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(54) **A storage and deployment unit for a coilable element and a method of handling a coilable element**

Speicher- und Einsatzeinheit für ein aufwickelbares Element und Verfahren zur Handhabung eines aufwickelbaren Elements

Unité de stockage et de déploiement d'un élément enroulable et procédé de manutention d'un élément enroulable

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Description

Field of the invention

[0001] The present invention concerns a device for storing, transporting and deploying an elongate, coilable element according to the preamble of claim 1 and a method of storing and transporting an elongate, coilable element to the preamble of claim 9.

Background of the invention

[0002] Offshore facilities, such as offshore wind power turbines and oil rigs, are normally connected to cables for supplying power to and/or from the facility or for communicating electrical signals to and/or from the facility. Particularly in the wind farm industry, several tens of wind power turbines may be interconnected by a network of cables. Offshore wind power turbines may be arranged with separation distances ranging between 500 metres and 1000 metres.

[0003] Laying such "in-field" cables between individual wind power turbines is performed by traditional cable-laying ships or barges, which are loaded with the necessary cable at shore and then sails to the offshore location where it moves between the offshore turbines in order to lay the various lengths of cable. The total length of cable required may be in the order of 100 kilometres, all spooled onto the ship's carousel or turntable. Alternatively, individual in-field cable lengths are spooled onto smaller reels and subsequently loaded onto the installation vessel into designated reel stands. The former method is the preferred one, as each cable length is cut to suit the as-installed positions of the turbines and the actual laying track of the cable in question; hence the required over-length is minimized, as is the cost. However, load-out of a long cable onto a carousel on a vessel is a time consuming and hence costly operation. Document WO2010/019047 is considered as being the closest prior art and discloses the features of the preamble of claim 1.

[0004] The present applicant has devised and embodied this invention in order to overcome the shortcomings of the prior art and to obtain further advantages.

Summary of the invention

[0005] The invention is set forth and characterized in the main claims, while the dependent claims describe other characteristics of the invention.

[0006] It is thus provided a device for storing, transporting and deploying an elongate, coilable element, characterized by a storage unit having a storage region for the element; and supports by means of which the device may be placed on, and skidded along, a surface.

[0007] In one embodiment, the device comprises a feeding unit releasably connectable to the storage unit and having first guiding means and second guiding means for feeding the element into and out of the storage

unit.

[0008] In one embodiment, the storage unit comprises an opening into the storage region, and first connectors configured for connection to corresponding second connectors on the feeding unit.

[0009] In one embodiment, the first connectors are in the region of the opening, whereby the first guiding means is arranged in the vicinity of the opening when the feeding unit and the storage unit are connected.

[0010] In one embodiment, the feeding unit further comprises a first motion control device, operable for feeding the element into or out of the storage region.

[0011] The storage region has preferably a circular cross-section and a central hub. In one embodiment, the first guiding means is arranged coaxially with the hub centre axis, and the axis is substantially vertical and the feeding unit is arranged on top of the storage unit.

[0012] It is also provided a system for storing, transporting and deploying an elongate, coilable element, characterized by one or more of the devices according to the invention arranged on a carrier; said carrier further comprising a second motion control device arranged to receive the element as it is being fed out of the second guiding means, and a third element guide for conveying the element off of the carrier.

[0013] The carrier is in one embodiment a ship having deck space for one or more of the devices according to the invention. The elongate, coilable element is preferably a cable, e.g. a cable having one layer of reinforcement.

[0014] It is also provided a method of storing and transporting an elongate coilable element, characterized by the steps of

- a) loading desired quantities of coilable element into a desired number of containers;
- b) storing the containers at an on-shore location;
- c) at a desired time, loading the containers onto a transportation vehicle; and
- d) transporting the containers on the vessel to a designated location.

[0015] In one embodiment of the method, the loading in step c comprises skidding.

[0016] The vehicle does in a preferred embodiment comprise a ship having a deck space for storing the containers.

[0017] The method of the invention is preferably executed using the invented device and system.

[0018] With this invention, standard supply vessels may be used as platforms for installing the cable. The mobilisation and demobilisation cost is significantly reduced, compared to the vessels of the prior art.

Brief description of the drawings

[0019] These and other characteristics of the invention will be clear from the following description of a preferential

form of embodiment, given as a non-restrictive example, with reference to the attached drawings wherein:

Figure 1 is a side view of a ship carrying the invented transportation and deployment device, and shows cable installation being performed from the invented device;

Figure 2 is a top view of the ship shown in figure 1;

Figure 3 is a side view of the transportation and deployment device;

Figure 4 is a side view of the cable feed unit, seen in the direction D as indicated in figure 3;

Figure 5 is a top view of the cable trough;

Figure 6 is a side view of the cable trough, seen in the direction C as indicated in figure 5;

Figure 7 is a side view of the cable trough, seen in the direction A as indicated in figures 5 and 8;

Figure 8 is a top view of the cable trough, seen in the direction B as indicated in figure 5;

Figure 9 is a side view of the invented transportation and deployment device on a quay, ready for loading into a ship; and

Figure 10 is a side view of the invented transportation and deployment device on a quay being skidded aboard a ship.

Detailed description of a preferential embodiment

[0020] The invented transportation and deployment device 12 generally comprises a container, or trough, 1 for holding a coilable element - such as a coilable cable - 14, and a releasable feed unit 4.

[0021] The container 1 is in the illustrated embodiment basically a metal cage, or trough, having a central hub 18 and curved inner side walls, thus defining a toroid-shaped storage compartment 19, into which the cable is coiled. The central hub radius is determined by the minimum bending radius for the coilable cable. The container comprises skidding beams 2, separated by slots 3, and upper, removable beams 11 which serve as stiffeners when the container is being lifted. Lifting lugs 22 are provided, whereby the container may be lifted, e.g. via slings 20 and a crane (not shown).

[0022] The feed unit 4 is designed to be positioned above the upward opening 24 of the container 1, and comprises pegs 26 for mating engagement with corresponding receptacles 25 on the container 1. The feed unit comprises a cable guide pipe 16, leading between the side of the feed unit and a guide funnel 17 which is

positioned in an upper, central region of the feed unit, concentric with the hub 18 (see figure 3) and opening downwards towards the container opening 24. The guide pipe 16 comprises a tensioner 5, by means of which the coilable elongate element (e.g. cable) may be moved within the pipe, and hence into or out of the compartment 19.

[0023] In use, coilable cable may be loaded into the storage compartment 19 of the container 1 at a cable manufacturing plant, e.g. via the feed unit 4 and using the tensioner 5 and guide pipe 16. Once a container has been filled with the desired length of cable, the feed unit is removed. Temporary beams 11 are attached to the container, and the container may be shipped to a load-out quay 23. The feed unit may be used to fill subsequent containers.

[0024] The invented device therefore allows a cable manufacturer to fill a number of containers, independently of the presence of any installation vessel. The containers may be stored at the cable manufacturer's premises until an installation vessel arrives and it is convenient to load the containers onto the vessel. As the device (container and feed unit) is modular and self-contained, the installation vessel need not be a specialized installation vessel, but may be any vessel with dynamic positioning capabilities and having sufficient deck space for the required number of containers. A conventional supply vessel with an open stern would be suitable.

[0025] Figures 9 and 10 show two containers 1a,b being skidded from the quay 23 and onto the deck 21 of a vessel 15, via a skidding ramp 8. The ship may be any conventional ship, having the deck space to hold the containers.

[0026] Figure 1 shows installation of a cable 14. The cable is coiled inside the rearward container 1a and fed out by means of the feed unit 4 as described above. The cable extends through a tensioner 9 on the ship and through a guide chute 10, and down into the water S.

Claims

1. A device (12) for storing, transporting and deploying an elongate, coilable element (14), comprising a storage unit (1) having a storage region (19) for the element; and supports (2) by means of which the device may be placed on, and skidded along, a surface (21, 23), **characterized by** that the device (12) further comprising a feeding unit (4) releasably connectable to the storage unit (1) and having first guiding means (17) and second guiding means (16) for feeding the element (14) into and out of the storage unit.
2. The device of claim 1, wherein the storage unit (1) comprises an opening (24) into the storage region (19), and first connectors (25) configured for connection to corresponding second connectors (26) on the

feeding unit (4).

3. The device of claim 2, wherein the first connectors (25) are in the region of the opening (24), whereby the first guiding means (17) is arranged in the vicinity of the opening when the feeding unit and the storage unit are connected.
4. The device of any one of the preceding claims, wherein the feeding unit further comprises a first motion control device (5), operable for feeding the element into or out of the storage region.
5. The device of any one of the preceding claims, wherein the storage region (19) has a circular cross-section and a central hub (18).
6. The device of claim 5, wherein the first guiding means (17) is arranged coaxially with the hub (18) centre axis (z).
7. The device of claim 6, wherein the axis (z) is substantially vertical and the feeding unit (4) is arranged on top of the storage unit (1).
8. A system for storing, transporting and deploying an elongate, coilable element (14), **characterized by** one or more of the devices according to any one of claims 1-7 arranged on a carrier (15); said carrier further comprising a second motion control device (9) arranged to receive the element (14) as it is being fed out of the second guiding means (16), and a third element guide (10) for conveying the element off of the carrier.
9. A method of storing and transporting an elongate coilable element (14), by using a device and a system according to any one of claims 1-8, **characterized by** the steps of
 - a) loading desired quantities of coilable element into a desired number of containers (1a, b);
 - b) storing the containers at an on-shore location;
 - c) at a desired time, loading the containers onto a transportation vehicle (15); and
 - d) transporting the containers on the vessel to a designated location.
10. The method of 9, wherein the loading in step c comprises skidding.
11. The method of claim 9 or claim 10, wherein vehicle comprises a ship (15) having a deck space (21) for storing the containers.
12. The method of any one of claims 9-11, using the device (12) of any one of claims 1-7.

13. The method of any one of claims 9-11, using the system of claim 8.

5 Patentansprüche

1. Vorrichtung (12) zum Speichern, Transportieren und Ausliefern eines länglichen, aufwickelbaren Elements (14), beinhaltend eine Speichereinheit (1) mit einem Speicherbereich (19) für das Element; und Träger (2) mittels derer die Vorrichtung auf einer Oberfläche (21, 23) platziert werden und über diese hinweggleiten kann, **dadurch gekennzeichnet, dass** die Vorrichtung (12) außerdem eine Zuführeinheit (4) beinhaltet, die lösbar mit der Speichereinheit (1) verbindbar ist, und erste Führungsmittel (17) und zweite Führungsmittel (16) zum Verbringen des Elements (14) in Speichereinheit hinein und aus dieser heraus aufweist.
2. Vorrichtung nach Anspruch 1, wobei die Speichereinheit (1) eine Öffnung (24) im Speicherbereich (19) aufweist, und erste Verbinder (25), die zur Verbindung mit korrespondierenden zweiten Verbindern (26) der Zuführeinheit (4) konfiguriert sind.
3. Vorrichtung nach Anspruch 2, wobei die ersten Verbinder (25) im Bereich der Öffnung (24) angeordnet sind, wobei das erste Führungsmittel (17) in der Nähe der Öffnung angeordnet ist, wenn die Zuführeinheit und die Speichereinheit verbunden sind.
4. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Zuführeinheit weiter eine erste Bewegungssteuervorrichtung (5) beinhaltet, die zum Verbringen des Elements in die oder aus der Speicherregion heraus betreibbar ist.
5. Vorrichtung nach einem der vorhergehenden Ansprüche, wobei die Speicherregion (19) einen kreisförmigen Querschnitt und eine zentrale Lagerung (18) aufweist.
6. Vorrichtung nach Anspruch 5, wobei das erste Führungsmittel (17) koaxial zur Zentralachse (z) der Lagerung (18) angeordnet ist.
7. Vorrichtung nach Anspruch 6, wobei die Achse (z) im Wesentlichen vertikal und die Zuführeinheit (4) oben auf der Speichereinheit (1) angeordnet ist.
8. System zum Speichern, Transportieren und Ausliefern eines länglichen, aufwickelbaren Elements (14), **dadurch gekennzeichnet, dass** eine oder mehrere der Vorrichtungen nach einem der Ansprüche 1 bis 7 auf einem Träger (15) angeordnet sind; wobei der Träger außerdem eine zweite Bewegungssteuervorrichtung (9) aufweist, die zum Aufnehmen

des Elements (14) angeordnet ist, wenn dieses aus dem zweiten Führungsmittel (16) ausgegeben wird, und eine dritte Elementführung (10) zum Befördern des Elements vom Träger herunter.

9. Verfahren zum Speichern und Transportieren eines länglichen, aufwickelbaren Elements (14) unter Verwendung einer Vorrichtung und eines Systems nach einem der Ansprüche 1 bis 8, **gekennzeichnet durch** die Schritte des

- a) Beladens gewünschter Mengen des aufwickelbaren Elements in eine gewünschte Anzahl Containern (1a, b);
- b) Speichern des Containers an einer On-Shore Position;
- c) Aufladen des Containers an einem gewünschten Zeitpunkt auf ein Transportvehikel (15);
- und
- d) Transportieren des Containers auf dem Schiff an einen Zielort.

10. Verfahren gemäß Anspruch 9, wobei das Beladen in Schritt c) ein Gleiten beinhaltet.

11. Verfahren nach Anspruch 9 oder 10, wobei das Vehikel ein Schiff (15) beinhaltet, das einen Platz (21) an Deck aufweist zum Speichern der Container.

12. Verfahren nach einem der Ansprüche 9 bis 11, unter Verwendung der Vorrichtung (12) eines der Ansprüche 1 bis 7.

13. Verfahren nach einem der Ansprüche 9 bis 11, unter Verwendung des Systems gemäß Anspruch 8.

Revendications

1. Dispositif (12) pour stocker, transporter et déployer un élément allongé, enroulable (14), comprenant :

une unité de stockage (1) ayant une région de stockage (19) pour l'élément ; et des supports (2) au moyen desquels le dispositif peut être placé sur une surface (21, 23) et ripé le long de cette dernière, **caractérisé en ce que** le dispositif (12) comprend en outre une unité d'alimentation (4), pouvant être raccordée de manière amovible à l'unité de stockage (1) et ayant des premiers moyens de guidage (17) et des seconds moyens de guidage (16) pour amener l'élément (14) à l'intérieur et à l'extérieur de l'unité de stockage.

2. Dispositif selon la revendication 1, dans lequel l'unité de stockage (1) comprend une ouverture (24) dans

la région de stockage (19), et des premiers connecteurs (25) configurés pour le raccordement à des seconds connecteurs (26) correspondants sur l'unité d'alimentation (4).

3. Dispositif selon la revendication 2, dans lequel les premiers connecteurs (25) sont dans la région de l'ouverture (24), moyennant quoi les premiers moyens de guidage (17) sont agencés à proximité de l'ouverture lorsque l'unité d'alimentation et l'unité de stockage sont raccordées.

4. Dispositif selon l'une quelconque des revendications précédentes, dans lequel l'unité d'alimentation comprend en outre un premier dispositif de commande de mouvement (5) adapté pour amener l'élément à l'intérieur ou à l'extérieur de la région de stockage.

5. Dispositif selon l'une quelconque des revendications précédentes, dans lequel la région de stockage (19) a une section transversale circulaire et un moyeu central (18).

6. Dispositif selon la revendication 5, dans lequel les premiers moyens de guidage (17) sont agencés de manière coaxiale avec l'axe central (z) du moyeu (18) .

7. Dispositif selon la revendication 6, dans lequel l'axe (z) est sensiblement vertical et l'unité d'alimentation (4) est agencée sur la partie supérieure de l'unité de stockage (1).

8. Système pour stocker, transporter et déployer un élément allongé, enroulable (14), **caractérisé par :**

un ou plusieurs des dispositifs selon l'une quelconque des revendications 1 à 7, agencé(s) sur un support (15) ; ledit support comprenant en outre un second dispositif de commande de mouvement (9) agencé pour recevoir l'élément (14) lorsqu'il est amené à l'extérieur des seconds moyens de guidage (16), et un troisième guide d'élément (10) pour transporter l'élément hors du support.

9. Procédé pour stocker et transporter un élément enroulable, allongé (14), en utilisant un dispositif et un système selon l'une quelconque des revendications 1 à 8, **caractérisé par** les étapes consistant à :

- a) charger des quantités souhaitées d'élément enroulable dans un nombre souhaité de conteneurs (1a, b) ;
- b) stocker les conteneurs sur un emplacement à terre ;
- c) à un moment souhaité, charger les conte-

neurs sur un véhicule de transport (15) ; et
d) transporter les conteneurs sur le bateau jusqu'à un emplacement désigné.

10. Procédé selon la revendication 9, dans lequel le chargement à l'étape c comprend un ripage. 5
11. Procédé selon la revendication 9 ou la revendication 10, dans lequel le véhicule comprend un bateau (15) ayant un espace de pont (21) pour stocker les conteneurs. 10
12. Procédé selon l'une quelconque des revendications 9 à 11, consistant à utiliser le dispositif (12) selon l'une quelconque des revendications 1 à 7. 15
13. Procédé selon l'une quelconque des revendications 9 à 11, consistant à utiliser le système selon la revendication 8. 20

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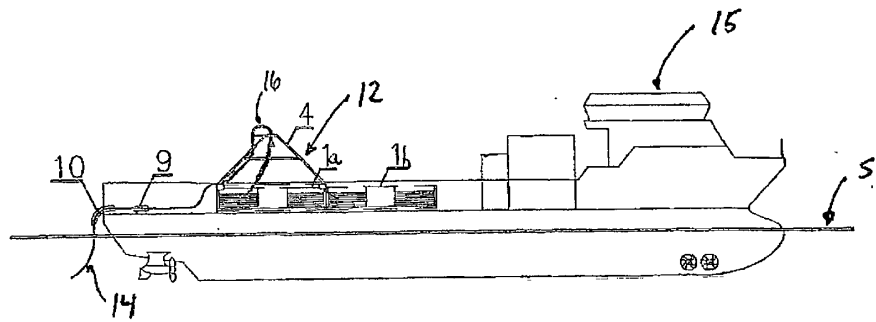


FIG. 1

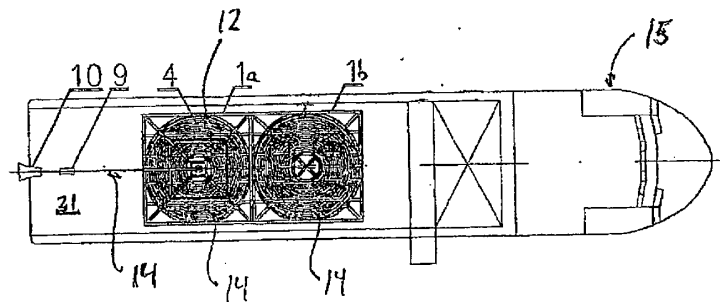


FIG. 2

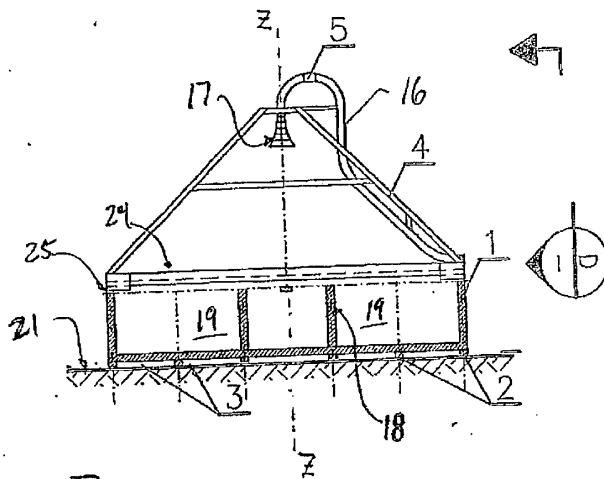


FIG. 3

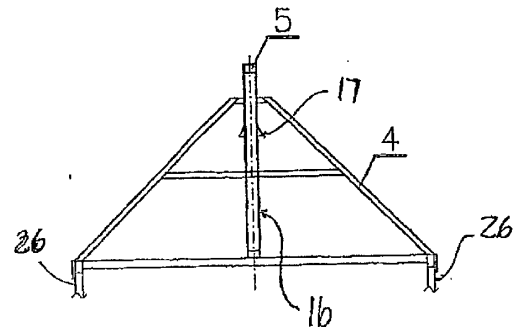


FIG. 4

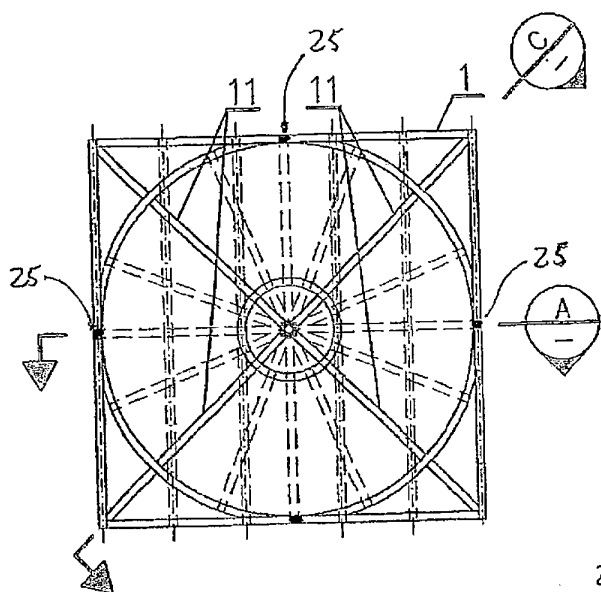


FIG. 5

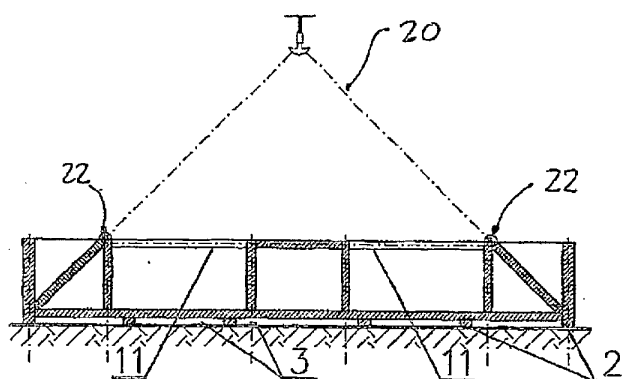


FIG. 6

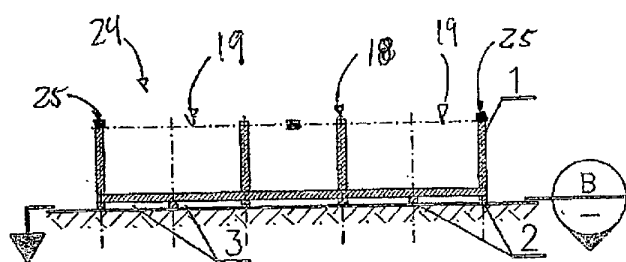


FIG. 7

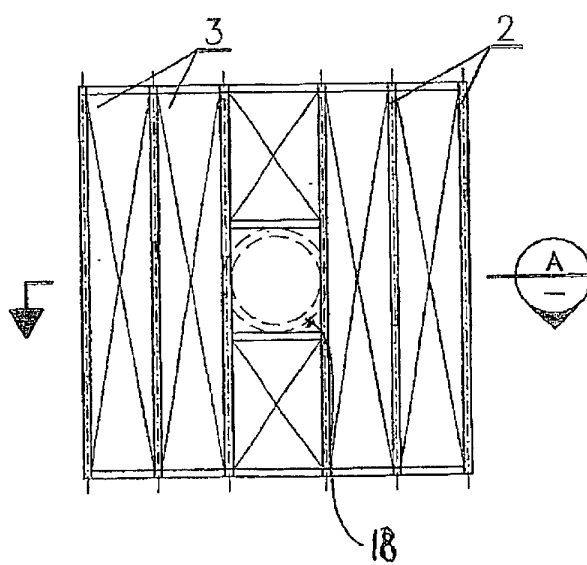


FIG. 8

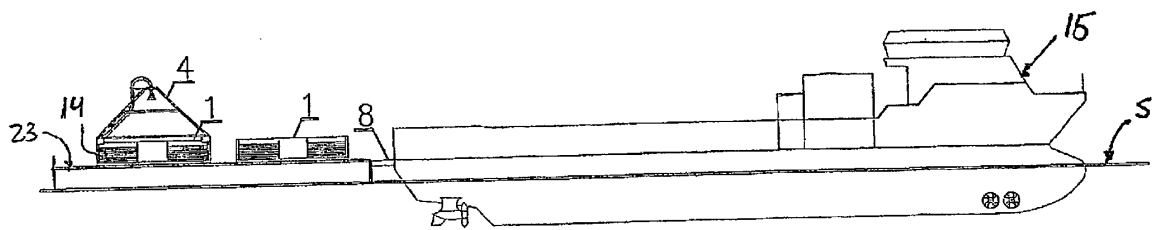


FIG. 9

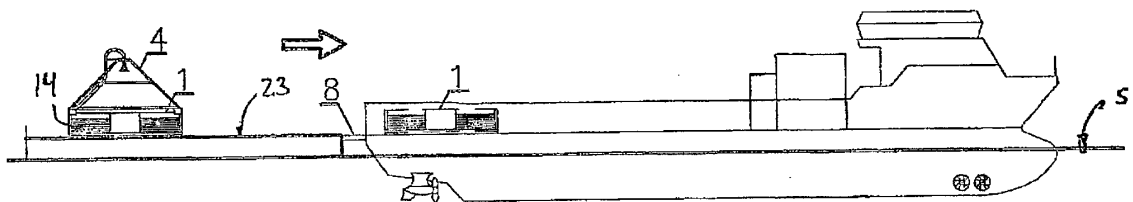


FIG. 10

REFERENCES CITED IN THE DESCRIPTION

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