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(54) **Anchor for rope and method of production**

(57) An anchor element (1) for rope possesses a cable (2) bent to give a first portion (10) in the form of a noose and a second portion (16) in the form of a leg.

The cable is wholly or partly encapsulated by a matrix (18) in which the cable is embedded and the matrix material is infiltrated between the strands and/or wires of the cable, resulting in a coherent and compact matrix.

The matrix is obtained by a conversion process, such as sintering, crosslinking or polymerizing, e.g. with administration of heat, designed to produce a coherent matrix that spreads between the wires and/or strands of the cable (2) and occupies the interstices between these.

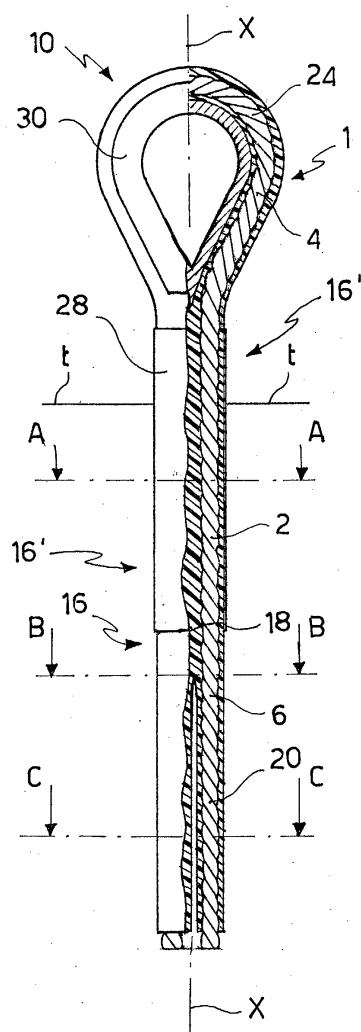


FIG. 1a

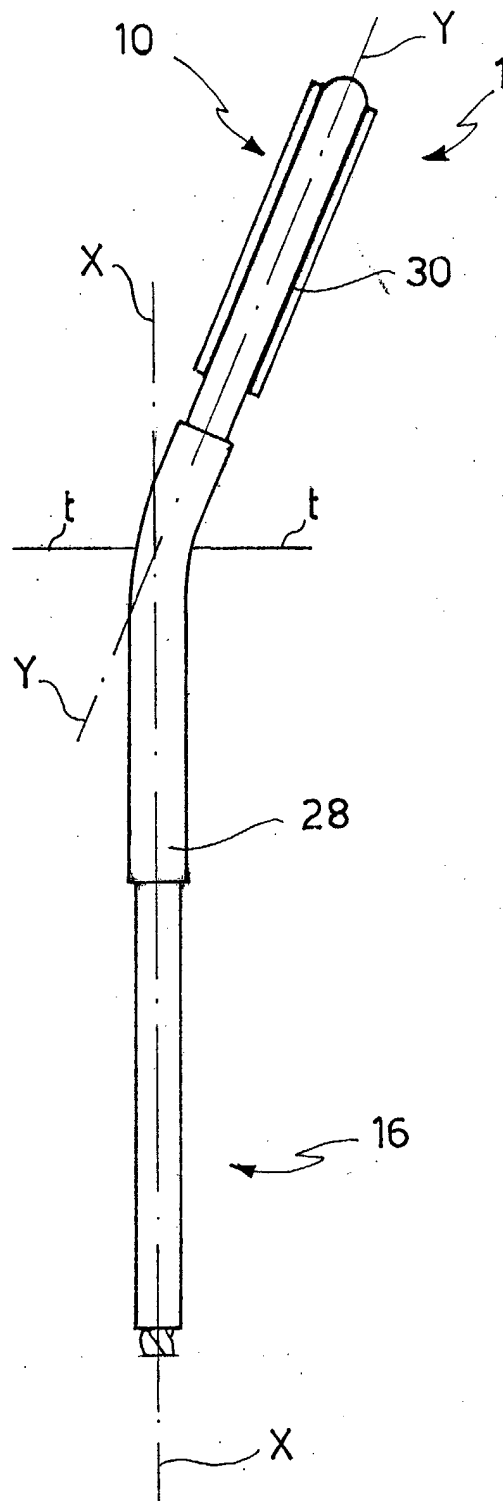


FIG. 1b

Description

[0001] The present invention relates to an anchor element for a rope. The said anchor element is particularly, but not necessarily, intended to act as an anchor for a rope or cable in boulder fences, snow nets or snow fences.

[0002] These systems essentially comprise a net held in place by means of ropes attached to a plurality of anchor elements fixed to the soil or a rock face by means of suitable fixing means.

[0003] The use of the said systems is extremely common, especially in mountainous or snowy regions, in the vicinity of roads, inhabited areas or snow pistes, or in the vicinity of rock slopes and faces.

[0004] These systems are literally barriers designed to catch boulders or fragments of rock or avalanches that come away from the rock faces, in the case of boulder fence systems, or to stop the snow, in the case of snow net systems.

[0005] Clearly, the reliability of these systems, and hence of each component part thereof, is of the utmost importance to the safety of the areas in which they are installed.

[0006] Of particular importance is the reliability of the anchor elements, that is those elements designed to be fixed to the soil or a rock face and to which the ropes are then attached to keep the nets in place.

[0007] The environments in which the anchor elements are installed are hostile to their structural integrity: they are driven into the ground or rock face or otherwise in contact with the material of the soil or rock, and at the same time are exposed, at least as regards the part above the soil, to the weather.

[0008] To all this must be added a constant static stress due to the pulling action of the rope which is preloaded in order to keep the net in its normal taut position, and sudden dynamic stresses of enormous intensity due to boulders or avalanches which subject the anchor element to fierce jerking.

[0009] The structural integrity of the anchor elements is undermined by corrosion phenomena due partly to humidity or water coming into contact with the metal parts of the element, and partly to electrolytic phenomena, for, as is known, the contact between the material of the soil or of a rock face and the metal that partly forms the anchor element generates an electrolytic cell capable of causing structural damage to the said element.

[0010] Not to be underestimated either is the corrosive action of acids and salts contained in the material of the soil or rock face.

[0011] Typically, as regards the construction of an anchor, products known in the sector use a cable bent to produce a loop or noose part and a leg.

[0012] Certain products use a tube, generally made of plastic, in which the cable is inserted, to provide protection.

[0013] In addition, it is known practice to inject, into

the residual space between the cable of the anchor element and the tube, along the leg of the latter, a material that acts as a buffer.

[0014] One device that works in this way is disclosed, for example, in document EP-A1-557241.

[0015] However, the devices known in the sector have the disadvantage of not providing complete insulation of the cable of the anchor element from water or humidity. As a result, time-consuming and expensive analyses have to be carried out at frequent intervals to ensure that there are no spots of corrosion in the cable.

[0016] The need is felt, therefore, to provide an anchor element for rope capable of completely insulating at least a section of the cable of the anchor element from water or humidity.

[0017] The problem addressed by the present invention is that of devising an anchor element for rope whose structural and functional characteristics shall satisfy the abovementioned requirements and at the same time obviate the disadvantages discussed with reference to the prior art.

[0018] This problem is solved by an anchor element and by a production method in accordance with the following claims. The dependent claims describe further alternative embodiments of the anchor element and production method according to the invention.

[0019] Other characteristics and the advantages of the anchor element according to the present invention will be found in the following description of a preferred, non-restrictive illustrative embodiment thereof, in which:

[0020] Figures 1a and 1b respectively show a front view, partly in section, and a side view, of one embodiment of an anchor element;

[0021] Figure 2a shows a view in cross section of the anchor element of Figure 1a, taken on the section line marked A-A in Figure 1a;

[0022] Figure 2b shows a view in cross section of the anchor element of Figure 1a, taken on the section line marked B-B in Figure 1a;

[0023] Figure 2c shows a view in cross section of the anchor element of Figure 1a, taken on the section line marked C-C in Figure 1a;

[0024] Figures 3a and 3b show views in cross section of an anchor element in accordance with another embodiment;

[0025] Figures 4a and 4b respectively show a front view, partly in section, and a side view, partly in section, of another embodiment of an anchor element;

[0026] Figure 5 shows a view in section of the anchor element of Figure 4a, taken on the section line marked D-D in Figure 4a;

[0027] Figures 6 and 7 show a front view in section of other embodiments of an anchor element;

[0028] Figures 8 and 9 show views in cross section of other embodiments of an anchor element; and

[0029] Figures 10a and 10b show views in cross section of other embodiments of an anchor element.

[0030] With reference to the appended figures, the

number 1 is a general reference for an anchor element according to the invention.

[0031] The anchor element 1 comprises a cable 2, preferably made of a metallic material, which has a central section 4, a first end section 6 and a second end section 8. Both end sections adjoin said central section 4, thus forming the continuous cable 2.

[0032] The cable 2, in one embodiment, is composed of a plurality of individual wires 2' twisted together to form the cable. The said cable 2 is preferably made up of seven wires 2'.

[0033] In another embodiment, the said cable is composed of a plurality of strands, each strand in turn made of a plurality of wires.

[0034] In yet another embodiment, the said cable 2 is composed of a plurality of untwisted wires 2''.

[0035] The cable 2 therefore has a plurality of core elements which in practice are a plurality of wires and/or a plurality of strands, depending on how the said cable is constructed, between which are spaces forming interstices 3.

[0036] In other words, even though in some embodiments of the cable 2 the wires 2', 2'' or strands are twisted, there are interstices 3 between them.

[0037] In yet another embodiment, the cable 2 is composed of a single wire.

[0038] The structure of the cable 2 offers advantageous flexibility characteristics.

[0039] The said cable is preferably made of a metallic material. Other embodiments use a cable made of composite material.

[0040] The cable 2 has a first portion 10 of the said anchor element designed to engage with means (not shown) for attaching the rope to the said anchor element.

[0041] The said first portion 10 is preferably configured as a loop or noose in order conveniently to take the said means for attaching the rope to the anchor element 1.

[0042] In other words, the said cable 1 is bent so that its central portion 4 forms an eye that will conveniently take the said rope attachment means.

[0043] The said means for attaching the rope to the anchor element 1 are, for example, an end section of the rope itself, suitably bent to form a noose, e.g. with the aid of clips, or a hook that connects onto the tie with shackles and the like.

[0044] The anchor element 1 also includes a second portion 16 designed to work together with means for fixing the said anchor element to the soil or to a rock face.

[0045] In particular, a first section 16' of the said second portion 16, in an installed configuration of the anchor element 1, is beneath a soil line t-t, that is, buried in the ground or in the rock face. A second section 16'' of the said second portion 16, next to the first portion 10 of the anchor element 1, is above the soil line or rock face t-t.

[0046] The first end section 6 and the second end section 8 of the bent cable 2 lie close together to form the said second portion 16, which is a leg for the said anchor element.

tion 8 of the bent cable 2 lie close together to form the said second portion 16, which is a leg for the said anchor element.

[0047] The means for fixing the said anchor element to the soil or to a rock face are a cement plinth or an injection of cement between the leg of the anchor element and the soil or rock face.

[0048] In a preferred embodiment, the said first portion 10 of the anchor element 1 basically lies on a plane having a first-portion line X-X that forms a bending angle A with a second-portion line Y-Y of a plane on which the said second portion 16 basically lies.

[0049] The said bending angle A is advantageously optimized to give the best position of the first portion 10 of the anchor element 1 to engage with the rope attachment means.

[0050] In another embodiment, the plane on which the first portion 10 of the anchor element 1 basically lies coincides with the plane on which the said second portion 16 basically lies.

[0051] In addition, the said anchor element 1 comprises a matrix 18 made of a matrix material which encapsulates at least one section to be protected 20 of the cable 2. This matrix infiltrates between the core elements of the cable.

[0052] In other words, according to the present invention, the cable 2 assumes the functions of a core to the anchor element 1, the said core being embedded, at least in part, in the matrix 18 which encapsulates the section to be protected 20 of the cable 2 by enclosing the core elements thereof, that is the wires 2', 2'' and/or the strands, and working its way into the interstices 3 situated between the latter.

[0053] Not only does the said matrix 18 consist of a matrix material that surrounds the said section to be protected 20 of the cable 2 and adhere to the surfaces of the core elements of the said cable, but also it propagates itself and spreads between the wires 2', 2'' and/or the strands of the cable 2, producing a coherent mass which encapsulates them.

[0054] The matrix 18 advantageously adheres to the surface of each of the wires 2', 2'' and of the strands, producing a coherent mass, that is, a mass whose parts exhibit close cohesion, and which is such as to prevent voids or cavities containing no matrix material remaining between the core elements and through which water or humidity could enter and condense and come into contact with the material of the cable and/or ensuring that differential cells are not created by structural difference.

[0055] In accordance with one aspect of the present invention, the said matrix 18 is obtained by a process of conversion of the said matrix material in which the said matrix material is turned into a coherent mass that adheres to the core elements of the cable.

[0056] The said matrix material is preferably originally in paste form and/or in small loose parts or powder, that is powder before the said conversion process is carried out.

[0057] In a preferred embodiment, the said conversion process is sintering, that is a process in which the powdered matrix material is converted into a coherent mass even without the matrix material being caused to melt.

[0058] In another embodiment, the said process of conversion is a polymerization of the matrix material or a polycondensation reaction.

[0059] In still another embodiment, the said matrix material is originally in the semi-solid or gel or pasty state and, following the said process of conversion, gives rise to a coherent and compact matrix between the core elements of the section to be protected 20 of the cable 2.

[0060] The said processes of conversion, in other embodiments, are facilitated or made easier or triggered by additives such as catalysts and the like, suitably added to the matrix material in predefined quantities.

[0061] In accordance with another aspect of the present invention, the matrix 18 is the result of the polymerization of a plastic resin which encapsulates the section to be protected 20.

[0062] In other words, the section to be protected 20 of the cable 2 is impregnated, for example in the liquid or semi-solid state or in a paste, with a plastic resin such as to permit complete enclosing of the said section to be protected and infiltration between the interstices of the core elements, for example between the wires and/or strands of the cable.

[0063] The polymerization process to which the said plastic resin is subjected produces, from the matrix material, a continuous and compact enclosing matrix which extends along the section to be protected 20.

[0064] In accordance with another aspect of the present invention, the matrix 18 in which the cable is at least partly immersed surrounds a section to be protected 24 of the first portion 10 of the anchor element 1, forming a matrix of the said section that adheres to the latter.

[0065] In other words, the matrix 18 extends to form a matrix around a section to be protected 24 of the eye or noose portion or loop of the anchor element 1.

[0066] The said matrix around the section to be protected 24 of the first portion 10 of the anchor element advantageously inhibits the initiation of electrolytic corrosion phenomena, differential cells and the like.

[0067] In accordance with yet another aspect of the present invention, the matrix 18 at least partly surrounds the first end section 6 and the second end section 8 of the cable 2, forming for the said end sections an integral matrix which adheres to the sections.

[0068] In other words, the matrix material placed around a first section to be protected 26' of the first end section 6 and around a second section to be protected 26" of the second end section 8 of the anchor element 1, i.e. around the leg of the latter, forms an integral matrix which encapsulates both of the sections to be protected.

[0069] The said matrix advantageously inhibits the development of corrosion phenomena and, at the same time, holds the sections of the leg together, acting as a binding means between the two end sections.

5 **[0070]** In one embodiment, the matrix material that produces the matrix 18 is a resin, preferably a plastic resin, such as a thermoset. In particular, the said thermosetting resin is an epoxy resin.

[0071] In a preferred embodiment, the matrix material that makes up the matrix 18 is filled with reinforcing fibres, such as glass fibres or carbon fibres.

10 **[0072]** In another embodiment, the matrix material that makes up the matrix 18 is a material with high stiffness properties following the conversion process, such as an epoxy resin.

15 **[0073]** In accordance with yet another aspect of the present invention, the matrix 18 is produced by a process of conversion of a matrix material that produces a matrix capable of keeping the said cable bent.

20 **[0074]** In other words, the physico-mechanical properties of the matrix material subjected to the conversion process are such as to keep the cable 2 in the bent configuration which creates the first portion 10 or noose and the second portion 16 or leg.

25 **[0075]** Filling the matrix material with the abovementioned reinforcing fibres accentuates the properties of the material, improving, in particular, its mechanical properties such as wear resistance, hardness, stiffness and so forth.

30 **[0076]** In an embodiment in which the matrix encapsulates the entire cable 2, the matrix material has stiffness properties such as to keep the cable 2 in the bent configuration.

35 **[0077]** In the embodiment in which the matrix 18 encapsulates one section of the leg, the stiffness and hardness properties of the matrix material are such as to act as binding means between the end sections of the cable 2.

[0078] In another embodiment, the said anchor element 1 comprises a separate sleeve 28 located on the leg of the anchor element 1 and preferably made of steel, which performs the functions of the binding means.

[0079] The binding means keep the end sections of the cable 2 close together to form the leg of the anchor element and prevent them coming apart due to the action of the rope under tension.

[0080] In a preferred embodiment, the stiffness and hardness properties of the matrix material of which the matrix 18 is composed are such that the said matrix simultaneously acts as reinforcing means 12 able to attenuate the action of the rope or of the means of attachment of the rope to the anchor element.

50 **[0081]** The said reinforcing means are also able to preserve the configuration of the said first portion 10 against the action of the rope attachment means.

55 **[0082]** In other words, the said reinforcing means are able to maintain the noose or eye configuration of the

first portion 10 of the anchor element 1.

[0083] In particular, in the embodiment of the anchor element 1 in which a section of the first portion 10 is provided with the matrix 18, the said matrix forms reinforcing means capable of attenuating the state of tension generated by the contact between the anchor element and the rope attachment means.

[0084] In another embodiment, the anchor element 1 includes, preferably inside the first portion 10 thereof, a separate rigid element housed inside the first portion 10 of the anchor element 1, so as to sit between the said first portion and the rope attachment means, acting as reinforcing means.

[0085] The said rigid element is preferably a thimble 30, that is an annular element, of round or ovoid shape, preferably in a metal such as steel or the like, or wood, which is inserted into the eye of the cable to protect it against wear.

[0086] The said thimble 30 comprises a channel seat between lateral containment walls, so that the eye of the cable or a portion of this eye engaging with the said thimble sits inside the said containment channel between the said side walls.

[0087] The structural configuration of the thimble ensures that the thimble is correctly positioned with respect to the central section 4 of the cable and keeps it permanently on the cable.

[0088] In the embodiment of the anchor element in which a section of the first portion 10 is provided with the matrix 18, the said matrix is interposed between the thimble and the cable.

[0089] In another embodiment of the anchor element according to the invention, the said anchor element includes forming means designed to define the angle between the said first portion 10 and the said second portion 16 of the said anchor element.

[0090] Specifically, the said forming means comprise a bar 32, preferably made of a metallic material or of the same matrix material which has undergone an earlier conversion process, this bar being bent at one end to define a first section of the bar 32' that forms with a second section of the bar 32" an angle approximately equal to the bending angle A formed by the line of the plane X-X of the first portion 10 of the anchor element with the line of the plane Y-Y of the second portion 16 of the said anchor element.

[0091] The bar 32 possesses a section which is preferably shaped to fit portions of the cable 2 (Figure 5).

[0092] In other words, the end sections of the cable 2 are fitted to the said bar 32 by securing means, such as a wire or other filament, one or more securing straps and the like, so that the said first portion 10 and the said second portion 16 of the anchor element 1 define the bending angle A between themselves.

[0093] In the abovementioned embodiment, the matrix 18 at least partly encloses the said second portion 16 of the anchor element 1, at least partly encapsulating the said end sections of the cable and the said securing

means, such as a wire or one or more straps.

[0094] The anchor element 1 according to the present invention can be produced by a method of production that includes the phase of impregnating at least one section to be protected of the cable 2 with a matrix material suitable for the distribution of the said material between the core elements of the section to be protected of the cable 2.

[0095] It will be obvious in carrying out the abovementioned method in which the said matrix material is a powdered material, the said powder is fine enough to allow the loose particles to infiltrate between the wires and/or strands of the cable. In carrying out the abovementioned method in which the said matrix material is a pasty or gelatinous or liquid mass, the said material has a fluidity such as to infiltrate easily between the said strands and/or wires, that is, a fluidity sufficient to distribute the said material between each of the core elements of the section to be protected of the cable 2.

[0096] The impregnation with the matrix material occurs between the core elements of the entire cable 2 or along a section thereof to be protected, for example a section of the first portion 10 designed to work together with the rope attachment means or with the rope itself, or along a section of the leg designed to work together with means for fixing the said anchor element to the soil or to a rock face.

[0097] Impregnation occurs by spreading the matrix material by painting or blowing processes or by immersion or by electrostatic action.

[0098] In particular, in the case in which the material is deposited by electrostatic action, the cable and the material are subjected to a predefined potential difference, whereby the matrix material, which is preferably a powder, is attracted to the cable, deposited in the section to be protected, and distributes itself between the interstices of the core elements of the cable, for example between the wires and/or strands.

[0099] The said method of production also includes the phase of carrying out a process of conversion of the said matrix material which produces a coherent matrix 18 that encapsulates the core elements of the section to be protected of the cable 2.

[0100] In other words, while the impregnation allows the matrix material to get into the "heart" of the cable, i. e. into its interior, the process of conversion turns the said matrix material into a coherent mass with good distribution between the wires and/or strands and with good adhesion to the surface of each of these.

[0101] Impregnation to the "heart" of the said cable means, in particular, that the matrix material penetrates between the wires and/or strands of the cable beyond the surface layer formed by these, which forms the surface layer of the cable.

[0102] Advantageously, impregnation to the "heart" also produces a protective matrix which, although scratched and worn by accidental external causes, remains intact within and capable of protecting the cable

against atmospheric agents, humidity, electrolytic phenomena and so on.

[0103] In one embodiment of the method of production, the said process of conversion involves sintering the matrix material, which is preferably in powder form. In another embodiment of the method of production, the said process of conversion is a polymerization reaction, for example of a matrix material consisting of a (preferably plastic) resin, such as an epoxy resin or vinyl ester.

[0104] In other embodiments of the method of production, the said process of conversion is a drying of the matrix material, the latter consisting for example of a paint or a solid, semi-solid or gelatinous paste.

[0105] In another embodiment of the method of production, the phase of carrying out the process of conversion includes the phase of administering a quantity of heat. The said quantity of heat is such as to trigger or facilitate the said process of conversion.

[0106] In particular the cable 2, preferably bent and with the powdered, pasty or gelatinous matrix material at least partly deposited on it, is ventilated with hot air, or is heated, in order to initiate and complete the said process of conversion, optionally facilitated or triggered by catalysts and additives.

[0107] In one embodiment, the method of production also includes the phase of bending the said cable in order to form the said first portion 10 and the said second portion 16 of the anchor element.

[0108] In a preferred embodiment, the said method includes the additional phase of filling the matrix material with reinforcing fibres such as glass fibres or carbon fibres.

[0109] In yet another embodiment of the abovementioned method of production, the said method includes the phase of filling the said matrix material with catalysts and/or additives, their job being to enhance the mechanical properties of the abovementioned material and/or facilitate the said processes of conversion.

[0110] In one embodiment of the abovementioned method, the phase of impregnating the matrix material is the first phase in the said method and is carried out with the cable straight or bent.

[0111] In other words, the said phase of depositing the matrix material is performed on the bare cable in order to deposit the said matrix material on predefined sections of the cable, thus ensuring impregnation with the matrix material, for example between the wires and/or strands of the cable.

[0112] In another embodiment of the method of production, the phase of impregnation with the matrix material precedes the phase of bending the cable and that of carrying out the process of conversion.

[0113] In another embodiment, the phase of impregnation with the matrix material comes after the phase of bending the cable and precedes that of carrying out the process of conversion.

[0114] Unusually, the anchor element according to the present invention provides improved insulation of a

section of the cable of the anchor element against water or against humidity.

[0115] For example, the matrix along the leg buried in the soil or in the rock face, adhering to the leg and infiltrating between the strands and/or wires of the cable, does not allow penetration or contact between the cable and water or humidity present in the soil or in the rock face.

[0116] Advantageously, furthermore, the said matrix provides, for example for those sections of the cable which are exposed to atmospheric agents or simply to the air, sound protection of the cable against such agents.

[0117] The whole translates into an improved reliability of the anchor element.

[0118] In accordance with another advantageous aspect, the mechanical properties that can be conferred on the matrix allow for embodiments of the anchor element that have no thimble and/or sleeve and yet remain equally reliable in the face of the action of wear, tension in the rope and deformation of the eye by the rope.

[0119] Advantageously, furthermore, the matrix is thin. The end sections of the cable can therefore be positioned very close together.

[0120] In other words, the said thickness of the matrix, for example in embodiments in which it extends along the entire length of the cable, allows the first noose or eye portion to be made very small, in such a way that the point of conjunction between the end sections of the leg is above the line of the soil or rock face in which the anchor element is inserted.

[0121] In this way, by virtue of the binding together of the said end sections of the cable by the said matrix or by the separate sleeve, the end sections have a tendency to diverge from each other above the line of the soil or rock face.

[0122] Advantageously, therefore, the said anchor element has a limited tendency to cause a widening or spreading of the hole made in the soil or rock face or in the anchor element fixing means in which the leg is inserted.

[0123] In accordance with another advantageous aspect, the said matrix at least partly encapsulates the said cable, forming means of protection capable of attenuating the action of the rope or of the means of attaching the rope to the anchor element.

[0124] The adhesion of the matrix material to the surface of the individual core elements of the cable, i.e. to the surface of the wires and/or strands, is advantageously increased by the impregnation by the matrix material between the said elements, resulting in a mechanical bond, and/or by a prior application of paint or immersion in a suitable material designed to increase the said adhesion.

[0125] Lastly, in accordance with another advantageous aspect, the said method of production is applicable to anchor elements having a bent cable that have already been made, as a means of improving their char-

acteristics or reconditioning them.

[0126] It should be observed that in accordance with the present invention, for the said anchor element provided with a matrix which penetrates into the heart of the cable and encapsulates its wires and/or strands, the said matrix remains bound to the said cable without necessitating the use of containment jackets to keep layers of added material in position.

[0127] Moreover, it should be observed that in accordance with the present invention the matrix that encapsulates the core elements of the cable, in one embodiment, is capable of keeping the cable bent, without the use of additional means of maintaining the shape of the anchor element.

[0128] It will be clear that a person skilled in the art may make numerous modifications and alterations to the anchor element and method of production described above in order to fulfil occasional and specific needs.

[0129] For example, besides sintering, crosslinking or polymerizing or condensation polymerizing, the process of conversion to which the matrix material is subjected is a process which, from a liquid, semi-solid, gelatinous or powdered material, produces a coherent and compact matrix that infiltrates between the strands and/or wires of the cable.

[0130] It will be clear that other embodiments also are to be understood as coming within the scope of protection of the invention as defined by the following claims.

Claims

1. Anchor element (1) for rope, in which a cable (2), comprising a plurality of core elements (2', 2'') that work together to form the said cable, has

- a first portion (10) designed to engage with means for attaching the rope to the said anchor element (1);
- a second portion (16) able to engage with means for fixing the said anchor element (1) to the soil or to a rock face;

the said anchor element being **characterized in that** it also comprises

a matrix (18), made of a matrix material, which encapsulates at least one section to be protected (20, 24, 26', 26'') of the said cable (2), infiltrating between the said core elements of the cable (2).

2. Anchor element (1) according to Claim 1, in which the said matrix (18) adheres to the surface of each of the said core elements (2', 2'') of the said section to be protected (20, 24, 26', 26'') of the cable (2).

3. Anchor element (1) according to Claim 1 or 2, in which the said matrix (18) is a coherent mass that encapsulates the said core elements (2', 2'') of the

said section to be protected (20, 24, 26', 26'') of the cable (2), between the interstices of which it infiltrates.

5 4. Anchor element (1) according to any one of the preceding claims, in which the said matrix material is a resin.

10 5. Anchor element (1) according to Claim 4, in which the said matrix material is a thermosetting resin.

6. Anchor element (1) according to Claim 5, in which the said matrix material is an epoxy resin.

15 7. Anchor element (1) according to any one of the preceding claims, in which the said matrix material includes predetermined quantities of reinforcing fibres.

20 8. Anchor element (1) according to any one of the preceding claims, in which the said matrix material includes predetermined quantities of catalysts.

25 9. Anchor element (1) according to any one of the preceding claims, in which the said first portion (10) includes the said section to be protected (24).

30 10. Anchor element (1) according to any one of the preceding claims, in which the said second portion (16) includes the said section to be protected (20).

11. Anchor element (1) according to any one of the preceding claims, that also includes reinforcing means for the said first portion (10).

12. Anchor element (1) according to Claim 11, in which the said reinforcing means are designed to attenuate the action of the rope attachment means.

40 13. Anchor element (1) according to Claim 11 or 12, in which the said reinforcing means are designed to maintain the configuration of the said first portion (10) against the action of the rope attachment means.

45 14. Anchor element (1) according to any one of Claims 11 to 13, in which the said matrix (18) forms the said reinforcing means.

50 15. Anchor element (1) according to any one of Claims 11 to 14, in which a thimble (30) forms the said reinforcing means.

55 16. Anchor element (1) according to any one of the preceding claims, that also includes binding means for the second portion (16) of the anchor element to keep together end sections of the cable (2) that form the said second portion.

17. Anchor element (1) according to Claim 16, in which the said matrix (18) forms the said binding means.
18. Anchor element (1) according to Claim 16 or 17, in which a sleeve (28) forms the said binding means. 5
19. Anchor element (1) according to any one of the preceding claims, that also includes forming means designed to define the angle of the bend between the said first portion (10) and the said second portion (16) of the said anchor element. 10
20. Anchor element (1) according to Claim 19, in which the said forming means comprise a bar (32) having a main section and an end section which is bent with respect to the said main section. 15
21. Anchor element according to Claim 19 or 20, that also includes means of securing the cable (2) to the forming means. 20
22. Anchor element (1) according to Claim 21, in which the said matrix (18) also encapsulates the said securing means. 25
23. Anchor element (1) for rope according to any one of the preceding claims, in which the said cable (2) has a central section (4) and adjoined end sections (6, 8), in which 30
- the said central section (4) forms the first portion (10) of the said anchor element (1);
 - the said end sections (6, 8) form the second portion (16) of the said anchor element; and
 - the matrix (18) is one integral piece and encapsulates at least part of both of the said end sections (6, 8). 35
24. Anchor element (1) for rope according to any one of the preceding claims, in which the cable (2) is bent to form the first portion (10) and the second portion (16), and the said matrix (18) is designed to keep the said cable bent. 40
25. Method of producing an anchor element (1) for rope, 45
- the said anchor element (1) comprising a cable (2) that has a plurality of core elements (2', 2'') that work together to form the said cable,
- the said production method comprising the following steps: 50
- impregnate at least one section to be protected (20, 24, 26', 26'') of the said cable (2) with a matrix material suitable for the distribution of the said material between the core elements (2', 2'') of the section to be protected (20, 24, 26', 26'') of the said cable (2); and 55
- carry out a process of conversion of the said matrix material which produces a coherent matrix (18) that encapsulates the said core elements (2', 2'') of the section to be protected (20, 24, 26', 26'') of the said cable (2).
26. Production method according to Claim 25, in which the said phase of carrying out a conversion process produces a compact matrix (18) around the said core elements (2', 2'') of the section to be protected (20, 24, 26', 26'') of the said cable (2).
27. Production method according to Claim 25 or 26, in which the said phase of carrying out a conversion process produces a matrix (18) that adheres to the surface of each of the said core elements (2', 2'') of the section to be protected (20, 24, 26', 26'') of the said cable (2).
28. Production method according to any one of Claims 25 to 27, in which the said phase of impregnating at least one section to be protected (20, 24, 26', 26'') of the said cable (2) is designed to distribute the said matrix material through to the heart of the said cable (2).
29. Production method according to any one of Claims 25 to 28, in which the said phase of carrying out a conversion process includes the phase of administering a quantity of heat to the said anchor element, the said quantity of heat being designed to trigger or facilitate the said conversion process.
30. Production method according to any one of Claims 25 to 29, in which the said phase of carrying out a conversion process is a phase of crosslinking the said matrix material.
31. Production method according to any one of Claims 25 to 30, in which the said phase of carrying out a conversion process is a phase of polymerizing the said matrix material.
32. Production method according to any one of Claims 25 to 31, in which the said phase of carrying out a conversion process is a sintering phase.
33. Production method according to any one of Claims 25 to 32, in which the said matrix material is in semi-solid form.
34. Production method according to any one of Claims 25 to 33, in which the said matrix material is in gelatinous form.
35. Production method according to any one of Claims 25 to 34, in which the said matrix material is in the form of loose particles.

36. Production method according to Claim 35, in which the said matrix material is a powder. Claims 25 to 47.
37. Production method according to any one of Claims 25 to 36, in which the said matrix material is a resin. 5
38. Production method according to Claim 37, in which the said matrix material is a thermosetting resin.
39. Production method according to Claim 38, in which the said matrix material is an epoxy resin. 10
40. Production method according to any one of Claims 25 to 39, that also includes the phase of filling the matrix material with predetermined quantities of reinforcing fibres. 15
41. Production method according to any one of Claims 25 to 40, that also includes the phase of filling the matrix material with predetermined quantities of additives. 20
42. Production method according to any one of Claims 25 to 41, that also includes the phase of filling the matrix material with predetermined quantities of catalysts. 25
43. Production method according to any one of Claims 25 to 42, that also includes the phase of bending the said cable to form a first portion (10) of the anchor element (1) designed to engage with means for attaching the rope to the said anchor element, and a second portion designed to work together with means for fixing the said anchor element to the soil or to a rock face. 30
35
44. Production method according to Claim 43, in which the phase of impregnating the matrix material precedes the phase of bending the cable (2). 40
45. Production method according to any one of Claims 25 to 44, that includes the phase of fitting the said cable with forming means designed to define an angle (A) between a first portion (10) and a second portion (16) of the said anchor element (1). 45
46. Production method according to any one of Claims 25 to 45, that includes the phase of fitting the said cable, having the said matrix (18), with a thimble (30). 50
47. Production method according to any one of Claims 25 to 46, that includes the phase of fitting the said cable, having the said matrix (18), with a sleeve (28). 55
48. Anchor element (1) for rope capable of being produced by the production method outlined in one of

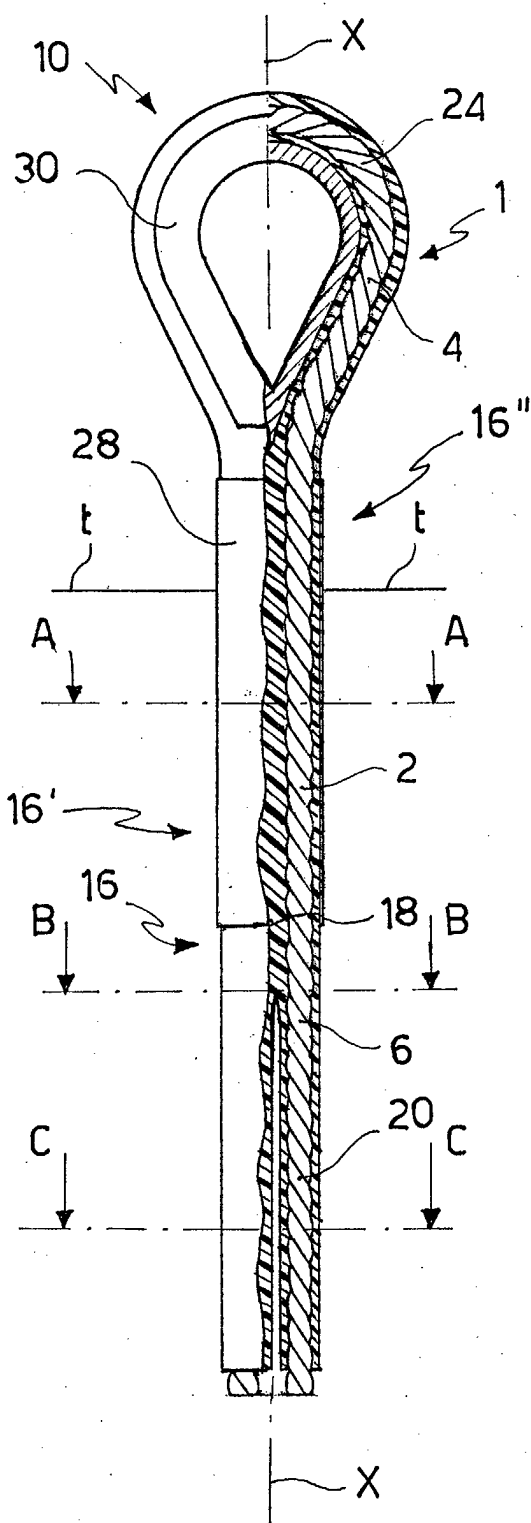


FIG. 1a

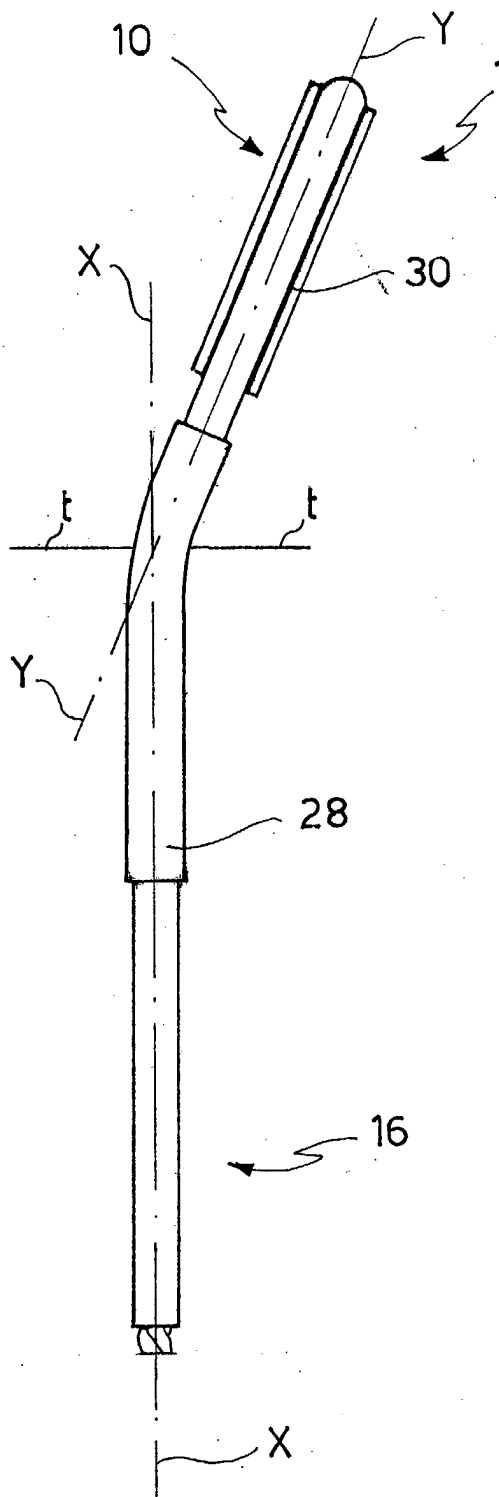


FIG. 1b

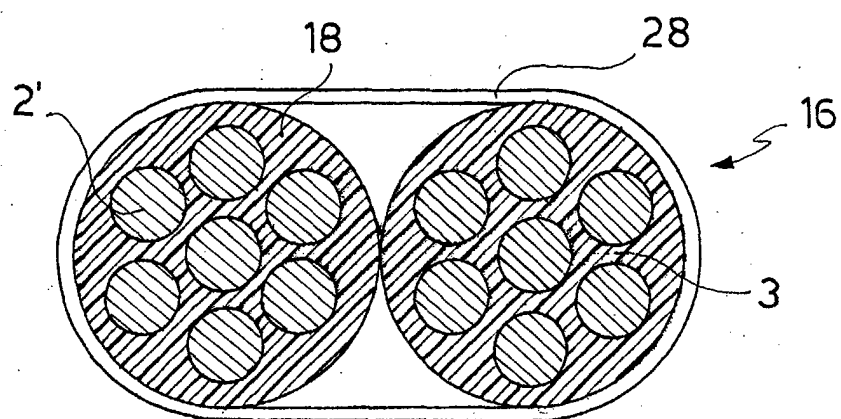


FIG. 2a

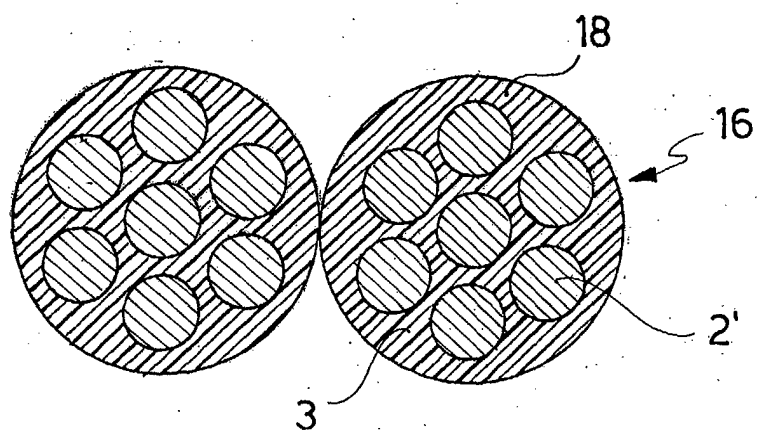


FIG. 2b

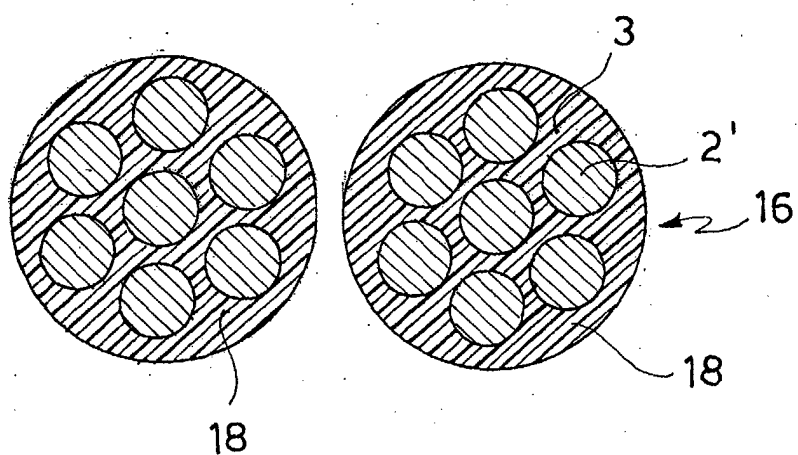


FIG. 2c

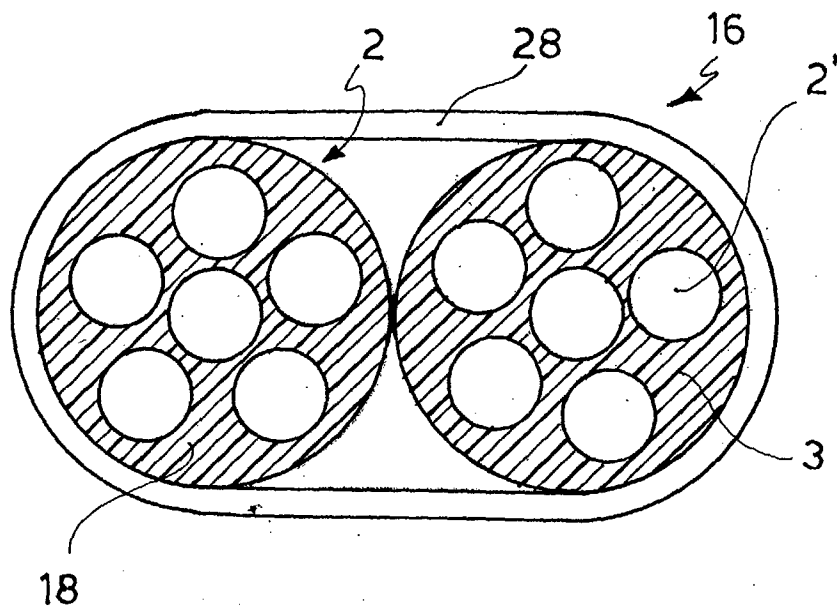


FIG. 3a

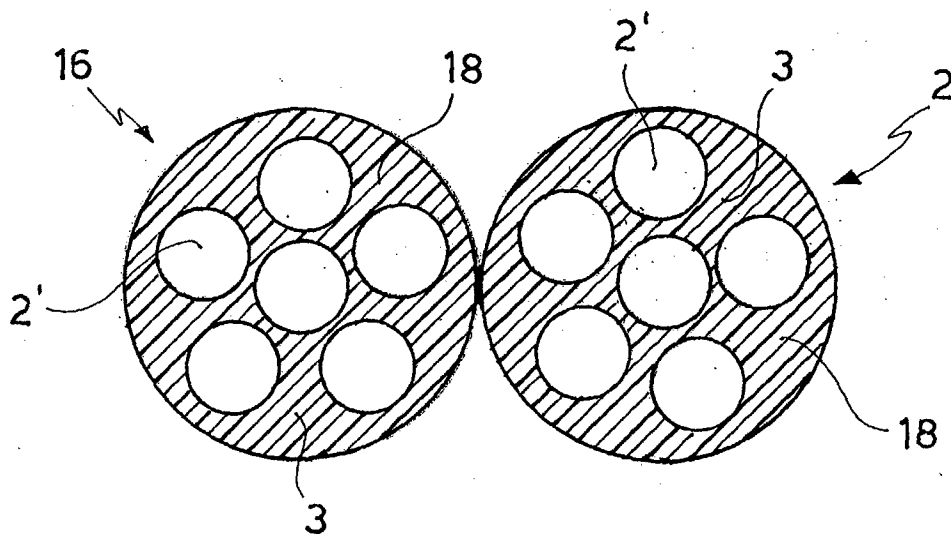


FIG. 3b

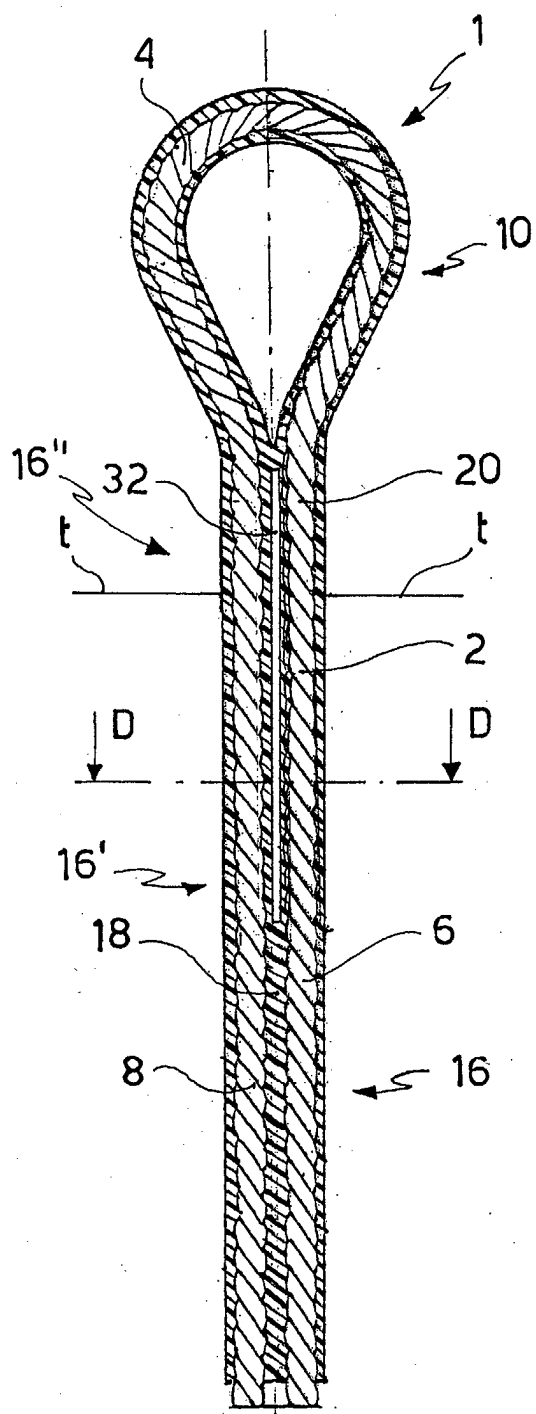


FIG. 4a

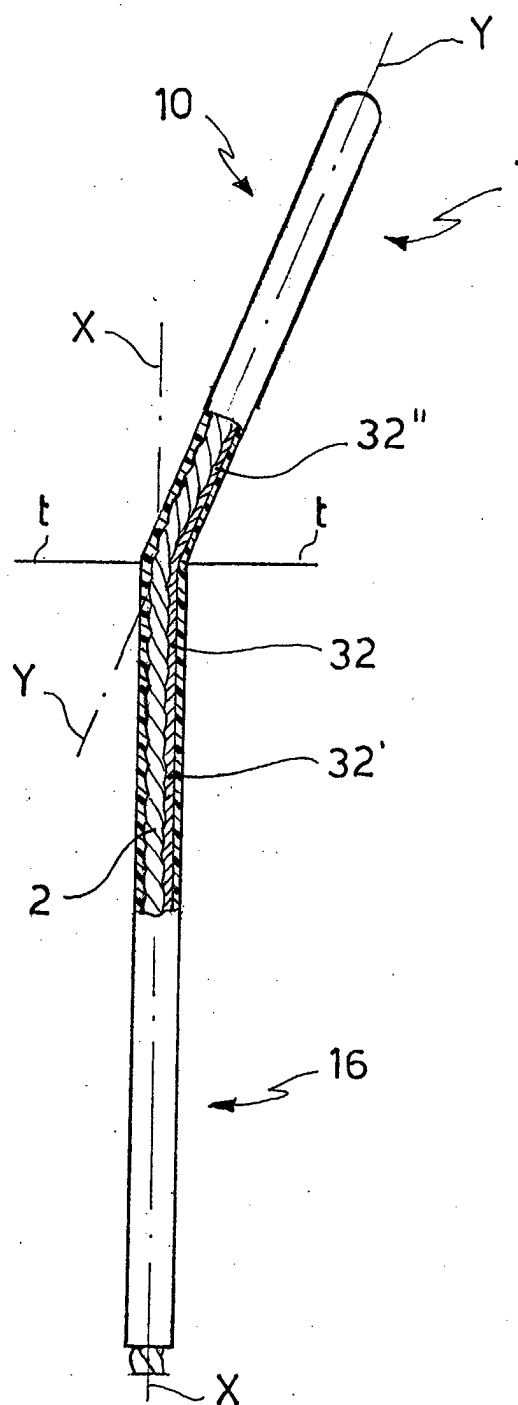


FIG. 4b

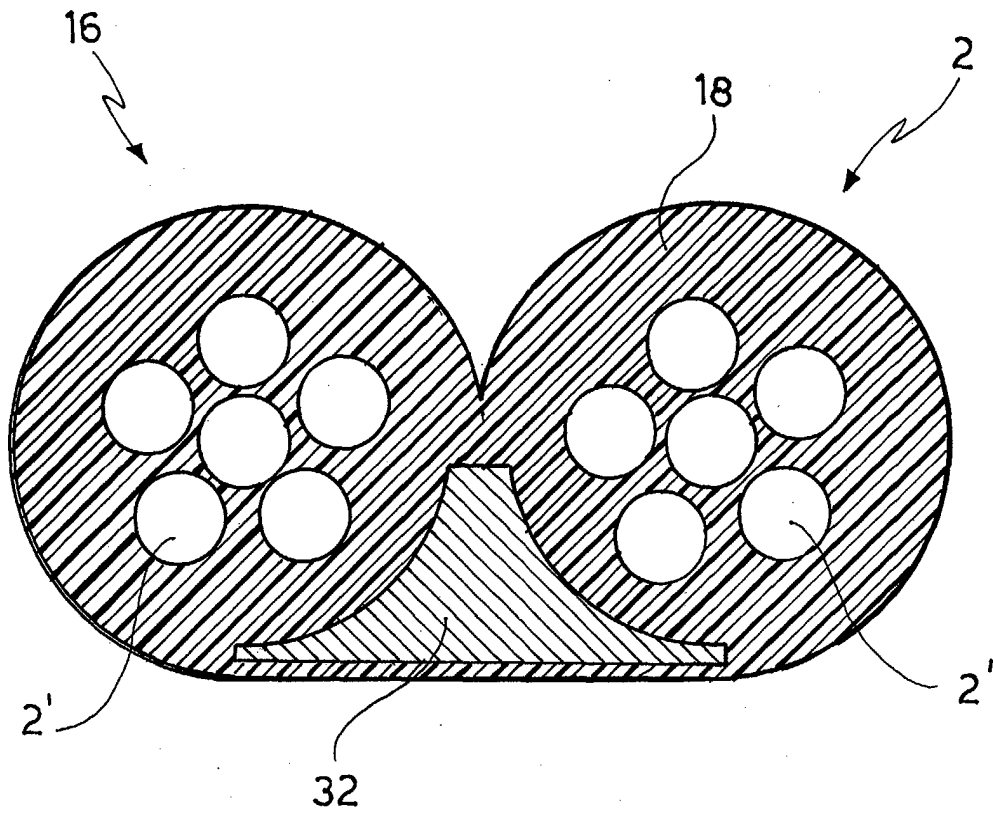


FIG. 5

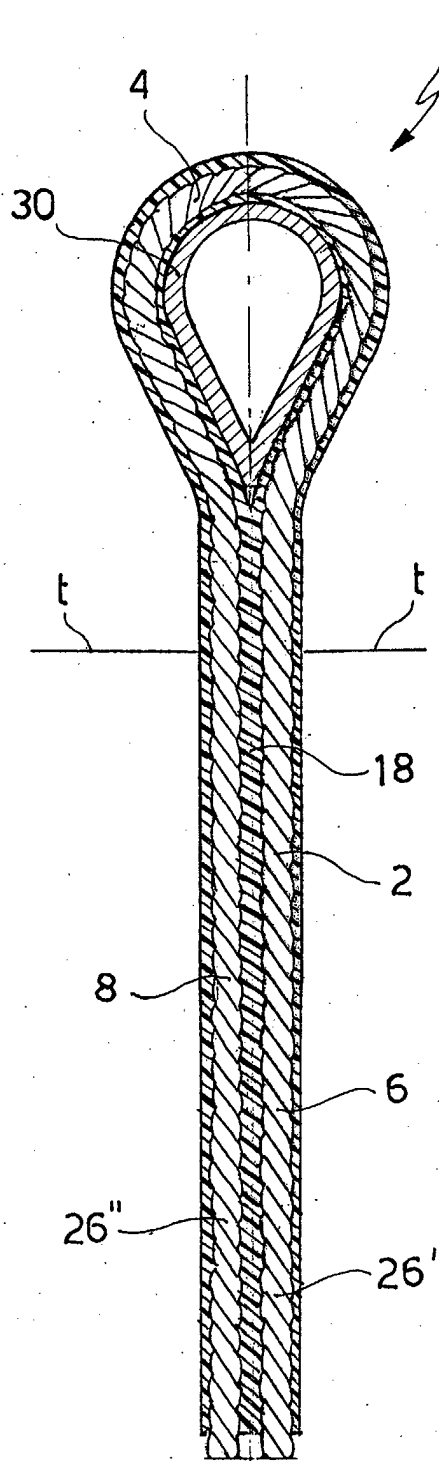


FIG. 6

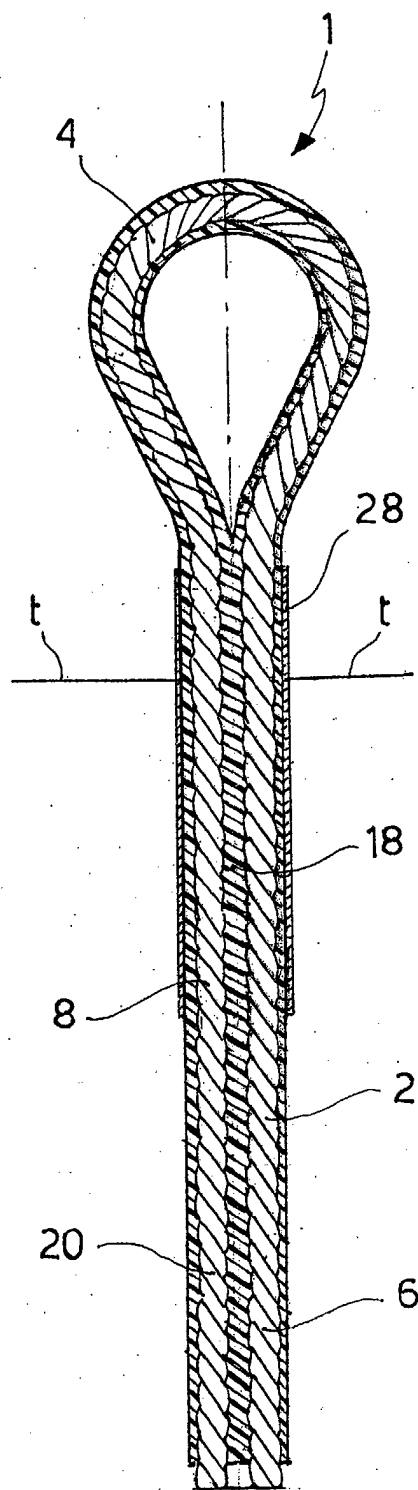


FIG. 7

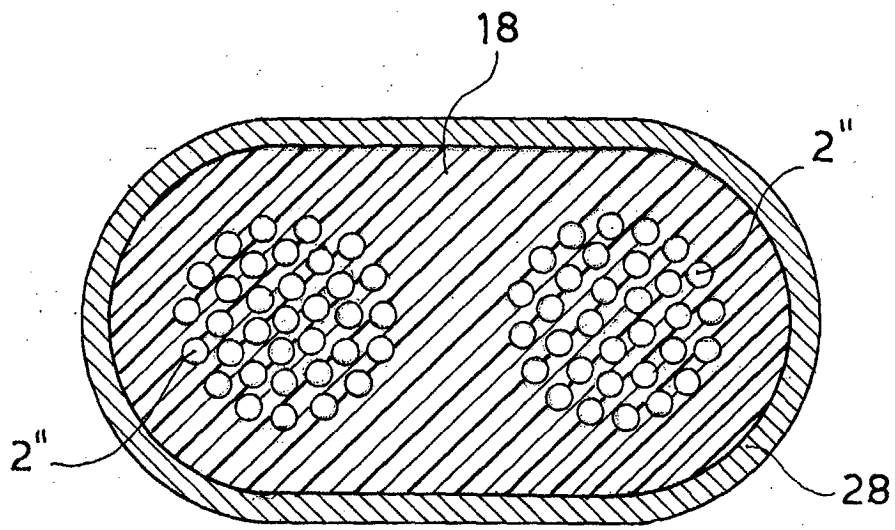


FIG. 8

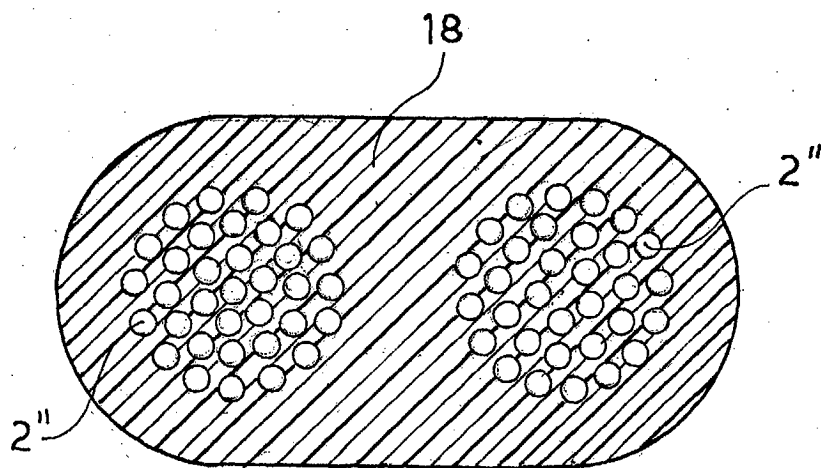


FIG. 9

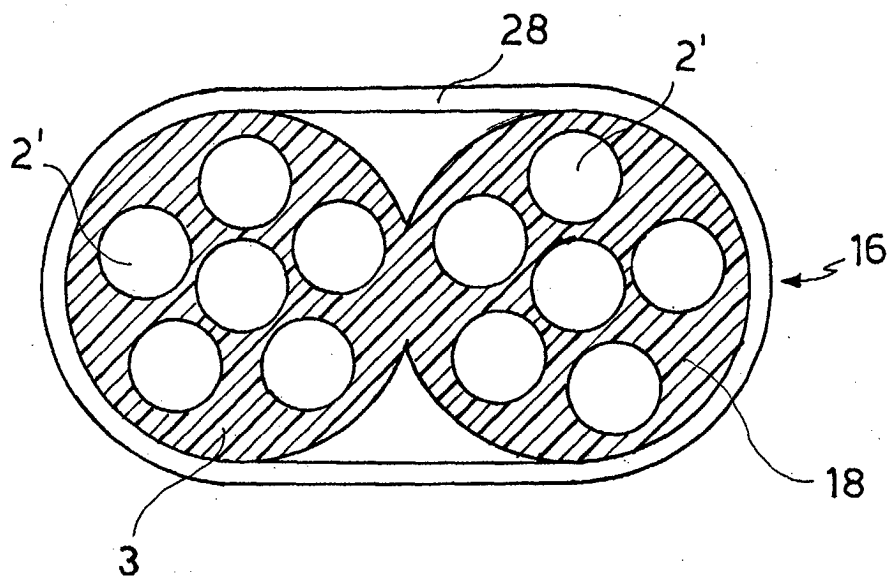


FIG. 10a

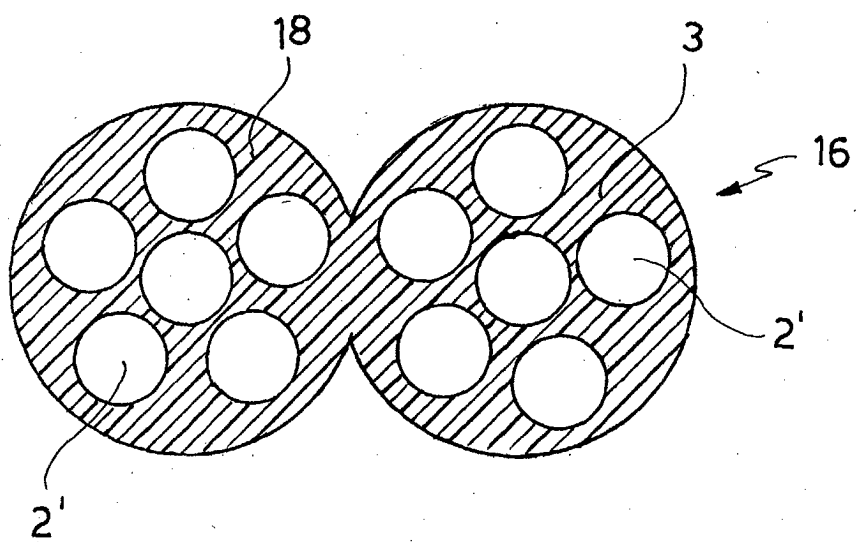


FIG. 10b



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 02 42 5769

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Place of search THE HAGUE		Date of completion of the search 2 April 2003	Examiner Kergueno, J
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