

WO 01/38169

PCT/FR00/03225

Device for destroying underwater objects

The present invention relates to the field of destroying underwater objects likely to present a danger to shipping, for example mines. Two main types of mine are known:

- bottom mines which rest on the sea bed, and
- buoyant mines which are tethered to a deadweight by a cable known as a mooring cable.

Bottom mines are destroyed by setting down an explosive charge known as a warhead in close proximity to the underwater object and exploding it. This procedure entails spotting the mine then bringing the warhead up close and finally causing explosion, as opposed to minesweeping which employs magnetic and/or mechanical means for setting off the mines or cutting their mooring cable.

The known methods for destroying an underwater bottom mine involve a step of detecting and/or of identifying the mine and a step of destroying the mine using a significant explosive charge, for example of the order of 50 to 100 kg, set down a distance of a few meters away from the mine that is to be destroyed, using an underwater vehicle, generally a remote controlled one.

Having recovered the underwater vehicle onto a mine hunter surface vessel, the mine is destroyed by exploding the charge, the shock wave of which causes sympathetic explosion of the mine.

Buoyant mines are destroyed using a similar detection and/or identification method followed by a step which consists in attaching pyrotechnic shears to the mooring cable, which shears are set in place using a remote controlled or wire-guided underwater vehicle. Here again, having recovered the underwater vehicle, the shears are pyrotechnically actuated by remote control from the surface vessel. The mine floats up to the surface and can be destroyed by gunfire.

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propulsion means and a second part equipped with an attack means, the second part being capable of pivoting with respect to the first part about an axis, so that the device can approach an underwater object in different orientations. The second part comprises at least one sensor means capable of detecting an underwater object so that the attack means and the sensor means can be oriented similarly with respect to an underwater object. The attack means is positioned correctly with respect to the underwater object right from the time of identification, and hence has better efficiency. The attack means may, if necessary, be repositioned, while at the same time maintaining detection.

Advantageously, the device comprises means of pivoting the second part with respect to the first part, the pivoting means being equipped with at least one motor. The orientation of the second part is thus precisely controlled.

In one embodiment of the invention, the pivoting means are equipped with at least one geared motor unit.

Advantageously, the second part comprises at least one means of observing underwater objects and/or at least one means of identifying underwater objects.

Advantageously, the second part comprises at least one means of estimating the range at which an underwater object lies, and/or at least one means of classifying underwater objects.

Advantageously, the second part comprises at least one means of remote communication with a support means such as a surface ship or an aircraft. The means of communication may comprise an acoustic transducer.

In one embodiment of the invention, the device comprises at least one database relating to underwater objects.

In another embodiment of the invention, the second part comprises at least one means of consulting

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a remotely situated database relating to underwater objects.

Advantageously, the device comprises at least one means of formulating an attack strategy according to the type of underwater object.

As a preference, the device comprises at least one means of commanding the second part to pivot, so as to find the best position for the acoustic transmission of data to a support means such as a surface ship.

Another subject of the invention is a method for destroying underwater objects in which the device moves toward an underwater object using propulsion means provided in a first part and angularly orientates a second part equipped with at least one attack means and with at least one sensor means so that the second part is suitably positioned with respect to the underwater object independently of the positioning of the first part.

The mine hunter is generally a surface vessel, but may also be an aircraft. In the latter case, a relay at the surface of the water allows the acoustic signals emitted by the underwater vehicle to be converted into radio or optical or electrical signals so that they can be sent to the aircraft.

The warhead will generally be a hollow charge, the exploding of which produces a main effect directed along one axis, hence the importance of the positioning with respect to the underwater object that is to be destroyed, this being all the more true since each type of mine has zones which are more sensitive or more fragile than others with respect to an external explosion.

The present invention will be better understood from studying the detailed description of one particular embodiment taken by way of entirely nonlimiting example, illustrated by the appended drawings, in which:

- Figure 1 is a view in longitudinal section on a vertical plane of the underwater vehicle of Figure 3;

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- Figure 2 is a view in longitudinal section on a horizontal plane of the underwater vehicle of Figure 3; and

- Figure 3 is a perspective view of an underwater vehicle according to one embodiment of the invention.

As can be seen in the figures, the underwater vehicle comprises a front end 1 of hemispherical overall shape, a rear end 2 with the overall shape of a truncated ogive and a central zone 3 of cylindrical overall shape.

The underwater vehicle is split into two parts articulated together; a first part 4 formed of the rear end 2 and of the central zone 3. The rear part 4 is equipped with propulsion means in the form of four careened propeller screws 5 and stabilizing means in the form of four retractable fins 6 arranged in a cross with the propeller screws 5 uniformly distributed between the fins 6. Figure 1 shows the lower fin 6 in the deployed position, the upper fin 6 being in the retracted position and therefore not visible. The same is true in Figure 2 of the left and right fins 6.

The rear part 4 also optionally comprises a protuberance 7 of cylindrical overall shape extending the rear end 2 backward. Arranged inside the protuberance 7 is a reel 7a of optical fiber which can be paid out as the underwater vehicle moves along and providing a link with the vessel or helicopter which launched the underwater vehicle. Also provided in the central zone 3 is a vertical conduit 8 inside which is arranged a propeller screw 9 forming a vertical propeller designed for changes in depth and precise vertical positioning of the underwater vehicle.

As can be seen more particularly in Figures 1 and 2, arranged inside the rear part 4 are an electric motor 10 for driving the propeller screw 9, four horizontal-propulsion electric motors 11, each driving a propeller screw 5, a number of batteries 12 for storing electrical energy, an electronic unit 13

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for controlling the electric propulsion motors, electronic boards 14 of a computer, a magnetic compass 15 and a transducer 16. There is also an electrical, hydraulic or pneumatic geared motor unit 17 and an
5 electronic control unit 18 assigned to the geared motor unit 17, the functions of which will be specified later on.

Coming out from the rear part 4 are two symmetric arms 19 oriented generally forward and each
10 at their free end supporting a journal 20. The front part 21, which is formed of the front end 1, is supported by the journals 20 and the arms 19 and is able to pivot with respect to the rear part 4 about the horizontal axis common to the two journals 20. Pivoting
15 of the front part 21 is brought about by the geared motor unit 17 controlled by the electronic unit 18. The fact of arranging the geared motor unit 17 and its electronic unit 18 in the rear part 4 makes it possible to reduce the mass of the front part 21 which can move
20 with respect to the rear part 4 and therefore reduces the pivoted mass. As a preference, the horizontal axis common to the two journals 20 passes through the center of gravity of the front part 21, which allows a smoother pivoting movement and reduces the torque
25 demanded of the geared motor unit 17. By virtue of the hemispherical shape of the second part 21, its pivoting does not affect the hydrodynamic behavior of the vehicle as a whole.

The front part 21 comprises a warhead 22
30 arranged more or less at its center and in the form of a hollow charge the effect of which is directed forward when the front part 21 is in the position of rest aligned with the rear part 4 at right angles to the axis of the journals 20. The front part 21 also
35 comprises a lamp 24 for illuminating the immediate surroundings of the underwater vehicle and oriented along an axis parallel to the axis of the hollow charge. Arranged symmetrically with the lamp 24 is a camera 23 of the analog or digital type, also oriented

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along an axis parallel to that of the hollow charge. The camera 23 and the lamp 24 project slightly from the generally hemispherical front end 1.

The front part 21 also comprises a sonar 5 25 arranged in a short cylindrical portion projecting from the front end 1 and oriented along a vertical axis, in the position of rest. An electronic unit 26 for controlling the sonar 25 is arranged inside the front part 21, as is a battery 27 for storing 10 electrical energy intended for the camera 23, the lamp 24, the sonar 25 and more generally all the power-consuming members associated with the front part 21. To communicate with the surface vessel or the aircraft which launched the underwater vehicle into the water, 15 there is a high-throughput transducer 28 projecting from the front end 1 more or less symmetrically with the sonar 25. The transducer 28 is controlled by an electronic unit 29 arranged inside the front part 21.

The rear part is also equipped with an echo 20 sounder 30 arranged in a lower zone of the underwater vehicle and capable of assessing the distance between said underwater vehicle and the bottom. An electronic unit 31 for controlling the transducer 16 is provided. The transducer 16 is arranged in a protuberance which 25 is more or less cylindrical along a vertical axis of the rear part 4 on the same side as the sonar 25. This transducer 16, of low throughput, allows propulsion commands from the surface ship or from the aircraft to be transmitted to the underwater vehicle and allows 30 information relating to the path of the underwater vehicle to be transmitted to the surface ship or to the aircraft. A flash 32 is arranged on the rear part 4 in an upper zone and allows a bright light to be emitted as the underwater vehicle returns to the surface to 35 make it easier for the surface ship or the aircraft to spot, particularly by night or under conditions of poor visibility.

For greater clarity, the longitudinal axis of the underwater vehicle is denoted 33, the axis of

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pivoting of the front part 21 or axis of the journals 20 is denoted 34, and the axis of the vertical propeller is denoted 35.

The underwater vehicle operates as follows. The
5 underwater vehicle is launched into the water from a surface ship or from an aircraft which has already spotted the object that is to be destroyed, for example using hull-mounted sonar, trailed dunking sonar, or alternatively a sonar-carrying vehicle moving in front
10 of the ship, or by other means. At the same time as or immediately after the underwater vehicle is launched into the water, the ship or the aircraft moves away to a safe distance where it does not run the risk of being damaged by the exploding of the warhead and of the
15 mine.

The underwater vehicle begins a gathering phase which, by virtue of its navigation means, particularly the propeller screws 5, takes it into a zone in which the previously spotted underwater object may be
20 located, using location means on board the underwater vehicle, particularly the sonar 25. The relocation step is performed through various maneuvers that make it possible to detect and locate the object in order to identify it. The sonar 25 is also used to estimate the
25 range at which the object lies from the vehicle. The identification step begins with an approach maneuver to allow the camera 23, possibly assisted by the lamp 24, to take pictures under good conditions. This taking of pictures may entail altering the orientation of the
30 front part 21 with respect to the rear part 4. The pictures taken by the camera 23 may either be processed automatically by image-processing software executed by a calculation unit, not depicted, arranged in the front part 21 or by the electronic boards 14, and making it
35 possible for the underwater object to be identified to confirm whether or not it is a mine, then, by comparison with a database, to be classified, that is to say for the type of mine to be recognized according to its manufacturer, its mass, its operation, etc., and

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more generally any characteristic useful in recognition. This automatic processing may be replaced by analysis followed by confirmation by a human operator after the pictures have been transmitted
5 acoustically by means of the transducer 28 to the surface ship or to the aircraft. It is also possible to envisage carrying out this automatic processing on board said ship or said aircraft.

The transmission of pictures to the surface
10 ship by the transducer 28, to confirm destruction in the case of a decision taken by an operator, or for information in the case of automatic processing, may entail pivoting the front part 21 with respect to the rear part 4 in order to aim at said ship, the purpose
15 of this being to achieve a good position for the acoustic transmission of the pictures by the transducer 28 and also a possible maneuvering of the underwater vehicle as a whole, particularly in the presence of acoustic obstacles such as thermoclines or physical
20 obstacles such as rocks.

Once the mine has been identified and a decision has been taken to destroy it, the attack step consists in describing a path suited to the type of mine identified, in order to come into contact with it
25 in a vulnerable zone, that is to say to present the hollow charge 22 in the position where it has the best chance of destroying the mine, then triggering firing. The return step consists, in the event of a negative identification, for example if the object is a piece of
30 wreckage and not a mine, in gathering toward a pre-ordained recovery zone in proximity to the surface ship or to the aircraft.

By virtue of the invention, the orientable head of the underwater vehicle is provided with sensors
35 which allow underwater objects to be observed, identified and classified, allow information and pictures gathered to be sent to the surface ship or to the aircraft under optimum conditions for information or confirmation, allow the range from the underwater

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vehicle to the underwater object to be assessed and, on the basis of this information, and following consultation of a database on board the underwater vehicle or on the surface ship or the aircraft, allow
5 an attack strategy to be formulated according to the type of mine. The fact of arranging the camera 23 and the warhead 22 on parallel axes allows positioning which is both more precise and more reliable, hence giving a greater probability of success, particularly
10 under difficult conditions, for example when there are underwater currents.

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CLAIMS



1. Device for destroying underwater objects, of the type comprising a first part (4) equipped with propulsion means and a second part (21) equipped with an attack means, the second part being capable of pivoting with respect to the first part about an axis, so that the device can approach an underwater object in different orientations, characterized in that the second part comprises at least one sensor means capable of detecting an underwater object so that the attack means and the sensor means can be oriented similarly with respect to an underwater object.
2. Device according to Claim 1, characterized in that it comprises means of pivoting the second part with respect to the first part, the pivoting means being equipped with at least one motor.
3. Device according to Claim 2, characterized in that the pivoting means are equipped with at least one geared motor unit (17).
4. Device according to any one of the preceding claims, characterized in that the second part comprises at least one means (23) of observing underwater objects and/or at least one means of identifying underwater objects.
5. Device according to any one of the preceding claims, characterized in that the second part comprises at least one means of locating an underwater object and/or at least one means (25) of estimating the range at which said underwater object lies, and/or at least one means of classifying underwater objects.
6. Device according to any one of the preceding claims, characterized in that the second part comprises at least one means (28) of remote communication with a support means such as a surface ship or an aircraft.
7. Device according to any one of the preceding claims, characterized in that it comprises at least one database relating to underwater objects.

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8. Device according to any one of the preceding claims, characterized in that the second part comprises at least one means of consulting a remote-situated database relating to underwater objects.
- 5 9. Device according to any one of the preceding claims, characterized in that it comprises at least one means of formulating an attack strategy according to the type of underwater object.
- 10 10. Device according to any one of the preceding claims, characterized in that it comprises at least one means of commanding the second part to pivot, so as to find the best position for the acoustic transmission of data to a support means such as a surface ship.

