que** lesdites résines sont indifféremment des polyoléfines, des polyuréthannes, des polystyrènes ou des polyvinyles.

8. Utilisation d'une grille textile multiaxiale selon l'une quelconque des revendications 1 à 3 incluses, pour un domaine géotechnique.

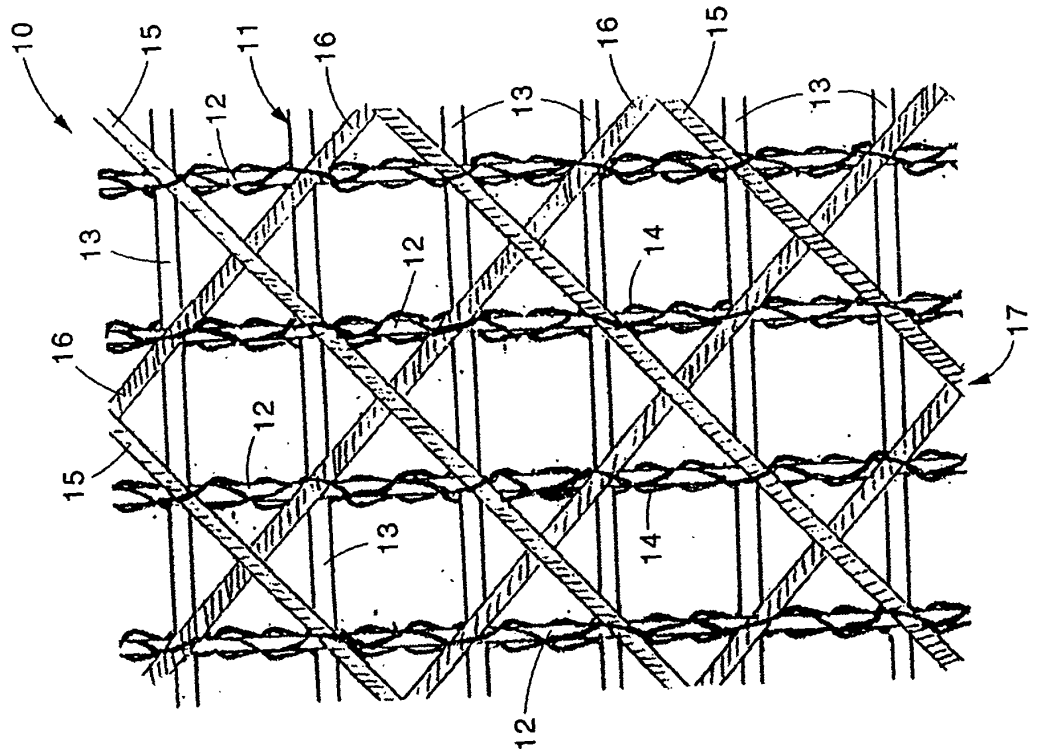
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fig. 1

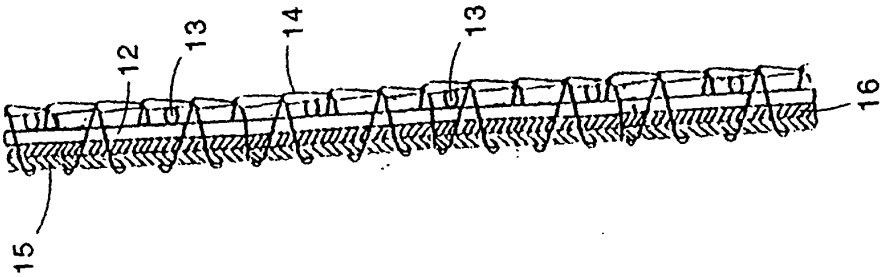
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fig. 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5795835 A **[0008]**
- US 2244835 A **[0009]**