

**MARINE OBJECT ABLE TO FLOAT ON WATER, COMPRISING A
DEPLOYABLE DEVICE FOR EMITTING AND/OR RECEIVING
ELECTROMAGNETIC WAVES**

5 The field of the invention is that of the communication devices installed on marine objects able to float on the surface of the water, notably on submersible underwater vehicles such as autonomous underwater vehicles, also called AUV, or manned underwater vehicles, also called UUV.

 When an AUV or a UUV leaves on mission, it performs its mission
10 at depth and returns to the surface in order to be retrieved by a surface vessel. Now, the AUV or the UUV does not always surface at the position at which it should theoretically surface. Operators located on the surface of the water, or on land, need to know the position of the AUV or UUV to come to retrieve it. The AUV or UUV may, moreover, need to know its position at
15 a given moment in its mission. It then surfaces before diving again. This is called self-relocation. Then, during a mission, in the context of a "pack of AUV or UUV", the latter may be required to exchange data between them or with another platform, and thus surface for that.

 The AUVs or UUVs are therefore conventionally equipped with a
20 wireless antenna for receiving satellite signals in line of sight with satellites and an emitting wireless antenna making it possible to transmit the position of the vehicle remotely or exchange data with the outside world. These antennas have to be released as far as possible above the surface of the water to allow for the reception of the signals emitted by the satellites and the
25 transmission of wireless waves with good performance levels.

 The antennas are generally installed on a fixed strut extending vertically above the underwater vehicle. This arrangement offers the advantage of being insensitive to the sea conditions, compared to a so-called flush arrangement in which the antennas are flush with the surface of the
30 body of the AUV or of the UUV. The flush antennas are covered with a thin layer of salt water which masks the antennas which degrades the performance levels of the antenna in heavy sea conditions. The flush antennas stop being efficient beyond a sea condition 2. The arrangement on a fixed strut does, however, present the drawback of affecting the
35 hydrodynamic profile of the vehicle and its navigation.

One solution for mitigating these drawbacks is to install the antennas on a deployable strut which is retracted, that is to say drawn back into the body of the vehicle when it is navigating and which is extended out of the body for communication requirements when the vehicle resurfaces.

5 These are called deployable antennas. There are different types of deployable antennas. In a first type, the antennas are deployed by the translation of the strut in a radial direction defined relative to the longitudinal axis of the AUV. This is called hoistable strut. The strut in retracted position then extends along a diameter of the vehicle. This first solution considerably

10 affects the accommodation capacity in the AUV which significantly reduces its payload. In a second solution, the strut is deployed by rotation about a horizontal axis at right angles to the longitudinal axis of the underwater vehicle. In its retracted position, the strut extends parallel to the longitudinal axis of the AUV and, in its deployed position, along a vertical axis. The

15 drawback of this solution is that it affects the rake of the AUV. The further the communication equipment has to be released above the surface of the water, the longer the strut has to be and the more the length of the AUV has to be increased accordingly. In other words, the performance levels of the antennas are highly dependent on the length of the section of the underwater

20 vehicle which is devoted to them and over which the strut can extend.

The aim of the invention is to mitigate all or some of these abovementioned drawbacks.

To this end, the invention relates to a marine object able to float on the surface of the water comprising a body delimited at least partially by a

25 curved surface comprising a housing emerging on said curved surface. The marine object comprises a deployable emitting/receiving device comprising an arm on which are mounted means for emitting and/or receiving electromagnetic waves, said arm being linked to said body by means of an articulation with a degree of freedom in rotation about an axis of rotation, the

30 articulation allowing the arm to pivot reversibly between a retracted position, in which the arm is housed in the housing and is flush with the curved surface, and a deployed position in which the arm extends out of said housing, the arm comprising a first surface, called outer surface; the outer surface is curved along the length of the arm. The outer surface is flush with

said curved surface and follows the curve of said curved surface when the arm is in its retracted position.

Advantageously, the arm is curved, the curvature of the arm following the curvature of said outer surface.

5 Advantageously, said arm extends at right angles to said axis of rotation.

Advantageously, said marine object is balanced such that a plane of flotation linked to the body stabilizes parallel to the surface of the water when said marine object floats in calm sea conditions, the axis of rotation
10 being parallel to the plane of flotation, the arm extending from a first end to a second end further away from the articulation than the first end, said arm comprising a first pole corresponding to the region of the arm located at the maximum altitude above the plane of flotation when the arm is in the deployed position, the first pole being situated in the vicinity of the second
15 end.

Advantageously, the deployed position is defined such that, when the arm occupies the deployed position, an axis, called vertical axis, passing through the first pole and the articulation, is at right angles to the plane of flotation in calm sea conditions.

20 Advantageously, the arm comprises a second pole corresponding to the region of the arm situated at the maximum altitude when the arm is in the retracted position, the second pole being located on the vertical axis.

Advantageously, the marine object comprises a section comprising the arm, the section being produced in a plane at right angles to
25 the axis of rotation when the arm is in the retracted position, the section being delimited by a closed curve, said closed curve having a perimeter; the portion of the perimeter over which the arm extends between the articulation and the first pole is defined, for a given position of the articulation, relative to the body, and for a predetermined angle formed between the axis of rotation
30 and the plane of flotation, as being the minimum portion of the perimeter such that, when the arm is in the deployed position, the distance separating the first pole from the articulation along the vertical axis is the maximum distance that can be obtained for said section.

Advantageously, the curve is a circle, in which said portion of the
35 circumference is equal to half of the circumference of the circle.

Advantageously, the length of the arm is greater than half of the circumference of the circle, the arm pivoting by an angle substantially equal to 180° between the deployed position and the retracted position.

Advantageously, the first pole is situated on the outer surface, in
5 which the outer surface is convex at least in a region encompassing the first pole.

Advantageously, the arm comprises a strut linking a head to the articulation, the head comprising the first pole and delimiting a housing in which are housed the emitting and/or receiving means.

10 Advantageously, the head comprises a support on which are mounted the emitting and/or receiving means, the support extending substantially parallel to the plane of flotation, in calm sea conditions, when the arm is in the deployed position.

Advantageously, the head is wider than the strut along the axis of
15 rotation.

Advantageously, the body locally has, around the arm, a cylinder form, the axis of rotation being parallel to the longitudinal axis of the cylinder.

Advantageously, the cylinder is a cylinder of revolution.

Advantageously, the body is the body of an underwater vehicle.

20 Advantageously, the object locally has neutral buoyancy, in a region comprising the arm.

Advantageously, the deployable emitting/receiving device is rigid.

Other features and advantages of the invention will become
25 apparent on reading the following detailed description, given as a nonlimiting example and with reference to the attached drawings in which:

- figure 1 schematically represents, in side view, an exemplary object according to the invention of the underwater vehicle type provided with a deployable emitting/receiving device,
- 30 - figures 2a and 2b schematically represent, in perspective, a section of the object of figure 1 in which the emitting/receiving device is retracted and, respectively, deployed,
- figures 3a and 3b schematically represent the object of figure 1 in cross section along an axis at right angles to the longitudinal

axis of the underwater vehicle, in which the emitting/receiving device is retracted and, respectively, deployed,

- figure 4 schematically represents a section of another exemplary object according to the invention in which the emitting/receiving device is retracted.

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From one figure to another, the same elements are identified by the same references.

The invention relates to a marine object 1 able to float on the surface of the water 2 which can be seen in figure 1. The marine object 1 comprises a body 3 which is, for example, the body of an underwater vehicle as represented in the example of figures 1 to 3b. An underwater vehicle is a submersible vehicle. The underwater vehicle can be an autonomous underwater vehicle, or not, self-propelled, towed or drifting. The body is delimited at least partially by a curved surface 4 which is, here, the outer surface of the hull 5 of the underwater vehicle. The hull 5 of the underwater vehicle is referenced in figures 2a and 2b. The curved surface 4 is therefore the surface of the body of the underwater vehicle oriented toward the exterior of the underwater vehicle, that is to say toward the exterior of the body 3 of the underwater vehicle or a portion of the surface of the body under water. The body 3 of the underwater vehicle comprises a central part 3a having a generally cylindrical form and ends 3b having, conventionally but in a nonlimiting manner, generally hemispherical forms. "Curved surface" should be understood, in the present patent application, to mean a surface whose direction varies without forming any angle. "Angle" should be understood to mean the figure formed by the intersection of a number of planes. In other words, the curved surface does not include any protruding or recessed angles, that is to say it has no angular points. The surface is also said to be a dished or incurved surface. In other words, by making a section of the curved surface in any plane, at least one curve is obtained in the plane. The curve never includes more than one tangent at a same point. In other words, its derivative is continuous.

In figures 2a and 2b, a section of the marine object 1 has been schematically represented in perspective, in the central part of the body of the underwater vehicle in two situations. A housing 6 visible in figure 2b is

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formed in the body 3. This housing 6 emerges on the curved surface 4. This housing 6 takes the form of a trench or channel extending along the curved surface 4. An opening 104, visible in figure 3b, is formed in the curved surface 4 such that the housing emerges on said curved surface over its entire length.

The underwater vehicle is provided with a device for emitting and/or receiving electromagnetic waves. This device comprises means for emitting and/or receiving electromagnetic waves 7, represented in figures 3a and 3b, comprising at least one emitter and/or at least one receiver of electromagnetic waves. In the embodiment of the figures, the emitting means 7 comprise an emitter 7a and a receiver 7b. These means 7 can comprise wireless communication transceivers allowing the vehicle to communicate with the outside world by a wireless link when located above the surface of the water. The communication means comprise, for example, one or more antennas for receiving signals emitted by satellites of GPS type. These antennas can be associated with a satellite positioning receiver or GNSS (Global Navigation Satellite Systems) receiver allowing the underwater vehicle 1 to be located. They comprise, for example, one or more antennas for emitting wireless waves making it possible for example to transmit the position of the AUV or of the UUV remotely. Examples of emitting antennas are the satellite telephony antennas of iridium type and the wireless communication antennas emitting in very high frequency or ultra-high frequency bands. They can also comprise a light source, for example, of the flashing light type allowing an operator to locate the AUV at night in the approach phase. It is for example possible to use a xenon lamp or LEDs (light-emitting diodes). For a good transmission of visual signals while limiting the scattering of the visual signals, the light source should be positioned as far as possible from the surface of the water above this surface. It is also possible to provide a camera (receiver of visual signals) making it possible, for example, to film the approaches to a hostile coastline. It is also possible to provide short-range communication antennas, for example of Wi-Fi or Bluetooth type, making it possible, for example, for the surfacing vehicle to communicate (exchange, transmission of acquired data) with another item of equipment of the same type, introducing the concept of "pack" of AUV, or differently, piloting station, surface unit managing the mission, etc. Generally,

in the interests of performance levels, the aim is to arrange these emitters/receivers in such a way as to be able to bring them as high as possible above the surface of the water when the object 1 floats on the surface of the water.

5 The features of the emitting and receiving device are defined parametrically relative to a curved surface 4 of predetermined form and dimensions and for a particular balancing of the object 1. Advantageously, the deployable emitting/receiving device is rigid. In other words, the deployable emitting/receiving device does not deform between its retracted
10 position and its deployed position.

 The emitters/receivers 7 are mounted on an arm 8 extending at right angles to the axis of rotation x_o . The arm 8 is mobile between a retracted position represented in figures 2a and 3a and a deployed position represented in figures 2b and 3b. Figures 3a and 3b represent a cross
15 section of the marine object 1 along the plane P at right angles to the axis of rotation x_o , when the arm is in its retracted position (figure 3a) and in its deployed position (figure 3b). The arm 8 is linked to the body 3 by means of an articulation 9 with a degree of freedom in rotation about an axis of rotation x_o , allowing the arm 8 to pivot reversibly between the retracted position,
20 represented in figures 2a and 3a, in which the arm 8 is housed in the housing 6 and is flush with the curved surface 4, and a deployed position, represented in figures 2b and 3b, in which the arm 8 extends out of said body 3. The arm 8 is rotated about the axis of rotation x_o by means of a rotary actuator 80 housed in the general section of the body 3. The reversibility is
25 obtained by rotation about the axis of rotation of the articulation.

 The axis of rotation x_o is at right angles to the plane of figures 3a and 3b and passes through the cross represented on each of these figures. In the embodiment of the figures, the axis of rotation x_o is parallel to the main axis x of the underwater vehicle, but it could form a non-zero angle with this
30 latter axis x. The arm 8 passes through the opening 104, referenced in figure 3b, to switch from the deployed position to the retracted position and vice versa. In its retracted position, the arm 8 substantially closes the opening 104. In other words, the arm 8 substantially closes the opening to within the operating play.

The positions of the arm 8 can also be seen in figures 2a and 2b in which the arm 8 is in the retracted position and, respectively, deployed position.

The arm 8 extends between a first end 11 and a second end 12.

5 The first end 11 is closer to the articulation than the head 12. The arm 8 comprises a first surface 10, called outer surface 10. The outer surface 10 is oriented toward the outside of the body 3 when the arm 8 is in the retracted position. It is then flush with the curved surface 4. In other words, it has a form intended to be in the continuity of the curve of the curved surface 4
10 when the arm 8 is in the retracted position. The outer surface 10 is a curved surface which is curved in the direction of the length of the arm 8. In other words, the change of direction is obtained over the length of the arm from the first end 11 to the second end 12.

The invention offers the advantage of exploiting the curvature of
15 the surface 4 to house the arm 8 which will make it possible to release the emitters/receivers above the surface of the water. The proposed solution makes it possible to limit the bulk on the body along the axis x. It further offers the advantages of being as effective as a solution with fixed strut of the same useful height (height of the strut head relative to the surface of the water) whatever the sea conditions and of not affecting the hydrodynamic (or
20 aerodynamic) profile of the underwater vehicle when the arm is in the retracted position. The impact on the drag of the underwater vehicle is almost zero; the arm, once folded back, is perfectly incorporated in the cylindrical sketch of the body of the underwater vehicle. This is a major point, because
25 endurance is one of the issues of any underwater vehicle in general, and of drones in particular. Finally, the bulk of the solution in the internal volume of the vehicle is particularly reduced compared to the solutions with hoistable strut. Thus, the internal accommodation capacity of the vehicle is safeguarded, which is a crucial element for the ease of integration of the
30 system onboard underwater vehicles.

Advantageously, as represented in figures 3a and 3b, the arm 8 is curved in the direction of its length and its curvature follows the curvature of the outer surface at least over most of its length. In other words, the arm 8 comprises a second face 13, called inner face 13, housed inside the body 3
35 when the arm 8 is in the retracted position. This inner face 13 follows the

curvature of the outer surface 10 at least over most of its length. This makes it possible to minimize the impact on the accommodation capacity of the body of the underwater vehicle.

In the embodiment of the figures, the axis of rotation x_0 is parallel
 5 to the main axis x of the underwater vehicle. This solution is particularly advantageous because it makes it possible to minimize the bulk within the body 3 along the axis x . In other words, the length of the section of the body 3 dedicated to the retractable emitting/receiving device is minimal and substantially equal to the width of the arm 8 which makes it possible to
 10 minimize the reduction of the payload of the underwater vehicle, for a body of given length, or else to minimize the impact on the rake of the underwater vehicle.

The emitting/receiving means 7 are housed in the portion of the arm situated between the articulation 9 and the second end 12. The end 12 is
 15 raised when the arm 8 switches from the retracted position to the deployed position. The arm 8 comprises, in its deployed position, the pole, that is to say the culminating point of the object 3, at least in the vicinity of the arm 8.

The object 1 has positive or zero buoyancy. The object 1 is advantageously balanced such that a plane of flotation F secured to the body
 20 3 stabilizes parallel to the surface of the water 2 when the object floats in calm sea conditions. The plane of flotation separates a part of the body 3 located above the surface of the water and a portion of the body 3 located below the surface of the water. The plane of flotation F is at right angles to the plane of figures 3a and 3b. In other words in calm sea conditions, the
 25 surface of the water 2 is always parallel to the plane of flotation F linked to the object. It can thus be stated that the plane of flotation F defines a horizontal plane when the object 1 floats on the water. As can be seen in figures 3a and 3b, the axis of rotation x_0 is parallel to the plane of flotation. This makes it possible, for a predetermined curved surface, for a
 30 predetermined length of the arm and a predetermined position of the articulation 9, to be able to bring the emitters/receivers to a maximum height relative to the surface of the water (maximum deployment amplitude) with a minimal bulk along the axis of rotation x_0 . In the embodiment of the figures, the axis of rotation x_0 being parallel to the main axis of the underwater
 35 vehicle x , the bulk along the length of the vehicle is minimized.

The axis of rotation x_0 is not necessarily parallel to the plane of flotation F . The arm 8 is, for example, helical and extends in a plane at right angles to an axis of rotation that is inclined relative to the plane of flotation.

Advantageously, as can be seen in figures 3a and 3b, the
 5 deployed position that can be seen in figure 3b is defined such that, when the arm 8 occupies the deployed position, a first pole 30 occupies a first position P_1 defined in a reference frame linked to the plane of flotation. The first pole 30 is the region of the arm 8 situated at the highest altitude when the arm is in the deployed position. The first position P_1 is the highest position occupied
 10 by the arm 8 when the arm occupies the deployed position. The deployed position is defined such that an axis z , called vertical axis, passing through the first position P_1 occupied by a first pole 30 and the articulation 9, is at right angles to the plane of flotation F . The first pole 30 is situated in the vicinity of the second end 12 of the arm 8. In other words, most of the length
 15 of the arm between the articulation 9 and the end 12 is situated between the articulation 9 and the first pole 30. "Vertical axis z " should be understood to mean an axis at right angles to the plane of flotation F . This arrangement makes it possible to release the emitters/receivers 7 to the maximum for a predetermined surface 4, for a predetermined position of the articulation 9 on
 20 the surface 4 and for a given length of the arm 8.

In the embodiment of the figures, the articulation 9 is arranged substantially at a second position P_2 , in a reference frame linked to the plane of flotation. The position P_2 is the position occupied by a second pole 31 of the body 3 when the arm 8 is in the retracted position. The second pole 31 is
 25 the region of the arm 8 situated at the highest altitude when the arm is in the retracted position. The second position P_2 is the highest position occupied by the arm 8 when the arm occupies the retracted position. In other words, the articulation is situated in the vicinity of the second pole 31. The articulation 9 is, moreover, arranged such that the vertical axis z passes through the
 30 second position P_2 occupied by a second pole 31 when the arm is in its retracted position. This arrangement makes it possible to release the arm 8 to the maximum and minimize the entry of the arm into the size of the body 3 upon rotation of the arm between the retracted position and the deployed position. This makes it possible to limit the length of the arm for a desired

deployment altitude. The positions P1, P2 and P3 (which will be defined later) are defined at least by their altitude relative to the plane of flotation F.

The section 15 of the object represented in figure 3a is a section of the object comprising the arm 8, when the arm 8 is in the retracted position.

5 This section is produced along the plane P shown in figure 1 and at right angles to the axis of rotation x_0 . The arm 8 being flush with the surface of the body 4, the section 15 is substantially identical to the section of the body locally around said arm 8. Advantageously, the portion of the circumference, that is to say of the perimeter, of the curve 17 delimiting the section 15, over

10 which the arm 8 extends between the articulation 9, that is to say between the region of the outer surface 10 situated above the articulation along the axis z , and the first pole 30, is defined for a given position of the articulation 9 relative to the body 3, and for a predetermined angle formed between the plane of flotation F and the axis x_0 , so as to be the portion of the minimum

15 circumference such that, when the arm 8 is in the deployed position, the distance separating the first pole 30 and the articulation 9 on the vertical axis z is the minimum distance that can be obtained for the section 15. The angle of rotation of the arm between the retracted position and the deployed position is then defined as a function of the length of the arm.

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In the embodiment of the figures, the section 15 is round and the curve 17 is a circle. The articulation 9 is situated substantially at the second position P2 occupied by the second pole 31 when the arm 8 is retracted. In other words, the articulation 9 is situated substantially at the altitude of the

25 second pole 31. The axis of rotation x_0 is parallel to the plane of flotation. Consequently, the portion of the circumference of the circle 17 separating the articulation 9 and the first pole 30 is substantially equal to half of the circumference of the circle. The arm 8 then pivots by an angle substantially equal to 180° between the deployed position and the retracted position. In

30 other words, the third position P3, in a reference frame linked to the plane of flotation. P3 is the position occupied by the first pole 30 when the arm is retracted is the lowest position occupied by the arm 8 when the arm is in the retracted position. When the arm is deployed, the first pole 30 occupies the first position P1 which is the highest position occupied by the arm when it is

35 deployed. This makes it possible to fully exploit the diameter of the vehicle, to

release the antennas from the surface of the water. In effect, the altitude of the first pole 30 above the articulation 9, once the arm is deployed, that is to say the altitude of the first position P1, is almost equal to the diameter of the vehicle. The intrinsic capacity of this system to maximize the distance of the antennas from the surface of the water merely increases the robustness of operation of the system with respect to the sea conditions. Given equal deployed antenna height, this solution is much more compact than a solution based on a strut rotating about a horizontal axis at right angles to the main axis of the underwater vehicle. In effect, the increase in the height of deployment of the arm does not affect the length of the section occupied by the emitting/receiving device but only the portion of the circumference occupied by the arm 8. In this embodiment, the length of the arm is greater than half of the circumference of the curve 17 delimiting the section 15. The arm pivots by an angle substantially equal to 180° about the axis of rotation between the retracted position and the deployed position.

Figure 4 shows the case of a section 105 delimited by an elliptical curve 107 defined by a great axis 108 and a small axis 109. The length of the half-great axis 108 is greater than the length of the small axis 109, so the optimum length for an articulation situated at the second pole of the ellipse on the small axis when the plane of flotation is parallel to the great axis is equal to a quarter of the circumference of the ellipse and the angle of rotation is 90° . If the half-great axis had a length smaller than the small axis, then the optimum length would be half of the circumference and the angle of rotation of 180° .

As can be seen in figure 2b, the arm 8 comprises a strut 40 and a head 41. The head comprises the first pole 30 visible in figures 3a and 3b. The strut 40 is linked on the one hand to the articulation 9 and on the other hand to the head 41. The head 41 is arranged at the end of the arm. The emitters/receivers 7 are mounted on the head 41. This makes it possible to release the emitters/receivers 7 to a maximum altitude above the surface of the water 2 because, when the arm 8 is deployed, the head 41 is directly above the strut 40, the emitters/receivers are therefore the highest elements of the object when the arm 8 is deployed. In the embodiment of the figures,

the head 41 delimits a closed housing 42 in which the emitters/receivers 7 are housed.

5 The invention makes it possible to install a plurality of antennas distributed around the first pole 30 in a plane parallel to the plane of flotation F when the arm 8 is deployed, without affecting the accommodation capacity in the central part of the body 3 since these antennas are distributed along the surface 4 when the arm is retracted. The various antennas can thus profit from the same height of deployment which maximizes their reach and avoids an effect of mutual masking between the antennas.

10 Advantageously, the head 41 comprises a support 43 on which are mounted the emission/reception means 7. The support 43 is substantially planar and extends parallel to the plane of flotation F when the arm 8 is in the deployed position. This arrangement makes it possible to avoid the mutual masking of the various emitters and receivers arranged on this surface. In the
15 embodiment of the figures, the arm 8 extends substantially over half of the perimeter of the curve 17; the planar support 43 is parallel to the plane of flotation F, when the water is calm, when the arm 8 is deployed and retracted.

20 It is also possible to distribute the emitting/receiving means 7 along the arm 8 between the articulation 9 and the second end 12 such that they are at different altitudes when the arm is deployed which makes it possible to maximize the useful payload surface area of light sources, and/or of emitting/receiving means. Since the outer surface 10 of the arm 8 is
25 curved, the effect of mutual masking between the various emitters/receivers is minimized compared to that obtained in the case of an installation on a vertical strut. This minimizing of the masking effect does not affect the accommodation capacity of the body 3 in its central internal part of the body 3. In the example of the figures, if the emitting/receiving means are
30 distributed along the top half of the arm 8, that is to say along a quarter circle, facing the outer surface 10, these emitting/receiving means are staggered in the horizontal plane, the masking effect is therefore minimized. As a variant, the arm comprises a strut extending from the first end 11 to the second end 12.

In the embodiment of the figures, the head 41 has a width greater than the strut 40 along an axis at right angles to the plane in which the arm 8 extends in the direction of its length. Thus, the space occupied by the emitting/receiving device along the section is limited and the space available
5 in the head 41 for installing therein emitters/receivers which will be located at the same height once the arm is deployed is increased, without affecting the accommodation capacity in the central internal part of the body 3 and while minimizing the impact on the buoyancy of the body 3.

10 In the embodiment of the figures, the outer surface 10 of the arm 8 is convex and the first pole 30 is included in the outer surface 10. In these figures, the first pole 30 is, moreover, at the summit of a convex surface which drops back toward the second end 12 on the one hand and toward the first end 11 on the other hand when the arm 8 is in the deployed position.
15 This allows both for its good incorporation in the cylindrical outline of the body of the vehicle in the retracted position but also, and above all, favors the flow of the seawater, and does so in order to avoid any formation of a skin of seawater on the surface of the window. In effect, the consequence of formation of a skin of salt water, even of very small thickness, is the masking
20 of the electromagnetic waves, such as the visual waves and the wireless waves, thus inherently canceling the main function of the relocation system: it is therefore a major risk. Generally, to obtain this effect, the outer surface 10 is a convex surface at least in a region encompassing the first pole 30. Moreover, this convex form confers on the window 45 – a curved region
25 encompassing the summit 30 and capping the housing 42 – a mechanical robustness thus conferring on it a better resistance to immersion pressure with a minimum thickness of material. This small thickness of the window 45 minimizes the attenuation of the waves received and/or transmitted. Moreover, the small thickness of the window 45 contributes to a lightening of
30 the strut head 41, which offers the following advantages: more stable roll-mode balance, of the AUV or of the UUV on the surface, need for a less powerful rotary actuator for the rotating of the mass: saving on weight and volume – onboard bulk – on the choice of the actuator. The thickness of the window is advantageously between 2 mm and 13 mm.

The emitting/receiving means 7 are housed in the strut head 41. The housing 42 is advantageously closed in a watertight manner. This protects the antennas from the mechanical stresses due to the immersion of the autonomous underwater vehicle during its mission. It has, for example, a
5 hydrostatic pressure resistance of 35 bar (i.e. 350 meters of immersion).

To optimize the weights, the marine object locally has neutral buoyancy in a region encompassing the arm 8. In the embodiment of the figures, this means that an emitting/receiving section comprising a section of the underwater vehicle provided with the emitting/receiving device and the
10 emitting/receiving device itself has neutral buoyancy. The strut 40 advantageously has hollow section so as to delimit a second housing receiving the wiring linking antennas to beacon, flashing lights and/or receiver of visual signals to power supply and control boards retained.

The portion 46 of the outer surface 10 facing the emitting/receiving
15 means 7 is the outer surface of the window 45. Said window is advantageously transparent to the waves sent and/or detected by said emitting/receiving means. For example, the portion 46 of the window included in the head 41 is transparent to both the frequencies of the UHF-VHF-GPS-iridium bands, i.e. in the 30 MHz – 2 GHz band, and to the visible spectrum.

20 The rotary actuator 80 can be passive, for example of the torsion or controllable spring type. In the latter case, this makes it possible, once the vehicle is located, to remotely control the folding down of the deployable arm. In effect, when folded down, the arm is perfectly incorporated in the hydrodynamic profile of the vehicle, which makes it possible to implement the
25 handling thereof while guaranteeing the integrity of the deployable device for emitting and/or receiving electromagnetic waves. This remote control can be produced from a surface vessel, by means of a satellite telephone communication link or by means of an underwater communication link. The satellite telephone communication advantageously uses a receiving antenna
30 incorporated in the arm 8, while the underwater communication requires the presence of a hydrophone onboard the vehicle and a transducer onboard the surface vessel.

To mitigate any risk of breakdown of the communication systems, an emergency fallback device is provided. It is produced from a magnetic
35 relay embedded onboard the body 3, which makes it possible, under the

action of a magnet, to control the folding down of the strut. The choice of the magnetic technology makes it possible to dispense with tight hull passages, while remaining compatible with the different materials usually used for the production of the hulls of autonomous underwater vehicles (composite carbon fiber, glass fiber, etc. – aluminum, titanium). Operationally, a diver is required to apply a magnet to the hull, at a precise point (level with the embedded magnetic relay) of the vehicle.

The form of the housing 6 and of the arm 8 are defined in such a way that not only can the housing 6 accommodate the arm 8 in the retracted position, but also so as to allow for its free deployment to its deployed position. The form of the bottom 60 of the housing 6 complements the inner surface 13 of the arm.

The strut 40 is advantageously produced in aluminum. The strut is advantageously protected by a conversion treatment (electrolytic treatment) and possibly painted. The strut head 41, notably the portion 45 of the surface 10 included in the head 41, is advantageously produced in thermoplastic material of PMMA (polymethyl methacrylate) type for the good trade-off offered between its optical qualities, its density and its mechanical strength.

The body 3 can be the body of a submersible underwater vehicle, autonomous or not. This body 3 is also able to float. As a variant, the body 3 is the body of a floating object such as a buoy, for example an acoustic buoy drifting on the surface of the water. The buoys can have various forms, such as, for example, a toroidal, cylindrical or spherical form.

The body 3 can have, locally around the arm, a cylindrical form, the axis of rotation being advantageously parallel to the longitudinal axis of the cylinder. The cylinder can be a cylinder of revolution. The body can be a cylindrical body, for example, a portion of cylinder intended to be incorporated on an underwater vehicle.

CLAIMS

1. A marine object (1) able to float on the surface of the water (2) comprising a body (3) delimited at least partially by a curved surface (4) comprising a housing (6) emerging on said curved surface (4), said marine object (1) being characterized in that it comprises a rigid deployable emitting/receiving device comprising an arm (8) on which are mounted means for emitting and/or receiving electromagnetic waves (7), said arm (8) being linked to said body (3) by means of an articulation (9) with a degree of freedom in rotation about an axis of rotation (xo), the articulation allowing the arm (8) to pivot reversibly between a retracted position, in which the arm (8) is housed in the housing and is flush with the curved surface (4), and a deployed position in which the arm (8) extends out of said housing (6), the arm comprising a first surface (10), called outer surface, the outer surface (10) being curved along the length of the arm (8), said outer surface (10) being flush with said curved surface (4) and following the curve of said curved surface (4) when the arm (8) is in its retracted position, the emitting/receiving device not being deformed between its retracted position and its deployed position, the body having locally, around the arm (8), a cylindrical form, the axis of rotation (xo) being parallel to the longitudinal axis of the cylinder.

2. The marine object (1) as claimed in the preceding claim, in which the arm (8) is curved, the curvature of the arm (8) following the curvature of said outer surface (10).

3. The marine object (1) as claimed in either one of the preceding claims, in which said arm (8) extends at right angles to said axis of rotation (xo).

4. The marine object (1) as claimed in any one of the preceding claims, in which said marine object (1) is balanced such that a plane of flotation (F) linked to the body (3) stabilizes parallel to the surface of the water (2) when said marine object (1) floats in calm sea conditions, the axis of rotation (xo) being parallel to the plane of flotation, the arm (8) extending from a first end (11) to a second end (12) further away from the articulation (9) than the first

end (11), said arm (8) comprising a first pole (30) corresponding to the region of the arm (8) located at the maximum altitude above the plane of flotation (F) when the arm (8) is in the deployed position, the first pole (30) being situated in the vicinity of the second end (12).

5. The marine object as claimed in the preceding claim, in which the deployed position is defined such that, when the arm (8) occupies the deployed position, an axis, called vertical axis (z), passing through the first pole (30) and the articulation (9), is at right angles to the plane of flotation (F) in calm sea conditions.

6. The marine object as claimed in claim 5, in which the arm comprises a second pole (31) corresponding to the region of the arm (8) situated at the maximum altitude when the arm (8) is in the retracted position, the second pole (31) being located on the vertical axis (z).

7. The marine object as claimed in any one of claims 4 to 6, in which the marine object (1) comprises a section (15) comprising the arm (8), the section (15) being produced in a plane at right angles to the axis of rotation (xo) when the arm (8) is in the retracted position, the section (15) being delimited by a closed curve (17), said closed curve having a perimeter; the portion of the perimeter over which the arm (8) extends between the articulation (9) and the first pole (30) is defined, for a given position of the articulation (9) relative to the body (3) and for a predetermined angle formed between the axis of rotation (xo) and the plane of flotation (F), as being the minimum portion of the perimeter such that, when the arm (8) is in the deployed position, the distance separating the first pole (30) from the articulation (9) along the vertical axis (z) is the maximum distance that can be obtained for said section (15).

8. The marine object as claimed in the preceding claim and claim 6, in which the curve (17) is a circle, and in which said portion of the circumference is equal to half of the circumference of the circle.

9. The marine object as claimed in the preceding claim, in which the length of the arm (8) is greater than half of the circumference of the circle,

the arm pivoting by an angle substantially equal to 180° between the deployed position and the retracted position.

10. The marine object as claimed in any one of claims 4 to 9, in which the first pole (30) is situated on the outer surface (10), in which the outer surface (10) is convex at least in a region encompassing the first pole (30).

11. The marine object as claimed in any one of claims 4 to 10, in which the arm comprises a strut (40) linking a head (41) to the articulation (9), the head (12) comprising the first pole (30) and delimiting a housing in which are housed the emitting and/or receiving means (7).

12. The marine object (1) as claimed in the preceding claim, in which the head (41) comprises a support (43) on which are mounted the emitting and/or receiving means (7), the support (43) extending substantially parallel to the plane of flotation (F), in calm sea conditions, when the arm (8) is in the deployed position.

13. The marine object (1) as claimed in either one of claims 11 and 12, in which the head (41) is wider than the strut (40) along an axis at right angles to the plane in which the arm extends in the direction of its length.

14. The marine object (1) as claimed in any one of the preceding claims, in which the cylinder is a cylinder of revolution.

15. The marine object as claimed in any one of the preceding claims, in which the body (3) is the body of an underwater vehicle.

16. The marine object (1) as claimed in any one of the preceding claims, said object locally having neutral buoyancy, in a region comprising the arm (8).

17. The marine object as claimed in any one of the preceding claims, in which, in its retracted position, the arm (8) substantially closes the opening (104), the opening being an opening formed in the curved surface (4) such that the housing emerges on said curved surface over its entire length.

18. The marine object as claimed in any one of the preceding claims, in which the outer surface is intended to be in the continuity of the curve of the curved surface when the arm is in the retracted position.

19. The marine object as claimed in any one of the preceding claims, comprising a rotary actuator (80), the arm (8) being rotated about the axis of rotation (xo) by means of a rotary actuator (80) housed in the general section of the body (3).

20. The marine object as claimed in the preceding claim, in which the actuator is controllable.