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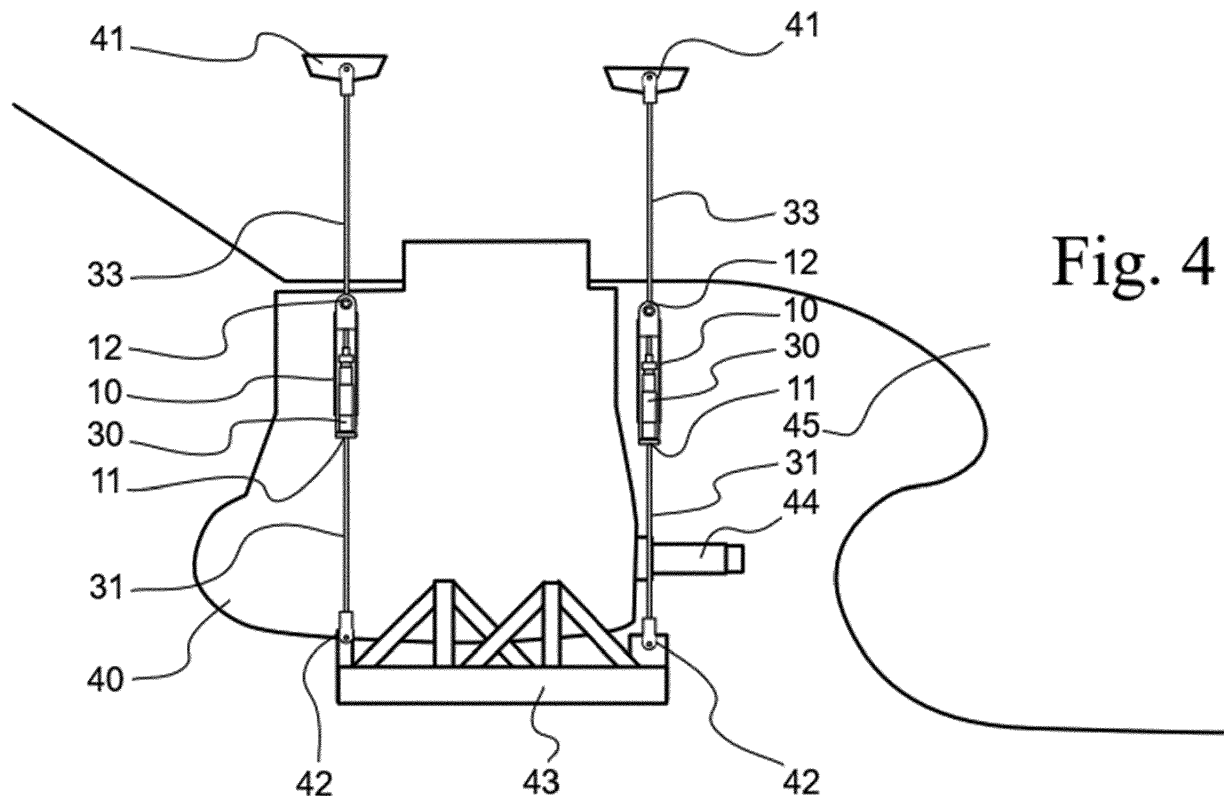
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(54) MOVING A PODDED PROPULSION SYSTEM

(57) A method, an apparatus and a system for lifting or lowering a pod of a podded propulsion system (40) is disclosed. A first lifting point (41) is arranged to the outer surface of a ship's hull (45). The first lifting point (41) may be welded onto a position allowing lowering of the pod.

A second lifting point (42) is arranged to the pod or to a platform (43) configured to carry the pod. A strand jack (30) is arranged between the first lifting point (41) and the second lifting point (42) with a support structure (10) enabling pivoted movement during the lifting process.

**Fig. 4****EP 3 385 157 A1**

Description

BACKGROUND

[0001] Podded propulsion systems may be periodically serviced by detaching a pod from the hull during dry docking. Sometimes, the pod must be removed for emergency repairs. The schedule for dry docking is tight - it is an expensive process, where all steps should be executed as effectively as possible.

[0002] Removing the pod during dry docking is a complex operation due to lack of space for the lifting and transporting equipment. The combined weight of the pod and a propeller may be in the range of 300,000 kg. Certain operations require detaching the pod, lowering it vertically onto a transport platform and transporting horizontally to a space allowing more complex maintenance or repair procedures. Cranes cannot be used under the ship's hull as the hull blocks the operational vertical lifting direction from the crane. Moving podded propulsion systems requires dedicated heavy lifting equipment with sufficient structural strength. Operating the lifting equipment requires careful planning and positioning, often customizing the system to match the ship's dimensions. Getting the lifting equipment itself to the dry dock may be a time-consuming process and because the size of the lifting equipment allows only ship transport, land transport is not a practical alternative. Assembling and disassembling the lifting equipment at the dry dock may take several days, in one example, between 10 to 14 days, wherein the process may obstruct other maintenance tasks at the dry dock. Supporting the heavy structures on the ground firmly during the lifting process may require additional precautions. Cramped space under the hull is a difficult environment for large-scale and heavy lifting or transporting equipment. Getting the lifting equipment itself into position for moving the pod may be a difficult process.

[0003] Some podded propulsion systems have a fin under the pod. If the lifting/transporting equipment requires vertical space under the hull, the fin must be removed before lowering the pod. Removing and re-attaching the fin may increase the time spent on the dry dock.

[0004] A strand jack may be used for lifting or lowering the pod. It allows precise controlled movements. EP2585365 discloses one example of a vertical lifting method using multiple strand jacks.

SUMMARY

[0005] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the detailed description. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter. Furthermore, the claimed subject matter is not limited to implementations that solve any or all disadvantages not-

ed in any part of this disclosure.

[0006] A method, an apparatus and a system for lifting or lowering a pod of a podded propulsion system is disclosed. A first lifting point is arranged to the outer surface of a ship's hull. The first lifting point may be welded onto a position allowing lowering of the pod. A second lifting point is arranged to the pod or to a platform configured to carry the pod. A strand jack is arranged between the first lifting point and the second lifting point.

[0007] Typically, strand jacks allow only cable movement parallel to the strand jack body. The direction of the cable is defined during installation of the strand jack, being transverse to the base plate. In the present solution, the strand jack is attached to a support structure that it may be installed between the first lifting point and the second lifting point. The support structure may move pivotally around the lifting point, enabling changes in the lifting direction. In some situations, the first lifting point and the second lifting point are not perfectly vertically aligned under the hull. The position of the first lifting point under the hull may vary between ships, wherein the platform configured to carry the pod may be reused. The pivotal movement of the support structure enables changing the geometry of the lift at different positions, while keeping the cable in parallel with the body of the strand jack.

[0008] Multiple strand jacks with multiple lifting points may be used simultaneously. Multiple strand jacks may be controlled precisely, enabling different lifting geometries. The support structure may be transported to the dry dock with flexible transport arrangements. In one example, the support structure may be delivered as air, rail or road transport; enabling quick response times for emergency repair or maintenance tasks. The combination of strand jacks and support structures does not consume height under the ship, wherein the fin may be left on the pod during the moving process. The saved space allows more structures for vertical movement, for example, rails along which the pod may be rolled from under the hull.

[0009] Many of the attendant features will be more readily appreciated as they become better understood by reference to the following detailed description considered in connection with the accompanying drawings. The embodiments described below are not limited to implementations which solve any or all the disadvantages of known pod lifting solutions or pod maintenance systems.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The present description will be better understood from the following detailed description read in light of the accompanying drawings, wherein

FIG. 1 illustrates one example of a support structure for a strand jack;

FIG. 2 illustrates multiple orthogonal projections of

the support structure;

FIG. 3 illustrates schematically one example having the strand jack and the support structure;

FIG. 4 illustrates schematically one example of a pod lifting as a starboard view;

FIG. 5 illustrates schematically the same example of a pod lifting as a stern view; and

FIG. 6 illustrates schematically the one example of a pod lifting as a stern view having strand jacks in alternative positions.

[0011] Like reference numerals are used to designate like parts in the accompanying drawings.

DETAILED DESCRIPTION

[0012] The detailed description provided below in connection with the appended drawings is intended as a description of the present examples and is not intended to represent the only forms in which the present example may be constructed or utilized. However, the same or equivalent functions and sequences may be accomplished by different examples.

[0013] Although the present examples are described and illustrated herein as being implemented in a dry dock lifting system and apparatus, they are provided as an example and not a limitation. As those skilled in the art will appreciate, the present examples are suitable for application in a variety of different types of heavy lifting with variable geometry.

[0014] One example of a podded propulsion system comprises an electric motor being mounted inside a pod unit and a propeller being connected directly to the motor shaft and to the electric motor. In one example, the motor is mounted inside the ship's hull. A mechanical transmission connects the motor inside the ship to the outboard unit by gearing. Examples of such gearing are L-drive and Z-drive systems.

[0015] FIG. 1 illustrates one example of a support structure 10 for a strand jack. FIG. 2 illustrates multiple orthogonal projections of the same example. In one embodiment, the support structure 10 is a rigid harness arranged around the strand jack. The support structure 10 is made of solid and durable material, such as steel. The example of FIG. 1 may be constructed from welded steel plates. Steel plates 13, 14 form an elongated body configured to surround the strand jack when installed inside the support structure 10. In other embodiments, the body may be made of rigid metal tubes or any rigid material providing sufficient structural strength.

[0016] The first end of the support structure comprises means 11 for attaching the support structure 10 to a lifting point, in this example, the means comprise an end plate 11 that may be connected directly to the lifting point, or

the end plate 11 may be connected to a connecting cable configured to attach to a lifting point. In one example, an opening 20 is configured to the end plate 11 at the first end of the support structure 10. Examples of lifting points are a first lifting point on an outer surface of the hull or a second lifting point supporting the podded propulsion system. The means 11 for attaching may be a lifting ear or opening, wherein a shackle or an axle is inserted through an opening and connected to the lifting point. In one embodiment, the means 11 for attaching the support structure 10 allow pivotal movement to the support structure 10 when it is connected to the lifting point.

[0017] Means for attaching the strand jack to the support structure comprise, in one embodiment, the end plate 11. The strand jack may comprise a base plate that may be bolted to the end plate 11 or attached to the end plate 11 in any rigid and detachable manner. In one embodiment, the strand jack is welded to the end plate 11. The strand jack comprises a cable at the opposite end of the end plate 11 configured to extend through a guide opening 15 configured to a guide plate 16 at the second end of the support structure 10. The guide plate 16 extends, in this example, to the steel plates 13, 14 of the support structure 10. A cable guide 12 is, in one embodiment, configured to guide the cable extending from the strand jack. In this example, the cable guide 12 comprises an eyelet that may be used to secure the support structure 10 during transport.

[0018] FIG. 3 illustrates schematically one example, where the strand jack 30 is configured to interact with the support structure 10. The support structure 10 is configured to be attached to a first cable 31 that may extend through the end plate 11 or may be connected to the end plate 11. The first cable 31 is configured to be connected to one of the lifting points via a connecting end 32 that may be attached to the lifting point via a shackle or other suitable connecting device. The strand jack 30 comprises a second cable 33 configured to be connected to the opposite lifting point to the first cable 31. The cable guide 12 may direct the loose end of the second cable 33 during the assembly phase.

[0019] In one embodiment, the frame of the support structure 10 is longer than the strand jack 30. The strand jack 30 is inside the support structure 10, wherein the support structure 10 provides protection to the strand jack 30 and aligns the cables 31, 33 properly to secure the operation. In one embodiment, one support structure 10 is configured to contain one strand jack 30. The vertical direction of the illustrated combination may be reversed; the support structure 10 may be attached to the lifting point on the ship's hull or to the pod support, wherein the connecting end of the second cable 33 operatively connected to the strand jack 30 is connected to the opposite lifting point.

[0020] FIG. 4 illustrates schematically one example of a pod lifting as a starboard view and FIG. 5 illustrates the same example as a stern view. The pod 40 is arranged on a platform 43 configured to support the pod 40. The

platform 43 comprises multiple second lifting points 42 for multiple support structures 10. The means 11 for attaching the support structure 10 to the pod 40 are coupled to the second lifting point 42. The support structure 10 contains the strand jack 30, wherein the cable 31 travels through the cable guide 12 of the support structure 10 and extends to a first lifting point 41 arranged to the outer surface of the ship's hull 45. The first lifting point 41 may be welded to the hull 45 permanently. In this example, the propeller has been removed from the axle 44. In some examples, the propeller may be left on the axle 44 and removed at an area having more operating space for removal, as the solution may leave sufficient space under the hull 45 for moving the whole pod 40.

[0021] As seen in FIG. 5, in some embodiments, the lifting angle is inclined. The first lifting points 41 may be positioned on the ship's hull 45 while optimizing multiple aspects, such as the space for lifting or means for moving the platform 43 under the hull 45. The lifting angle must not be perfectly vertical. This enables the platform 43 to be used with different hull configurations, as the positions of the first lifting points 41 may vary between different ships. Pivotal lifting points 41, 42 and the support structure enable variable geometries to the lifting process. The lifting system may be applied to different situations, thereby reducing the time window reserved for disassembling and reassembling the podded propulsion system. The strand jack 30 may be controlled with a computer-implemented system that enables individual micro-movements in the range of 1 mm. Multiple strand jacks 30 may be controlled simultaneously with sensor information that may be received from different sources, for example, distance sensors, accelerometers or levels. The variable geometries may be controlled during the lifting or lowering process.

[0022] In one embodiment, components of the lifting system are sized to fit inside an ISO container. The combination of the strand jack 30 and the support structure 10 may be lifted from an open-top container, thereby reducing the time window for the pod lifting/lowering process.

[0023] An example discloses a method for lifting or lowering a podded propulsion system in relation to a hull. The method comprises providing a strand jack comprising a cable; and moving the podded propulsion system with the strand jack. The method further comprises attaching a strand jack to a support structure; providing a first lifting point to an outer surface of the hull; providing a second lifting point to support the podded propulsion system; and attaching the cable and the support structure between the first lifting point and the second lifting point for lifting or lowering the podded propulsion system. In an embodiment, the support structure contains a single strand jack. In one embodiment, the method comprises providing the support structure around the strand jack. In one embodiment, the method comprises providing the second lifting point to a platform supporting the podded propulsion system. In one embodiment, the method com-

prises attaching the cable to the first lifting point and attaching the support structure to the second lifting point. In one embodiment, the method comprises attaching the cable to the second lifting point and attaching the support structure to the first lifting point. In one embodiment, the combination of the strand jack and the support structure is reversible in relation to the lifting points. In one embodiment, the method comprises transporting the strand jack and the support structure to the lifting site on an open-top cargo container.

[0024] Alternatively, or in addition, herein is disclosed a support structure for lifting or lowering a podded propulsion system in relation to a hull. The support structure comprises means for attaching the support structure to a first lifting point on an outer surface of the hull or to a second lifting point supporting the podded propulsion system; and means for attaching a strand jack to the support structure, the strand jack comprising a cable configured to be attached to the first lifting point or to the second lifting point for lifting or lowering the podded propulsion system. In one embodiment, the means for attaching the support structure to a first lifting point on an outer surface of the hull or to a second lifting point supporting the podded propulsion system are pivotable. In one embodiment, the support structure comprises a frame longer than the strand jack, wherein the strand jack is configured to be attached to a first end of the support structure and the cable is configured to extend through the second end of the support structure.

[0025] Alternatively, or in addition, a system is disclosed for lifting or lowering a podded propulsion system in relation to a hull, comprising a strand jack having a cable. The system comprises a support structure having means for attaching to the strand jack; a first lifting point configured to an outer surface of the hull; and a second lifting point configured to support the podded propulsion system; wherein the cable and the support structure comprise means for attaching between the first lifting point and the second lifting point for lifting or lowering the podded propulsion system. In one embodiment, the support structure comprises a frame longer than the strand jack, wherein the strand jack is configured to be attached to a first end of the support structure and the cable is configured to extend through the second end of the support structure. In one embodiment, the system comprises a platform supporting the podded propulsion system, said platform comprising the second lifting point. In one embodiment, the system comprises an open-top cargo container configured for transporting the strand jack and the support structure to the lifting site. In one embodiment, the means for attaching the support structure to the first lifting point or to the second lifting point are pivotable.

[0026] Alternatively, or in addition, the strand jack control function can be performed, at least in part, by one or more hardware components or hardware logic components. An example of the control system described hereinbefore is a computing-based device comprising one or more processors which may be microprocessors, con-

trollers or any other suitable type of processors for processing computer-executable instructions to control the operation of the device in order to control one or more sensors, receive sensor data and use the sensor data. The control system may be positioned on the host system and connected to the apparatus or to the submersible flotation device via the umbilical cord. The computer-executable instructions may be provided using any computer-readable media that is accessible by a computing-based device. Computer-readable media may include, for example, computer storage media, such as memory and communications media. Computer storage media, such as memory, includes volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information, such as computer-readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EPROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other non-transmission medium that can be used to store information for access by a computing device. In contrast, communication media may embody computer-readable instructions, data structures, program modules, or other data in a modulated data signal, such as a carrier wave, or other transport mechanism. As defined herein, computer storage media does not include communication media. Therefore, a computer storage medium should not be interpreted to be a propagating signal per se. Propagated signals may be present in a computer storage media, but propagated signals per se are not examples of computer storage media. Although the computer storage media is shown within the computing-based device, it will be appreciated that the storage may be distributed or located remotely and accessed via a network or other communication link, for example, by using a communication interface.

[0027] The apparatus or the device may comprise an input/output controller arranged to output display information to a display device which may be separate from or integral to the apparatus or device. The input/output controller is also arranged to receive and process input from one or more devices, such as a user input device (e.g. a mouse, keyboard, camera, microphone or other sensor). The control system for the strand jacks may use various input or output information or metrics received from sensors monitoring the lifting process.

[0028] Any range or device value given herein may be extended or altered without losing the effect sought.

[0029] Although at least a portion of the subject matter has been described in language specific to structural features and/or acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as examples of implementing the claims

and other equivalent features and acts are intended to be within the scope of the claims.

[0030] It will be understood that the benefits and advantages described above may relate to one embodiment or may relate to several embodiments. The embodiments are not limited to those that solve any or all of the stated problems or those that have any or all of the stated benefits and advantages. It will further be understood that reference to 'an' item refers to one or more of those items.

[0031] The steps of the methods described herein may be carried out in any suitable order, or simultaneously where appropriate. Additionally, individual blocks may be deleted from any of the methods without departing from the spirit and scope of the subject matter described herein. Aspects of any of the examples described above may be combined with aspects of any of the other examples described to form further examples without losing the effect sought.

[0032] The term 'comprising' is used herein to mean including the method blocks or elements identified, but that such blocks or elements do not comprise an exclusive list and a method or apparatus may contain additional blocks or elements.

[0033] It will be understood that the above description is given by way of example only and that various modifications may be made by those skilled in the art. The above specification, examples and data provide a complete description of the structure and use of exemplary embodiments. Although various embodiments have been described above with a certain degree of particularity, or with reference to one or more individual embodiments, those skilled in the art could make numerous alterations to the disclosed embodiments without departing from the spirit or scope of this specification.

Claims

1. A method for lifting or lowering a podded propulsion system (40) in relation to a hull (45), comprising:

providing a strand jack (30) comprising a cable (33); and

moving the podded propulsion system (40) with the strand jack (30),

characterized by:

attaching a strand jack (30) to a support structure (10);

providing a first lifting point (41) to an outer surface of the hull (45);

providing a second lifting point (42) to support the podded propulsion system (40); and

attaching the cable (33) and the support structure (10) between the first lifting point (41) and the second lifting point (42) for lift-

ing or lowering the podded propulsion system (40).

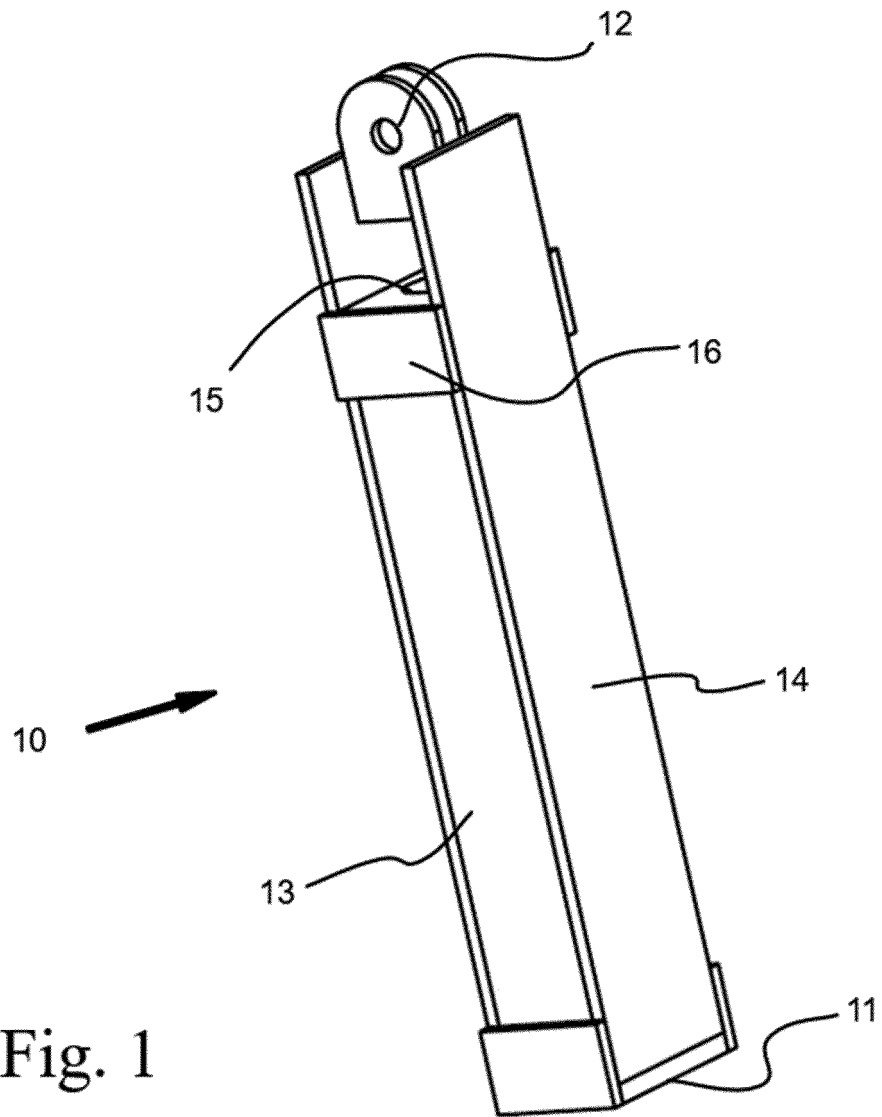
2. A method according to claim 1, **characterized by** providing the support structure (10) around the strand jack (30). 5
3. A method according to claim 1 or claim 2, **characterized by** providing the second lifting point (42) to a platform (43) supporting the podded propulsion system (40). 10
4. A method according to any of the claims 1 to 3, **characterized by** attaching the cable (33) to the first lifting point (41) and attaching the support structure (10) to the second lifting point (42). 15
5. A method according to any of the claims 1 to 3, **characterized by** attaching the cable (33) to the second lifting point (42) and attaching the support structure (10) to the first lifting point (41). 20
6. A method according to any of the claims 1 to 5, **characterized by** transporting the strand jack (30) and the support structure (10) to the lifting site on an open-top cargo container. 25
7. A support structure for lifting or lowering a podded propulsion system (40) in relation to a hull (45), **characterized by** comprising: 30

means for attaching the support structure (10) to a first lifting point (41) on an outer surface of the hull (45) or to a second lifting point (42) supporting the podded propulsion system (40); and means for attaching a strand jack (30) to the support structure (10), the strand jack (30) comprising a cable (33) configured to be attached to the first lifting point (41) or to the second lifting point (42) for lifting or lowering the podded propulsion system (40). 40
8. A support structure according to claim 7, **characterized in that** the means for attaching the support structure (10) to a first lifting point (41) on an outer surface of the hull (45) or to a second lifting point (42) supporting the podded propulsion system (40) are pivotable. 45
9. A support structure according to claim 7 or claim 8, **characterized by** comprising a frame longer than the strand jack (30), wherein the strand jack (30) is configured to be attached to a first end of the support structure (10) and the cable (33) is configured to extend through the second end of the support structure (10). 50
10. A system for lifting or lowering a podded propulsion

system (40) in relation to a hull (45), comprising a strand jack (30) having a cable (33), **characterized by** comprising:

a support structure (10) having means for attaching to strand jack (30);
a first lifting point (41) configured to an outer surface of the hull (45); and
a second lifting point (42) configured to support the podded propulsion system (40); wherein the cable (33) and the support structure (10) comprise means for attaching between the first lifting point (41) and the second lifting point (42) for lifting or lowering the podded propulsion system (40).

11. A system according to claim 10, **characterized by** the support structure (10) comprising a frame longer than the strand jack (30), wherein the strand jack (30) is configured to be attached to a first end of the support structure (10) and the cable (33) is configured to extend through the second end of the support structure (10).
12. A system according to claim 10 or claim 11, **characterized by** comprising a platform (43) supporting the podded propulsion system (40), said platform (43) comprising the second lifting point (42).
13. A system according to any of the claims 10 to 12, **characterized by** comprising an open-top cargo container configured for transporting the strand jack (30) and the support structure (10) to the lifting site.
14. A system according to any of the claims 10 to 13, **characterized in that** the means for attaching the support structure (10) to the first lifting point (41) or to the second lifting point (42) are pivotable.



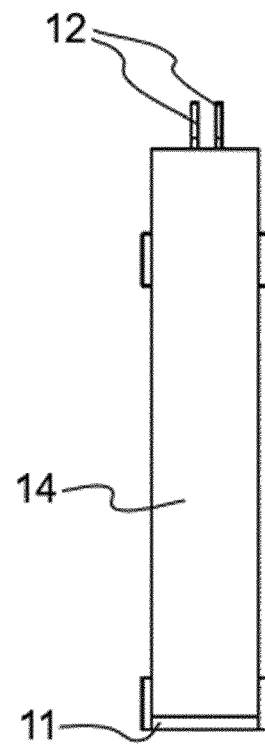
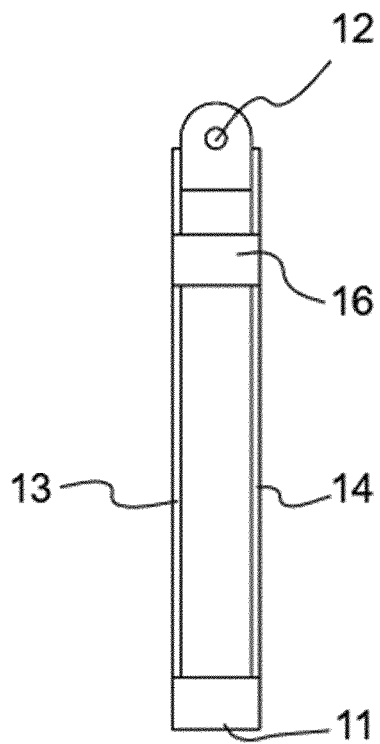
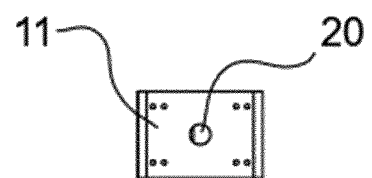


Fig. 2



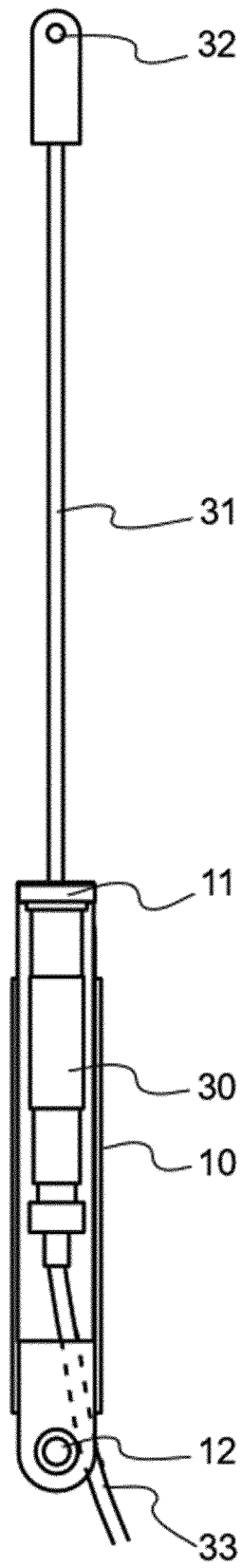
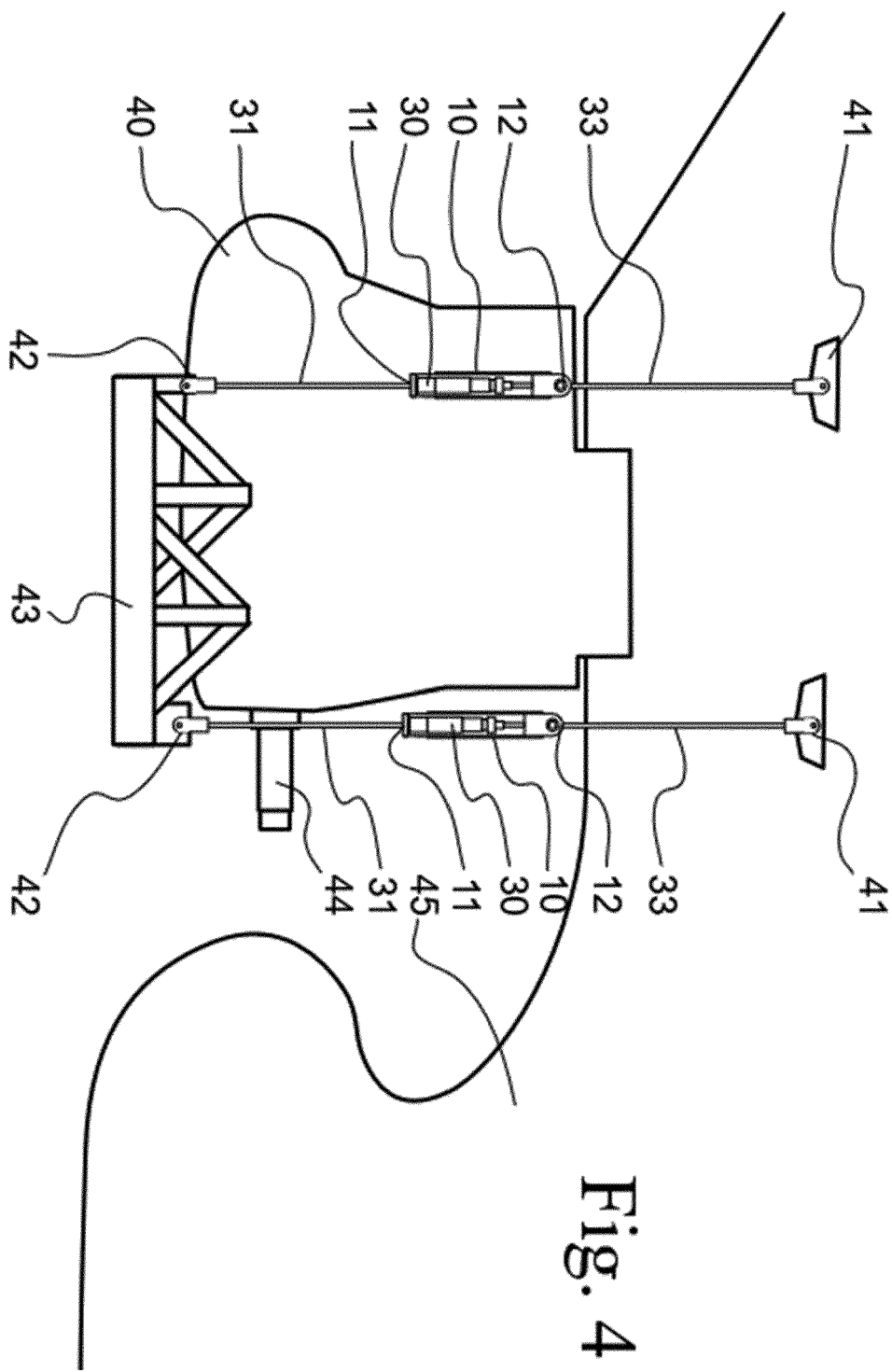


Fig. 3



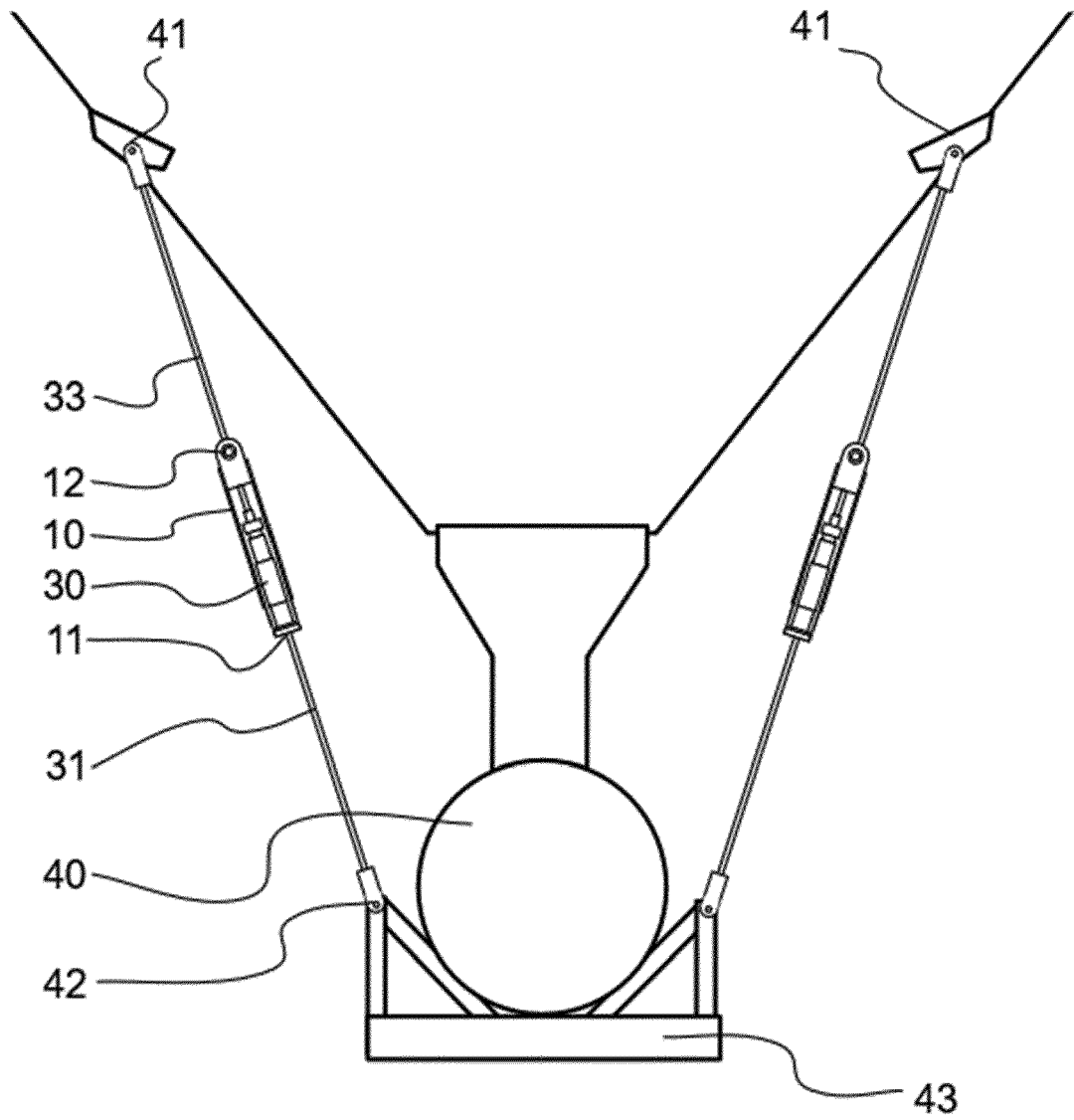


Fig. 5

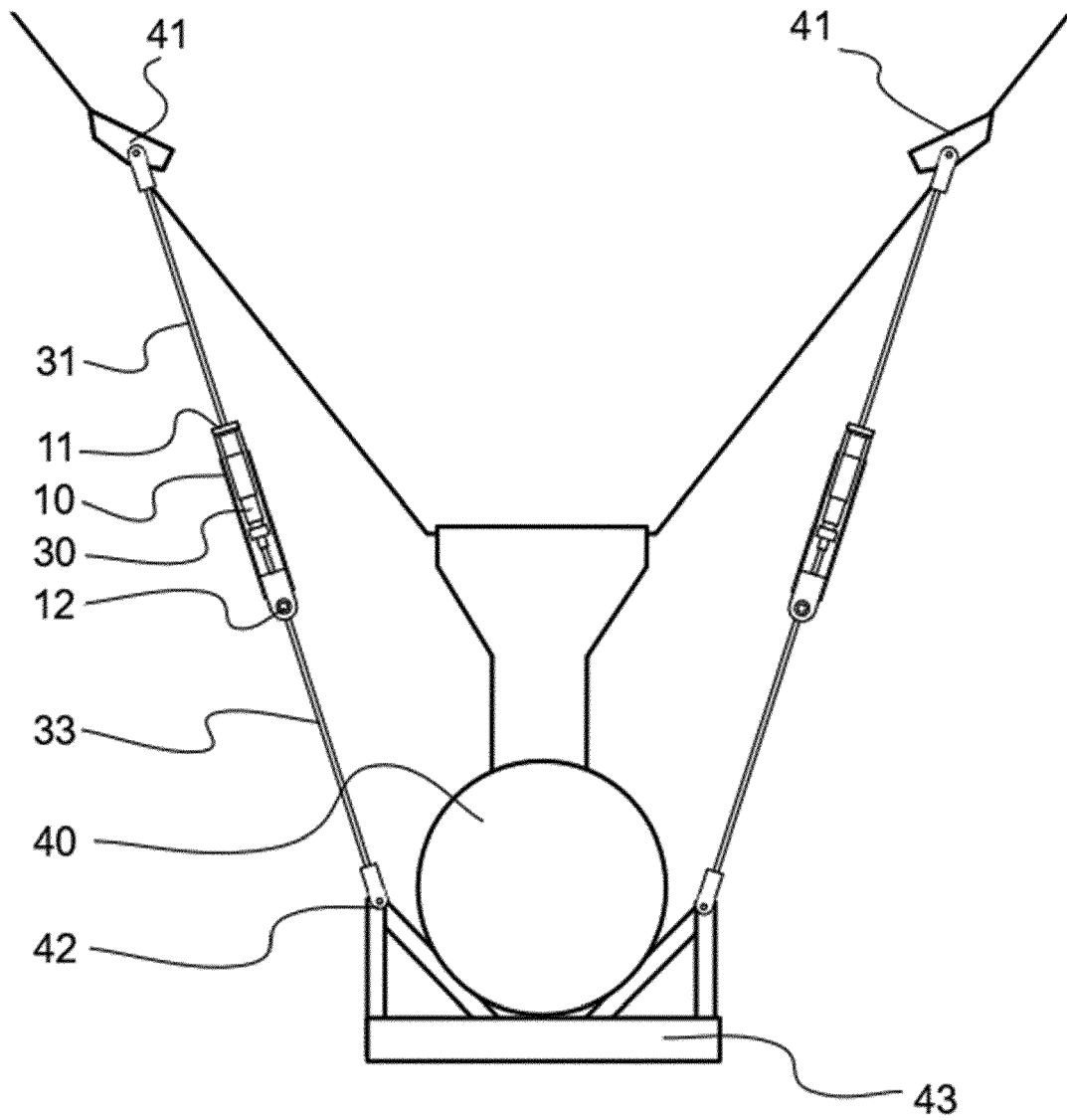


Fig. 6



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Application Number
EP 17 16 4663

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Place of search The Hague		Date of completion of the search 22 November 2017	Examiner Gardel, Antony
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