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(71) Applicant *(for all designated States except US):* **TS R & D S.R.L.** [IT/IT]; Via Gualco 4/B, 1-16165 Genova GE (IT).

(72) Inventor; and
(75) Inventor/Applicant *(for US only):* **MATTEUCCI, Francesco** [IT/IT]; Via Piaggio, 48/7, 1-16 136 Genova GE (IT).

(74) Agent: **CACCIAMANI, Clizia;** c/o INNOVA & PART-NERS S.r.L, Via Cola di Rienzo 265, 1-00192 Roma (RM) (IT).

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[Continued on nextpage]

(54) Title: APPARATUS FOR CUTTING UNDERWATER STRUCTURES

(57) Abstract: Apparatus for cutting underwater structures, in particular for cutting underwater structures (20) lying on the seabed, comprising cutting means (4) movable along suitable guiding means (3, 203) which are in turn arranged on suitable support means (1); said support means (1) are provided, at one end, with drilling means (201) in such a way that said support means (1) can be thrust into holes (11) drilled in the seabed (10) by said drilling means (201) in the proximity of an underwater structure (20) lying thereon.

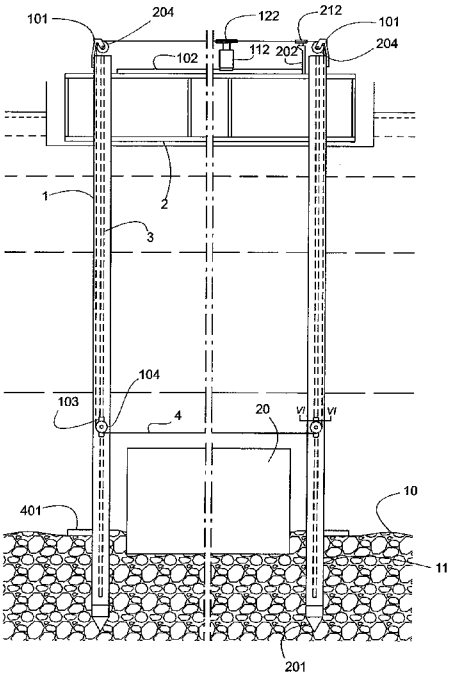


Fig. 1

WO 2013/080228 A1

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

APPARATUS FOR CUTTING UNDERWATER STRUCTURES

TEXT OF THE DESCRIPTION

The present invention relates to an apparatus for cutting underwater structures and, in particular, it relates to an apparatus for cutting underwater structures lying on the seabed.

Devices for cutting underwater structures which operate with fixed blades, such as the device described for example in the document US-A-3056267, or which are provided with several rotating blades with a coordinated action, such as the device described in the document US-A-4180047, are known. However, both devices have the drawback that they operate only on the emerging free end of the underwater structure.

In the document EP-B-0540834 there are described a method and an apparatus for cutting underwater structures which make use of a diamond cable as cutting means; with this apparatus, it is possible to cut the underwater structure at any height between the bottom end and the surface. On the other hand, the same apparatus as described in that document does not appear to be particularly suitable for machining operations which involve structures, such as wrecks or underwater construction debris, lying on the seabed.

A partial solution to this type of problem can be found in the document WO 2004/072529, which describes a method for removing underwater pipelines; however, it must be considered that not all underwater structures are able to adopt the approach used according to the cited document for positioning and guiding the cutting means. In particular, the already mentioned wrecks or debris do not often provide secure gripping points and, therefore, it is difficult to contemplate positioning the cutting apparatus directly on these underwater structures. On the other hand, positioning support platforms on the sides of the structure to be cut in order to suitably

support the cutting apparatus is highly more complex and hence correspondingly expensive.

Therefore, the object of the present invention is to provide an apparatus for cutting underwater structures, and in particular for cutting underwater structures lying on the seabed, which is able to suitably support the cutting means and which is in any case simple to be positioned and installed and which can be adapted to different types of seabed.

Accordingly, the object of the present invention is an apparatus for cutting underwater structures, in particular for cutting underwater structures lying on the seabed, comprising cutting means movable along suitable guiding means which are in turn arranged on suitable support means; said support means are provided, at one end, with drilling means in such a way that said support means can be thrust into the seabed in the proximity of an underwater structure lying thereon.

In a first embodiment, said support means comprise at least two uprights with a substantially tubular cross-section which are provided at one end with a connecting cross-piece, and each provided at the opposite end with drilling means. The guiding means comprise guides arranged inside each of the uprights.

In another embodiment, the cutting means comprise a cable, preferably a closed-loop diamond cutting cable, arranged on a plurality of pulleys and positioned in such a way to generate a cutting line on a plane substantially perpendicular to the plane of the seabed on which the structure to be cut lies.

Particularly, said cable is mounted on at least one pulley which is movable along each of said support means. Furthermore, said cable can be arranged on at least one pulley which is fixed with respect to each of said guiding means, there being provided means for adjusting the configuration of the closed loop of the cutting cable.

Other advantages and features will be apparent from the following

detailed description of an embodiment of the present invention, which is provided by way of illustration, and not by way of limitation, with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram showing an embodiment of the apparatus according to the present invention during a first operative step thereof;

Figure 2 is a view similar to Figure 1, with the apparatus according to the invention shown during a second operative step thereof;

Figures 3 and 4 are two top plan views of the apparatus according to the invention during two different operative steps;

Figure 5 is an enlarged detail of Figure 1;

Figure 6 is a cross-sectional detail along line VI-VI of Figure 1;

Figure 7 is another enlarged detail of Figure 1;

Figure 8 shows a view, with parts in cross-section, of a second embodiment of the present invention;

Figure 9 is a view, with parts in longitudinal section, of a second embodiment of the present invention.

Figure 1 shows the apparatus according to the present invention; reference numeral 1 denotes a support upright of the apparatus, consisting of a hollow tube inside which a guide 3 is arranged to movably support a slide 103. A pulley 104 for a diamond cutting cable 4 is positioned on the slide 103. The apparatus comprises two uprights 1 which are arranged parallel to each other and connected by means of a transverse connecting frame 2. An arm 101 having a pulley 204 connected thereto is provided on the end of each upright. The cable is also positioned both on a pulley 122 which is movable by driving means 112 along a guide 102 situated on the frame 2, and on a pulley 212 which is located on an arm 202 projecting from the frame 2. Both the pulley 122 and the pulley 212 are arranged on a plane which is perpendicular to the plane defined by said uprights.

The opposite end of each of said uprights 1 is provided with drilling

means 201 which have drilled axial holes 11 in the seabed 10, said axial holes 11 accommodating a significant portion of said uprights as shown in the figure. An underwater structure 20 to be cut can be seen between said uprights. Each upright 1 has a support foot 401 at least partially surrounding said upright 1 in the proximity of the end provided with the drilling means 201.

Figure 2 shows the same apparatus as in Figure 1; like parts are referred to by like reference numerals. In the figure it can be noted that the active portion of the diamond cable, namely that portion which is directed towards the structure 20 and situated between the two movable pulleys 104, has performed the cut through said structure 20.

Figure 3 shows a top plan view of the apparatus according to the invention; like parts are referred to by like reference numerals. The figure shows the transverse connecting frame 2 to which the uprights 1 are attached. The pulleys 204 are arranged at the inlet openings of the uprights 1 and, as can be seen from Figures 1 and 2, they are suitably supported. The frame 2 has arranged thereon a guiding means, specifically a rail 102, along which the driving means 112 for the pulley 122 allow the latter to be moved along the entire length of said rail in order to recover the cable 4. Said cable 4 is also wound around the transmission pulley 212 as already described above.

In Figure 4 it can be noted that the pulley 122 is located on the opposite side of the rail 102, and that the plane of rotation of the pulley 204 located at the inlet opening of the upright 1 towards which said pulley 122 has moved has changed considerably.

Figure 5 shows a detail of the apparatus according to the present invention; the pulley 204 arranged at the inlet opening of the upright 1 is connected to the upright 1 through the projecting arm 101 which at one end is connected to said upright 1, while at the opposite end it has a hinged joint 111 which is coupled, by means of an axial pin 141, to a bush 131 of a bracket 121 on which the pulley 204 is mounted in a rotatably idle manner.

Accordingly, the pulley 204 can pivot with respect to the through-axis of the pin 141 .

Figure 6 shows a cross-sectional detail along the line VI-VI of Figure 1. The guiding means are located inside the tubular body of the upright 1 and include a girder 3 having an H-shaped cross-section attached to a second girder 203 with an H-shaped cross-section, said girders being oriented at 90° with respect to each other. The slide 103 on which the pulley 104 is mounted in a rotatably idle manner comprises two side flanges 113 each of which accommodates two rollers 123 cooperating with the ends of the side walls 213 of the girder 203; instead, rollers 133 cooperate with the inner part of the side walls 213 of said girder. The slide 103 moves along the girder 203 due to the female threaded bush 143 which is fixed to said slide and engaged with the worm screw 403 provided with suitable driving means (not shown in the figure). The diamond cable 4 passes through the upright 1 in the region of the slit 301 .

Figure 7 shows another detail of Figure 1; like parts are referred to by like reference numerals; this figure shows the slide 103 which carries the pulley 104 rotating idle on the hub 114, on which pulley the cable 4 is driven. The slide has the flanges 113 which carry the rollers 123 cooperating with the ends of the side walls 213 of the girder 203. Instead, the slide supports the rollers 133 which cooperate with the inner portion of the side walls 213 of the girder 203; the figure also shows the worm screw 403.

Figure 8 shows a second embodiment of the invention, with parts in cross-section. In this case, the pulley 404 is movable along the upright 1 since it is located on the edge of the carriage 5 travelling along the inner wall 501 of the upright 1, by means of the wheels 105 which are directed with their respective axes 115 so that said wheels are all in contact with the inner wall 501 of said upright 1. The pulley 404 is mounted on an arm which is pivotally connected with respect to a 605 projecting from said carriage 5 and with a pivoting axis parallel to the longitudinal axis of said upright 1.

The carriage 5 moves inside the upright 1 without rotating along it due to the presence of the cursor 215 which projects from the radial arm 205 fixed to the carriage 5 and engages inside the slit 301, i.e. the same slit which allows passage of the cutting cable. The carriage moves along the upright due to a chain 405 which slides inside a duct 505 formed longitudinally with respect to said carriage 5 and which is connected to the flange 305 projecting axially from the above-mentioned carriage. The chain is connected to suitable driving means - not shown in the figures - which are arranged in the transverse frame *2:*

Furthermore, inside the upright there are ducts 541 which are structurally coupled to said upright 1 through suitable means not shown in the figure; said ducts 541 can power and control the drilling means 201 by connecting them to the transverse frame 2. Moreover, a duct 551 is provided to form a water suction line which is also operated by suitable means not shown in the figure and positioned, for example, on either the frame 2 or auxiliary means, and which allows removal of the debris generated by the drilling means 201 and, more generally, all the debris which may be located inside said upright 1.

The aforementioned upright 1 has the T-shaped longitudinal members projecting from its outer side wall and provided with the wheel-type guiding means 421 and 431, along which the C-shaped bushes 411 to the foot 401 are mounted slidably. The bushes are each provided with the locking screw 441 having operating means 451.

Figure 9 shows a portion of the upright 1 with parts in longitudinal section relating to the embodiment shown in Figure 8; like parts are referred to by like reference numerals. In the figure it can also be seen how the wheels 105 make use of the inner side wall 501 of the upright 1 as a guiding means, along with an interaction between the cursor 215 and the slit 301. Moreover, it is also clear how the chain 405 is fastened to the two ends of the carriage 5 via the flanges 305 axially projecting from it, and how the return

section of said chain travels inside the duct 505 arranged longitudinally on said carriage 5. The chain driving means - not shown in the figures - will be preferably also located on the transverse frame, and the chain itself will be provided with transmission means arranged near the drilling means 201.

The operating principle of the apparatus according to the present invention will become clear from the description below. In order to cut the underwater structure 20, the apparatus according to the invention must be conveniently positioned, with the uprights 1 arranged along the sides of the structure itself. At this point, the drilling means 201 are activated so as to drill the holes 11 in the seabed 10, allowing the uprights 1 to thrust into the seabed. A foot 401 is located along the sides of each upright and, as can be seen from Figure 8, it is movable along the upright on suitable guiding means and may be fixed relative thereto. The feet 401 allow the apparatus according to the present invention to be positioned fixedly with respect to the structure 20, therefore facilitating the cutting operation performed by the diamond cable 4. The apparatus can be adapted for carrying out the cut of the underwater structure by inserting the two upright simultaneously or consecutively and then connecting the frame 2 thereto.

Then, the diamond cable is activated and the means for driving the pulley 122 displace it along the guide 102 of the frame 2 so that the cable length between the pulley 122 and the pulleys 204 has the minimum length, as shown in Figure 4 of the accompanying drawings. The device located on the transverse frame 2 may comprise several movable pulleys, depending on the total length of the cable loop 4 required to cut the underwater structure 20. The movements of the pulleys are synchronous to those of the pulley 122 in order to assure that the cable is always stretched throughout the operation.

Furthermore, the pulley 122, as well as the possible pack of pulleys serving the same purpose, and the transmission pulley 212 can be arranged on planes which are parallel to the plane defined by said uprights.

At the same time, the appropriate driving means will cause the

movable pulleys 104 or 404 to move down along the uprights 1 so as to enable the cable 4 to cut the underwater structure 20.

In the embodiment shown in Figures 6 and 7, the means for driving the slides 103, namely the worm screw 403, will move said slides, and therefore the pulleys 104, towards the seabed and therefore towards the structure to be cut, so as to cause the active portion of the cable 4 to interfere with the structure 20. The worm screws and the drilling means are provided with suitable driving means which may comprise both hydraulic motors and electric motors. As shown in Figure 2, once the cable has reached the end of its cutting path, the active portion may be retracted by repositioning the pulley 122 with a displacement in the direction opposite to the direction of the displacement performed previously and driving the worm screws 403 in the opposite direction of rotation, therefore causing the slides to move back up along the guides 3.

In the embodiment shown in Figures 8 and 9, the carriages 5 have the advantage, compared to the slides 103, of being guided directly by the internal wall 501 of the upright 1. In fact, the insertion of the cursor 215 inside the slit 301 eliminates the possibility of said carriages being able to rotate about their longitudinal axis inside the upright 1. Moreover, the means for driving said carriages 5, namely the chain 405, has a greater operational flexibility and simplicity compared to the worm screw engaged with the female thread. In this embodiment, the pulley 404 which carries the cutting cable 4 is pivotally mounted with respect to the carriage 5, so that it can be adapted more easily to both the cutting operations and the displacement operations along the upright 1.

Due to the displacement of only the active portion of the cable loop, it is not required to move the driving means which rotate the cable loop along the apparatus, with a significant saving both from the point of view of management of the spaces inside the upright and the volume occupied by cables which would have to be moved along the apparatus.

Thereafter, the apparatus will be repositioned above the structure 20 by extracting the ends which carry the drilling means from the holes 11 drilled in the seabed and drilling new holes at a position suitable for the next cut.

As can be noted again from Figure 4, the pulley 204 located at the inlet opening of the upright 1 close to the pulley 212 is on a plane which is inclined with respect to that of the pulleys 104. For this purpose, the bracket 121 on which the pulley 204 idly rotates is pivotally mounted with respect to the arm 101 of the upright 1 in the manner shown in Figure 5.

The cable may be driven along the pulley 122, namely the same pulley which moves along the rail 102, in order to adjust the configuration of the loop of the diamond cable 4. The potential advantage which can be obtained is essentially linked to the greater cable portion in contact with this pulley due to its position within the loop of the cable 4. This driving action can also be implemented using both hydraulic motors and electric motors.

The apparatus designed in this manner may be positioned close to the structure to be removed in an extremely simple and safe manner, since the penetration of the ends of the uprights 1 carrying the drilling means 201 should be able to ensure a sufficient stability of the apparatus during the cutting operations. The depth of the holes varies depending on the consistency of the seabed, the length of the uprights and the size of the cut to be performed by the apparatus, namely the overall height of the structure to be cut and therefore the duration of the cutting operation. However, a depth of penetration into the seabed equal to about 5-15% of the total length of the uprights, and preferably equal to about 10%, may be considered suitable. The use of the feet 401 ensures that the cutting apparatus is much more stable without unduly complicating the overall construction of said apparatus.

Furthermore, advantageously, there can be provided floating members, such as tanks connected to the uprights, in order to enhance the vertical arrangement and the stability of the uprights.

In general, the use of the diamond cable as a cutting instrument for underwater structures has proved to be effective and reliable over the years; nevertheless, this apparatus may be designed with different cutting means without departing from the scope of protection of the present invention.

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CLAIMS

1. Apparatus for cutting underwater structures, in particular for cutting underwater structures (20) lying on the seabed, comprising cutting means (4) movable along suitable guiding means (3, 203; 501) which are in turn attached to suitable support means (1), characterized in that said support means (1) are provided, at one end, with drilling means (201) in such a way that said support means (1) can be thrust into holes (11) drilled in the seabed (10) by said drilling means (201) in the proximity of an underwater structure (20) lying on the seabed (10).

2. Apparatus according to Claim 1, wherein the cutting means comprise a closed-loop diamond cutting cable (4) arranged on a plurality of pulleys (104, 204; 404, 204) and positioned in such a way to generate a cutting line on a plane substantially perpendicular to the plane of the seabed (10) on which the structure (20) to be cut lies.

3. Apparatus according to any one of the preceding Claims 1 or 2, wherein said support means comprise at least two uprights (1) with a substantially tubular cross-section which are provided at one end with a transverse connecting frame (2), and each provided at the opposite end with drilling means (201).

4. Apparatus according to Claim 3, wherein said cutting cable (4) is mounted at least on a pulley (104; 404) movable along each of the guiding means (3; 203; 501) attached to said support means (1).

5. Apparatus according to any one of the preceding Claims 3 or 4, wherein said uprights (1) are provided with a longitudinal slit (301) formed in said uprights (1), said slits facing each other.

6. Apparatus according to Claim 5, wherein the guiding means comprise guides (3, 203) arranged inside each of the uprights (1).

7. Apparatus according to Claim 5, wherein said guiding means comprise the inner side wall (501) of said uprights (1).

8. Apparatus according to Claim 6, wherein said movable pulley (104) is freely rotatably mounted on a slide means (103) sliding along said guiding means (203) and provided with movement means (143, 403).

9. Apparatus according to Claim 8, wherein said movement means comprise a female-threaded bush (143) integral to said slide (103) and a worm screw (403) provided with driving means.

10. Apparatus according to Claim 7, wherein said movable pulley (404) is freely rotatably mounted on a carriage (5) which is fitted inside said upright (1) and which uses the inner wall (501) of said upright as a guiding means.

11. Apparatus according to any one of Claims 2 to 10, wherein said cable (4) is arranged on at least one pulley (204) fixedly connected to each of said support means (1) in the proximity of the end of said support means which is provided with drilling means (201), there being provided means (102, 112, 122, 212) for adjusting the configuration of the closed loop of the cutting cable (4).

12. Apparatus according to Claim 11, wherein said configuration adjusting means comprise at least one transmission pulley (212) and at least one movable pulley (122) which can be moved by suitable driving means (112) on guiding means (102) arranged perpendicularly to said support means (1) and positioned between said pulleys (204) which are fixedly connected to said support means (1), said transmission pulley (212) and said movable pulley (122) being in contact with said cable (4).

13. Apparatus according to Claim 12, wherein said movable pulley is further provided with means for rotationally driving the closed loop of the diamond cable (4).

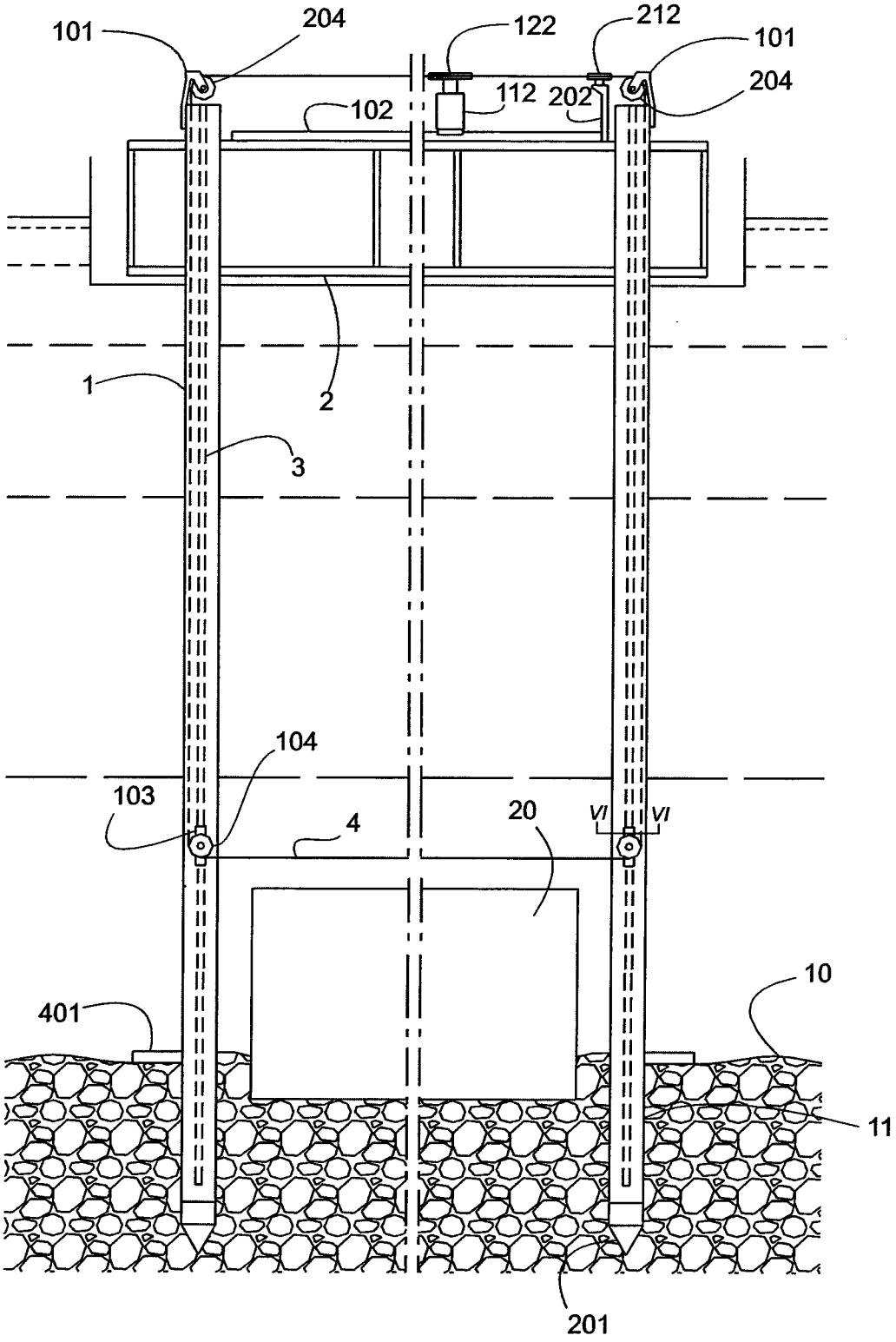

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Fig. 1

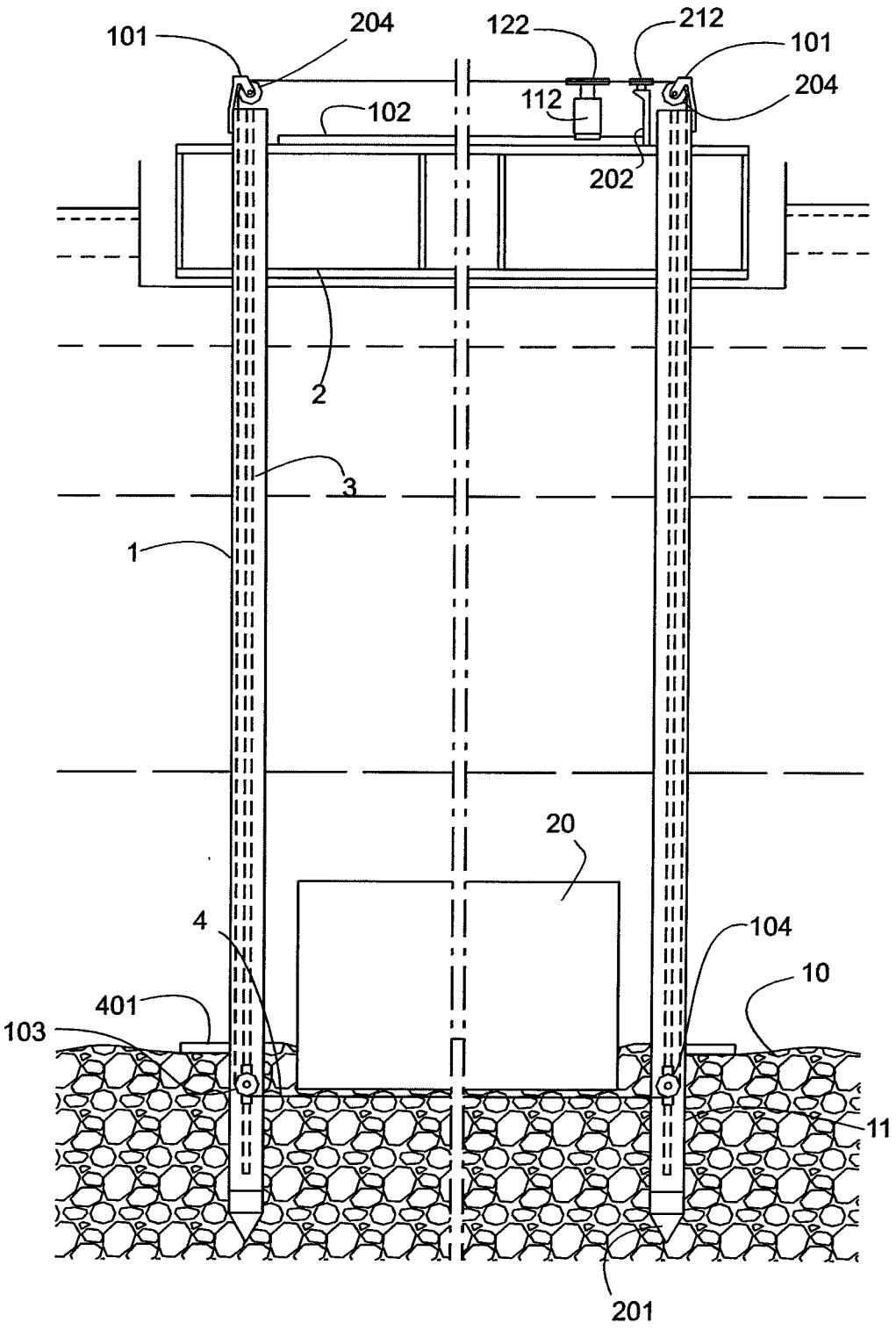


Fig. 2

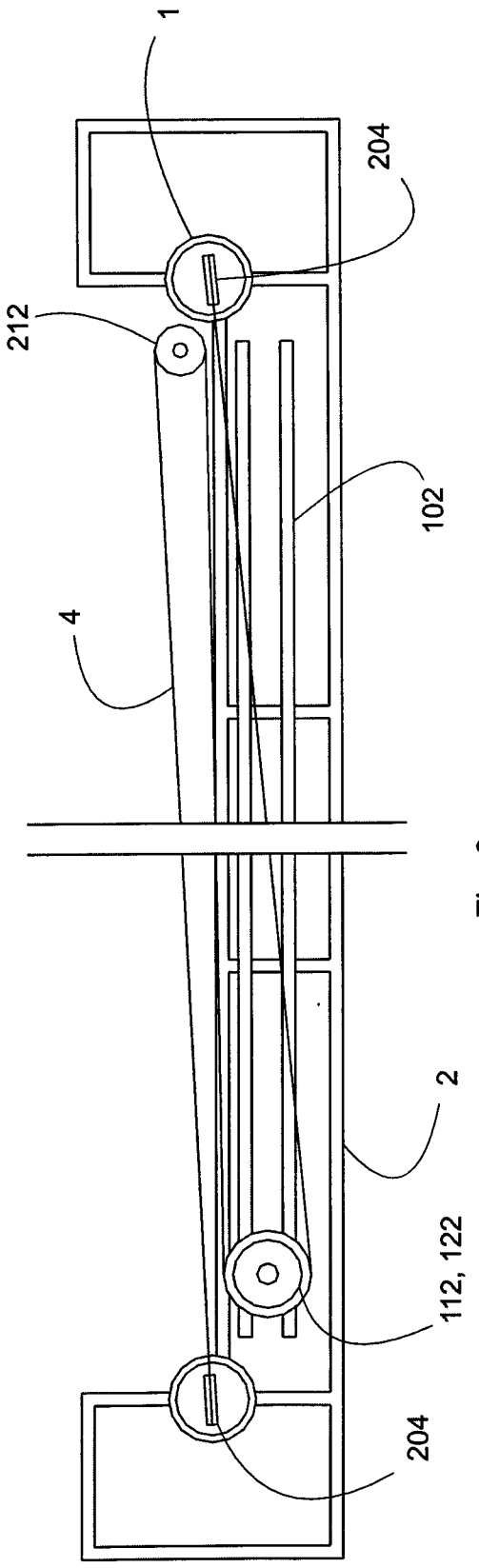


Fig. 3

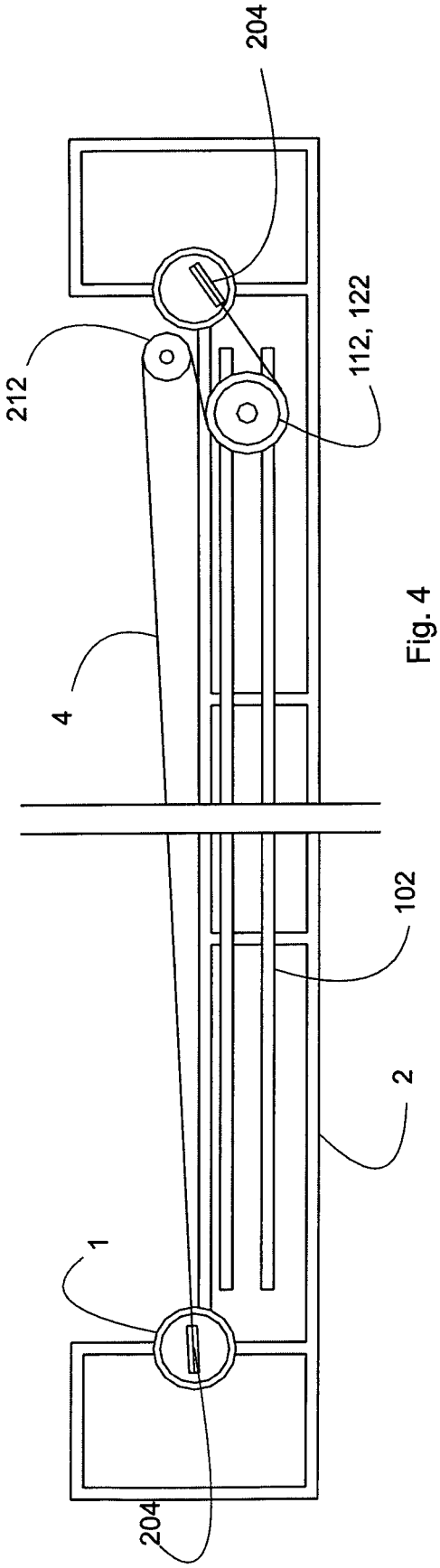


Fig. 4

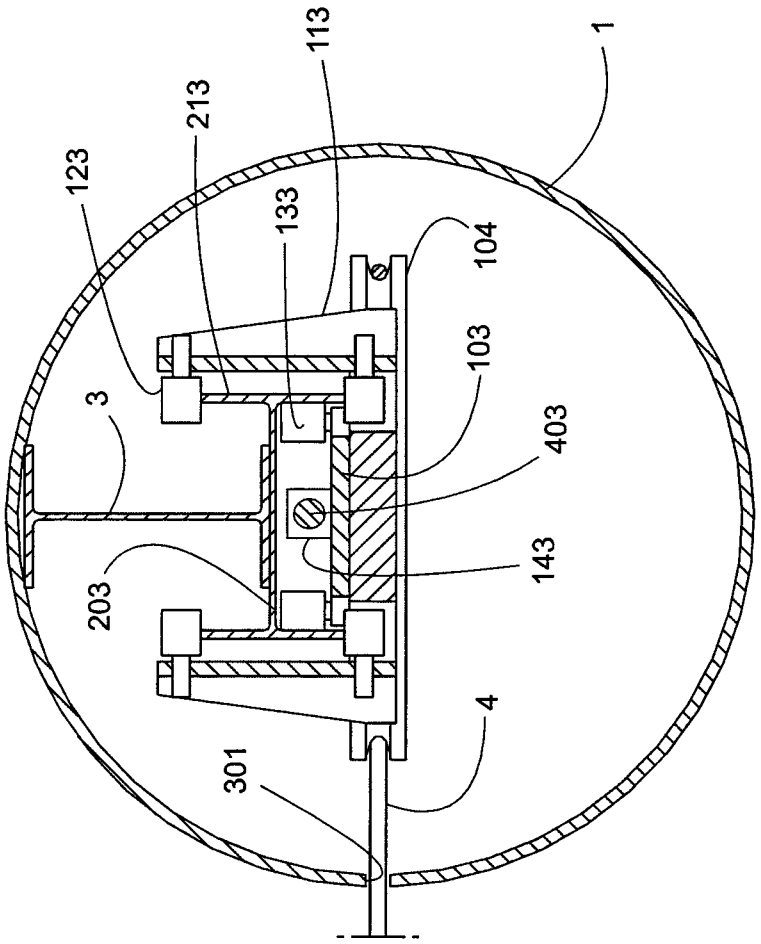

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Fig. 6

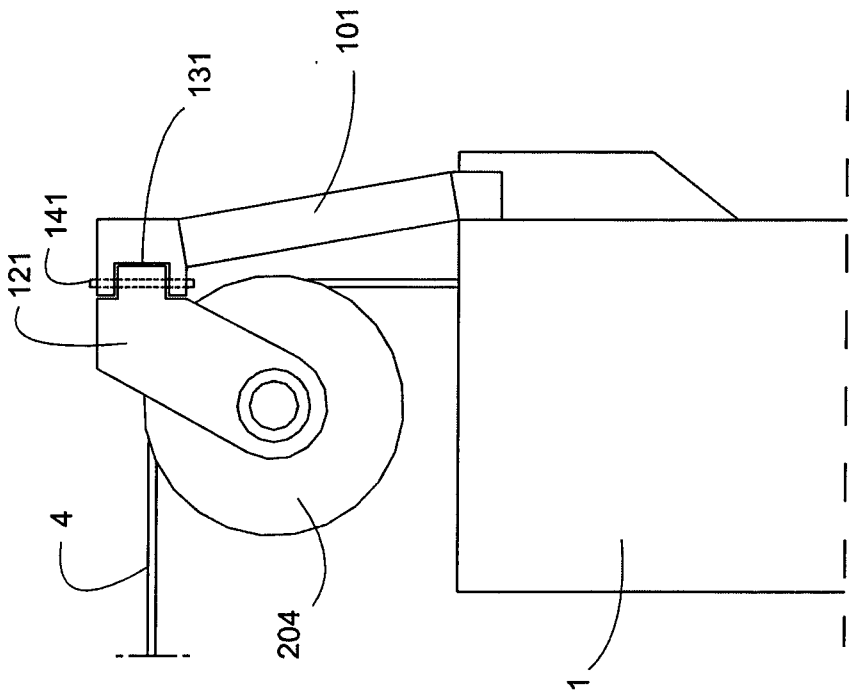

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Fig. 5

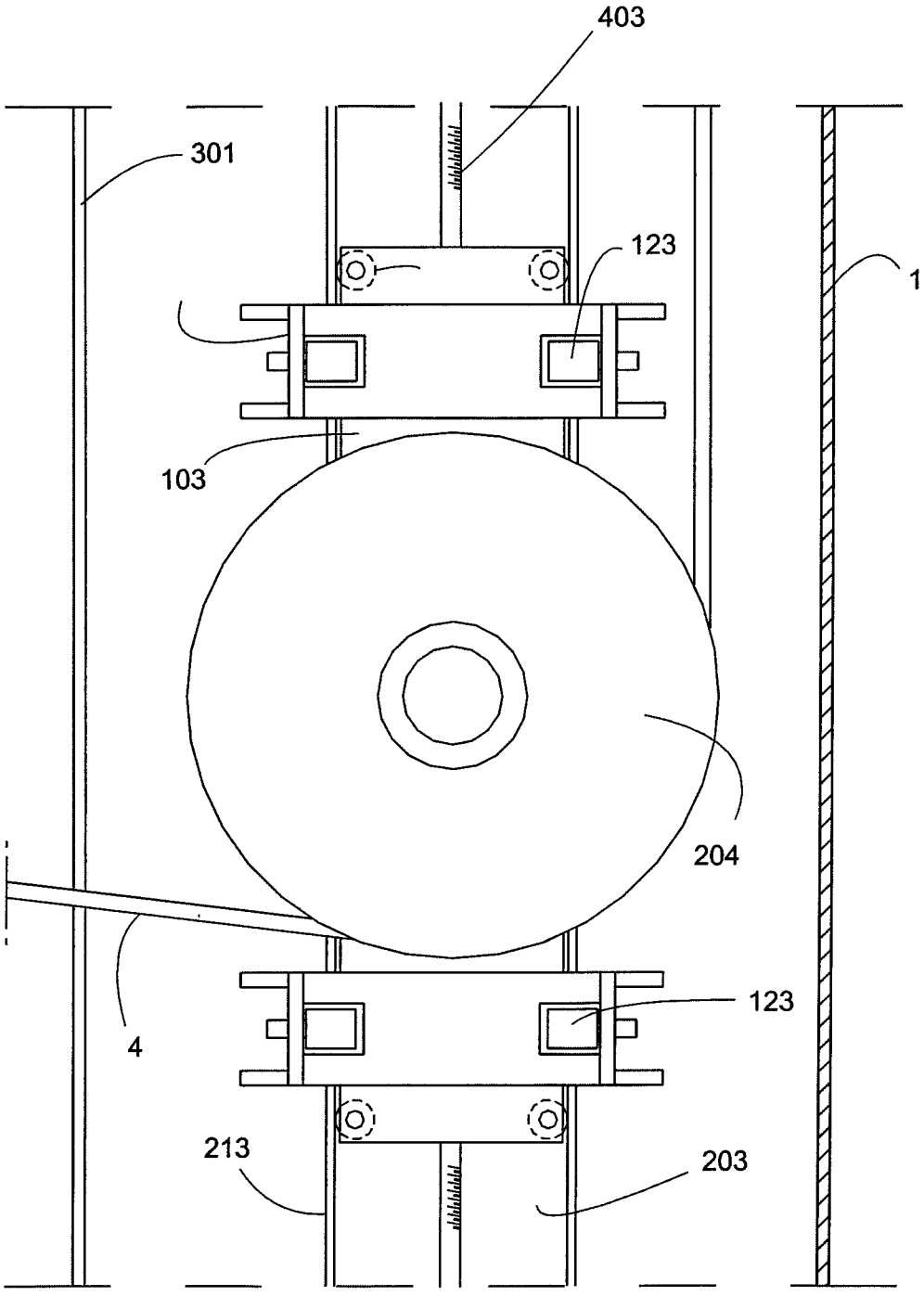


Fig. 7

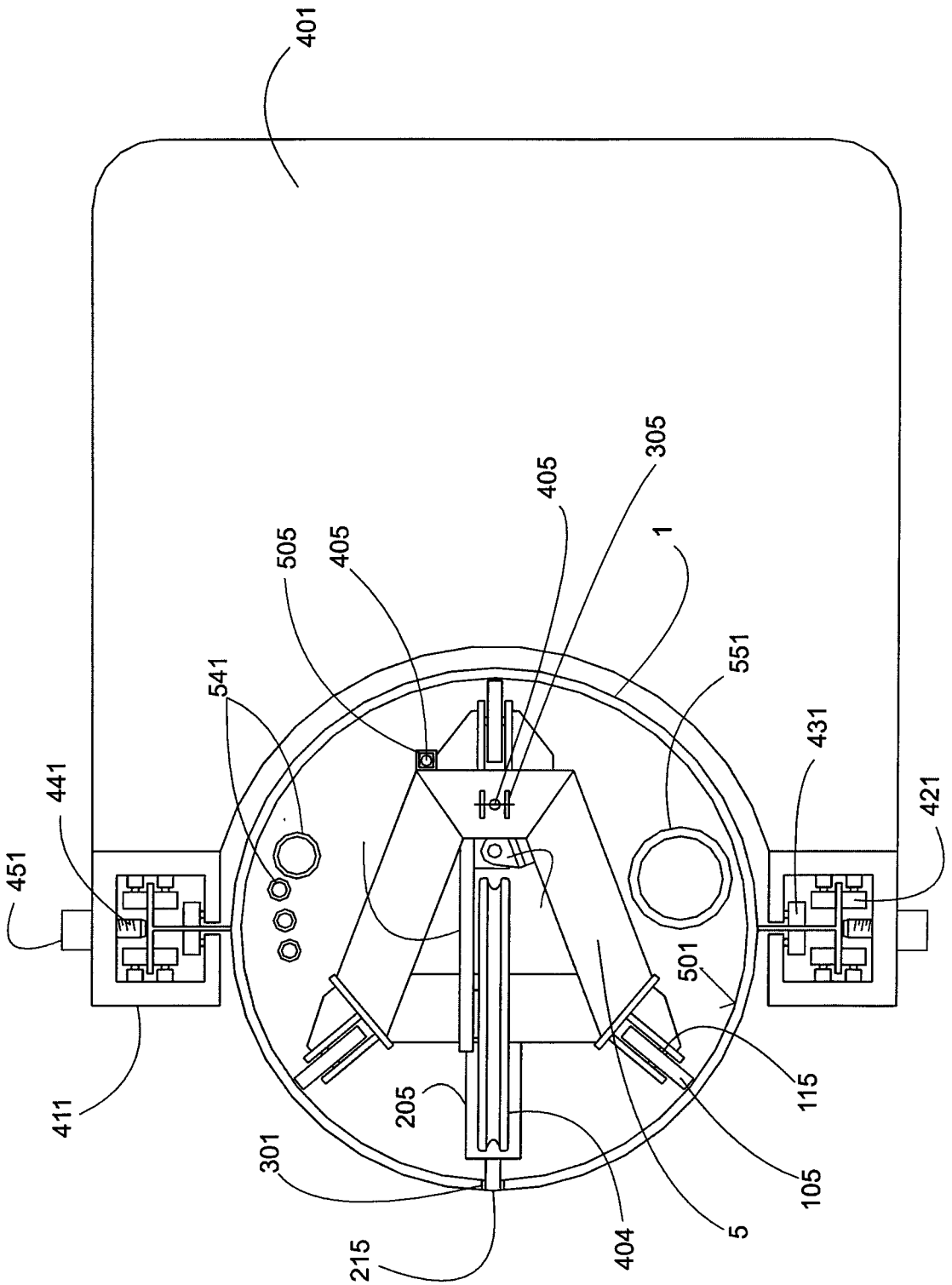

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Fig. 8

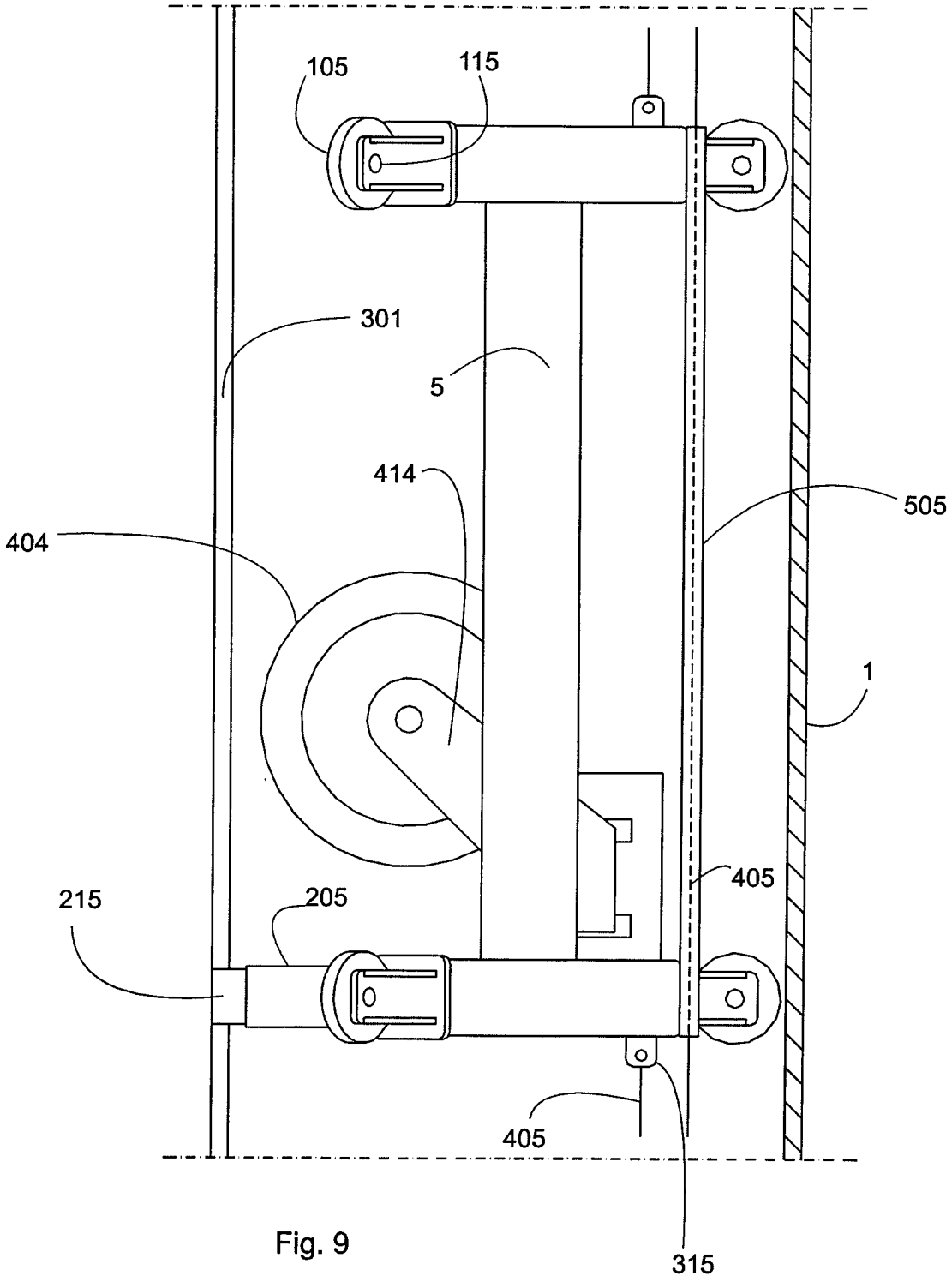


Fig. 9

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2011/000388

A. CLASSIFICATION OF SUBJECT MATTER
INV. B23D57/00
ADD.

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)
B23D

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)
EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02/075059 A1 (TS TECNOSPAMEC S R L [IT] ; MATTEUCCI FRANCESCO [IT]) 26 September 2002 (2002-09-26)	1,3-8, 10
A	page 4, line 3 - page 7, line 30 figures 2-6	2,9,11
X	US 2009/266552 A1 (BARRA MARC T [US] ET AL) 29 October 2009 (2009-10-29)	1-4
A	paragraphs [0015] - [0038] figures	5,11-13
X	WO 2006/126884 A1 (NORSE CUTTING & ABANDONMENT AS [NO] ; BANG KNUT [NO]) 30 November 2006 (2006-11-30)	1,2
A	page 5, line 15 - page 6, line 3 figures 1,4,5	3,11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
25 July 2012	01/08/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Charlot, David

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IT2011/000388

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 02075059 A1	26-09-2002	BR 0208194 A	23-03-2004
		CN 1531616 A	22-09-2004
		DE 60208353 T2	03-08-2006
		DK 1373645 T3	22-05-2006
		EP 1373645 A1	02-01-2004
		IT GE20010026 A1	20-09-2002
		NO 20034218 A	22-09-2003
		UA 79928 C2	10-08-2007
		US 2004069103 A1	15-04-2004
		WO 02075059 A1	26-09-2002
US 2009266552 A1	29-10-2009	NONE	
WO 2006126884 A1	30-11-2006	GB 2438349 A	21-11-2007
		US 2008304915 A1	11-12-2008
		WO 2006126884 A1	30-11-2006