

Device for and method of transferring personnel, equipment and/or structural elements from a surface vessel to an offshore structure

The invention relates to a device for transferring personnel, equipment and/or structural elements from a surface vessel to an offshore structure, in particular a fixed offshore structure, such as a wind turbine, or to
5 another vessel, the device comprising a foundation mounted or to be mounted on a surface vessel, an arm, e.g. a telescopic boom, pivotally connected to the foundation, e.g. via at least one gimbal or pair of gimbals, and at least one gripper connected to the free end of the arm for coupling
10 the arm to an offshore structure. The invention further relates to a method of transferring personnel, equipment and/or structural elements.

It is known to provide access to a platform of an offshore wind turbine by providing e.g. rubber buffers on
15 the front of a vessel such that the buffers of the vessel push against landing tubes on each side of a ladder of the turbine support to create enough friction to prevent movement, such as roll, heave or yaw, of the vessel relative to the support in three planes. Personnel can then transfer
20 across the gap between the front of the vessel and the access ladder, i.e. across the so-called splash zone.

As explained in WO 2012/107459, this arrangement suffers from the drawback that the frictional force between the vessel and the support is highly variable, and is
25 dependent upon the difference between the thrust generated by the vessel and the wave action on the hull of the vessel, as well as any material such as slime and barnacles adhering to the landing tubes. The available friction can also be reduced as a result of roll of the boat, and it is necessary
30 for personnel to step between the ladder and the vessel

which is moving relative to the support of the wind turbine, making transfer hazardous, especially in rough seas.

One known attempt to overcome this problem consists of an access apparatus mounted to a vessel and having a platform for personnel which moves relative to the vessel to compensate for motion of the vessel relative to the turbine support, so that the platform is substantially stationary relative to the support of the wind turbine. However, this arrangement suffers from the drawback that the apparatus requires much power, is expensive to acquire and run, and requires a large vessel to accommodate it.

WO 2012/107459 relates to an access apparatus (numeral 2 in the Figures of WO 2012/107459) for enabling transfer of personnel between a seaborne vessel (6) and an offshore installation. The apparatus comprises a body (18) adapted to be mounted to a deck (4) of a seaborne vessel, clamping members (10) adapted to grip a buffer tube, mounted to a support of an offshore installation, therebetween, to limit vertical movement of the buffer tube relative to the clamping members, wherein the clamping members can pivot relative to the body about a respective single pivot axis extending in at least two mutually perpendicular directions.

WO 02/20343 relates to a vessel provided with a telescopingly extendable gang plank mounted thereon for movement about a vertical axis. A coupling device provided at the free end of the gang plank is adapted to enclose a vertically directed engagement rod on an offshore pole body and thus connect the ship to the pole body. With the ship manoeuvred in a certain position the gang plank may be either directed and extended towards the engagement rod or be manoeuvred while taking its extended position laterally into contact with the engagement rod and subsequently (partially) retracted again.

WO 2012/069835 relates to a lift (2) to enable access between a waterborne vessel (1) and a structure (30).

In an embodiment shown in Figure 3 of WO 2012/069835 "The access lift 2 further comprises a base 5 ... which supports the lift shaft assembly 3 (and the platform 4). ... damped roller assembly 10 further comprises a yoke beam 15, to which the rollers 11 are rotatable mounted. ... The yoke beam 15 further supports an actuated arm 16 for each of rollers 12, ..." The yoke beam (15) is also attached to the base (5), i.e., the arm (16) and the lift shaft assembly (3) are both attached to the base, not to each other.

It is an object of the present invention to provide a transferring device, in particular one which allows relatively straightforward coupling of the arm to an offshore structure and/or relatively safe or comfortable transfer of personnel and/or equipment.

To this end, the device according to the invention is characterized by a second arm that is pivotally connected to the (first) arm.

In an embodiment, a support for personnel, e.g. a so-called basket, and/or a second gripper for structural elements, e.g. building components of an offshore structure under construction, is connected to the second arm at or near its free end.

In another embodiment, the second arm is pivotally connected at or near the free end of the first arm or movable along the first arm, e.g. from a position at or near the foundation to a position at or near the free end of the first arm.

With the present invention, the first arm can be coupled to the offshore structure at a first location, e.g. a lower location facilitating the coupling of the first grippers to the structure, and, by means of the second arm mounted on the first arm, personnel, equipment and/or structural elements can be transferred to a second location, e.g. a higher location such as a wind turbine transition piece platform.

In an embodiment, the first gripper, the second arm and, if present, the support and/or second gripper form a module, which module is detachable from the first arm, at least upon coupling the first gripper to an offshore structure.

In a more specific embodiment, the module comprises a power supply and/or a manually operable power generator, thus providing the module with a degree of autonomy and allowing the vessel to leave once it is detached from the module, and or a controller for operating the module when detached from the vessel.

In an embodiment, at least one of the pivotal connections, preferably both the connection between the first arm and the foundation and the connection between the second arm and the first arm, comprises at least two gimbals, i.e. are pivotable about at least two axes.

In another embodiment, at least one of the arms, preferably both the first arm and the second arm, is telescopic.

The invention also relates to a surface vessel comprising a device according to any one of the preceding claims for transferring personnel, equipment and/or structural elements from the vessel to an offshore structure.

The invention also relates to a method of transferring personnel, equipment and/or one or more structural elements from a surface vessel to an offshore structure, such as a wind turbine, or to another vessel comprising the steps of

coupling a first arm, pivotally connected to the vessel, to an offshore structure,

transferring personnel, equipment and/or one or more structural elements from the surface vessel to the offshore structure by means of a second arm that is pivotally connected to the first arm.

In an embodiment, the method comprises actively compensating for the motions of the vessel during the coupling of the arm to the offshore structure, preferably such that the free end of the (first) arm relates to the offshore structure.

To reduce power consumption, in an embodiment, compensation is switched to idle when the arm is coupled to the offshore structure. I.e., after coupling, the distal end of the arm (at the coupling) relates to the offshore structure and the proximal end of the arm (at the foundation) and the vessel move freely with respect to said structure.

In an embodiment, a support for personnel, e.g. a so-called basket, and/or a second gripper is connected to the second arm at or near its free end and the (pivotal) motion of the support and/or the second gripper is initially synchronized with the vessel. After personnel, equipment and/or structural elements have been loaded on or attached to the second arm, the pivotal motion of the support and/or the second gripper is synchronized with the offshore structure, e.g. when a downward movement of the vessel is detected and/or by moving the support and/or the second gripper upwards, away from the deck of the vessel.

In another embodiment, the offshore structure comprises a platform for personnel and equipment and personnel and/or equipment is moved, by means of the second arm, from the vessel to the platform.

In yet another embodiment, one or more structural elements are moved, by means of the second arm, from the vessel to the offshore structure. I.e., the device and method of the present invention are employed during the building of an offshore structure.

In a further embodiment, the first gripper, the second arm and, if present, the support and/or second gripper form a module and, upon coupling the first gripper

to an offshore structure, the module is detached from the first arm and thus from the vessel.

For the sake of completeness, attention is drawn to the following prior art.

5 WO 2012/021062 relates to a vessel (1) including a motion compensation platform (4). The platform comprises at least one carrier (6) for bearing, moving and/or transferring a load, and a gangway (16) provided with a first end (16a) pivotally connected to the carrier (6) and a
10 second end (16b) for contacting a target area. Further, the platform comprises a multiple number of first actuators (5) for moving the carrier (6) relative to the vessel (1), and at least a second actuator for moving the gangway (16) relative to the carrier (6). The platform also comprises a
15 control system arranged for driving the multiple number of first actuators (5), and motion sensors for measuring motions relative to at least one element in a target area, which measurements are used as input for the control system. The control system is also arranged for driving the at least
20 one second actuator

WO 2011/154730 relates to a vessel (numeral 1 in the Figures of that publication) comprising a roller assembly (32), the assembly comprising at least one roller arranged to bear against a structure to be accessed, the
25 assembly further comprising a damper to inhibit rotation of the roller such that the roller arranged to inhibit relative movement of the vessel to the structure and the vessel further comprising a gangway assembly (10) for a vessel comprising a gangway (12), a pivotally mounted base (20), a
30 sensor arrangement to sense movement of the vessel, an end portion (14) of the gangway pivotally connected to the base and an actuator connected to the gangway responsive to signals from the sensor arrangement to control the vertical position of an opposite end portion (15) of the gangway so
35 as to compensate for vertical movement of the vessel, and

the base arranged to respond to and compensate for roll of the vessel.

Within the framework of the present invention, "near" the free end of the arm is defined as closer to the free or distal end than to the pivotal or proximal end of the arm. A gimbal is a pivoted support that allows the rotation of an object, e.g. a telescopic arm, about an axis. A set of e.g. two or three gimbals, one mounted on the other typically with orthogonal pivot axes, may be used to allow an object, e.g. a basket, mounted on the innermost gimbal to remain independent of the rotation of the vessel, e.g. to maintain the free end of an arm related to an offshore structure despite the motions of the vessel.

The invention will now be explained in more detail with reference to the drawings, which schematically show embodiments of the device and method according to the present invention.

Figure 1 is side view of a first example of a transferring device according to the present invention.

Figures 2A and 2B are side views of the coupling of the device in Figure 1 to an offshore wind turbine.

Figures 3A to 3C are side views of the transferring of personnel or equipment to the offshore wind turbine.

Figures 4A to 4D are side views of the transferring of personnel or equipment similar to that shown in Figures 3A to 3C, after the vessel left.

Figures 5A and 5B are side views of a second embodiment of the transferring device according to the present invention.

Elements that are identical or performing substantially the same function are denoted by the same numeral.

Figure 1 shows a first embodiment of a device 1 for transferring personnel from a surface vessel 2 to an offshore structure. In this example the structure is a wind

turbine 3 comprising a platform 4 (Figure 2A), a ladder 5 providing access to the platform, and landing tubes 6 on either side of the ladder.

The device 1 comprises a foundation 10 mounted on the stern deck 11 of the vessel 2, a first telescopic arm 12 pivotally connected by a pair of gimbals 13 to the foundation and a pair of grippers 14 connected to the free end of the first arm 12 for coupling the first arm to an offshore structure, such as the wind turbine 3. A second telescopic arm 15 is pivotally connected to the first arm by a pair of gimbals 16 located near the free end of the first arm. Further, a basket 17 for transferring personnel and small equipment is pivotally connected to the free end of the second arm by means of one or two gimbals 18.

Figures 2A and 2B show how the vessel 1 manoeuvres its stern towards the wind turbine 3 and the first arm 12 is extended towards the landing tubes 6 of a wind turbine, while actively compensating for the motions of the vessel 2 such that the free end of the first arm 12 and the gripper 14 relate to the offshore structure. The first arm 12 is subsequently coupled to the landing tubes 6 by means of the grippers 14 (Figure 2B) and, once a coupling has been established, motion compensation is switched to idle.

Subsequent events are shown in Figures 3A to 3C. Personnel embarks and/or small equipment is loaded on the basket while the basket rests e.g. on the foundation or directly on the deck 11 (Figure 3A), i.e. its motion is synchronized with the vessel. When complete, the motion of the basket is synchronized with the offshore structure, e.g. by moving the basket upwards, away from the deck of the vessel (Figure 3B). The second arm is extended and the basket moved to the platform on the wind turbine, enabling transfer to the platform without employing the ladder 5 (Figure 3C).

Figures 4A to 4D show the same procedure, albeit with a second example of the device and method according to the present invention. In this example, the gripper 14, the second arm 15, the basket 17, and a hydraulic power supply form a module, which module is detachable from the first arm 12, at least upon coupling the first gripper 14 to an offshore structure 3. The module further comprises a controller for operating the arm and basket.

Upon coupling the first gripper 14 to an offshore structure 3, the module is detached from the first arm 12 (Figure 4A). The vessel 2 leaves once it is detached from the module (Figure 4B). The second arm is extended and the basket 17 moved to the platform 4 on the wind turbine 3, enabling transfer to the platform without employing the ladder 5 (Figures 4C and 4D).

Figures 5A and 5B show the installation of a wind turbine tower 20 on a so-called transition piece 21 on a monopile 22. In Figure 5A, the first arm 15 is already coupled to the monopile by means of the gripper 14, in this example below the surface. Once the tower 20 on deck 11 of the vessel 2 is secured in a second gripper 23, the motion of the second gripper is synchronized with the offshore structure, e.g. by moving the gripper upwards, away from the deck of the vessel. The second arm is subsequently moved to the structure and the tower placed on the transition piece (Figure 5B). In an embodiment, the tower is held in place by the second gripper while it is fixed to the transition piece.

The invention is not restricted to the above-described embodiments, which can be varied in a number of ways within the scope of the claims. In an example, the second arm is located near the foundation during manoeuvring of the first arm and, after the first arm has been coupled to the offshore structure, moved along the first arm towards

the coupling, thus effectively reducing the weight of the first arm while it is being manoeuvred.

CLAIMS

1. Device (1) for transferring personnel, equipment and/or structural elements (20) from a surface vessel (2) to an offshore structure, such as a wind turbine (3), or to another vessel comprising a foundation (10) mounted or to be mounted on a surface vessel (2), an arm (12) pivotally connected to the foundation (10) and at least one gripper (14) connected to the free end of the arm (12) for coupling the arm (12) to an offshore structure (3), **characterised by** a second arm (15) that is pivotally connected to the (first) arm (12).

2. Device (1) according to claim 1, wherein a support (17) for personnel and/or a second gripper (23) for structural elements (20) is connected to the second arm (15) at or near its free end.

3. Device (1) according to claim 1 or 2, wherein the second arm (15) is pivotally connected to the first arm (12) at or near its (12) free end or movable along the first arm (12).

4. Device (1) according to any one of the preceding claims, wherein the first gripper (14), the second arm (15) and, if present, the support (17) and/or second gripper (23) form a module, which module is detachable from the first arm (12), at least upon coupling the first gripper (14) to an offshore structure (3).

5. Device (1) according to claim 4, wherein the module comprises a power supply and/or a manually operable power generator.

6. Device (1) according to any one of the preceding claims, wherein at least one of the pivotal connections (13, 16), preferably both the connection (13) between the first arm (12) and the foundation (10) and the connection (16) between the second arm (15) and the first arm (12), comprises at least two gimbals and/or wherein at least the

foundation (10) is provided with a system for actively compensating for the motions of the vessel (2) during the coupling of the arm (12) to the offshore structure (3).

7. Device (1) according to any one of the preceding
5 claims, wherein at least one of the arms (12, 15), preferably both the first arm (12) and the second arm (15), is telescopic.

8. Surface vessel (2) comprising a device (1)
according to any one of the preceding claims for
10 transferring personnel, equipment and/or structural elements (20) from the vessel (2) to an offshore structure (21, 22) or to another vessel.

9. Method of transferring personnel, equipment
and/or one or more structural elements (20) from a surface
15 vessel (2) to an offshore structure, such as a wind turbine (3), or to another vessel comprising the steps of

coupling a first arm (12), pivotally connected to
the vessel (2), to an offshore structure (3),

transferring personnel, equipment and/or one or
20 more structural elements (20) from the surface vessel (2) to the offshore structure (3) by means of a second arm (15) that is pivotally connected to the first arm (12).

10. Method according to claim 9, comprising
actively compensating for the motions of the vessel (2)
25 during the coupling of the first arm (12) to the offshore structure (3).

11. Method according to claim 10, comprising
switching to idle when the arm (12) is coupled to the
offshore structure (3).

30 12. Method according to any one of claims 9-11, wherein a support (17) and/or a second gripper (23) is connected to the second arm (15) at or near its free end, wherein the motion of the support (17) and/or the second gripper (23) is synchronized with the vessel (2) and, after
35 personnel, equipment and/or structural elements (20) have

been loaded on or attached to the second arm (15), the motion of the support (17) and/or the second gripper (23) is synchronized with the offshore structure (3).

13. Method according to any one of claims 9-12,
5 wherein the offshore structure (3) comprises a platform (4) and wherein personnel and/or equipment is moved, by means of the second arm (15), from the vessel to the platform (4).

14. Method according to any one of claims 9-13,
10 wherein one or more structural elements (20) are moved, by means of the second arm (15), from the vessel (2) to the offshore structure (3).

15. Method according to any one of claims 9-14,
wherein the first gripper (14), the second arm (15) and, if present, the support (17) and/or second gripper (23) form a
15 module and, upon coupling the first gripper (14) to an offshore structure (3), the module is detached from the first arm (12).