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CABLE FAIRING ATTACHMENT

STATEMENT OF GOVERNMENT INTEREST

[0001] The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

CROSS REFERENCE TO OTHER PATENT APPLICATIONS

[0002] Not applicable.

BACKGROUND OF THE INVENTION

(1) Field of the Invention

[0003] The present invention relates to cable fairings, and more specifically to systems and methods for automatically applying fairings to a cable as it is deployed from a winch.

(2) Description of the Prior Art

[0004] Unfaired cable has a normal drag coefficient of approximately 1.5, compared to about 0.2 for a cable with hard fairings. When an unfaired cable is deployed from a winch into a fluid medium, this increased drag significantly increases the amount of cable required to achieve a certain depth.

[0005] Despite this reality of operation, cables are often not faired because faired cables require increased winch sizes compared to non-faired cables and faired cables also increase the complexity of handling the cable. Conventional winches can typically only accommodate one layer of faired cable. Some specialized winches have been designed to accommodate two (or more) layers of faired cable by separating them with annular steel shells. However, these designs are complex and expensive.

[0006] Several fairing designs allow multiple layers of cable to be wound on a single winch. Ribbon fairing and hairy fairing are commonly used. These fairings include streamers (ribbons) or short pliant hairs attached to the cable.

[0007] Another type of fairing, known as zipper fairing, consists essentially of a sheet of reinforced polyethylene (or similar material) that is wrapped around the cable and then sealed (zipped) to itself at two free ends. These designs do reduce drag, but not nearly as much as hard fairings. Furthermore, these designs tend to be destroyed by handling systems.

[0008] Another major issue affecting automated attachment of hard fairings is the alignment of the fairing during attachment. Hard fairings are typically held together with screws. Some hard fairings have internal fasteners that snap together as the two fairing pieces are attached to the cable. Automating screw

attachments onboard a ship would require a complicated attachment system. Additionally, potential misalignment problems preclude onboard automation of either of these designs.

[0009] What are therefore needed are systems and methods for automatically applying hard fairings to a cable as the cable is deployed from a winch.

SUMMARY OF THE INVENTION

[0010] It is therefore a general purpose and object of the present invention to provide systems and methods for automatically applying fairings to a cable as the cable is deployed from a winch.

[0011] To attain the object described, the fairings are fabricated in two halves, with each half having a recess to accommodate the cable. Like halves are chained together and the two halves are stored on separate spools. Counter-rotating wheels adjacent to and on opposite sides of the cable serve to feed the fairing halves from the spools to the cable as the cable is deployed.

[0012] As fairing halves approach the cable, magnets in the fairing halves are attracted to each other and bring the two halves of the fairing together around the cable. In a variation of the attraction properties, a magnet in one of the fairing halves is replaced with iron, steel or other material that is

strongly attracted to magnets. The magnetic attraction helps to correctly align the fairings. When the cable is retrieved, guides align the fairings such that a wedge can pry the two halves apart. The halves can be picked up by the wheels and fed back onto the spools.

[0013] In one embodiment, a system for applying fairings to a cable includes a first spool of first fairing halves and a second spool of fairing halves complimentary to the first fairing halves. The system includes first and second wheels whose rotations feed the first and complimentary fairing halves from the respective spools to respective locations proximate to and on opposite sides of the cable. Each fairing half has at least one magnet disposed therein, such that magnetic attraction between the magnets results in clamping the fairing halves about the cable to form a full fairing.

[0014] In one embodiment, complimentary grooves in the fairing halves accommodate the cable therein. The surfaces of the grooves can be textured for gripping the cable. In a further embodiment, connectors are attached between each of the first fairing halves and between each of the complimentary fairing halves. In a still further embodiment, fin guides can be affixed to the first and second wheels along their respective perimeters. The fin guides align the fairing halves for clamping about the cable.

[0015] In one embodiment, the connectors can be fabricated of a flexible chord. Still further, the connectors can be continuous through a plurality of fairing halves.

[0016] In one embodiment, one or both of the fairing halves has an indent extending along an edge transverse to the cable when the fairing halves clamp about the cable. A wedge is disposed to engage the indent so as to separate the fairing halves from the cable as the fairing halves move over the wedge. In one embodiment, a fairing guide adjacent the cable angularly aligns a plurality of the full fairings along the cable.

[0017] In one embodiment, a fairing system includes complimentary first and second fairing halves. Each fairing half includes one or more magnets and the halves include complimentary grooves. Magnetic attraction between the magnets clamps the fairing halves about a cable to form a full fairing, with the grooves accommodating the cable therein.

[0018] In one embodiment, connectors attach a plurality of first fairing halves to each other to form a chain. Similarly, connectors attach a plurality of second fairing halves to each other to form another chain. The connectors can be fabricated of flexible chord. Further, the connectors can be continuous through a plurality of fairing halves.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] A more complete understanding of the invention and many of the attendant advantages thereto will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings wherein:

[0020] **FIG. 1** depicts a top view of a system of the present invention in which the system is capable of automatically applying fairings to a cable;

[0021] **FIG. 2** depicts a partial side view of a chain of fairing halves;

[0022] **FIG. 3** depicts a cross-sectional view of a fairing attached to a cable; and

[0023] **FIG. 4** depicts a top view of fairings being retrieved.

DETAILED DESCRIPTION OF THE INVENTION

[0024] Referring to **FIG. 1**, there is shown a top view of system **10** of the present invention. In the figure, the system **10** deploys cable **12** from cable reel **14** and feeds the cable from a ship **2** into a fluid medium **4** - in the direction indicated by arrow **A**. In addition to deploying the cable **12**, the system **10** automatically attaches fairings **16** onto cable **12**.

[0025] The fairings **16** are fabricated in two complimentary halves, **16a** and **16b**, which are stored separately on respective

spools **18a** and **18b**. As will be explained in further detail hereinafter, the halves **16a** are chained together on the spool **18a** and the halves **16b** are chained together on the spool **18b**.

[0026] The chained halves **16a** and **16b** are fed onto respective wheels **20a** and **20b**, which are near to, and on opposite sides of, the cable **12**. As the cable **12** is fed through the system **10**, the wheels **20a** and **20b** counter-rotate (as indicated by arrows **B1** and **B2**) and hence feed the fairing halves **16a** and **16b** towards the cable. As the fairing halves **16a** and **16b** rotate with the respective wheels **20a** and **20b**, they are brought adjacent the cable **12** (designated in phantom generally as area **C** in **FIG. 1**).

[0027] As the fairing halves **16a** and **16b** near each other on opposite sides of the cable **12**, magnetic attraction between fairing halves start to pull the fairing halves together and free them from the respective wheels **20a** and **20b**. As the fairing halves **16a** and **16b** become free of the respective wheels **20a** and **20b**, the fairing halves attach to each other about the cable **12** to form the full fairings **16**.

[0028] The system **10** can also be used in retrieving the cable **12** from the medium **4** back onto the ship **2**, with the fairing halves **16a** and **16b** returned onto the respective spools **18a** and **18b**. In retrieving the cable **12**, the direction of arrows **A**, **B1** and **B2** in **FIG. 1** would be reversed. Guides **22** angularly align the fairings **16** for retrieval onto the wheels **20a** and **20b**.

[0029] Referring now to **FIG. 2**, there is shown a side view of chained fairing halves **16a**. As the fairing halves **16a** and **16b** are complimentary, those of ordinary skill in the art will recognize that **FIG. 2** may also represent the fairing halves **16b** and that the following discussion applies equally to the fairing halves **16b**. The chained fairing halves **16a** are linked by a flexible connector **24**.

[0030] As is known in the art, anti-stacking rings (not shown) can be fitted to a cable to limit the movement of fairings along the cable, especially as the diameter becomes smaller when the cable is under tension due to the Poisson effect. The length of the connector **24** and the location of the connector relative to the cable **12** can be such as to accommodate such stacking rings. Preferably, but not for limitation, the connector **24** may be a rope, cable, cord, or chain of material, such as Kevlar®, steel, or high-strength polymer, that has sufficient strength to withstand the handling, deployment and hydrodynamic forces that the fairing halves **16a** are subjected to.

[0031] Depending on the chosen fabrication technique, but not for limitation, the connector **24** may be continuous through the fairing halves **16a** (e.g., the fairing halves **16a** may be cast about connector). Alternately, or in combination, individual fairing halves **16a** can be linked by connectors **24** after

fabrication. For example, the fairing halves **16a** may be fabricated with a loop to which connectors **24** are attached, allowing for varying the length between the chained fairing halves **16a**.

[0032] To provide the magnetic attraction previously described with respect to **FIG. 1**, one or more magnets **26** are recessed into the fairings halves **16a**. The number and location of the magnets **26** will depend on the strength of magnets, the size of the cable **12** and the specific design of the fairing halves **16a**.

[0033] The groove **28** accommodates the cable **12** when the fairing halves **16a** and **16b** are brought together about the cable, as described previously with respect to **FIG. 1**. The surface of the groove **28** may be dimpled or otherwise textured to minimize slippage of the cable **12** within the fairings **16**.

[0034] For retrieval purposes, as will be explained in further detail hereinafter, first edge **16a(1)** of the fairing halves **16a** has chamfer **30** extending the length thereof. To maintain the symmetry between the fairing halves **16a** and **16b**, but not for limitation, the chamfer **30** also extends along opposite edge **16a(2)** of the fairing halves **16a**. For clarity of illustration, edges **16a(1)** and **16a(2)** are designated only on one of the fairing halves **16a** in **FIG. 2**.

[0035] Referring also to **FIG. 3**, there is shown a schematic cross-sectional view of the fairing **16** taken at reference line **3-3** of **FIG. 1**. The fairing halves **16a** and **16b** are disposed about the cable **12** to form full fairing **16**. For clarity of illustration but not limitation, the fairing halves **16a** and **16b** are shown slightly separated. In actual deployment, the fairing halves **16a** and **16b** would abut each other and the cable **12**. The fairing halves **16a** and **16b** can be fabricated such that the fairing **16** has a shape known to those of skill in the art to reduce drag. The mutual attraction of the magnets **26** holds the fairing halves **16a** and **16b** together while the cable **12** is held within the complimentary grooves **28**.

[0036] Referring now to **FIG. 4**, there is shown a top view of the fairings **16** being retrieved. As the fairing **16** approaches the wheels **20a** and **20b** in the direction of arrow **D**, wedge **32** inserts itself in the chamfers **30** (only two of which are designated - for clarity). Continued movement of the fairing **16** in the direction of arrow **D** results in the wedge **32** splitting the fairing into the fairing halves **16a** and **16b**. Fins **34** guide the fairing halves **16a** and **16b** onto the respective wheels **20a** and **20b**. - which counter-rotate in the directions indicated by arrows **E1** and **E2**. In turn, the wheels **20a** and **20b** feed the fairing halves **16a** and **16b** onto the respective spools **18a** and

18b (shown in **FIG. 1**). When retrieval is complete, the wedge **32** can be removed such that deployment of the cable **12** can proceed.

[0037] What has thus been described is a system that automatically applies fairings to a cable as the cable is deployed from a winch. The fairings are fabricated in two complimentary halves. A recess, or groove, in each half accommodates the cable. One set of halves are chained together and are stored on a first spool. A complimentary set of halves is also chained together and stored on a separate spool.

[0038] Counter-rotating wheels adjacent to and on opposite sides of the cable serve to feed respective fairing halves from the spools towards the cable. As the wheels rotate, the fairing halves approach the cable. Magnets in the complimentary fairing halves are attracted to each other and bring the two halves of the fairing together about the cable. The cable is held firmly in place within the grooves of the respective halves. When the cable is retrieved, guides align the fairings such that a wedge can pry the two halves apart. The halves can be picked up by the wheels and fed back onto the spools.

[0039] The system provides the advantages of hard fairings, in terms of drag and robustness, while lessening the alignment tolerances normally required for automatic application of hard fairings to a cable. The attraction of the magnets in the fairing halves tends to self-align the halves as they are

brought together about the cable. In addition, the weight of the magnets would tend to lessen the length of cable required to achieve a certain depth.

[0040] Obviously many modifications and variations of the present invention may become apparent in light of the above teachings. For example, the wheels **20a** and **20b** may include depressions thereon that the respective fairing halves **16a** and **16b** may fit into. In addition to aligning the fairing halves, fins **34** (or a combination of fins **34** and depressions) can serve to appropriately separate the fairing halves from one another. As further examples, the chamfer **30** can have a rounded profile, or can simply be an indent that the wedge **32** can engage. Also, the magnets **26** can have an anti-corrosion coating.

[0041] In light of the above, it is therefore understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

Attorney Docket No. 85033

CABLE FAIRING ATTACHMENT

ABSTRACT OF THE DISCLOSURE

Systems and methods for automatically applying fairings to a cable as the cable is deployed from a winch are provided. Each fairing has two halves, with each half having a recess, or groove, to accommodate the cable. Like halves are connected together and the two halves are stored on separate spools. Counter-rotating wheels adjacent to and on opposite sides of the cable serve to feed the fairing halves from the spools to the cable as the cable is deployed. As the fairing halves approach the cable, magnets in the fairing halves are attract each other and bring the two halves together around the cable and firmly hold the two halves together. When the cable is retrieved, guides align the fairings such that a wedge can pry the two halves apart. The halves can be picked up by the wheels and fed back onto the spools.

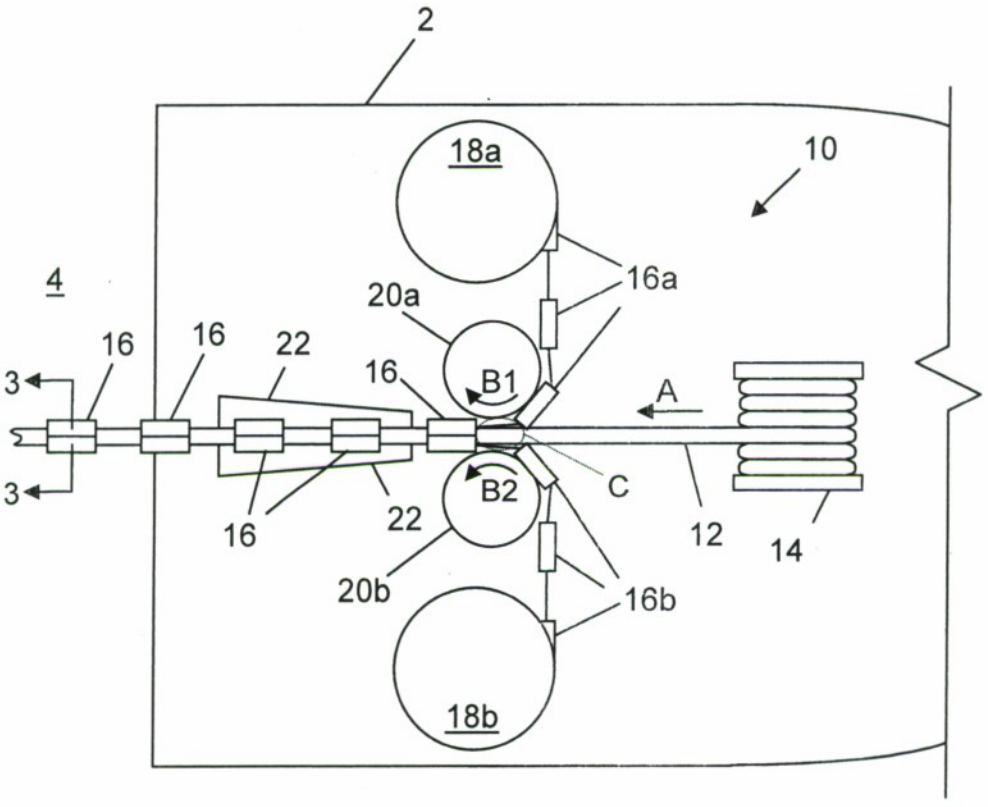

FIG. 1

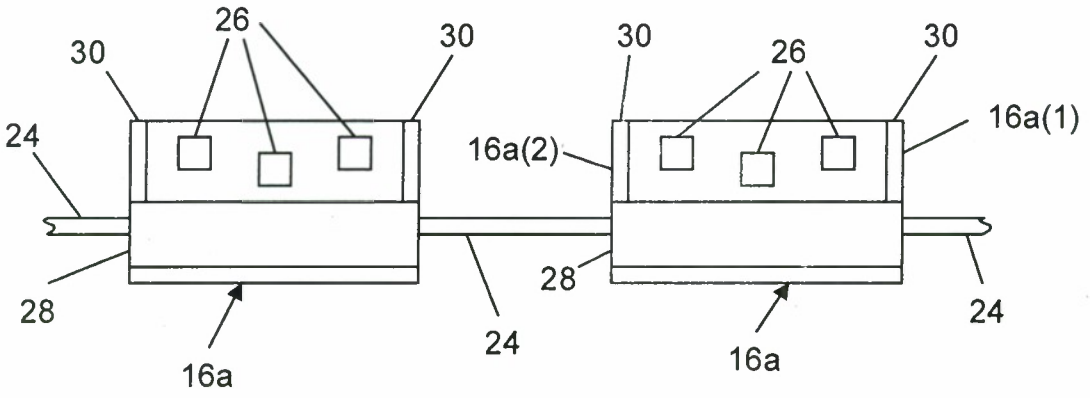
26
30
30
30
26
30
24
16a(2)
16a(1)
28
28
24
16a
24
16a

FIG. 2

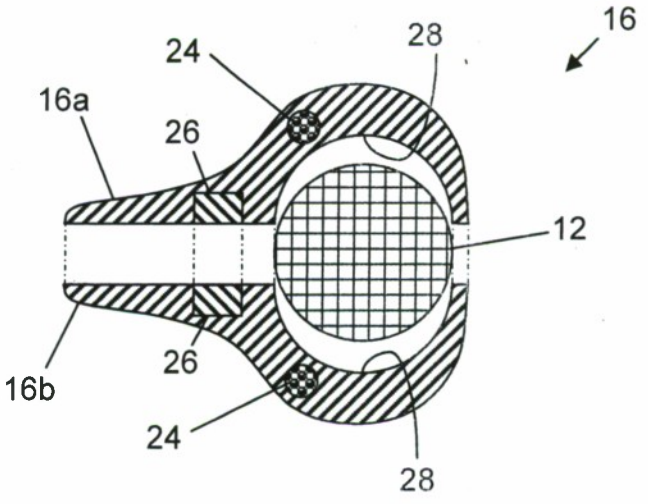
16
24
28
16a
26
12
26
16b
24
28

FIG. 3

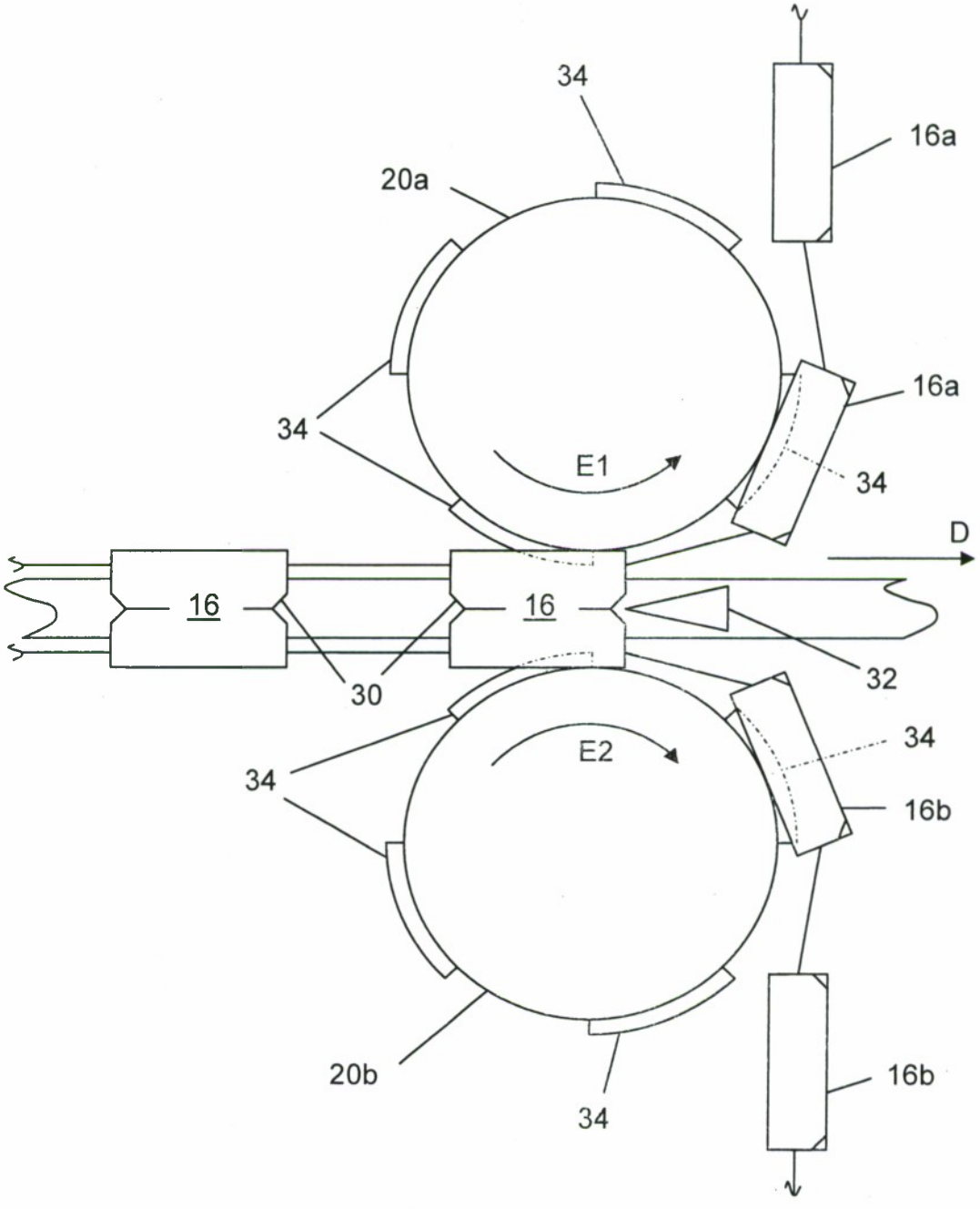

FIG. 4