



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
21.04.2021 Bulletin 2021/16

(51) Int Cl.:
E01D 22/00 (2006.01) E01D 11/04 (2006.01)

(21) Application number: **19737802.9**

(86) International application number:
PCT/ES2019/070405

(22) Date of filing: **11.06.2019**

(87) International publication number:
WO 2019/238996 (19.12.2019 Gazette 2019/51)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **12.06.2018 ES 201830573**

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(54) **SYSTEM AND METHOD FOR DESTRESSING BRACES BY INCORPORATION OF, OR SUBSTITUTION BY, IMPROVED FILLER MATERIAL**

(57) The present invention relates to a system and method for detensioning guy lines by incorporating, or replacing with, improved filler material. Specifically, the method consists of removing in one area the sheath covering the guy line and the cement grout (if it has those elements) and leaving it clean, placing a formwork around it wherein the improved filler material is injected, which enables, once set, having an area with improved strength and adhesion in order to be able to locate ther-

eon clamps at the ends and starting from them yoke-shaped structures joined to each other by post-tensioning bars or tendons, whereon hydraulic cylinders act in order to release the tension from the guy line and pass it to the post-tensioning bars or tendons and thus be able to cut the strands or wires of the guy lines, in order to subsequently relax the hydraulic cylinders in stages until the guy line is completely detensioned.

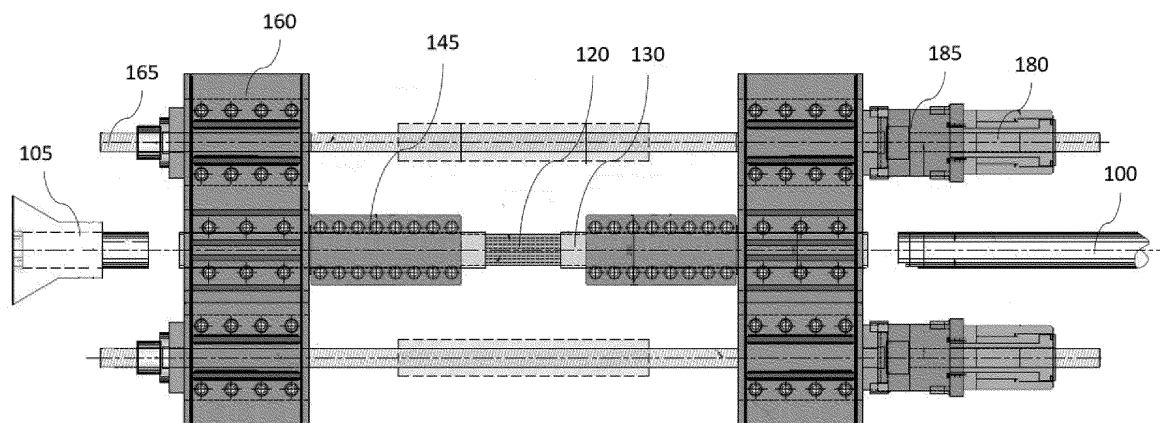


Figure 10

Description

[0001] System and method for detensioning guy lines by incorporating, or replacing with, improved filler material

Field of the invention

[0002] The invention relates to a system and a method for detensioning wherein, in a certain area, the filler material of the guy line is replaced by another one with improved features or said filler material is incorporated into the guy line if it initially lacked it.

Background of the invention

[0003] In the state of the art some systems related to dismantling or replacing pre-tensioning cables such as those described in the following documents are known.

[0004] The patent US6701599 B2 discloses dismantling a pre-tensioning cable having a sheath, wherein the tendon extends in the sheath and is tensioned between two anchoring devices, and a hardened material fills the sheath around the tendons.

[0005] The Spanish patent ES2377716 T3 proposes a method of dismantling a tensioning cable between a first anchoring point and a second anchoring point in a structure which includes the steps of releasing a span of the cable from said first and second anchoring points; supporting said span of the cable; and extracting said span from the cable at a distance from at least one of said first and second anchoring points.

[0006] Document US 9021644 B2 describes a method for replacing a cable of a structure, like a suspension bridge with towers in the structure thereof, which involves placing a set of mobile temporary hangers on the upper cable which is to be replaced, the cable to be replaced is located in the lower portion of these hangers and the cable is removed from the anchors, such that it is maintained thanks to the upper cable. The hangers are moved towards the deck of the bridge in order to remove the cable to be replaced.

Description of the invention

[0007] The present invention relates to a system for detensioning guy lines (100) by incorporating, or replacing with, an improved filler material (125), in a certain area, which is made up of:

- a formwork in two or more portions (130) arranged to be placed around an area of the guy line (100) from which the sheath (110) and the cement grout have been previously removed, if it has these elements, leaving the strands or wires (120) of the guy line (100) clean, wherein said formwork (130) is arranged in order to be able to inject a filler material (125) which, once set, provides an area of improved

strength and adhesion,

- two clamps (145) arranged to be placed on each side of the area of the guy line (100) with the clean strands or wires (120), on the area with improved strength and adhesion, on the formwork tube (130),
- two yoke-shaped structures (160) arranged to be placed one on each outer side of each clamp (145) and around the guy line (100),
- at least two post-tensioning bars or tendons (165) arranged to join together both yoke-shaped structures (160),
- a hydraulic cylinder (180) arranged in each post-tensioning bar or tendon (165), resting on the yoke-shaped structures (160), arranged to transfer, when acting on them, the load from the guy line (100) to the post-tensioning bars or tendons (100) and wherein each hydraulic cylinder (180) can incorporate a tensioning bridge (185) arranged to retain the load transferred to the post-tensioning bars or tendons (165) when acting on them (185).

[0008] Moreover, the invention also relates to a method for detensioning a guy line (100) anchored and covered with a sheath (110) and cement grout or other types of protections which incorporates the following steps:

- a. removal of the sheath (110) covering the guy line (100), if it has one, in an area of the free length thereof,
- b. removal of the cement grout or another filler, if it has one, from the area wherein the sheath (110) has been removed until the strands or wires (120) of the guy line (100) are left clean,
- c. placing the portions of a formwork (130) around the clean strands or wires (120),
- d. injecting a filler material (125) into said formwork (130) which, once set, provides an area of improved strength and adhesion,
- e. placing two clamps (145), one at each end of the clean area of the guy line (100),
- f. placing two yoke-shaped structures (160), one on each side on the outside of each clamp (145) and around the guy line (100),
- g. joining both yoke-shaped structures (160) to each other by means of at least two post-tensioning bars or tendons (165),
- h. actuating hydraulic cylinders (180) arranged in the post-tensioning bars or tendons (165), on the outside of the yoke-shaped structures (160), in order to transfer the load from the guy line (100) to the post-tensioning bars or tendons (165), wherein the cylinders (180) are actuated until they reach the force of the guy line,
- i. retaining the load transferred to the post-tensioning bars and tendons (165) acting on a tensioning bridge (185) incorporated by each cylinder (180),
- j. cutting the strands or wires of the guy line (100).
- k. relaxing the hydraulic cylinders (180) in stages

until the guy line (100) is completely detensioned.

[0009] Unlike the guy lines with self-protected strands, wherein strand-by-strand detensioning is normally possible for the disassembly or total replacement thereof, with the present invention, in the detensioning of the guy lines which, formed mainly by wires, strands or other types of load-bearing elements, wherein the guy lines can be covered by a collective sheath made of steel, polyethylene or similar, the interface between the strands, wires or load-bearing elements and the sheath can be injected or not with cement grout or another material, which acts as an element for filler and protection against corrosion, and there may also be other types of internal coverings at an individual level for each element or groups of them, such as resin and microspheres in the vicinity of the anchor, and cement grout in the free length require a different treatment which is not envisaged in the state of the art.

[0010] This situation makes it necessary that for the detensioning thereof, the guy line (100) must be acted on as a whole, either from the rear portion thereof by means of a multi-strand jack, or acting in the free length of the guy line by transferring the load from the guy line to post-tensioning tendons or bars by means of friction clamps.

[0011] Therefore, the proposed system and method enables incorporating a material with improved features to the guy line whereon fastening or retaining elements can be placed in order to create auxiliary anchoring points whereon it can act to transfer the load from the guy line to other secondary or support elements for the detensioning thereof.

[0012] As seen, unlike the existing solutions, with the present invention, the detensioning of guy lines which are injected with resin and/or microspheres in the area of the anchor, and cement grout in the free length can be carried out, enabling acting on the guy line as a whole by acting on the free length of the guy line by transferring the load from the guy line to post-tensioning tendons or bars by means of friction clamps fixed to the improved filler material incorporated in an area of the guy line.

[0013] The present invention also enables the detensioning, by means of improved filler material and a friction clamp, in those guy lines of any type wherein it is not possible to connect to the rear portion of the anchor due to a lack of sufficient length of the strands after the anchor, or due to other causes in general, whether they be guy lines made up of self-protected strands or of strands, wires or other types of cable with any type of protection, regardless of the type of anchor they have (wedges, wedges with resin, cold upset butt welds, etc.).

[0014] These and other advantages are apparent in light of the detailed description of the invention.

Brief description of the drawings

[0015]

Figure 1 shows an example of a guy line which could be portion of a bridge or similar structure, wherein said guy line is seen as anchored in the lower portion thereof to a deck (in the upper one it will be to a pylon) at the outlet of which an element is located which concentrates the bundle of strands or wires of the guy line. This figure shows an operator who could be performing the phase for uncovering the sheath of the guy line and removing the cement grout, or another filler material, adhered to the strands or wires of the guy line.

Figure 2 shows an example of the detail of a guy line wherein it is observed that the sheath covering it has been removed, as well as the cement grout, or another filler material, leaving the strands or wires accessible.

Figure 3 shows an example similar to Figure 1, wherein, once the sheath of the guy line has been stripped and cleaned of the cement grout, or another filler material, a tube has been placed in two parts around the strands or wires and on the inside of which said tube is injected with high-strength resin so that the area can have a strength and adhesion appropriate for using the retaining clamps.

Figure 4A shows an example of the front detail and Figure 4B, a cross section of half a pipe placed around the strands or wires, used to be able to inject high-strength resin inside, staying arranged there in order to subsequently place the friction clamp thereon.

Figure 5 shows an example of the detail of a guy line with the tube for injecting high-strength resin on the inside thereof and wherein the temporary clamps for securing the tube and the fittings for injecting the resin are seen.

Figure 6 shows an example of the detail of a cross section of a friction clamp made up of two parts joined by threaded bars and placed around a guy line without the sheath thereof, if it had one, and the cement grout, or another filler material, with the improved filler material thereof and the formwork tube in two portions.

Figure 7 shows an example of the detail of a side view of a friction clamp for guy lines made up of two parts and joined by threaded bars.

Figure 8 shows an example of the detail of a top view of one of the yokes making up the system, which secure two post-tensioning bars or tendons and in between, crossing through the yoke, the detensioning guy line.

Figure 9 shows a cross section of the yoke, wherein the threaded bars and fastening screws are visible, the two post-tensioning bars or guy lines and, in the centre, the space occupied by the guy line to be detensioned.

Figure 10 shows the detail of a top view of the system wherein it shows the guy line to be detensioned, both yokes, both retaining clamps on the area of improved

filler material and the two hydraulic cylinders intended to exert force on the post-tensioning bars or tendons which cross through both yokes.

Figure 11 shows the detail of a side view of the system wherein it shows the guy line to be detensioned, the yokes, the retaining clamps on the area of improved filler material and the hydraulic cylinders destined to exert force on the post-tensioning bars passing through both yokes.

Detailed description of the invention

[0016] The elements defined in this detailed description are provided to help create an overall understanding of the invention. Accordingly, those skilled in the art will recognise that variations and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. In addition, the detailed description of sufficiently known functions and elements are omitted for reasons of clarity and conciseness.

[0017] The invention relates to a system and method for detensioning guy lines (100) by incorporating, or replacing with, improved filler material.

[0018] The system is adapted for structural elements made up of the guy lines (100) to be detensioned, which tend to include an adjustable active anchor and a passive anchor not able to be adjusted. It is common for both anchors to be protected by an enveloping cowling filled with grease or wax in the case of the active anchor and filler made of cement grout or also grease or wax in the case of the passive anchor.

[0019] In the outlet area of the guy line (100) of the pylon (200) and of the deck (300), a centring element (105) is usually arranged to concentrate the bundle of strands or wires (120). The free length of the guy line (100) is covered with a collective sheath (110) of High-Density Polyethylene (HDPE) or another generally plastic or metal material, and is injected with cement grout or another protective material.

[0020] Unlike the guy lines made of self-protected strands, wherein strand-to-strand detensioning is normally possible for the total disassembly or replacement thereof, the guy lines (100) which are injected with resin and microspheres in the area of the anchor or another type of collective filler, and cement grout, or similar material, in the free length require a different treatment.

[0021] This situation makes it necessary that, for the detensioning thereof, the guy line (100) must be acted on as a whole, either from the rear portion thereof by means of a multi-strand jack, or acting in the free length of the guy line by transferring the load from the guy line to post-tensioning bars or tendons by means of friction clamps, although if the latter is not possible, given that the strength and adhesion features of the filler materials of the free length of the very strands or wire of the guy line do not enable the forces of the guy line to be transferred by friction. This is why the present invention entails

an improvement of the strength and adhesion of the filler material, by means of incorporating, or replacing with, a filler material with improved features.

[0022] The detensioning by means of improved filler material and friction clamps is used in those guy lines (100), whether they have injected strands or wires, with self-protected strands, etc., wherein it is not possible to connect to the rear portion of the anchor due to a lack of sufficient length of the strands after the anchor, or due to other causes in general.

[0023] In the method to be performed, firstly, and as seen in Figs. 1 and 2, the protective sheath (110) is cut, if the guy line was equipped with that element, in the free length of the guy line (100) in the lower area near the deck (300) or in another area if convenient. To do so, a length of several metres is uncovered, which can be approximately 3m and a centred area of that uncovered area is cleaned, which can be approximately 2.65m, until the remains of the cement grout, or another filler material, adhered to the strands or wires (120) are completely removed. The cleaning of both the outer and inner strands or wires (120) can be carried out, preferably, with a jet of water.

[0024] Once this area is clean, and as a main feature of the invention, a material with improved features is injected, generally consisting of a resin-based material or similar with or without a load of aggregates in order to ensure an area with improved strength and adhesion, suitable for placing friction or retention clamps in said areas.

[0025] In order to proceed to incorporate the filling, as shown in Figs. 3 and 5, auxiliary elements are installed which act as a formwork at both ends, such as metal tube halves (130), leaving a free area and without injecting between both sides to be able to subsequently operate in order to cut the load-bearing elements or strands (120) of the guy line (100).

[0026] The two halves of the tube are joined with provisional flanges (135) and a special filler material, for example resin, is injected into it through fittings (140) located along the tube. Between the two halves of the tube (130), in the lateral joining areas thereof, there are some shims and a seal. An example of said tube (130) and the cross section thereof is shown in Figs. 4A and 4B.

[0027] Once the filler material is set, the fittings (140) and the provisional flanges (135) of the tube (130) are removed and the two clamps (145), upper and lower, made up of two portions (150) joined by threaded bars (155) are installed. The tightening of the threaded bars (155) so that the guy line (100) is secured is preferably performed with a tensioner acting in a distributed and progressive manner on each of them (155).

[0028] Subsequently, a reaction structure in the shape of a yoke (160) is installed as shown in Figs. 8 and 9, and which supports both clamps (145) from above and below as shown in Figs. 10, 11 and 12.

[0029] Both yoke-shaped structures (160) are joined to each other by post-tensioning bars or tendons (165)

and in the middle of said structures the guy line to be detensioned (100) is located. Preferably, two post-tensioning bars or tendons (165) are used, one on each side of the guy line (100), although another number could be used, according to the structural needs.

[0030] Each of these yoke-shaped structures (160) is made up of two halves which are joined together and therefore secure the guy line (100) and the post-tensioning bars (165) by means of screws and threaded bars (170).

[0031] The post-tensioning bars or tendons (165) are actuated by means of two cylinders or hydraulic jacks (180) with the aim of transferring the load from the guy line (100) thereto as shown in Figs. 10, 11 and 12. These cylinders (180) are equipped with a tensioning bridge (185) in order to be able to retain the strength of the post-tensioning bars or tendons (165) mechanically.

[0032] In the part of the process intended for the detensioning, force is then applied with the two hydraulic cylinders (180) until reaching the force of the guy line (145). Then, the retaining nuts located in the tension bridges (185) are fastened, maintaining the force of the post-tensioning bars or tendons (165) and releasing pressure in the hydraulic cylinders (180).

Once the force of the guy line (100) has been transferred from the area between clamps (145) to the post-tensioning bars or tendons (165), it is possible to then cut the guy line (100) in said area, progressively, strand-by-strand (or wire-by-wire) (120).

[0033] Once all the strands or wires (120) of the guy line (100) have been sectioned, the hydraulic cylinders (180) are used to transfer the force from the mechanical locking of the post-tensioning bars or tendons to the hydraulic cylinders. At that time, the retaining nuts located on the tensioning bridges (185) are loosened and pressure is then relieved and the hydraulic cylinders (180) are retracted. If the stroke of the jack or hydraulic cylinder (180) is exhausted, the retaining nuts of the tensioning bridges (185) will be fastened and the cylinders (180) will be extended again.

[0034] The process is repeated until the guy line (100) is completely detensioned.

Claims

1. A system for detensioning a guy line (100) by incorporating, or replacing with, improved filler material **characterised in that** it is made up of:

- a formwork in two or more portions (130) arranged to be placed around an area of the guy line (100) from which the sheath (110) and the cement grout have been previously removed, if it has these elements, leaving the strands or wires (120) of the guy line (100) clean, wherein said formwork (130) is arranged in order to be able to inject a filler material (125) which, once

set, provides an area of improved strength and adhesion,

- two clamps (145) arranged to be placed on each side of the area of the guy line (100) with the clean strands or wires (120), on the area with improved strength and adhesion, on the formwork tube (130),

- two yoke-shaped structures (160) arranged to be placed one on each outer side of each clamp (145) and around the guy line (100),

- at least two post-tensioning bars or tendons (165) arranged to join together both yoke-shaped structures (160),

- a hydraulic cylinder (180) arranged in each post-tensioning bar or tendon (165), resting on the yoke-shaped structures (160), arranged to transfer, when acting on them, the load from the guy line (100) to the post-tensioning bars or tendons (165) and wherein each hydraulic cylinder (180) can incorporate a tensioning bridge (185) arranged to retain the load transferred to the post-tensioning bars or tendons (165) when acting on them (185).

2. The system for detensioning a guy line (100) according to claim 1, **characterised in that** said filler material (125) is high-strength resin with or without a load of aggregates.

3. The system for detensioning a guy line (100) according to claim 1, **characterised in that** said formwork in two or more portions (130) has the shape of a tube with any cross section, they are joined with flanges (135) and it can incorporate fittings (140) arranged for injecting the filler material.

4. The system for detensioning a guy line (100) according to claim 1, **characterised in that** between the portions of said formwork (130), in the lateral joining areas thereof, shims and/or sealing material or elements are located.

5. The system for detensioning a guy line (100) according to claim 1, **characterised in that** each clamp (145) is made up of two or more portions (150) which are secured around the guy line (100) with threaded bars, screws or other fastening elements (155).

6. The system for detensioning a guy line (100) according to claim 1, **characterised in that** each yoke-shaped structure (165) is made up of two or more portions which are joined and secured to the guy line (100) and to the post-tensioning bars or tendons (165) with threaded bars, screws or other fastening elements (170).

7. The system for detensioning a guy line (100) according to claim 1, **characterised in that** each tensioning

bridge (185) incorporates a retaining screw (or another mechanical locking system) arranged to retain the transferred load when it is actuated.

8. A method for detensioning a guy line (100) anchored and covered with a sheath (110) and cement grout or another type of protection, **characterised in that** it incorporates the following steps:

- a. removal of the sheath (110) covering the guy line (100), if it has one, in an area of the free length thereof,
- b. removal of the cement grout or another filler, if it has one, from the area wherein the sheath (110) has been removed until the strands or wires (120) of the guy line (100) are left clean,
- c. placing the portions of a formwork (130) around the clean strands or wires (120),
- d. injecting a filler material (125) into said formwork (130) which, once set, provides an area of improved strength and adhesion,
- e. placing two clamps (145), one at each end of the clean area of the guy line (100),
- f. placing two yoke-shaped structures (160), one on each side on the outside of each clamp (145) and around the guy line (100),
- g. joining both yoke-shaped structures (160) to each other by means of at least two post-tensioning bars or tendons (165),
- h. actuating hydraulic cylinders (180) arranged in the post-tensioning bars or tendons (165), on the outside of the yoke-shaped structures (160), in order to transfer the load from the guy line (100) to the post-tensioning bars or tendons (165), wherein the cylinders (180) are actuated until they reach the force of the guy line,
- i. retaining the load transferred to the post-tensioning bars and tendons (165) acting on a tensioning bridge (185) incorporated by each cylinder (180),
- j. cutting the tendons of the guy line (100).
- k. relaxing the hydraulic cylinders (180) in stages until the guy line (100) is completely detensioned.

9. The method for detensioning a guy line (100) according to claim 8, **characterised in that** in step d) said filler material (125) is high-strength resin with or without a load of aggregates.

10. The method for detensioning a guy line (100) according to claim 8, **characterised in that** in step c) the portions making up the formwork (130) have the shape of a tube with any cross section and are placed around the strands or wires (120) by means of flanges (135).

11. The method for detensioning a guy line (100) accord-

ing to claim 8, **characterised in that** in step d) said filler material is injected inside the formwork (130) by means of fittings (145) incorporated in the formwork (130).

12. The method for detensioning a guy line (100) according to claim 8, **characterised in that** in step e) each clamp (145) is made up of two or more portions (150) and they are secured around the guy line (100) with threaded bars or screws (155) which are tightened in a distributed manner.

13. The method for detensioning a guy line (100) according to claim 8, **characterised in that** each yoke-shaped structure (160) is made up of two or more portions which are joined and secured around the guy line (100) in step f) and to the post-tensioning cables or tendons (165) in step g) with screws or threaded bars (170).

14. The method for detensioning a guy line (100) according to claim 8, **characterised in that** in step i) the actuation on the tensioning bridge (185) incorporated by each hydraulic cylinder (180) is performed by actuating a retaining screw (or another mechanical locking device) incorporated by the tensioning bridge (185).

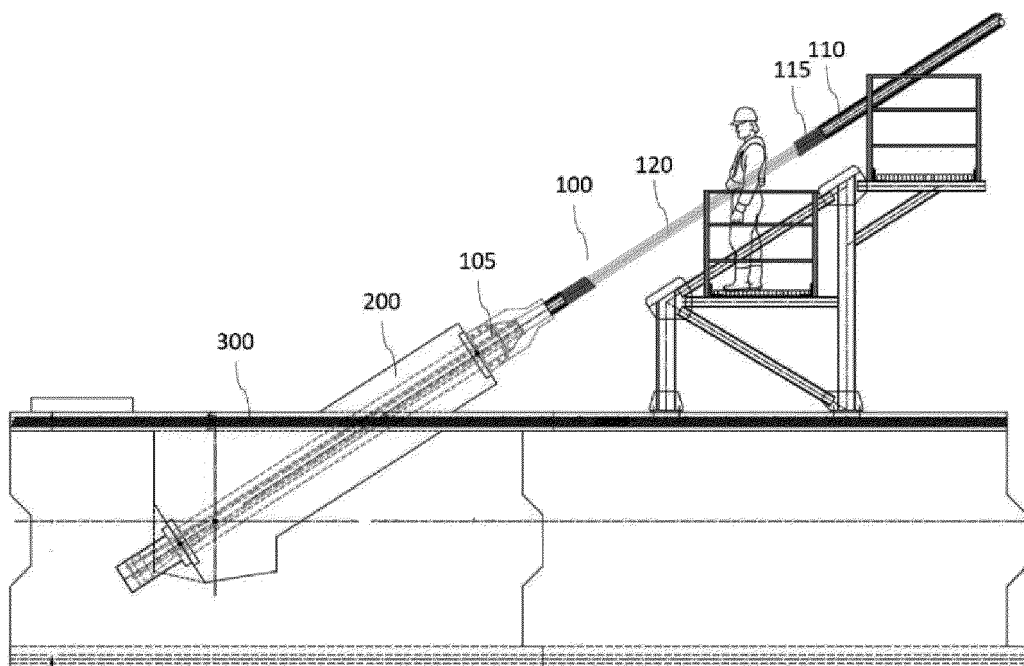


Figure 1

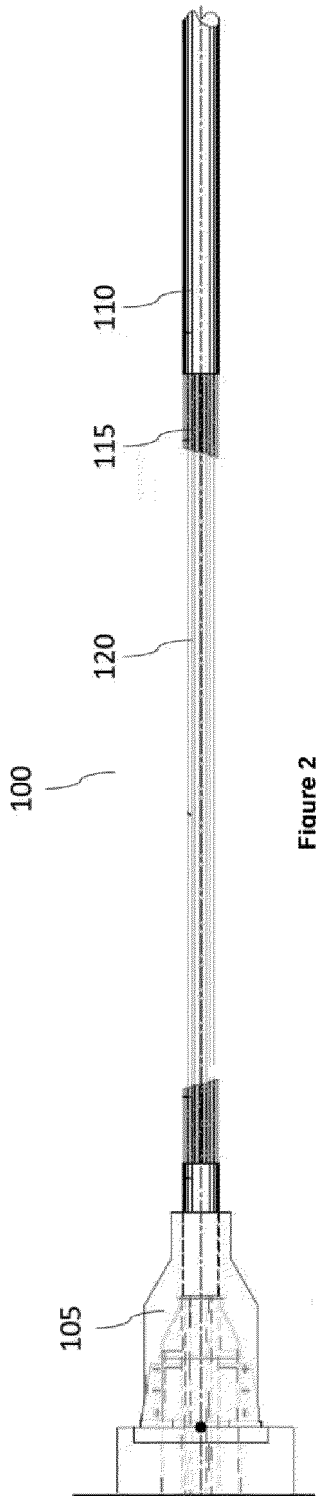


Figure 2

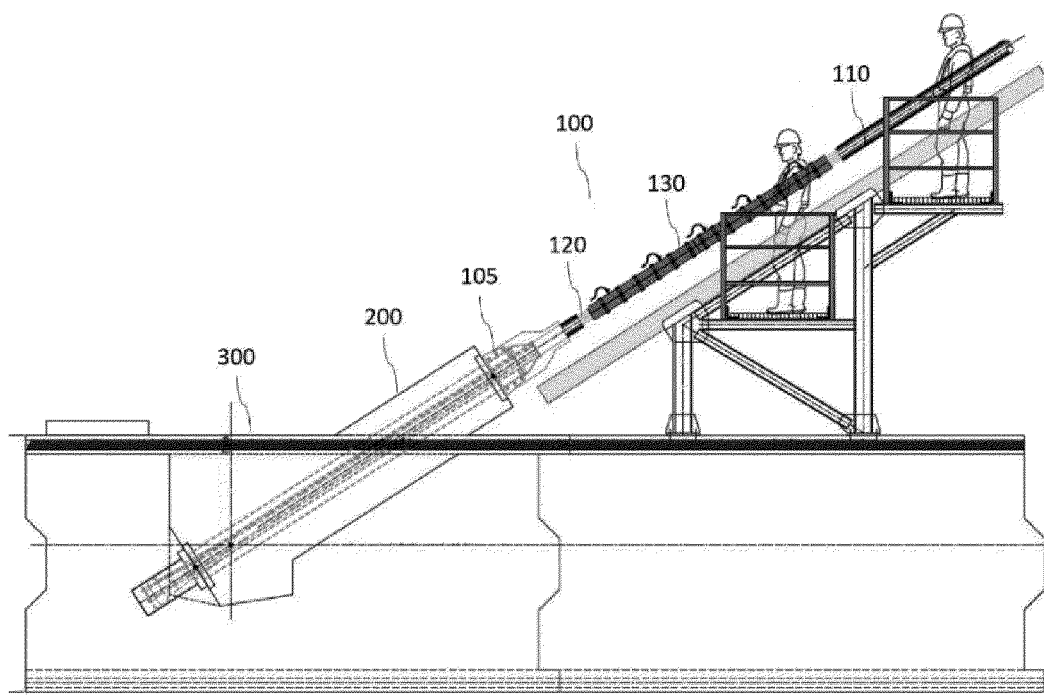


Figure 3

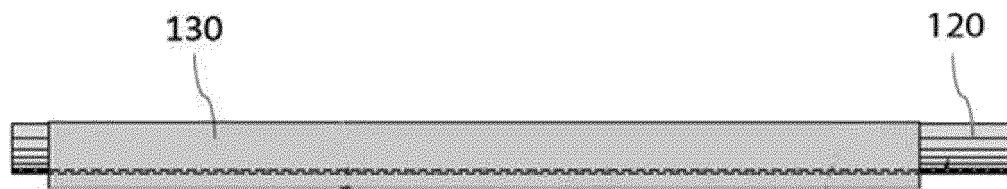


Figure 4A

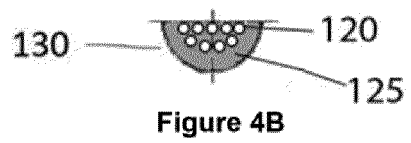


Figure 4B

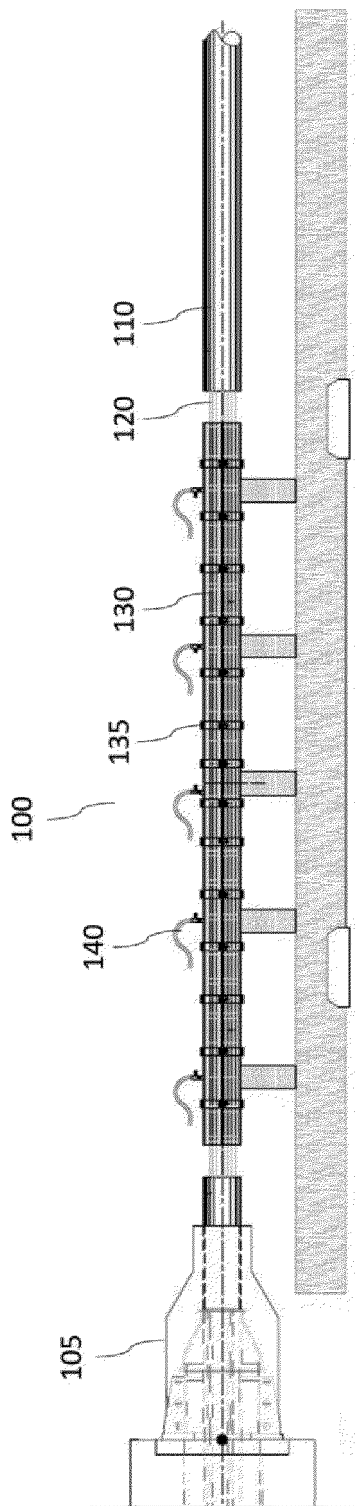


Figure 5

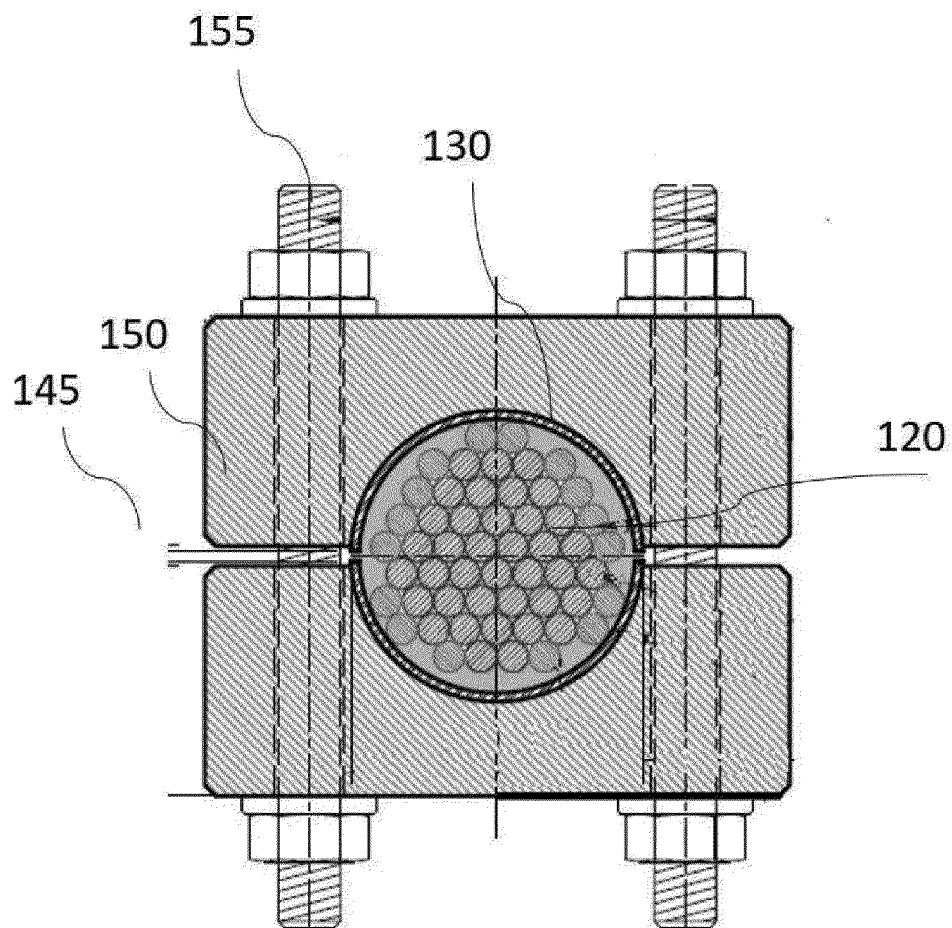


Figure 6

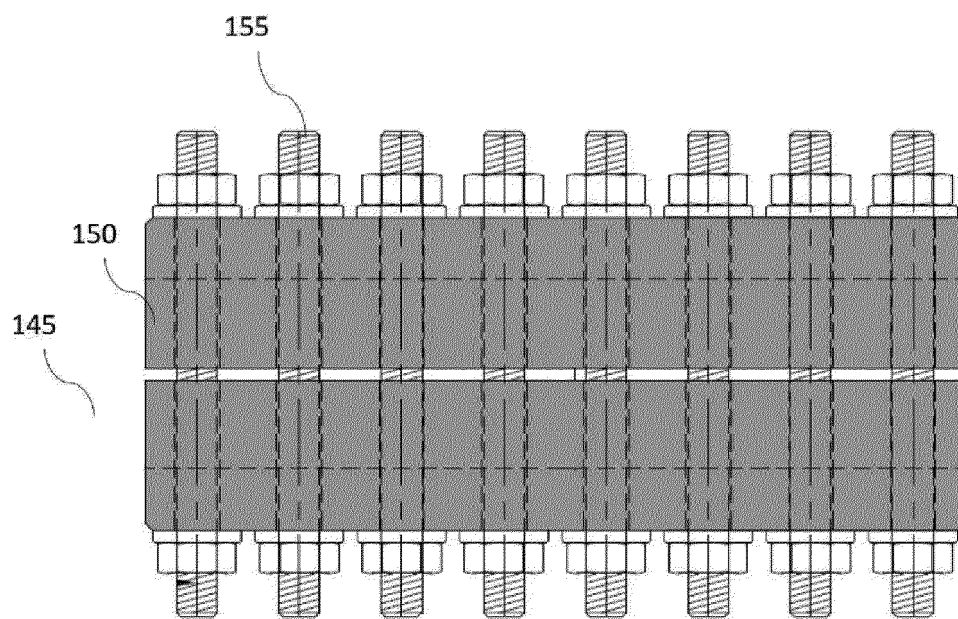
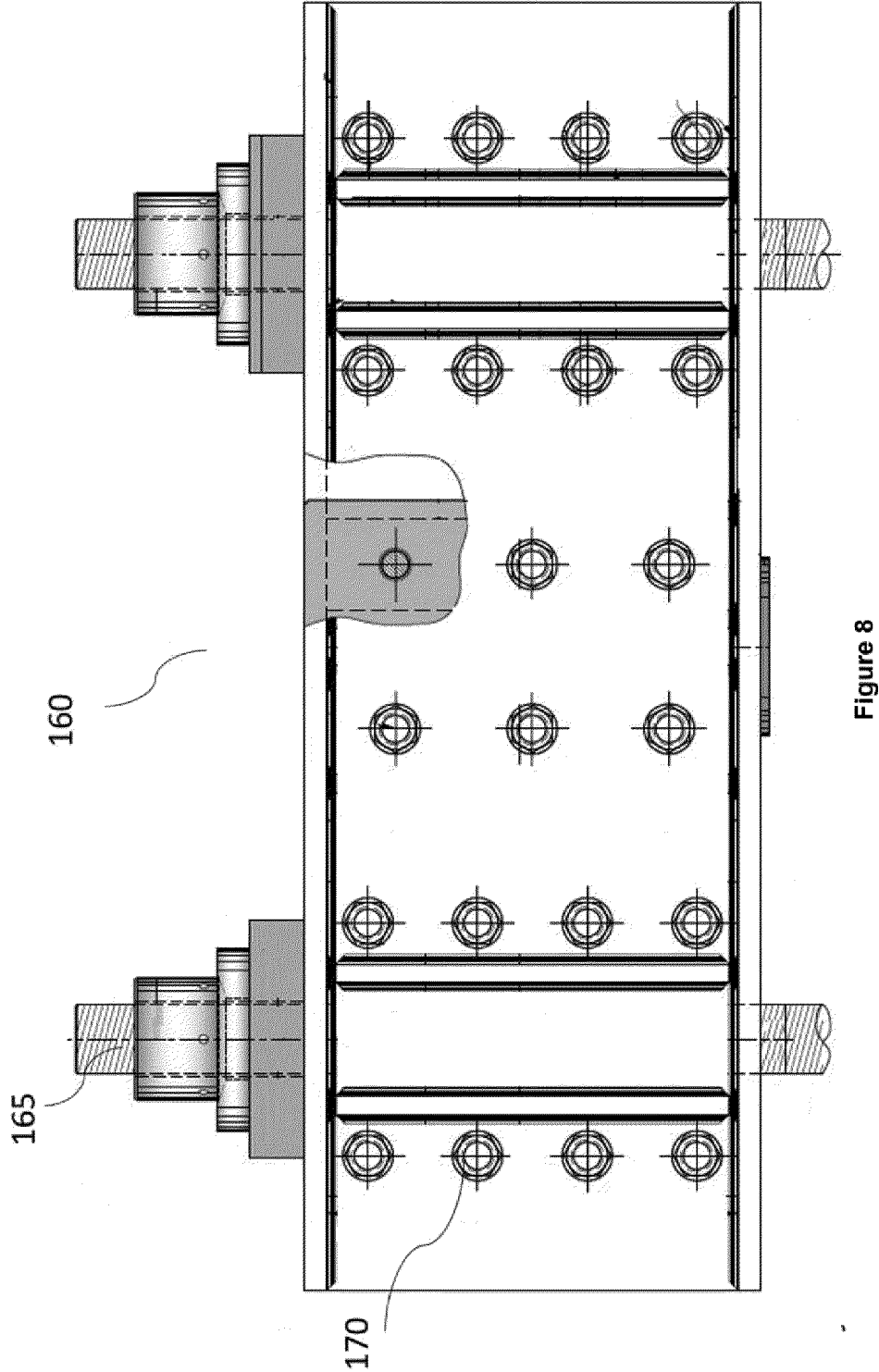


Figure 7



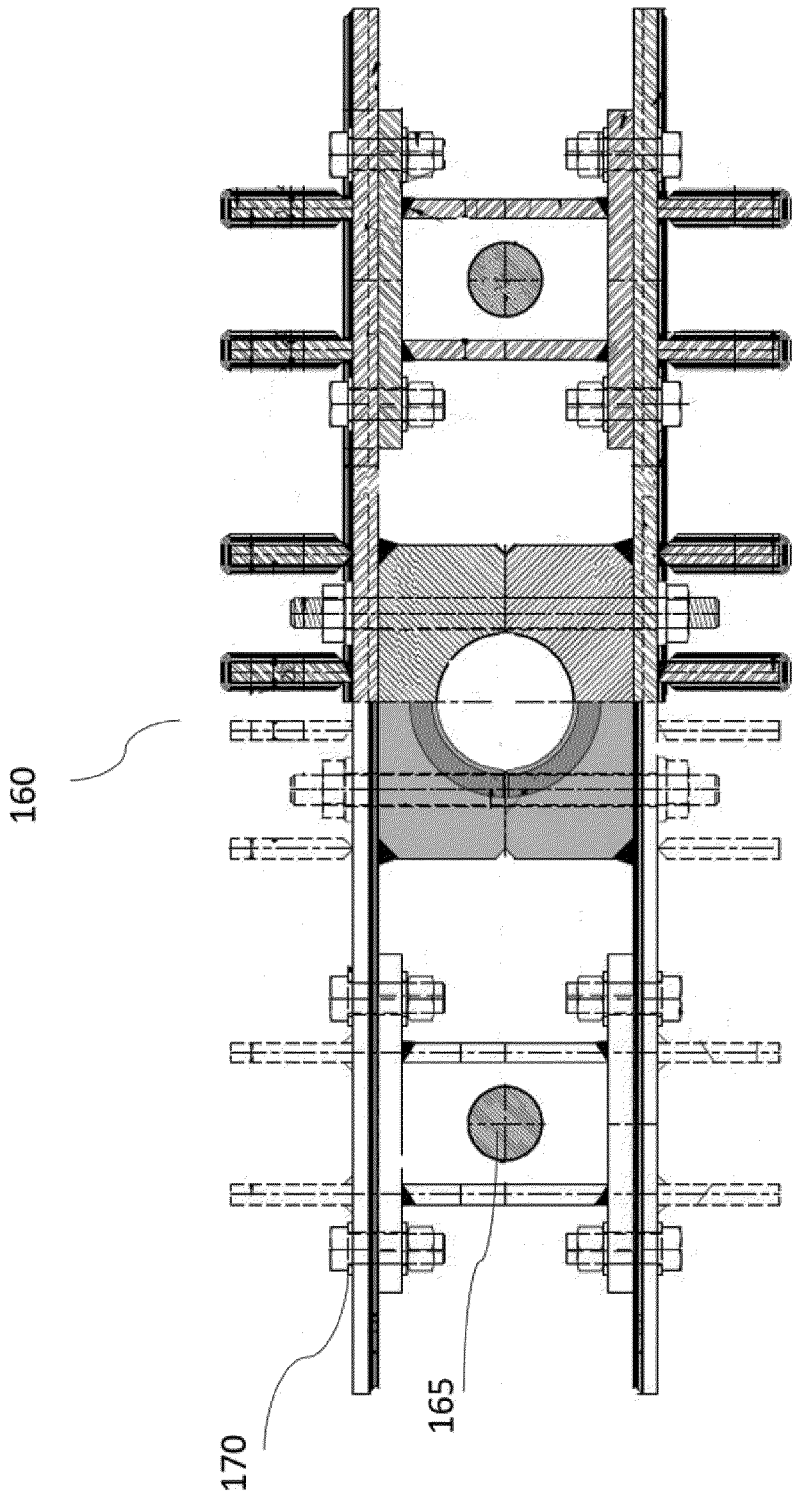


Figure 9

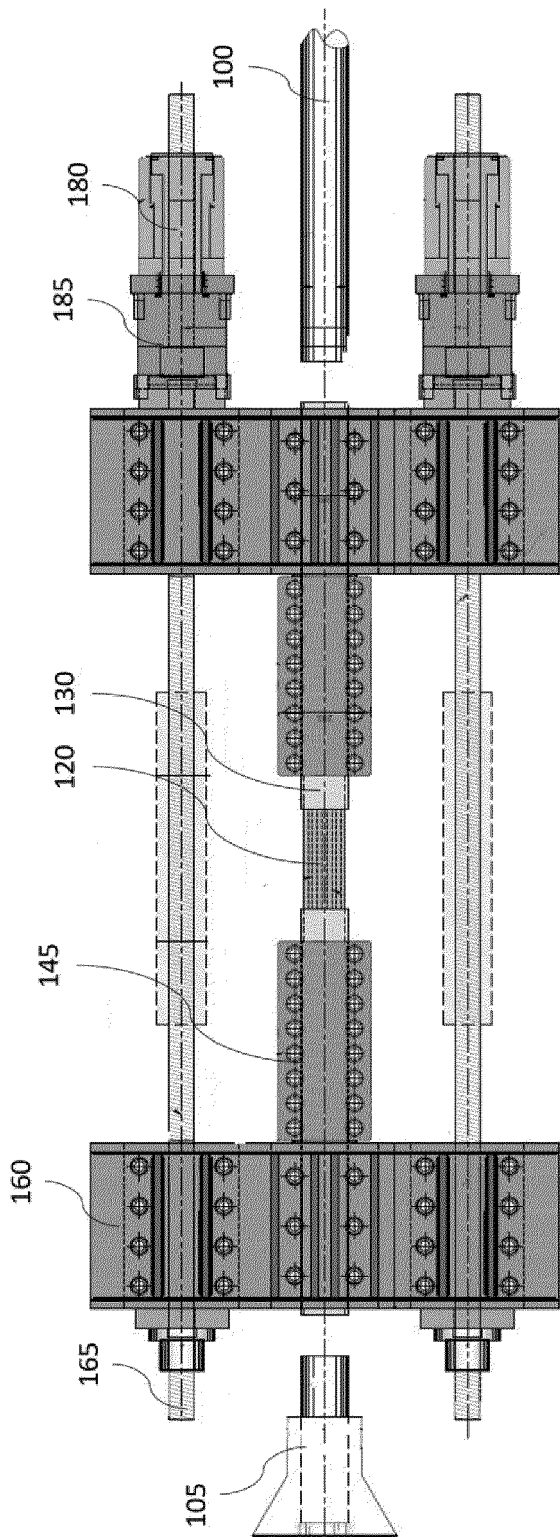


Figure 10

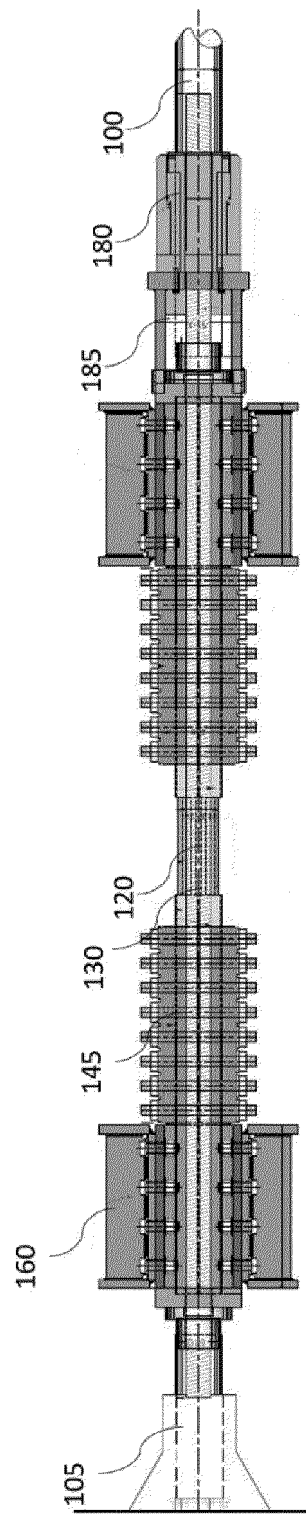


Figure 11

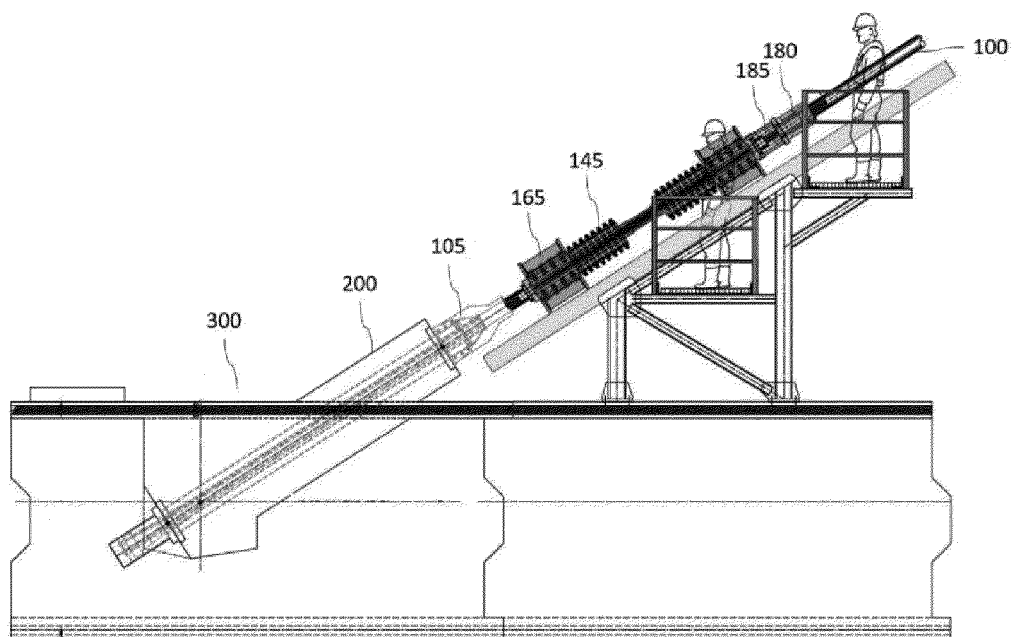


Figure 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/ES2019/070405

A. CLASSIFICATION OF SUBJECT MATTER INV. E01D22/00 ADD. E01D11/04		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) E01D		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EP0-Internal		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 1 887 139 A1 (FREYSSINET [FR]) 13 February 2008 (2008-02-13) figures 3-5	1-14
A	----- CN 106 192 763 A (JIANGSU FASTEN CABLE CO LTD) 7 December 2016 (2016-12-07) figures 3,4	1-14
A	----- FR 2 745 829 A1 (BAUDIN CHATEAUNEUF [FR]) 12 September 1997 (1997-09-12) figure 2	1-14
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search 9 September 2019		Date of mailing of the international search report 20/09/2019
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Saretta, Guido

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