

**System for launching and recovering marine and submarine devices
assisted by tiltable protective components**

The present invention is in the maritime field and relates to a system
5 for launching and recovering marine or submarine devices (Launch And
Recovery System (L.A.R.S.)) capable on the one hand of raising the device
from the water as far as a towing system on board a support vessel and on
the other hand of lowering the device from the support vessel onto the sea. It
notably applies to launching towed or autonomous submarine devices, the
10 latter then being provided with a temporary connection during the launch and
recovery phases.

The operations of launching and recovering a marine or submarine
device from or to a support vessel also responsible for the transportation of
said device generally include a critical phase, especially in a choppy sea.
15 That phase consists in the passage from the totally out of the water state in
which the device is fastened to the handling means employed to the totally
submerged state in which the device no longer has any connection with the
latter means, and vice versa. In fact, it is during these critical phases that the
swell is the most dangerous for the integrity of the device, the latter being
20 agitated by the swell when it is close either to the structure of the vessel or to
that of the lifting and handling means, with the attendant risk of striking them.
This is the case in particular for a marine or submarine device in the launch
or recovery phase when the device is partly in the water: its movements are
not yet (or no longer) completely controlled by the lifting and handling means.

25 Accordingly, where autonomous devices, not towed by the
vessel, are concerned, one known solution consists in providing mooring
means on the hull of the device, for example securing means, said securing
means being such that the device can be lifted whilst remaining in a
horizontal position. Launching and recovery can then be carried out using a
30 winch mounted on a mobile gantry placed at the stern of the vessel, for
example, or a crane, the gantry or the crane making it possible to position the

lifting winch over the recovery area. Thereafter launching and raising are effected vertically, which limits the possibilities of collision with the vessel during raising or lowering. Alternatively, the device can be lifted by placing it in a cradle type device itself including appropriate securing points.

5 This type of solution is applicable, notably autonomously, to devices towed from the center but is not easily applicable to devices towed from the front, however, in that, for obvious reasons of efficacy, the aim is to tow and to handle the device using a single cable. Handling by means such as those described above using a single cable proves delicate because it leads to the
10 device passing from the vertical position to the horizontal position during launch and conversely during recovery. This handling moreover necessitates complementary operations the object of which is, after the device is lifted and positioned above the deck of the vessel, to deposit the device flat on the deck of the vessel or more generally in a storage area. These operations
15 generally necessitate the intervention of human operatives, which intervention is rendered more delicate and more dangerous in a heavy sea. In the case of devices towed from the front, the solution that is generally preferred consists in using a handling cable temporarily attached above the center of gravity of the device.

20 A solution that is also used provides handling based on the placement of means including an inclined ramp on which the device slides onto the surface of the water or to leave it and return to the vessel. The ramp is generally configured to guide the device along a rectilinear trajectory, which prevents the device from being able to move laterally. However, a ramp of
25 this kind is not generally suitable for use in a heavy sea: lateral movements of the device can then damage it.

 Using such means advantageously makes it possible to launch and to deploy the device behind the vessel by allowing the towing cable to play out and, conversely, to recover the device on board the vessel by winding in the
30 cable, for example onto the drum of a winch. In this way the device towed by the vessel can be launched and recovered when the vessel is moving so that

the device is naturally positioned on the axis of forward movement of the latter.

Various solutions have been developed to alleviate these problems of coming into contact, generally suited to a given type of device.

5 These known solutions generally consists in reinforcing the structure of the device, principally the nose, so that the latter resists impacts following entry into contact with the end of the ramp. It also consists in using means for minimizing these impacts, in particular configuring the ramp so that its end is situated below the surface of the water so that the device floating on the
10 surface comes into contact with the inclined surface of the ramp and not its end. Solutions of this kind nevertheless prove inadequate in a heavy sea because the slamming effect of the waves is then accentuated by the movement of the vessel.

Other solutions have been developed (see for example EP
15 20110793422 and US 8430049B1) in which the vessel incorporates a tiltable articulated ramp. The inclination of the ramp makes it possible to control the submerged part of the ramp. Once the ramp is submerged, the device is towed over the abutment that separates the ramp from the surface of the water. Moreover, in a heavy sea the ramp may come out of the water.

20 The foregoing solution is effective but cannot be fitted to all vessels. In fact, many vessels cannot support the weight necessary for the installation of the equipment linked to the operation of a tiltable articulated ramp. The problem solved by the present invention is to cause the marine or submarine device to pass over a step situated between the end of the ramp
25 and the water, notably when a small vessel is used, for example less than 50 meters long and preferably less than 20 meters long, incapable of supporting the installation of equipment that is too heavy, such as a tiltable articulated ramp as described in the prior art.

The present invention consists in a system comprising a ramp and
30 a device for launching and recovering a marine or submarine device from

and to a support vessel, said device including a carriage and at least one protective component, characterized in that:

- each of said protective components is connected to the carriage by a pivot connection of which the axis is parallel to the surface of the water when said device is secured to said vessel;
- at least one of said protective components is adapted to raise said marine or submarine device partially or totally out of the water during a recovery and to place said marine or submarine device in or partially in the water during a launch by rotation of said protective component or elements about said carriage;
- said carriage and said ramp are connected by a sliding connection;
- said ramp is fastened to said vessel;
- at least one of said protective components is adapted to raise or to deposit said marine or submarine device by contact with an element chosen from at least a wing of said marine or submarine device, at least one lateral protuberance of said marine or submarine device and the hull of said marine or submarine device;
- said system includes at least one sliding zone situated along said ramp, in contact with said protective part and fastened to said vessel, and in that
- at least one of said protective components is adapted to cooperate with said sliding zone to cause said marine or submarine device to move from a support of at least one of said protective components to a support of said ramp or from said support of said ramp to said support of at least one of said protective components.

The system advantageously comprises at least two of said protective components fastened together.

Said protective component or each of said protective components advantageously comprises a protective part and an arm connected by a complete connection and such that said arm or each of said arms is connected by one of said pivot connections to said carriage.

Each of said protective parts advantageously comprises at least one curved part and is adapted to limit the movements of said marine or submarine device.

At least one part of one of said protective parts of the system is advantageously hollowed out so as not to come into contact with fragile parts of the marine or submarine device.

Said pivot connection connecting each protective component to the carriage is advantageously freely rotatable.

At least one of said protective parts of the system advantageously includes at least one roller mounted at one of its ends and pivoting about a second axis parallel to the surface of the water when said system is secured to said vessel.

At least one of said protective parts advantageously includes at least one roller mounted on a part of said protective part adapted to cooperate with said sliding zone and pivoting about a second axis parallel to the surface of the water when said system is secured to said vessel.

The vessel advantageously includes traction means adapted to control the sliding of said marine or submarine device on said ramp. Said carriage of said system can be in direct or indirect contact with said marine or submarine device during recovery or launch of said marine or submarine device.

Said marine or submarine device is advantageously autonomous and at least one of said protective components includes an attachment device enabling connection of said autonomous submarine device at least to said protective component.

Said traction means of the system advantageously include a winch, a traction cable and drive means such that said traction cable is fastened to said marine or submarine device, is driven by said winch, itself fastened to said support vessel and such that the carriage includes a fairlead guiding said traction cable on the axis of the ramp.

The system advantageously comprises at least one raising element fastened to at least one of said sliding zones in which at least one of said protective components is able to cooperate with at least one of said raising elements to cause said marine or submarine device to move from a support of at least one of said protective components to a support of said ramp or from said support of said ramp to said support of at least one of said protective components.

At least one of said sliding zones of the system is advantageously adapted to force the rotation of at least one of said protective components about said carriage when said carriage slides on said ramp, locally raising said marine or submarine device to facilitate its recovery or its launch.

The system advantageously also includes at least one raising element fastened to at least one of said sliding zones, adapted to force by contact the rotation of at least one of said protective components about said carriage when said carriage slides on said ramp, locally raising said marine or submarine device to facilitate its recovery or its launch.

The system is advantageously adapted to modify the attitude of said marine or submarine device during the launch or the recovery of said marine or submarine device.

The present invention also consists in a vessel equipped with at least one of said systems.

The invention will be better understood and other advantages, details and features thereof will become apparent in the course of the following explanatory description given by way of example and with reference to the appended drawings, in which:

- figure 1 is a diagrammatic perspective view of the launch and recovery device;
- figure 2 is a diagrammatic profile view of one embodiment of a protective part supporting a wing of a marine or submarine device;
- figure 3 is a profile view of the entire system at the moment of launch or recovery;

- figure 4 is a perspective view of the entire system when the marine or submarine device is entirely mounted on a ramp, and
- figure 5 is a sequence of diagrammatic profile views of the entire system describing a complete recovery phase.

5 The following description presents a number of embodiments of the device of the invention: these examples are not limiting on the scope of the invention. These embodiments present both the essential features of the invention and additional features linked to the embodiments considered. For clarity, the same elements bear the same reference numbers in the various
10 figures.

In the remainder of the text the terms front, rear, in front of and behind are defined relative to the longitudinal axis of the vessel 6 oriented from the stern toward the bow of the vessel 6.

Figure 1 presents a diagrammatic perspective view of the launch
15 and recovery device 1. That device comprises two elements: the carriage 2 and the protective component 5, itself comprising two parts fastened together, the protective part 4 and the arm 3. In the figure 1 example, the two protective components 5 are installed one on each side of the carriage 2 and are fastened to each other. They can pivot about the carriage about the axis
20 y shown. That axis y is parallel to the surface of the water 25 when the device is secured to a support vessel as described hereinafter in order to be able to lift or to deposit the marine or submarine device 7 carried by the protective parts 4, preferably having a curved part to prevent forward or rearward movement of the marine or submarine device 7 during the
25 maneuver. In one particular embodiment the carriage 2 includes a part 26 that has the function of a fairlead.

Figure 2 presents a diagrammatic profile view of one embodiment of a protective part 4. The shape of this embodiment is in part curved. One of its functions is to carry the marine or submarine device 7 and to limit or to
30 prevent movements toward the front of the device 7 of swerving, heaving, lurching, rolling and yawing caused by external stresses. In one particular

embodiment of the invention, the rear of the protective part 4 features a hollowed out part. This configuration can be particularly useful in the case of contact between the protective part 4 and a wing 12 of the marine or submarine device 7.

5 The rear of the wing 22, termed the trailing edge, is thinner and mechanically weaker than the front part 23: in this embodiment, contact can occur only on the surface of the mechanically strongest part of the wing 12.

Figure 3 presents a profile view of one embodiment of the whole of the L.A.R.S. during a phase of launching or recovering a marine or
10 submarine device 7. In this embodiment the position of the protective component 5 is determined by three factors:

- the pivot connection with the carriage 2, described above,
- the difference between the force of gravity and the Archimedean upthrust exerted on the protective component 5: in this particular
15 embodiment the protective component 5 is termed of the heavy type because it does not float, and
- the contact with the wing 12 of the marine or submarine device 7 that bears on the protective component 5.

In this configuration, the pivot connection connecting one of the
20 protective components 5 and the carriage 2 is qualified as freely rotatable. Although the rotation can be constrained by one of the above three factors, this qualification is also made to distinguish this embodiment from a particular embodiment in which the position of a protective component 5 can be determined primarily by a driving torque applied by first driving means to the
25 protective component 5 via the pivot connection connected to the carriage 2. In one particular embodiment of the invention, a floating protective component can for example be coupled to first driving means to control the submersion of the floating protective component.

In figure 3 the carriage 2 is situated at the bottom of the ramp 11, in a
30 low or retracted position, to which ramp it is connected by a sliding connection. In the phase of launching or raising the marine or submarine

device 7 the front end of the device 7 is fastened to the traction cable 16. This traction cable 16 is inserted in the fairlead 26 of the carriage 2 and remains in close contact therewith, which has the advantageous effect of maintaining the axis of the device 7 on the axis of the ramp 11 as it moves
5 along the latter.

This remaining in contact occurs naturally because the carriage 2 is a heavy component the weight of which, in the absence of the marine or submarine device 7, tends to cause it to descend along the ramp 11. During a launch, the carriage 2 therefore accompanies the movement of the marine
10 or submarine device 7. In one particular embodiment of the invention, the carriage 2 includes second driving means that enable it to force the descent along the ramp 11 in order to remain in contact with the marine or submarine device 7 during its recovery or launch.

The marine or submarine device 7 is raised or lowered by traction
15 means 14 consisting of the traction cable 16 fastened to the marine or submarine device 7 and a winch 15 fastened to the support vessel 6 that enables the cable 16 to be wound in during a recovery phase or the cable 16 to be paid out during a launch phase thanks to third driving means 20 able to impose a second driving torque on the winch 15. In one particular
20 embodiment, the marine or submarine device 7 can be an autonomous marine or submarine device. In this case, the marine or submarine device 7 is provided with a temporary connection during the launch and recovery phases: the connection between the traction cable 16 and the device 7 is termed indirect. During the use of an autonomous marine or submarine
25 device this embodiment can be combined with or replaced by an embodiment in which at least one of the protective components 5 has a device for attaching it to the device 7 enabling the device 7 and the protective component or components to be connected when they come into contact at the commencement of recovery of the device 7, for example.

30 Figure 3 also presents a raising component 18 situated at the edge of the ramp 11. Its function is described in detail in the description of figure 4.

Figure 3 illustrates an example of the protective component 5 coming into contact with the raising component 18 during the recovery or launch phase.

Figure 4 presents a diagrammatic perspective view of the entire system when the marine or submarine device 7 has been raised completely onto the ramp 11. According to an embodiment presented in this figure, the marine or submarine device 7 has been recovered using the device described in figure 1 in which the two protective components 5 are installed one on each side of the carriage 2 and are fastened to each other. This feature enables the marine or submarine device 7 to pass over the step between the end of the ramp 11 and the surface of the water 25 without the nose or the front of the marine or submarine device 7 being in contact with the ramp 11. This method makes it possible to avoid impacts capable of damaging fragile onboard components such as components or sensors, in particular of a sonar.

Figure 4 makes it possible to illustrate the sliding zone 17 situated along the ramp 11. It remains in contact with the protective component or components 5 when the carriage 2 slides along the ramp 11. According to one embodiment considered, the protective part 4 comprises a roller 10 mounted at one of its ends and pivoting about an axis parallel to the surface of the water 25, as illustrated in figure 3. This roller 10 enables the protective part 4 not to rub on the sliding zone 17 when the marine or submarine device 7 moves on the ramp 11. According to another embodiment of the invention, the protective part 4 comprises one or more rollers 10 mounted on a part of said protective part 4 able to cooperate with said sliding zone 17 and/or a raising component 18 pivoting about a second axis parallel to the surface of the water 25 when the system is secured to the vessel 6. These rollers make it possible to prevent rubbing between the protective components 5 and the sliding zone 17 and/or one or more raising components 18. They are for example arranged under the protective part or parts 4 relative to the frame of reference of the vessel.

According to the embodiment considered, the sliding zone 17 also enables the raising component 18, which is fastened to it, to be supported with the object of causing the protective component 5 to move through contact.

5 Figure 4 moreover illustrates protection and sliding means 30 mounted on the ramp 11 and adapted to favor the movement of the device 7 along the ramp 11 because of the traction exerted by the traction cable 16 and gravity. Said means are for example rollers disposed laterally on the bottom of the ramp 11 and on which the device 7 rolls.

10 Figure 5 is a sequence of diagrammatic profile views of the entire L.A.R.S. showing a complete phase of recovery of the marine or submarine device 7. One of the main technical problems can be illustrated by figure 5.F. That figure illustrates the vertical step of height h present between the surface of the water 25 and the end of the inclined ramp 11. That vertical wall
15 represents a source of impacts or shocks with the wall of the marine or submarine device 7 during launch and recovery thereof, notably when the front of the marine or submarine device 7 passes between the surface of the water 25 and the bottom of the ramp.

The effect of the present invention is to enable launching and
20 recovery of the marine or submarine device 7 avoiding all contact between the step described above and the front of the marine or submarine device 7. The recovery sequence is described on the basis of figure 5.A. That figure illustrates an approach phase of the marine or submarine device 7. The latter is submerged and fastened to the traction cable 16. It may however be noted
25 that another embodiment may include a marine or submarine device 7 navigating on the surface during this recovery phase. The carriage 2 is placed in a retracted position, i.e. at the bottom end of the ramp 11, by gravity or by the second driving means. The protective components 5 are in the low position, i.e. pivoted downward, so as to be submerged to receive the
30 marine or submarine device 7. In the figure 5.A example, the principal axis of

inertia of the protective components makes an angle with the surface of the water 25 between 80° and 90° inclusive.

Figure 5.B illustrates the phase of the marine or submarine device 7 coming alongside. The traction cable 16 is wound in by the winch 15. In this
 5 embodiment the marine or submarine device 7 has wings 12. The traction by the cable draws the wings 12 into abutment with the protective components 5.

Figure 5.C illustrates the phase of the front part of the marine or submarine device 7 mounting the step. The traction cable 16 continues to be
 10 wound in by the winch 15. The protective components 5 are constrained by the wings 12 of the marine or submarine device 7, by the sliding zone 17 and by the raising components 18: the protective components 5 then pivot about the carriage 2, their rotation being forced by the sliding zone 17 and/or a raising component 18. This rotation of the protective components 5 raises the
 15 front of the marine or submarine device 7 to the level of the ramp. The front of the marine or submarine device 7 does not at this time touch any component of the L.A.R.S., which makes it possible to protect the sensors from potentially destructive shocks.

Figures 5.D and 5.E illustrate the continued raising of the marine
 20 or submarine device 7 on the ramp 11. In figure 5.D, the traction cable 16 continues to be wound in by the winch 15. The protective components 5 continue to pivot about the carriage 2 as the carriage 2 slides forward along the ramp 11. The protective components 5 slide, or in one particular embodiment roll, on the raising component 18, enabling the front of the
 25 marine or submarine device 7 to be raised further. The body of the marine or submarine device 7, stronger than its front, bears on protection and sliding means 30 of the ramp, in this instance rollers.

In figure 5.E, the traction cable 16 continues to be wound in by the winch 15. When traction is applied, the marine or submarine device bears on
 30 the protection and sliding means 30 of the ramp 11 until it rests on the ramp 11. The contact between the protective components 5 and the raising

components 18 ceases and the protective components 5 slide or roll on the sliding zones 17.

Figure 5.F illustrates the marine or submarine device 7 raised to the end of the ramp 11. The protective components 5 are no longer in their raised position. The front of the marine or submarine device 7 then rests on the ramp 11 via its body. The protective components 5 remain in contact with the wings 12 and therefore notably limit or prevent rolling of the marine or submarine device 7.

The attitude of the marine or submarine device 7 varies during launch or recovery as a function of its initial attitude and loads imposed by the system. In embodiments of the invention, the normal maximum attitude variation of the marine or submarine device 7 may be between 0 and 90° inclusive. The system is able to modify the attitude of said marine or submarine device during launch or recovery of said marine or submarine device.

In one particular embodiment of the invention, the marine or submarine device 7 does not comprise either wings 12 or lateral protuberances. The recovery and launch phases are analogous to those illustrated in figure 5: in this embodiment, the protective part or parts 4 are directly in contact with the hull of the marine or submarine device 7.

CLAIMS

1. A system comprising a ramp (11) and a device (1) for launching and recovering a marine or submarine device (7) from a support vessel (6), said device (1) including a carriage (2) and at least one protective component (5), characterized in that:
- each of said protective components (5) is connected to the carriage (2) by a pivot connection of which the axis is parallel to the surface of the water (25) when said device is secured to said vessel (6);
 - at least one of said protective components (5) is adapted to raise said marine or submarine device (7) partially or totally out of the water during a recovery and to place said marine or submarine device (7) in or partially in the water during a launch by rotation of said protective component or elements (5) about said carriage (2);
 - said carriage (2) and said ramp (11) are connected by a sliding connection;
 - said ramp (11) is fastened to said vessel (6);
 - at least one of said protective components (5) is adapted to raise or to deposit said marine or submarine device (7) by contact with an element chosen from at least a wing (12) of said marine or submarine device (7), at least one lateral protuberance of said marine or submarine device (7) and the hull of said marine or submarine device (7);
 - said system includes at least one sliding zone (17) situated along said ramp (11), in contact with said protective part (4) and fastened to said vessel (6), and in that
 - at least one of said protective components (5) is adapted to cooperate with said sliding zone (17) to cause said marine or submarine device (7) to move from a support of at least one of said protective components (5) to a support of said ramp (11) or from said

support of said ramp (11) to said support of at least one of said protective components (5).

- 5 2. The system as claimed in the preceding claim comprising at least two of said protective components (5) fastened together.
- 10 3. The system as claimed in any one of the preceding claims, in which said protective component (5) or each of said protective components (5) comprises a protective part (4) and an arm (3) connected by a complete connection and such that said arm (3) or each of said arms (3) is connected by one of said pivot connections to said carriage (2).
- 15 4. The system as claimed in any one of the preceding claims in which each of said protective parts (4) comprises at least one curved part and is adapted to limit the movements of said marine or submarine device (7).
- 20 5. The system as claimed in any one of the preceding claims in which at least one part of one of said protective parts (4) is hollowed out so as not to come into contact with fragile parts of the marine or submarine device (7).
- 25 6. The system as claimed in any one of the preceding claims in which said pivot connection is freely rotatable.
- 30 7. The system as claimed in any one of the preceding claims in which at least one of said protective parts (4) includes at least one roller (10) mounted at one of its ends and pivoting about a second axis parallel to the surface of the water (25) when said system is secured to said vessel (6).

8. The system as claimed in any one of the preceding claims in which at least one of said protective parts (4) includes at least one roller (10) mounted on a part of said protective part (4) adapted to cooperate with said sliding zone (17) and pivoting about a second axis parallel to the surface of the water (25) when said system is secured to said vessel (6).
9. The system as claimed in any one of the preceding claims comprising traction means (14) adapted to control the sliding of said marine or submarine device (7) on said ramp (11).
10. The system as claimed in any one of the preceding claims in which at least one of said protective components (5) includes an attachment device enabling connection of said marine or submarine device at least to said protective component (5).
11. The system as claimed in either one of claims 9 or 10 in which said traction means (14) include a winch (15), a traction cable (16) and drive means (20) such that said traction cable (16) is fastened to said marine or submarine device (7), is driven by said winch (15), itself fastened to said support vessel (6) and such that the carriage (2) includes a fairlead (26) guiding said traction cable (16) on the axis of the ramp (11).
12. The system as claimed in any one of the preceding claims in which at least one of said sliding zones (17) is adapted to force the rotation of at least one of said protective components (5) about said carriage (2) when said carriage (2) slides on said ramp (11), locally raising said marine or submarine device (7) to facilitate its recovery or its launch.
13. The system as claimed in any one of the preceding claims comprising at least one raising element (18) fastened to at least one

of said sliding zones (17) in which at least one of said protective components (5) is able to cooperate with at least one of said raising elements (18) to cause said marine or submarine device (7) to move from a support of at least one of said protective components (5) to a support of said ramp (11) or from said support of said ramp (11) to said support of at least one of said protective components (5).

14. The system as claimed in any one of the preceding claims in which at least one of said raising elements (18) is adapted to force by contact the rotation of at least one of said protective components (5) about said carriage (2) when said carriage (2) slides on said ramp (11), locally raising said marine or submarine device (7) to facilitate its recovery or its launch.

15. The system as claimed in any one of the preceding claims adapted to modify the attitude of said marine or submarine device (7) during the launch or the recovery of said marine or submarine device (7).

16. A vessel (6) equipped with at least one system according to any one of the preceding claims.