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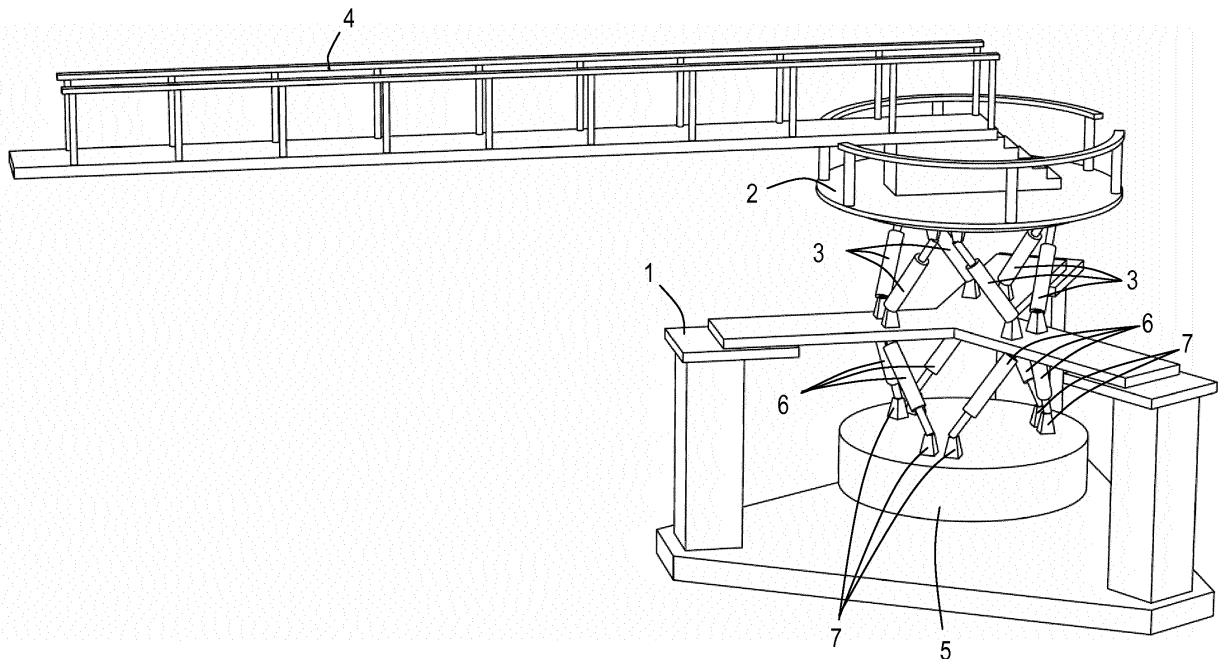
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**(54) Vessel with system for transferring persons or goods and such system**

(57) The invention concerns a vessel comprising a system for transferring persons or goods from the vessel while subjected to waves and/or swell towards a substantially stationary destination, wherein the system comprises a platform (2) for supporting the persons or goods during transfer, and platform actuators (3) connecting the platform to the vessel and adapted for moving the platform relative to the vessel in such a manner that the platform is maintained spatially in a substantially sta-

tionary position.

In accordance with the invention the system further comprises at least one compensation mass (5) for at least partially compensating motions of the vessel caused by the activation of the platform actuators (3), wherein a compensation actuator (7) couples the at least one compensation mass to the vessel for a movement relative thereto.



**Fig.1**

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## Description

**[0001]** In a first aspect the present invention relates to a vessel comprising a system for transferring persons or goods from the vessel while subjected to waves and/or swell towards a substantially stationary destination, wherein the system comprises a platform for supporting the persons or goods during transfer, and platform actuators connecting the platform to the vessel and adapted for moving the platform relative to the vessel in such a manner that the platform is maintained spatially in a substantially stationary position.

**[0002]** Its main field of use is offshore industry where it is a known problem to transfer persons or goods from a vessel which moves in consequence to the influence of, among others, the swell, waves, currents and wind relative to a (substantially) stationary destination such as, for example an offshore drill rig, offshore wind turbine or another large vessel.

**[0003]** In response to this problem a vessel has been developed in accordance with the preamble of the main claim. Such a vessel is known from WO2007/120039.

**[0004]** The known system comprises a movable platform, a so called Stewart platform, which is actuated by six piston-cylinder assemblies in response to the motions of the vessel, in such a manner that the platform maintains a (substantially) stationary spatial position, thus a stationary position relative to the stationary destination. For the actual transfer of the persons or goods the platform may be provided with a gangway, crane or alike.

**[0005]** It has appeared that during use of such a vessel the platform and platform actuators are constantly activated for achieving the desired compensation and thus exert considerable forces of inertia onto the vessel. Especially in case of lightly damped vessel motions (such as rolling for monohull vessels and also pitching for multihull vessels) this may prove disadvantageous. This situation may even be worse because vessels with respect to such barely damped motions move at or near to their natural frequencies and the excitation by the platform activators occurs exactly at those frequencies. As a result of the occurring resonance rather small excitations already may lead to large amplitudes of the resulting vessel movements.

**[0006]** It is an object of the present invention to provide an improved vessel of the above type and to prevent or diminish occurring resonance effects.

**[0007]** Thus, in accordance with the present invention a vessel is provided which is **characterized in that** the system further comprises at least one compensation mass for at least partially compensating motions of the vessel caused by the activation of the platform actuators and by the resulting motion of the platform relative to the vessel, wherein a compensation actuator couples the at least one compensation mass to the vessel for a movement relative thereto.

**[0008]** The compensation actuators compensate the excitations of the vessel caused by the accelerations of

the platform and platform actuators, by moving the at least one compensation mass in such a manner that the mentioned excitations are counteracted by opposite excitations.

5 **[0009]** In one embodiment of the vessel the compensation actuator is adapted for counteracting a rotational motion of the vessel around at least a first axis of rotation. For example it is conceivable that the compensation actuator is adapted for counteracting a rolling and/or pitching movement of the vessel.

10 **[0010]** In another embodiment of the vessel it is possible that the at least one compensation mass is adapted to be moved linearly by its compensation actuator(s).

15 **[0011]** The at least one compensation mass may comprise multiple masses, each with dedicated compensation actuator(s). For example, two compensation masses may be provided which are adapted to be moved linearly by their respective compensation actuators substantially in parallel to the longitudinal axis of the vessel and in parallel to transverse axis of the vessel, respectively. These masses may be used primarily to counteract longitudinal and transverse motions of the vessel.

20 **[0012]** In such a case it is conceivable too, that both compensation masses are combined into a single mass which is adapted to carry out the linear movements in parallel to the longitudinal axis of the vessel and in parallel to transverse axis of the vessel, respectively.

25 **[0013]** Constructively, it is advantageous when the compensation actuators comprise assemblies of linear guides and linear actuators. However, also other devices for achieving a linear motion of the compensation mass or masses may be used.

30 **[0014]** In yet another embodiment of the vessel according to the present invention the compensation actuators are adapted for offering the at least one compensation mass a rotational movement with three degrees of freedom and a linear movement with three degrees of freedom. This offers the compensation mass a full range of movements for compensating nearly all excitations of the vessel.

35 **[0015]** In such a case it is possible that the compensation actuators comprise six linear actuators, such as hydraulic or pneumatic piston cylinder assemblies which each at both ends by means of universal joints are connected to the vessel and the at least one compensation mass, respectively. Basically, such an arrangement will correspond with a known arrangement of actuators used to move the platform.

40 **[0016]** In a special embodiment of the vessel according to the present invention, the at least one compensation mass is defined by an auxiliary platform moved by auxiliary platform actuators substantially similar to the platform and platform actuators and adapted to be moved substantially in counter phase to the motion of the platform and platform actuators. The auxiliary platform and auxiliary platform actuators will counteract (and compensate) the excitation caused by the platform and platform actuators.

**[0017]** To be most effective, a compensation mass theoretically should coincide with the platform and platform actuators; however, because of possible concurrent technical difficulties of such a theoretical arrangement, in practice there will be a small distance between those parts of the system. Thus, in accordance with another embodiment, the at least one compensation mass may be located substantially at the same level as and close to the platform and platform actuators. The relative position between those parts then may be optimised with respect to the best compensation of the excitation in view of the most important movement of the vessel (for example rolling in monohull vessels and pitching in multihull vessels).

**[0018]** In another embodiment of the at least one compensation mass is located below the platform and platform actuators. Also in such a case the compensation mass may comprise an auxiliary platform moved by auxiliary platform actuators substantially similar to the platform and platform actuators; but also other types of a compensation mass are conceivable, for example using linear guides and linear actuators.

**[0019]** In yet another embodiment, the vessel further comprises control means for controlling the compensation actuators of the at least one compensation mass adapted to generate control signals for said compensation actuators based upon the movement of the platform. Such an embodiment directly uses the movement of the platform (for example based upon the control signals for its platform actuators) to generate the required control signals for the compensation actuators of the compensation mass.

**[0020]** However, it is possible too that the vessel further comprises control means for controlling the compensation actuators of the at least one compensation mass, which control means comprises sensors for sensing the motion of the vessel and means for generating control signals for said compensation actuators based upon an output of said sensors. As a result also the movements of the vessel (irrespective the origin thereof, for example due to the activation of the platform or due to environmental influences such as waves, current or wind) are used as an input to generate control signals for the compensation actuators of the at least one compensation mass.

**[0021]** Then, in one embodiment of the vessel, the control means may be adapted to generate control signals for said compensation actuators for counteracting rolling and pitching of the vessel. But also other movements of the vessel (depending on the type of vessel) may be compensated.

**[0022]** In a second aspect, the present invention relates to a system for transferring persons or goods from a vessel towards a substantially stationary destination for use on a vessel according to the present invention. According to the present invention such a system comprises a platform for supporting the persons or goods, and platform actuators adapted for connecting the plat-

form to the vessel and moving the platform relative to the vessel in such a manner that the platform is maintained spatially in a substantially stationary position, and further comprising at least one compensation mass for at least partially compensating motions of the vessel caused by the activation of the platform actuators and by the resulting motion of the platform relative to the vessel, and compensation actuators mountable to the vessel and to the at least one compensation mass for a movement thereof relative to the vessel.

**[0023]** Hereinafter the invention will be elucidated by means of the drawing, in which:

Figure 1 schematically shows a first embodiment of a system for transferring persons or goods according to the present invention,

Figure 2 schematically shows a second embodiment of a system for transferring persons or goods according to the present invention.

Figure 3 schematically shows a third embodiment of a system for transferring persons or goods according to the present invention, and

Figure 4 schematically shows an embodiment of a compensation mass as it can be mounted on one or more locations of the vessel.

**[0024]** Referring to figure 1 only a small part of a vessel 1 is illustrated showing a system for transferring persons or goods from the vessel towards a substantially stationary destination mounted on an upper deck. Such a system generally comprises a platform 2 for supporting the persons or goods, platform actuators 3 connecting the platform 2 to the vessel 1 and a gangway 4 mounted on the platform 2.

**[0025]** The platform actuators 3 (which for example may comprise six fast acting pneumatic or hydraulic piston cylinder assemblies) are adapted for moving the platform 2 relative to the vessel 1 in such a manner that the platform is maintained spatially in a substantially stationary position, notwithstanding a movement of the vessel 1 due to external influences such as, among others, the swell, waves, and wind. As a result the platform 2 may be kept stationary relative to a (substantially) stationary destination (such as, for example an offshore drill rig, offshore wind turbine or another vessel) and persons or goods may be transferred in a safe manner to said stationary destination (for example by means of the gangway 4).

**[0026]** The system as described up to this point corresponds with a well known system for transporting people from a ship to a stationary construction located at sea as used on vessels to date. In accordance with the present invention, such a system further comprises at least one compensation mass for at least partially compensating motions of the vessel 1 caused by the activation of the platform actuators 3 and by the resulting motion of the platform 2 relative to the vessel.

**[0027]** In the embodiment according to figure 1 there

is a single compensation mass which by means of compensation actuators is mounted to the vessel for a movement relative thereto. The compensation mass is defined by an auxiliary platform 5 (which may or may not be similar to the primary platform 2; it is conceivable, for example, that the auxiliary platform is defined by a mass with the same mass and inertia as the primary platform, but without exactly the same outer appearance; as such a gangway generally will not be present).

**[0028]** The compensation actuators are defined by auxiliary platform actuators 6. As is the case with the platform 2, the compensation actuators 6 preferably comprise six (linear) actuators, such as hydraulic or pneumatic piston cylinder assemblies which each at both ends by means of universal joints 7 are connected to the vessel 1 and to the at least one compensation mass 5, respectively.

**[0029]** The auxiliary platform 5 and auxiliary platform actuators 6 are adapted to be moved substantially in counter phase to the motion of the platform 2 and platform actuators 3. As such, the compensation mass may be adapted for counteracting a rotational motion of the vessel 1 around at least a first axis of rotation (for example for counteracting a rolling and/or pitching of the vessel).

**[0030]** Basically the compensation actuators 6 according to the embodiment of figure 1 are adapted for offering the compensation mass (auxiliary platform) 5 a rotational movement with three degrees of freedom and a linear movement with three degrees of freedom. For compensating the movement of the vessel 1 caused by the forces generated by the system for transporting people from the ship to the stationary platform in general only the rotation around the longitudinal axis of the vessel 1 and/or the rotation around a horizontal axis perpendicular to the longitudinal axis need to be compensated as due to the shape of the vessel 1 that are the only movements that might show increasing oscillations as a result of the forces earlier mentioned. In situations that the compensation mass 5 compensates only for rotation around one or two axis it is sufficient to let this compensation mass 5 rotate around one or two axis and linear movements of the compensation mass 5 are not required. The number of compensation actuators can then be reduced to one or two compensation actuators 6 that let the compensation mass 5 oscillate in one or two orthogonal planes respectively.

**[0031]** In the illustrated embodiment the compensation mass 5 is located immediately below the platform 2 and platform actuators 3 (specifically below the upper deck of the vessel 1), but it is conceivable too that it is located substantially at the same level as (and preferably close to) the platform 2 and platform actuators 3. In a further embodiment, a smaller compensation mass 5 might be located in front or behind the platform 2 or at both sides of platform 2.

**[0032]** The system further may comprise control means (not illustrated) for controlling the compensation actuators 6 of the compensation mass 5, adapted to gen-

erate control signals for said compensation actuators 6 based upon the movement of the platform 2 (and the movement of the platform actuators 3). Further additional control means (not shown) may be provided, also for controlling the compensation actuators 6 of the compensation mass 5. Such additional control means may comprises sensors(not illustrated) for sensing the motion of the vessel 1 and means for generating control signals for said compensation actuators 6 based upon an output of said sensors. As a result control signals for the compensation actuators 6 may be calculated in such a manner that the compensation mass (auxiliary platform) 5 carries out a movement for in an optimal manner compensating (counteracting) an excitation caused by the movement of the platform 2 at one hand, and an excitation caused by a movement of the vessel 1 at the other hand (which may be caused by the movement of the platform 2 but also by external influences, such as wind, current and waves).

**[0033]** Of course it is also possible that the control signals for the compensation actuators 6 of the compensation mass 5 are directly derived from the original control signals for the platform actuators 3 (for example having substantially the same magnitude but an opposite sign, depending on the characteristics of the system in general and of the compensation mass in specific).

**[0034]** Referring to figure 2, a second embodiment of a vessel with system according to the present invention is illustrated. The upper part of the system (which, basically represents a state of the art system) is similar to the system for transporting people from a ship to a stationary construction located at sea as described before and therefore the description thereof is not repeated.

**[0035]** The lower part of the system according to this second embodiment comprises two compensation masses 8,9 which are adapted to be moved linearly by respective compensation actuators 10,11 (for example in parallel to the longitudinal axis of the vessel 1 and in parallel to transverse axis of the vessel, respectively). The compensation actuators 8,9 (which may comprise any type of linear actuators, such as for example cylinder piston assemblies, cable drives, gear racks) are devised for moving the compensation masses 10,11 to and fro, for example along linear guides 12,13 attached stationary to the vessel 1 and located immediately under the upper part of the system, for instance immediately under the upper deck.

**[0036]** Although this second embodiment shows two separate compensation masses each adapted for a to and fro movement in a specific direction, it is also conceivable that both compensation masses 8,9 are combined into a single mass which is adapted to carry out linear movements in different directions (for example in parallel to the longitudinal axis of the vessel and in parallel to transverse axis of the vessel, respectively) and, thus, in combination may carry out movements in any other direction (in a plane extending through said two original directions) or even along a curved trajectory, if needed

(in said plane).

[0037] The operation of this second embodiment generally is similar to that of the first embodiment (although, because this embodiment only allows the compensation mass or masses to be moved in a more restricted manner, its capability for compensating or counteracting excitations may be less). Control means and sensors may be provided in accordance with the first embodiment.

[0038] Referring to figure 3 a third embodiment of a vessel with system according to the present invention is illustrated schematically. The figure 3 shows the vessel 1 with a platform 14 mounted on the rear of the vessel. Platform actuators 15 move the platform 14 and maintain the platform 14 in a stationary position while the ship moves in waves and/or swell. It will be clear that the platform 14 can rotate on a turret 18 that is mounted on the deck, that the platform 14 can move in height by changing its inclination and that the length can be adapted as required. In the shown embodiment transverse compensators 16 are mounted on deck in front and at the rear of the turret 18 and the longitudinal compensators 17 are mounted under the deck. In other embodiments these positions can be different and are dependent on the available space and the required compensation.

[0039] Referring to figure 4 an embodiment of a compensation mass as it can be mounted on one or more locations of the vessel is illustrated schematically. In the embodiment, an actuator 20 can move a mass 19 can move over a rail. As shown the actuator 20 comprises a motor, for instance a hydraulic motor, that drives a gear that engages a rack mounted in the direction of the rail. The actuator 20 and the mass 19 are mounted under a cover 21 to protect them against the environment.

[0040] The invention is not limited to the embodiments described before, which may be varied widely within the scope of the invention as defined by the appending claims. For example, the compensation mass may have a mass which differs from the mass of the platform (with or without its actuators) and may be moved in any other appropriate manner, for example as a pendulum with a pendulum arm with specific length by means of three linear actuators positioned around said pendulum arm.

## Claims

1. Vessel comprising a system for transferring persons or goods from the vessel while subjected to waves and/or swell towards a substantially stationary destination, wherein the system comprises a platform for supporting the persons or goods during transfer, and platform actuators connecting the platform to the vessel and adapted for moving the platform relative to the vessel in such a manner that the platform is maintained spatially in a substantially stationary position, **characterized in that** the system further comprises at least one compensation mass for at least partially compensating motions of the vessel

caused by the activation of the platform actuators, wherein a compensation actuator couples the at least one compensation mass to the vessel for a movement relative thereto.

2. Vessel according to claim 1, wherein the compensation actuator is adapted for counteracting a rotational motion of the vessel around at least a first axis of rotation.
3. Vessel according to claim 2, wherein the compensation actuator is adapted for counteracting a rolling and/or pitching movement of the vessel.
4. Vessel according to any of the previous claims, wherein the at least one compensation mass is adapted to be moved linearly by its compensation actuator(s).
5. Vessel according to claim 4, wherein the at least one compensation mass comprises multiple masses, each with dedicated compensation actuator(s).
6. Vessel according to claim 5, wherein two compensation masses are provided which are adapted to be moved linearly by their respective compensation actuators substantially in parallel to the longitudinal axis of the vessel and in parallel to transverse axis of the vessel, respectively.
7. Vessel according to claim 6, wherein both compensation masses are combined into a single mass which is adapted to carry out the linear movements in parallel to the longitudinal axis of the vessel and in parallel to transverse axis of the vessel, respectively.
8. Vessel according to any of the claims 4-7, wherein the compensation actuators comprise assemblies of linear guides and linear actuators.
9. Vessel according to any of the previous claims, wherein the compensation actuators are adapted for offering the at least one compensation mass a rotational movement with three degrees of freedom and a linear movement with three degrees of freedom.
10. Vessel according to claim 9, wherein the compensation actuators comprise six linear actuators, such as hydraulic or pneumatic piston cylinder assemblies which each at both ends by means of universal joints are connected to the vessel and to the at least one compensation mass, respectively.
11. Vessel according to any of the previous claims, wherein the at least one compensation mass is defined by an auxiliary platform moved by auxiliary platform actuators substantially similar to the platform

and platform actuators and adapted to be moved substantially in counter phase to the motion of the platform and platform actuators.

12. Vessel according to any of the previous claims, wherein the at least one compensation mass is located substantially at the same level as and close to the platform and platform actuators. 5

13. Vessel according to any of the claims 1-11, wherein the at least one compensation mass is located below the platform and platform actuators. 10

14. Vessel according to any of the previous claims, further comprising control means for controlling the compensation actuators of the at least one compensation mass adapted to generate control signals for said compensation actuators based upon the movement of the platform. 15

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15. Vessel according to any of the previous claims, further comprising control means for controlling the compensation actuators of the at least one compensation mass, which control means comprises sensors for sensing the motion of the vessel and means for generating control signals for said compensation actuators based upon an output of said sensors. 25

16. Vessel according to claim 15, wherein the control means are adapted to generate control signals for said compensation actuators for counteracting rolling and pitching of the vessel. 30

17. System for transferring persons or goods from a vessel towards a substantially stationary destination for use on a vessel according to any of the previous claims, comprising a platform for supporting the persons or goods, and platform actuators adapted for connecting the platform to the vessel and moving the platform relative to the vessel in such a manner that the platform is maintained spatially in a substantially stationary position, and further comprising at least one compensation mass for at least partially compensating motions of the vessel caused by the activation of the platform actuators and by the resulting motion of the platform relative to the vessel, and compensation actuators mountable to the vessel and to the at least one compensation mass for a movement thereof relative to the vessel. 35

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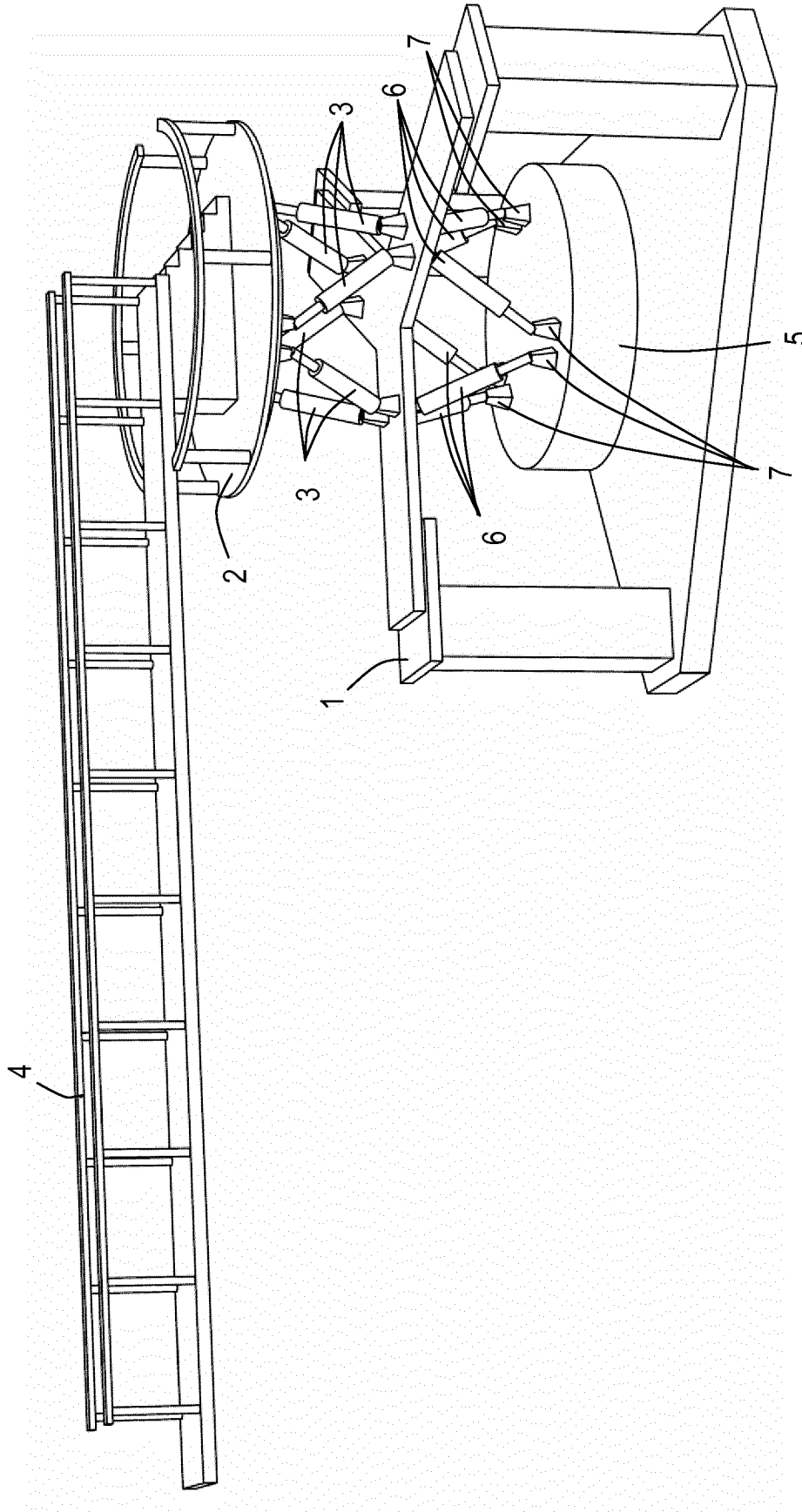


Fig.1

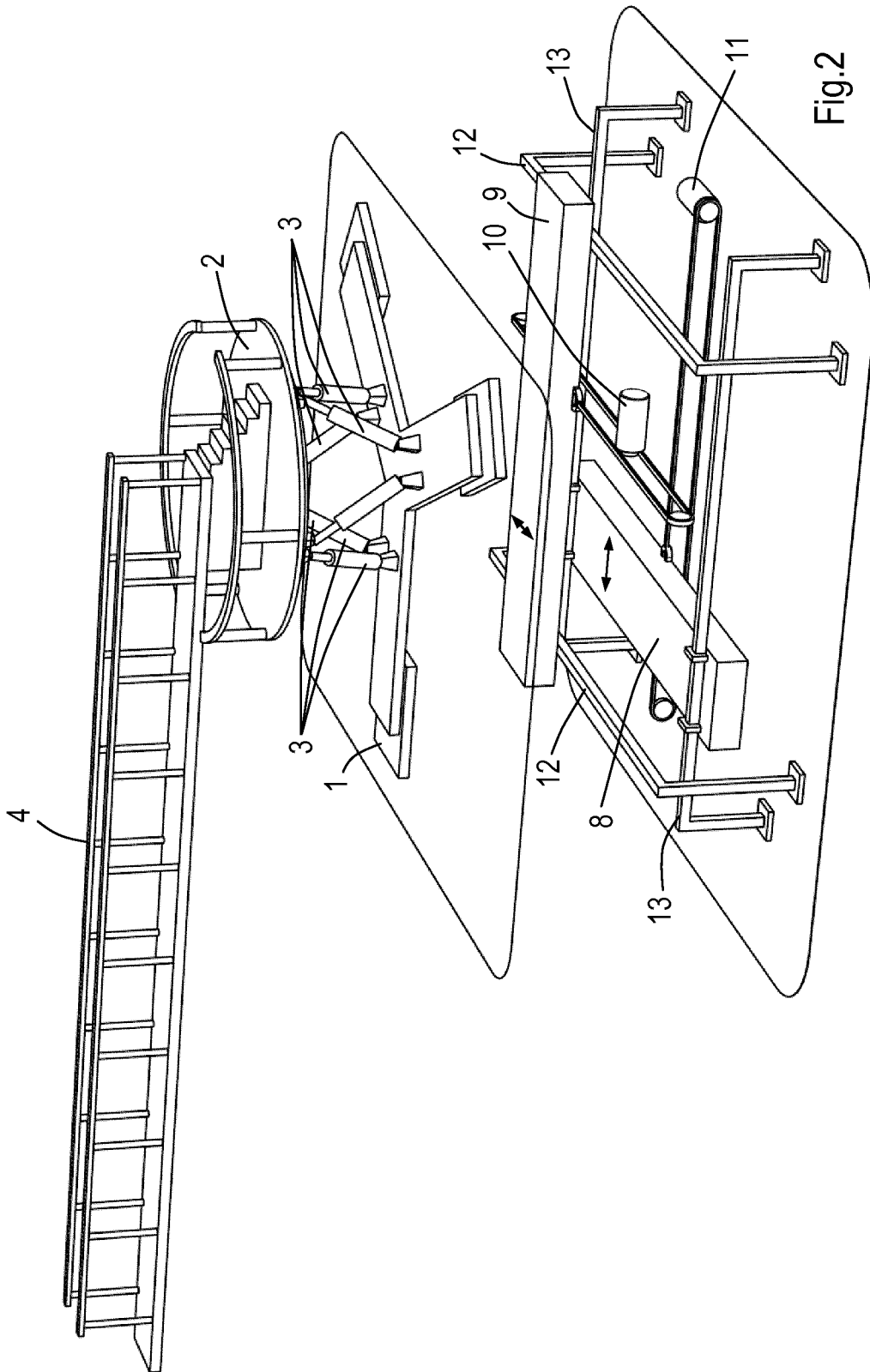


Fig. 2

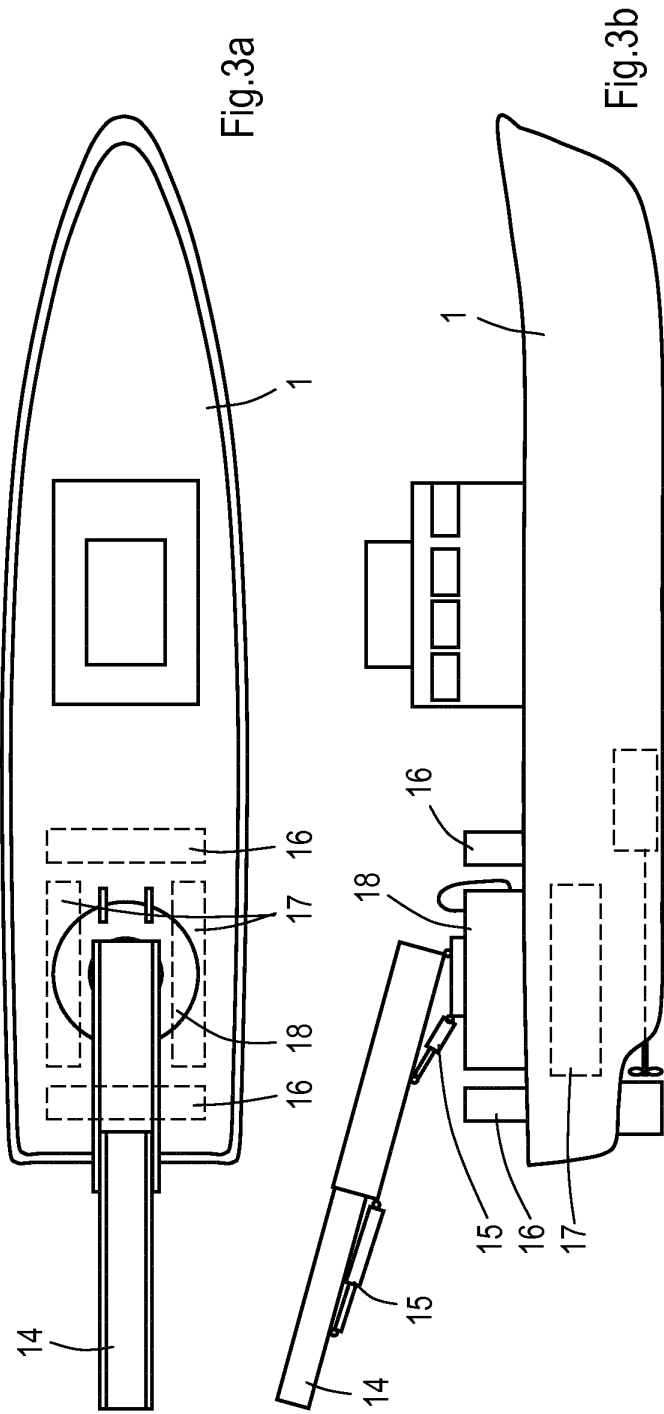


Fig.3a

Fig.3b

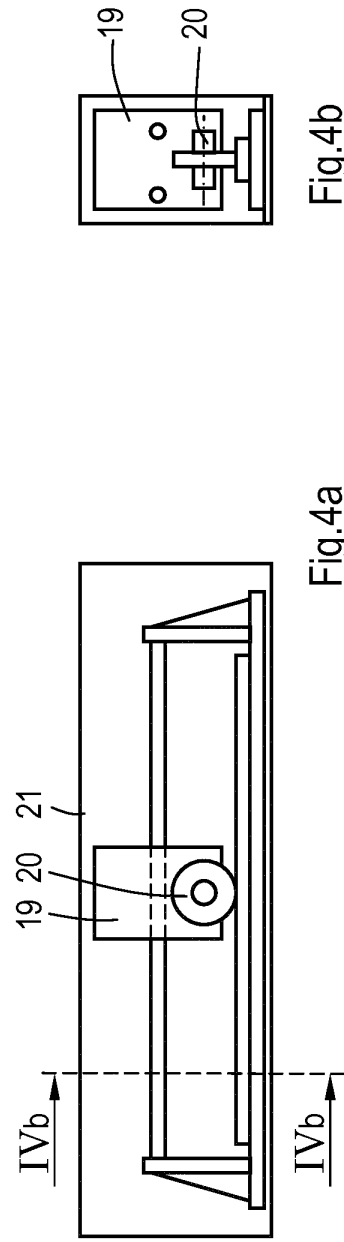


Fig.4b

Fig.4a



EUROPEAN SEARCH REPORT

Application Number  
EP 12 18 7023

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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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Place of search Munich		Date of completion of the search 6 March 2013	Examiner Vermeulen, Tom
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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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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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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