



amarchand mangaldas

Our Ref.: DR/ISS/ps/0036234.P3338IN00

March 26, 2015

E-FILING

The Controller of Patents
The Patent Office
New Delhi

Dear Sir,

Re: New Indian Patent Application based on PCT/JP2013/074814

International Filing Date:	September 13, 2013
Applicant:	Nippon Steel & Sumikin Metal Products Co., Ltd.
Title:	Wire Rope-Tensioning Method in Slope Stabilization Construction Method
Priority:	Japanese Patent Application No. 2012-209782 dated September 24, 2012

Enclosed herewith is an application accompanied by a complete specification and supporting documents for grant of a patent under the Patents Act, 1970 by:

Nippon Steel & Sumikin Metal Products Co., Ltd., a company organized under the laws of Japan, of 17-12, Kiba 2-chome, Koto-ku, Tokyo 135-0042, Japan.

The requisite fee submitted in respect of making the application is as follows:

- | | |
|---|------------|
| 1. On application for patent claiming a single priority | Rs. 8,000 |
| 2. For additional sheets of specification in addition to 30: 17x800 | Rs. 13,600 |

Total Rs. 21,600

The applicant undertakes to submit an executed power of authority within one month of the date of filing.

As required by Public Notice no. CG/Public Notice/PO/2012/15 dated July 2, 2012, the applicant has refrained from submitting documents already available with the International Bureau in connection with the corresponding PCT application. However, upon the Learned Controller's request, the applicant would submit any requested document (insofar as available) that is otherwise required to be furnished to the Patent Office by the International Bureau.

Contd...p/2

amarchand & mangaldas & suresh a. shroff & co.

advocates & solicitors

amarchand towers, 216, okhla industrial estate, phase - III, new delhi - 110 020

tel. : (91-11) 41590700, 40606060, 41000541, 26920500

fax : (91-11) 26924900, 26922900

email : am.delhi@amarchand.com

other offices : mumbai, bangalore, kolkata, ahmedabad, hyderabad, chennai



amarchand mangaldas

The Controller is respectfully requested to take the application on record.

Yours sincerely,

Dev Robinson
IN/PA-367

Enc.:

- (i) Form 1;
- (ii) Verified English language translation of the complete specification (in conformation with the international application), No. of pages 47, No. of claims 6;
- (iii) Drawings, No. of sheets 15;
- (iv) Form 3;
- (v) Form 5; and
- (vi) Abstract.

Herewith prescribed fee of Rs. 21,600/- through electronic transfer from Axis Bank Ltd.

To Follow:

- (i) Power of authority; and
- (ii) Proof of right.

FORM 1 THE PATENTS ACT 1970 (39 of 1970) & THE PATENTS RULES, 2003 APPLICATION FOR GRANT OF PATENT (See Section 7, 54 & 135 and Rule 20(1))	(FOR OFFICE USE ONLY) Application No: Filing Date: Amount of Fee Paid: CBR No: Signature:									
1. APPLICANT										
<table border="1"> <tr> <th data-bbox="196 539 659 607">Name</th> <th data-bbox="659 539 853 607">Nationality</th> <th data-bbox="853 539 1351 607">Address</th> </tr> <tr> <td data-bbox="196 607 659 741">Nippon Steel & Sumikin Metal Products Co., Ltd.</td> <td data-bbox="659 607 853 741">Japanese</td> <td data-bbox="853 607 1351 741">17-12, Kiba 2-chome Koto-ku, Tokyo 135-0042 Japan</td> </tr> </table>		Name	Nationality	Address	Nippon Steel & Sumikin Metal Products Co., Ltd.	Japanese	17-12, Kiba 2-chome Koto-ku, Tokyo 135-0042 Japan			
Name	Nationality	Address								
Nippon Steel & Sumikin Metal Products Co., Ltd.	Japanese	17-12, Kiba 2-chome Koto-ku, Tokyo 135-0042 Japan								
2. INVENTORS										
<table border="1"> <tr> <th data-bbox="196 808 659 875">Name</th> <th data-bbox="659 808 853 875">Nationality</th> <th data-bbox="853 808 1351 875">Address</th> </tr> <tr> <td data-bbox="196 875 659 1111">IWASA, Naoto</td> <td data-bbox="659 875 853 1111">Japanese</td> <td data-bbox="853 875 1351 1111">c/o Nippon Steel & Sumikin Metal Products Co., Ltd. 17-12, Kiba 2-chome Koto-ku, Tokyo 135-0042 Japan</td> </tr> <tr> <td data-bbox="196 1111 659 1312">IKEDA, Takeo</td> <td data-bbox="659 1111 853 1312">Japanese</td> <td data-bbox="853 1111 1351 1312">c/o Nippon Steel & Sumikin Metal Products Co., Ltd. 17-12, Kiba 2-chome Koto-ku, Tokyo 135-0042 Japan</td> </tr> </table>		Name	Nationality	Address	IWASA, Naoto	Japanese	c/o Nippon Steel & Sumikin Metal Products Co., Ltd. 17-12, Kiba 2-chome Koto-ku, Tokyo 135-0042 Japan	IKEDA, Takeo	Japanese	c/o Nippon Steel & Sumikin Metal Products Co., Ltd. 17-12, Kiba 2-chome Koto-ku, Tokyo 135-0042 Japan
Name	Nationality	Address								
IWASA, Naoto	Japanese	c/o Nippon Steel & Sumikin Metal Products Co., Ltd. 17-12, Kiba 2-chome Koto-ku, Tokyo 135-0042 Japan								
IKEDA, Takeo	Japanese	c/o Nippon Steel & Sumikin Metal Products Co., Ltd. 17-12, Kiba 2-chome Koto-ku, Tokyo 135-0042 Japan								
3. TITLE OF THE INVENTION: "WIRE ROPE-TENSIONING METHOD IN SLOPE STABILIZATION CONSTRUCTION METHOD"										
4. ADDRESS FOR CORRESPONDENCE OF APPLICANT/AUTHORIZED PATENT AGENT IN INDIA Amarchand & Mangaldas & Suresh A. Shroff & Co. Amarchand Towers 216, Okhla Industrial Estate Phase-III, New Delhi-110020, India	Telephone No.: (91) (11) 41590700, 40606060, 41000541, 26920500 Fax No.: (91) (11) 26924900, 26922900 Mobile No.: 91 98100 10435 E-mail: dev.robinson@amarchand.com									

5. PRIORITY PARTICULARS OF THE APPLICATION(S) FILED IN CONVENTION COUNTRIES

Country	Application Number	Filing Date	Names of the Applicant(s)	Title of the Invention
Japan	2012-209782	September 24, 2012	Nippon Steel & Sumikin Metal Products Co., Ltd.	Wire Rope-Tensioning Method in Slope Stabilization Construction Method

6. PARTICULARS FOR FILING PATENT COOPERATION TREATY (PCT) NATIONAL PHASE APPLICATION

International Application Number	International filing date as allotted by the receiving office
PCT/JP2013/074814	September 13, 2013

7. PARTICULARS FOR FILING DIVISIONAL APPLICATION

Original (first) application number	Date of filing of Original (first) application

8. PARTICULARS FOR FILING PATENT OF ADDITION

Main application/patent Number	Date of filing of main application

9. DECLARATION:**(i) Declaration by the inventor(s)**

We, the above named inventors, are the true & first inventors for this invention and declare that the applicant herein is our assignee.

(a) Date _____

(b) Signature: _____

(c) Name of Inventor: IWASA, Naoto

(a) Date _____

(b) Signature: _____

(c) Name of Inventor: IKEDA, Takeo

(ii) Declaration by the applicant in the convention country

We, the applicant in the convention country, declare that the applicant herein is our assignee.

(a) Date _____

(b) Signature: _____

(c) Name of Inventor: _____

(iii) Declaration by the applicant:

We, the applicant hereby declare that:-

- ☐ We are in possession of the above-mentioned invention. ✓
- ☐ The complete specification relating to the invention is filed with this application. ✓
- ☐ The invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by us before the grant of patent to us. ×
- ☐ There is no lawful ground of objection to the grant of the patent to us. ✓
- ☐ We are the assignee of the true & first inventors. ✓
- ☐ The application(s), particulars of which are given in Para-5 was the first application in the convention country in respect of our invention. ✓
- ☐ We claim priority from the above mentioned application filed in convention country and state that no application for protection in respect of the invention had been made in a convention country before that date by us or by any person from which we derive title. ✓
- ☐ Our application in India is based on international application under Patent Cooperation Treaty (PCT) as mentioned in Para – 6. ✓
- ☐ The application is divided out of our application, particulars of which are given in Para – 7 and pray that this application may be treated as deemed to have been filed on ___under sec.16 of the Act. ×
- ☐ The said invention is an improvement in or modification of the invention particulars of which are given in Para – 8. ×

10. Following are the attachments with the application:

- a) Verified English language translation of the complete specification (in conformation with the international application), No. of pages 47, No. of claims 6;
- b) Drawings, No. of sheets 15;
- c) Form 3;
- d) Form 5; and
- e) Abstract.

Herewith, prescribed fee of Rs. 21,600/- through electronic transfer from Axis Bank.

We hereby declare that to the best of our knowledge, information and belief the facts and matters stated herein are correct and we request that a patent may be granted to us for the said invention.

Dated this 26th day of March, 2015.

Nippon Steel & Sumikin Metal Products Co., Ltd.


(Dev Robinson)
of Amarchand & Mangaldas &
Suresh A. Shroff & Co.
Attorneys for the Applicant

The Controller of Patents
The Patent Office
New Delhi

IN THE MATTER OF
THE PATENTS ACT, 1970 (No. 39 of 1970)
AND
THE PATENTS RULES, 2003
AND
IN THE MATTER OF

Indian Patent Application titled **“Wire Rope-Tensioning Method in Slope Stabilization Construction Method”**

VERIFICATION OF ENGLISH LANGUAGE TRANSLATION OF
INTERNATIONAL APPLICATION NO. PCT/JP2013/074814

We, Nippon Steel & Sumikin Metal Products Co., Ltd., a company organized under the laws of Japan, of 17-12, Kiba 2-chome, Koto-ku, Tokyo 135-0042, Japan, the applicant herein verify:

- (i) that the present application is based on International PCT Application PCT/JP2013/074814,
- (ii) that the specification attached hereto is an English language translation of International Patent Application numbered PCT/JP2013/074814 filed at the Japanese Patent Office and accorded the filing date of September 13, 2013, which application was filed in Japanese language, and
- (iii) that the English language translation attached hereto is correct, complete and faithful to the best of our knowledge and belief.

Dated this 26th day of March, 2015.

Nippon Steel & Sumikin Metal Products Co., Ltd.



(Dev Robinson)
of Amarchand & Mangaldas &
Suresh A. Shroff & Co.
Attorneys for the Applicant

The Controller of Patents
The Patent Office
New Delhi

FORM 2
THE PATENTS ACT 1970
(39 OF 1970)
&
THE PATENTS RULES, 2003
COMPLETE SPECIFICATION
(See section 10 and rule 13)

1. TITLE OF THE INVENTION :

“WIRE ROPE-TENSIONING METHOD IN SLOPE STABILIZATION
CONSTRUCTION METHOD”

2. APPLICANT:

- (a) NAME: Nippon Steel & Sumikin Metal Products Co., Ltd.
- (b) NATIONALITY: Japanese
- (c) ADDRESS: 17-12, Kiba 2-chome
Koto-ku, Tokyo 135-0042
Japan

3. PREAMBLE TO THE INVENTION:

COMPLETE

The following specification particularly describes the invention and the manner in which it is to be performed.

DESCRIPTION

Title of Invention

WIRE ROPE-TENSIONING METHOD IN SLOPE
STABILIZATION CONSTRUCTION METHOD

5 Technical Field

[0001] The present invention relates to a natural slope stabilization construction method for stabilizing a slope with a number of anchors, compression plates attached to anchor heads, and a wire rope for coupling the anchor heads to each other. More specifically, the present invention relates to a method of tensioning a wire rope by human power on a slope where heavy equipment is unavailable.

Background Art

[0002] In this slope stabilization construction method, it is known that the slope stabilization effect is further increased by coupling the anchor heads to each other with a wire rope (Patent Literature 1 and others). That is, the wire rope is effective for preventing or alleviating slope failures because, in addition to the reinforcing effect by the anchors and the effect of pressing soil mass by the compression plates, the wire rope exerts the holding effect of holding the anchors when the anchors are deformed during landslides, the load distribution effect of distributing local load acting on the anchors, and other effects.

[0003] When anchors are installed on a slope, the anchors are arranged in a grid-like arrangement (the arrangement of rows and columns) or in a triangular arrangement (the arrangement in which the mutual positional relation of anchors is such that each is positioned at a vertex of a triangle). In the triangular arrangement, as shown in Fig. 1,

anchors 1 are installed in a triangular arrangement so as to be located at the vertexes of triangles, each of which has one side that defines the slope dip direction, and the anchors 1 are coupled to each other with a wire rope 2 such that at least anchors in the up-down direction of the slope are coupled to each other (see, for example, Patent Literatures 2 and 3). In this case, in general, the wire rope is routed so as to form a loop around three anchors adjacent to each other with a space in the triangular arrangement. Fig. 1 shows compression plates 3 and turnbuckles 4.

[0004] Furthermore, it also has been disclosed that, in tightening a wire rope with a turnbuckle in human-power operation on a slope where heavy equipment is unavailable, a removable tensiometer is used to obtain appropriate tensile force of a wire rope (Patent Literature 4).

[0005] According to the slope stabilization construction method, for example, described in the literatures listed above, the wire rope is arranged at a plurality of anchor heads and tightened with a turnbuckle coupled to the wire rope for exerting tension. However, no specific description is given as to the technique for drawing a wire rope to such a length that can be tightened with a turnbuckle, before tightening by rotating the turnbuckle.

Citation List

Patent Literature

[0006] [Patent Literature 1] Japanese Patent Application Laid-Open Publication No. 9-111761, paragraph [0005], Fig. 2

[Patent Literature 2] Japanese Patent Application Laid-Open Publication No. 2002-088769, paragraph [0002], Fig. 2 and others

[Patent Literature 3] Japanese Patent Application Laid-Open
Publication No. 2002-173939, paragraph [0002], Fig. 1 and others

[Patent Literature 4] Japanese Patent Application Laid-Open
Publication No. 2007-262734

5 **Summary of Invention**

Technical Problem

10 [0007] The length adjusted by a turnbuckle for use in the slope
stabilization construction method is not so long, as with general-purpose
turnbuckles. Although the length can be adjusted to some extent so
that tensile force is applied to a wire rope by human power, the adjusted
length is limited to such an extent that tensile force is applied, and such
a turnbuckle does not work enough to adjust large looseness at a stage
when the wire rope is routed to form a loop around the anchors.
Before the wire rope is tightened with the turnbuckle, it is therefore
15 necessary to fix the length, for example, by drawing the wire rope
sufficiently to reduce the length and thereafter fixing the wire rope with
a wire clip. Thus, it is required to sufficiently remove the looseness on
the wire rope before tightening. In the slope stabilization construction
method, however, it is required that a wire rope of 5 to 15mm in
20 diameter and 5 to 15m in length should be drawn in order to reduce the
length and remove the looseness. This operation requires a large force
and is not easy to perform by human power. Moreover, the operation
is laborious because the construction place is a steep slope.

25 A method of tensioning a wire rope in the slope stabilization
construction method thus has been sought, which facilitates the
operation by human power on a steep slope for drawing a wire rope for

adjusting the length before applying a large tensile force to the wire rope with a turnbuckle.

[0008] The present invention aims to facilitate the wire rope looseness removing operation performed by human power even on a steep slope before applying a large tensile force to a wire rope with a turnbuckle as described above in the slope stabilization construction method.

Solution to Problem

[0009] In order to solve the problem described above, the present invention according to claim 1 provides a wire rope tensioning method in a slope stabilization construction method in which

a number of anchors are installed on a natural slope in a triangular arrangement such that three of the anchors adjacent to each other with a space are positioned at vertexes of a triangle, a compression plate is attached and fastened to a head of each of the anchors to apply compression force against a ground, and three of the anchors in the triangular arrangement are coupled to each other with a single wire rope forming a loop when coupled with a turnbuckle having coupling bolts on both ends thereof, the wire rope tensioning method includes:

permanently coupling one end of the wire rope to a coupling portion of the coupling bolt at one end of the turnbuckle, the coupling bolt being screwed or not screwed in a body of the turnbuckle in advance, before arrangement of the wire rope on the slope;

bringing the wire rope into a temporary loop-like coupling state in which

the turnbuckle is positioned between two of the anchors that define an up-down direction of the slope,

another end, oriented up the slope, of the wire rope passes through a coupling portion of the coupling bolt at another end, oriented down the slope, of the turnbuckle with the coupling bolts screwed in both ends thereof, and extends down the slope, and

5 the wire rope forms a loop with the turnbuckle;

pulling and drawing the other end of the wire rope extending down the slope, in a downward direction of the slope, to remove looseness of the wire rope formed in a loop;

10 permanently coupling the other end of the wire rope to the coupling portion of the coupling bolt at the other end of the turnbuckle; and

turning the turnbuckle to apply tensile force to the wire rope.

15 Here, the up-down direction of the slope refers to a direction extending to the upside or the downside with respect to the horizontal direction at a certain position on the slope.

[0010] According to claim 2, in the wire rope tensioning method of claim 1, a temporary coupling structure is formed in advance at the other end of the wire rope, the temporary coupling structure coupling a wire rope end portion passed through the coupling portion of the coupling bolt at the other end of the turnbuckle to the coupling portion in a releasable manner, and

20 the temporary loop-like coupling state is formed with the wire rope, where the wire rope forms a loop with the turnbuckle.

[0011] According to claim 3, in the wire rope tensioning method of claim 2, means for permanently coupling the other end of the wire rope to the coupling bolt at the other end of the turnbuckle forms a

permanent coupling structure after the temporary coupling structure is released, the permanent coupling structure has a structure that fixes an overlapping portion formed by folding back the other end of the wire rope passed through the coupling portion of the coupling bolt, and

5 the overlapping portion is fixed by squeezing a clamp tube receiving the overlapping portion with a squeezer, or by fastening the overlapping portion with a wire clip, or by braiding the overlapping portion.

[0012] According to claim 4, in the wire rope tensioning method of any
10 one of claims 1 to 3, the turnbuckle to be positioned between two of the anchors is positioned between two of the anchors that define a slope dip direction. Here, the slope dip direction refers to a direction in which the slope is steepest at a certain position.

[0013] According to claim 5, in the wire rope tensioning method of
15 claim 2, the temporary coupling structure at the other end of the wire rope is formed by fitting a thimble through the coupling portion of the coupling bolt at the other end of the turnbuckle, passing the wire rope end portion through the coupling portion of the coupling bolt along the thimble, folding back the wire rope end portion to form an overlapping
20 portion, inserting the overlapping portion through a clamp tube, and temporarily fixing the overlapping portion on the side opposite to the coupling portion with respect to the clamp tube, with tape or a linear material.

[0014] According to claim 6, in the wire rope tensioning method of
25 claim 5, the thimble fitted through the coupling portion of the coupling bolt at the other end of the turnbuckle has a size larger than a size of a

thimble used as another thimble at the one end of the wire rope, the other thimble having a standard size adapted for a diameter of the wire rope.

Advantageous Effects of Invention

5 [0015] In the invention according to claim 1, when three anchors in a triangular arrangement are coupled to each other with a wire rope, the wire rope is brought into a temporary loop-like coupling state in which the turnbuckle is positioned between two anchors that define the up-down direction of a slope, the other end, oriented up the slope, of the
10 wire rope passes through the coupling portion of the coupling bolt at the other end, oriented down the slope, of the turnbuckle with the coupling bolts screwed in both ends thereof and extends down the slope, and the wire rope forms a loop with the turnbuckle.

As described above, in the temporary loop-like coupling state,
15 the other end of the wire rope passes through the coupling portion of the coupling bolt at the other end of the turnbuckle and extends down the slope.

When the other end of the wire rope extending down the slope is pulled in the downward direction of the slope, the wire rope is drawn
20 and the looseness of the wire rope is removed. This operation of drawing the wire rope and removing the looseness is performed by pulling the wire rope to the downside of the slope.

The slope that undergoes the slope stabilization construction method is typically a steep slope. In the tugging operation of pulling
25 the wire rope to the downside of the slope, in addition to the tugging force applied by the arm of the worker, the weight of the worker acts as

tugging force because the slope is steep. The wire rope therefore can be pulled and drawn with a large tugging force.

As described above, even on a steep slope where heavy equipment is unavailable, the looseness of the wire rope can be removed by drawing the wire rope by human power.

5 [0016] As in claim 2, at the other end of the wire rope, a temporary coupling structure is formed in advance, in which the wire rope end portion is coupled to the coupling portion of the coupling bolt at the other end of the turnbuckle in a releasable manner. By doing so, at a stage when the temporary coupling structure is released after the wire rope is routed around each of three anchors and brought into a temporary loop-like coupling state in which it forms a loop, the other end of the wire rope extends down the slope. In this state, the other end portion of the wire rope can be pulled and drawn immediately.

10

15 The workability is thus good.

[0017] As in claim 4, when the turnbuckle is positioned between two anchors that define the slope dip direction, the weight of the worker acts greatest as tugging force among directions to the downside of the slope, so that the wire rope tensioning method of the present invention functions most effectively.

20 [0018] As in claim 5, with the method of forming the temporary coupling structure at the overlapping portion with tape or a linear material after passing the wire rope through the coupling portion of the coupling bolt along the thimble fitted through the coupling portion of the coupling bolt and passing the folded overlapping portion through a clump tube, the operation of releasing the temporary coupling structure

25

is easy, and the permanently coupling operation can be carried out with the wire rope end portion generally kept as it is after the coupling is released. The workability is thus extremely good.

[0019] As in claim 5, in a case where the temporary coupling structure of the other end portion of the wire rope includes a thimble and a clamp tube, when the wire rope is drawn in order to remove the looseness of the wire rope, the clamp tube receiving the overlapping portion of the wire rope end portion is pushed closer to the thimble in order to eventually achieve permanent coupling. With a thimble having a standard size adapted for the diameter of the wire rope used therewith, pushing the clamp tube toward the thimble requires an extremely large force and is difficult to perform by human power, because the horseshoe shape of the thimble is small. As in claim 6, however, the thimble fitted through the coupling portion of the coupling bolt at the other end of the turnbuckle has a size larger than a size of the thimble having a standard size adapted for a diameter of the wire rope. Accordingly, pushing the clamp tube toward the thimble requires less force, and the clamp tube can be easily pushed toward the thimble by human power.

Brief Description of Drawings

[0020] [Fig. 1] Fig. 1 is a plan view of a slope on which a slope stabilization construction method is executed by applying a wire rope tensioning method in an embodiment of the present invention.

[Fig. 2] Fig. 2 is a longitudinal cross-sectional view partially showing the slope in Fig. 1.

[Fig. 3] Fig. 3(a) is a partially enlarged view of one of anchors 1 in Fig. 1, and Fig. 3(b) is a cross-sectional view thereof.

[Fig. 4] Fig. 4 is a partially enlarged view of Fig. 1, showing a state in which the heads of three anchors in a triangular arrangement are coupled to each other with a single wire rope.

5 [Fig. 5] Fig. 5(a) shows the wire rope used in the foregoing embodiment, (a wire rope with a turnbuckle) in a linear state without an intermediate portion, Fig. 5(b) is an enlarged view of the vicinity of the body of the turnbuckle in Fig. 5(a), and Fig. 5(c) is an enlarged view of the vicinity of the turnbuckle when the wire rope in (a) is in a temporary loop-like coupling state.

10 [Fig. 6] Fig. 6 to Fig. 11 are diagrams illustrating the operation procedure for coupling the heads of three anchors in the triangular arrangement with a single wire rope as shown in Fig. 4. Fig. 6 shows an initial stage of the operation of routing a wire rope around three anchors in the triangular arrangement.

15 [Fig. 7] Fig. 7 shows the step following Fig. 6, at a stage in which the wire rope is further routed around the bottom anchor to bring a bolt (coupling bolt) at one end of the wire rope and the body of the turnbuckle close to each other, before the wire rope is brought into a temporary loop-like coupling state with the turnbuckle.

20 [Fig. 8] Fig. 8 shows the step following Fig. 7, at a stage in which the bolt at the one end of the wire rope is screwed in one end (upper end) of the body of the turnbuckle to achieve a temporary loop-like coupling state.

25 [Fig. 9] Fig. 9 shows the step following Fig. 8, at a stage in which temporary coupling is released by removing a vinyl tape that is a part of a temporary coupling structure for temporarily coupling the other

end of the wire rope to the ring portion (coupling portion) of the bolt at the other end of the turnbuckle.

5 [Fig. 10] Fig. 10 shows the step following Fig. 9, at a stage in which the looseness of the wire rope is removed by pulling and drawing the other end, extending down the slope, of the wire rope released from the temporary coupling, by human power downward in the slope dip direction.

10 [Fig. 11] Fig. 11 shows the step following Fig. 10, at a stage in which a clamp tube, which is part of the temporary coupling structure for temporarily coupling the other end portion of the wire rope to the ring portion of the bolt at the other end of the turnbuckle, is compressed with a squeezer to form a permanent coupling structure at the other end of the wire rope thereby achieving permanent coupling, and an extra length portion of the wire rope extending down the slope is then fixed with a vinyl tape (followed by turning the turnbuckle to apply a predetermined tensile force to the wire rope, resulting in the operation completed state in Fig. 4).

20 [Fig. 12] Fig. 12 shows various types of the turnbuckle portion in the wire rope used in the wire rope tensioning method of the present invention, in which (a) shows the wire rope used in the foregoing embodiment, and (b) to (e) show different types.

 [Fig. 13] Fig. 13 shows a state at a stage corresponding to Fig. 7 in each of the cases where the wire rope tensioning operation is performed with the wire ropes of the types in Figs. 12(a) to (e).

25 [Fig. 14] Fig. 14 is a diagram corresponding to Fig. 4, showing a case where the turnbuckle to be positioned between two anchors is

positioned at an angle relative to the slope dip direction.

[Fig. 15] Fig. 15 is a diagram showing another embodiment of a thimble used for coupling the other end of the wire rope to the bolt at the other end of the turnbuckle.

5 **Description of Embodiments**

[0021] Embodiments for carrying out a wire rope tensioning method in a slope stabilization construction method in the present invention are described below with reference to the accompanying drawings.

[0022] [First Embodiment]

10 Fig. 1 is a plan view of a slope on which a slope stabilization construction method is executed by applying a wire rope tensioning method in an embodiment of the present invention. Fig. 2 is a longitudinal cross-sectional view partially showing the slope in Fig. 1. Fig. 3(a) is an enlarged view of one of anchors 1 in Fig. 1, and Fig. 3(b)
15 is a cross-sectional view thereof.

 The slope stabilization construction method to which the wire rope tensioning method in the present invention is applied is as follows. As shown in Fig. 1 and Fig. 2, a number of the anchors 1 are installed on a natural slope in a triangular arrangement such that three anchors 1
20 adjacent to each other with a space are positioned at the vertexes of a triangle. A compression plate 3 is attached and fastened to the head of each anchor 1 to provide compression force against a ground. Three anchors 1 in the triangular arrangement are then coupled with a single wire rope 2 having both ends coupled together with a turnbuckle 4 to
25 form a loop. "Coupling the anchors 1 with a wire rope" not only includes directly engaging the wire rope 2 with the anchors 1 but also

includes coupling through the compression plate 3 by directly engaging the wire rope 2 with the compression plates 3. The anchors 1 are inserted to a certain depth of the solid ground 10 under a surface layer that is likely to slide.

5 The compression plate 3 illustrated in the figures, as shown in Fig. 3, is structured such that a cylinder 6 is vertically fixed to the center of an approximately triangular bottom plate 5 having a central hole 5a receiving the anchor 1, and reinforcing ribs 7 are fixed to the bottom plate 5 on three sides. Each reinforcing rib 7 has a hole 7a for
10 allowing passage of the wire rope 2. The compression force is applied against the ground by putting the cylinder 6 of the compression plate 3 over the head of the anchor 1, placing a washer 8 thereon, and screwing and tightening a nut 9 on the threaded portion of the head of the anchor 1.

15 [0023] Fig. 4 is a partially enlarged view of Fig. 1, showing a state in which three anchors 1 in the triangular arrangement are coupled to each other with a single wire rope 2 to form a loop with the turnbuckle 4 and the turnbuckle 4 is then turned to apply tension to the wire rope 2. The wire rope 2 forms a loop such that a coupling bolt 4b at one end A' of
20 the turnbuckle 4 is coupled to one end A of the wire rope 2 and a coupling bolt 4c at another end B' of the turnbuckle 4 is coupled to another end B of the wire rope 2 (hereinafter, in general, the coupling bolts 4b, 4c of the turnbuckle 4 are simply referred to as bolts 4b, 4c).

25 The turnbuckle 4 in the embodiment is structured such that the bolts 4b and 4c are screwed into the one end A' and the other end B', respectively, of a tubular body 4a. The bolts 4b and 4c are both

eyebolts having ring portions 4b₁ and 4c₁, respectively. In the turnbuckle 4 used in the present invention, at least the bolt 4c at the other end is an eyebolt having the ring portion 4c₁ as a coupling portion or a hook bolt having a hook portion as a coupling portion.

5 [0024] The operation procedure to reach the state in Fig. 4 in which tension is applied to the wire rope 2 will be described.

Fig. 5(a) shows a state of the wire rope 2 used in the present embodiment before the wire rope tensioning operation. Fig. 5(b) is an enlarged view of the other end B of the wire rope 2 in Fig. 5(a). Fig. 10 5(c) is an enlarged view of the vicinity of the turnbuckle when the bolt 4b coupled to the one end A of the wire rope 2 is screwed in the turnbuckle 4 coupled to the other end B of the wire rope 2 to achieve a temporary loop-like coupling state.

In the wire rope 2 in the present embodiment, as shown in Fig. 15 5(a), the one end A of the wire rope 2 is permanently coupled to the bolt 4b disengaged from the one end A' of the turnbuckle 4, and the other end B of the wire rope 2 is temporarily coupled to the bolt 4c screwed in the other end B' of the turnbuckle 4.

In the present invention, before the operation of tensioning the 20 wire rope 2, the one end A of the wire rope 2 is permanently coupled to the bolt 4b at the one end A' of the turnbuckle 4 in advance, as described above. As will be described later, the bolt 4b at the one end A' of the turnbuckle 4 may be either screwed or not screwed in the body 4a of the turnbuckle 4.

25 [0025] The structure for permanently coupling the one end A of the wire rope 2 to the bolt 4b at the one end A' of the turnbuckle 4 is as

follows. As illustrated in the figures, a thimble 12b is fitted through the ring portion 4b₁ of the bolt 4b at the one end A' of the turnbuckle. The one end A of the wire rope 2, fitted along the thimble 12b, is passed through the ring portion 4b₁ of the bolt 4b and folded, and this folded overlapping portion (the rope folded into a doubled rope) is arranged so as to pass through a clamp tube 13b. The clamp tube 13b is compressed to achieve permanent coupling. It is noted that the clamp tube 13b is put on the one end A of the wire rope 2 in advance before being fitted along the thimble 12b. As described above, in the present embodiment, coupling in an unreleasable manner is referred to as "permanent coupling". Here, the clamp tube 13b is compressed so that the coupling between the one end A of the wire rope and the ring portion 4b₁ of the bolt 4b at the one end A' of the turnbuckle cannot be released.

A temporary coupling structure 16 for temporarily coupling the other end B of the wire rope 2 to the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle 4 in a releasable manner is as follows. A thimble 12c is fitted through the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle. The other end B of the wire rope, fitted along the thimble 12c, is passed through the ring portion 4c₁ of the bolt 4c and folded, and this folded overlapping portion is arranged so as to pass through a clamp tube 13c and is temporarily fixed with, for example, a vinyl tape 14 (or a linear material) on the side opposite to the ring portion 4c₁ with respect to the clamp tube 13c. It is noted that the clamp tube 13c is put on the other end B of the wire rope 2 in advance before being fitted along the thimble 12c. As described above, in the present embodiment, coupling in a releasable manner is referred to as

"temporary coupling". Here, the temporary fixing with the vinyl tape 14 can be easily released by removing the vinyl tape 14 because the clamp tube 13c is not compressed unlike the clamp tube 13b. Therefore, the coupling between the other end B of the wire rope and the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle can be released.

[0026] When the wire rope 2 in Fig. 5(a) having both ends worked as described above is routed around three anchors 1 arranged in a triangular arrangement, for example, as shown in Fig. 6, with the one end A of the wire rope 2 positioned below the anchor 1 at the top of the triangular arrangement, the wire rope 2 is first routed around the anchor 1 at the top, further routed around the anchor 1 on the side not at the bottom, and then routed around the anchor 1 at the bottom as shown in Fig. 7, so that the bolt 4b permanently coupled to the one end A of the wire rope 2 and the turnbuckle 4 temporarily coupled to the other end B of the wire rope 2 come close to each other.

Next, as shown in Fig. 8, the bolt 4b coupled to the one end A of the wire rope 2 is screwed in the one end A' of the body 4a of the turnbuckle 2, thereby achieving a temporary loop-like coupling state in which the wire rope 2 forms a loop. It is noted that the wire rope 2 is in the temporary loop-like coupling state in which it is temporarily coupled to form a loop, because the other end B of the wire rope 2 is temporarily coupled to the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle, as previously mentioned. In this temporary loop-like coupling state, the turnbuckle 4 is positioned between two anchors 1 that define the slope up-down direction. The other end B,

oriented up the slope, of the wire rope 2 passes through the ring portion 4c₁ of the coupling bolt 4c at the other end B', oriented down the slope, of the turnbuckle 4 with the coupling bolts 4b, 4c screwed at both sides and extends down the slope. The wire rope 2 forms a loop with the turnbuckle 4.

5
Next, the temporary coupling is released, as shown in Fig. 9, by removing the vinyl tape 14 which is a part of the temporary coupling structure 16 for temporarily coupling the other end B of the wire rope 2 to the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle 4. Although the wire rope 2 keeps a loop even in this state, the other end B of the wire rope 2 is not fixed. At the stages in Fig. 8 and Fig. 9, the wire rope 2 routed around three anchors 1 in the temporary loop-like coupling state is loose, as shown in the figures. As the temporary coupling has been released by removing the vinyl tape 14, the wire rope end portion at the other end B of the wire rope 2 extends down the slope in a free state (the wire rope end portion is called a downward extending portion 2a). As described above, in the temporary loop-like coupling state, the wire rope 2 keeps a loop state in a state in which its looseness can be adjusted.

10
15
20
25
[0027] Next, the downward extending portion 2a, extending down the slope, at the other end B of the wire rope 2 released from the temporary coupling in the previous step is pulled and drawn by human power in the downward direction X of the slope dip direction in order to remove the looseness of the wire rope 2. Fig. 10 shows a state in which the looseness of the wire rope 2 is removed by drawing the wire rope 2 by human power. The length of the downward extending portion 2a at the

other end B of the wire rope 2 is increased due to the drawing of the wire rope. The increased length of the downward extending portion 2a is called an extra length portion 2a' of the wire rope.

[0028] In the temporary loop-like coupling state in Fig. 9 in which the looseness of the wire rope 2 is to be removed, the other end B of the wire rope 2 released from the temporary coupling in the previous step passes through the inside of the groove of the thimble 12c fitted through the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle 4 and extends down the slope (downward extending portion 2a). Therefore, as previously mentioned, when the downward extending portion 2a of the wire rope 2 extending down the slope is pulled in the downward direction X of the slope, the wire rope 2 is drawn and the looseness of the wire rope 2 is removed. The operation of removing the looseness by drawing the wire rope 2 in this manner can be carried out by pulling the wire rope 2 to the downside X of the slope.

The slope that undergoes the slope stabilization construction method is typically a steep slope. In the tugging operation of pulling the wire rope 2 to the downside X of the slope, in addition to the tugging force applied by the arm of the worker, the weight of the worker acts as tugging force because the slope is steep, so that the wire rope can be pulled and drawn with a large tugging force. As described above, the looseness can be removed by drawing the wire rope 2 by human power even on a steep slope where heavy equipment is unavailable.

At the other end B of the wire rope 2, a temporary coupling structure 16 is formed in advance for coupling the wire rope end portion to the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle

4 in a releasable manner. Therefore, at a stage when the temporary coupling structure is released after the wire rope 2 is routed around three anchors 1 and brought into the temporary loop-like coupling state in which it forms a loop, the wire rope end portion extends down the slope (downward extending portion 2a) so that the wire rope end portion can be pulled and drawn immediately. The workability is thus good.

In the present embodiment, the turnbuckle 4 is positioned between two anchors that define the slope dip direction, with which direction the weight of the worker acts greatest as tugging force among directions to the downside of the slope, so that the wire rope tensioning method of the present invention functions most effectively.

The temporary coupling structure 16 in the embodiment is formed by passing the wire rope 2 through the ring portion 4c₁ of the bolt 4c along the thimble 12c fitted through the ring portion 4c₁ of the bolt 4c, folding back the wire rope 2, and passing the folded overlapping portion through the clamp tube 13c, followed by temporarily fixing the overlapping portion with the vinyl tape 14. The temporary coupling structure 16 therefore can be released with such a simple operation as removing the vinyl tape 14. The permanently coupling operation can be carried out by compressing the clamp tube 13c in a state generally close to the original state, although the length of the downward extending portion 2a is increased by drawing the wire rope after releasing the coupling. The workability is therefore extremely good.

[0029] Next, the clamp tube 13c, which is a part of the temporary coupling structure 16 for temporarily coupling the other end B of the wire rope 2 to the ring portion 4c₁ of the bolt 4c at the other end B' of

the turnbuckle 4, is compressed with a squeezer to form a permanent coupling structure 15 at the other end B of the wire rope as shown in Fig. 11, thereby achieving permanent coupling. The extra length portion 2a' of the wire rope extending down the slope is fixed, for example, with a vinyl tape 17.

In the state in which the wire rope 2 is drawn by human power as described above, tensile force can be easily applied to the wire rope 2 by turning the turnbuckle 4, because the wire rope 2 is less loose. After the state in Fig. 11, the body 4a of the turnbuckle 4 is turned to apply a predetermined tensile force to the wire rope 2, resulting in the operation completed state in Fig. 4.

[0030] [Second Embodiment]

In the foregoing embodiment, the wire rope 2 is prepared as illustrated in Fig. 5(a), in which the one end A of the wire rope 2 is permanently coupled to the bolt 4b at the one end A' of the turnbuckle 4 and the other end B of the wire rope 2 is temporarily coupled through the temporary coupling structure 16 to the bolt 4c screwed in the turnbuckle 4 at the other end B' of the turnbuckle. However, as for the structure of both ends of the wire rope 2, wire ropes of various types can be used as shown in Figs. 12(b) to (c).

The wire rope in Fig. 12(a) is the same as the wire rope in Fig. 5(a). In Figs. 12(a) to (e), the wire ropes 2 having both ends worked are represented as a whole as wire ropes 2A, 2B, 2C, 2D, and 2E.

[0031] In the wire rope 2B in Fig. 12(b), the one end A of the wire rope 2 is permanently coupled to the bolt 4b screwed in the body 4a of the turnbuckle 4 at the one end A' of the turnbuckle, and the other end B of

the wire rope 2 is temporarily coupled through the temporary coupling structure 16 to the bolt 4c disengaged from the body 4a of the turnbuckle 4 at the other end B' of the turnbuckle.

5 When the wire rope tensioning operation is performed with the wire rope 2B, the stage corresponding to Fig. 7 described above is as shown in Fig. 13(b).

In order to bring the wire rope 2B into the temporary loop-like coupling state as in Fig. 8, the bolt 4c disengaged from the body 4a of the turnbuckle 4 at the other end B' of the turnbuckle is screwed into the
10 body 4a.

[0032] [Third Embodiment]

In the wire rope 2C in Fig. 12(c), the one end A of the wire rope 2 is permanently coupled to the bolt 4b at the one end A' of the turnbuckle 4 with the bolts 4b, 4c screwed in both sides of the body 4a,
15 and the other end B of the wire rope 2 forms a temporary coupling loop 16', which is in a state not engaged with the ring portion 4c₁ of the bolt 4c in the temporary coupling structure 16 described above.

When the wire rope tensioning operation is performed with the wire rope 2C, the stage corresponding to Fig. 7 described above is as
20 shown in Fig. 13(c).

In order to bring the wire rope 2C into the temporary loop-like coupling state as in Fig. 8, once after the vinyl tape 14 and the thimble 12c are removed from the other end B of the wire rope 2, the temporary coupling structure 16 is formed by fitting the thimble 12c through the
25 ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle 4, passing the wire rope end portion through the ring portion 4c₁ and

through the clamp tube 13c, and wrapping the vinyl tape 14 through the operation described above.

[0033] [Fourth Embodiment]

5 The wire rope 2D in Fig. 12(d) is formed by disengaging the bolt 4c at the other end B' of the turnbuckle 4 from the body 4a, in the wire rope 2A in Fig. 12(a).

When the wire rope tensioning operation is performed with the wire rope 2D, the stage corresponding to Fig. 7 described above is as shown in Fig. 13(d).

10 In order to bring the wire rope 2D into the temporary loop-like coupling state as in Fig. 8, the bolts 4b, 4c on both sides of the turnbuckle are screwed into the respective sides of the body 4a of the turnbuckle 4.

[0034] [Fifth Embodiment]

15 In the wire rope 2E in Fig. 12(e), the one end A of the wire rope 2 is permanently coupled to the bolt 4b at the one end A' of the turnbuckle 4 with the bolts 4b, 4c screwed in both ends of the body 4a, and the other end B of the wire rope 2 is a rope terminal having the end not specially worked, with the thimble 12c, the clamp tube 13c and a vinyl tape (not shown) placed aside.

20 When the wire rope tensioning operation is performed with the wire rope 2E, the stage corresponding to Fig. 7 described above (in this case, a stage in which the other end B of the wire rope 2 with a rope terminal is brought closer to the bolt 4c at the other end B' of the turnbuckle 4) is as shown in Fig. 13(e).

25 In order to bring the wire rope 2E into the temporary loop-like

coupling state as in Fig. 8, first, the wire rope 2 is passed through the clamp tube 13c, and the other end B of the wire rope 2 is temporarily coupled to the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle 4.

5 In this case, the temporary coupling structure 16 is formed by fitting the thimble 12c into the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle 4, passing the other end B of the wire rope 2 through the ring portion 4c₁ of the bolt 4c along the thimble 12c, folding back the other end B of the wire rope 2, passing the folded overlapping portion through the clamp tube 13c, and temporarily fixing the
10 overlapping portion, for example, with the vinyl tape 14 on the side opposite to the ring portion 4c₁ with respect to the clamp tube 13c.

[0035] [Sixth Embodiment]

 In the foregoing embodiments, the turnbuckle 4 is positioned
15 between two anchors 1 that define the slope dip direction X (the direction in which the slope is steepest at that position). The embodiments, however, are not limited thereto and can be applied to a case where the turnbuckle 4 is positioned between two anchors 1 spaced apart at least in the up-down direction of a slope.

20 For example, as shown in Fig. 14, the embodiments can be applied to, for example, a case where the turnbuckle 4 is positioned between the side anchor 1 and the bottom anchor 1, of three anchors 1 in the triangular arrangement as in the embodiments.

 Also in this case, when drawing the wire rope 2, the worker can
25 give a pull by own weight and can pull the wire rope 2 with a large force because the worker pulls the wire rope end portion at the other end

B of the wire rope 2 in the downward direction of the slope.

[0036] [Seventh Embodiment]

5 In the foregoing embodiments, as illustrated by a wire rope 2A in Fig. 12(a) (the same as Fig. 5(a)), it is assumed that the thimble 12b at the part where the one end A of the wire rope 2 is permanently coupled to the bolt 4b at the one end A' of the turnbuckle 4 has the same size as the thimble 12c that is a part of the temporary coupling structure 16 for temporarily coupling the other end B of the wire rope 2 to the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle 4.

10 In actuality, however, as shown by a wire rope 2A' in Fig. 15, a thimble 12c' that is a part of the temporary coupling structure 16 preferably has a size larger than the thimble 12c having a standard size adapted for the diameter of the wire rope and used as a thimble at the part where the one end A of the wire rope 2 is permanently coupled to the bolt 4b at one end. For example, if the wire rope has a diameter of 8 mm, preferably, a thimble for 8 mm adapted for the 8-mm diameter is used as the thimble 12b at the one end and, for example, a thimble for 12 to 24 mm is used as the large thimble 12c' at the other end.

15 [0037] In the case of a structure having a thimble and a clamp tube as the temporary coupling structure 16, when the wire rope is drawn in order to remove the looseness of the wire rope, the clamp tube receiving the overlapping portion of the wire rope end portion is pushed closer to the thimble in order to eventually achieve permanent coupling. With a thimble having a standard size adapted for the diameter of the wire rope used therewith, pushing the clamp tube toward the thimble requires an

20 extremely large force and is difficult to perform by human power on a

25

steep slope, because the horseshoe shape of the thimble is small. However, as with the thimble 12c' in Fig. 15, with the thimble 12c' fitted through the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle 4, pushing the clamp tube toward the thimble requires less force because the thimble 12c' has a size larger than the thimble 12b of a standard size adapted for the diameter of the wire rope. The clamp tube therefore can be easily pushed toward the thimble by human power.

[0038] [Eighth Embodiment]

In the foregoing embodiments, means for squeezing the clamp tube 13c receiving the overlapping portion of the other end of the wire rope passed through the ring portion of the bolt and folded, with a squeezer is employed as the permanent coupling structure 15 for permanently coupling the other end B of the wire rope 2 to the ring portion 4c₁ of the bolt 4c at the other end B' of the turnbuckle 4. The embodiments, however, are not limited thereto, and means for fastening the overlapping portion with a wire clip for achieving permanent coupling may be employed. Alternatively, means for braiding the overlapping portion for achieving permanent coupling may be employed. Although it is preferable to fit a thimble through the ring portion, a thimble may not be used.

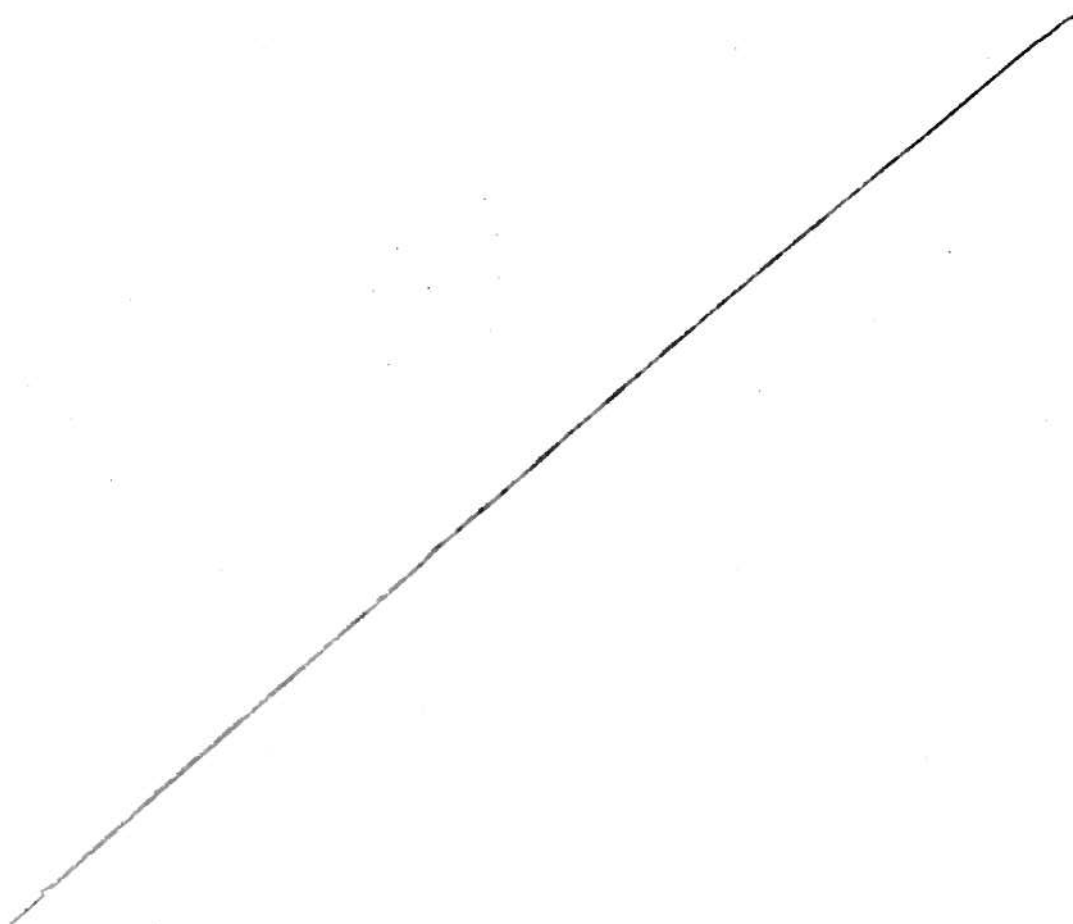
The turnbuckle used in the present invention is turned for length adjustment generally in contact with the ground surface of a slope and therefore preferably has a structure in which bolts 4b, 4c are screwed in the tubular body 4a as in the turnbuckle 4 in the embodiments.

However, a frame turnbuckle having a body shaped like a frame may be used.

Reference Signs List

	[0039]	1	anchor
		2	wire rope
		2a	downward extending portion
5		2a'	extra length portion of the wire rope
		A	one end of the wire rope
		B	another (the other) end of the wire rope
		A'	one end of a turnbuckle
		B'	another (the other) end of the turnbuckle
10		3	compression plate
		4	turnbuckle
		4a	body (of the turnbuckle)
		4b	bolt (coupling bolt) at one end (of the turnbuckle)
		4b ₁	ring portion (coupling portion) (of the bolt at one end)
15		4c	bolt (coupling bolt) at the other end (of the turnbuckle)
		4c ₁	ring portion (coupling portion) (of the bolt at the other
			end)
		5	bottom plate (of the compression plate 3)
		5a	central hole
20		6	cylinder
		7	reinforcing rib
		7a	hole for allowing passage of the wire rope
		8	washer
		9	nut
25		10	solid ground
		12b	thimble (at the one end A of the wire rope)

- 13b clamp tube (at the one end A of the wire rope)
- 12c, 12c' thimble (at the other end B of the wire rope)
- 13c clamp tube (at the other end B of the wire rope)
- 5 14 vinyl tape or linear material (part of a temporary coupling structure)
- 15 permanent coupling structure
- 16 temporary coupling structure
- 17 vinyl tape (for fixing the extra length portion of the wire rope)
- 10



We Claim:

1. A wire rope tensioning method in a slope stabilization construction method in which a number of anchors are installed on a natural slope in a triangular arrangement such that three of the anchors adjacent to each other with a space are positioned at vertexes of a triangle, a compression plate is attached and fastened to a head of each of the anchors to apply compression force against a ground, and three of the anchors in the triangular arrangement are coupled to each other with a single wire rope forming a loop when coupled with a turnbuckle having coupling bolts on both ends thereof, the wire rope tensioning method comprising:

permanently coupling one end of the wire rope to a coupling portion of the coupling bolt at one end of the turnbuckle, the coupling bolt being screwed or not screwed in a body of the turnbuckle in advance, before arrangement of the wire rope on the slope;

bringing the wire rope into a temporary loop-like coupling state in which

the turnbuckle is positioned between two of the anchors that define an up-down direction of the slope,

another end, oriented up the slope, of the wire rope passes through a coupling portion of the coupling bolt at another end, oriented down the slope, of the turnbuckle with the coupling bolts screwed in both ends thereof, and extends down the slope, and

the wire rope forms a loop with the turnbuckle;

pulling and drawing the other end of the wire rope extending down the slope, in a downward direction of the slope, to remove

looseness of the wire rope formed in a loop;

permanently coupling the other end of the wire rope to the coupling portion of the coupling bolt at the other end of the turnbuckle; and

5 turning the turnbuckle to apply tensile force to the wire rope.

2. The wire rope tensioning method according to claim 1, wherein a temporary coupling structure is formed in advance at the other end of the wire rope, the temporary coupling structure coupling a wire rope end portion passed through the coupling portion of the coupling bolt at the other end of the turnbuckle to the coupling portion in a releasable manner, and

10

the temporary loop-like coupling state is formed with the wire rope, where the wire rope forms a loop with the turnbuckle.

3. The wire rope tensioning method according to claim 2, wherein means for permanently coupling the other end of the wire rope to the coupling bolt at the other end of the turnbuckle forms a permanent coupling structure after the temporary coupling structure is released,

15

the permanent coupling structure has a structure that fixes an overlapping portion formed by folding back the other end of the wire rope passed through the coupling portion of the coupling bolt, and

20

the overlapping portion is fixed by squeezing a clamp tube receiving the overlapping portion with a squeezer, or by fastening the overlapping portion with a wire clip, or by braiding the overlapping portion.

25

4. The wire rope tensioning method according to any one of claims

1 to 3, wherein the turnbuckle to be positioned between two of the anchors is positioned between two of the anchors that define a slope dip direction.

5 5. The wire rope tensioning method according to claim 2, wherein the temporary coupling structure at the other end of the wire rope is formed by fitting a thimble through the coupling portion of the coupling bolt at the other end of the turnbuckle, passing the wire rope end portion through the coupling portion of the coupling bolt along the thimble, folding back the wire rope end portion to form an overlapping portion, 10 inserting the overlapping portion through a clamp tube, and temporarily fixing the overlapping portion on the side opposite to the coupling portion with respect to the clamp tube, with tape or a linear material.

15 6. The wire rope tensioning method according to claim 5, wherein the thimble fitted through the coupling portion of the coupling bolt at the other end of the turnbuckle has a size larger than a size of a thimble used as another thimble at the one end of the wire rope, the other thimble having a standard size adapted for a diameter of the wire rope.

Dated this 26th day of March, 2015.

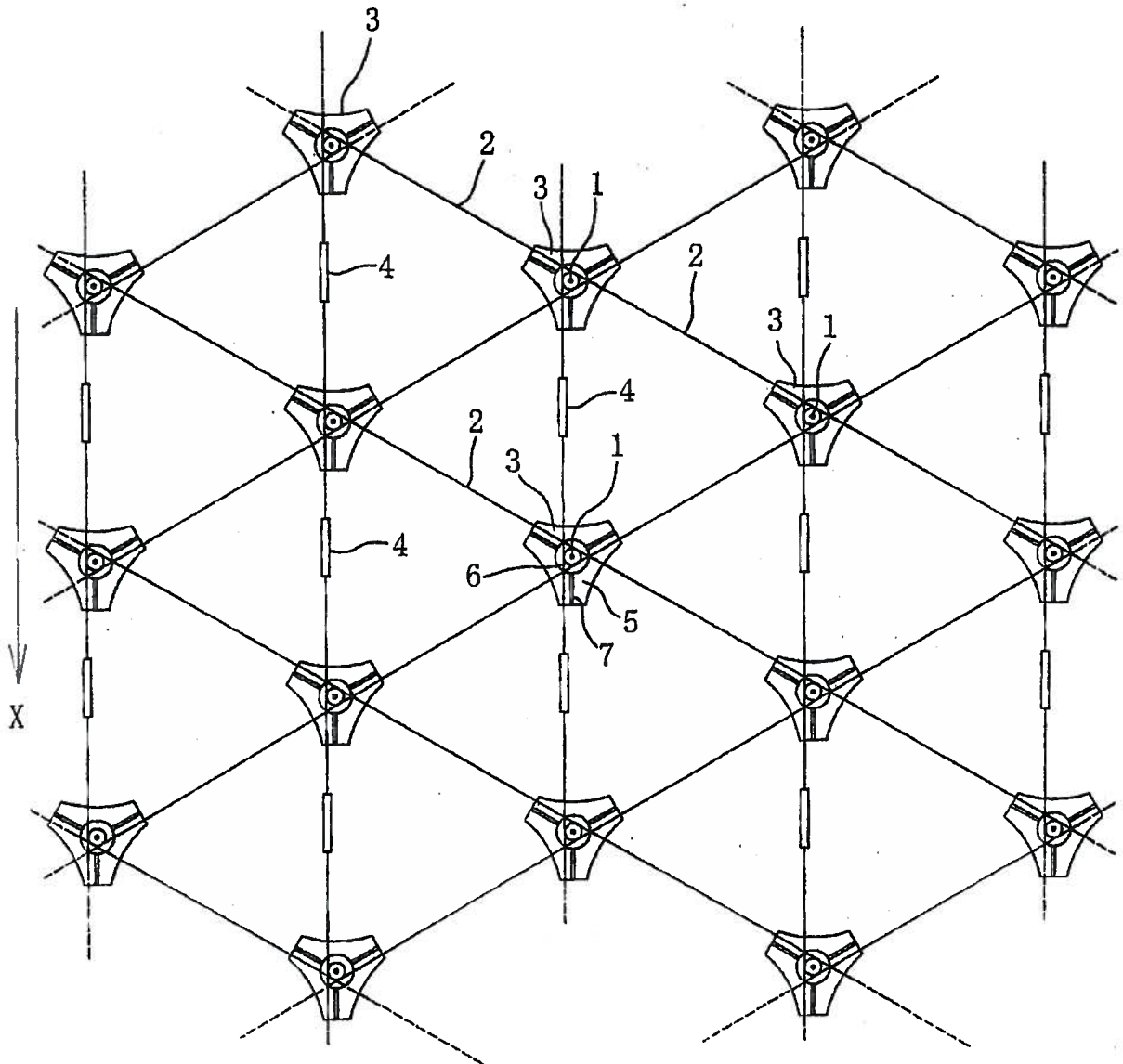
Nippon Steel & Sumikin Metal Products Co., Ltd.



(Dev Robinson)

of Amarchand & Mangaldas &
Suresh A. Shroff & Co.
Attorneys for the Applicant

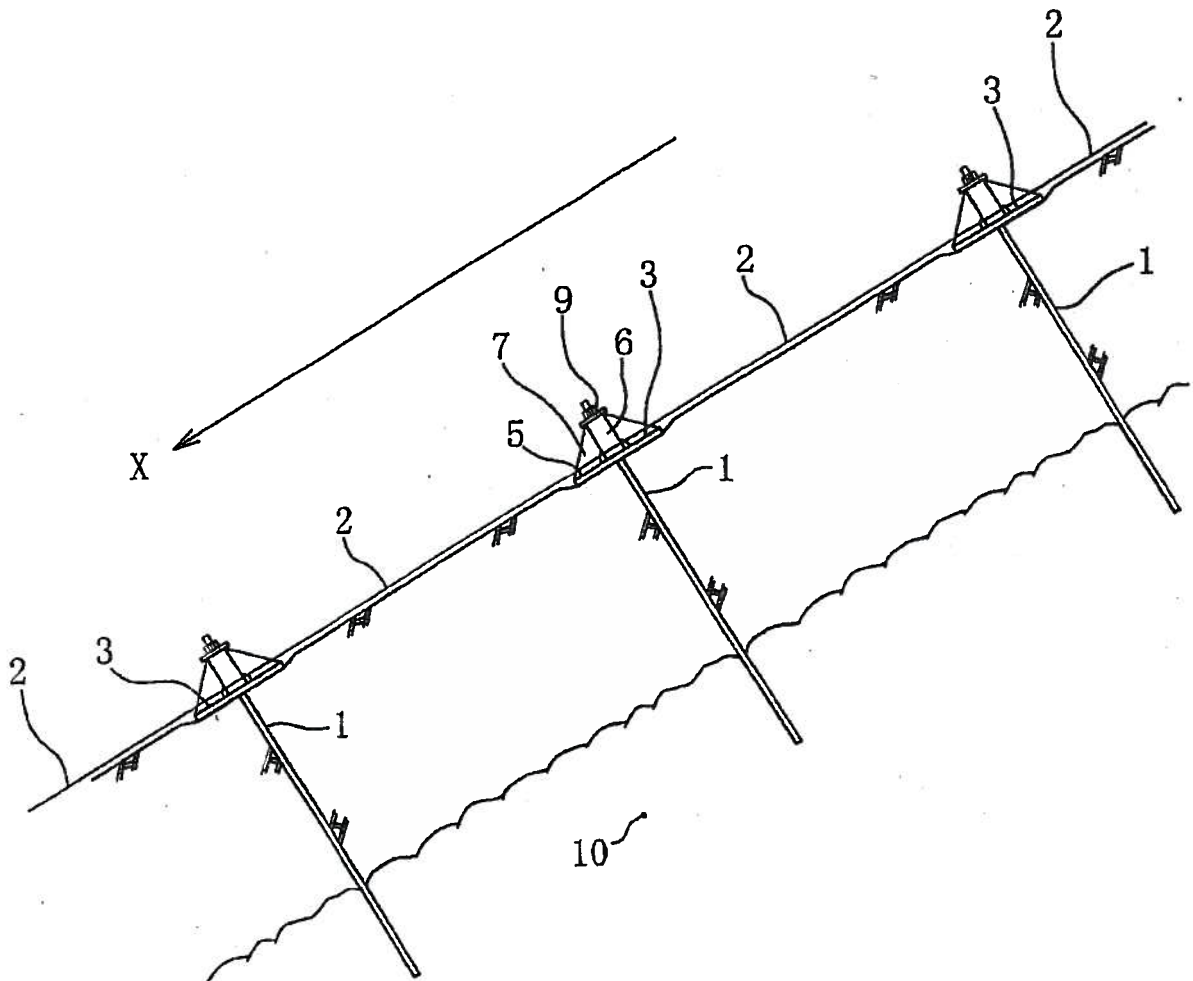
Fig.1



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

Fig.2

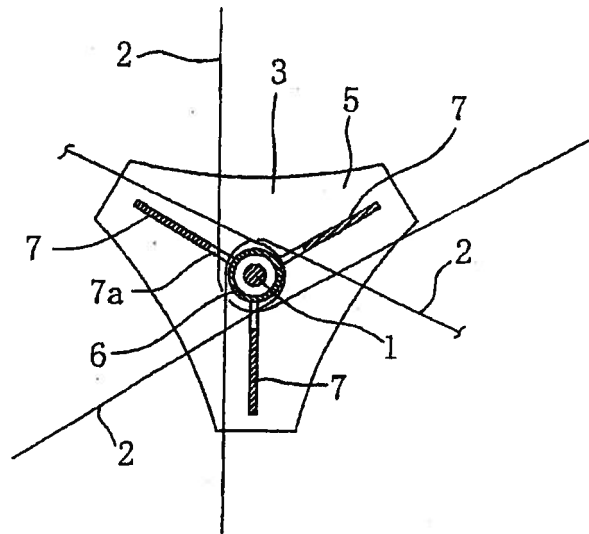


Dev Robinson

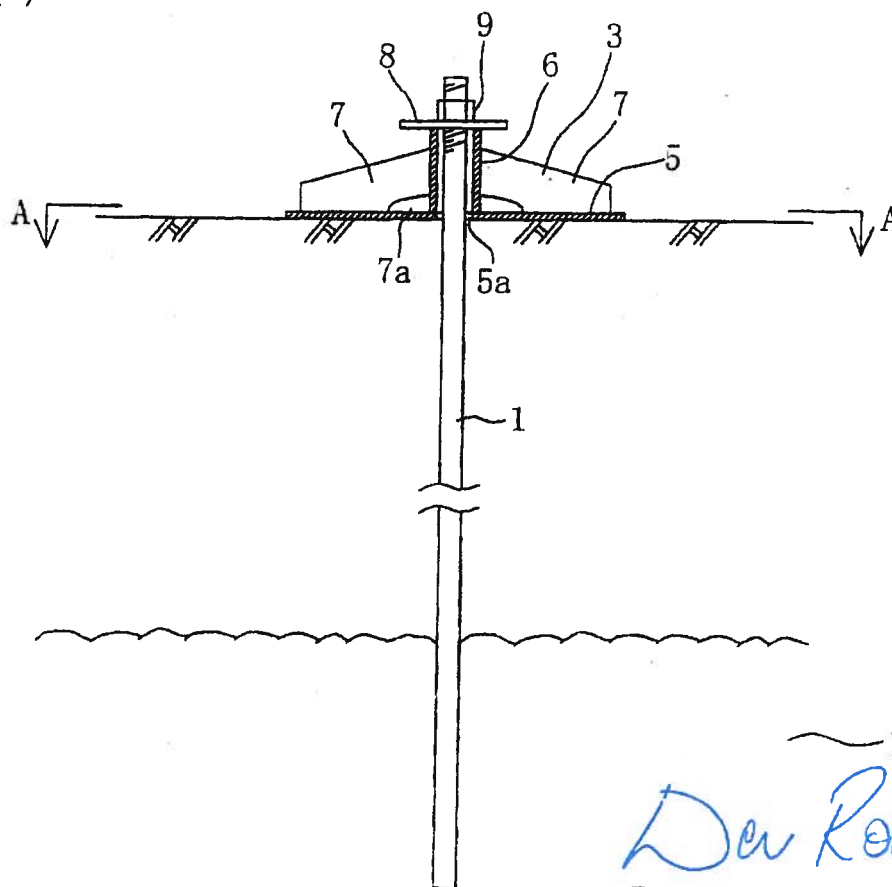
(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

Fig.3

(a)



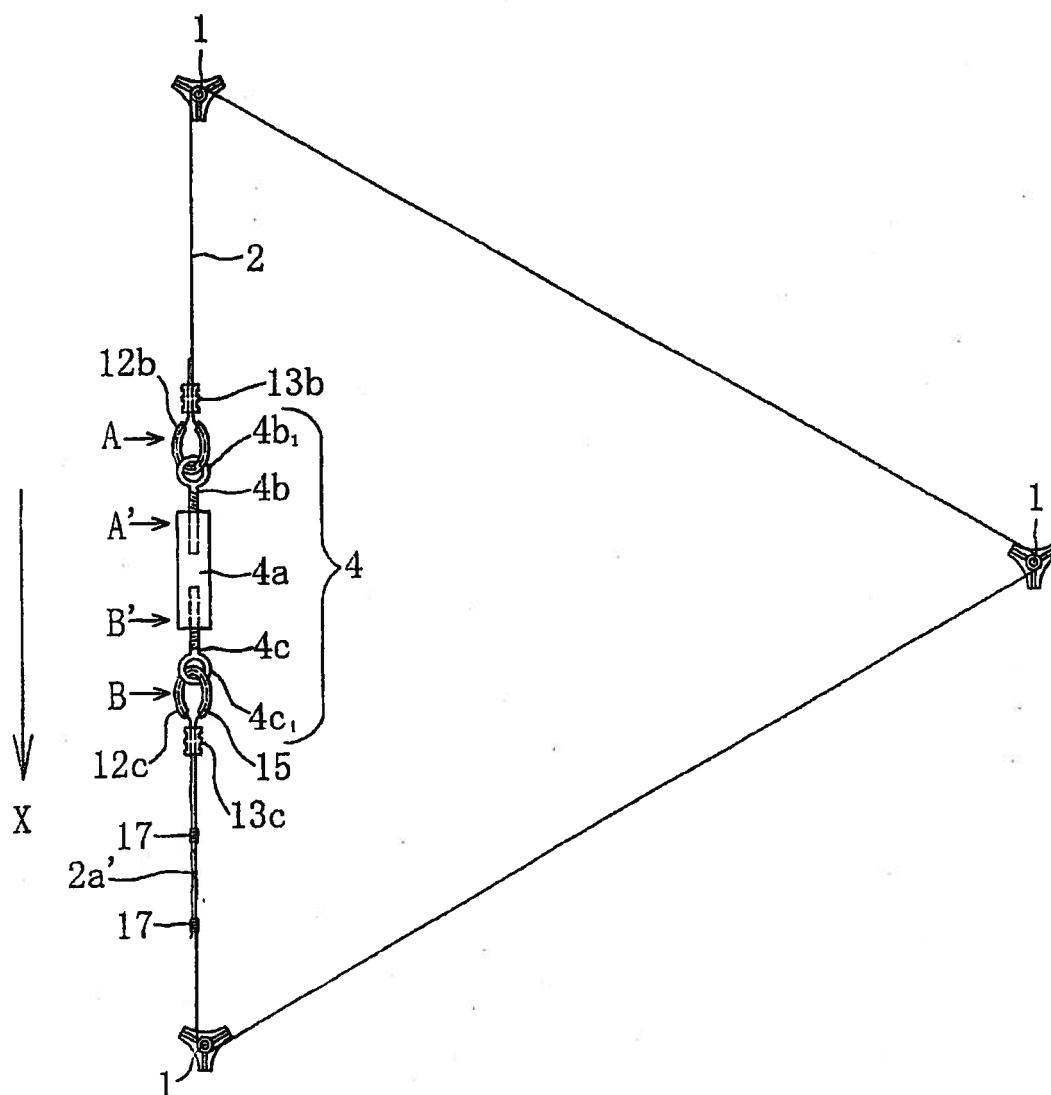
(b)



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

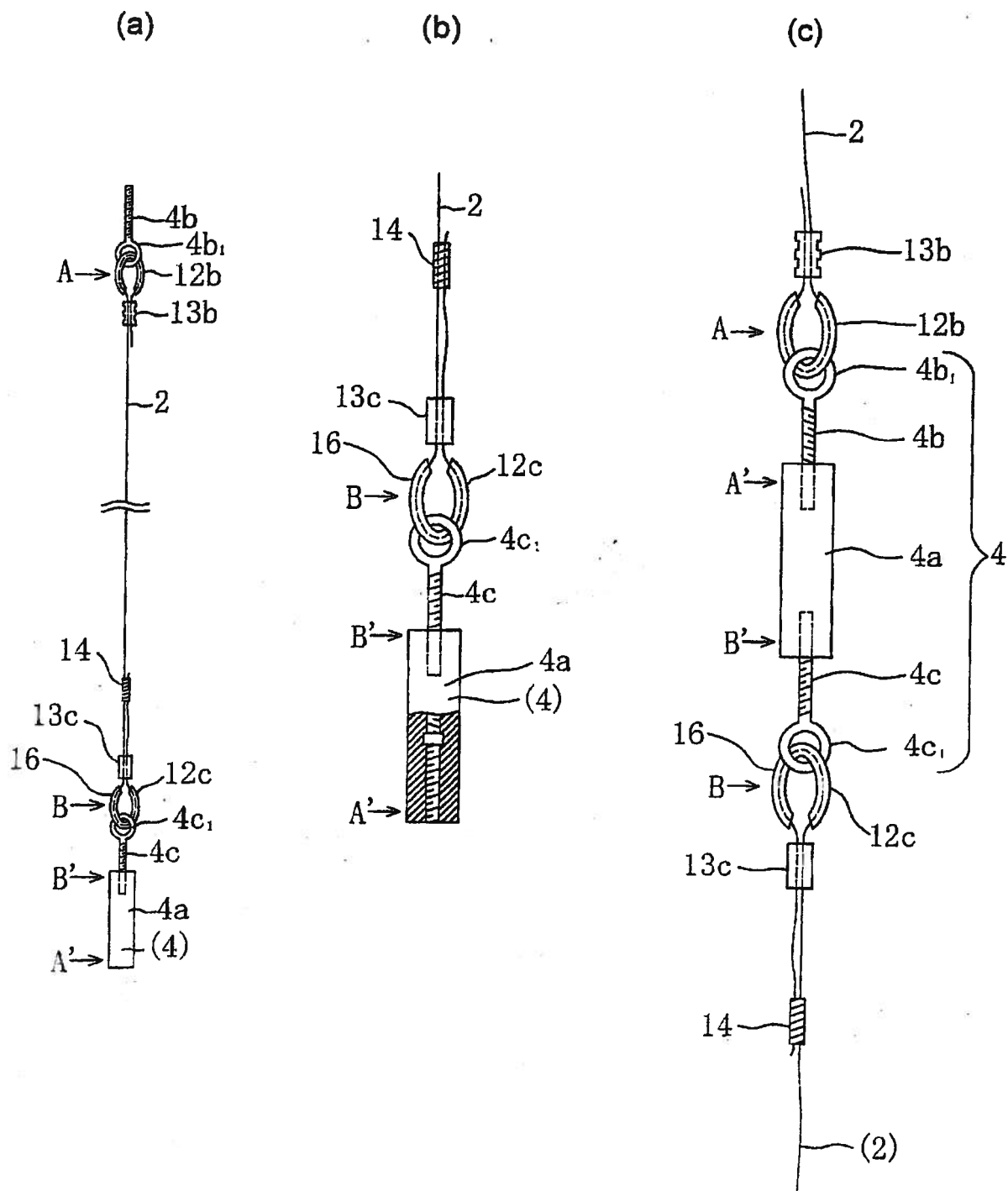
Fig.4



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

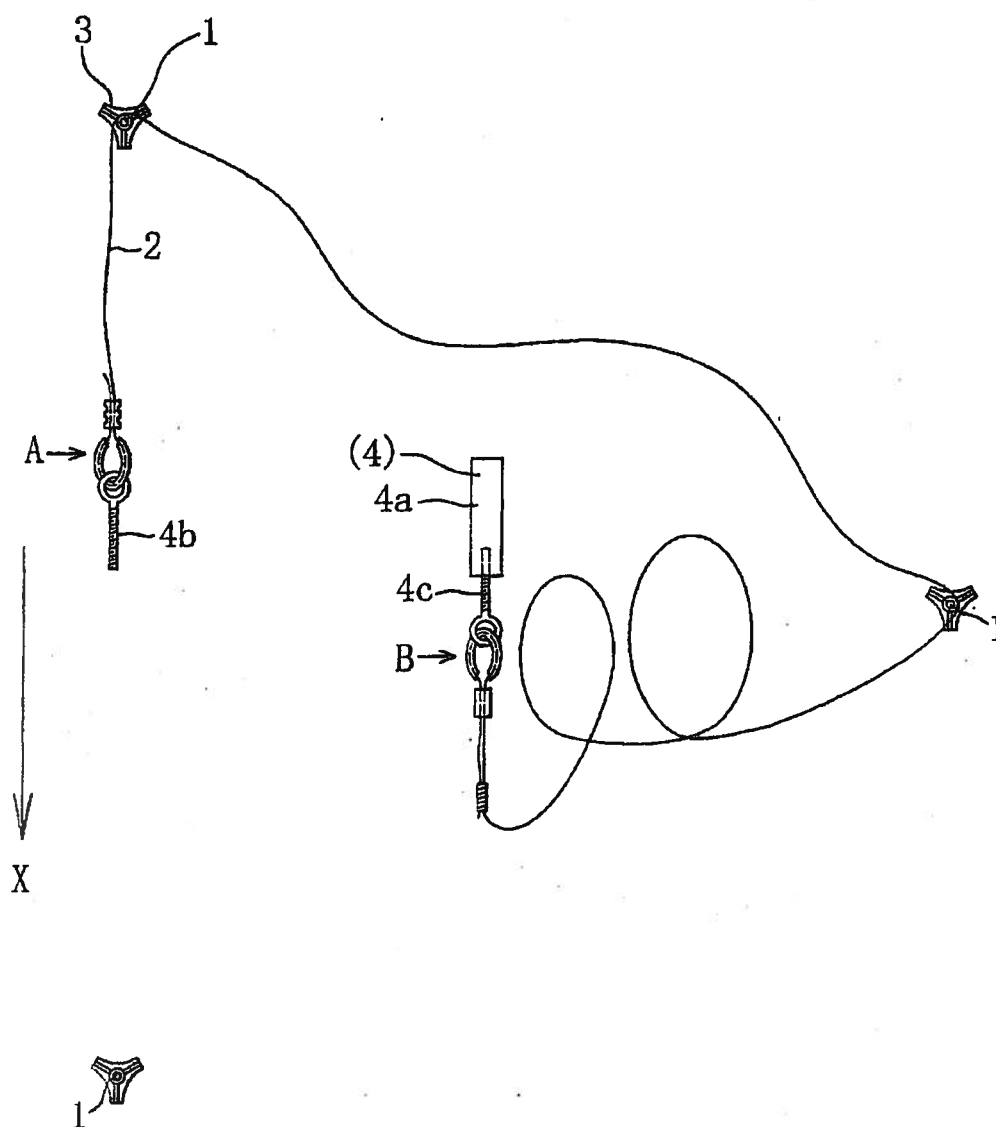
Fig.5



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

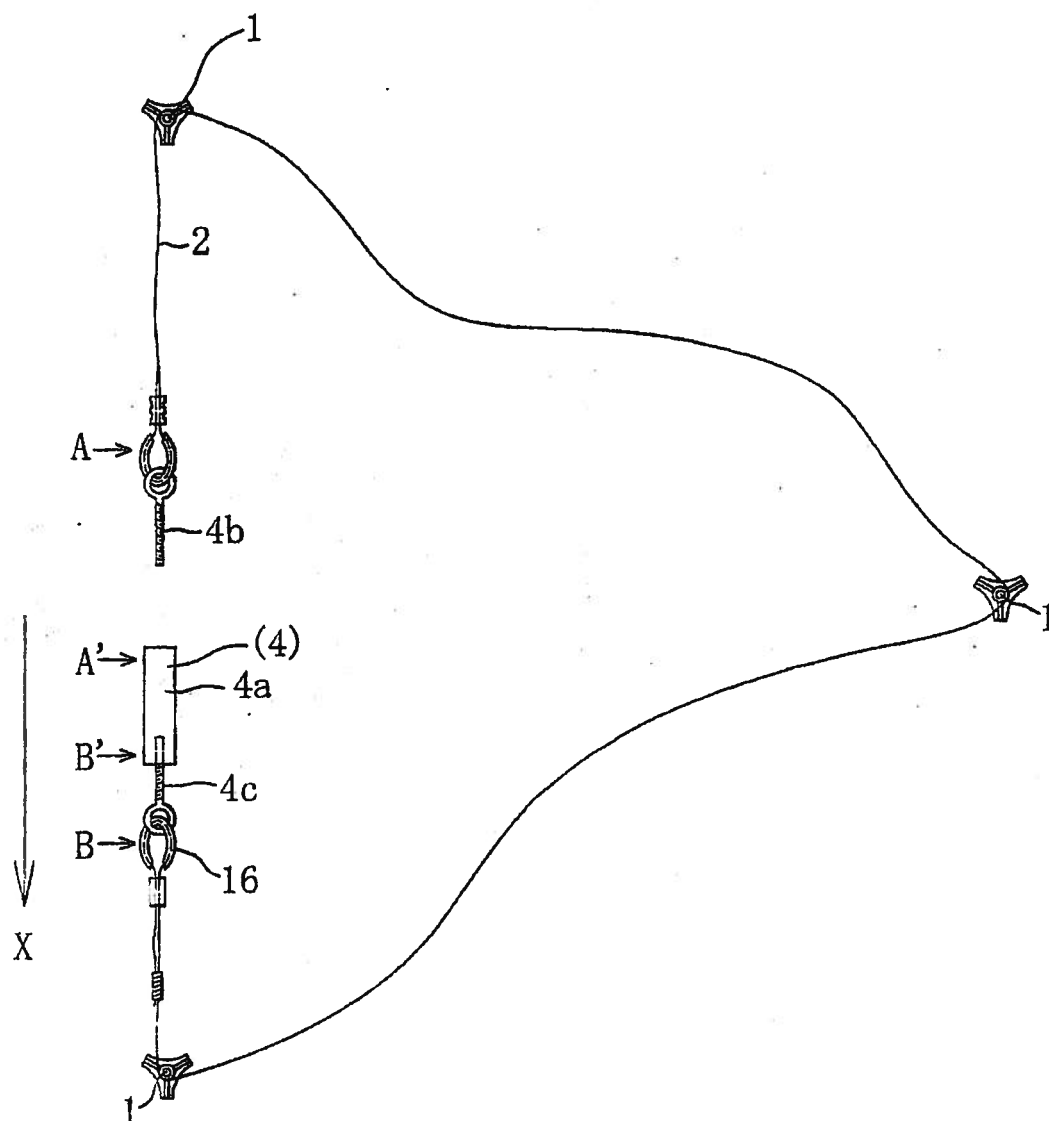
Fig. 6



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

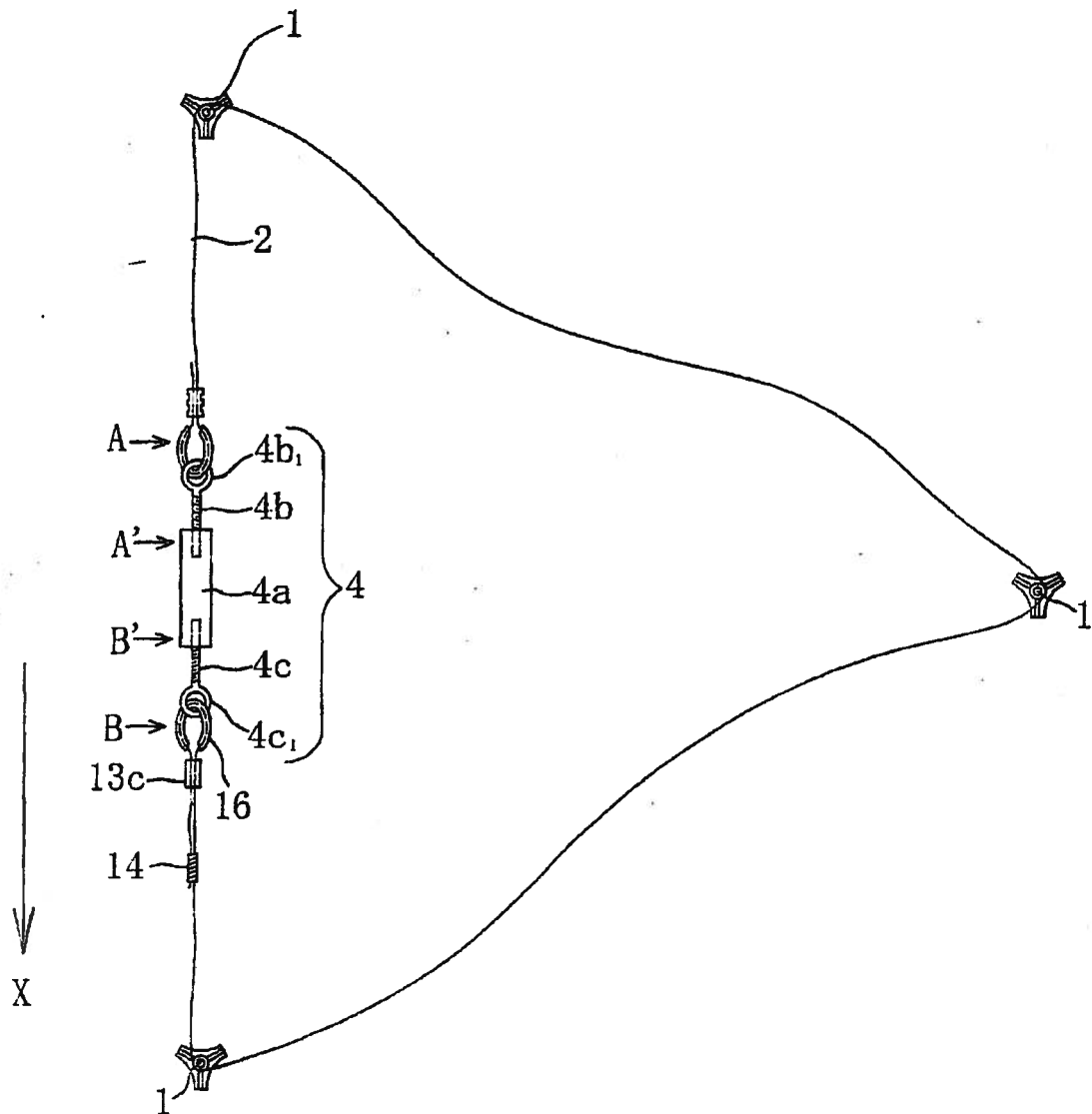
Fig.7



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

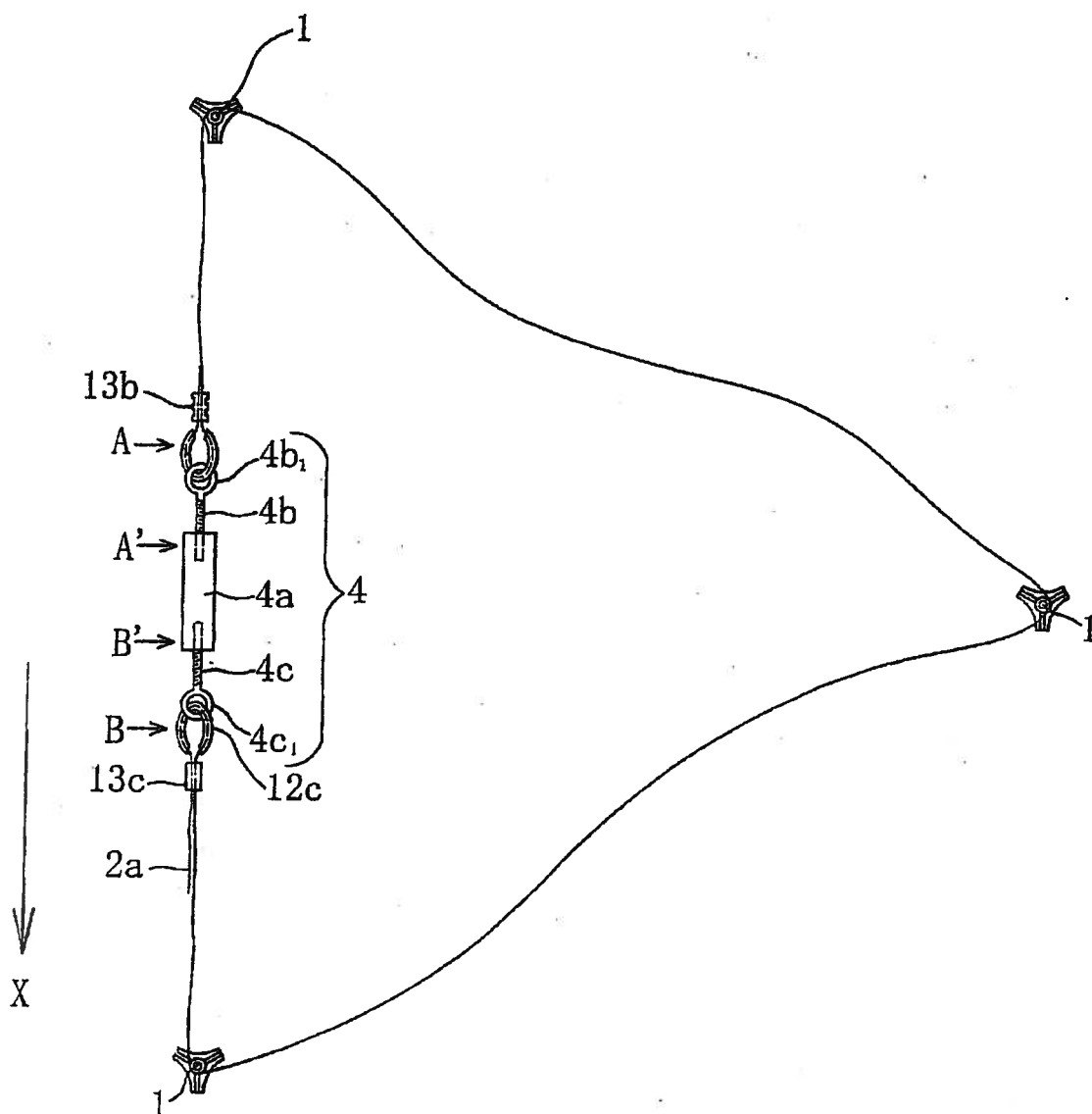
Fig.8



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

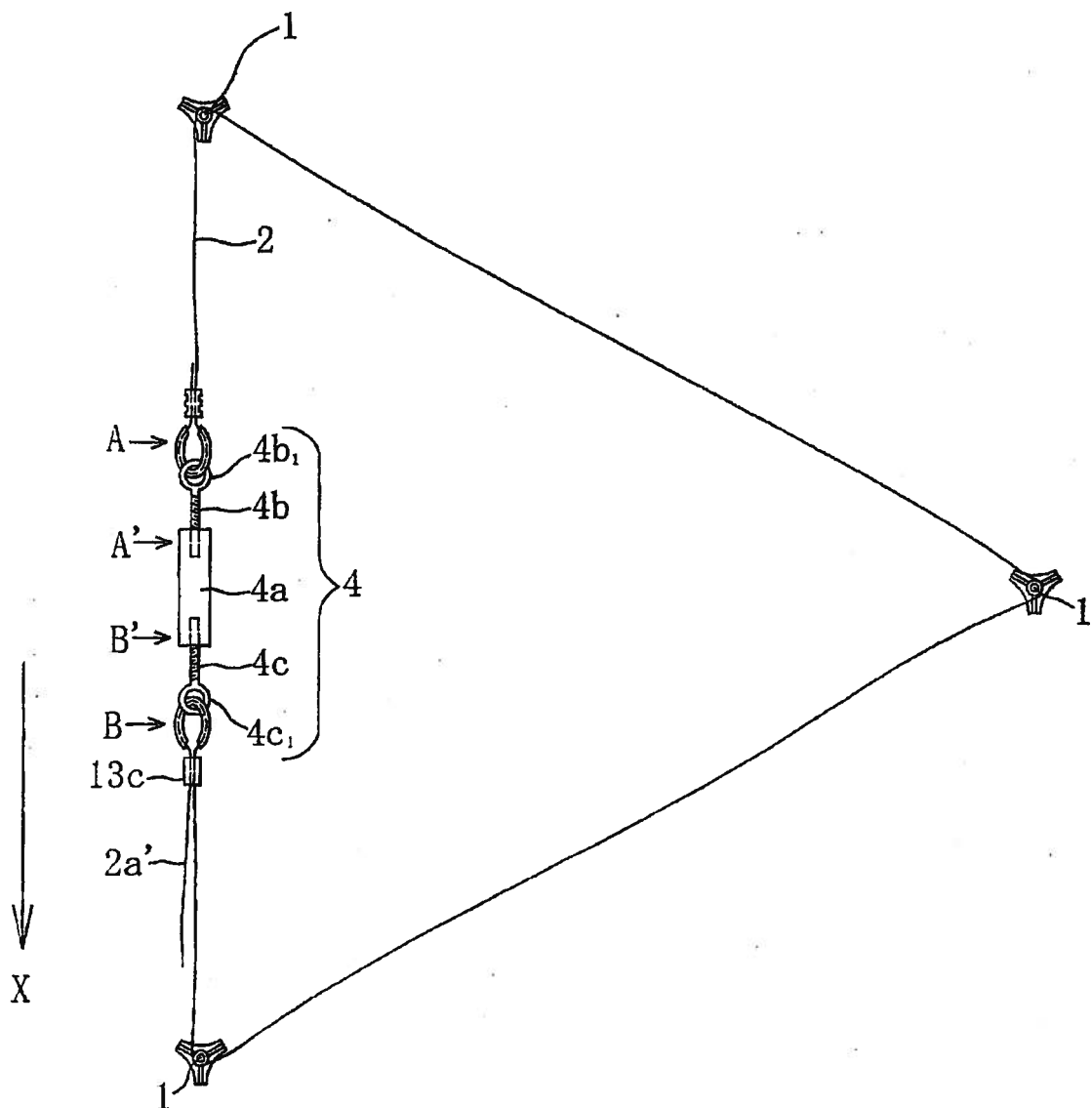
Fig.9



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

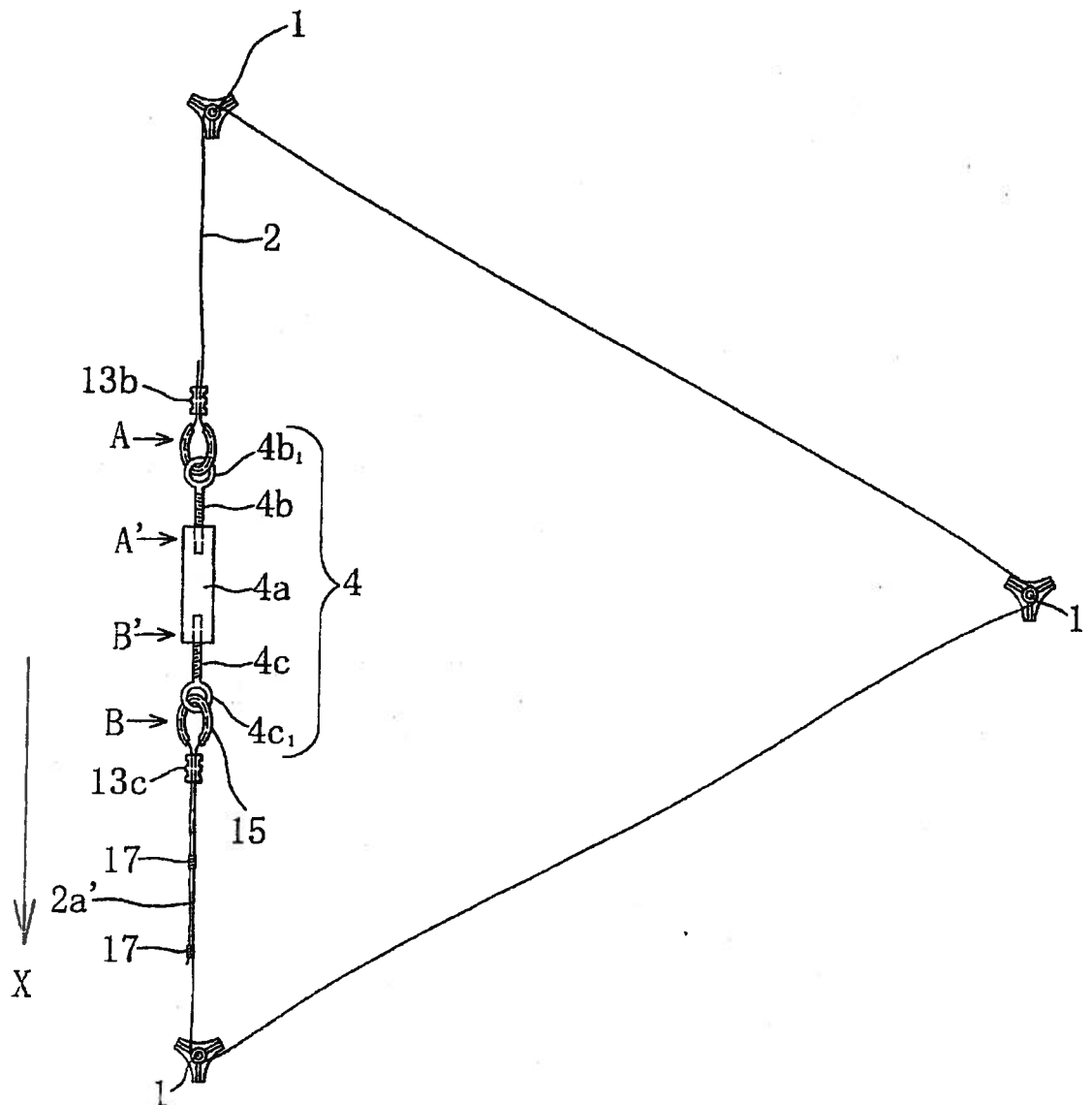
Fig.10



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

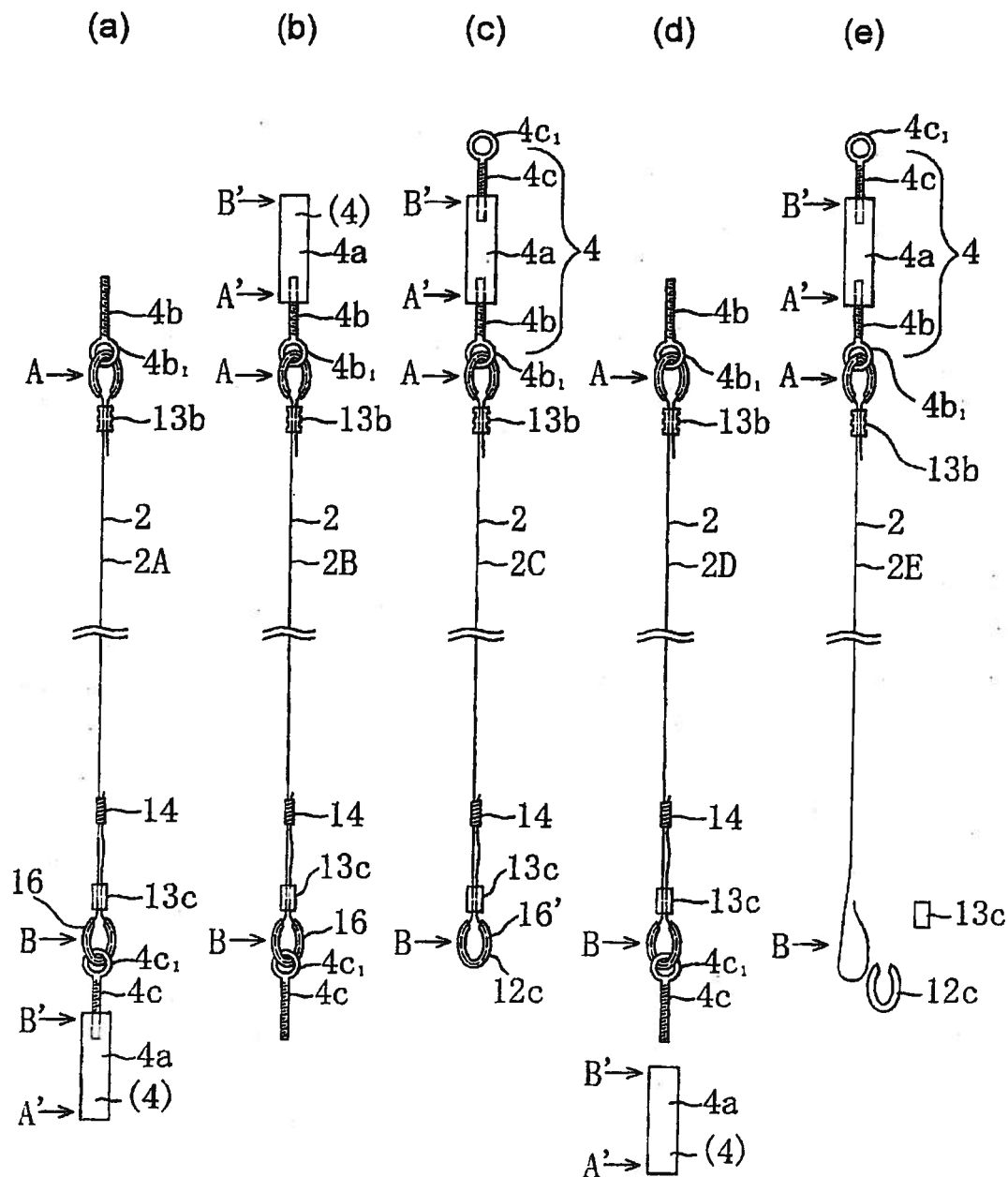
Fig.11



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

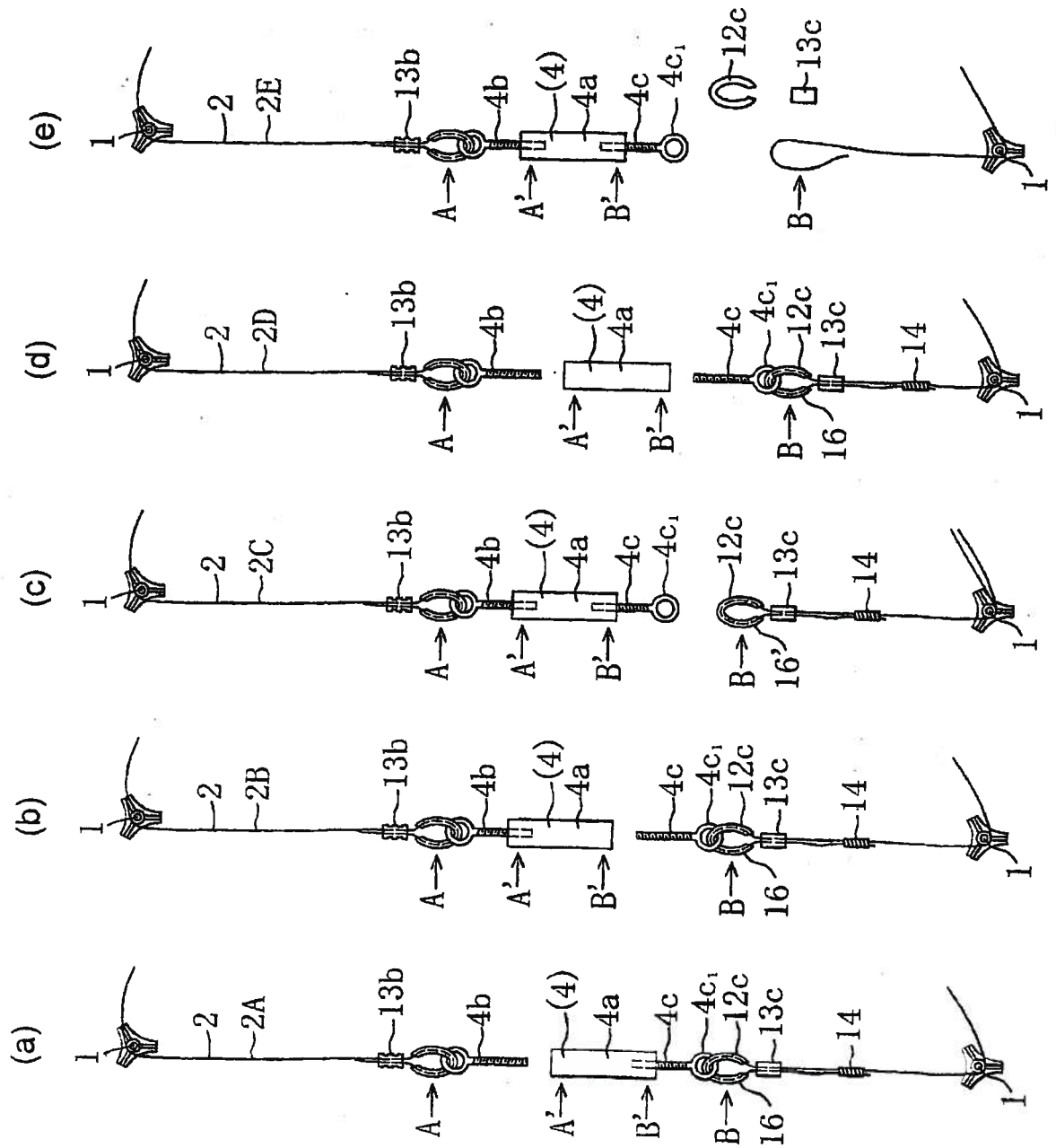
Fig.12



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

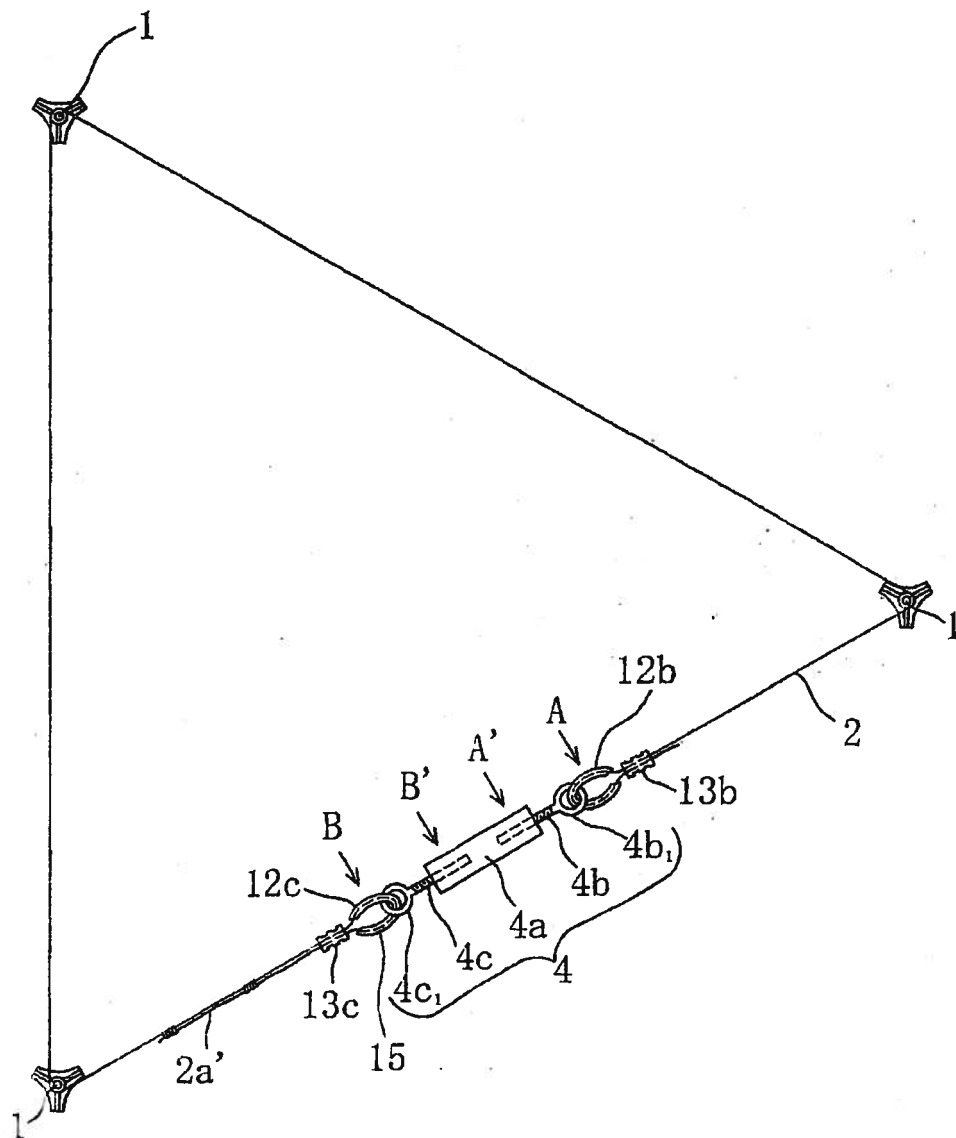
Fig.13



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

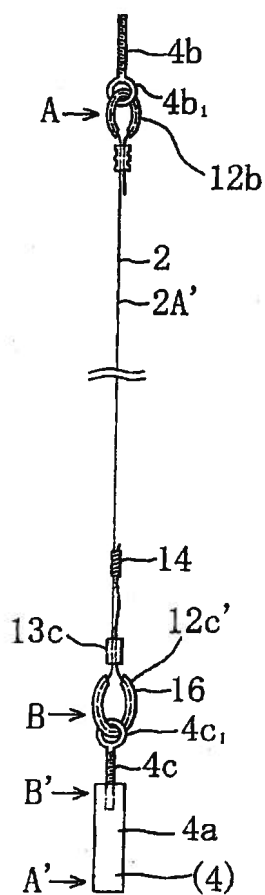
Fig.14



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

Fig.15



Dev Robinson

(DEV ROBINSON)
OF AMARCHAND & MANGALDAS &
SURESH A. SHROFF & CO.
ATTORNEYS FOR THE APPLICANT

ABSTRACT

WIRE ROPE-TENSIONING METHOD IN SLOPE STABILIZATION

CONSTRUCTION METHOD

A wire rope tensioning method includes: permanently coupling one end of a wire rope to a coupling portion of one of coupling bolts at one end of a turnbuckle, the coupling bolt being screwed or not screwed in a body of the turnbuckle in advance, before arrangement of the wire rope on a slope; bringing the wire rope into a temporary loop-like coupling state in which the turnbuckle is positioned between two of the anchors that define an up-down direction of the slope, another end, oriented up the slope, of the wire rope passes through a coupling portion of another coupling bolt at another end, oriented down the slope, of the turnbuckle with the coupling bolts screwed in both ends thereof, and extends down the slope, and the wire rope forms a loop with the turnbuckle; pulling and drawing the other end of the wire rope extending down the slope, in a downward direction of the slope, to remove looseness of the wire rope formed in a loop; permanently coupling the other end of the wire rope to the coupling portion of the coupling bolt at the other end of the turnbuckle; and turning the turnbuckle to apply tensile force to the wire rope.

Fig.7

