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(54) Title: SUBSEA DEVICE FOR SEDIMENT REMOVAL

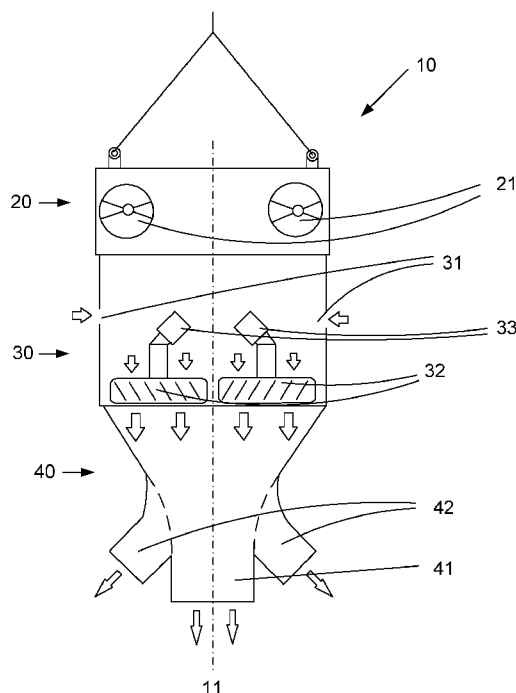


Fig. 1A

(57) Abstract: Subsea device (10) with vertical axis (11) for removal of sediment, comprising a pump unit (30) which supplies pressurized water to a nozzle assembly (40) and nozzle assembly (40) comprising a central nozzle (41). The nozzle assembly (40) furthermore comprises at least two additional nozzles (42) directed with an inclination in relation to the central nozzle (41) and arranged angularly symmetric in relation to the vertical axis (11) of the device.

The present invention concerns a subsea device for removal of sediment as indicated by the preamble of claim 1.

Background

5 There is often a need for excavating masses at a seafloor, for example to level areas before installations of structures, trenching of ditches before deployment of pipes, uncovering of deployed pipes. The masses to be moved can vary from clay and silt to rocks.

A number of devices for trenching sediment at the seafloor are known in the art, hereunder devices which make use of conventional centrifugal pumps as well as ejectors for establishing suction power.

10 Known technology also encompass blowers which direct a powerful water-jet towards the seafloor in order to disintegrate sediment and blow them away. An example of the known technology in this field is WO 2008/065360 (Rotech Holdings Ltd.).

The disadvantage with the prior art technology is that the masses are blown into a cloud that rapidly envelopes the blower, takes away all visibility and renders visually controlled work
15 impossible. Furthermore it is a challenge that trenched masses fall back into the ditch/ hole and form layers of unstable sediment.

Objects

It is an object of the present invention that the masses can be blown farther away and out of for example a ditch line. It as an object that the remaining seafloor remains as intact as possible and
20 it is an object to maintain visibility so that the trenching can be handled in a controlled manner adjacent to vulnerable objects. It is furthermore an object that the blower be smaller, lighter and more effective than blowers of prior art technology. It is an object to largely manufacture the blower from standard components.

The present invention

25 The above objects are ensured by a device according to the present invention as defined by claim 1. Preferred embodiments are disclosed by the dependent claims.

The present invention renders it possible to blow sediment away from the seafloor. The invention renders it possible to move sediment farther away compared to what is possible with conventional blowers; the sediment can be removed in chosen and desired direction and with larger capacity
30 than what has earlier been possible. At the same time the present invention renders it possible to maintain visibility to a much larger extent than with conventional blowers.

The device according to the present invention includes a housing comprising a pump device arranged to blow water in a mainly downwards direction, water inlet to allow water to enter the pump device, a nozzle assembly to discharge water directionally controlled out from the housing as well as a particular device for holding the device in a certain desired orientation during work operations. The device may also be denoted a "blower".

The particular new aspect of the device is the nozzle assembly which surprisingly has proved to place the device in a pocket empty of sand and sediment even under challenging work operations. Furthermore it is of importance that the device can be maintained in desired position at any time and independent of varying inflicted loads.

By "angularly symmetric" about an axis is understood that the respective nozzles are arranged with constant angular distance so that the sum of the horizontal forces from the nozzles are zero. If there are only two inclined nozzles, they are arranged with a mutual angular distance of 180 degrees. If there are more than two nozzles, they can be arranged in pair, still with 180 degrees between each nozzle in each pair. Other configurations are also contemplated when more than two nozzles are employed, but balanced such that the force components in horizontal direction sum up to zero.

With regard to the pump unit, it can be of any per se known type.

The arrangement for holding the device in a certain, desired position can typically comprise two opposite thrusters that maintain the orientation of the blower. This is preferably achieved automatically based on signals from an integrated gyro unit. The arrangement for holding the device in a certain desired position can also be an eccentric anchoring or suspension that prevents the device from rotating. Alternatively adjustable flaps or rudders may be used on the water jets from the main nozzles. In the case that the blower has just one single nozzle, the directionally controlling unit may typically be a wire suspended from a boat, barge, or other stationary or movable object.

The pump device suitable for creating the downward oriented water jet that can erode the sediment may typically comprise one or more thrusters (propels) that create a water jet downwards and out from the nozzles.

The nozzle assembly comprises two or more nozzles that are arranged with a downward inclination and in the case where there is no external bottom anchoring, to opposite sides. Typically one nozzle will point downwards and two nozzles will be downward inclined, but it is also contemplated that a number of nozzles can be arranged with varying orientations.

About the invention

Figure 1A is a side sectional view of a blower according to an embodiment of the present invention.

Figure 1B is a top view of the blower shown in Figure 1A.

- 5 Figure 2 is a side sectional view of a blower according to another embodiment of the present invention.

Figure 3 shows schematically use of the blower shown in Figures 1A and 1B

- Reference is now made to Figure 1A. The device according to the present invention can generally be seen as divided into three sections or floors where the top section is given reference numeral
10 20, middle section 30 and bottom section 40.

Top section 20 can be denoted a directionally controlling unit which controls and limits rotation around the vertical axis 11. This unit typically comprises two thrusters 21, one at each side, but may also be eccentrically connected by a wire that holds back any rotation.

- The middle section 30 can also be denoted a pump unit and comprises water inlet 31, at least one
15 thruster or propel 32 (two shown in Figure 1A) powered by a motor 33. The pump unit 30 is arranged to suck water in through the water inlets 31 and to move it vertically downwards to bottom section which is the nozzle assembly 40 of the blower 10.

- The bottom section or the nozzle assembly 40 of the blower is shown in Figure 1A comprising a
20 central nozzle 41 arranged to direct water substantially vertically downwards with a force sufficient to disintegrate/ erode more or less solid masses at the seafloor. In addition the blower has inclined nozzles 42 arranged symmetrically around the vertical axis 11 through the blower 10. When only two nozzles 42 are arranged mutually symmetrically around a common vertical axis, it means that their horizontal components are directed oppositely in relation to one another and that their angle in relation to the vertical axis is the same. For instance both nozzles can be
25 arranged with an angle deviating 20 degrees from the axis, 25 degrees from the axis, 30 degrees from the axis, or other chosen, common angle for both the two nozzles.

- These nozzles contributes to blow disintegrated material much farther away from the blower compared to what the central nozzle 41 is capable of alone, and not less important these nozzles 42 contributes to holding the space around the blower free from sediment, so that the operator
30 has good visibility and so that water sucked into the blower does not become severely contaminated. Since the side nozzles come in pairs, the blower maintains a neutral position in the water, since the horizontal forces are nulled out.

Figure 1B shows the blower seen from straight above, where the two horizontal thrusters 21 (one at each side) control or limit the rotation of the blower around its vertical axis, or simultaneously or separately are used to move the blower along a line parallel with the thruster axis. Typically it is desirable at the thrusters ensure that the blower's orientation is held stationary, without rotation.

5 The nozzles 41 and 42 (two), a number of three in total, are shown with dotted lines.

Figure 2A shows a slightly different embodiment from that shown in Figures 1A, 1B. The only difference is that there is an extra set of side nozzles 43 which has a direction a little closer to the horizontal line than the side nozzles 42. This embodiment thus can create an even larger horizontal movement of sediment, but is otherwise equivalent with the embodiment shown in
10 Figures 1A, 1B. Also other nozzle configurations having a substantially vertical central nozzle and a number of inclined nozzles arranged in pair or rotationally symmetrically around the blower's vertical axis are contemplated.

Figure 2B shows a top view of the blower from Figure 2A in principally the same manner as Figure 1B does for the variant according to Figure 1A. The dotted lines show the nozzle assembly
15 comprising the nozzles 41, 42 (two) and 43 (two), a total of five nozzles.

Figure 3 shows the blower suspended by a wire 51 or the like from a crane 52 arranged on a barge or boat 53. It should be emphasized, however, that the suspensions, cranes or the like do not form part of the invention and can have entirely different forms than those shown. In some cases a rigid, jointed suspension may be used, thus eliminating the need for stabilizing thrusters present.
20 The device according to the present invention can advantageously be provided with sonar, echo-sounder or the like (not shown) to monitor the distance to the seafloor and to subsea installations. It can furthermore be provided with gyro (not shown) which in cooperation with the thrusters 21 automatically can control and limit any rotation about the vertical axis.

Claims

1. Subsea device (10) with vertical axis (11) for removal of sediment, comprising a pump unit (30) which supplies pressurized water to a nozzle assembly (40) and nozzle assembly (40) comprising a central nozzle (41), **characterized in** that the nozzle assembly (40) furthermore
5 comprises at least two additional nozzles (42) directed with an inclination in relation to the central nozzle (41) and arranged angularly symmetric in relation to the vertical axis (11) of the device.
2. Subsea device (10) as claimed in claim 1, **characterized in** that a directionally controlling unit (20) controls any rotation around the vertical axis (11).
3. Subsea device (10) as claimed in claim 2, **characterized in** that the directionally controlling
10 unit (20) comprises two horizontal thrusters.
4. Subsea device (10) as claimed in claim 3, **characterized in** that the two horizontal thrusters (21) can be operated in parallel to move the device along a line parallel with the thruster axis.
5. Subsea device (10) as claimed in any one of claims 1 to 4, **characterized in** that the nozzle
15 assembly (40) comprises three nozzles of which one nozzle is oriented straight downwards while the other two nozzles are oriented with a downward inclination and in opposite directions.
6. Subsea device (10) as claimed in any one of claims 1 to 4, **characterized in** that the nozzle assembly (40) comprises two additional nozzles (43) which are oriented with a downward inclination, angularly symmetrical around the device vertical axis (11).
7. Subsea device (10) as claimed in claim 6, **characterized in** that the nozzle assembly (40)
20 comprises two mutually opposite nozzles (42) and two further mutually opposite nozzles (43) having an inclination from the vertical axis (11) which is different from that of the nozzles (42).
8. Subsea device (10) as claimed in claim 7, **characterized in** that each of the additional inclined nozzles (43) are arranged straight above a respective inclined nozzle (42).
9. Subsea device (10) as claimed in claim 1, **characterized in** that the device (10) is arranged
25 to be operated from a crane (52).
10. Subsea device (10) as claimed in claim 1, **characterized in** that the device is equipped with sonar, echo sounder, or the like to monitor the distance from the bottom and to subsea stations.
11. Subsea device (10) as claimed in claim 2, **characterized in** that the device is equipped with a gyro which in cooperation with the thrusters (21) are arranged to automatically control any
30 rotation about the vertical axis (11).
12. Subsea device (10) as claimed in claim 1, **characterized in** that the flushing pressure is provided by use of one or more propels or thrusters (32).

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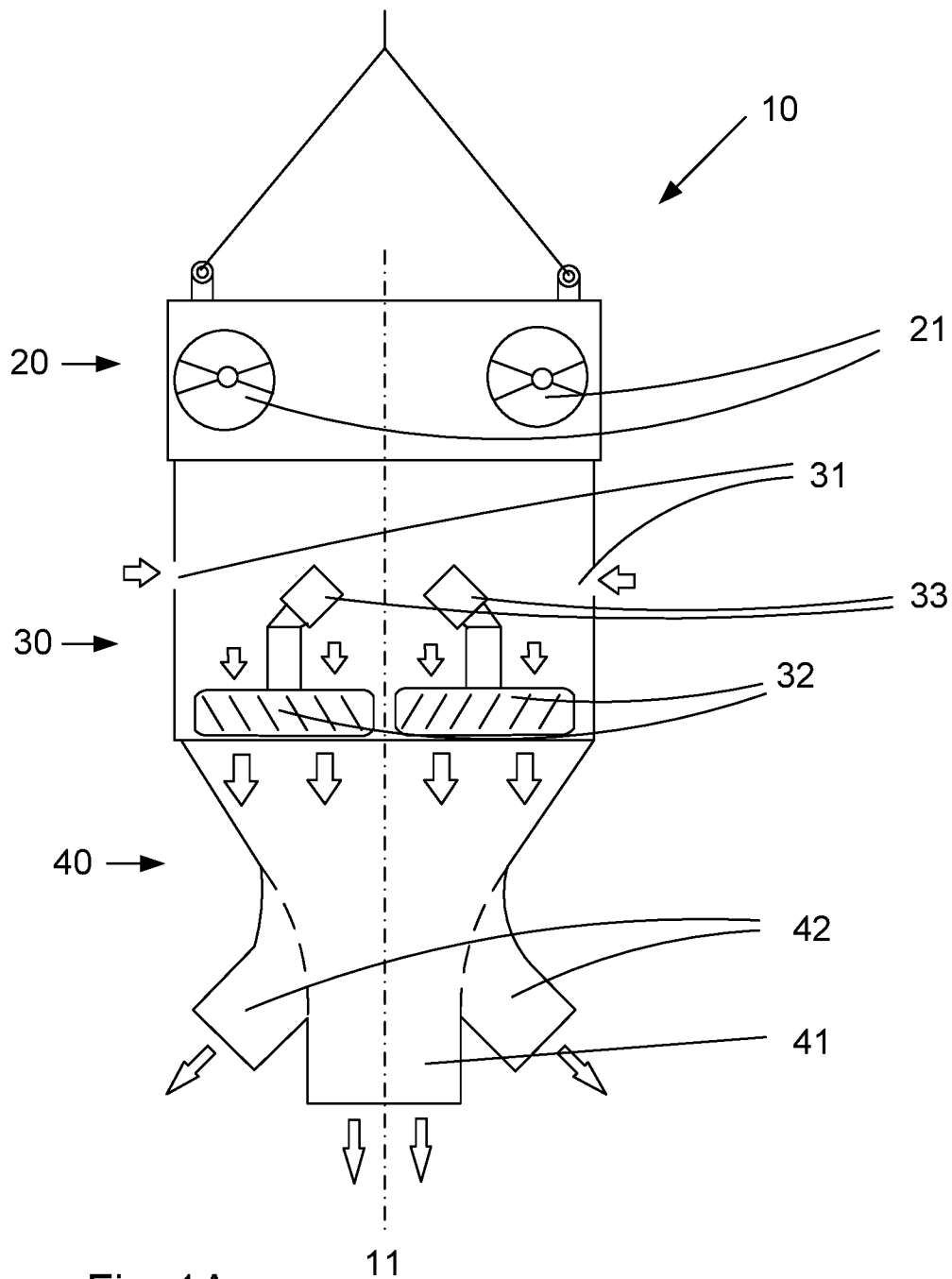


Fig. 1A

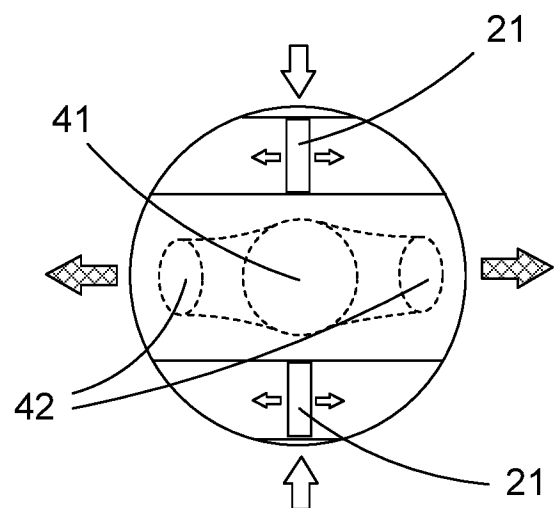


Fig. 1B

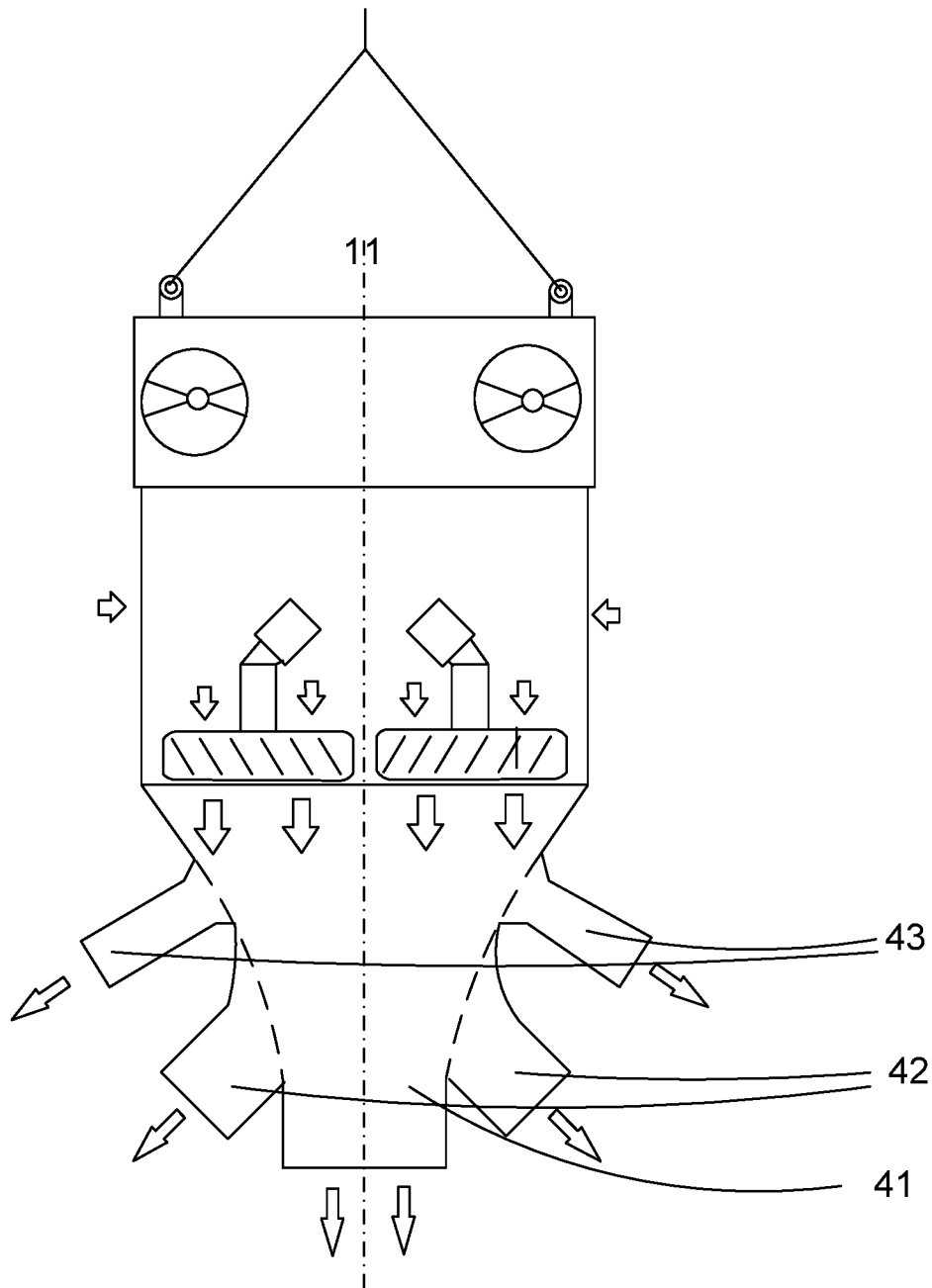


Fig. 2A

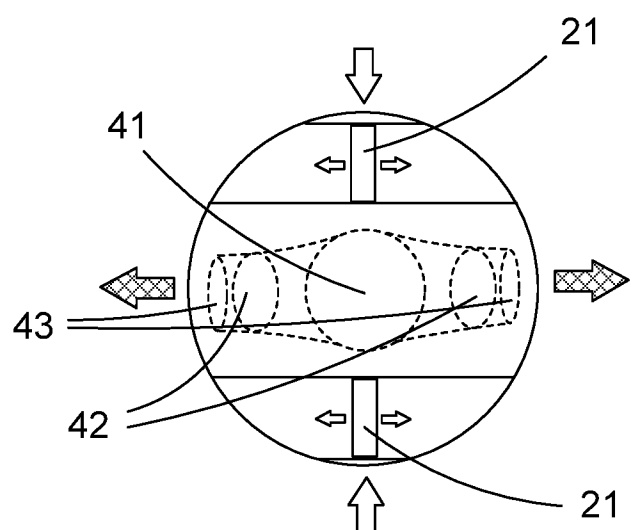


Fig. 2B

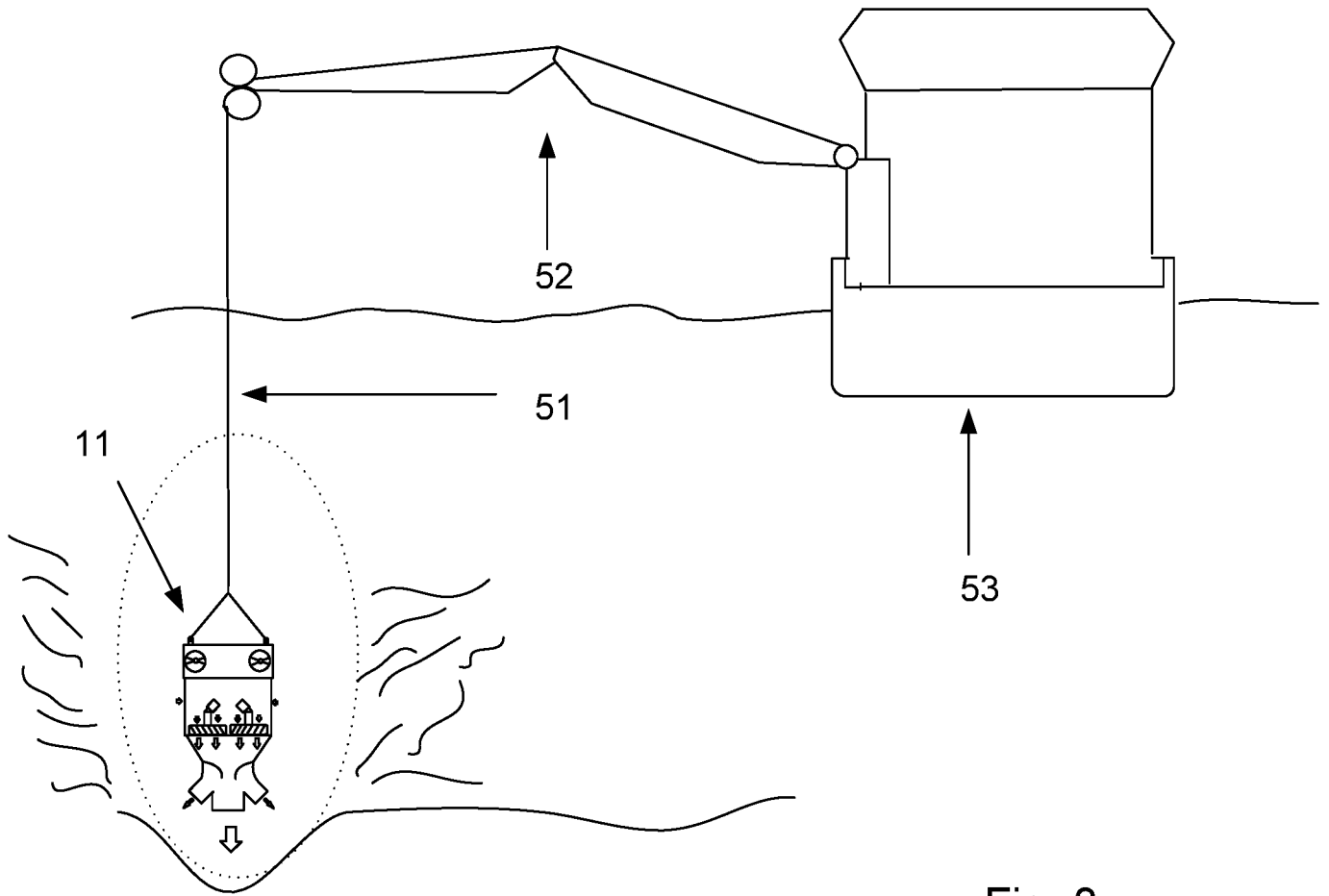


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER E02F 3/88 (2006.01), E02F 3/90 (2006.01), E02F 3/92 (2006.01), E02F 5/28 (2006.01) 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) E02F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched DK, NO, SE, FI: Classes as above.		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPODOC, WPI, FULDEKST: ENGELSK, TYSK, FRANSK		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010/0139130 A1 (WAGENAAR, Dirk C.) 2010.06.10, see the whole document, and particularly the abstract, description sections 0026, 0044 and 0047, and figure 2.	1 - 12
A	US 6053663 A (DIKKEN, Jacob Jan et al.) 2000.04.25, see the whole document, and particularly description column 8, and figures 11 - 16.	1 - 12
A	US 6125560 A (BEAUMONT, Robert Walter D.) 2000.10.03, see the whole document, and particularly the abstract, and figures 4 - 6.	1 - 12
A	US 1661672 A (MORRISON, Edgar H.) 1928.03.06, see the whole document, and particularly the figures 1 - 4.	1 - 12
☐ 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 17/06/2014		Date of mailing of the international search report 18/06/2014
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INTERNATIONAL SEARCH REPORT
Information on patent family members

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