DEVELOPMENT FOR SALVAGING A MARINE OR SUBMARINE ENGINE

Inventors: Viorel CIAUSU, SAINT RAPHAEL (FR); Marc LUCCIONI, LA SEYNE SUR MER (FR); Vincent RIGAUD, LE REVEST (FR)

Assignee: IFREMER-INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER, ISSY-LES-MOULINEAUX (FR)

Filed: Aug. 15, 2011

ABSTRACT

A device for salvaging a marine or submarine engine, this device comprising: a supple tie line (20) having a first end (21) to be connected to the engine (80), a bobbin (30) to which is connected a second end (22) of the supple tie line (20), the supple tie line being adapted to be wound around the bobbin, and a ballast charge (50) adapted to be combined with the bobbin (30). The bobbin (30) and the ballast charge (50) are such that the bobbin combined with the charge sinks, while the bobbin released from the charge floats; and the supple tie line (20) and the bobbin (30) cooperate such that the bobbin is released from the charge (50) by the unwinding of the supple tie line (20) wound around the bobbin (30).
DEVICE FOR SALVAGING A MARINE OR SUBMARINE ENGINE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a Paris Convention Application of French Appl. No. 1056656, filed on Aug. 18, 2010, which is incorporated by reference in its entirety.

TECHNICAL FIELD

The present disclosure relates to a device for salvaging a marine or submarine engine, and a marine or submarine engine equipped with such a device.

In particular, said engine can be an autonomous submarine vehicle or AUV (for Autonomous Underwater Vehicle).

BACKGROUND

Installations for salvaging AUV in water from a ship are already known. These installations typically comprise a traction system for pulling the AUV via a cable connecting the traction system and the AUV.

Installation examples of this type are described in published patent applications PCT No. WO 2008012472 and No. WO 2008012473.

In this type of installation, the cable is initially onboard the AUV. The first steps of salvaging the AUV consist of releasing the cable and waiting until it deploys in the water. Once the cable is deployed, it can be caught from the ship, for example by means of a harpoon or a grapple, and the free end of the cable (i.e. the end not connected to the AUV) can be hauled back on board the ship. The cable can then be attached to the traction system.

Now, these first steps and, in particular, the deployment of the cable in the water, can be a problem. In fact, it happens that the cable does not deploy correctly and especially remains near the AUV. In this case, it can be necessary to bring the ship close to the AUV to pick up the cable, increasing the risk of collision between the ship and the AUV and therefore the risk of damaging the AUV. It also eventuates that the cable can wind around some parts (ailerons, screw propeller, etc.) of the AUV, again increasing the chance of damaging the AUV.

There is therefore a need for a sure and simple solution for correctly deploying the cable connected to the AUV.

SUMMARY

The present disclosure relates to a device for salvaging a marine or submarine engine, this device comprising a supple tie line having a first end intended to be connected to said engine; a bobbin to which is connected a second end of the supple tie line, the supple tie line being adapted to be wound about the bobbin; and a ballast charge adapted to be combined with the bobbin. In this device, the bobbin and the ballast charge are such that the bobbin combined with said charge sinks, while the bobbin released from said charge floats, and the supple tie line and the bobbin cooperate such that the bobbin is released from said charge by the unwinding of the supple tie line wound about the bobbin.

The methods of use and the advantages of such a device are the following.

The bobbin, enclosed by the supple tie line and weighted by the ballast charge, is previously onboard the marine or submarine engine. The type of engine concerned is not limited and can be a floating engine or an engine in controlled immersion, and especially an AUV, a torpedo, a surface drone or another engine of similar architecture.

When the engine is to be salvaged from a salvaging base (e.g. a ship, a wharf, an offshore platform, etc.), the bobbin is first released or dropped from the engine. The bobbin then sinks because of the ballast charge. As it sinks, the bobbin brings along with it the supple tie line which unwinds as the bobbin goes down towards the bottom of the water. The unwinding of the supple tie line then prompts the release of the charge and accordingly the unballasting of the bobbin. Advantageously, freeing the charge happens at the end of the unwinding of the supple tie line, i.e. this release is caused by the unwinding of the last turns of the supple tie line.

Once released from its ballast charge, the bobbin becomes floating (i.e. its density becomes less than that of water) such that it no longer sinks, but instead floats to the surface. As the bobbin rises, the engine and the bobbin do not drift in the same way as they are not subjected to the same conditions of wind and current. The result is that the bobbin moves away horizontally relative to the engine as it rises and the bobbin surfaces at a significant distance from the engine.

Due to the descent of the bobbin and the relative movement away from the engine, the supple tie line is correctly deployed and spaced apart from the engine, making later salvaging easier. Also, the risk of the supple tie line winding about the engine is limited. Finally, relative to the prior art, salvaging of the tie line, and therefore of the engine, is easier and the risk of damaging the engine is less.

Supple tie line designates any type of sufficiently supple tie line which can be wound about the bobbin. This supple tie line must also be sufficiently resistant to support traction forces exerted on it. The supple tie line is, for example, a cable or a cord. Advantageously, the supple tie line is non-floating but sufficiently light so that the behaviour of the supple tie line in water is controlled mainly by the movement of the bobbin and the optional first ballast element described hereinbelow.

In certain embodiments, the supple tie line bears a first stop between its first and second ends, and the device also comprises at least one first ballast element configured to slide along the supple tie line between the first end and the first stop.

When the bobbin sinks, taking the tie line with it, the first ballast element slides along the tie line until it comes into abutment against the first stop. In this way, the first ballast element exerts on the first portion of tie line located between the first end and the first stop a traction force directed downwards, which tends to keep this first portion of tie line substantially vertical. The first ballast element and the stop also form an articulation zone about which the second portion of tie line, located between the first stop and the second end of the tie line, pivots when the bobbin rises to the surface. The fact that this articulation zone exists and is located at a certain distance below the engine further limits the risk of the tie line winding about the engine. In particular, this risk remains limited even if the engine is running after deployment of the tie line.

In certain embodiments, the bobbin has a winding surface about which the supple tie line can be wound, and the bobbin has a recess for receiving the ballast charge; this recess
having a first opening through which the ballast charge can pass, this first discharge opening being located on the winding surface.

[0019] In certain embodiments, the first opening is closed or blocked by a first cover, the first cover having an external face defining a part of the winding surface.

[0020] In certain embodiments, the second end of the supple tie line is connected to an attachment point located inside the recess, the supple tie line passes through the first cover, and the supple tie line bears a second stop between its second end and the cover. This second stop pulls the cover so as to unblock the first opening during unwinding of the supple tie line. Unblocking the first opening then allows the ballast charge to exit the recess and unballast the bobbin which will then rise to the surface.

[0021] In certain embodiments, the recess has a second opening through which the ballast charge can pass, this second opening being located outside the winding surface and closed or blocked by a second cover. The ballast charge can be introduced inside the recess through this second opening. Since the cover is located outside the winding surface, placing and removing the cover can be done independently of the winding of the supple tie line about the bobbin. For example, this allows one to introduce the ballast charge into the bobbin while the supple tie line is already wound about the latter.

[0022] In certain embodiments, the bobbin bears at least one second ballast element, this second ballast element being arranged on the bobbin so as to orient the first opening downwards, when the bobbin is under water. This helps to empty the recess of the ballast charge more easily and completely.

[0023] Another aim of the present disclosure is a marine or submarine engine equipped with a device such as described earlier, the first end of the supple tie line being connected to said engine.

[0024] In certain embodiments, said engine is configured to take onboard the bobbin enclosed by the supple tie line, the engine comprising a release system for releasing the bobbin.

[0025] In certain embodiments, the release system is remote-controlled. It can be remote-controlled from the salvaging base of the engine, where this salvaging base might be a ship, a wharf, an offshore platform, etc.

[0026] Several embodiments are described in the present disclosure. It is specified however that, unless otherwise stated, the features described in relation to one embodiment can be applied to another embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The attached drawings are schematics and are not necessarily to scale; their main aim is to illustrate the principles of the invention.

[0028] In these drawings, from one figure (FIG.) to the other, similar elements (or parts of element) are identified by the same reference sign. Also, elements (or parts of elements) belonging to different embodiments but having an analogous function are identified by reference numerals spaced apart by 100, 200, etc.

[0029] FIG. 1 is a perspective view of an example of a device according to the present disclosure, comprising a bobbin and a supple tie line wound about this bobbin.

[0030] FIG. 2 is a sectional view of the device of FIG. 1, as per the sectional plane II-II.

[0031] FIG. 3 is a sectional view, similar to that of FIG. 2, illustrating the bobbin before the ballast charge is introduced inside the bobbin.

[0032] FIG. 4 is a perspective view, illustrating the bobbin of FIG. 1 during release of the ballast charge.

[0033] FIG. 5 is a sectional view of another example of a device according to the present disclosure, comprising a bobbin and a supple tie line wound about this bobbin.

[0034] FIG. 6 is a sectional view of the device of FIG. 5, as per the sectional plane VI-VI, after unwinding of the supple tie line.

[0035] FIGS. 7 to 10 illustrate an example of an engine according to the present disclosure. These figures illustrate the successive steps of the deployment of the supple tie line fitted to this engine.

FIG. 11 is a detailed view of the front part of the engine identified by the circle XI in FIG. 7.

DETAILED DESCRIPTION OF EMBODIMENTS

[0037] Embodiments of the device propose are described in detail hereinbelow, in reference to the attached drawings. These embodiments illustrate the characteristics and advantages of the invention. However, it is recalled that the invention is not limited to these particular embodiments.

[0038] FIG. 1 illustrates an example of a device 10 for salvaging a marine or submarine engine 80. This engine 80 is shown in FIGS. 7 to 10.

[0039] The device 10 comprises a supple tie line 20 and a bobbin 30. The supple tie line 20 has two ends 21, 22. The first end 21 is connected to the engine 80, and the second end 22 is connected to the bobbin 30. In the example, the supple tie line 20 is a cord.

[0040] The bobbin 30 comprises a central core 31 defining a winding surface 33 for the tie line 20. This winding surface 33 is bordered by two flanges 34, 35 which keep the tie line 20 between them. In this example, the central core 31 and one of the flanges 34 form a monobloc assembly. The other flange 35 is fixed to the central core, for example by screwing (screw 36). It is to be noted that such a configuration has been chosen to adjust the floatability of the bobbin, and the flange 35 made from floating material(s) is machined, for example, with variable dimensions to vary the Archimedes thrust.

[0041] The central core 31 has a general shape of a hollow cylinder of axis A, with two openings at its axial ends, respectively blocked by two covers 37, 38. The cover 37 is mounted, for example by screwing on the flange 34 and cannot be dismantled. The cover 38 located to the side of the flange 35 blocks the opening 42 and is removable. The central core 31 and the covers 37, 38, together define a recess 40.

[0042] This recess 40 takes up a ballast charge 50. This ballast charge 50 is formed by an assembly of elementary charges of limited size such as for example metal balls, grains of sand, etc. In particular, the size of these elementary charges is clearly less than that of the openings 41, 42 of the recess 40.

[0043] This ballast charge 50 is introduced inside the recess 40 through the opening 42, herein called "inlet opening", as symbolised by arrow F1 of FIG. 3. This is possible as the cover 38 is removable. Also, as the inlet opening 42 and its cover 38 are located outside the winding surface 33 of the tie line 20, it is possible to place/remove the cover 38 even when the cable 20 is wound about the bobbin 30. The ballast charge 50 can therefore be introduced into the recess 40, through the inlet opening 42, after the winding of the cable 20.

[0044] The recess 40 also has another opening 41, herein called "discharge opening", through which the ballast charge 50 can exit the recess 40. This discharge opening 41 (see FIG. 4) is located on the winding surface 33 and, in this example,
it is closed or blocked by another cover 39 whereof the external face 39A defines a part of the winding surface 33.

[0045] The supple tie line 20 and the bobbin 30 cooperate such that the bobbin 30 is released from the charge 50 by the unwinding of the supple tie line 20 wound about the bobbin 30. More particularly, in this example, the unwinding of the supple tie line 20 causes displacement of the cover 39 and therefore the unblocking of the discharge opening 41.

[0046] More precisely, the second end 22 of the tie line 20 is connected to an attachment point 44 located inside the recess 40. Also, the supple tie line 20 passes through the cover 39 and bears a stop 45 between its second end 22 and the cover 39. The stop 45 is, for example, a node obtained by interlacing of the tie line 20. The length of the tie line 20 between its end 22 and the stop 45 is greater than the distance between the attachment point 44 and the cover 39 in its position closed. So, when the last turn of the tie line 20 unwinds, the tie line 20 stretches and the second stop 45 pulls the cover 39, which unblocks the discharge opening 41. The ballast charge 50 can then exit through the opening 41, as shown by arrow F2 in FIG. 4.

[0047] As the ballast charge 50 exits the recess 40 by gravity, via the opening 41, it is preferable for this opening 41 to be oriented downwards as much as possible. For this purpose, several solutions, which can be used alone or in combination, are proposed. One solution consists in providing a discharge opening 41 highly extended circumferentially (for example, more than 180°). Another solution consists in not positioning the attachment point 44 on the supple tie line 20 in a position diametrically opposite the discharge opening 42 but instead positioning the attachment point 44 near the discharge opening 41 and especially on the same side of the axis A as the opening 41. Another solution consists in mounting on the bobbin 30 one or more ballast elements 51, these ballast elements 51 being arranged on the bobbin 30 so as to orient the opening 41 downwards, when the bobbin is under water. In the example of FIGS. 1 to 4, five ballast elements 51 in the form of a pin are fixed on the flange 34 of the bobbin 30, on the same side of the axis A as the discharge opening 41.

[0048] Another example of a device 110 is represented in FIGS. 5 and 6. As does the device 10, the device 110 comprises a supple tie line 120 and a bobbin 130. The supple tie line 120 has two ends. The first end is connected to a submarine or marine engine, and the second end 122 is connected to the bobbin 130, at the level of an attachment point 144.

[0049] The bobbin 130 comprises a central core 131 defining a winding surface 133 for the line 120. This winding surface 133 is bordered by two flanges 134, 135 which keep the tie line 120 between them. In this example, the central core 131 and the two flanges 134, 135 form a monobloc assembly.

[0050] In this example, the central core 131 is not hollow. Yet it could be, especially for fluidity reasons.

[0051] The bobbin 130 has a recess 140 for receiving a ballast charge 150. This ballast charge 150 is a single piece such as, for example, a metal bar.

[0052] The recess 140 has the form of a groove made in the winding surface 133 and, in the example, oriented parallel to the axis of the bobbin.

[0053] The ballast charge 150 is introduced in the recess 140 via the upper opening 141 of the groove. The “upper opening” is the opening located facing the bottom of the groove. This upper opening 141 is located on the winding surface 133. The ballast charge 150 is introduced in the recess 140 prior to the winding of the tie line 120 around the bobbin 130.

[0054] The supple tie line 120 and the bobbin 130 cooperate such that the bobbin 130 is released from the charge 150 by the unwinding of the tie line 120. More particularly, in this example, it is the turns of the tie line 120 which keep the ballast charge 150 in the recess 140 and consequently the unwinding of the last turns releases the ballast charge 150 which can then slip out of the recess 140, as shown by arrow F3 in FIG. 6.

[0055] As the ballast charge 150 exits the recess 140 by gravity, via the opening 141, it is preferable for this opening 141 to be oriented downwards as much as possible. For this purpose, several solutions, which can be used alone or in combination, are proposed. One solution consists of positioning the attachment point 144 of the supple tie line 120 in a position diametrically opposite the opening 141, as shown in FIG. 6. Another solution consists of mounting on the bobbin 130 one or more ballast elements, these ballast elements being arranged on the bobbin 130 so as to orient the opening 141 downwards, when the bobbin is under water.

[0056] FIGS. 7 to 10 represent an example of an engine 80 according to the present disclosure. These FIGS. illustrate the successive steps of the deployment of the supple tie line 20 fitted on this engine 80.

[0057] In the example, the engine 80 is an autonomous underwater vehicle or AUV. It is equipped with a device 10 of the type shown in FIGS. 1 to 4. Of course, it could be equipped with another type of device and, especially, with the device 110 of FIGS. 5 and 6.

[0058] The engine 80 is configured to be able to take on board the bobbin 30 enclosed by the supple tie line 20. For example, the engine 80 has in its front part, or <<nose>> 80A, a recess 82 for receiving the bobbin 30, the tie line 20 and a ballast element 70 which also forms part of the device 10. The first end 21 of the tie line 20 is connected to the nose 80A of the engine 80, at an attachment point located inside or near the recess 82. The ballast element 70 is mounted to slide on the tie line 20.

[0059] The engine 80 also comprises a release system for releasing the bobbin 30. This release system can have different structures and different operating modes which depend in particular of the way in which the bobbin 30 is initially connected to the engine 80 and on the shape of the recess 82. In the example, the recess 82 is closed by a trap 85 (see FIG. 11) which can be opened by way of thrust means such as springs or jacks. In another example, the release system comprises an electromagnet which, when active, blocks the bobbin 30 inside its recess and which, when deactivated, releases the bobbin 30. Advantageously, the release system is remote-controlled.

[0060] On completion of its mission, the engine 80 returns to the surface where it is stopped (i.e. its propulsion means are stopped) or is still moving. Salvaging the AUV starts with releasing the bobbin 30 by using the release system remote-controlled from a distance, for example from a ship (not shown).

[0061] The bobbin 30 then dives under the effect of gravity and the tie line 20 unwinds in the water column located under the nose 80A of the engine 80, as shown by arrow F4 in FIG. 7. At the same time, the ballast element 70 slides along the tie line 20 until it stops against a stop 71 shown by arrow F5 in FIG. 8. This stop 71 is located at a significant distance from
the first end 21 of the tie line. For example, this stop is a node obtained by interlacing of the tie line 20.

After unwinding of the final turn of the cable 20, the cover 39 of the bobbin 30 opens and the ballast charge 50 is released, as shown in FIG. 8. The bobbin 30 then becomes floating and rises to the surface, pulling with it the tie line 20 as shown in FIG. 9. At the surface, the bobbin 30 behaves like a drifting buoy. The bobbin 30 can then be caught and taken on board the ship using different methods.

For example, one method consists in using a floating harpoon which is dragged by the ship on the cable. At the same time, the engine 80 moves in such a way that the trajectory of the tie line 20 intersects that of said cable. After intersection, the bobbin 30 is taken on board the ship by way of the cable and the harpoon.

Another method consists of approaching the engine 80 with the ship, the engine 80 idling or being stopped. When the ship is at a suitable distance, a harpoon is launched from the bridge of the ship to catch the bobbin 30.

With respect to the behaviour of the assembly formed by the engine 80, the bobbin 30 and the tie line 20 in the water, after the bobbin is released, it is to be noted that, in the first instance, the device functions in a water column. Next, once the ballast charge 50 is dropped, the bobbin rises to the surface. The bobbin 30 then drifts under the action of deep-sea currents, while the engine 80 drifts under the action of the wind and the surface sea current. The result is that the bobbin 30 arrives at the surface at a significant distance from the engine 80, achieving the goal in question.

When the bobbin 30 rises to the surface, the non-floating supple tie line 20 naturally tends to adopt the form of a small chain. The curve of this small chain is deformed by the ballast element 70. This ballast element creates a point of inflection between a first portion 20A of the tie line 20, extending between the first end 21 of the tie line and the stop 71, and a second portion 20B of the tie line extending between the stop 71 and the second end 22. The ballast element 70 tends to orient the first portion 20A as vertically as possible. This prevents the first portion 20A of the tie line from rising to the surface near the bulk of the engine 80, in particular when the engine 80 is moving, as shown in FIG. 10. The presence of the ballast element 70 and its stop 71 therefore clearly decreases the risk of seeing the tie line 20 becoming snarled in the ailerons or in the engine screw 80.

A device for salvaging a marine or submarine engine, this device comprising:

1. A supple tie line having a first end to be connected to said engine,
a bobbin to which is connected a second end of the supple tie line, the supple tie line being adapted to be wound around the bobbin, and
a ballast charge adapted to be combined with the bobbin;
in which the bobbin and the ballast charge are such that the bobbin combined with said charge sinks, while the bobbin released from said charge floats; and
in which the supple tie line and the bobbin cooperate such that the bobbin is released from said charge by the unwinding of the supple tie line wound around the bobbin.

2. The device of claim 1, wherein the supple tie line bears a first stop between its first and second ends, and wherein the device also comprises at least a first ballast element configured to slide along the supple tie line between the first end and the first stop.

3. The device of claim 1, wherein the bobbin has a winding surface around which the supple tie line can be wound, and wherein the bobbin has a recess for receiving the ballast charge, this recess having a first opening through which the ballast charge can pass, this first opening being located on the winding surface.

4. The device of claim 3, wherein the first opening is blocked by a first cover, the first cover having an external face defining a part of the winding surface.

5. The device of claim 4, wherein the second end of the supple tie line is connected to an attachment point located inside the recess, wherein the supple tie line passes through the first cover, and wherein the supple tie line bears a second stop between its second end and the cover in such a way that the second stop pulls the cover so as to unblock the first opening during unwinding of the supple tie line.

6. The device of claims 3, wherein the recess has a second opening through which the ballast charge can pass, this second opening being located outside the winding surface and being blocked by a second cover.

7. The device of claim 3, wherein the bobbin bears at least a second ballast element, this ballast element being arranged on the bobbin so as to orient the first opening downwards, when the bobbin is under the water.

8. A marine or submarine engine equipped with a device of claim 1, the first end of the supple tie line being connected to said engine.

9. The marine or submarine engine of claim 8, wherein the engine is configured to take on board the bobbin enclosed by the supple tie line, the engine comprising a release system for releasing the bobbin.

10. The marine or submarine engine of claim 9, wherein the release system is remote-controlled.

* * * * *