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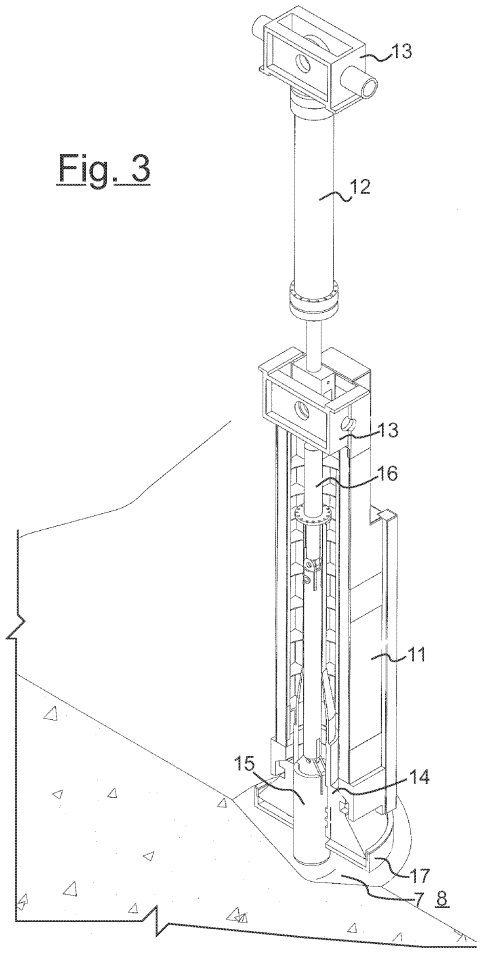
(54) **DEVICE FOR SITTING ON THE SEABED FOR SELF-RAISING SEA VESSELS**

(57) A sea vessel for laying bulkheads gates in a seabed has a pontoon (2); and a number of legs (4) movable in ascending/descending direction with respect to the pontoon (2), wherein each leg id provided with a support foot comprising a semi-spherical joint connected to the telescopic means; and a centering pin connected elastically to the support foot and configured for centering a recess in the seabed.

Fig. 3



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Description

[0001] The present invention relates to a sea vessel for laying bulkheads gates in a seabed.

[0002] More specifically, the present invention relates to a sea vessel for laying bulkheads gates in a seabed and configured for resting stably on a base plate positioned on a bed, preferably a seabed, under safety conditions.

[0003] As is known, the necessity of transporting and moving loads by lifting is extremely frequent in the maritime field, within a wide variety of application areas relating to the energy industry and civil, maritime and port constructions.

[0004] Various solutions are currently available for covering the different operative demands, in relation to the dimensions and weight of the end-products to be moved, the installation requirements and environmental reference scenarios.

[0005] A solution currently adopted for lifting, transporting and installing voluminous and heavy offshore end-products consists of a self-propelled pontoon on which moving means are positioned (lifting/lowering) of the end-product. These means are preferably positioned symmetrically on the emerging surface of the hull of the pontoon. The latter also comprises a series of constraining means to the seabed consisting of a plurality of moveable legs in a vertical direction, peripherically arranged, which are lowered and rest against the seabed to stabilize the pontoon and lift it above sea level in order to actuate the positioning phases of the end-product transported, without being substantially influenced by weather-sea conditions.

[0006] An example of a self-propelled pontoon suitable for moving large-dimensional steel bulkhead is that which will be used for the MOSE project which has been proposed for regulating the tide flows in the lagoon of the city of Venice. This is a modular C-shaped pontoon whose side concavity allows the bulkhead - removed from onshore shipyards and brought in correspondence with the inlet mouths of the lagoon (Malamocco, Chioggia, Lido San Nicolò and Lido-Treporti) where they will be installed to form four barriers, hinged on base plates, each of which consisting of about 20 bulkhead - to be lifted, housed for transportation and lowered.

[0007] The pontoon has at least four retractable legs, symmetric with respect to the hull, which are lowered until they rest on the bottom of the lagoon to allow the hull to be raised above sea level at the moment in which the bulkhead must be lowered into the water and installed.

[0008] More specifically, when the pontoon, which is transporting the bulkhead, arrives in position, it lowers the four legs to rest on a concrete base already situated on the bed of the lagoon, lifts the hull and then lowers the bulkhead. This operation has various difficulties due to the fact that in the positioning phase of the pontoon and lowering of the legs, the hull is subjected to the weather- sea conditions which, among other things, also cause rolling, pitching and yawing movements which limit, or even prevent, the positioning and constraining operations to the seabed, to be correctly effected. Due to these movements of the hull, in fact, there is the risk that the retractable legs can collide strongly against the concrete base, becoming damaged, or preventing an accurate positioning of the legs themselves.

[0009] Whereas the yawing can be regulated by a precise management of the self-propelling means, nothing can be done for the rolling and pitching.

[0010] An object of the present consists in providing a sea vessel which overcomes the drawback of the prior art.

[0011] According to the present invention there is provided a sea vessel for laying bulkheads gates in a seabed the sea vessel comprising a pontoon (2); and a number of legs (4) movable in ascending/descending direction with respect to the pontoon (2), wherein each leg comprises:

- a support foot comprising a semi-spherical joint connected to the telescopic means; and
- a centering pin connected elastically to the support foot and configured for centering a recess in the seabed.

[0012] According to the present invention, the leg comprises a structural element forms the holding part of the leg of the sea vessel and consists of a reticular structure or a hollow cylindrical structure or in the form of a parallelepiped with a square or rectangular structure. It can be made of stainless steel or corrosion-resistant metal alloy and can be lowered or lifted by means of rack systems or with hydraulic systems of "jacking" type.

[0013] The shock-absorption and centering device is characterized by the presence of elastic means which respectively connect the telescopic means and the centering pin to the structural element and support foot respectively. Said elastic means are produced by means of jacks or oil-dynamic pistons connected to accumulators or by means of mechanical springs or rubber elements for guaranteeing malleability.

[0014] The telescopic means and centering pin, described in more detail hereunder with reference to the enclosed Figures, are both coaxial with the structural element and essentially consist of structures made of steel or metal alloy.

[0015] The sea vessel of the present invention can be better understood by referring to the schemes of the enclosed drawings, which represent illustrative and non-limiting embodiments of the invention. In particular,

- Figure 1 represents a sea vessel of the pontoon type equipped with legs for self-raising in the navigation phase, with the legs raised;
- Figure 2 represents the sea vessel of Figure 1 resting on the seabed and raised with respect to the water

level;

- Figure 3 illustrates a detail of the resting system, in a vertical section, in the operational phase; and
- Figure 4 represents a detail of the support foot.

[0016] With reference to the Figures, the sea vessel (1) is the pontoon (2) prepared for the laying of bulkhead gates for the MOSE project and consists of a plurality of modular means assembled and arranged in C-form, so that the cavity (3) allows the metallic bulkhead gates to be housed, during their transferal, and lowered or recovered, in the case of their installation or removal for maintenance.

[0017] The pontoon has vertical legs (4) moveable in a descending/ascending direction which, in the navigation phase, are lifted as illustrated in Figure 1. The legs are positioned along the perimeter of the hull and symmetrically,to guarantee the equilibrium and balancing of the hull when it is in a resting condition on the seabed or on the base plate and in complete emersion (Figure 2). Once it has reached the site, the pontoon is stabilized, by lowering one or more sonar references to the seabed, then, by managing the propulsion means (6), it is positioned so that the projection of the legs onto the seabed substantially coincides with the corresponding centering recesses (7) of the legs, arranged on the concrete base (8), prepared for housing and supporting the bulkhead gates (9), in the drawing already in an operative position.

[0018] At this point, the legs (4) are lowered towards the recesses by means of a specific system (Jack-in System)(10). The legs of the pontoon can only be moved in a vertical direction, downwards or upwards, remaining constrained to the pontoon with respect to the other movements. This means that, in the case of a rough sea and consequently strong pitching and rolling of the hull of the pontoon, the legs (4) are subjected to an oscillating movement (in various oscillation planes) substantially centered on the corresponding recess.

[0019] In order to prevent these oscillations from causing collision against the base plate, which could damage it and jeopardize the stability of the pontoon, or lose the precise position requested, once they arrive in correspondence with the surface of the base plate, for example at a distance of 100 to 150 cm, the descent of the legs is stopped and the resting system, object of the present invention, is initiated.

[0020] The resting system comprises the telescopic element (11), constrained to the leg (4) by means of an elastic system (12), for example a hydraulic piston with an accumulator or a gas spring, fixed internally to the leg by means of cardan joints (13), the support foot (18) comprising the semi-spherical joint (14) and the centering pin (15) constrained by means of a spring (16) to the semi-spherical joint. The resting of the support foot on the surface of the base plate can be further achieved with a support disk (17) connected to the semi-spherical joint by means of a negligible mass connection elastic element, produced, for example, with rubber elements in order to have limited impact forces.

[0021] The telescopic element is lowered until it touches the base plate. The possible collision is absorbed by the damping system (12). Contemporaneously, the flat surface (17) of the foot rests on the surface of the base plate (8), thanks to the semi-spherical joint.

[0022] Under the thrust of the oscillating movement of the legs, the flat surface of the foot slides on the base plate around the recess until the centering pin (15) enters the recess (7). The pin itself guides the oscillating movement towards the vertex of the recess allowing the foot to be put into position. In order to favour the centering of the pin (15) in the recess (7) and therefore stop the oscillating movement of the legs, the recess and tip of the pin have a V-shaped vertical section, to guarantee a seat for the pin towards the centre of the recess.

[0023] Once the foot has been centered, the resting system is progressively tightened to activate the lifting phase of the pontoon. The legs (4) are re-lowered, which, after touching the surface of the base plate, allow the thrust to be applied for lifting the hull of the pontoon above the sea level.

Claims

1. A sea vessel for laying bulkheads gates in a seabed, the sea vessel comprising a pontoon (2); and a number of legs (4) movable in ascending/descending direction with respect to the pontoon (2), wherein each leg comprises:

   - a support foot comprising a semi-spherical joint connected to the telescopic means; and
   - a centering pin connected elastically to the support foot and configured for centering a recess in the seabed.

2. The sea vessel as claimed in claim 1, comprising

   - a structural element configured to lowering and raising with respect to the pontoon; and
   - telescopic means connected to the structural element through hinged elastic means;

3. The sea vessel as claimed in claim 1, wherein the support foot comprises a support disc, which defines a flat part configured to face the seabed and is elastically connected to the semi-spherical joint.

4. A sea vessel and a base plate arranged on the seabed, the base plate being configured to house and support bulkhead gates and comprising a plurality of recesses, the sea vessel being configured as claimed in any one of the foregoing claims.

5. A sea vessel and a base plate as claimed in claim 4, wherein the sea vessel comprises four legs (4)

comprising respective centering pins configured to be housed in corresponding recesses (7).

6. A sea vessel and a base plate as claimed in claim 4 or 5, wherein the sea vessel comprises propulsion means (6) for positioning the sea vessel (1) so that the projection of the legs (4) corresponds to respective recesses (7).

7. A sea vessel and a base plate as claimed in any one of claims 4 to 6, wherein each recesses has a vertex and each centering pin has a tip with a V-shaped vertical section.

Fig. 1

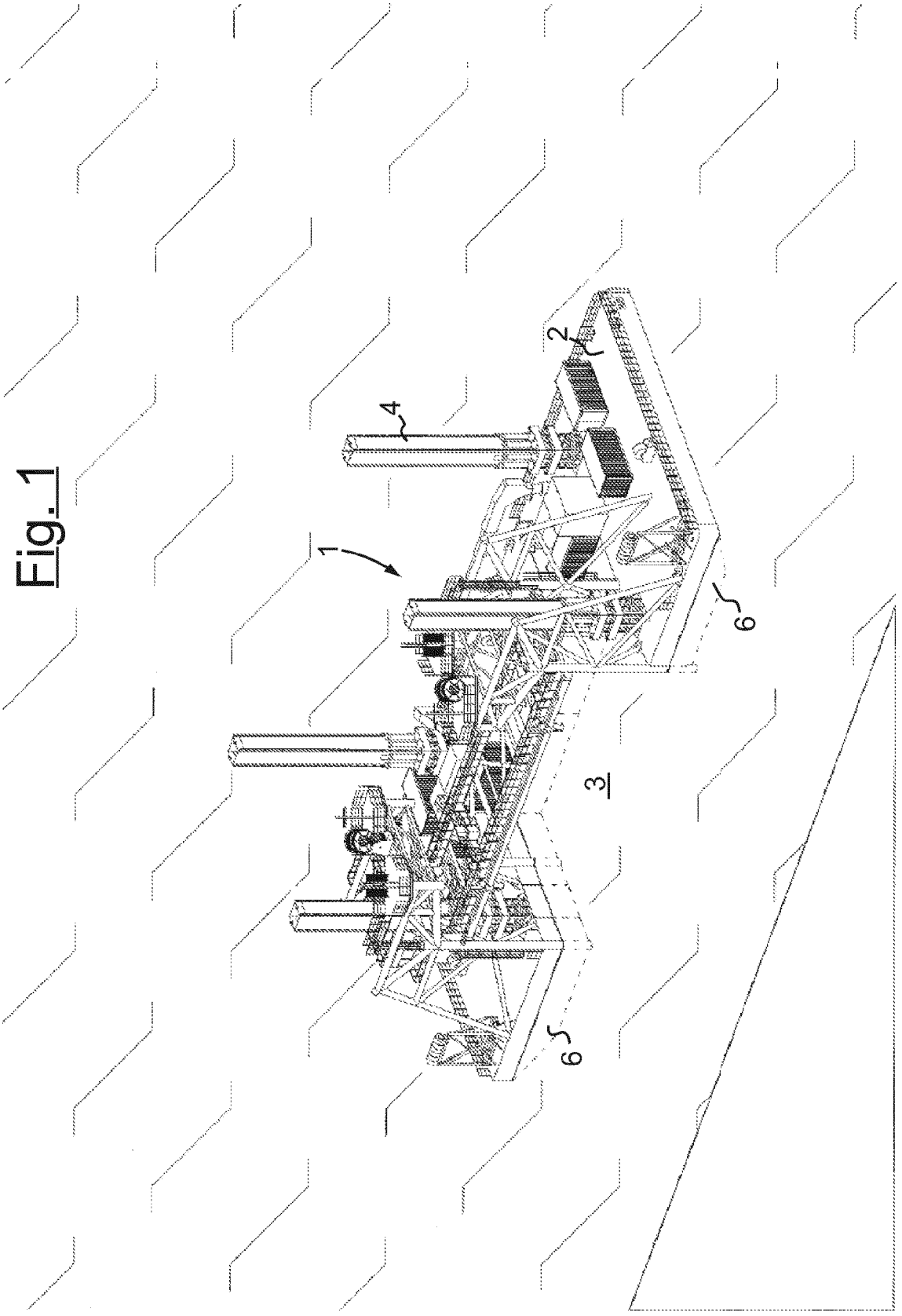


Fig. 2

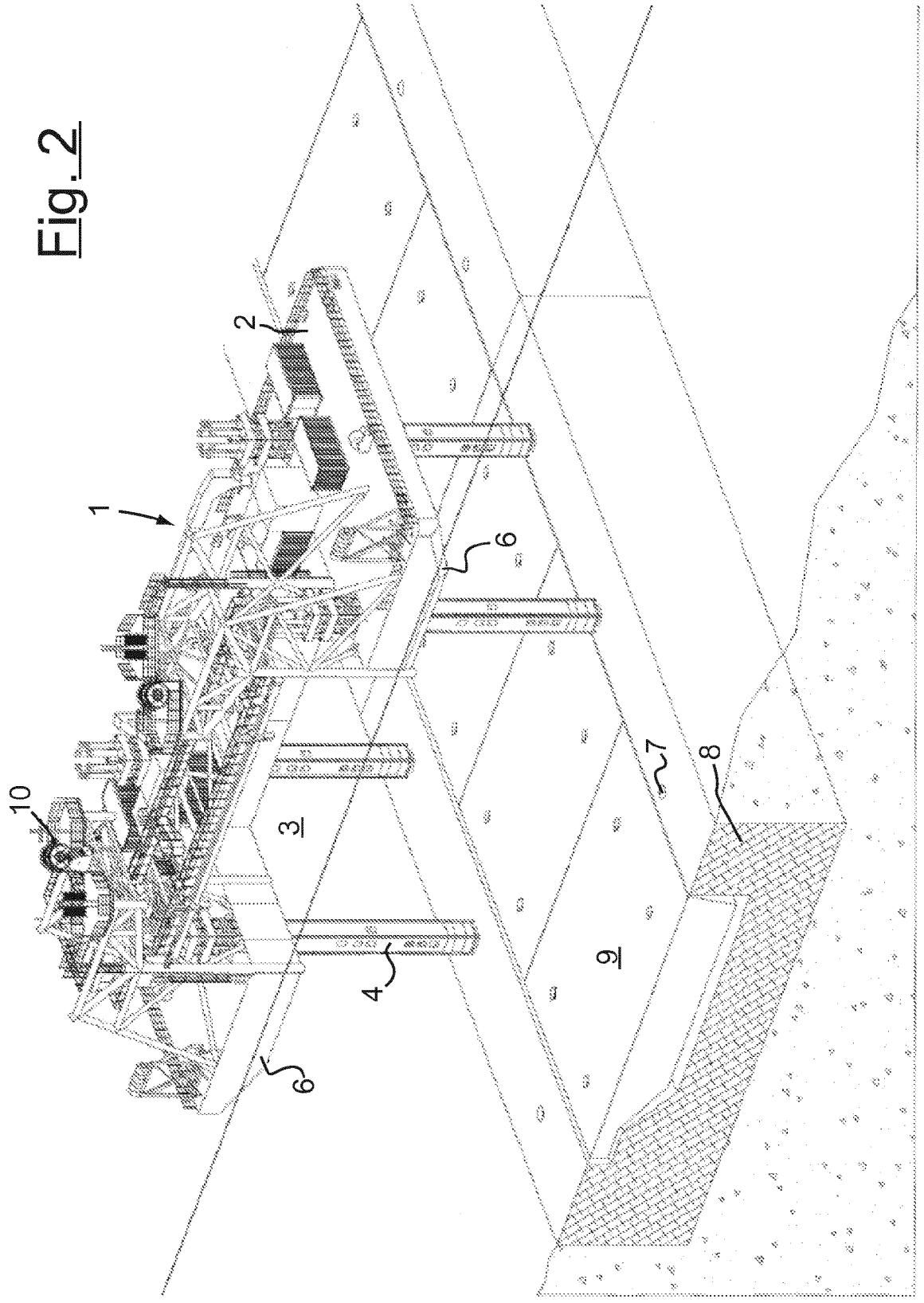


Fig. 3

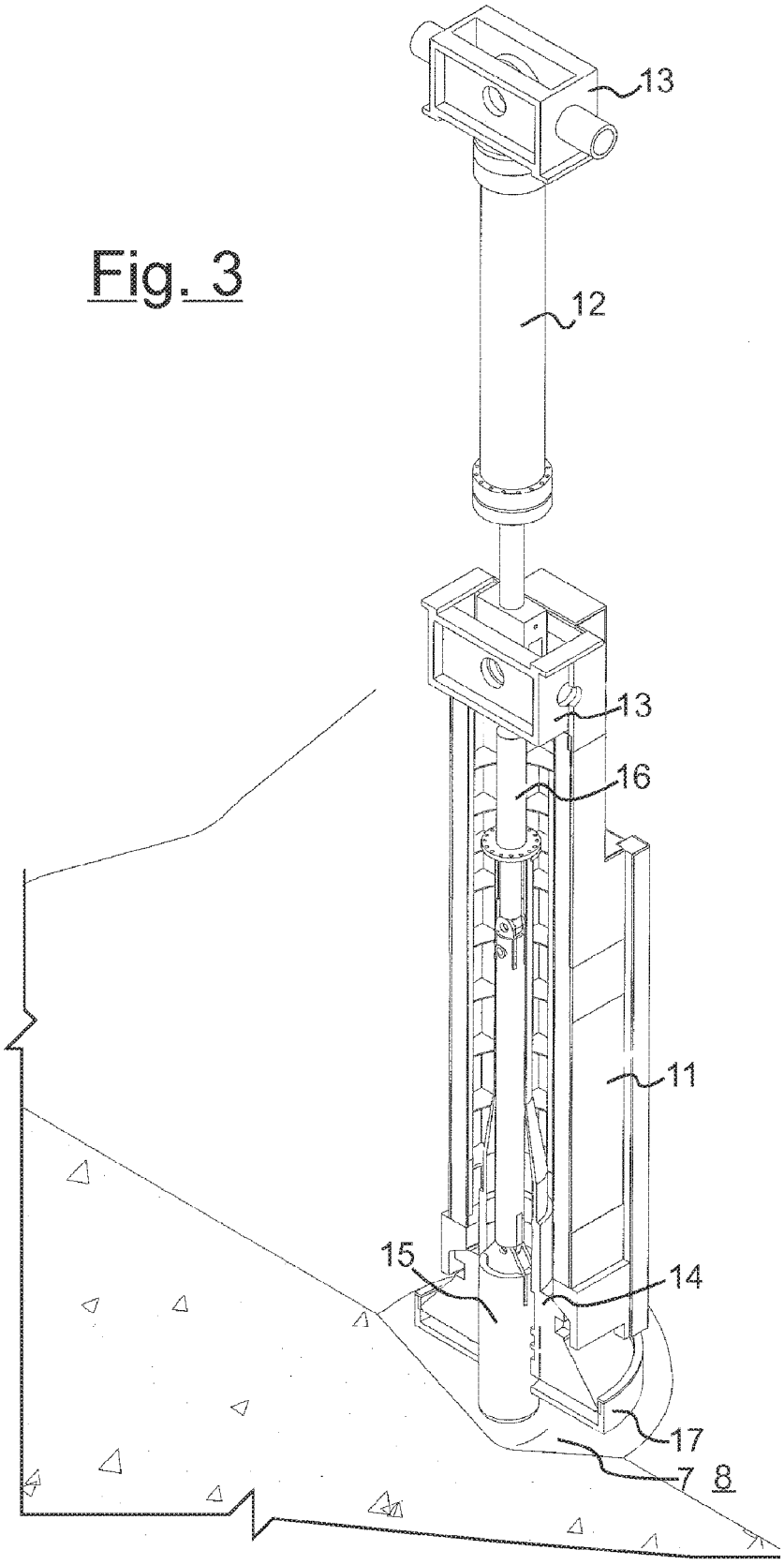
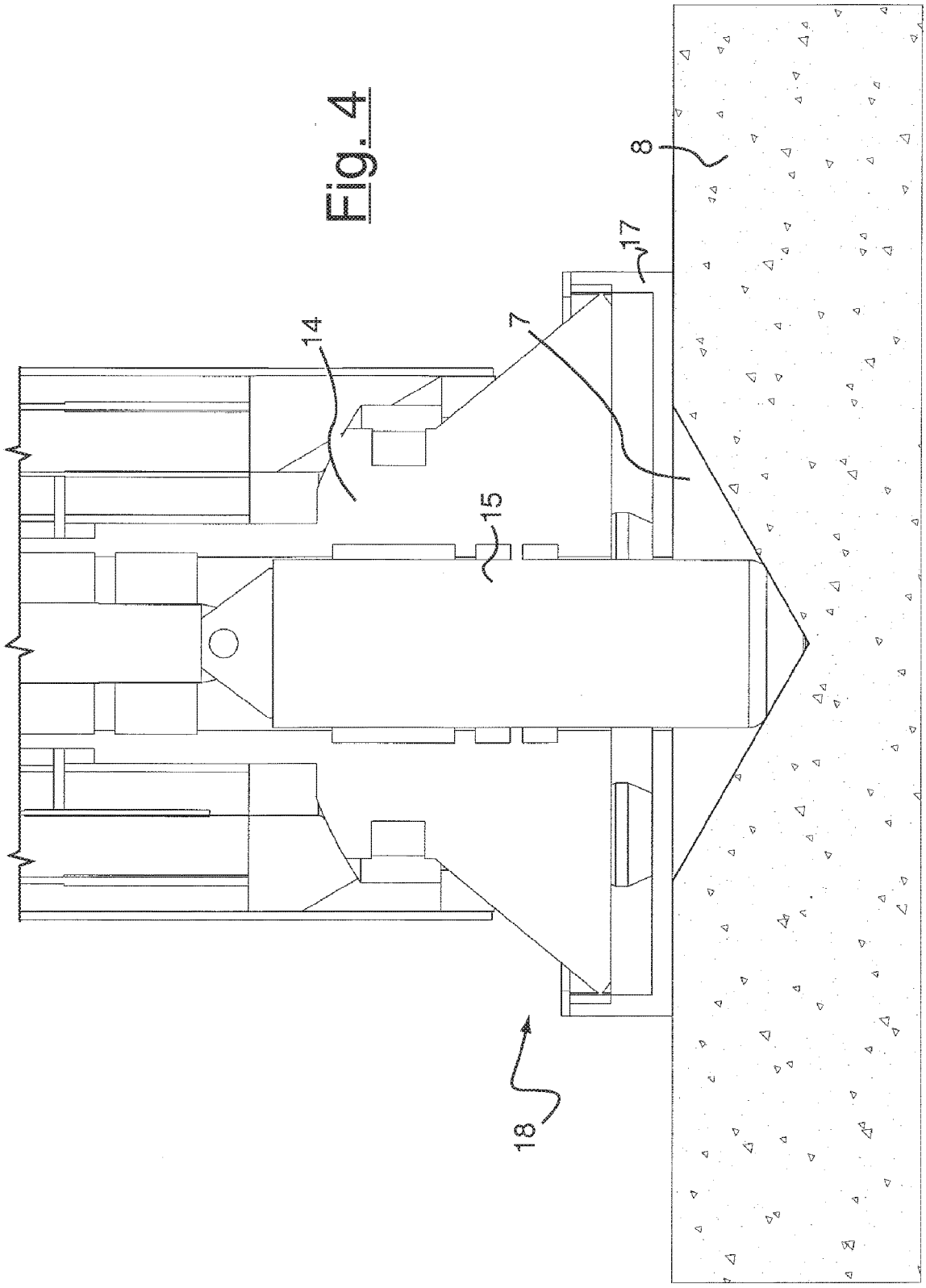


Fig. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 15 17 7584

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 600 761 A (HALLIBURTON ERLE P) 17 June 1952 (1952-06-17) * column 3, line 62 - column 4, line 5 * * column 4, line 6 - line 32; figures 1-5 *	1-7	INV. E02B17/02 E02B17/00
A	US 4 968 181 A (GOLDMAN JEROME L [US]) 6 November 1990 (1990-11-06) * column 2, line 26 - line 53; figures 1-4 *	1-3	
A	US 3 138 932 A (KOFAHL DAVID C ET AL) 30 June 1964 (1964-06-30) * column 1, line 64 - column 3, last line; figures 1-4 *	4-7	
A	JP S64 75707 A (SHIMIZU CONSTRUCTION CO LTD) 22 March 1989 (1989-03-22) * abstract; figures 1-5 *	1	

TECHNICAL FIELDS SEARCHED (IPC)
E02B
E02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 October 2015	Zuurveld, Gerben

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 17 7584

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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08-10-2015

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82