(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
2 February 2017 (02.02.2017)

WIPO | PCT

(10) International Publication Number
WO 2017/017701 A1

(51) International Patent Classification:
B63B 27/16 (2006.01) *B63G 8/00* (2006.01)
B63B 27/36 (2006.01)

(21) International Application Number:
PCT/IT2015/000191

(22) International Filing Date:
30 July 2015 (30.07.2015)

(25) Filing Language: Italian

(26) Publication Language: English

(71) Applicant: **MKU S.R.L.** [IT/IT]; Corso Porta Nuova 20, 37122 Verona (IT).

(72) Inventor: **MORETTI, Giuliano**; Via Magellano 32, 37138 Verona (IT).

(74) Agent: **LISSANDRINI, Marco**; BUGNION S.p.A., Via Pancaldo 68, 37138 Verona (IT).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

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

(54) Title: LIFTING DEVICE FOR LAUNCHING AND RECOVERING UNDERWATER VESSELS OR TORPEDOES

(57) Abstract: Described is a device (20) for lifting, launching and recovering underwater vessels or torpedoes (V) to be applied to crane arms, comprising a unit (22) for supporting and clamping the vessel (V) equipped with mechanical arms (26, 27, 30, 31, 32) to fit around the vessel, the saddle being supported with the possibility of angular adjustment by a portal (23) coupled to a crane through a flange (21), the supporting unit (22) consisting of a saddle equipped with mechanical arms (26, 27, 30, 31 and 32) which move by controlled operation of respective actuators (33).

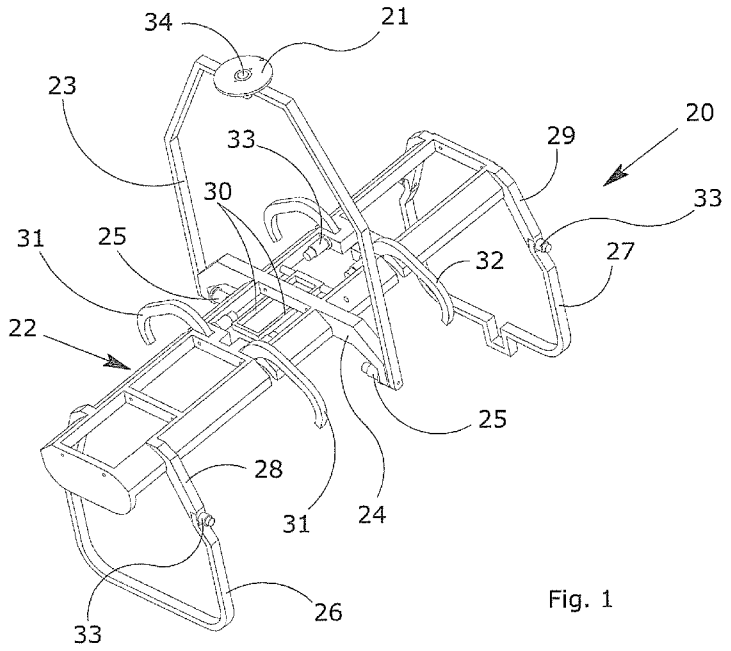

Fig. 1

WO 2017/017701 A1

LIFTING DEVICE FOR LAUNCHING AND RECOVERING UNDERWATER VESSELS OR TORPEDOES

****

TECHNICAL FIELD

This invention relates to a lifting device for launching and recovering underwater vessels or torpedoes.

It is a lifting device which allows the gripping of underwater vessels, and its movement during both entry to and exit from the water.

Compared with the prior art solutions, the device according to this invention aims to avoid the traditional use of divers who are forced to manually fasten a sort of sling lowered by a crane in the area in question, thereby achieving an evident advantage from the operational point of view.

This invention can be advantageously applied in the nautical or naval sector and in particular in that of military ships and oceanographic and oil industry research vessels and the relative systems for the launching and recovery of underwater vessels and torpedoes designed for underwater search and reconnaissance.

BACKGROUND ART

It is known that in the naval sector and in particular in the context of the navy or in that of ships used for oceanographic research or in that of oil industry ships, vessels or underwater means are used for surveying or exploration which can be used for monitoring different situations depending on the mission and the aims for which it has been designed.

Some of these vessels consist of actual

reconnaissance torpedoes comprising apparatuses of various types which can be used for any type of inspection even for daytime and night-time surveying both for military and civil purposes or even for naturalistic and scientific purposes.

In general, these underwater vessels may be defined as remote controlled underwater vessels, which have given rise to the need to use means which allow them to be launched in water and recovered from water.

These launching and/or recovery means usually consist of slings of various types which are fastened on the cable of a crane which must in turn be designed to allow the manoeuvres for hooking, lifting and release both out of and in water.

These coupling and release operations are currently performed manually by specially trained operators who must manually attach the sling around the underwater vessel so that the crane to which the sling is in turn attached can lift it from the ship to lower it into the water during the launching operations and vice versa lift it from the water and lower it onto the ship during the recovery operations.

Both the launching and recovery operations of the underwater vessel which use the traditional slings currently require the intervention of divers, who must free the slings from the vessel during the launch phase and attach the sling during the recovery phase.

It can be inferred that the operations necessary for freeing the sling during the launching phases are relatively easier than the operations necessary for coupling the vessel to the sling during the recovery phases, but it can also be inferred that both the

coupling and the releasing of the sling in water are extremely difficult for the technicians and equally onerous from the management point of view, especially considering any adverse weather-marine conditions, during which the divers and the relative support ships must operate with great difficulty.

Moreover, the difficulty in the steps for recovering the underwater vessel is even more evident if one considers a circumstance highlighted also by the operators of ships used for testing torpedoes, wherein the torpedo, at the end of its travel, floats in a vertical position.

DESCRIPTION OF THE INVENTION

The aim of this invention is to provide a lifting device for launching and recovering underwater vessels or torpedoes comprising means which determine an automatic coupling and releasing mechanism for the launching and recovery phases, thereby creating a condition which is able to eliminate or at least reduce the above-mentioned drawbacks.

The invention aims in particular to provide a lifting device for the launching and recovery of underwater vessels and torpedoes which avoids the intervention by divers which has always been necessary, using the prior art slings, for freeing the sling from the vessel during the launching phases and for attaching it to the vessel during the recovery phases.

This is achieved by means of a lifting device for launching and recovering underwater vessels or torpedoes, the features of which are described in the main claim.

The dependent claims of the solution according to

this invention describe advantageous embodiments of the invention.

According to this invention, the lifting device consists of a structure which can be coupled to the head of a lifting unit consisting, for example, of a crane and comprising a supporting and clamping saddle supported by a supporting portal and equipped with some mechanical arms which move with the initial aim of fitting around the floating vessel, centring it and finally coupling it to the saddle, both for the launching and recovery operations.

By using the portal which supports the saddle, it is possible to lift the saddle and vessel together, whatever the orientation of the vessel, since it acts on the centre of gravity of the saddle and vessel combined.

DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will become clear on reading the description given below of one embodiment, provided as a non-limiting example, with the help of the accompanying drawings, in which:

- Figure 1 shows a schematic perspective view of the lifting device for launching and recovering underwater vessels or torpedoes in its entirety;
- Figures 2, 3 and 4 are schematic front, side and perspective views, respectively, of the apparatus according to the invention during a first step of attaching the underwater vessel;
- Figures 5, 6 and 7 are front, side and perspective views, respectively, of the apparatus according to the invention during a second step of attaching the vessel;

- Figures 8, 9 and 10 are front, side and perspective views, respectively, of the apparatus according to the invention during a third step of attaching the vessel;
- Figures 11, 12 and 13 are front, side and perspective views, respectively, of the apparatus according to the invention during a fourth step of attaching the vessel;
- Figures 14 to 16 are front, side and perspective views, respectively, of the apparatus according to the invention during a fifth step of attaching the vessel.

DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

With reference to the accompanying drawings, and initially in particular to Figure 1, the numeral 20 indicates generally a lifting apparatus according to this invention designed for lifting underwater vessels or torpedoes, labelled V, for their launching and recovery, to be applied to movement arms, preferably to the arm of a crane.

The apparatus 20 for launching and recovering the above-mentioned devices comprises the following components:

- a flange 21 associated with a rotary actuator for connecting to an arm or a head of a crane;
- a supporting and clamping saddle 22 equipped with mechanical arms for fitting around the floating vessel;
- a command and control system to be positioned on the operator console of the crane.

The saddle 22 is coupled to the flange 21 by the

interposition of a portal 23, comprising a curved bar of the fork type, the two lower ends of which are pivoted to the lateral ends of a crosspiece 24 located transversely and in a central zone relative to the saddle 22.

The flange 21 is provided with an upper pin for the connection, by the rotary actuator, to the head of the crane on which it is coupled, and at its lower end the flange comprises a second pin which inserts into a circular seat on the gantry which supports the saddle. In detail, the rotary actuator rotates the flange 21 about a first axis, preferably vertical, also called the "yawing motion".

The portal 23 allows the angular movement of the saddle by actuators 25 positioned at oscillation pins to which is coupled. In detail, the actuators 25 rotate the saddle 22 about a second axis, preferably horizontal, also called the "pitching motion".

The saddle 22, which consists of a metal containment body substantially rectangular in shape, formed, in the embodiment illustrated, by two parallel uprights fixed to crosspieces, forming a structure shaped on the basis of the upper surface of the vessel.

The saddle 22 is equipped with some mechanical arms which move by the controlled operation of respective actuators, having the initial aim of fitting around the floating vessel, to centre it and finally attach it to the saddle.

The mechanical arms are of three types:

- two positioning arms 26 and 27 located at the two outermost sectors of the saddle 22 and hinged on the ends of respective brackets 28 and 29, which fit around the vessel V and push it against the saddle;

- two pushing arms 30 which act on the vessel at the points planned for the lifting, pushing the bow of the vessel V against the front part of the saddle.
- Two locking arms 31 and 32 which connect the vessel to the saddle, allowing lifting for launching and recovery operations.

Each of the arms 26, 27, 30, 31, 32 is moved by respective hydraulic actuators, labelled 33, located at each rotation pin of each arm, which are controllable by the crane operator by means of a joystick.

By using the portal 23 which supports the saddle 22, it is possible to lift the saddle and vessel together, whatever the orientation of the vessel, since it acts on the centre of gravity of the saddle and vessel combined.

In the upper structure of the portal 23 there is a circular seat 34 in which the lower pin of the flange 21 for connecting to the head of the crane is inserted, whilst the rotary actuator connected to the flange contributes to the orientation of the entire system.

From an operational point of view, when the saddle has coupled with the vessel, the crane operator recovers everything onto the ship using the re-entry movement of the telescopic sections of the arm and then, in sequence, the vertical and horizontal traversing movements (rotation) of the arm.

The parts of the structure of the saddle 22 which come into contact with the external structure of the vessel are protected with elastomers, rubber or other materials which guarantee the protection of the surface of the vessel and simultaneously allow an easy sliding during the operations for positioning the vessel inside the saddle.

The body of the saddle 22 is rotatable relative to the portal 23 using the hydraulic actuator 25, manoeuvred by the crane operator.

The features of device described above allow the floating vessel to be fastened, along the vertical axis, in the best position for then being lifted and recovered on board.

All the arms 26, 27, 30, 31, 32, used to position the vessel inside the saddle 22 are moved by means of hydraulic actuators.

Depending on the chosen materials, the saddle has an approximate weight of 700 kg.

The structure of the saddle is fitted with an electro-hydraulic system for controlling all the actuators 25 and 33, which represents the command and control system to be positioned on the console of the crane operator.

According to an embodiment of the invention, for each movement of the device there is a two-way control actuated by a solenoid valve with the position maintained in the absence of commands (centres closed).

Use is also made of a "valve pack" present on the device according to this invention which is connected to a local IO (in-out) module and from this to the control unit by means of a field bus. A dedicated multi-pole cable, installed along the crane up to the device, allows the necessary electrical connection between the device and the control console.

Each actuator is equipped with a built-in position transducer.

Use is also made of at least one inclinometer with two axes integral with the portal of the device and with

four sensors positioned at the four corners of the frame to monitor the distance between the vessel and the recovery device.

The various sensors and transducers are linked with the control console in such a way as to provide the operator with the configuration of the device in any condition.

The control panel located upstream of the crane is equipped with a local processing and diagnostic unit (PLC) as well as the necessary electrical components for feeding the logic and the sensors and solenoids of the device. The operation commands and the system status signals can be returned from this panel towards the control console located in the crane cab.

A brief description is given below of an example of the process for launching and recovering the lifting device according to this invention.

The launching process comprises the following steps:

1) when the ship is sailing, the crane is in the stowage position on board, the end part of its arm completely withdrawn and connected to the vessel, already inserted in the device, using the connecting flange 21 between crane head and portal of the saddle;

2) when the ship arrives in the operating area, the crane operator uses the control console to rotate the crane and extend the arms to position the vessel outside the ship, lowering it completely to sea level in the launch position;

3) the operator uses the control console to position the saddle 22 with the vessel oriented along the bow-stern axis acting on the rotary actuator connected with the flange; at the same, the portal 23 of the saddle 22

is also oriented in the correct launching gradient: vertical-horizontal. The vessel is then connected to the saddle only using the locking arms.

4) The operator opens the locking arms 31 and 32 and lifts the saddle 22, whilst the propellers of the vessels are started from the ship. The vessel is free in the water and is ready to perform its mission.

5) When the vessel starts its navigation, the crane operator lifts the empty saddle 22 and then returns the crane to the rest position on the deck of the ship.

The recovery process is illustrated in Figures 2 to 16 and comprises the following steps:

1) when the vessel has completed the mission, the parent ship moves alongside the vessel and prepares for its rapid recovery;

2) the vessel floats in a vertical position;

3) the operator prepares the crane rotating it and moving the arms to bring the saddle 22 in position above the vessel. The saddle 22 is connected by the portal to the head of the crane. All the arms of the saddle are in the open position;

4) the operator orients the position of the saddle 22 which is located vertically so as to be oriented above the upper section of the vessel. The saddle orients according to the vertical axis manoeuvring the rotary actuator and the orientation of the gantry of the saddle (Figures 2, 3 and 4);

5) the operator lowers the saddle 22, which is connected to its portal 23, until the vessel is inside the positioning arms (Figures 5, 6, 7);

6) the operator turns the positioning arms 26 and 27 and simultaneously lowers the saddle 22 along the surface

of the vessel to complete the capture;

7) the positioning arms 26 and 27 push the vessel in the correct direction against the fixed part of the structure of the saddle 22 to complete the capture;

8) when the capture is completed, the pushing arms 30 are activated to position the bow of the vessel in contact with the front part of the saddle;

9) lastly, with the vessel positioned completely inside the saddle, the locking arms are closed and the vessel is ready to be recovered (Figures 8, 9 and 10);

10) at this point the operator withdraws the telescopic sections of the arm of the crane, lifting the saddle and vessel to the floating line and starting to drain the ballast water from the vessel. The portal 23 is unlocked in such a way that saddle and vessel are free to position themselves;

11) the saddle and vessel are at the floating line, but, with the reduction in the ballast, they vary their trim due to the fact that the position of the barycentre of the system varies relative to its longitudinal metacentre. The portal of the saddle, hinged at the barycentre of the saddle, allows the rotation of the saddle and vessel system to a horizontal position;

12) when the vessel has completely discharged the water ballast and the system floats in a horizontal position, the portal 23 is locked in a vertical position;

13) the operator lifts the saddle and vessel out of the water, opens the positioning arms and brings the crane and system to the stowage position on the ship (Figures 11, 12 and 13);

14) after having rotated the crane inside the ship, the operator lowers the saddle and vessel towards their

rest position, opens the positioning arms and replaces the system in its stowage position on the ship (Figures 14, 15 and 16).

As may be noted, the device according to this invention makes it possible to achieve all the above-mentioned aims, and in particular avoids the intervention by divers which has always been necessary, using the prior art slings, for freeing the sling from the vessel during the launching phases and for attaching it to the vessel during the recovery phases.

The invention as described above refers to a preferred embodiment. It is nevertheless clear that the invention is susceptible to numerous variations falling within the scope of the disclosure, in the context of technical equivalents.

CLAIMS

1. A device (20) for lifting, launching and recovering underwater vessels or torpedoes (V), characterised in that it comprises a supporting unit (22) equipped with mechanical arms (26, 27, 30, 31, 32) designed to clamp and retain the vessel (V), the supporting unit being movable by rotation about a first axis, the mechanical arms (26, 27, 30, 31 and 32) being movable between an open position to allow the vessel (V) to be housed and a closed position to allow the vessel (V) to be clamped.

2. The device (20) for lifting, launching and recovering underwater vessels or torpedoes (V) according to the preceding claim, characterised in that the supporting unit comprises a portal (23) connected to a flange (21) which can be coupled to a movement arm, the flange defining the first axis of rotation.

3. The device (20) for lifting, launching and recovering underwater vessels according to claims 1 and 2, characterised in that the gantry (23) comprises a curved bar of the fork type, the two lower ends of which are pivoted to the lateral ends of a crosspiece (24) located transversely and in a central zone relative to the saddle (22) of the supporting and clamping unit, the pin ends of the bar defining a second axis of rotation.

4. The device (20) for lifting, launching and recovering underwater vessels according to claim 1, characterised in that the supporting unit (22) comprises a saddle equipped with hinging means for the mechanical arms (26, 27, 30, 31 and 32).

5. The device (20) for lifting, launching and recovering underwater vessels according to one of the preceding claims, characterised in that the flange (21) is equipped with an actuator rotating about the first axis, preferably vertical, also called the "yawing motion".

6. The device (20) for lifting, launching and recovering underwater vessels according to one of the preceding claims, characterised in that the gantry (23) allows the angular movement of the saddle by the actuators (25) located at the oscillation pins to which the saddle is coupled, the actuators (25) activate a rotation of the saddle (22) about a second axis, preferably horizontal, also called the "pitching motion".

7. The device (20) for lifting, launching and recovering underwater vessels according to one of the preceding claims, characterised in that each of the arms (26, 27, 30, 31, 32) is moved by respective hydraulic actuators (33), positioned at each rotation pin of each arm.

8. The device (20) according to one of the preceding claims, characterised in that all the operations are managed by an electric-hydraulic control system for controlling the actuators (25, 33).

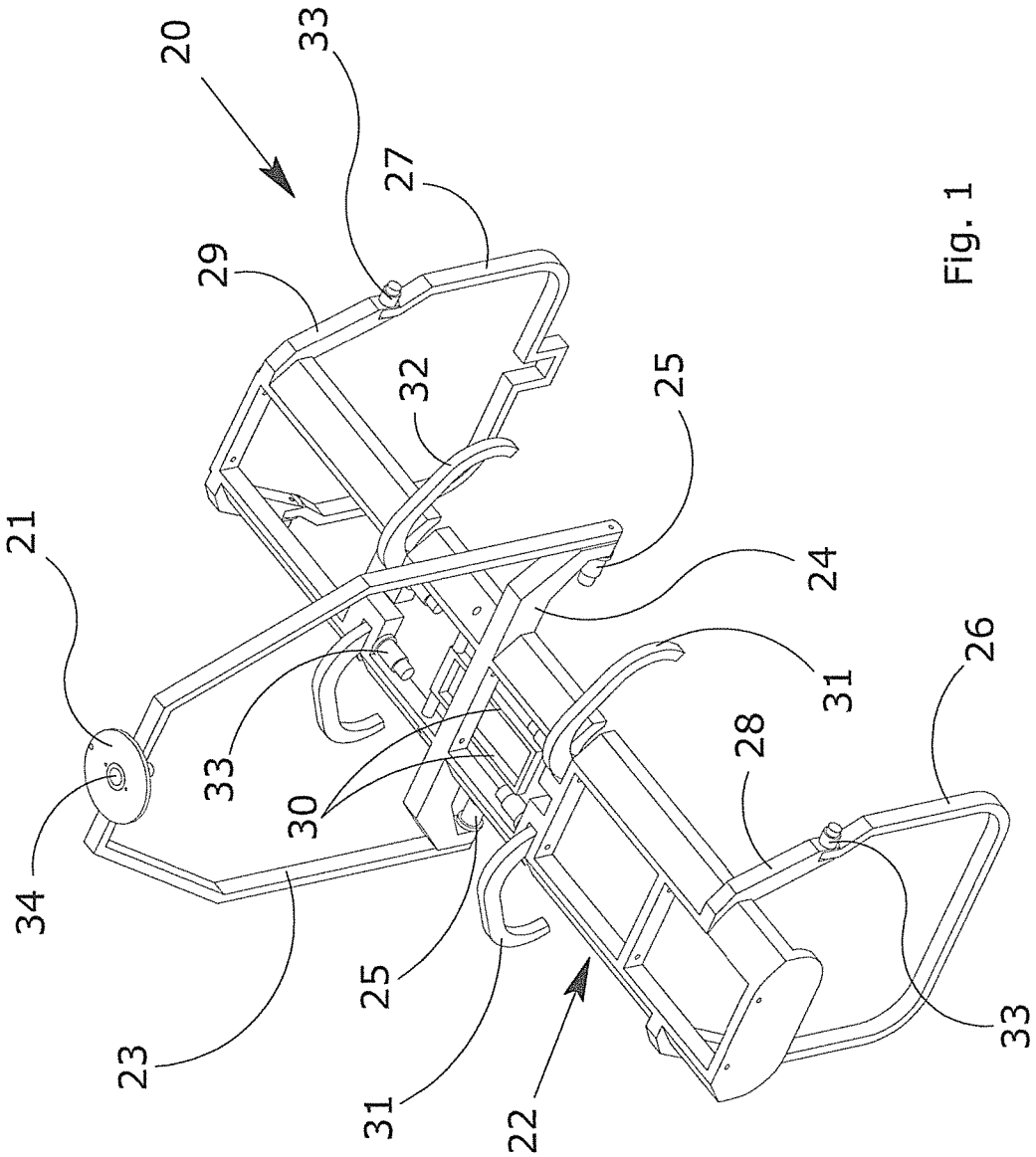

Fig. 1

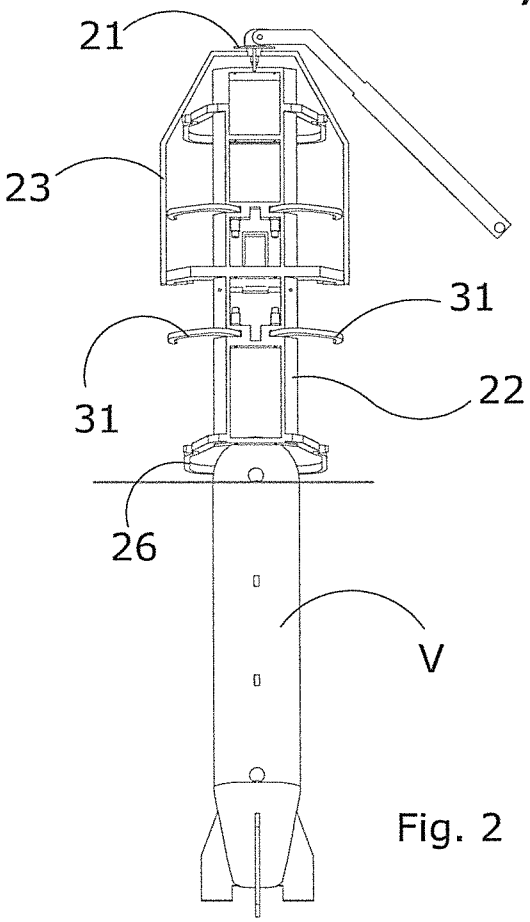

Fig. 2

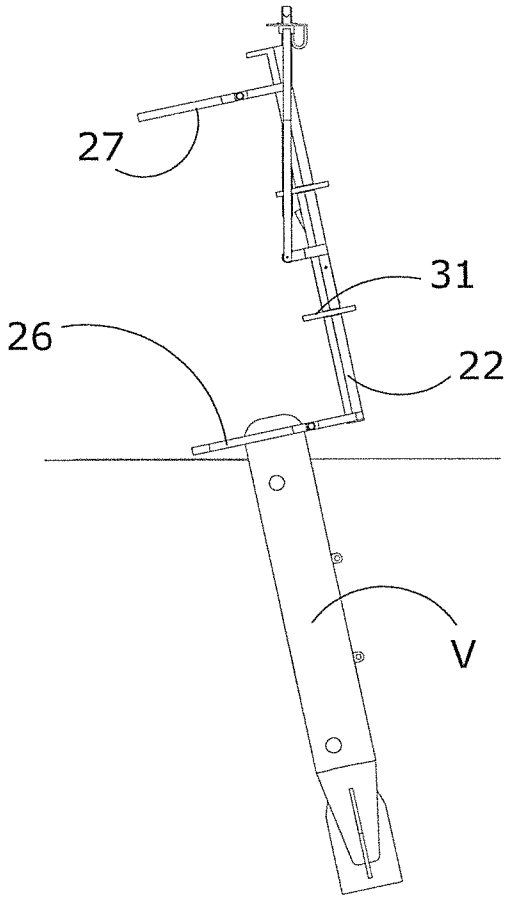

Fig. 3

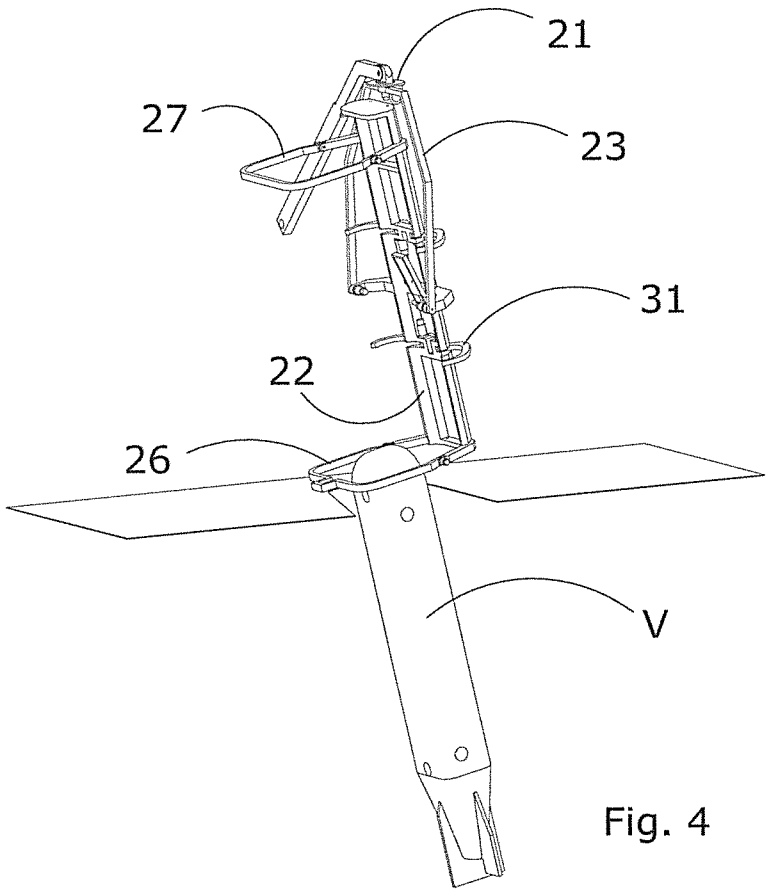

Fig. 4

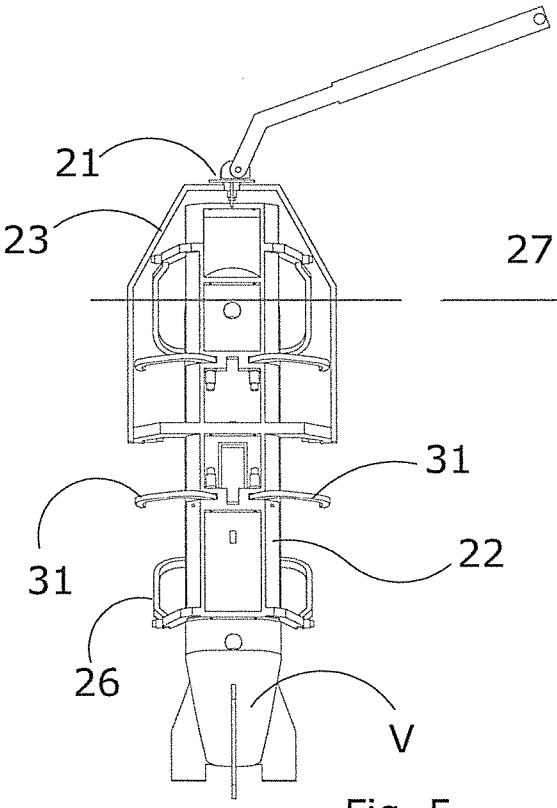

Fig. 5

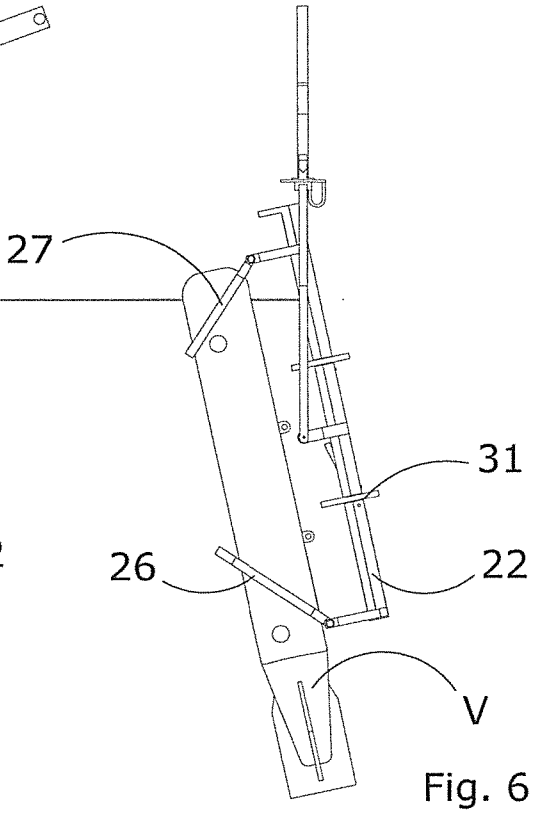

Fig. 6

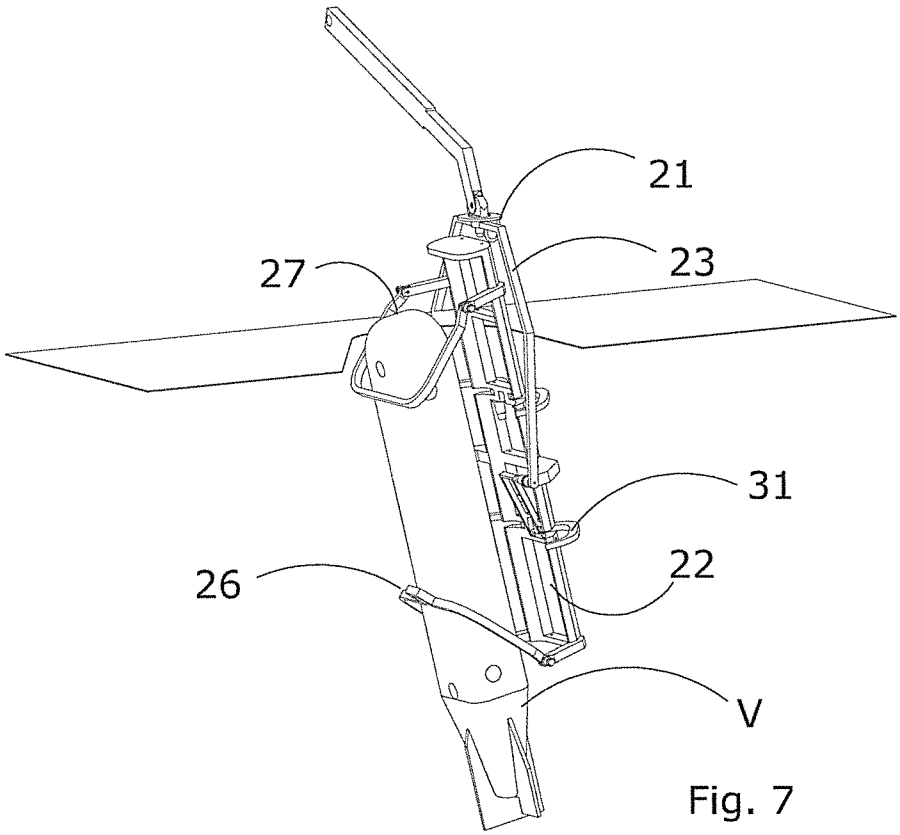

Fig. 7

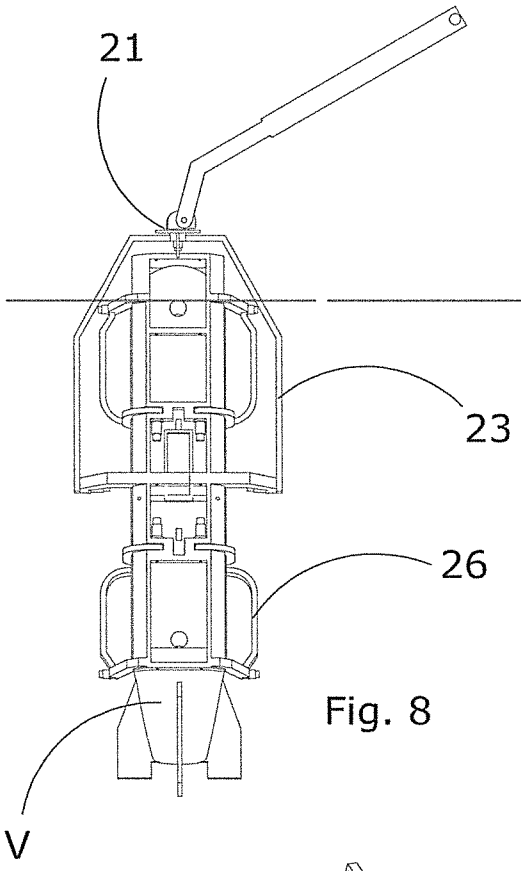

Fig. 8

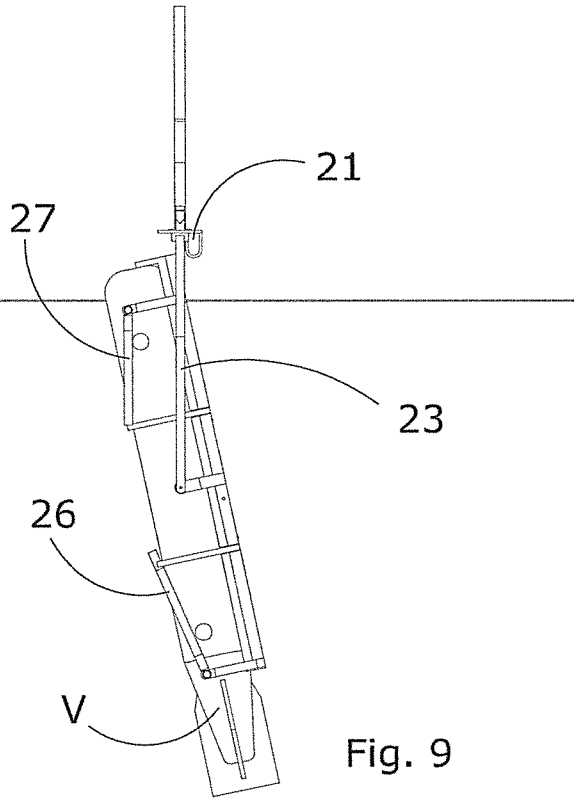

Fig. 9

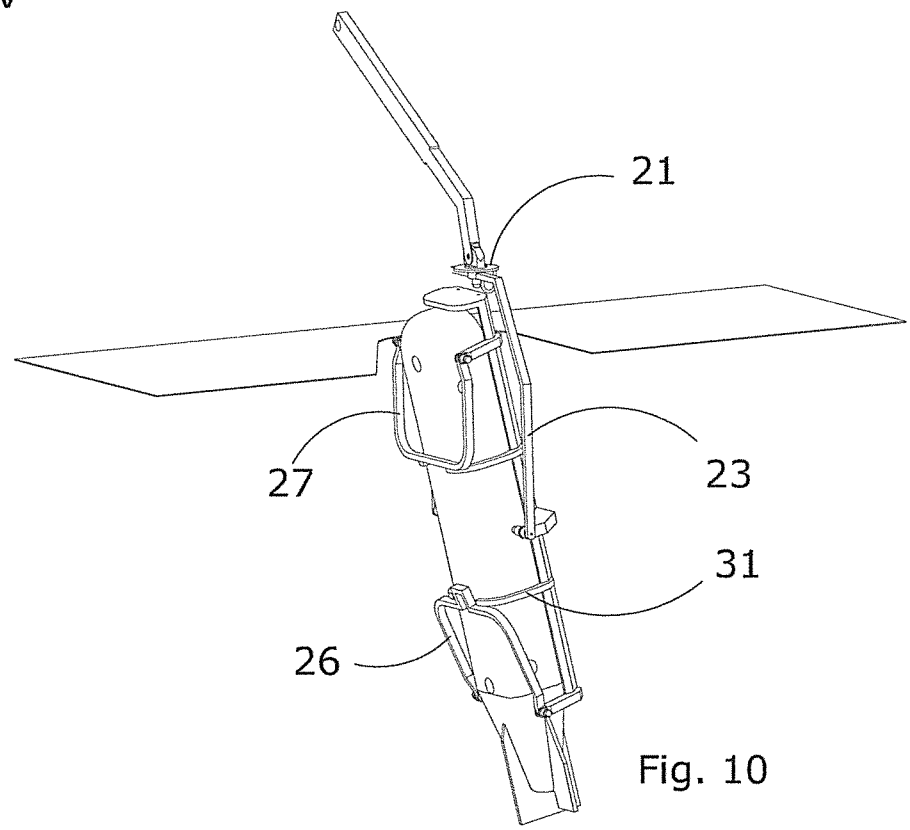

Fig. 10

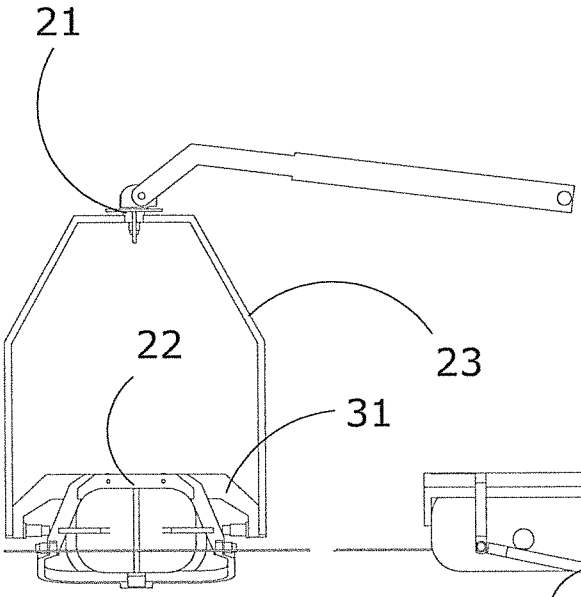

Fig. 11

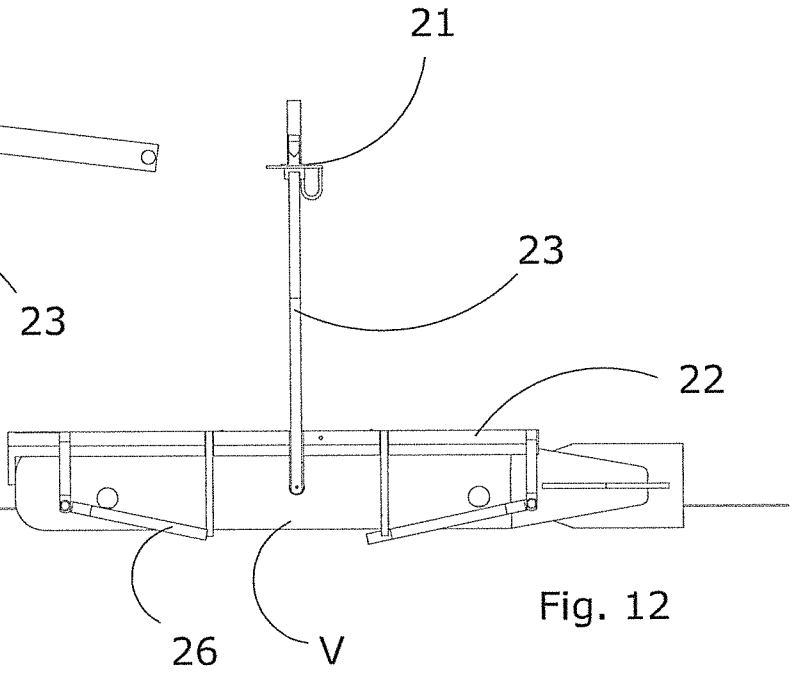

Fig. 12

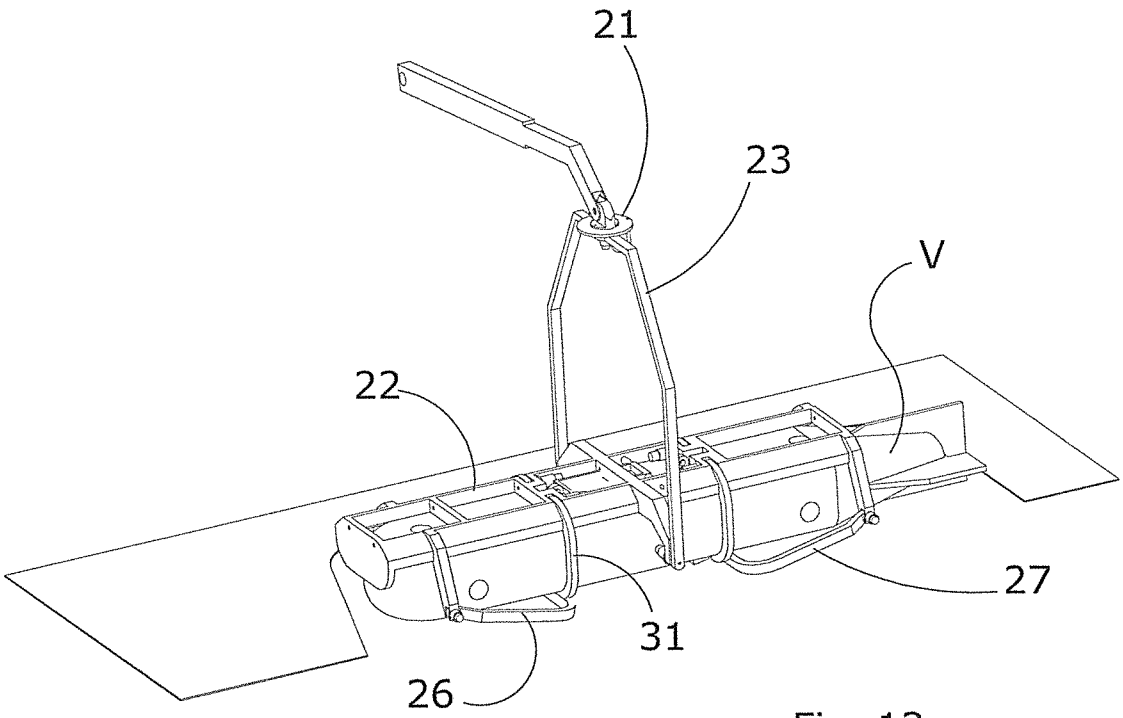

Fig. 13

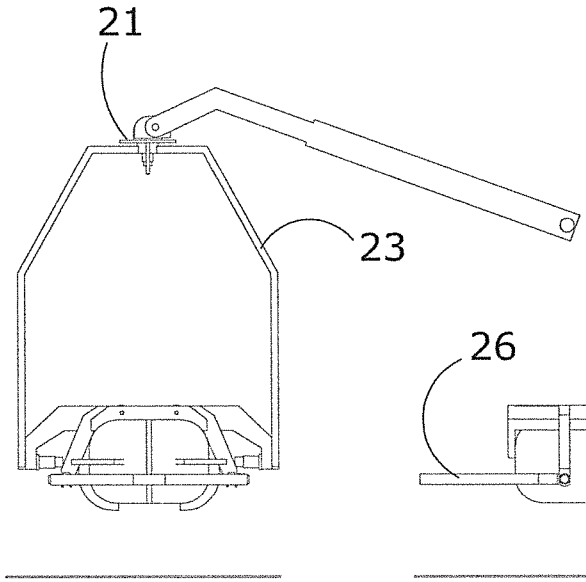

Fig. 14

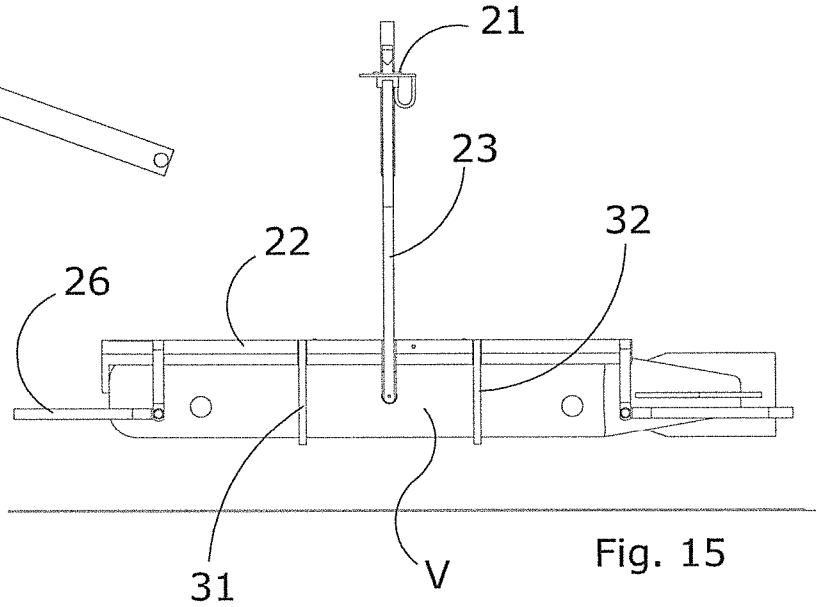

Fig. 15

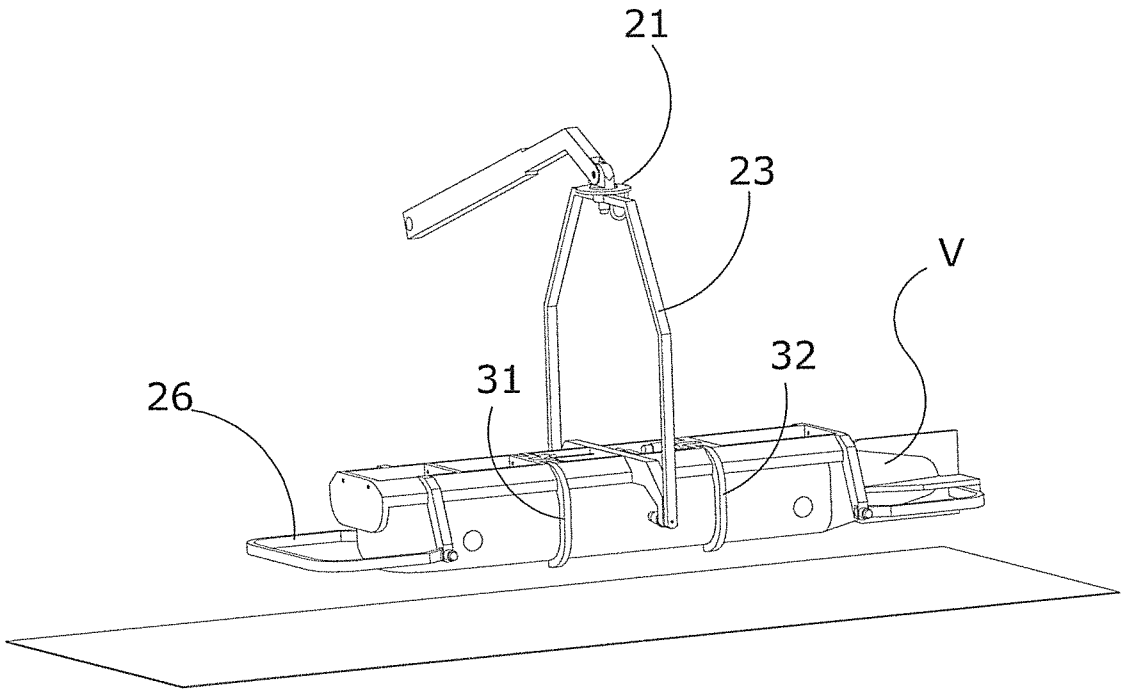

Fig. 16

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2015/000191

A. CLASSIFICATION OF SUBJECT MATTER
INV. B63B27/16 B63B27/36 B63G8/00
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)
B63B B63G

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 A	EP 0 532 096 A1 (RIVA CALZONI SPA [IT]) 17 March 1993 (1993-03-17) column 3, line 45 - column 4, line 5 figure 1 figures	1,4,5,7, 8 6

X	DE 10 2012 112333 A1 (UNIV BERLIN TECH [DE]) 9 January 2014 (2014-01-09) the whole document	1-4,6

X	EP 2 468 621 A1 (ECA [FR]) 27 June 2012 (2012-06-27) paragraph [0024] paragraphs [0052] - [0059] figures	1,4,8

	-/--	

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 May 2016	12/05/2016

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	Barré, Vincent

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2015/000191

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GHIGNONE S ET AL: "Robot crane for underwater vehicles automatic launching and retrieval", PROCEEDINGS OF THE SYMPOSIUM ON AUTONOMOUS UNDERWATER VEHICLE TECHNOLOGY. WASHINGTON, JUNE 2 - 3, 1992; [PROCEEDINGS OF THE SYMPOSIUM ON AUTONOMOUS UNDERWATER VEHICLE TECHNOLOGY], NEW YORK, IEEE, US, vol. -, 2 June 1992 (1992-06-02), pages 282-290, XP010065035, DOI: 10.1109/AUV.1992.225223 ISBN: 978-0-7803-0704-9 the whole document -----	1

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IT2015/000191

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0532096 A1	17-03-1993	AT 125504 T	15-08-1995
		CA 2077857 A1	11-03-1993
		DE 69203680 D1	31-08-1995
		DE 69203680 T2	21-03-1996
		EP 0532096 A1	17-03-1993
		IT 1251567 B	17-05-1995
		US 5253606 A	19-10-1993
DE 102012112333 A1	09-01-2014	NONE	
EP 2468621 A1	27-06-2012	EP 2468621 A1	27-06-2012
		FR 2969573 A1	29-06-2012
		SG 182120 A1	30-07-2012