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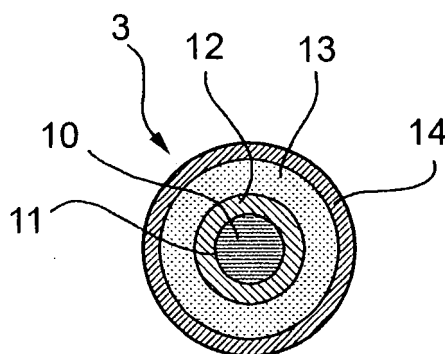
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(54) **Torpedo wire-guidance system**

(57) A wire-guidance system (1) for a torpedo (2), having two reels (4, 5) of optical-fibre cable (3) located on a torpedo (2) and a launch pad (6) respectively; both the reels (4, 5) are formed from a single reinforced optical-fibre cable (3) of an outside diameter of less than 0.75

mm, and having an optical fibre (10), at least one coat (11, 12) of polymer material, a reinforcing layer (13) defined by a longitudinal armour of yarn made of aramidic fibres, glass fibres, carbon fibres, or combinations of these, and a outer sheath (14) of polyamide 12.

FIG. 2



Description

[0001] The present invention relates to a torpedo wire-guidance system.

[0002] Torpedo wire guidance systems are known which substantially comprise a reel on the torpedo, containing tens of kilometres of optical-fibre cable; and a reel on the launch pad of a submarine, containing a few kilometres of cable. The cables of the two reels are connected by an underwater optical connector. The cable of the reel on the torpedo (hereinafter referred to as the "torpedo reel") must meet conflicting requirements : on the one hand, it must be of high tensile strength to withstand the loads to which it is subjected, especially over the first part of the mission just after launching; and, on the other, it must be of a diameter compatible with the coil on the torpedo reel, which must contain tens of kilometres of cable for long-range missions.

[0003] Accordingly, in one known solution, the torpedo reel is formed with two different types of cable : a first reinforced cable of good tensile strength but relatively large diameter (as much as 0.85 mm), and a second non-reinforced cable, smaller in diameter (less than 0.75 mm) but of poor tensile strength. The first cable is used over the first part of the mission (e.g. a few hundred metres) and so forms the inner portion of the reel, while the second cable forms the rest of the reel; and the two cables are connected by a flexible joint.

[0004] The hybrid solution briefly described above, however, has several drawbacks.

[0005] Using two types of cable in the same reel makes the reel vulnerable to sharp temperature gradients typical of military equipment storage : because of the difference in the expansion coefficients of the two cables, deformation occurs at the interface areas, thus resulting in irreversible, localized increases in attenuation.

[0006] Moreover, using two different types of cable - especially a non-reinforced cable for the outermost part of the torpedo reel - limits the pull that can be applied to the cable when winding it, and so results in an uneven coil in terms of residual stress. This in turn results in potential collapse of the coil at the unwinding stage, at which the innermost layers of the reel are released into the sea first, and potential release of residual stress in the presence of a temperature gradient.

[0007] Another drawback is that, in the event the torpedo is recovered after an exercise mission, the reel cannot be used again, on account of all the reinforced cable having been unwound.

[0008] Moreover, because of the poor tensile strength of the non-reinforced cable, the filler grease used to fill the gaps between the turns cannot be applied automatically, and must therefore be applied by hand to each layer of turns, which makes the process difficult to control and results in inconsistent quality of the finished reels.

[0009] Finally, using a non-reinforced cable for most of the torpedo reel increases the risk of accidental breakage caused by the dynamics of the torpedo or external

events (abrasion on the sea bed, collision with obstacles).

[0010] It is an object of the present invention to provide a torpedo wire guidance system designed to eliminate the aforementioned drawbacks typically associated with known systems.

[0011] According to the present invention, there is provided a system as claimed in Claim 1.

[0012] A preferred, non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows, schematically, a wire-guidance system in accordance with the present invention;

Figure 2 shows a schematic cross section of an optical-fibre cable of the Figure 1 system.

[0013] Number 1 in Figure 1 indicates a wire-guidance system of a torpedo 2, employing an optical-fibre cable 3. The system substantially comprises a reel 4 on torpedo 2 (hereinafter referred to as "torpedo reel 4"), containing tens of kilometres of cable 3; and a reel 5 on a launch pad 6 of a submarine 7 (hereinafter referred to as "submarine reel 5"), containing a few kilometres of cable 3. Both reels unwind outwards, and the respective cables 3 are connected by a connector 9.

[0014] According to the present invention, torpedo reel 4 comprises one type of reinforced cable 3; and submarine reel 5 preferably comprises the same type of cable.

[0015] With reference to Figure 2, cable 3 of torpedo reel 4 comprises a monomodal inner optical fibre 10, preferably an ITU-T G625D type, of less than 0.36dB/km @ 1310 nm attenuation, and which comprises, in known manner, a glass core, cladding, and mantle (not shown) to a total outside diameter of about 250 µm.

[0016] Optical fibre 10 is covered with a first roughly 4 µm thick coat 11 of acrylic dye for cable identification and primary protection.

[0017] From the inside outwards, cable 3 also comprises a second acrylic protective coat 12; a reinforcing layer 13; and a polyamide 12 outer sheath 14. Reinforcing layer 13 conveniently comprises a longitudinal armour of non-twisted yarn made of aramidic fibres, glass fibres, carbon fibres, or combinations of these, and which is distributed evenly about optical fibre 10.

[0018] The reinforcing layer yarn is preferably Kevlar® (DuPont registered trademark).

[0019] Optical fibre 10 with first and second coats 11 and 12 has an outside diameter of about 0.35 mm; and the complete cable 3 has an outside diameter of 0.75 mm or less.

[0020] This structure enables cable 3 to withstand the stress exerted by use in a heavy-duty torpedo, with no impairment in the optical characteristics of the optical fibre, and in particular to achieve the following performance:

- maximum operating pressure : 125 bars

- tensile strength : 300 N
- minimum radius of curvature : 35 mm
- resistance to prolonged immersion in seawater.

[0021] The small diameter and weight - 0.45 kg/km or less - of cable 3 enable tens of kilometres of cable to be housed, in the form of a reel, in the confined space available on torpedo 2.

[0022] Cable 3 may be produced in lengths compatible with the maximum length of reel 4, so no joins inside reels 4, 5 are required.

[0023] In a preferred embodiment of the invention, cable 3 is fitted with magnetic markers 15 comprising Mu-metal bands covered with a thin coating of acrylic material.

[0024] Magnetic markers 15 are equally spaced, e.g. every few hundred metres, along the cable, and are detectable by an induction sensor inside torpedo 2, so the length of the travelled trajectory can be measured directly, and the position of the torpedo with respect to the launcher determined accurately. Magnetic markers 15 are so sized as not to affect the radius of curvature of cable 3 and therefore winding of the cable into reels.

[0025] The advantages of the present invention will be clear from the foregoing description.

[0026] In particular, using a single cable 3, at least for torpedo reel 4, eliminates the problems caused by thermal-gradient-induced deformation at the interface between different cables, thus also eliminating consequent attenuation problems.

[0027] Moreover, using a single reinforced cable, greater pull can be applied when winding it, thus ensuring greater stability of reel 4 at the unwinding stage, and safeguarding against collapse of the coil.

[0028] Given the improvement and consistency in the tensile strength of cable 3, the filler grease can be applied automatically, e.g. by extrusion, prior to the winding stage, and therefore in controllable manner to achieve consistent product quality.

[0029] If the torpedo is recovered at the end of an exercise mission, the torpedo reel can be used again (providing, obviously, enough cable is left for the next mission) by simply eliminating the unwound length of cable and joining the cable of the torpedo reel to that of the submarine reel by means of a connector, with no need to replace the whole reel.

[0030] Finally, using a cable 3 reinforced along its whole length reduces the risk of accidental breakage caused by the dynamics of the torpedo or external events (impact or abrasion).

[0031] Clearly, changes may be made to the wire-guidance system as described herein without, however, departing from the protective scope as defined in the accompanying Claims.

Claims

1. A wire-guidance system (1) for a torpedo (2), comprising at least one reel (4) of optical-fibre cable (3), **characterized in that** said reel (4) comprises one type of cable (3), and said cable (3) has a reinforcing layer (13) along its whole length.
2. A system as claimed in Claim 1, **characterized in that** said reinforcing layer (13) comprises a longitudinal armour of yarn made of fibres selected from the group comprising aramidic fibres, glass fibres, carbon fibres, or combinations of these.
3. A system as claimed in Claim 2, **characterized in that** said yarn is non-twisted.
4. A system as claimed in Claim 2 or 3, **characterized in that** said yarn is evenly distributed about the optical fibre (10).
5. A system as claimed in one of the foregoing Claims, **characterized in that** said cable (3) has an outside diameter of maximum 0.75 mm.
6. A system as claimed in any one of the foregoing Claims, **characterized in that** said cable (3) of said reel (4) is formed in one piece with no joins.
7. A system as claimed in Claim 4, **characterized in that** said cable (3) has a number of magnetic markers (15) equally spaced along its length.
8. A system as claimed in Claim 5, **characterized in that** said magnetic markers (15) are made of Mu-metal.
9. A system as claimed in any one of the foregoing Claims, **characterized in that** said reel (4) is carried by a torpedo.
10. A system as claimed in Claim 9, **characterized by** comprising a second reel (5) mounted on a launch pad (6) and comprising said cable (3).
11. A system as claimed in Claim 10, **characterized in that** said reel (5) mounted on said launch pad (6) comprises a single cable (3) with no joins.
12. Use of a reinforced optical-fibre cable (3), with no joins, for producing a reel (4) of a wire-guidance system of a torpedo (2).

FIG. 1

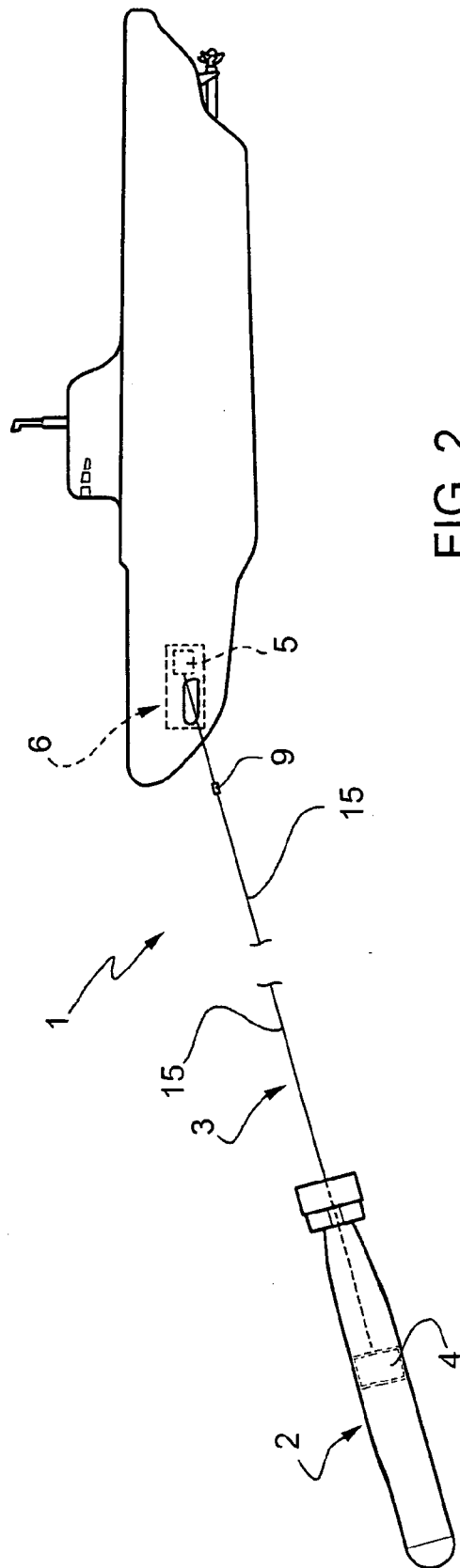
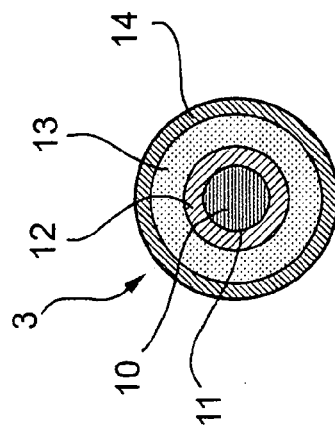


FIG. 2





EUROPEAN SEARCH REPORT

Application Number
EP 08 42 5223

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	* page 3, line 16 - line 20 *	7,8	
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A	* column 3, line 28 - line 58 * * column 4, line 46 - line 55; claims 1,3,5,6; figure 1 *	7-11	

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A	* paragraph [0038]; claims 24,27,60,63; figure 8 *	1-6,9-12	

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 November 2008	Examiner Giesen, Maarten
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 08 42 5223

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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12-11-2008

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