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(54) IMPREGNATED NEST WITH ADDITIVES

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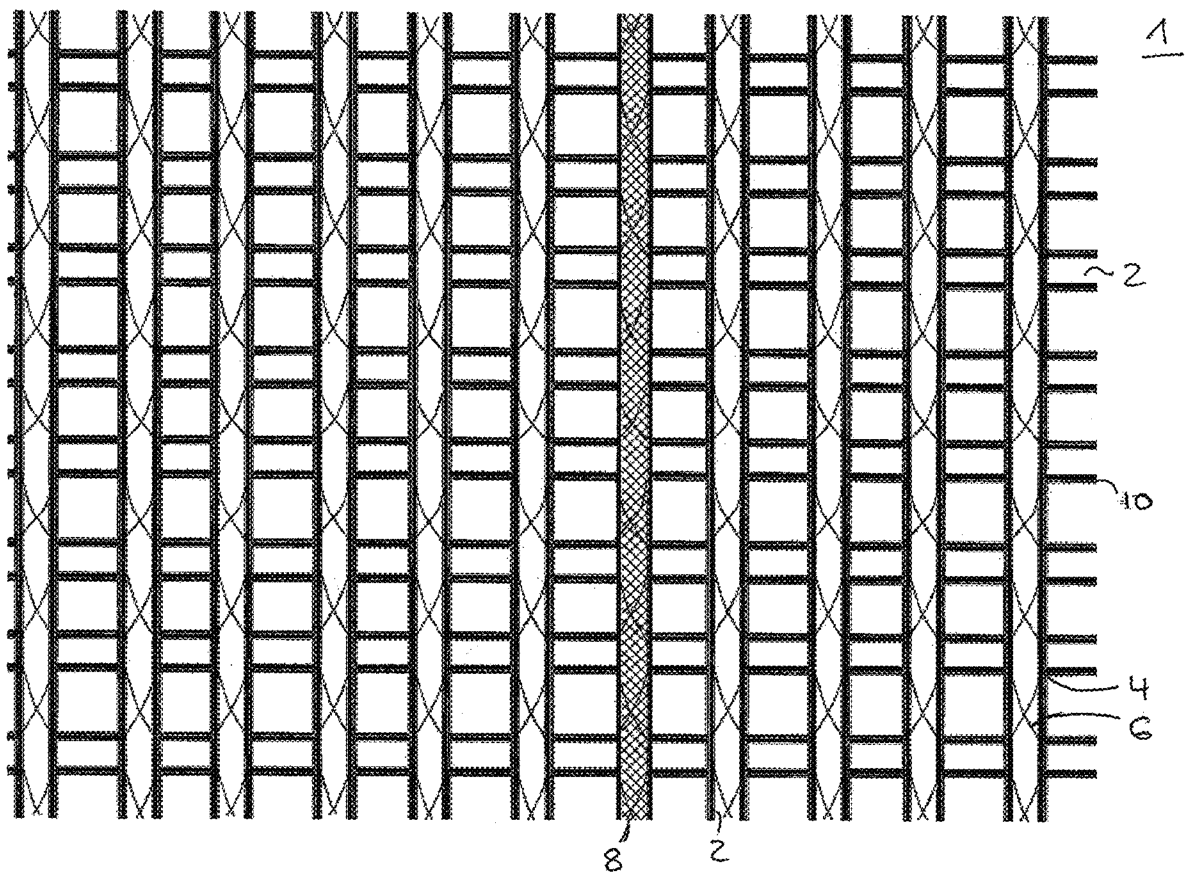
(57) **ABSTRACT**

The invention provides a method for producing a textile reinforcement from a nest, wherein an impregnation is applied onto a thread of the nest or onto the nest, wherein the textile reinforcement allows a mechanical reinforcement for freely weathered and trafficked buildings and is easy to lay. For this purpose, the impregnation comprises a basic material to which at least one additive is admixed.



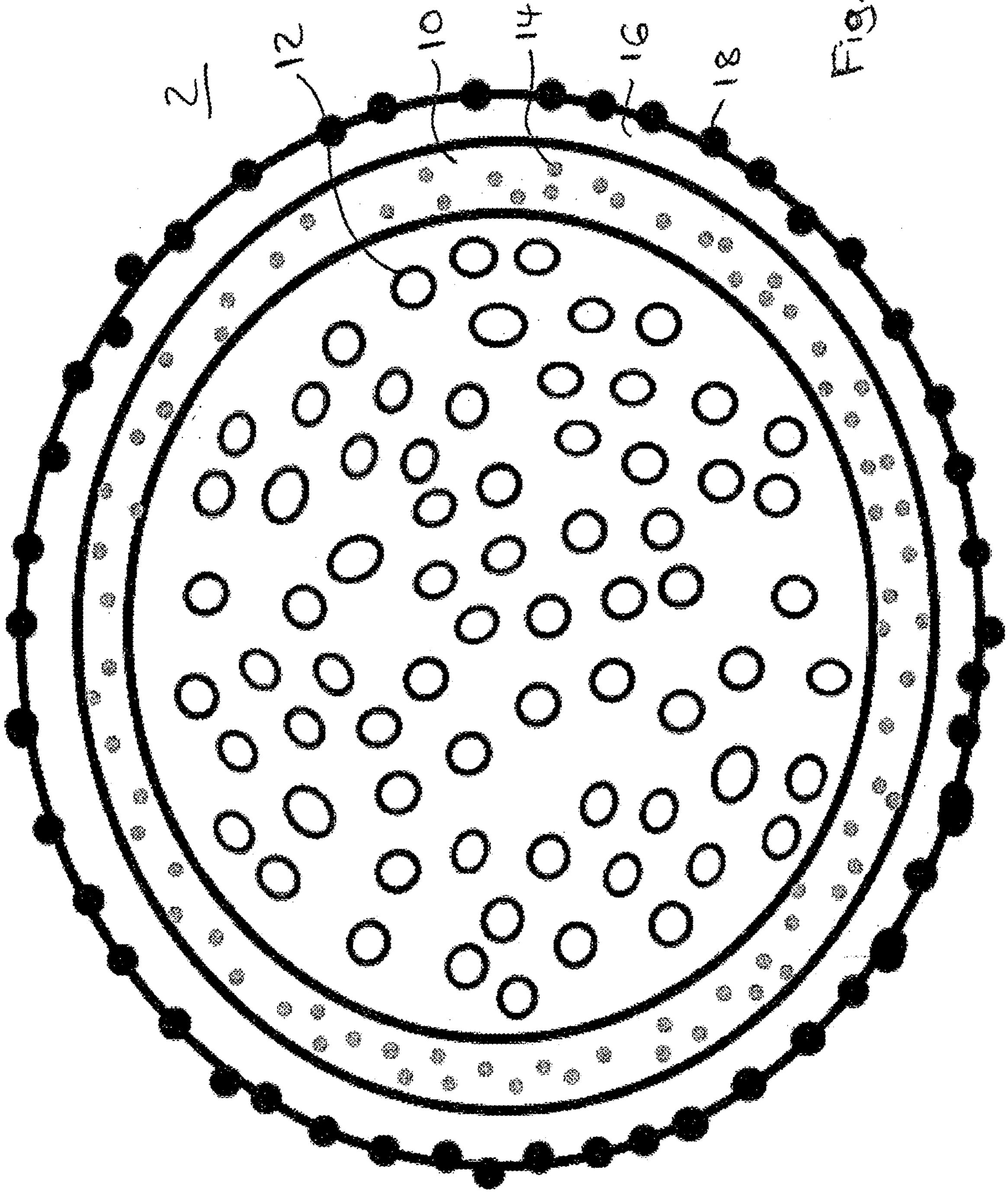


Fig. 1

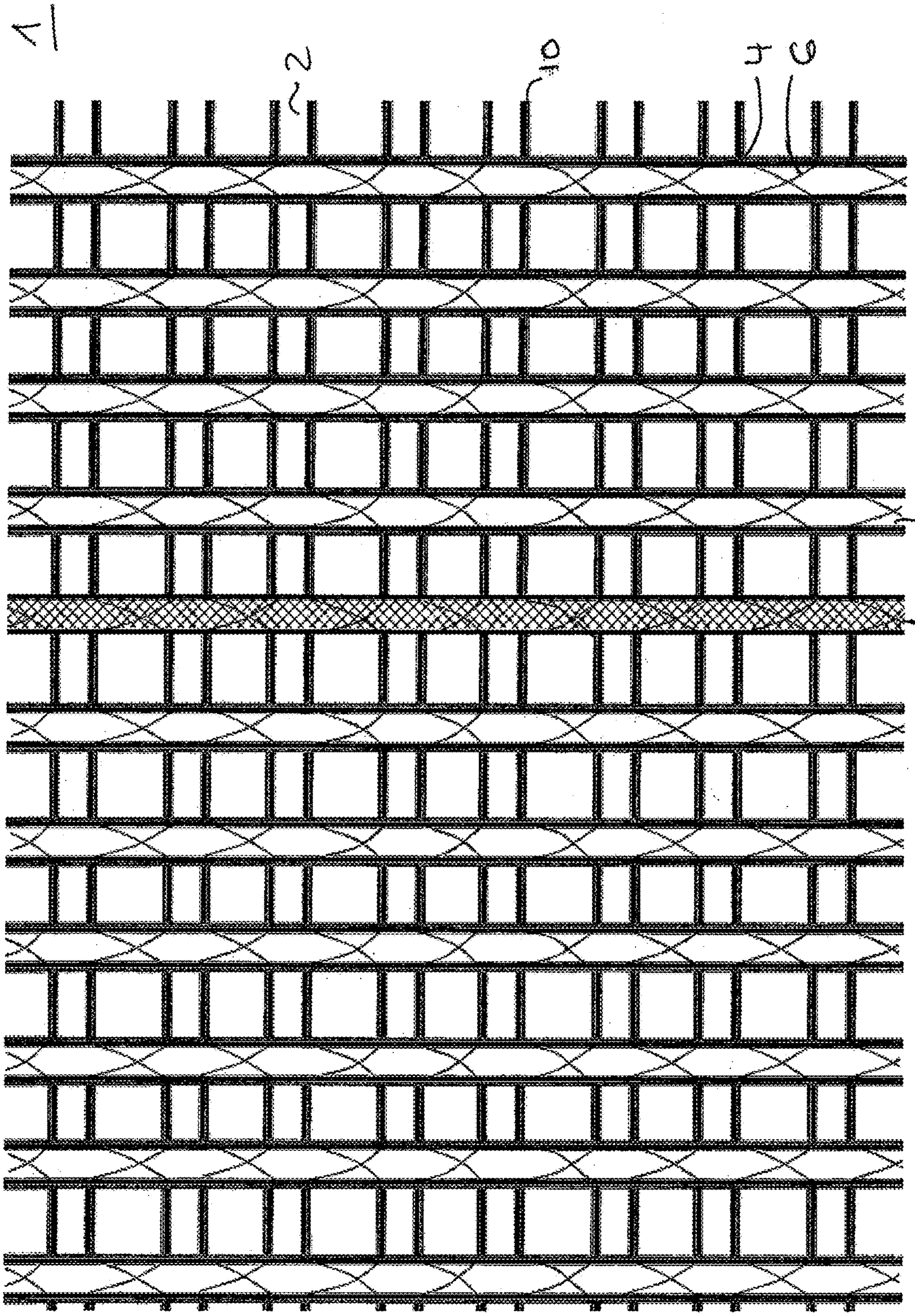


Fig. 2

IMPREGNATED NEST WITH ADDITIVES

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the priority benefit of EP Pat. App. 18200952.2, titled "Getränktes Gelege mit Additiven", filed Oct. 17, 2018, which is hereby incorporated by reference in its entirety.

[0002] The following is an accurate translation of the priority document into English.

FIELD OF INVENTION

[0003] The invention relates a method for producing a textile reinforcement from a nest, wherein an impregnation onto a thread or a string of the nest or onto the nest. Furthermore, the invention relates to such a textile reinforcement.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] A nest produced according to the above-described method is explained in detail by means of an exemplary embodiment in a drawing in which

[0005] FIG. **1** is a cross-sectional view of a thread of the nest,

[0006] FIG. **2** shows a nest with a primary anode sewn in.

DETAILED DESCRIPTION

[0007] Buildings made of reinforced concrete are integral parts of the infrastructure in almost all countries of the worlds. In addition to residential and commercial buildings, many trafficked buildings are built of reinforced concrete, e.g. parking blocks, garages, highways, bridges, tunnels, etc. A large number of these buildings are used for 50 to 100 years (and sometimes even longer). However, in addition to mechanical stress, above all dew salts affect the reinforced-concrete buildings. As a rule, dew salts contain chloride. Therefore, in combination with water, solutions are formed which cause corrosion in the buildings. Therefore, in many buildings, substantial, cost-intensive repair works have to the carried out on the reinforcement after 20-25 years already.

[0008] For this purpose, usually, the contaminated covering concrete is removed, the reinforcing steel is cleaned and provided with a new corrosion prevention (e.g. based on polymer or cement). However, often the repaired region lasts only few years (due to mechanical, thermal and/or hygric incompatibilities), so that soon, another repair will be necessary, especially when the covering concrete is greatly stressed. This causes high costs, is a considerable intervention into the building and last, not least, leads to limitations of use during the repair works.

[0009] One possibility to suppress and, ideally, prevent corrosion, is the cathodic corrosion prevention (CCP) of buildings. Being a largely nondestructive repair method, the cathodic corrosion prevention is an increasingly important economical repair method for building components threatened or damaged by corrosion.

[0010] However, in particular in case of trafficked buildings made of reinforced concrete, many trafficked buildings (bridges, parking building) must, in addition to the corrosion prevention, be subsequently reinforced, due to a continually increasing traffic volume and an increasing vehicle weight (trucks, SUV's). For this purpose, a multitude of methods exist, such as, e.g., prestressing with external prestressing elements, shearing-force reinforcement with prestressing elements or shearing lugs made of steel, top concreting with doweling, cross-sectional supplements by means of air-placed concrete with additional concrete reinforcement and (slottedly) glued CFK (steel) lamellas.

[0011] Up to now, however, no method is known which would protect freely weathered and trafficked buildings made of reinforced steel against steel corrosion and would constitute at the same time a mechanical reinforcement for the building. Although increasingly, composite materials made of carbon concrete or other textile concretes made of basalt or AR glass fibers, impregnated in an epoxy resin or styrene-butadiene rubber, are used, their possibilities of application are still limited, because they are only suitable, for example, for interior structures which are hardly exposed to weather influences, or they lack the often necessary freedom of form.

[0012] For example, the present textile carbon reinforcements only fulfill the function of building reinforcement or of corrosion prevention. Attempts are, however, already made to impregnate the carbon fibers in epoxy resin or styrene-butadiene rubber, in order to obtain a stable nest. Nests with epoxy-resin impregnation possess a high bond strength, whereas nests with styrene-butadiene rubber are characterized in particular by their good processability, ductility and, in particular, sufficient polarization properties. However, at present, no impregnation is available which would possess a marked mechanical bond and at the same time a good processability/ductility as well as advantageous polarization properties.

[0013] It is, furthermore, a common feature of the present impregnated textile reinforcements that they are very difficult to lay around corners and edges or in case of acute angles and narrow radii of curvature (e.g. transition from ground to support). Due to the poor flexibility of the textile reinforcement or to the causing of defective spots because of narrow radii of curvature, the effects of reinforcement and corrosion prevention are not achieved in the required manner.

[0014] The invention is, therefore, based on the problem to provide a method for producing a textile reinforcement, and a textile reinforcement, which allows a mechanical reinforcement for freely weathered and trafficked buildings and is easy to lay.

[0015] The textile reinforcement can, for example, also comprise glass. If within the framework of the mechanical reinforcement, a cathodic corrosion prevention shall be possible, the use of a carbon nest or of a nest formed at least partially by carbon fibers offers itself for this purpose.

[0016] By nest, one understands within the framework of the present application a surface body consisting of several layers of substantially parallel stretched threads. The individual layers are placed one on top of the other and fixed to each other in the crossing points. If the threads of different layers are oriented in two different directions, a biaxial nest is given, if several layers with several orientations are provided, a multiaxial nest is given. Within the framework of the present application, one also understands, therefore, by the term "nest" a grid which also has a corresponding structure.

[0017] By the thread of a nest, one understands an individual stretched string. This thread may consist of a number of carbon multifilaments forming together a thread or string.

[0018] This problem is solved according to the invention by the impregnation comprising a basic material to which an additive is admixed.

[0019] The invention starts out on the consideration that the provision of a sufficient mechanical reinforcement and possibly a sufficiently high conductivity for the cathodic corrosion prevention can be achieved by a suitable choice of an impregnation medium. It has turned out that the nest of the textile reinforcement can be adapted to the environmental conditions prevailing on the site of application in a particularly easy manner if the impregnation and, there, the basic medium used for the impregnation, is modified by admixing additives to increase the electrical, mechanical and thermal properties. It is possible, for example, by admixing carbon nanotubes, metal particles, salts (or ionic compounds) or graphite, to increase the electrical properties, in particular the conductivity, while the thermal properties can be influenced by admixing metals, carbon particles and graphite particles. To improve the mechanical properties, in particular also the bond with the solid mortar, it is possible to admix hard materials, for example in the form of silicon carbite, quartzes and ceramics.

[0020] It is, furthermore, possible to modify the process parameters and the possible processability of the nest, in particular of a carbon nest, by admixing additives. It is imaginable to use plasticizers, retarders or thickeners to influence also the properties of the fresh and solid mortar.

[0021] By admixing additives, it can in particularly be achieved that the solidity of the mortar is particularly high in the area of the nest, while it is relatively low on the surface. This solidity gradient, decreasing in the direction facing away from the nest, allows a particularly flexible use of the nest.

[0022] For a particularly flexible and manifold possibility of modification, the basic material is, in a preferred embodiment, synthesized by radical polymerization from a monomer and a starter. In this case, it is possible to admix the additive to the monomer and/or the starter already prior to the synthesization. This enables a modification of the impregnation already prior to the synthesization of the basic material. Additionally or alternatively, it is, however, also possible to admix the additive to the already synthesized basic material before, during and/or also after the impregnation in the form of spreading it onto the impregnated nest.

[0023] In a special form of impregnation or else in connection with the subsequent coating, the starter is applied in a first process on the nest and the monomer is only applied afterwards, so that the synthesization of the basic material is effected directly on the nest.

[0024] It has turned out to be particularly advantageous to use a polymethylmethacrylate as a basic material for the impregnation because due to its low density, this basic material can be introduced particularly well into the interspaces of the nest, but also into the interspaces of the fiber strings. In addition to using polymethylmethacrylates as basic material, it is, however, also imaginable in general to use the above-mentioned epoxy resins, styrene-butadiene rubbers and acrylates or polyurethanes.

[0025] To produce a solid bond between the impregnated textile reinforcement and the surrounding concrete, the surface of the impregnated carbon nest is, in a preferred embodiment, roughened and thus enlarged. For this purpose, additives are admixed to the coating medium in the form of particles which cause such an enlargement of the surface. In particular, granite, quartz powder, hydrated cement or conductive particles can be used. The enlarged surface results in a force and form-locking bond (reinforcing effect). By admixing conductive particles, the charge transition can be optimized in order to improve the cathodic corrosion prevention. Alternatively or additionally, ionic compounds, concrete admixtures, mixtures of salts and microsilica (as suspension or also in solid form) or pozzolanic reactives can be used. They can influence the kinetics of the hardening reaction, in order to increase, in case of using salts, the conductivity in the border area, on the one hand, and the solidity of the mortar in the environment of the nest, on the other hand.

[0026] In addition to enlarging the surface of the nest by admixing particles, it is also possible, in an advantageous embodiment, to apply a coating on the already impregnated nest, which coating, like the particles, enlarges the surface or provides for a better incorporation of the additives. This coating may then either form the carrier medium for the particles or provide itself for a better bond. In a preferred embodiment, additives are admixed to this coating medium, too, to improve the electrical, thermal or mechanical properties before, during or after its application on the impregnated nest.

[0027] The impregnation or else the coating can be applied in particular by the immersion-bath method, an emulation process, a spray process or may also be painted or rolled on.

[0028] The advantages achieved with the invention consist in particular in that through use of an impregnation of the nest, in case of a carbon nest, in particular of the carbon fibers, carbon threads or the entire nest containing carbon, which is adapted to the application range in question and modified by an additive, it is possible to influence the properties of the reinforcement, but also of the mortar, in the immediate environment of the reinforcement. In this way, it is possible to protect, in addition to plane surfaces, also curved, freely weathered and trafficked buildings permanently against steel corrosion and, at the same time, to mechanically reinforce them. It is in this case a particular advantage that it can be achieved, by suitably modifying the mechanical properties, that the carbon nest used in this case, being a thin-layer textile concrete, can provide a sufficient load-bearing capacity or a load increase even without the combination with a cathodic corrosion prevention. Together with the removal of thin former coats which are not needed for load bearing (such as screed, asphalt or less solid concrete), this may, therefore, reduce the load, increase the load-bearing capacity and enlarge the overhead clearances in parking blocks.

[0029] Thus, the increase of solidity in the vicinity of the fibers leads to an improved performance without causing an excessive formation of cracks due to shrinkage. Furthermore, the admixture of plasticisers on the fiber can improve the penetration into the fabric.

[0030] In detail, the essential advantages of the coating medium used lie in improving the electrical, chemical and mechanical properties of the entire system, in particular the high mechanical load-bearing or load-carrying capacity of the materials used (e.g. in case of static and dynamic tensile, adhesive-pull and shearing stresses), the long-term resistance against environmental influences, i.e. chemical inertia as well as thermal stability in a temperature range of −20° C. to 80° C. The load-carrying behavior in a larger temperature range can also be improved. Furthermore, the advantages lie in the flexible processability and ductility (drapability) and, at the same time, sufficient rigidity for laying the textile reinforcement. Connections over corners and edges can be produced in a force-locking and electrically conductive manner. Furthermore, the rigidity enables an easy application in the laying process. Further advantages are the high bond strength between the concrete and the textile reinforcement (possibly due to the additional use of a coating) and the optimized conductivity in the "metallic" conductor (carbon, conductor of 1st order) and the good charge transition to the ionic conductor (concrete; conductor of 2nd order).

[0031] FIG. **1** is a cross-sectional view of a thread **2** of a nest. The thread **2** comprises a multitude of individual carbon multifilaments **12**, each of which includes between several 1,000 and up to 100,000 individual filaments. The thread **2** is provided, in the exemplary embodiment according to FIG. **1**, with an impregnation **10** to which one or several additives **14** have been admixed in the impregnation process to improve the electrical, mechanical or also thermal properties. In a downstream production step, the thread **2** has been coated with a coating medium **16**. In the present case, a sanding took place, so that the coating **16** serves as a carrier medium for the particles **18**. The sanding increases the surface of the thread **2**, which results in better bonding properties with the mortar.

[0032] The nest **1** according to FIG. **2** comprises a multitude of threads **2** or strings, arranged in two planes. Each plane comprises a number of threads **2**, which are spaced from each other and substantially parallel to each other. Each of these threads **2** comprises a number of carbon multifilaments, which in the present exemplary embodiment have been glued together to form a long stretched string. It is, however, also imaginable to sew these carbon multifilaments together to a string or connect them with each other in another manner. The threads **2** of two planes lie substantially orthogonal to each other, so that a grid structure with rectangular interspaces is formed. The threads **2** are fixed in the crossing points **4** with a continuous sewing thread **6**, but they can also be glued together or connected with each other in another manner.

[0033] Of course, the planes of the nest **1** need not necessarily be arranged orthogonal to each other, but can also be arranged, depending on the intended application, at another angle. It is also imaginable to provide more than two planes.

[0034] In the exemplary embodiment according to FIG. **2**, a band-shaped primary anode **8** is sewn onto a thread **2** along the entire length, so that the anode system, contrary to a contacting in one single point, can be supplied with current over the entire length. In addition to sewing the primary anode **8** onto a thread **2**, it is, also imaginable that the primary anode **8** is sewn into a thread **2** and is thus substantially completely surrounded by carbon multifilaments.

[0035] To increase the mechanical, electrical and thermal properties, in particular to improve the layability and activation of the mechanical properties of the nest **1** and also of the anode system embedded in the mortar, an impregnation **10** and afterwards, a coating according to the above explanations is applied on the nest **1**. By suitably choosing the recipe of the impregnation and the coating and by admixing corresponding additives, it is possible in this case to provide a nest **1** for an anode system, which possesses optimum mechanical, electrical and thermal properties for the application and operating site in question.

LIST OF REFERENCE NUMBERS

[0036] **1** Nest
[0037] **2** Thread
[0038] **4** Crossing point
[0039] **6** Sewing thread
[0040] **8** Primary anode
[0041] **10** Impregnation
[0042] **12** Carbon multifilaments
[0043] **14** Additives
[0044] **16** Coating
[0045] **18** Particle

1. A method for producing a textile reinforcement from a nest, wherein an impregnation is applied onto a thread of the nest or onto the nest, characterized in that the impregnation comprises a basic material to which at least one additive is admixed.

2. The method for producing a textile reinforcement of claim **1**, wherein the basic material is synthesized by radical polymerization from a monomer and a starter and wherein the at least one additive is admixed to the monomer, the starter, or the synthesized basic material.

3. The method for producing a textile reinforcement of claim **1** wherein a polymethylmethacrylate is used as the basic material.

4. The method for producing a textile reinforcement of claim **1**, wherein at least one coating is applied to the nest after the impregnation is applied.

5. The method for producing a textile reinforcement of claim **4**, wherein an additive is admixed to the one coating before, during, or after the coating is applied to the nest.

6. The method for producing a textile reinforcement of claim **1**, wherein the impregnation is applied by an immersion-bath method, an emulation process, or a spray process.

7. A textile reinforcement produced according to the method of claim **1**.

8. A textile reinforcement produced according to the method of claim **2**.

9. A textile reinforcement produced according to the method of claim **3**.

10. A textile reinforcement produced according to the method of claim **4**.

11. A textile reinforcement produced according to the method of claim **5**.

12. A textile reinforcement produced according to the method of claim **6**.

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