METHOD FOR CONTROLLING A TORPEDO, TORPEDO THEREFOR AND ANTENNA SECTION OF SUCH A TORPEDO

The invention relates to a method for steering a torpedo to at least one target, wherein the torpedo surfaces one or more times in the area of a waterway close to the surface and adjacent to the water surface during its journey to the target, wherein the torpedo also remains submerged, however, in this area close to the surface, and extends a radio antenna into the above-water area above the water surface. Furthermore, the invention relates to a torpedo, which can be controlled remotely using this method, having an extendable radio antenna and a radio receiver for reception of position data. A steering method such as this and a corresponding torpedo are known from DE 601 24 520 T2. The invention also relates to an antenna section of a torpedo such as this, which is formed from sections.

Conventionally, torpedoes are launched from submarines and are guided to the target by interchanging data via an optical waveguide between the torpedo and the submarine. For this purpose, both the torpedo and a cassette, which belongs to the torpedo but remains in the submarine, each have an optical waveguide spool, from which the optical waveguide is unwound during the torpedo run and the submarine movement, respectively.

However, optical waveguides such as these can be produced only with a limited length. The ranges of such torpedoes guided by optical waveguides are therefore limited.

Furthermore, it is known from EP 0 494 092 A2 for a torpedo to be allowed to surface into an area close to the surface during its journey to the target, to unfold an antenna and to receive steering commands via the

radio antenna, which are used for steering to the target.

Furthermore, DE 10 2006 045 686 B3 discloses an unmanned underwater vehicle having a radio apparatus which is used for transmission of surveillance data.

Furthermore, DE 10 2006 024 858 B4 discloses a method for transmission of current images of a guided missile to an underwater vehicle via a permanent optical waveguide link.

Furthermore, DE 172 245 A describes an underwater moving body which is controlled from the land or from the water via guide wires.

Finally, US 3,890,919 discloses a launching apparatus for torpedoes on submarines.

In the end, the invention is based on the problem of increasing the range of (remotely) controlled torpedoes.

The invention solves this problem by means of a method for steering, in particular remote steering, of a torpedo of the type mentioned initially, in which the torpedo surfaces one or more times in the area of a waterway close to the surface and adjacent to the water surface during its journey to the target, wherein the torpedo also remains submerged, however, in this area close to the surface, extends a radio antenna into an above-water area above the water surface, and then receives position data via the radio antenna, which position data has target position data relating to the target and is transmitted to the torpedo from a land-based, airborne or seaborne control center, and uses this position data in order to steer to the target.

Furthermore, the invention solves the problem by means of a torpedo of the type mentioned initially having a control section for guiding the torpedo to a target, by means of which control signals for controlling control surfaces of the torpedo can be produced for course and depth determination of the torpedo, wherein the torpedo has an antenna section with an extendable radio antenna and a radio receiver for receiving position data which has target position data relating to the target, which position data is transmitted to the torpedo from a land-based, airborne or seaborne control center, and the position data can be supplied to the control section.

Finally, the invention also solves this problem by the provision of an antenna section for a torpedo such as this formed from sections, having an extendable radio antenna and a radio receiver for receiving position data which has target position data, wherein the antenna section has an interface which is designed such that the position data can be supplied to a control section.

The control section takes account of the position data to produce control signals which are presented to control surfaces of the torpedo in a control-surface section such that the torpedo travels to the desired target.

Because of a radio communication device in the torpedo, the invention allows signals to be transmitted by means of electromagnetic waves. Electromagnetic waves are normally not used for transmitting signals in the water since they have only a very short range in water. However, the invention is based on the discovery that electromagnetic waves can also be used in a worthwhile form for remote steering of torpedoes if the torpedo extends a radio antenna above the water surface while

electromagnetic waves are being transmitted. Electromagnetic signals can then be interchanged over long distances via a radio antenna such as this. Such distances significantly exceed the range of conventional optical waveguide spools. The use of electromagnetic waves for steering a torpedo therefore makes it possible to considerably increase the range of torpedoes. For this purpose, the invention envisages that the torpedo will surface to close below the water surface such that the antenna can be extended above the water surface. The position of the torpedo can be determined precisely, with the course of the torpedo to the target being determined precisely, using the position data received by means of the antenna. The received position data therefore makes it possible to compensate for any course fluctuations of the torpedo, which can occur during a phase without external data transmission, even over long ranges and long distances.

According to the invention, a further antenna section is installed for this purpose in a conventional torpedo formed from sections, which antenna section has the extendable antenna and a corresponding radio receiver for receiving position data. This antenna section can be installed in a torpedo formed from sections with minimal effort, as a result of which there is no need to completely redesign torpedoes. For this purpose, the antenna section has an interface which is designed such that the position data obtained by means of the antenna section can be supplied to a control section, by means of which control signals for controlling the torpedo control surfaces can be produced for course and depth determination of the torpedo.

The position data advantageously has target position data relating to the target, which position data is transmitted to the torpedo from a land-based, airborne or seaborne control center. The received position data

may therefore be or contain data transmitted from a control center - in addition to or as an alternative to the position data from a navigation system. This allows changes in the target position to be transmitted to the torpedo, thus allowing the target to be tracked even over relatively long torpedo journey times, and therefore target journey times. This is advantageous when the target has completed a maneuver and there is therefore a risk of the target moving out of the expected target region. This makes it possible to ensure that the target is within the detection range of the torpedo when the torpedo approaches the target. The target region, or an expected target region located within the target region, can therefore be readjusted, making it possible to take account of target maneuvers while steering to the target. This is particularly advantageous since long torpedo ranges actually result in long journey times by the torpedo, which can lead to significant position changes and possibly also course changes of the target during the journey time of the torpedo.

In one preferred embodiment, the torpedo has a torpedo sonar with a limited detection range, wherein the torpedo is launched outside a so-called target detection area which is determined around a target, within which target detection area the detection range is sufficient to detect the target, and the torpedo is steered to the target by means of the torpedo sonar on reaching a target region which is located within the target detection area. The torpedo's own torpedo sonar is therefore used only in the target region. This is advantageous because the range of a torpedo sonar is normally limited, and it is therefore possible to steer the torpedo on the basis of its own torpedo sonar only in a tightly constrained area around the target. The torpedo is guided to the target region by means of the radio antenna and the position data received via the

radio antennas and, on reaching the target region, the torpedo activates its own torpedo sonar, and then autonomously finds its target. There is therefore no need for the torpedo to surface in the vicinity of the target. This is advantageous since surfacing and extending an antenna increase the risk of radar detection of the torpedo, even when the torpedo hull is still submerged.

In a further special embodiment, the position data has so-called own position data of the torpedo, that is to say data from which the torpedo's own position results. This data is obtained by means of a satellite-based, airborne, land-based and/or seaborne navigation system, and is used for correction of the torpedo's own course. This is advantageously GPS navigation data, that is to say data from a satellite-based global positioning system. This variant is advantageous since an angle error occurs with respect to the course of the torpedo while the torpedo is traveling over a long distance, because of limited accuracy of a torpedo's own navigation system under water, in particular a gyrometer or gyroscope. The longer-lasting the journey of a torpedo, the greater the discrepancy from the desired course becomes because of the angle error. The torpedo uses the received position data to determine its own position, in order then to carry out the necessary course correction.

In a further special embodiment, the torpedo has not only a radio receiver for reception via the radio antenna but also a radio transmitter for transmission via the radio antenna, such that the position data, in particular target position data or else own position data, can be transmitted via a bidirectional radio data link. This radio data link will advantageously be passed via one or more satellite-based, land, airborne and/or seaborne relay stations. Thanks to a

bidirectional radio data link such as this, it is possible for a link to be set up between the control center and the torpedo only when the torpedo has registered with a relay station. A data interchange is therefore carried out in both directions for setting up a link, that is to say from the torpedo to the control center and, conversely, from the control center to the torpedo. This allows additional special commands to be passed to the torpedo, such as the command to terminate a mission.

In a further special embodiment, the torpedo transmits current and/or previously stored sonar data from the torpedo sonar via the radio data link to the control center. The control center therefore receives precise sonar data from a sonar close to the target, specifically the torpedo sonar, which is useful for position surveillance in the control center.

In a further special embodiment, the control center is a mobile control center which receives targets assigned by a permanently installed, remote operation center. That is to say the control center is itself guided by a higher-level operation center, and then itself guides the torpedo to its target. An organization such as this having a mobile control center is advantageous since this allows the control center to be installed quickly, and in particular to be deployed in the vicinity of the coast. This is particularly advantageous when the communication between the control center and the torpedo is passed via land-based, airborne or seaborne relay stations. This is because any obstructions, such as mountains, which could adversely affect the communication link, can thus be bypassed.

In a further special embodiment, the target position data is obtained from land-based, airborne and/or seaborne radar and/or visual surveillance. This allows

target position data to be obtained very precisely and in an up-to-date form as well, to be precise often more precisely than the data obtained from passive sonar installations in submarines. The precision of the target data is thus advantageously increased.

In a further special embodiment, waypoints for its route to the target are signaled to the torpedo and/or are transmitted by radio, which waypoints are then steered to during its journey to the target. Guidance of a torpedo along waypoints is advantageous since this allows obstructions, such as islands or other restricted regions, for example sea lanes for commercial shipping or areas of jurisdiction of other states, to be bypassed.

In a further special embodiment, the control center makes a target selection during the journey of the torpedo when surveillance identifies a plurality of targets instead of one previously assumed single target, and the control center signals a selected target to the torpedo, which target the torpedo has to attack. This embodiment is advantageous when a plurality of marine vessels are in a group, in particular also including merchant vessels, which must not be attacked.

The antenna section of the torpedo is advantageously lighter than the water displaced by it, in particular seawater, as a result of which the antenna section reduces the torpedo's own negative buoyancy. This is because torpedoes are normally provided with negative buoyancy, so that they sink to the seabed when the propulsion system is not running. However, the reduction in the negative buoyancy reduces the energy required by the torpedo during its journey, thus allowing greater ranges to be achieved.

The torpedo is advantageously launched from a land-based deployment system. For this purpose, the torpedo is accommodated in a launching apparatus for launching the torpedo, which has a container, which can be moved on land, for transporting the container, wherein the container contains a deployment system for land-based deployment of the torpedo into a coastal waterway.

This variant is based on the knowledge that torpedoes need not necessarily be launched from an offshore platform, but this is also possible by means of a land-based system. A land-based deployment system is provided for this purpose, by means of which torpedoes can be deployed into the water directly from land, and can be launched there. This means that seaborne platforms are superfluous, thus making it possible to dispense with the use of costly surface vessels or underwater vessels. This makes it possible to produce a significantly more cost-effective system for launching torpedoes which, furthermore, can be used highly flexibly because of its mobility.

The deployment system preferably has a cantilever arm which can be extended from the container, a trolley and a cable, wherein the trolley can be moved on the cantilever arm, and one of the two ends of the cable can be connected indirectly or directly to the torpedo and is passed over the trolley, and its second end is connected to a drive, by means of which the torpedo can be let into the water when the cantilever arm is extended and the trolley has been moved to an outer limit position on the cantilever arm. The torpedo can therefore be moved out of the container with the aid of the trolley and the movable cantilever arm, can be let essentially vertically into the water above the waterway, and can then be launched.

This embodiment is particularly advantageous because this ensures that the torpedo can be deployed in a controlled manner into the water even in shallow waterways. The torpedo can be launched even in a shallow water depth, since it can be accelerated from a stationary, horizontal rest position. This is made possible by the torpedo being released to a predetermined water depth essentially vertically and guided on a cable.

In a further preferred embodiment, the deployment system has a cage for holding the torpedo, wherein the first end of the cable can be connected to the cage. Because of a cage such as this, the torpedo does not require any unlatching device in order to disconnect it from the cable, as would be necessary in the case of an alternative, direct attachment of the cable to the torpedo. However, this would first of all lead to sinking and therefore to vertically directed acceleration of the torpedo. However, because of the cage, the torpedo can be accelerated horizontally out of the cage.

The embodiment as a cage, that is to say with only a few straps which surround the torpedo, is particularly advantageous since no air need be displaced when immersing the torpedo, as would be the case, for example, with a tubular container. Furthermore, there is also essentially no recoil on the cage during launching of the torpedo, which would lead to uncontrollable movements of the cage, and would therefore make it harder to launch the torpedo horizontally. The use of a cage is therefore also advantageous in terms of the required water depth. This is because, if a torpedo with a running propeller were first of all to start a dynamic dive because of an inclination, a substantially deeper water depth would be required for launching. However, because of the

horizontal launching orientation of the torpedo, assisted by the cage, even shallow water depths are sufficient to launch the torpedo.

In a further special embodiment, the cantilever arm is in the form of a telescopic cantilever arm with a plurality of telescope segments. A telescopic cantilever arm such as this allows longer cantilever arm ranges and therefore a launch position further away from the shore, where greater water depths can be expected. The options for use of the launching apparatus are in this way extended since, therefore, the torpedo can be deployed into the water even from shores which fall away gradually.

In a further special embodiment, the container has a counterweight which is arranged in the area of the end of the container and is opposite a possibly closeable opening, in particular a rear opening, for the cantilever arm to move out of. This embodiment is advantageous with respect to longer cantilever arm ranges, which have a tendency to cause a greater tilting torque on the container, with the risk of tilting of the container about a rear lower edge of the container or about a (rear) axle of a trailer carrying the container. The counterweight allows a tilting torque such as this to be counteracted. The counterweight therefore allows longer cantilever arm ranges. As already stated above, this leads, however, to an increased field of use, since the greater range allows a torpedo to be deployed even in a waterway which falls away gradually, since greater water depths can be reached because of the longer cantilever arm range.

The cantilever arm is advantageously mounted in the upper area of the container. This allows the space below the cantilever arm to remain free for storage of a plurality of torpedoes. This allows a multiplicity of

torpedoes to be accommodated in a single container, without any problems.

In a further embodiment, the deployment system has a sliding device which can be lengthened, starting under a torpedo located in the container or adjacent to a cage holding the torpedo, extending via a closeable opening, in particular a rear opening, in the container, and inclined downward. This allows a torpedo to be deployed into the water by sliding, and then to be launched. For this purpose, the torpedo requires only an inclined sliding path, which is advantageously in the form of a groove. This sliding path starts in the container under the torpedo or adjacent to said cage, and is lengthened by one or more sections outside the container in the course of launch preparations. This allows the deployment system to also be used on beaches or on muddy coastal sections where the immediate shore area cannot be driven on.

The sliding device therefore advantageously has a plurality of slide lengthening segments, which can be connected to one another. This allows the slide to be lengthened such that it is also possible to reach greater water depths, in which the torpedo can be launched without any problems and without the risk of damage on the bottom of the waterway.

In a further advantageous embodiment, the deployment system has a cage for holding the torpedo, in which case this cage can be pivoted about a pivoting shaft, which is provided in the area of the container opening, on a vertical plane by means of a drive. Pivoting of this cage means that the torpedo starts to slide from a predetermined inclination angle, as a result of which it enters the water via the sliding device. The torpedo is thus released by pivoting the cage.

In one special embodiment, the cage has attachment means for attaching a cassette to a communication line which connects the launching apparatus and the torpedo, in particular in the case of an optical waveguide. Torpedoes are normally connected via a communication line to a control center for controlling the torpedo. The communication line is for this purpose unwound from the torpedo, in which case a communication conductor spool is normally also unwound from the launch platform, in the case of moving launch platforms. However, since, according to the invention, the launch platform remains stationary while the torpedo is running in the water, only a communication conductor spool with a short length is required in the area of the launching apparatus. This part of the communication line is, however, accommodated in a cassette, which is advantageously attached to the cage.

In this case, the cassette advantageously comprises a spool on which the communication line is wound up, as well as a protective flexible tube for guiding the communication line. The protective flexible tube in this case has a length which corresponds to a plurality of times the length of the cage. In this case, "a plurality of times the length" also means non-integer multiples of the length. In this way, the communication line is protected by the protective flexible tube, to be precise over a length which is greater than the length of the cage. The communication line is therefore protected not only in the area of the cage but also in the area of the surf, that is to say also in an area in which wave strikes could possibly damage the communication line if it were unprotected in the water.

In a further special embodiment, the container is provided with a control space, which is equipped with at least one workstation. This control space has control devices for launching and guiding the torpedo.

By way of example, the launching process can be initiated via this control space. Furthermore, for example, a torpedo mission can also be terminated from this control space, if this were to become necessary.

In one specific embodiment, the control space is separated from the space which holds the torpedo by a partition wall, which preferably has a door. This partition wall advantageously has a projection in the direction of the control space, in the area of the torpedo. This increases the maximum length of a torpedo which is accommodated in the container. This allows a torpedo to be extended by one or more additional battery sections. This is advantageous since this allows its range to be increased.

The container is advantageously a forty-foot container with the normal dimensions for maritime trade. Containers such as these have a length of 12.19 m, a width of 2.44 m and a height of 2.60 m. The container is therefore preferably designed in accordance with ISO 668. This is advantageous because a container such as this can be loaded using conventional loading facilities onto marine vessels or onto goods vehicles and trailers for holding such standard containers. This simplifies the handling of such containers, and reduces the costs incurred for production and use.

The launching apparatus therefore preferably provides a trailer for transporting the container. However, alternatively, the container can be firmly connected to a chassis.

Further advantageous embodiments will become evident from the dependent claims and from the exemplary embodiments, which will be explained with reference to the attached drawing, in which:

Figure 1 shows one exemplary embodiment of a method according to the invention for steering a torpedo;

Figure 2 shows one exemplary embodiment of a torpedo according to the invention, and

Figure 3 shows a scenario to explain the remote control of a torpedo and the tracking of a target region.

Figure 1 shows a torpedo 1 which has been deployed into a sea region 4 from a land-based deployment system 3 provided in a container 2. The container is located on a trailer 5, which can be moved on land by means of a towing vehicle 6. A plurality of such container-based, land-based deployment systems 3, 3', 3'' are positioned along a coastline 7. Control systems are located within the container 2 and are connected via a communication line 8, for example an optical waveguide, to the torpedo 1, at least over a first distance, and therefore for a first time period. This first distance is limited by the length of the communication line which, in particular, is wound on a spool which is fitted within the torpedo 1. For this first time period, the torpedo 1 can be guided by means of the communication line, but can also transmit data, in particular sonar data, back to the control systems in the container 2. However, the length of the communication line 8 is no longer adequate for distances greater than this first distance, as a result of which the torpedo 1 is guided via a radio link 9.

For this purpose, the torpedo 1 has a radio antenna 10 which, in the illustrated exemplary embodiment via a satellite 11, a communication link connects to the control system accommodated in the container 2, and/or to a mobile control center 12. The control system

within the container 2 is therefore likewise equipped with a radio antenna 13, and the mobile control center 12 likewise has a radio antenna 14. The mobile control center 12 and the radio antenna 14 are each connected to a transmitting/receiving device 15, which interchanges data with the control center 12 and generates signals for transmission via the antenna 14, as well as converting signals received by the antenna 14 to data signals for the control center 12.

The mobile control center 12 is in turn connected via a radio-based or cable-based link 16 to a higher-level operation center 17, which receives radar surveillance data, obtained via a radar 18, relating to a sea region. The radar surveillance data is used to assign one or more torpedoes 1 to enemy targets, which torpedoes 1 are guided to the relevant target, in order to neutralize the target.

As an alternative to or in addition to surveillance by means of a radar, optical and/or hydroacoustic surveillance systems can be used to locate targets.

After the operation center 17 has assigned targets to the control center 12, coordinated via the link 16, the control center 12 steers a torpedo 1 to the target region.

Since the target region may be located beyond the range of the communication line 8 and beyond the detection range of a torpedo's own torpedo sonar, the torpedo 1 is steered via a radio link. Therefore, the torpedo 1 surfaces to closely below the water surface at predetermined times, to be precise to such a distance that its drive and control-surface section are still completely under the water, in order to ensure controllability of the torpedo. Closely below the water surface, the torpedo extends its radio antenna

sufficiently that it is located above the water surface and can set up a radio link, without being interfered with by the water, to the satellite 11 or to other airborne, seaborne or land-based relay stations. These relay stations have a radio link to the control center 12.

Via this link, the torpedo 1 receives data relating to the target, in particular information about a change in the target region or expected target region, possibly as well as further information relevant to its mission, such as a command to terminate a mission or to bypass restricted sea regions in which obstructions or own or friendly marine vessels are located.

Additionally or alternatively, via the antenna 10, that is to say in the surfaced state, the torpedo 1 receives information about its own position, to be precise via a satellite-based navigation system, such as GPS (global positioning system) or Galileo or similar land-based, seaborne or airborne systems. The torpedo 1 can therefore determine its own position exactly when in the surfaced state. If its target and the position thereof have already been defined precisely in advance, for example because this is a fixed-position target, there is no need for a bidirectional communication link to the control center 12. In fact, precise position data relating to the own position is then sufficient to reliably guide the torpedo 1 to the target.

However, if the target assigned to the torpedo 1 is a moving target, in particular a water craft, the torpedo 1 activates its own on-board sonar at the latest as soon as the target region is within range of the torpedo sonar, and guides itself to the target on the basis of its own sonar data.

The torpedo's own sonar data is preferably sent back via said relay stations to the control center 12, via the antenna 10 when the torpedo 1 is surfaced, thus allowing the control center 12 to identify whether the target data obtained by means of the previous surveillance, for example using the radar 18, was sufficiently detailed. In particular, it is possible in this way to determine whether a target actually consists of only a single target or a group of a plurality of targets. If the latter is the case, a target selection is made in the control center 12 or in the operation center 17, for example by the most important target being neutralized, or civilian targets not being attacked.

Figure 2 shows an enlarged illustration of the torpedo 1. Adjacent to a sonar head 19, the torpedo 1 has a section 20 with an explosive charge. Furthermore, the torpedo has a plurality of battery sections 21, 22, 23, 24 as well as a control section 25, a communication conductor section 26 which contains a spool with a communication line, and a drive section 27 with a motor for driving two contrarotating propellers 28, 29. Furthermore, the torpedo 1 has a control-surface section 29 with a plurality of control surfaces 30 for determining the course and the depth of the torpedo during its journey.

Approximately in the area of its center of gravity, the torpedo has an antenna section 31, which has an extendable antenna 10 as well as radio communication devices for transmission and/or reception. By way of example, the antenna 10 is telescopic. It has a length which is sufficient to allow it to reach the water surface even when the torpedo 1 is submerged, in order in this way to set up a satellite communication link or at least to allow data to be received from a satellite-based navigation system.

The torpedo 1 advantageously reduces its speed of movement before it extends the antenna 10, and increases its speed again once the antenna 10 has been retracted.

The antenna 10 has a structure by means of which data can be received and/or transmitted at at least two frequencies. This is advantageous since, on the one hand, own position data can be received, in particular via a satellite navigation system and, on the other hand, target position data and further data can be interchanged via a further communication channel. The frequencies are advantageously provided in the same frequency band, in order that the antenna structure required for each frequency is essentially of the same order of magnitude.

The antenna 10 advantageously has a plurality of separate antenna structures, in particular two. This is advantageous since each antenna structure is designed specifically for one specific frequency range. The signal-to-noise ratio can therefore be optimized for each individual antenna structure. The antenna structures are preferably designed in a similar embodiment size, which is as small as possible. This makes it easier to arrange the antenna 10 in a streamlined form in the retracted state. Alternatively, the antenna has a multiband antenna structure, which is tuned to a plurality of frequencies. Bidirectional communication is provided by means of at least one of the frequencies.

Taking account of its volume, the antenna section 31 is lighter than the surrounding (sea)water and in this way reduces the negative buoyancy of the torpedo 1. This reduces the energy required by the torpedo, thus making it possible to increase its range.

With the exception of the antenna section 31, the components of the torpedo 1 correspond essentially to those of a conventional torpedo to which a further section, specifically the antenna section 31, has been added, however. The antenna section 31 is therefore a modular component, which can be introduced into conventional torpedo concepts.

The antenna section 31 can therefore be connected to the control section 25 merely via an interface, in order to ensure data interchange of the transmitted and received radio data.

Figure 3 illustrates the guidance of a torpedo 1 to a target Z which is moving along a target path 33. The torpedo 1 moves along its own path 34.

The torpedo 1 is deployed into the sea region 4 by means of the land-based deployment system accommodated in the container 2, and first of all moves there over the distance D subject to remote control by means of the communication line, for example by means of optical waveguide or copper cable.

Once the communication line has been completely unwound and is thus disconnected, the torpedo 1 first of all surfaces at the position P1 and receives new coordinates for a target region 35 within which an expected target region is located at a time at which the torpedo 1 could have reached the expected target region 36. The torpedo 1 surfaces again at a predefined time, to be precise at the position P2. However, by means of radar-based surveillance and/or possibly hydroacoustic surveillance and/or visual surveillance, it has been found in the operation center 17 that the target Z has carried out a target maneuver, that is to say a course change, as a result of which the target

region as well as the expected target region have changed, and the new target region is represented by the reference number 37 in Figure 3, and the new expected target region by the reference number 38.

The torpedo 1 therefore itself carries out a course change and leaves the initially planned route 39, turning onto a new route 40.

The dashed line around the torpedo 1 in Figure 3 shows a detection area 41 within which the torpedo's own signal can detect targets. Figure 3 therefore illustrates that the distance traveled by the torpedo is significantly greater than the detection radius associated with the detection area 41. The torpedo 1 therefore cannot be controlled solely by its own on-board sonar. It is therefore controlled via the above-mentioned radio link, via which the torpedo 1 is guided into the target region 35 or 37. As soon as the target region 35 or 37 is located within a so-called target detection area 42, around the target, which is governed by the detection range of the torpedo 1, the torpedo 1 can be steered to the target by means of the torpedo's own sonar. However, in this case as well, that is to say when the target region 37 is within the target detection area 42, it is worthwhile, depending on the situation, for the torpedo to surface and set up a communication link via said relay stations to the control center 12 and/or to the operation center 17, in order to transmit data from the target region to the control center 12 and/or operation center 17, since this is useful for surveillance purposes.

Figure 3 also illustrates that the special remote control of the torpedo makes it possible to bypass restricted regions 43, such as islands, by means of predefined waypoints.

The remote control method according to the invention allows significantly longer ranges for torpedoes, which are achieved in particular by the torpedo traveling at a significantly reduced speed, in order to use less energy per distance traveled. However, the relatively low speed leads to considerable discrepancies from a predefined course, since the angle discrepancy is, inter alia, time-dependent, that is to say it becomes greater the longer the torpedo is moving. These course discrepancies are overcome according to the invention by course corrections, which are dependent on determining the position of the torpedo. This position determination is carried out according to the invention in the surfaced state, on the basis of data from a preferably satellite-based navigation system.

The invention allows conventional torpedoes to be upgraded to achieve significantly longer ranges. The fields of use and operational purposes of torpedoes can thus be extended considerably by the invention.

All of the features mentioned in the above description and in the claims can be used according to the invention both individually and in any desired combination with one another. The invention is therefore not restricted to the described and claimed feature combinations. In fact, all combinations of individual features should be regarded as having been disclosed.

CLAIMS
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1. A method for steering a torpedo (1) to at least one target (Z), wherein the torpedo (1) surfaces one or more times in the area of a waterway (4) close to the surface and adjacent to the water surface during its journey to the target (Z), wherein the torpedo (1) also remains submerged, however, in this area close to the surface and extends a radio antenna (10) into an above-water area above the water surface,
characterized in that
the torpedo (1) then receives position data via the radio antenna (10), which position data has target position data relating to the target and is transmitted to the torpedo (1) from a land-based, airborne or seaborne control center (12), and uses this position data in order to steer to the target (Z).

2. The method as claimed in claim 1,
characterized in that
the torpedo (1) is fitted with a torpedo sonar (19) with a limited detection range and is launched outside a so-called target detection area (42) which is determined by the detection range around a target (Z), within which target detection area (42) the detection range is sufficient to detect the target (Z), and wherein the torpedo (1) is steered to the target (Z) by means of the torpedo sonar (19) on reaching a target region (37) which is located within the target detection area (42).

3. The method as claimed in claim 1 or 2,
characterized in that
the position data is used to determine own position data for the torpedo (1) which is obtained by means of

a satellite-based, airborne, land-based and/or seaborne navigation system, and this own position data is used to correct the own course of the torpedo (1).

4. The method as claimed in claim 3,
characterized in that
the torpedo (1) has a radio receiver, which receives via the radio antenna (10), as well as a radio transmitter, which transmits via the radio antenna (10), wherein the position data is transmitted via a bidirectional radio data link (9), which is passed via one or more satellite-based, land-based, airborne and/or seaborne relay stations (11).

5. The method as claimed in claim 4,
characterized in that
the torpedo (1) transmits current and/or previously stored sonar data from the torpedo sonar (19) via the radio data link (9) to the control center (12).

6. The method as claimed in one of the preceding claims,
characterized in that
the torpedo (1) is launched from a land-based deployment system (3).

7. The method as claimed in one of the preceding claims,
characterized in that
the target position data is obtained from land-based, airborne and/or seaborne radar surveillance and/or visual surveillance and/or hydroacoustic surveillance.

8. The method as claimed in one of the preceding claims,
characterized in that

waypoints for its route to the target (Z) are signaled to the torpedo (1) and/or are transmitted by radio, which waypoints are steered to during its journey.

9. The method as claimed in one of the preceding claims,
characterized in that
the control center (12) makes a target selection during the journey of the torpedo when surveillance identifies a plurality of targets instead of one previously assumed single target (Z), and the control center (12) signals a selected target to the torpedo (1), which target the torpedo (1) has to attack.

10. A torpedo having an extendable radio antenna (10) and a radio receiver for reception of position data,
characterized by
a control section (25) for guiding the torpedo to a target, by means of which control signals for controlling control surfaces (30) of the torpedo (1) can be produced for course and depth determination of the torpedo (1), and
an antenna section (31), which has the extendable radio antenna (10) and the radio receiver, wherein the radio receiver is designed to receive position data which has target position data relating to the target, which position data is transmitted to the torpedo (1) from a land-based, airborne or seaborne control center (12) and can be supplied to the control section (25).

11. The torpedo as claimed in claim 10,
characterized in that
the antenna section (31) has a receiving part for a satellite-based, airborne, land-based and/or seaborne navigation system, which is designed in order to determine own position data from the received position

data, wherein the torpedo (1) is designed to determine course correction data for correction of an own course to a target from the own position data.

12. The torpedo as claimed in claim 10 or 11, characterized in that
the antenna section (31) is lighter than the water to be displaced by it, in particular seawater.

13. A launching apparatus having a torpedo as claimed in one of claims 10 to 12, wherein the torpedo (1) is accommodated in the launching apparatus for launching the torpedo (1), wherein the launching apparatus has a container (2), which can be moved on land, for transporting the torpedo (1), and the container (2) has a deployment system (3) for land-based deployment of the torpedo (1) into a coastal waterway.

14. An antenna section of a torpedo (1), which is formed from sections, as claimed in one of claims 10 to 12 having an extendable radio antenna (10) and a radio receiver for receiving position data which has target position data relating to a target, which position data is transmitted to the torpedo (1) from a land-based, airborne or seaborne control center (12), wherein the antenna section has an interface which is designed such that the position data can be supplied to a control section, by means of which control signals for controlling control surfaces (30) of the torpedo (1) can be produced for course and depth determination of the torpedo (1).