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(54) **Retaining net, such as rocks retaining net and the like, and method of performing said retaining net**

(57) A retaining net (10, 15) for holding off soils and rocks, snow and avalanches, which reaches an in-

creased life time, comprises steel wires (14) or ropes (16, 17), braided together, having a surface protection layer comprising a zinc and aluminium alloy.

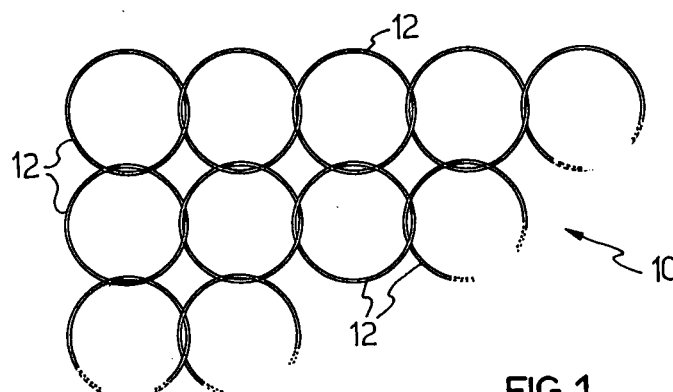


FIG.1

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Description

Field of application

[0001] The present invention relates to a retaining net to hold off soil and rocks, snow and avalanches, so called rock fences and avalanche fences, comprising wires or ropes, braided together.

Prior Art

[0002] It is known the need of having at disposal retaining nets, of the above specified type, which can efficiently resist to the corrosive action typical of the environmental agents, both atmospheric and of the soil, and which maintain their mechanical properties for a long time.

[0003] It is in fact known that especially in mountainous areas, where these retaining nets are usually arranged, the environmental conditions are particularly aggressive, and they are characterised by a high humidity, acidity and also amounts of oxidizing agents, such as for example ozone and intense sun radiation.

[0004] A method for realising a retaining net to hold off soil and rocks, snow and avalanches is described for example in patent application WO01/ 60547 A1 to the same Applicant.

[0005] Another method for realising a retaining net of the above cited type is described for example in European patent application n° 02425710.7 to the same Applicant.

[0006] Retaining nets have been proposed wherein the wires composing the steel ropes, forming the meshes of the nets themselves, are superficially coated with a zinc protection layer. This latter is a material normally used properly against corrosion, and in particular it prevents the formation of rust.

[0007] These retaining nets have however the drawback that the zinc protection layer, although being efficient, has a limited resistance to corrosion in time, so that, after a few years, the nets risk to corrode and to lose their mechanical properties.

[0008] It is thus necessary to program systematic controls on the status of the nets, in order to avoid the loss of their resistance to loads or even their relaxation.

[0009] Frequent controls however require the use of considerable energies and efforts, with high operating costs.

[0010] It is in fact to be considered that the retaining nets are normally arranged in inaccessible areas and they are thus difficult to be reached by operators.

[0011] The problem underlying the present invention is therefore that of realising a retaining net able to efficiently resist, and also for long in time, to the corrosive action of environmental agents, so that no frequent controls on their conservation status are necessary.

Summary of the invention

[0012] This problem is solved by a retaining net of the above specified type, wherein steel ropes or wires have a superficial protection layer comprising an alloy of zinc and aluminium.

Brief description of the drawings

[0013] Further characteristics and advantages of the invention will appear from the following description of some embodiments, given by way of indicative and non-limiting example with reference to the attached drawings.

[0014] Figure 1 shows a partial view of a retaining net according to the present invention.

[0015] Figure 2 shows an enlarged view of a detail of the net of figure 1.

[0016] Figure 3 shows a view of a retaining net according to the present invention, in accordance with a varying embodiment.

[0017] Figure 4 shows an enlarged detail of the net of figure 3.

Detailed description of the invention

[0018] With reference to the figures, a retaining net 10 according to the present invention is shown. The retaining net 10, which is of the so called ring type with four contact points, is intended to be implemented spread, for example on the wall of a mountain, to preserve an underlying road from rock fall. Alternatively the net is implemented, by means of suitable supports, with a certain angle with respect to the mountain wall, in order to perform capture and stop action against possible rocks detached from the mountain wall itself.

[0019] The retaining net 10 comprises steel wires 14 braided together. In the example, this wire has a section diameter of around 3,5-4 mm with a very high resistance of around 150-180 decaN / mm².

[0020] Each steel wire 14 is closed and rolled up more than once on itself like a ring 12, to form a circular mesh and in the preferred embodiment with the terminal end plumbed in the same ring. Rings 12 are chained one another and they have, in the specific case, four mutual contact points. For simplicity the case of a net of the so called six contact point type, wherein each ring of the net is connected with the other six rings is not shown. Each ring 12 has a diameter substantially of 340mm.

[0021] The retaining net 10 is provided also with other known structural elements and metal trinkets of steel, which are not shown in Figure 1 for simplicity. These structural elements comprise for example connecting elements for connecting more nets 10 with each other, tightening elements for fixing the net 10 to the mountain wall, and also elements for supporting, or tensioning, the net 10 itself, such as for example vertical rods, bars, cross members or other elements.

[0022] According to a characteristic of the present invention, the wire 14 of the net 10 has a surface protection layer 13 comprising a zinc and aluminium alloy, which has a high life time.

[0023] This zinc and aluminium alloy is advantageously made of around 95% of zinc, around 5% of aluminium and of suitable amounts of binder compounds.

[0024] According to the invention also the structural elements and the metal trinkets cited above are coated with the surface protection layer 13 of zinc-aluminium alloy. A retaining net 10 is thus obtained wherein all the elements are protected with the same alloy, and they substantially have the same life time.

[0025] Preferably the wire is protected with around 800 g/m² of zinc-aluminium alloy, so as to further ensure their high resistance to corrosion.

[0026] In Figures 3 and 4 another type of retaining net 15 according to the invention is shown, which is characterised for the high mechanical resistance properties under stimulation both of the static and impulsive type.

[0027] The net 15 comprises in particular a plurality of warp ropes 16 and a plurality of woof ropes 17 crossing one another at right angles in correspondence of knots 18. Ropes 16 and 17 are in this case made of twisted steel strands and they have a diameter d=8 mm.

[0028] Each knot 18 comprises, besides ropes 16 and 17, junction elements 20, including metal trinkets of steel, for tying the two ropes 16 and 17 together in correspondence with the knot 18, which are provided with relative tightening elements 21.

[0029] According to the invention, all the elements of the net 15, i.e. ropes 16 and 17, junction elements 20, metal trinkets and tightening elements 21 are coated with a surface protection layer 13 of zinc-aluminium alloy.

[0030] A retaining net 15 is thus obtained, which, besides having a high mechanical, it also has a high long-lasting resistance to corrosion, which does not require frequent maintaining and revising works.

[0031] It is clear that within the scope of the present invention any other type of retaining net can be provided, having both wires and tightening and junction metal trinkets, coated with the surface protection layer 13 of zinc-aluminium.

[0032] The present invention also relates to a method for realising a retaining net 10, 15 of long-lasting resistance to corrosion, wherein wires 14 or ropes 16 and 17, of steel, are coated with a surface protection layer 13 comprising a zinc-aluminium alloy.

[0033] In particular, the method according to the present invention provides a first step wherein the zinc-aluminium alloy is prepared and a second step wherein single elemental wires 14 in the preferred embodiment, both wires composing rings or wires intended to compose ropes 16 and 17, before crossing each other, are coated with this alloy.

[0034] The wire coating is obtained by depositing the zinc and aluminium alloy on each elemental wire 14 at

a lower temperature than the tempering temperature of the steel to be protected and such as not to cause degradation of the mechanical properties of the steel of the single composing wires. It is to be noted that the single elemental wires are brought to the necessary dimension by cold threading the wire rod, so that the mechanical characteristics required are obtained.

[0035] The step of preparing the alloy can be carried out according to any known technology in the metallurgical field. Hereafter two examples of preparation of the alloy and relevant application of the wires are shown by way of example.

[0036] In a first solution of the method according to the present invention the surface protection layer 13 is obtained by depositing the zinc and the aluminium in two distinct moments on the wires 14, or the ropes 16 and 17. In particular, in a first moment, the wire 14, or rope 16 and 17, is coated, after an accurate pickling, with substantially pure zinc.

[0037] The zinc plating of the wire 14, or of the rope 16 and 17, can be performed for example by dipping in a melted zinc bath or by electrolytically depositing, through sherardizing or other known technology, such as for example spraying.

[0038] In a second moment an aluminium layer is deposited on the zinc surface, e.g. through electrodeposition. Afterwards, the wire 14, or the rope 16 and 17, is introduced into an irradiation chamber. Under irradiation, the aluminium diffuses and is uniformly distributed throughout the zinc.

[0039] In a second solution, the alloy is obtained by preparing an eutectic compound of zinc-aluminium. The wire 14, or the rope 16 and 17, after an accurate pickling, is dipped into the melted eutectic compound bath, maintained at a suitable temperature.

[0040] The main advantage of the net according to the invention stays in the increase of its life time, obtained thanks to the fact that the protection layer of zinc and aluminium confers a high resistance to corrosion to the wires or ropes, which can last for a very long time, even five times higher than the life time of the known protection layer.

[0041] A further advantage stays in that such a protection layer leaves the steel wire mechanical properties unaltered, preserving their intrinsic characteristics of high resistance to loads.

[0042] A further advantage of the retaining net 10, 15 is that, once installed, it has not to be frequently controlled by an operator, thus allowing a considerable saving.

[0043] Moreover, the method according to the invention has the advantage of not requiring sophisticated apparatuses for realising the surface protection layer 13 of zinc-aluminium of the wires 14, or of the ropes 16 and 17, and of allowing the use of any suitable technology already known in the metallurgic field.

[0044] Obviously a skilled person in the art could make changes and modifications as for the above described retaining nets and realising method, in order to

satisfy specific, contingent needs, being all the modifications under the scope of the invention as defined in the following claims.

Claims

1. A retaining net for holding off soil and rocks, snow and avalanches, of the type comprising wires (14), or ropes (16, 17), of steel, braided together, having a surface protection layer (13), **characterised in that** said protection layer (13) comprises a zinc and aluminium alloy. 5
2. A retaining net according to claim 1, **characterised in that** the zinc and aluminium alloy comprises around 95% of zinc and around 5% of aluminium. 10
3. A retaining net according to claim 1 or 2, **characterised in that** the zinc and aluminium alloy comprises besides zinc and aluminium also binder compounds. 15
4. A retaining net according to any of the preceding claims, **characterised in that** the zinc and aluminium of said surface protection layer form an eutectic compound. 20
5. A retaining net according to any of the preceding claims, **characterised in that** in said surface protection layer (13) the aluminium is diffused throughout the zinc. 25
6. A retaining net according to any of the preceding claims, **characterised in that** said wires (14) are closed like a ring (12) and rolled up on themselves more than once, to form a circular mesh, wherein each ring (12) is chained with an adjacent ring. 30
7. A retaining net according to claim 6, **characterised in that** it comprises fixing and connecting structural elements of the net itself, including steel trinkets, which are coated with zinc and aluminium alloy. 35
8. A retaining net according to any of the claims 1 to 5, **characterised in that** said ropes (16, 17) form a warp and woof weave and they are connected one another by means of mutual junction means (20), including steel trinkets. 40
9. A retaining net according to claim 8, **characterised in that** said mutual junction means (20) are coated with the zinc and aluminium alloy. 45
10. A retaining net according to claim 9, **characterised in that** said junction means (20) are provided with tightening means coated with the zinc and aluminium alloy. 50
11. A method for realising a retaining net, made of a set of wires (14), or ropes (16, 17), of steel, comprising a first step wherein said wires (14), or said ropes (16, 17), are coated with a surface protection layer (13) and a second step wherein said wires (14), or said ropes (16, 17), are braided together, **characterised in that** said surface protection layer (13) is realised with a zinc and aluminium alloy. 55
12. A method according to claim 11, **characterised in that** said surface protection layer (13) is obtained through a first sub-step wherein on each of said wires (14), or of said ropes (16, 17) a zinc plating is performed to form a pure zinc temporary layer, a second sub-step wherein on said temporary layer an aluminium layer is deposited, and a third sub-step wherein the aluminium is diffused throughout the zinc temporary layer.
13. A method according to claim 12, **characterised in that** during said third sub-step the aluminium is diffused throughout the zinc through irradiation.
14. A method according to claim 11, **characterised in that** said surface protection layer (13) is obtained by dipping each of said wires (14), or said ropes (16, 17), in an eutectic compound bath of zinc and aluminium.
15. A method according to the preceding claims, **characterised in that** the zinc and aluminium alloy layer is formed on the single elemental wires (14) brought to the necessary dimension by cold threading of wire rod, so that the mechanical characteristics required to the wire and the desired protection layer are obtained.
16. A method according to any of the preceding claims, **characterised in that** said surface protection layer (13) is obtained by depositing on each elemental wire (14) at a lower temperature than the tempering temperature of the steel to be protected and such as not to cause the degeneration of the mechanical characteristics of the steel of the single elemental wires.

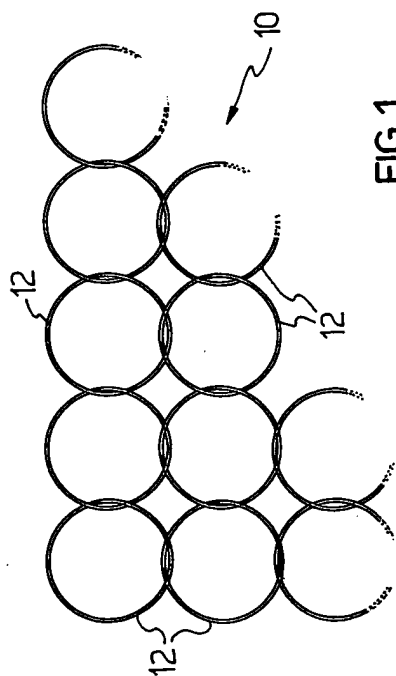


FIG. 1

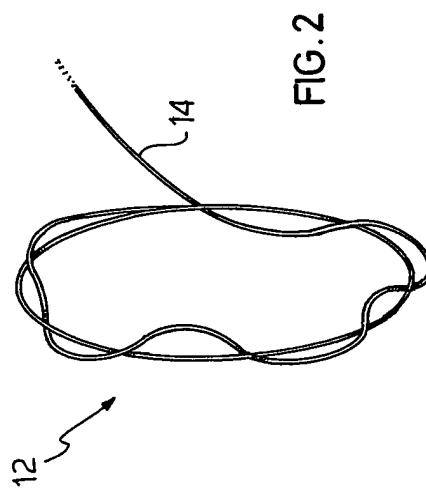


FIG. 2

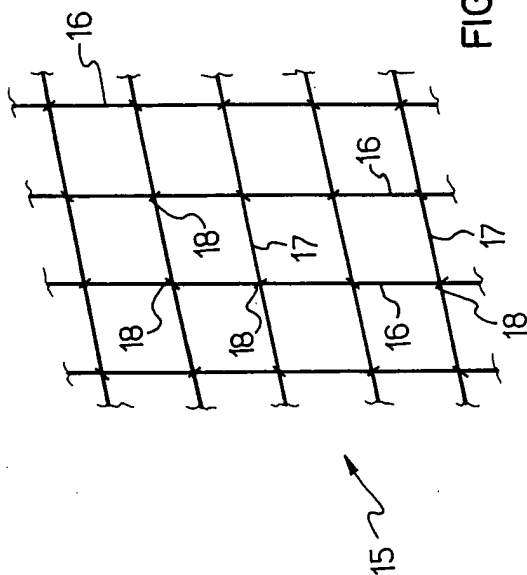


FIG. 3

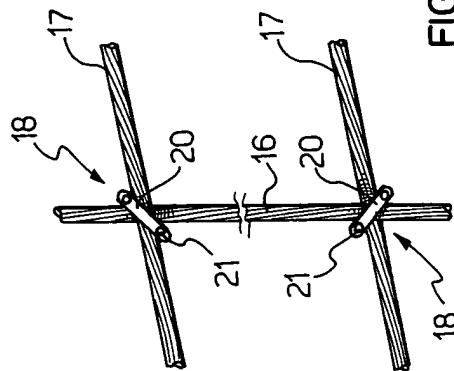


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 03 42 5779

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Place of search MUNICH		Date of completion of the search 11 May 2004	Examiner Geiger, H
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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